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S03: FRUIT PRODUCTION SYSTEMS FOR SUSTAINABLE AND RESILIENT DEVELOPMENT

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S01: FRUIT PRODUCTION SYSTEMS FOR SUSTAINABLE AND RESILIENT DEVELOPMENT; BUCHAREST, EHC2024, MAY 13-16

ORAL PRESENTATIONS

SESSION I- TOMORROW'S FRUIT TREE – NURSERY PRODUCTION FOR FUTURE ORCHARDS

S03-I-O-1

Rootstocks have been and will be a major component of successful, sustainable, and resilient fruit production

G. Fazio, Keynote speaker

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A green revolution that started in the roots of dwarfed apple orchards has increased productivity, quality, and efficiency of apple production while at the same time decreased the acreage, labor, treatments needed to grow those apples – all things that reduce greenhouse gas emissions. Dwarfing and early bearing conferred by apple rootstocks to grafted scion varieties like Honeycrisp, Gala, Golden and Granny reduces the size of the apple tree from 10-15 meters tall down to a manageable size of 2-3 meters and at the same time reduces the juvenility years (length of nonbearing time from planting) from 5-7 years to 1 or 2 years. Imagine if all tree fruit and nut growing systems on earth were able to achieve higher production on less land and much earlier after planting than the current norm? It is estimated that dwarfing and early bearing have added yearly \$2-3 billion every year in production efficiency in the U.S. alone, this estimate is likely more than 10 times larger when we consider world production. Fruit growers worldwide who have used dwarfing rootstocks should congratulate themselves for their major reduction in the carbon footprint of the fruit industry. While recent advances in apple genomics and metabolomics have shed some light on the mechanisms associated with dwarfing and early bearing in apple, the possible the identification of similar processes and application in other fruit crops needs major research effort and investment as it will bear enormous benefit to the world community. Dwarfing and early bearing is not the only answer to climate change as there are other threats connected to water quality and availability, heat and cold stress, large oscillations in temperature, appearance of new diseases caused by changes in weather patterns which are in part connected to the implementation of rootstock technologies. Our goal is to understand and find ways to leverage the genetic variability in apple rootstocks to curb such threats and promote a successful, sustainable and resilient production of high-quality fruit.

Keywords: Climate change and rootstocks, dwarfing, early bearing, cold hardiness, heat stress, water quality.

S03-I-O-2

Counteracting water stress effects in hazelnut by plant stimulating peptides applications or mycorrhizae inoculation on potted young plants

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In the current climate change scenario, defining multiple strategies to increase crop resilience and mitigate the negative consequences on crop production is pivotal. Hazelnut (*Corylus avellana* L.) is one of the most important nut tree crops grown in several countries all over the world and mainly in the Mediterranean Basin area. In southern Italy hazelnut has historically been grown rainfed in hilly areas, while more recently, thanks to the increasing interest in this species, new orchards are also planted in fertile and irrigated plains, under different climate conditions compared to the traditional cultivation areas. However, even in these new areas limited availability of water resources and the well-known sensitivity of hazelnut to water stress and high temperature forces to take in consideration sustainable production systems. Hazelnut is well known as a very sensitive species to both water stress and high temperatures. This study aims to evaluate the effect of biostimulant treatments, in mitigating the effects on the growth performances and morpho-physiological adaptive responses under prolonged water stress in potted young hazelnut plants. The research was conducted in a cold polycarbonate greenhouse on one-year-old micro-propagated plants of cv Tonda di Giffoni, at the Department of Agricultural Sciences of the University of Naples Federico II, during two consecutive growing seasons (2021-2022). Three irrigation levels (i.e., 100, 80, and 60% of the Daily Water Requirement, DWR) were applied in combination with none or two different biostimulants (plant stimulating peptides or mycorrhizal inoculum, both enriched with PGPR). During the two seasons, growth rate, eco-physiological behaviour, and leaf functional traits were investigated. Results showed interaction effects between the water deficit level and the type of biostimulant applied. Further investigations are ongoing on the same plants transplanted to the field to understand if drought pre-conditioned and biostimulant treated plants will better cope with water stress.

Keywords: biostimulants, sustainable production, nursery, drought pre-conditioned plants, Tonda di Giffoni

S03-I-O-3

Valorization of hazelnut shells as substrate component for nursery potted cultivation of GF677 rootstock

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Italy with 85,000 t (2021) is the second hazelnut world producer. In the Italian hazelnut industry, a large part of the production, being destined to the confectionery, undergoes to minimal processing in industrial shelling plants even located in the mainly hazelnut production areas. Currently the main re-use of hazelnut shells at local level is as fuel for domestic use. Italian hazelnut cultivars have an effective kernel yield between 40 and 46%, therefore, potentially Italy can produce 45,000 t of hazelnut shells per year. A valorization of this by-product could make the hazelnut cultivation more sustainable, not only environmentally but also economically. A possible alternative to combustion could be the use as an inert material for the preparation of substrates mix for the cultivation of potted plants at nursery level. In almost all the substrates a variable percentage of inert material is useful for ensuring a correct drainage of the irrigation water. To this extent the main spread material used in Italy for this purpose is pumice. However, the availability of pumice is increasingly reduced, with raising costs. The aim of this work is to evaluate the efficiency of hazelnut shells as substitutes for pumice for the preparation of substrates suitable for the cultivation of potted plants in nurseries. Considering the relevance for the international market, the trial was conducted on GF677 rootstock. The test was conducted in 2023 in a cold greenhouse, in Caserta (Southern Italy) on GF677 plants. Substrates containing 10, 20 and 30% by volume of hazelnut shells or 10, 20 and 30% by volume of pumice stone were compared to a substrate without inert as control. In six months of pot cultivation, no evidence of differential effects was found between substrates with shells and with pumice at 10 and 20% concentrations. On the contrary plant vegetative growth were negatively affected under treatments without inert material and containing 30% of hazelnut shells.

Keywords: pumice; growing media; *Corylus avellana* L.; plant propagation; circular economy

S03-I-O-4

Use of biostimulants to improve the growth of young potted olive trees

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In 2022-2023, an experiment was conducted to evaluate the effects on the growth of young olive trees of two biostimulants, a micro-organism based (microbial biostimulant) one, believed to promote mycorrhizal formation, and the other based on humic and fulvic acids. The objective was to reduce the time required to obtain transplant-ready trees or to have larger and higher-quality trees within the same timeframe. For the experiment, 35-40 cm tall potted trees of the cultivar Leccino were used. At the beginning of the trial in spring, trees were transplanted into larger pots and treated with the biostimulants, which were applied to the soil. In addition, they were fertilized with either 100% or 50% of the recommended dose. The treatments were applied, following a factorial design of eight treatments. The effects of the treatments were evaluated by measuring tree growth and assessing photosynthetic efficiency and leaf nutritional status. The microbial biostimulant resulted in greater stem diameter and tree height. Moreover, it led to increased development of lateral branches and late in 2023 tertiary branching occurred. The biostimulant based on humic and fulvic acids gave positive effects on growth only when combined with 100% fertilization. Further studies are being conducted to determine the effects on leaf activity and nutritional status, biomass production (determined through plant dissection), mycorrhizal formation, and potential interaction among the factors considered (microbial biostimulant, biostimulant based on humic and fulvic acids, and fertilization rate).

Keywords: humic and fulvic acids, *Glomus spp.*, microbial biostimulants, mycorrhizae, *Olea europaea* L. vegetative growth

SESSION II- ROOTSTOCKS, CULTIVARS, AND PLANTING SYSTEMS

S03-II-O-1

Future orchards: integrating the components of physiology, technology, genetics, and efficiency to achieve sustainable profitability and resilience

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Planning a new orchard requires many critical decisions that are dependent not only on 1) currently available rootstock and scion genetics, 2) a horticultural and physiological understanding of fruit tree vegetative and reproductive growth, and 3) current market and labor forces, but also anticipation of 4) future labor skills, costs and availability, 5) advances in new orchard technologies, and 6) the potential impacts of climatic changes and extremes. The genetics of an orchard are essentially fixed at planting. Horticultural techniques that optimize the physiological processes associated with growth and fruiting can be varied somewhat from year to year as necessary to respond to seasonal variations. However, long-term orchard canopy architecture and management plans impact initial decisions on tree and row spacing, trellis support structures, and training intensity, which impacts initial investment costs, labor needs, and first returns on

investment. Increasingly, these various factors suggest that new orchards should be developed as narrow planar canopies, which can be achieved at either high (single leader) or moderate (multiple leader) planting densities, and as single (vertical) or dual (angled) fruiting walls, each strategy having advantages and disadvantages. This rationale for planar orchards is supported by enhanced physiological efficiencies for both vegetative and reproductive development and processes, increased labor efficiencies, improved management precision, facilitation of developing digital data acquisition technologies for more informed decision-making, and the potential to adopt automated and/or robotic technologies at various scales as they develop during the expected life of the orchard. This presentation will discuss each of these future orchard decision components and their integration towards the goal of achieving sustainable orchard profitability and resiliency in a changing climate.

Keywords: training systems, canopy architecture, apple, cherry, peach, pear, stone fruit, pome fruit, photosynthesis, labor, planar fruiting wall, rootstock, productivity, yield, fruit quality, precision management

S03-II-O-2

History and New Releases from the Geneva® Apple Rootstock Breeding Program

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The Geneva® apple rootstock breeding program has been operating at Cornell University since the late 1960s with the main goal to develop new material resistant to pests and diseases endemic to North America. The U.S. Department of Agriculture joined this effort in the late 1990s leveraging field, laboratory, technical and germplasm resources the program had and adding a major component on genetics, genomics and marker assisted breeding. The project has maintained the focus on resistance to fire blight, crown and root rot while evaluating material for increases in orchard productivity. The program also worked with external national and international institutions such as the NC-140 rootstock evaluation collaborative group to test its products in multiple environments. The process, which for some apple rootstocks has spanned 3-4 decades from initial cross to final release, has produced several rootstocks including G.11, G.16, G.41, G.935, G.214, G.814, G.778, G.222, G.213, G.210, G.969, G.890. Each of these rootstocks has displayed outstanding properties as well as some shortcomings. While breeding, the program made discoveries about the nature of dwarfing, early bearing and the propensity of the rootstock to impact partitioning of photosynthate away from excessive vegetative growth and into fruit production. More recently, the program has made discoveries on additional traits that modulate fruit quality (fruit size and nutrient content), tree architecture, influence on chilling hour requirement, graft union strength, brittle or malformed graft unions, root morphology and metabolic compounds, phytohormone influence on grafted scions, interaction with woolly apple aphids, interaction of rootstocks with multi-leader training systems, and interaction with soil

properties (pH and composition). As we learned more about each of the Geneva® rootstocks, it has become clear that the observed diversity in traits is an asset to the diverse applications/environments representing apple orchards worldwide. Each orchard is unique in its soil and climate characteristics, this combined with different scion cultivar characteristics and vigor means that no one rootstock is the best choice in all situations. This awareness leads the program to continue to pursue new rootstocks which are better in certain niche situations than all other rootstocks. All these considerations, in addition to new nursery and field performance results have led the Geneva® apple rootstock breeding program to release three new rootstocks: Geneva® 257 (G.257), Geneva® (G.484), and Geneva® (G.66).

Keywords: apple rootstock, fire blight resistance, semi-dwarfing, yield efficiency, fruit size, mineral nutrient profile

S03-II-O-3

Identifying successful pollinizers of the newly introduced apple cultivars `Eden` and `Fryd` in Norway

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The club apple cultivars `Eden` (`Wursixo`) and `Fryd` (`Wuranda`) have been newly introduced to Norwegian apple growers. The breeders are Fresh Forward, The Netherlands and the parents of the cultivars are `Honeycrisp` x `Magic Star`. The apple (*Malus domestica*. Borkh.) is an allogamous species with gametophytic type of self-incompatibility and to achieve high yields and profitable production, suitable pollinizers are required. The pollen donors must flower annually and produce viable pollen at the most fertile stage for the recipient in order to ensure effective pollination and fertilization of the flowers. To have good fruit set, two to three compatible cultivars, with overlapping flowering time, must be grown in apple orchards to achieve effective cross-fertilization. In this study, several approaches were investigated to find the right pollinizers. In 2021 and 2022, seeds were extracted from `Eden` and `Fryd` and the genomic DNA was isolated. The DNA obtained was used for genotyping with a set of 15 SSR markers and subsequently for paternity analyses. Based on these results, cross-pollination and self-pollination of the two cultivars were conducted at NIBIO Ullensvang in 2022 and 2023. `Eden` was pollinated with the cultivars `Fryd`, `Professor Sprenger`, `Rubinstep`, `Red Aroma` and `Asfari`, while `Fryd` was crossed with `Eden`, `Professor Sprenger`, `Rubinstep`, `Red Aroma` and `Elstar`. Fruit set was determined prior to harvest. The fruit set in 2022 was significantly higher for both cultivars than in 2023. For `Eden`, the final fruit set was over 30 % for all cross combinations in 2022. The fruit set in the following year for `Eden` was greater than 10 % for the pollinizers `Fryd`, `Asfari` and `Rubinstep`.

For 'Fryd', the fruit set in 2022 was over 40 % for all pollinizers and a maximum of 10 % in the following year, except for 'Red Aroma' with only 5 % fruit set. These introduced apple cultivars can be grown in the orchard with any of the pollinizers tested, only the pollinizer 'Red Aroma' should be avoided.

Keywords: *Malus domestica* Borkh., apple seeds, paternity analyses, DNA markers, controlled crossings, pollinizers

S03-II-O-4

Narrow vertical planar orchard canopies for European plum (*Prunus domestica* L.) grown on vigorous rootstocks- advantages and limitations

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The European plum (*Prunus domestica* L.) in Bosnia and Herzegovina is exclusively grown on the cherry plum rootstock (*Prunus cerasifera* Ehr.). In the new, more intensive orchards, spindle training systems are the most common (plum spindle, improved pyramid). The proper training and management of these training systems is possible with the significant engagement of an educated labour, which has become a serious problem in recent years. In order to raise the level of efficiency in plum production, during the period 2019-2024, preliminary research was conducted to assess the possibility of training plum trees in narrow vertical planar orchard canopies (biaxial and multiaxial - UFO). The research was carried out with varieties with a dominant short (Stanley) and long (Grossa di Felisio - Empres) fruiting shoots. The paper presents the most significant advantages and limitations of the mentioned training systems in plum production. The vigor of cherry plum as a rootstock, with pronounced acrotonic growth of new shoots, enables a relatively simple and correct system training, the vitality of the trees and a very successful replacement of the fruiting branches. The initial yield is achieved in the third growing season, and in the fourth, the first economically significant yield. The fruit quality is high regardless of the variety, and the fruit uniformity is very high. Pruning is simplified, protection against pathogens is significantly easier, and harvest is very efficient, which makes production significantly more cost-effective. For the successful training of two-dimensional systems, adequate trellis system in the orchard and increased participation of summer pruning are necessary. Due to greater vigor of the orchard, about 80% of manual operations can be carried out from the ground. Two-dimensional training systems can be important for increasing labor efficiency, mechanization of work operations, digitalization and robotization in the production process, which can significantly increase production efficiency.

Keywords: training system, production, quality, efficiency

S03-II-O-5

Growth and fruiting performance of some German plum varieties, in a high-density planting system

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German plum cultivars have been widely spread in the last years across Europe as well, fact that raises the need to investigate the pomological value of these cultivars grown in different cultivation areas in order to be recommended or not for cultivation in a particular area. Therefore, the current research has been carried out to evaluate the pomological characteristics of eight German plum cultivars: as follow: ‘Topfirst’, ‘Katinka’, ‘Toptaste’, ‘Hanita’, ‘Haganta’, ‘Jojo’, ‘Tophit’ and ‘Topend Plus’. The experiment has been carried out in a commercial plum orchard, located in Sînmihaiu Almașului, Sălaj County, Romania. The observations and measurements upon flowering time, fruit ripening, tree vigour, yield, fruit quality parameters and disease resistance were made during the period 2016-2022. The first yield, induced by variety and rootstock combination was early; the trees began to bear fruits starting from the second and third year after planting for all cultivars studied. The trees showed a high yield potential even from early ages. The vigour of all cultivars grafted on Saint Julien rootstock was middle, with some variations, which made them suitable for high-density cultivation and Zahn Spindle training system. ‘Topend Plus’ and ‘Tophit’ varieties were found to be the most outstanding in terms of all the characteristics evaluated but ‘Topfirst’, ‘Topend Plus’ and ‘Toptaste’ varieties, in some years, proved to be susceptible to *Pseudomonas syringae*.
Keywords: *Prunus domestica*, pomological traits, tree vigour, time of ripening, yield

S03-II-O-6

Root architecture and topography in high density pear orchard of Abbé Fétél

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The root system plays a fundamental role in the well-being of the fruit tree and in the productivity of the orchard. The root system of a tree undergoes a continuous growth

and expansion in a planar, centrifugal and radial way. Over the years, the planting densities in pear cultivation have increased greatly with the introduction of improved agricultural techniques and through the use of dwarfing quince rootstocks. The root system of trees in high density plantation had to face therefore a reduction of the available volume for its expansion, due to the proximity of other roots of the same genotype. The reduction of available soil volume for root growth, in a changing climatic context characterized by a general increase in temperatures, scarcity of precipitation, and extreme weather events, favored the development of conditions incompatible with proper root function, especially in the shallower soil layers and in a bare soil. In this context, the study of root topography and architecture plays a key role in the sustainable management of the orchard. This work evaluated the root architecture and topography in high-density pear orchards with different rootstocks (dwarfing quince and weak pear clones). In 2022, core samples were taken in orchards in Emilia-Romagna (central Italy), at different depths (0-20cm, 20-40cm) and at different distances from the trunk, both along the row (AR) and inter-row (IN). Root length density and mean diameter were determined using the WinRhizo® software for root analysis. The results indicate a concentration of roots in a rather limited soil zone, especially along the planting row, with limited expansion in depth. This situation contributes to make the pear intensive orchard a fragile system that is often unable to respond to extreme and changing climate conditions.

Keywords: root length density, root diameter, root distribution, planting intensification, rootstock.

S03-II-O-7

Training systems for a super-high density almond orchard with 'Soleta' and 'Lauranne' cultivars

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The increase in almond consumption, the development of novel rootstocks and self-fertile cultivars, and the establishment of plantations in newly irrigated areas have led to significant progress in the productive techniques of almond tree cultivation. One of the most important progresses has been the increase in planting density, leading to the development of a new productive model, the super-intensive. In this model, the plants are trained in a hedge system through mechanical pruning, so that they can be over-row harvested using a straddle machine. However, the challenges are great to achieve an efficient and productive system. One of them involves pruning and training operations and the choice of the best-adapted cultivars to the hedge cultivation system and labor mechanization. In this perspective, the objective of this 5-year research study was to compare the agronomic behavior of almond cultivars 'Soleta' and 'Lauranne' grafted onto 'Rootpac 20' dwarfing rootstock and planted in a super-intensive system, when trained in a vertical axis, three-axis palmette and hedge systems. The trunk section area, together with the firewood removed from green and winter pruning, and the orchard

productivity were evaluated, as well as the almond quality parameters. The results indicate that the trunk section was affected by the training systems, as well as the firewood from pruning, with higher values in the vertical axis system, especially for 'Lauranne'. This cultivar reached the highest fruit yield in the three-axis palmette than in the vertical axis or hedge training systems, while 'Soleta' trees showed greater yield efficiency in the vertical axis system. The training system did not affect the almond quality parameters, except the kernel yield of the 'Soleta' almonds. The results suggest that the training system affects the productive behavior of the almond trees under a super-intensive model, which varies with the cultivar.

Keywords: intensification, pruning, mechanical harvesting, tree vigor, productivity, quality parameters.

S03-II-O-8

Evaluation of apple rootstocks under replant soils in Spain

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In the Catalunya apple production area, virgin soils are becoming scarcer. As old orchards decline economically, there is an increasing necessity of replanting old sites. Historically, replanting of old orchard sites has resulted in uneven development of the canopies and lower profitability. The aim of this work was to evaluate different apple rootstocks with 'Golden' and 'Gala' as the scions under replant soils at IRTA Mas Badia research experimental station (La Tallada d'Empordà, Spain). The first experiment was planted in 2001 and used 'Golden Delicious Reinders®' as the scion variety. It compared nine rootstocks (CG.3007, G.41, CG.4013, CG.4202, G.11, G.16, P.16, M.9 PAJAM® 2 Cepiland and M.9 NAKB 337) during seven seasons. The second field trial was planted in 2014 and evaluated seven rootstocks (G.11, G.41, M.9 NAKB 337, M.9 PAJAM® 1 Lancep, M.9 PAJAM® 2 Cepiland and M.200) with 'Galavalcov' as the scion cultivar. The last trial was planted in 2014 and compared six rootstocks (G.11, G.41, SUPPORTER® 4 PI.80, M.9 EMLA, M.9 PAJAM® 2 Cepiland and M.200) with 'Brookfield Gala® Baigentcov' as the scion cultivar. The last two trials were evaluated during 9 seasons. The tree vigor was measured by the size of trunk cross sectional area (TCSA). In the 'Golden Delicious Reinders®' trial, P.16 had the lowest vigor (8.2 cm² TCSA), followed by G.11 (19 cm² TCSA) and all other rootstocks (CG.3007, G.41, CG.4013, CG.4202, G.16, M.9 PAJAM® 2 and M.9 NAKB 337) had higher vigor with TCSA between 22 and 27 cm². The highest cumulative yield was with G.11 (460 t/ha), followed by M.9 NAKB (404 t/ha), M.9 PAJAM® 2 (391 t/ha) and G.41 (374 t/ha). All other rootstocks showed cumulative yields lower than 350 t/ha. With the 'Galavalcov' and 'Brookfield Gala®' trials, M.200 showed the highest vigor (>27 cm²/TCSA) while the lowest vigor was with M.9 PAJAM® 1 with 'Galavalcov' and PI.80 with 'Brookfield Gala®' (<17 cm²/TCSA). All other

rootstocks were in a similar range of vigor with both cultivars (between 18 and 24 cm²/TCSA). Cumulative yield over the first 9 seasons was greatest for G.11, G.41 and M.200 in both cultivars. However, G.41 and G.11 had larger fruit size compared with the other rootstocks. Overall, G.41 and G.11 can maintain growth after the first years of plantation and outgrow traditional dwarfing rootstocks in the tough replant conditions of Catalunya.

Keywords: *Malus X domestica*, rootstock, Geneva®, crop load, fruit size, yield efficiency, Fruit quality

S03-II-O-9

Establishment of crop load levels for the newly introduced apple cultivars

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Successful introduction of the new cultivars requires proper pomological, phenological and as well as technological evaluation. It is particularly important at the harsh Norwegian climate conditions. Investigations were conducted with apple cultivar 'Eden' / 'Wursixo' (WUR 6), with the aim to establish an optimal balance between yield, fruit quality and bearing regularity. Four different crop load levels were tested in 3 consecutive years in the orchard planted 3.5 x 1 m and trained as slender spindle. Lower crop load levels guaranteed good return bloom, a very high share of fruits harvested during the first picking, and larger fruits. Increasing crop load led to less intensive return bloom, smaller fruit sizes and higher share of fruits harvested during the second picking. It was found that 'Eden' is strictly alternating cultivar and precise crop load levels according to the tree age and tree vigour were defined. In order to keep 'Eden' trees in regular bearing mode crop load levels should be maintained at 4.5-5 fruits cm⁻² of trunk cross-sectional area (TCSA) in the 3rd and 6-7 fruits in the 4th growing season.

Keywords: *Malus x domestica* Borkh., yield, fruit quality, return bloom

S03-II-O-10

Evaluation of the vegetative-productive characteristics of different international olive cultivars grown in rainfed conditions in a high-density orchard in central Italy

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To revive the Italian olive-growing sector, the national production of olives and extra virgin olive oil must be increased. For this, the productivity of current olive orchards needs to be improved by renewing part of the plantations and expanding the olive-growing areas, also by introducing new cultivation systems. Regarding the latter, in recent years, new high and very high-density models have been proposed which require cultivars with

limited vigor. At present, the cultivars that appear best adapted to very high-density cultivation are Arbequina, Arbosana and Koroneiki and others are being added, mainly from genetic improvement programs. The aim of the present work was to evaluate the adaptability to high-density cultivation of Italian cultivars chosen from among those which, according to available information, could best adapt to such a cultivation system (also considering minor cultivars). The study was conducted in central Italy in an olive orchard of different cultivars planted at a distance of 5 × 2 m. The cultivars chosen for their low vigor and compact vegetative habitus and/or their high productive aptitude were: Borgiona, Don Carlo, FS17, Gentile di Anghiari, Gentile di Montone, Giulia, Leccio del Corno, Maurino, Moraiolo, Pendolino, Piantone di Falerone and Piantone di Mogliano. The cultivar Arbequina was used as the reference (control). In the period 2022-2023, most of the Italian cultivars showed greater vegetative growth (trunk section and pruned material) with respect to Arbequina, but it is very important to note that it was possible to maintain the crowns of the trees in the space available with selective pruning which thus far has not caused significant vegetative-productive imbalances. The cultivars FS17, Gentile di Anghiari, Leccio del Corno, Maurino and Piantone di Mogliano had a production and production efficiency (calculated on per unit of canopy volume) similar to that of Arbequina, with Leccio del Corno having the highest production and a production efficiency higher than that of Arbequina. Other interesting varieties were Don Carlo and Piantone di Falerone, which gave a slightly lower production. Regarding the quality of the extracted oils, all the Italian cultivars had higher contents of total phenolic substances than Arbequina. Overall, the results showed that several Italian varieties are promising, having shown similar production behavior to the reference cultivar and high oil quality. Further information is needed for a long-term evaluation of the cultivars considered.

Keywords: high-density plantations, cultivar, olive oil quality, *Olea europaea* L., olive vigor, yield efficiency.

S03-II-O-11

Different planting densities and pruning models in olive orchards

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The field trial, located at IFAPA “Alameda del Obispo” center, was planted in February 2017 using ‘Arbequina’ cultivar. It consists of four treatments with three planting densities: Intensive (I) with 416 trees/ha (7x3,42m), High Density (HD) with 833 trees/ha (6x2m), and Superintensive (S) with 1666 trees/ha (4x1,5m). Additionally, within the S density two training pruning management systems are compared: Superintensive with central axis (SC), and mechanical cut in height (1,2m) during the formation of the hedgerow (SR). The experimental design is in randomized blocks with three repetitions and elementary subplots of 4 rows for SC and SR, and 6 for HD and I. Fertiligation is applied daily to cover water and nutritional requirements. During the first two years, periodic measurements of trunk diameter were performed using a digital caliber. Harvesting was done using a trunk shaker for I, a tractor-drawn integral harvester for HD, and a self-propelled all-round harvester for SC and SR. Olive production and olive oil on dry and wet matter were measured. Accumulated production measured during four

years showed significant differences among treatments. In the first two harvesting season, pruning interventions in SR had decreased its production. In the two following years, there were no differences in production for SR, SC and H. However, there are still production differences for I treatment due to the fact that the trees have not reached their maximal vegetative development.

Keywords: Olive tree, tree density, hedgerow, pruning

S03-II-O-12

30 years of experience with Gisela rootstocks at the Education and Research Centre for Horticulture in Erfurt - Gisela 5 is still the most productive rootstock for sweet cherries

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In 1991, the Education and Research Centre for Horticulture was founded in Erfurt to carry out applied experiments horticulture and to advise growers on the generated results. Since then, production systems for sweet cherries have been a key focus in the fruit-growing department. In addition to the testing of cultivars, planting systems, rain covers and fertigation/irrigation, rootstock trials have traditionally been part of the trial programme. In the first rootstock trial (1993-2003), the rootstock Gisela 5, irrigated and non-irrigated, showed significantly higher yields than the rootstocks F12/1, Colt, Weiroot 158, PiKU 1, Tabel Edabriz. Since 1998, Gisela 5 has therefore been the most important rootstock in central German cherry cultivation. Further rootstock trials confirmed the high productivity also in comparison to semi-vigorous rootstocks. Since 2012, a rootstock trial with the cultivar 'Regina' has been running under replant conditions. After 10 years Gisela 5 is still the rootstock with the highest yields while maintaining a high fruit quality compared to Gisela 3, PiKU1, Weiroot 720, WeiGi 2 and Gisela 5 high grafted. Trees on the more vigorous rootstocks Gisela 12 and Gisela 13 had larger fruit calibers in comparison to trees grafted on Gisela 5 but slightly lower yields. The results show, that Gisela 5 can still be recommended as rootstocks for fresh soils and under replant conditions.

Keywords: *Prunus avium* L., trunk diameter, fruit mass, replant condition, yield efficiency

SESSION III- PRE-HARVEST FACTORS AFFECTING POST-HARVEST CROP PERFORMANCE

S03-III-O-1

Bee exclusion as a method to increase 'WA 38' bloom return in Washington State

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'WA 38', is an apple launched in Washington characterized by medium vigor, Type 4 habit, and self-thinning. For this reason, the variety does not require any chemical thinning but rarely a mid-summer hand thinning touch in case of high-crop load. Fruit set occur on different bearing woods: brindilla tip, lateral buds, 2-yr-spurs, 3+yr-old spurs. The tendency of 'WA38' to bear fruit in the outer canopy means this variety has the propensity to develop blind wood. In previous research, flower buds counted for three consecutive years on WA38 reported mainly primary flower buds (on brindilla tips and spurs), but secondary flowering from lateral buds was also observed. Moreover, a significant fluctuation in flower bud counts year after year suggested a potential biennial trend that could be detrimental to achieving consistent production. A bee exclusion netting treatment was tested as a possible sustainable option to modulate the fruit set and, therefore, the crop load management to a desired target compared to an un-netted, un-thinned control (natural fruit set). The study was conducted in Rock Island (WA) on a 9-year-old 'WA 38'/M.9-Nic29 conventional block trained at spindle (3.0 x 0.9 m) for three consecutive years. At the early stage of king flowers bloom (~40-60%), single-row drape nets were deployed yearly around the entire canopies to limit bee pollination. The net removal was done approximately 4-5 weeks after deployment corresponding to a midpoint in the natural fruitlets shedding period. Applying an exclusion net during bloom aimed to limit the pollination of flowers to a pre-defined target to avoid competition between fertilized fruitlets in the first 4 weeks after pollination. The parameters assessed to define the physiological response to the netting treatment were: the number of fruit set on trees at the time of net removal, apple count per tree at harvest, yield per tree, average fruit mass, crop load, fruit size distribution, and pack-out in both netted-at-bloom and un-netted treatments. The net deployment at king flowers bloom led to a higher average apple mass per tree than un-netted control but not a consistently significant difference in the number of apples and yield per tree. The pack-out analysis confirmed a greater proportion of apples in the "large" category in the netted-at-bloom treatment. Return bloom evaluated in March 2022 and 2023 revealed more flower buds per tree in previously netted trees than in un-netted trees.

Keywords: apple, netting, fruit set

S03-III-O-2

Maximizing Japanese plum crop value: response of fruit size and yield efficiency to crop load for different cultivars and quality traits that determine fruit price

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In the last decade, new cultivars of Japanese plums (*Prunus salicina*) have been introduced to cultivation in Chile, with a primary focus on the Asian market, where has been arose a great demand for high-quality fresh fruit. The new cultivars are characterized by large fruit, attractive color and sweetness. However, there is lack of information regarding the fruit size and yield response to increasing crop load and, consequently, how to maximize the crop value. During the 2019-2020, 2021-2022, 2022-2023, 2023-2024 seasons, several thinning trials on 18 cultivars were conducted in commercial plum orchards located in central Chile (33° to 34°S). Data from these experiments were used to analyze the response of fruit size and yield to increasing crop load. Yield was expressed as fruits per hectare that intercepts 70% (ha70i) of incident photosynthetically active radiation (PAR). According to the usual management given to the cultivars, a range of crop load between 245.000 and 595.000 fruits/ha70i, or 35 to 85 fruits/m² PARI, was used. The inverse response of fruit weight and direct response of yield to increasing crop load was described by linear equations in all cases. 60 fruits/m² PARI was used to compare cultivars regarding fruit size and yield efficiency; crop load adjusted yield of cultivars varied between 36.4 and 67.1 t ha70i, meanwhile, crop load adjusted fruit weight varied between 88 to 158 g. 'Larry Anne', 'Black Kat', 'Happy Giant', 'September Yummy', 'Dapple Delight', 'Crimson Fall' and 'Black Majesty' obtained the larger fruit size and, consequently, the higher yield. On the other hand, 'Autumn Pride' and 'Flavor Rich' exhibited the smallest fruit size and the lower yield. Despite fruit size is an important trait that influences the price, high sugar content (>16°Brix) and red or bicolor skin are also important factors to maximize the crop value.

Keywords: *Prunus salicina*, photosynthetically active radiation, intercepted radiation, thinning, yield.

S03-III-O-3

Evaluation of different treatments to reduce cuticle defects in 'Fuji' apple under Spanish conditions

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'Fuji' apples are susceptible to cuticle defects and the most important is skin cracking. The cause is not yet known; however, symptoms increase in severity with high humidity and temperature conditions and delayed harvest. The research aimed to assess the impact of various agrochemical products on fruit cracking and russeting in 'Fuji' apples, as well as the effect of rain covers integrated with hail nets on fruit cracking, russeting, and color. Trials were conducted over two seasons from 2021 and 2022 in mature 'Fuji' apple orchards in Mas Badia, Catalunya, Spain. Thirteen agrochemical products were sprayed at commercial rates and timings and the results indicated that all products showed similar levels of cracking (between 30% and 17%) compared to the control treatment (25%), except for water alone (33%). Additionally, trees under rain cover demonstrated a reduction in fruit cracking (5.8%) compared to those without cover (15%) in 2021 and the incidence was 2.4% and 26% of fruits with cracking respectively in 2022. However, the fruits under rain covers integrated with hail nets showed lower red blush color. Further evaluation of products and their interactions is necessary to ensure they do not exacerbate cracking. While rain cover systems were effective in controlling fruit cracking, they were associated with reduced red coloration in the fruits.

Keywords: *Malus x domestica* Borkh, Cracking, Russeting, Cuticle, weather conditions

S03-III-O-4

The effect of different combinations of thinners and surfactants on fruit thinning of Golden Delicious apple

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The effect of two apple fruit thinners, metamitron (MM) and 6-benzyladenine (BA), used alone or with the addition of different surfactants, was examined on the Golden Delicious apple cultivar in 2022. The surfactants Surfare, Trend, mineral oil (concentration 0.1%) and Inex (concentration 0.05%) in combination with MM 300 mg l-1 or BA 200 mg l-1 were applied at 13.7 mm fruit diameter. Untreated trees (UTC) served as a control treatment. At harvest, the fruits were divided into four classes according to their size: < 60 mm, 60-70 mm, 70-80 mm, and > 80 mm, and for each class the total number of fruits and yield per tree were determined. The fruit weight, number of seeds in the fruit, fruit firmness, starch-iodine index, the content of soluble solids and total acids, and return bloom were also evaluated. The combination of mineral oil with BA had the highest number of fruits per tree, significantly more than UTC, with the lowest yield of fruits larger than 70 mm in diameter. In contrast, the combination with MM had the best thinning effect, the lowest number of fruits per tree with the greatest reduction in the proportion of the smallest fruits (< 70 mm) and the best return bloom. The MM + Trend treatment also increased the proportion of the largest fruits in the yield. In combination with BA, the surfactant Surfare was the most effective and resulted in a significant improvement in the return bloom compared to UTC, while the other surfactants had little effect or were

even worse than the treatment with BA alone. The treatments did not differ in terms of fruit ripening parameters, with the exception for soluble solids content.

Keywords: apple thinning, surfactants, metamitron, 6-benzyladenine

S03-III-O-5

A non-microbial biostimulant influenced agronomical parameters in a Southern Italy olive tree orchard

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The use of sustainable agricultural practices is fundamental in modern agriculture and, even in traditional olive orchards, the use of biostimulants can be a solution. This research aimed to observe the effect of a non-microbial biostimulant on the agronomic behavior of olive trees. The study was carried out in a 3 ha-olive orchard located at Trani (Apulia, southern Italy), on 50-year-old cv. Coratina trees. A liquid biostimulant fertilizer, consisting of a balanced and optimized mixture of peptides and free amino acids, was applied via foliar spraying. Eight different treatment strategies were applied, with variable amounts of applications in the two years, evaluating the effect on shoot growth, yield, and oil quality. The strategy with 3 treatments per year showed the longest shoots, observing the same results of the block with only one treatment done in differentiation stage. While yield parameters showed no statistical differences, the pigmentation index decreased with the increment of applications. The olive oils were all chemically found to be extra virgin, with a good composition of unsaturated fatty acids. The polyphenol content is positively influenced by the number of treatments, allowing both a longer shelf-life and the utilization of the EFSA claim for the production of nutraceutical olive oils. Further research is necessary to understand better olive trees' response to biostimulants, considering the application of other solutions. These encouraging results are an incentive to continue research on the application of biostimulants on olive trees.

Keywords: Shoot growth, yield, pigmentation index, oil quality, cv. Coratina

S03-III-O-6

SWOT analysis and policy recommendations to support the fruit and vegetable sector in Germany

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The fruit and vegetable sector in Germany currently faces severe challenges. Over the past two years, production costs increased steeply due to rising energy prices and labor

costs affecting farm profitability. Climate change leads to more frequent extreme weather incidents and the spread of new pathogens, however, pesticide availability and use are increasingly restricted by legislation. Therefore, this paper aims at developing policy recommendations to support the development of the fruit and vegetable sector, based on a SWOT-analysis (strengths, weaknesses, opportunities, and threats). The data base includes an extensive review of literature and interviews with key experts from farms, research, extension, and politics. The identified strengths include a high degree of mechanization, high labor productivity, sustainable production systems, a great share of organic production, the availability and usage of risk management measures, high product quality standards. Major weaknesses are a low profitability in fruit production, scarcity of skilled labor, the low adoption of efficient irrigation technologies, weak market power of producer organizations and a lack of pest management options. Opportunities are identified in ongoing innovation and technology development, e. g. for digitization, labor, energy and resource saving, and climate protection. Consumer preferences for regional and sustainable production provide market opportunities. Major risks are seen in the increase in adverse effects from climate change as well as in ever increasing social expectations and documentation requirements regarding fertilizer, pesticide, and peat use. The heavy loss of capacities for research and education at university level is a risk for labor availability and innovation capacity. Based on these results, policy recommendations were developed addressing a number of challenges, e. g. liquidity of fruit farms, efficient water use, legal documentation requirements, availability of pest management options, funding of research projects and structures, and implementation of a funding scheme to reestablish horticultural sciences at university level.

Keywords: fruit production, vegetable production

SESSION IV - FRUIT TREE PHYSIOLOGY AND CLIMATE CHANGE

S03-IV-O-1

Do plant “growth regulators” really regulate growth? Plant development and plant growth are not synonymous

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Much scientific literature refers to plant development and growth as though they are synonymous. While plant physiology texts (E.g., Taiz et al. 2015) and horticulture texts (E.g., Sansavini et al. 2019) emphasize the roles of various plant hormones in coordinating plant development, they simultaneously refer to them as plant growth regulators. On the other hand, the same texts emphasize assimilation processes and the important role of carbohydrate and nutrient availability as well as water relations in enabling growth to occur. The terms growth and development are often used interchangeably and the literature rarely emphasizes the difference between plant

development and plant growth. This causes confusion and a lack of clear thinking when attempting to develop explanations for plant growth responses in specific circumstances. Hormone physiologists often try to explain particular growth responses in terms of hormonal theory whereas environmental physiologists will likely explain the same responses in terms of environmental conditions and availability for the resources required for achieving growth. In this paper I will argue for a clearer differentiation between plant development and plant growth and suggest that plant hormones should not be thought of as plant growth regulators, but rather as plant development coordinators. Plant development coordinators (plant hormones) set up the conditions necessary for plant growth but availability of plant growth substances; carbohydrate and nutrient availability along with temperature and water relations, are often what actually regulate plant growth rates. Treating development and growth as separate but interdependent processes could clarify much understanding of the underlying processes involved in the regulation of plant growth. These concepts will be discussed in the context of understanding the mechanisms involved in several physiological phenomenon of fruit trees.

Keywords: hormones, plant growth regulators, dwarfing rootstocks, growth rates

S03-IV-O-2

Cracking patterns in sweet cherries: A correlation analysis with quality attributes

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Fruit cracking poses a significant challenge in sweet cherry cultivation, often triggered by heavy rainfall preceding and during harvest periods. This physiological disorder results in substantial economic losses, with severity varying based on the location of cracks on the fruit: whether on the cheeks (side cracks), in the stylar scar area, or within the stem cavity. Various factors influence the incidence of sweet cherry cracking, including cultivar selection, environmental conditions, rootstock choice, fruit size, flesh characteristics, cuticle properties, and developmental stage. In this study, we aimed to assess cracking occurrences in two sweet cherry cultivars (Early Bigi and Lapins, grafted on "Saint Lucie 64" rootstock) and establish correlations between cracking indices and other quality parameters. Fruits were collected at commercial maturity stages. Field evaluations included determining total yield and trunk cross-sectional area to calculate yield efficiency. Moreover, 150 defect-free fruits underwent cracking index determination. Additionally, 30 fruits were assessed for size, weight, wax content, flesh firmness, epidermis rupture force, total soluble solids, pH, titratable acidity, and maturity index. Overall, quality parameters were significantly influenced by cultivar. CV. Lapins exhibited larger, heavier, firmer, sweeter fruits with higher acidity and maturity index compared to cv. Early Bigi. However, cv. Lapins also displayed a higher cracking index, positively correlated with aforementioned parameters and negatively correlated with wax content. Notably, Early Bigi showed elevated wax content alongside a lower cracking index.

Cracks in the stylar scar region were most prevalent in both cultivars. These findings suggest cv. Lapins cherries in the North Portugal region exhibit superior quality attributes compared to cv. Early Bigi, although the latter remains valuable due to its early ripening trait. Furthermore, larger, firmer, more mature, and lower wax content cherries demonstrated increased susceptibility to cracking, contrasting with smaller, softer, less mature, and higher wax content fruits. This study contributes valuable insights into mitigating fruit cracking and optimizing sweet cherry cultivation practices, facilitating informed decision-making for growers and stakeholders in the industry.

Keywords: Fruit cracking; Sweet cherry production; Cracking incidence; Quality parameters; Cultivar variability; Fruit quality assessment

S03-IV-O-3

Evaluation of frost risk during apple bloom in Germany

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Late spring frost events constitute a major challenge for apple producers in Germany. Extreme events like the 2017 frost can lead to dramatic yield losses, causing major economic damage for fruit growers. However, fruit-growing regions differ in terms of frost risk due to specific geographic characteristics such as continentality and elevation. For management decisions such as the choice of early- or late-blooming varieties or the application of specific protection measures, robust quantification of frost risk is indispensable. While for some regions such estimates have been generated, spatially explicit data that covers the main fruit-growing areas as well as smaller orchards, which are distributed all over the country, is still lacking. Here, we present a nationwide analysis of the risk of late spring frost during and after apple bloom. We used phenology and temperature data from the German National Meteorological Service (Deutscher Wetterdienst) to quantify frost risk after the start of bloom (BBCH 60) (a) for a historic (1993-2007) and a recent (2008 to 2022) time period and (b) for early- and late-ripening apple varieties. We define frost as temperatures below 0°C and as temperatures below -2.2°C, with the latter being a commonly used threshold for harmful frost during apple bloom. Based on these analyses, we provide maps of spring frost risk. These maps can support the planning and management of apple orchards all over Germany.

Keywords: apple phenology, frost damage, spatial interpolation, weather extremes

S03-IV-O-4

Endo-dormancy period of in some apple cultivars is affected by fall and winter rainfall during a decade of investigation

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The overcoming of the endo-dormancy (rest) in the boreal and temperate trees is linked to some climatic factors. Mainly chilling temperatures and photoperiod are reckoned the most important factors, others (rain, mist, dew, wind, intensity of light, etc) have had limited studies. However, in the past some scientists found that the natural precipitations and mist treatments can reduce the chilling requirements of buds and advance the bud break in spring. These studies were carried out during short periods (one-two years or in protected conditions) and taking in consideration few cultivars of temperate fruit trees. To have a wide knowledge of how the rainfall during the autumn-winter period can interfere with bud dormancy the monthly data were collected from September to December of eleven years (from 2010 to 2021); more over periods of months with accumulating monthly rainfall were rounded up from September to December. Eight scab resistant apple cultivars and two apple standard cultivars were taken into consideration to evaluate the endo-dormancy completion in term of days (from January 1st each year according O. M. Heide method), Chilling Portion (CP) Chilling Unit (CU) and Chilling day (Cannell M.G.R. and Smith R.I.) accumulated. The data of endo-dormancy completion and rainfall were moderate negative correlated indicating that the rainfall wetting the buds reduced their chilling requirement; accumulated rainfall in autumn showed best negative correlations mainly in relation to chilling-days to reach endo-dormancy completion; the cultivars had different habits in relation to the tested chilling methods of calculation. The results were in line with ones issued from the past studies underlining that the rainfall can contribute to reduce the chilling requirement although it is not taken in consideration actually. The causes of the effect of rainfall on the reduction of chilling requirement and/or endo-dormancy period of the buds could be linked to leaking of plant growth inhibitors placed in the scales and/or the accumulation of useful chilling temperatures that are available during the rainfall.

Keywords: Buds burst, one-year-old shoot, spur, plant growth regulator, leaching.

S03-IV-O-5

Pneumatic defoliation increases the anthocyanin content in the peel of bicolored apple cultivars 'Nicoter' and 'Rosy Glow'

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Pneumatic defoliation of apple trees is a novel approach to increase the penetration of sun radiation within the tree canopy to improve the formation of red color in the fruit peel, therefore improving the quality of bicolored apples. This work provides a deep investigation of the effects of summer pruning, pneumatic defoliation and their combination on the anthocyanin contents in the peel of 'Nicoter' and 'Rosy Glow' apples with particular attention to the fruit side and its location on the tree. While apple peels of 'Rosy Glow' enhanced their anthocyanin levels following all treatments, independent of the fruit side and orientation, the efficiency of the treatments in 'Nicoter' significantly depended on the position of the apples within the tree canopy and on the side of the fruit: inside the canopy, all treatments increased the anthocyanin content of the sun-exposed fruit side. On the outer side of the tree canopy, only pneumatic defoliation or the combination of summer pruning with pneumatic defoliation enhanced the anthocyanin contents on the sun-exposed side of the fruit, while none of the treatments proved to be significantly efficient on the sun-averted side of apples grown on the outer side of the canopy. The observations from our study constitute the basis for the routine employment of the novel pneumatic defoliation technique in the commercial cultivation of bicolored apple cultivars.

Keywords: *Malus domestica*, Club varieties, fruit quality, fruit color, summer pruning.

S03-IV-O-6

Transcriptional regulation of sugar metabolism in citrus under cold stress

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Citrus is always challenged by a variety of abiotic stresses like drought and cold that negatively influence growth and development, production and fruit quality. Understanding of citrus plant response to the stresses plays a key role in elucidation of relevant mechanism and if of are of paramount significance for exploiting key genes that can be used for genetic engineering to generate novel germplasms/cultivars with improved stress tolerance in citrus. By using either suppression subtraction hybridization or high throughput RNA-sequencing we found that a range of genes involved in sugar metabolism are conspicuously up-regulated in *Poncirus trifoliata*, a cold-hardy plant, by stress treatment. These genes include b-amylase 1 (PtrBAM1) and alkaline/neutral invertase 7 (PtrA/NINV7). We first showed that both PtrBAM1 and PtrA/NINV7 played positive role in cold tolerance by modulating sugar metabolism. Then we performed yeast one-hybrid screening of cDNA libraries to identify upstream transcription factors. As a result, CBF1, ABF4 and ABR1 were shown to transcriptionally regulate PtrBAM1, whereas AHL14 and AHL17 act as regulators of PtrA/NINV7. Interestingly, ABF4 was revealed to regulate ABR1 at transcriptional level. Except transcriptional regulation we also demonstrate that protein complexes formed between ABF4 and ABR1 or between AHL14 and AHL17 to reinforce the regulation of downstream target genes. Finally, all of the transcription factors positively function in stress tolerance by orchestrating their targets-mediated sugar metabolism. In addition, ERF108 functions in cold tolerance by modulation of raffinose synthesis via regulating expression of a raffinose synthase-

encoding (RaS) gene. Taken together, a complex transcriptional cascade works to regulate sugar accumulation for imparting the stress tolerance.

S03-IV-O-7

The effects of the summer and fall temperatures on bud endo-dormancy of some apple cultivar trees in a temperate climate area

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Many experimental trials in controlled environments on some boreal angiosperm tree species (e.g., acer (*Acer platanoides*), black alder (*Alnus glutinosa* (L.) Moench) and birch (*Betula spp.*) indicated the increase of late summer and autumn temperatures during endo-dormancy induction affected the timing of next spring bud burst. In these species the buds had the enhancement of chilling requirement (CR) and delayed bud burst. Few studies were carried out on this matter in the temperate fruit trees in temperate climate zones where the climate warming could act on the CR of the buds. The aims of this study were to shed a light on the effects of summer-fall temperatures on the physiology and the phenology of apple buds during the winter: the duration (days) of the endo-dormancy, the CR evaluation and timing of bud burst. During eleven years eight scab resistant apple cultivars and two apple standard cultivars were evaluated for the endo-dormancy completion in term of Days (from January 1st each year according to O. M. Heide method), Chilling Portion (CP), Chilling Unit (CU) and Chilling Days (ChD) accumulated. Mean, maxima, minimum and difference maxima-minimum daily temperatures were gathered per each month from August to December; more over periods of months with accumulating temperatures were fulfilled from August to December. The data of endo-dormancy completion and temperatures were correlated indicating that summer and fall temperatures had weak or no effect on the tested cultivars while late fall and winter accumulated temperatures showed positive and high correlations mainly in relation to Days to reach endo-dormancy completion. The results were not in line with ones issued from the past studies in controlled environments likely due to the fluctuations of the diurnal temperatures in outdoor conditions during endo-dormancy induction of buds and the use of bearing trees instead of one year old seedlings of boreal zones species often applied.

Keywords: Rest, growth, disease, seasons, warming, investigation

S03-IV-O-8

Analysis of the leaf-area-to-fruit ratio in apple tree training systems using a mobile LiDAR laser scanner

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In recent decades, the slender spindle has become the standard tree training system in commercial apple orchards, yet alternative systems, such as two-dimensional fruiting walls, may allow more profitable production and harmonize better with emerging mechanization opportunities. Fruit quality strongly depends on the vegetative growth of the tree. Since trees vary in leaf area and associated fruit-bearing capacity, the number of fruits per tree alone is insufficient for predicting performance potentials. Therefore, to explore the yield potential, we investigated the leaf-area-to-fruit ratio just before harvest by means of light detection and ranging (LiDAR) in an experimental apple orchard near Bonn, Germany. The experimental orchard consisted of trees of *Malus × domestica* Borkh. 'Elstar' (n = 30), which were trained as slender spindle (n = 10), upright biaxial trees (n = 10), and Drapeau trees with three axes (n = 10). A mobile LiDAR laser scanner (R2000, Pepperl+Fuchs, Mannheim, Germany) was mounted on a tractor and driven parallel to the tree rows at constant speed (0.5 km h⁻¹) to collect three-dimensional data along the row. The geometric features of linearity, curvature and the LiDAR's apparent reflectance intensity were derived from the 3D point cloud and used to distinguish leaves from other plant parts, allowing estimation of the leaf area of each tree (LALiDAR). The LALiDAR measurements were carried out 114 days after full bloom (DAFB), when the leaf area was also measured manually (LAManual) by means of defoliation. In parallel, fruit diameter, colour and crop load per tree were measured during harvest at 120 DAFB (first picking) and 130 DAFB (second picking), allowing estimation of the leaf-to-fruit ratio for each tree.

Keywords: apple, training system, LiDAR, leaf-area-to-fruit ratio, precision horticulture

S03-IV-O-9

Spatiotemporal Assessment of Olive Crop Dormancy Conditions in Extremadura (Southwest Spain) Using the NDTR Index

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Olive cultivation has great significance in Spanish agriculture, especially in the southwest of the Iberian Peninsula. One crucial aspect is understanding the conditions that govern its winter dormancy phase, a period during which the trees cease their vegetative growth in the autumn and enter a state of rest until favorable thermal conditions return in early spring. This study focuses on analyzing the dormancy period in various olive cultivation areas in Extremadura over the period from 1990 to 2021. To conduct this research, the NDTR index is used, defined as the number of days when the mean temperature remains below 14.4°C during the months of December to February. The main objective is to examine the temporal evolution of this index over several decades, providing insights into how the duration of the olive crop's dormancy period has varied. A spatiotemporal analysis is conducted to depict the evolution of the NDTR index in the studied areas of Extremadura. This offers a comprehensive understanding of regional variations in olive dormancy conditions, which is important for adapting agricultural practices to the specific

characteristics of each area. It is observed that the northern areas exhibit higher values of this index compared to the southern areas, indicating differences in olive dormancy conditions within the región. Given the prominent value of olive cultivation in the Spanish agricultural context, understanding the dormancy phase of these trees becomes an urgent necessity to ensure their long-term productivity.

Keywords: Olive, NDTR Index, Extremadura, winter dormancy, spatiotemporal analysis.

S03-IV-O-10

The impact of climate changes on the plum species in the Southern part of Romania

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Climate changes, more and more evident in the last years, have a strong influence on the growth and fruiting of fruit tree species and implicitly on the plum. In the Southern part of Romania, in the period 1969-2023, were recorded increasing of some climatic elements (1‰ assurance): mean, maximum and minimum temperatures of the air and of the soil surface, as well as for the Penman-Monteith potential evapotranspiration. Due to the significant increase in the maximum and mean temperatures of February, March and April, the onset of vegetation of plum trees occurred 10-15 days earlier. For example on 'Tuleu gras' cv. in the continental climate of Romania, in the last half century, there was an advance of the phenological stages of 19 days for stage 51 (bud swelling), 10 days for stage 53 (bud burst), 12 days for stage 61 (beginning of flowering), and 8 days for stage 69 (end of flowering). This advance had serious implications on the damage caused by frosts and late frosts. In the last 22 years, climatic accidents were recorded: in 2002 - late spring frosts, respectively -3.8°C on April 6th versus the high temperature in February and March; in 2009 - late spring frosts, respectively -3.4°C on April 23th; in 2010 – winter frost, respectively -23.9°C on January 25th; in 2017- late spring frosts, respectively -4.2°C on April 21-22th; 2020 - late spring frost, -6.2...-7.1°C on March, 16-17th; 2022 – late spring frost, -1.8...-5.8°C on April, 18-21th; 2023 – late spring frost, -1.4...-6.4 on March, 29-30th. All these climatic accidents had visible negative effects on the start and period of flowering, pollination, fruit set and consequently on fruit production (e.g.: low temperatures from April, 2017 led to the loss of yield in a proportion of 92 % on 'Stanley' cv. and 100 % on 'Centenar' cv.). There are several solutions to avoid the negative effect of climatic accidents: creation of cultivars with late flowering and resistant to late spring frosts and correct micro zoning of the plum cultivars.

Keywords: plum, climatic trends, phenological stages, late frosts, damages.

S03-IV-O-11

Plant growth regulators for improving citrus production: Chilean experience

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The use of plant growth regulators (PGRs) in modern citriculture is a well-established practice. Countries like Spain, Japan, and the USA have successfully utilized and developed various PGRs over the last three decades within their citrus industries. However, the strategic programs for PGR application must be adapted to each country's unique conditions, considering differences in concentration rates, application timings, cultivar responses, behaviors, and industry requirements. Additionally, rethinking the timing and dosage of application is crucial to avoid residues at harvest. Common challenges in oranges and mandarins include small fruit sizes and high fruit discard percentages. In this context, we share our Chilean experience with PGRs aimed at enhancing citrus production, potentially benefiting other countries facing similar challenges. Synthetic auxins like 2,4 DP and NOA can improve fruit size when applied during early flower formation and petal fall in 'Tango' Mandarin and 'Fukumoto' orange trees. Great thinning responses are observed with 3,5,6 TPA and NAA when applied in the early stages of fruit growth (e.g., 7 mm in 'Tango' mandarin). The thinning effects exhibit a rate-moment response, requiring a higher rate as the fruit grows to achieve the same thinning response. At later stages, such as the end of June drop, the thinning response decreases, but it enhances growth rates, resulting in larger fruit at harvest. On the other hand, 2,4 D has demonstrated significant success in reducing winter fruit drop in 'Tango' mandarin, a characteristic pre harvest drop in this cultivar grown in cold climates. Cytokinins, specifically 6-Benzyladenine (6-BA), sprayed during the flowering process, prove effective in improving fruit size and shifting size distribution curves towards larger sizes without enhancing fruit set. Abscisic acid (ABA) and 1-aminocyclopropane-1-carboxylic acid (ACC) show a promising thinning effect without any concerns about residues, but the correct rates are still being evaluated.

Keywords: 2,4-dichloro phenoxy propionic acid (2,4-DP), 2,4 D 2,4-Dichlorophenoxyacetic acid (2,4D), 2-naphthylloxyacetic acid (NOA), 3,5,6-trichloro-2-pyridyloxyacetic acid (3,5,6 TPA), 6-Benzyladenine (6-BA), Abscisic acid (ABA), 1-aminocyclopropane-1-carboxylic acid (ACC).

S03-IV-O-12

Effect of bumblebee pollination on fruit quality in extra-early season nectarine orchard

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Fruit size is an important parameter influencing fruit quality in peach and nectarine. Fruit thinning is often employed for obtaining proper commercial fruit size, although it does not work adequately in early-maturing varieties due to their short fruit growth period. Peach (*Prunus persica*, L., Batsch) is considered a self-compatible species that do not require pollinizers to set fruit. However, cross-pollination improves fruit size in different species due to increased seed size and sink strength. Insect pollinators can facilitate cross-pollination in peach orchards designed with different varieties growing nearby, thus potentially improving fruit quality. Consequently, this study aimed to assess the potential benefits of bumblebee pollination in nectarine orchards designed with blocks of different

cultivars. To do so, during flowering time, we installed a bumblebee-hive in a block of “Flariba” nectarine trees in the area adjacent to a different cultivar. Fruit quality parameters, including weight, size and firmness, were compared in tree-rows at increased distances from the bumblebee hive and the pollinizer variety. Additionally, we counted the number of insects’ visits during flowering, the pollen adhesion in the stigma and the fertilization level in sampled flowers of these tree-rows. Our results showed a significant effect of the distance from the bumblebee hive on fruit weight and diameter, with the largest fruits obtained from trees closer to the hive. It was also found a higher bumblebee visitation rate in trees near to the hive with flowers showing also higher pollen adhesion. Therefore, we conclude that the introduction of bumblebee hives, while not mandatory for peach production, can have a beneficial impact on fruit quality in nectarine orchards.

Keywords: fruit size, pollinator activity, pollen adhesion

SESSION V - WATER AND NUTRITION FOR SUSTAINABLE FRUIT PRODUCTION

S03-V-O-1

Soil enzymatic activity in first life period of peach orchards from central Portugal

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Soil enzymes are responsible for the catalysis of numerous chemical reactions and are associated with the decomposition of organic matter, nutrient cycling and the availability of mineral elements for absorption by the roots. In general, they are considered good indicators of soil quality. Thus, the assessment of enzymatic activity is often used as an indicator of microbiological activity which, in turn, is a result of soil maintenance practices such as tillage, pesticide application and fertilization. The enzyme activity, as bioindicator, can be one used to monitor the contribution of agriculture to monitor soil

sustainability and preservation, one challenge for humanity. In the present work we monitored the enzymatic activity of dehydrogenase, β -glucosidase, acid phosphatase and urease, in 4 peach orchards located in the Portuguese region of Beira Interior during the 1st and 2nd leaves after installation (2015 and 2016). Significant differences were observed in the activity of those enzymes between the different orchards and between the sampling times indicating a significant evolution during the period under observation. The highest values observed were: 28.89 $\mu\text{g TPF}\cdot\text{g}^{-1}\cdot\text{h}^{-1}$ for dehydrogenase, 0.47 $\mu\text{mol p-nitrophenol}\cdot\text{g}^{-1}\cdot\text{h}^{-1}$ for β -glucosidase, 1.71 $\mu\text{mol p-nitrophenol}\cdot\text{g}^{-1}\cdot\text{h}^{-1}$ for acid phosphatase and 0.62 $\mu\text{mol N-NH}_4^+\cdot\text{g}^{-1}$ of soil $\cdot\text{h}^{-1}$ for urease. The highest dehydrogenase activity occurred in the orchard with the highest application of organic materials, namely compost that includes sewage sludge from wastewater treatment. The activity of β -glucosidase showed an increase from the 2015 cycle to the 2016 cycle. The accumulation of plant residues on the soil surface may be a reason for that evolution, especially because no tillage was carried out in any of the studied orchards. The evolution of acid phosphatase activity was globally similar in all orchards, with the highest activity being observed in the period after planting, which corresponds to a period of intense plant growth and, therefore, high nutrient needs. After the spring-summer period of 2015, a decrease in the activity of acid phosphatase was observed, which may be associated with greater root growth and dispersion. Urease activity showed a small range of variation over time. However, the lowest values were observed in the spring season in both the 1st and 2nd plant cycles.

Keywords: *Prunus persica*, soil maintenance, dehydrogenase, β -glucosidase, acid phosphatase, urease.

S03-V-O-2

Deficit irrigation in French prunes (*Prunus persica* L. cv. French): Physiological, productive and soil microbiological comparison between super-high and low density orchards in Mediterranean climate conditions

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In Chile, the Rootpac 20 rootstock has recently been introduced into French prune (*Prunus domestica* L. 'French') orchards to increase plant density and facilitate mechanized harvesting and pruning. Dwarfing rootstocks are shallow-rooted and induce changes in phytohormone concentrations related to growth and water stress tolerance. An experiment was conducted in the O'Higgins region of Chile during two consecutive seasons to compare the effects of regulated deficit irrigation (RDI) in two adjacent French prune orchards. The first orchard, under conventional management (DC), was grafted on Marianna 2624, open vase-trained, with a planting density of 500 pl/ha. The second orchard, Super High Density (SHD), was grafted on Rootpac 20, trained in continuous

hedgerow, at a planting density of 1,900 pl/ha. Results showed a lower severity of water stress in the SHDO due to a greater decrease in leaf stomatal conductance of plants under RDI. Fresh and dry fruit quality was similar in both orchards, regardless of the irrigation practice. However, SHD fruit was firmer at different maturity levels (Brix between 15 and 35). Plants under RDI in the SHD induced changes in microbiological dynamics associated with an increase in beneficial microorganisms. Therefore, RDC in SHDO may not only improve fruit quality but also soil microbiota.

Keywords: water stress, sustainability, irrigation, drought, dwarfing rootstock

S03-V-O-3

Sustainability in apple cultivation through a circular approach: assessing the potential of pelleted pig slurry as a viable alternative to mineral fertilizers

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Modern fruit cultivation often relies on mineral fertilizers, a key factor in increasing yields, profit, and profitability. However, the widespread use of synthetic fertilizers contributes to soil nutrient depletion and ecosystem degradation. Livestock-derived organic waste materials could represent a viable alternative in fruit crop nutrition. Animal wastes as fertilizers have been employed mainly on cereal crops, while data about their distribution in orchards are lacking and are limited to cattle manure or poultry litter. The present study evaluated the response of young apple trees to pig slurry application as a partial or total substitute to mineral fertilizers over the period 2018-2021. To maximize the efficacy, raw wastes were transformed into easy-to-handle pellets and acidified to reduce gas emissions. Five different treatments were compared: T1 - unfertilized control; T2 - acidified pellet; T3 - un-acidified pellet; T4 - acidified pellet combined with mineral fertilizers; T5 - traditional farm fertilization plan. Crop growth (trunk cross-sectional area), productivity (yield, crop load index), basic analytical parameters (soluble solid content, pH, titratable acidity, size), and the nutraceutical properties (total polyphenolic content, antioxidant capacity) of the fruits were analysed at harvest and during the post-harvest. The overall sustainability of the management system was evaluated through the carbon footprint (LCA). Among the pelletized treatments, T4 exhibited the highest average production yield (26.23 kg/tree) and crop growth (+6.8 cm²) over the considered period, demonstrating outcomes similar to the T5 (25.87 kg/tree and +6.8 cm²) and statistically higher than the unfertilized control (22.84 kg/tree and +4.76 cm²). According to LCA, the combined treatment T4 proven to be the least impactful particularly for acidification, photochemical oxidation, and eutrophication impacts. This study showed that the use of pelletized and acidified pig slurry may be a viable way to reduce synthetic fertilizers and environmental impacts of apple cultivation.

Keywords: nutrient management, agronomy, sustainable agriculture, carbon footprint, animal waste, resource utilization

S03-V-O-4

Effect of a bio-organic fertilizer on the growth of pomegranate plantlets

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Sustainable agriculture production has become increasingly challenging in recent years. The use of eco-friendly organic fertilizers and biostimulants is a growing approach to face current and future challenges. In the present study, a bio-organic fertilizer was tested to evaluate its effect on the growth of pomegranate plantlets. Seaweed-based fertilizer containing rhizosphere bacteria was applied to one-year-old potted plantlets of 'Acco' and 'Wonderful' cultivars using the label and double doses. Treatment effectiveness was compared with negative control consisting of only water, and chemical control with urea at a dosage that provided the same amount of total nitrogen supplied by the organic fertilizer. The treatments were applied by fertigation every 10 days. At the end of experiment, plant growth parameters such as plant height, number of leaves and fresh and dry weight of shoots and leaves were measured. The results showed that the tested bio-fertilizer significantly promoted the growth of pomegranate plantlets of both cultivars. In 'Acco'cv., the fresh and dry weights of the shoots and leaves were two and three times more than negative control when the bio-fertilizer was applied at label and double doses, respectively. These results suggest that bio-organic fertilizers could be an alternative to chemical ones to promote the early growth of fruit crops.

Keywords: biostimulant, seaweed-based fertilizer, sustainability, fertigation, 'Acco', 'Wonderful'

S03-V-O-5

Scouting ecophysiological variables for managing Regulated Deficit Irrigation in almond

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In semi-arid areas, almond orchards face adverse conditions caused by climate change. Sustainable irrigation strategies and innovative approaches monitoring plant functionality can reduce water consumption increasing water use efficiency. The use of proximal and remote sensors is critical to assess the most appropriate time windows and the intensity of water restriction. The present study aims to monitor the response of almond trees subjected to differentiated irrigation regimes and identify optimal thresholds of ecophysiological variables, linked with tree functionality, to manage irrigation. The trial was carried out in an almond orchard cv. Guara where irrigation was differentiated during the kernel filling period supplying 100% (CTRL), 80% (mRDI) and 60% (sRDI) of Crop Evapotranspiration (Etc). Results showed a good relationship among variables describing plant functionality and pedoclimatic variables such as air temperature, vapor pressure deficit and soil water content. Stomatal conductance (gs), stem water potential (Ψ_s), photosynthesis (Pn) and PKo/Kc (variable describing the electron flux exiting PSII and the carboxylative activity of RuBisCO), were generally higher during fruit growth,

declining during kernel filling and increasing again during post-harvest irrigation. Values of g_s , Ψ_s PKo/Kc and Pn in mRDI were slightly lower than CTRL and higher than sRDI in almost the entire kernel filling period. Yields, volume and dry weight of fruit were similar among the treatments, but sRDI showed a higher number of tight-hull fruit (approximately 20% more than the control). These preliminary results suggest that in almond both g_s , Ψ_s , Pn and PKo/Kc are responsive to pedoclimatic variations, showing values closely related to the water-functional state of plants. The mRDI treatment allowed the greatest water saving without affecting yields and fruit quality. Considering the development of new sensors able to monitor the above-mentioned variable in a quick and low-cost way, the use of plant-based thresholds for managing irrigation is desirable.

Keywords: Water Stress, Stomatal conductance, Photosynthesis, Stem water potential, Chlorophyll Fluorescence, Sensors

S03-V-O-6

Use of a plant microtensiometer to improve water productivity in deficit-irrigated sweet cherry trees under Mediterranean climate conditions

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Regulated deficit irrigation (RDI) is a sustainable practice that improves water use efficiency in fruit orchards. Although several studies have found consistent and positive effects of this practice, RDI requires frequent measurement of plant water stress (i.e., stem water potential). The pressure chamber (PC) has been the most reliable device for measuring stem water potential (SWP) for decades. However, the PC requires a well-trained operator and cannot provide continuous measurements of SWP. Recently, a plant microtensiometer (MT) has been successfully introduced in horticulture to estimate SWP continuously in several woody plants. Nevertheless, there is little information on the application of this device to manage RDI in commercial fruit orchards. A study was conducted in a commercial sweet cherry orchard for two consecutive years to determine stem water potential (SWP) thresholds for improving water productivity in deficit-irrigated plants using a plant microtensiometer (MT). MT SWP estimates strongly correlated with PC SWP measurements ($R^2 = 0.81$, $p\text{-value} < 0.05$) for a SWP range between -1.8 and -0.4 MPa. Moderate and severe RDI induced reductions in stomatal conductance and F_v/F_m but did not change parameters indicative of early defoliation, such as intercepted solar radiation, leaf area index, and normalized difference vegetation index. Leaf stomatal conductance decreased by 50% when SWP estimates were close to -1.3 MPa, validating this SWP threshold as a physiological limit for moderate RDI. However, the most severe RDI was the only treatment that improved water productivity compared to the wet control (30%). These results confirm that the MT is a reliable tool to monitor SWP in water-conservative irrigation practices oriented to improve water productivity.

Keywords: water stress, stem water potential, regulated deficit irrigation, water conservation

S03-V-O-7

Another tool to improve resilience to HLB? Improvement of root growth of Valencia oranges with addition of potassium nitrate and iodine in fertigation

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Huanglongbing (HLB) or citrus greening, is an extremely destructive disease, and the most serious threat to the citrus industry worldwide. There is no cure, but well-balanced plant nutrition helps to prolong the productivity of HLB-affected trees. Iodine (I) is a plant micronutrient that has a role in root growth and resilience to abiotic stress in horticultural crops. KNO₃ is a water-soluble source of potassium (K) and nitric-nitrogen (N-NO₃), with both nutrients directly available for the plant. This work describes the co-application of potassium nitrate (KNO₃) and I with the aim to improve root growth of citrus trees in Florida. Hypothetically, prevention of I-deficiency in the plant, can help to prevent the decline of root growth of infected citrus trees. Two balanced nutrient solutions containing KNO₃ with or without I were compared to each other and to a local practice fertilizer recipe without I. Uptake of I and its effect on root growth was studied on potted Valencia orange trees, in a RCB trial design. Total plant weight was 33-39% greater when KNO₃ was a K and N source in the recipe. KNO₃ with I increased concentrations of I in roots, leaves and twigs, and improved leaf NDVI. Fibrous root growth was improved significantly only when I was included with KNO₃. In a next trial in an HLB infected orchard, KNO₃ with or without I in the nutrient solution, resulted in 16% resp. 9% more solids (kg ha⁻¹) compared to the local practice.

Keywords: Citrus greening, beneficial micronutrient, fertilizer, resilience, yield, KNO₃

S03-V-O-8

Effect of irrigation and mulching treatment on fruit and vegetative growth in sweet cherry trees

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Irrigation is an essential management practice to ensure growth and regular production of high quality fruit in sweet cherries, especially in sunny dry areas. In some regions, the amount of water for irrigation is limited or provided by drinking water. Improving irrigation strategies to reduce the amount of irrigation water without reducing the amount of product produced is therefore necessary to use the available water as efficiently as possible. In an experimental sweet cherry orchard, the growth response of fruit and shoots, as well as yield and fruit mass was compared between irrigated and non-irrigated trees, either with or without mulching treatment with spent mushroom substrate of the tree row in the third and fourth leaf (2022, 2023). Irrigation treatments were applied with dripping lines with integrated drippers below the soil surface, above the soil surface or with micro-sprinklers above the soil surface. Irrigation was aimed at maintaining soil moisture above 50% of the available field capacity at a depth of 25 cm. The amount of

water applied before harvest was higher in the micro-sprinkler irrigated trees compared to the drip irrigated trees in both years. The increase in fruit diameter and shoot length was slightly influenced by the mulching treatment. However, yield was higher in non-irrigated trees in 2022 and in irrigated and non-irrigated trees in 2023 when trees received the mulching treatment compared to trees with open soil in the tree row. Furthermore, trees receiving the highest amount of irrigation water had the highest fruit mass and the highest trunk cross-sectional area. The seasonal pattern of fruit growth rates was similar between treatments. For the purpose of sustainable intensification of horticultural production systems, mulching the tree row in tree fruit orchards has the potential to make the most efficient use of the scarce resource of water.

Keywords: fruit quality, pruning, *Prunus avium*, shoot growth, trunk diameter, yield efficiency

SESSION VI - LIVING MULCH AND ALTERNATIVE SOLUTIONS FOR SOIL MANAGEMENT

S03-VI-O-1

Study of weed control methods in plum orchard

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The plum (*Prunus domestica* L.) is one of the most widely grown fruit species in Bulgaria. This is due to its high ecological adaptation and the possible multiple processing purposes. Effective weed control in plum orchards is of great importance for obtaining high and quality yields. In two consecutive growing seasons (2022 and 2023) a field trial for comparison of different weed control methods was conducted. The study was conducted at an experimental orchard in the Fruit Growing Institute – Plovdiv, Bulgaria. The experiment included the following treatments: 1. Untreated control; 2. Polypropylene mulch; 3. Wood chip mulch; 4. Around-stem plastic blocks; 5. Flurostar 200 (200 g/l Fluroxypir) – 0.90 l ha⁻¹ + Stratos Ultra (100 g/l Cycloxydim) – 2.00 l ha⁻¹ (herbicidal treatment applied in a tank mixture); 6. NASA 360 SL (360 g/l Glyphosate) – 8.00 l ha⁻¹. In the spring of 2022, the different mulches were applied after initial tillage, early in spring, with a diverting tiller before the weeds developed. Herbicides were applied in the crop growth stage beginning of fruit growth (BBCH 72). The presence of weeds in the row strip leads to a decrease in the content of total chlorophyll in the leaves of the trees. In the second experimental year, the total number of weeds in untreated control increased by 44%. The polypropylene mulch and the Around-stem plastic blocks exert 100.0% control of weeds during both reporting dates. On the first reporting date, the wood mulch control of the grass weeds slightly decreased, and on the second reporting date, it decreased against all weeds. High weed control was established after the application of Flurostar + Stratos Ultra in tank mix and NASA 360 SL. The use of polypropylene mulch

or Around-stem plastic blocks is a good alternative to weed control through herbicides. In both variants is a good balance between the yields and the quality of the production.

Keywords: Plums, weeds, biometry, yields.

S03-VI-O-2

Living mulch under the row as a tool for sustainable soil management in orchards

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Environmental sustainability in an agroecosystem is funded in a sustainable land use. FAO defines conservative an agricultural system that “promotes minimal soil disturbance, the maintenance of permanent cover and the diversification of plant species” (FAO, 2014). In a period of climate change with extreme events that are increasingly unpredictable in duration and range, the diffusion of soil conservation techniques is important to mitigate negative effects, in particular erosion, drought and increase in summer temperatures. Bare soils contribute to degradation and loss of fertility and therefore reduce the sustainability of the orchard agroecosystem and ultimately farmers' income. A soil with a vegetal cover is certainly more protected from erosion. Grass cover also positively affects porosity and the formation of large stable aggregates. The residues of herbaceous cover form an organic mulch that helps regulate soil temperature, allowing a lowering of high summer temperatures, increases soil organic matter and creates habitats favorable to natural enemies, thus also becoming an important and effective aid for integrated pest management. Grassing has been used for several years in the inter-rows as its management is possible with conventional machines already present in many agricultural companies. Under the row, grassing is less widespread because mechanization is possible with more specific, expensive and not always available tools for farmers. Living mulch is one of the alternatives to chemicals or tillage for under-the-row soil management, it suppresses the most competitive weeds during the early stages of growth and at the same time adds several ecological services to the agroecosystem. The choice of the best species must be based on several aspects: adaptability to local pedoclimatic conditions, a limited rooting depth which reduces competition with the main crop for water and nutrients and finally rapid soil coverage with the aim of reducing the presence of spontaneous very competitive and limit soil exposure to atmospheric agents.

Keywords: spontaneous weeds, conservative agriculture, root distribution, soil protection

S03-VI-O-3

Agroecological strategies for table olive production in Greece: increasing sustainability and resilience through an integrated approach

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Table olives production is an important element for Greek and Mediterranean agriculture. The farming methods followed are more intensive than those applied for olive oil production due to the relatively stricter olive fruit's quality standards. Nevertheless, intensification generates a greater environmental impact, especially regarding resources depletion, soil health, climate-related emissions, and biodiversity, putting at risk the sustainability and resilience of the olive farming system. Contrariwise, agroecological approaches, emphasizing best farming practices like reduced soil management, cover crops use, agroecosystem diversification, and optimal resources management, can deliver tangible results for increasing sustainability and resilience. Through a corporate social responsibility (CSR) project, we have installed an integrated agroecological plan for implementing sustainable farming methods in 15 farms, located in central Greece, commercially producing table olives. The main pillars of sustainability improvement were i) inputs & resources management, ii) climate footprint, iii) soil health and iv) biodiversity enhancement. A set of practices were adopted by farmers, through constant training and consultancy support, including the use of cover crops, reduced soil tillage, integrated pest control, production, and use of compost by farm residues and landscape enhancement by incorporating ecological infrastructure elements. The first outcomes of the strategy's implementation highlight a significant decrease of inputs' use and increased knowledge of proper farming methods and practices. Based on the above, a private standard's label is planned, to be applied by a broader group of olive farmers and other fruit crops.

Keywords: table olives, agroecology, resilience, climate, soil health, cover crops, biodiversity

SESSION VII- PROTECTED FRUIT GROWING AND HORTIVOLTAICS

S03-VII-O-1

Recovering plastics in horticulture - on the way to sustainability

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Background: In view of the dispute on reducing plastics in general, the use of plastics in horticulture is examined with regard to its sustainability. Seven case studies were chosen for this contribution: 1) Hail nets (apple, pears, blueberry), 2) Polytunnels, 3) Reflective groundcover, 4) Asparagus mulch, 5) strawberry mulch, 6) flower pots and 7) slow release fertiliser. Methods: The traditional triple sustainability criteria Rs (re-duce, re-use and recycling) were applied. Three further criteria are added, single plastic,

degree of contamination (or cleaning effort) and availability of alternatives as a re-place strategy. Results: Hail nets appear sustainable due to their longevity over 8-15 years, single plastic (HD-PE) with little contamination and lack of efficient alternatives. Reflective mulches qualify for sustainability, if re-used several times, cleaned and properly stored over winter, single plastics (PP) and little contamination, except for metallised PE with its single use or cases with the possibility of pre-harvest defoliation. The 8+ year longevity and cleaning machines make double-sided black and white Asparagus foil without alternative sustainable. Algae based carrageen hydrogel may be an alternative to polymer encapsulated slow release fertiliser. Single use LD-PE mulches in strawberry and vegetable open field production appear the least sustainable option with the utmost need for non-fossil alternatives and research. Retrieval schemes such as MAPLATM, PolieCo TM and ERDE™ collect 30-40% of agricultural foils with an annual increase of ca. 25% in case of ERDE, a major contribution to sustainable use of plastics in agriculture and horticulture.

Keywords: Climate change, hail net, Asparagus, resource conservation, polyethylene, polypropylene, mulch, recycling, resilience, slow release fertiliser; sustainability, sustainable horticulture

S03-VII-O-2

Artificial shading effects on winter chilling accumulation in sweet cherry cv. Santina: A case study

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Gradual warming during winter is critical for temperate fruit species with high chill accumulation requirements, such as sweet cherry. Currently, farmers use chemical rest breaking agents (RBAs) like Hydrogen Cyanamide (HC). However, these are only effective if a minimum threshold of chill accumulation is satisfied. According to recent reports, temperatures are expected to rise, especially in temperate regions. Therefore, technologies are required to increase the efficiency of chill accumulation without losing productivity and profitability of perennial fruit systems. This work aimed to determine the effect of shading on chill accumulation in sweet cherry cv. Santina in the Central Valley of Chile. Two trials were established with two treatments each: a control (full sun) and a shading treatment (under a shade cloth). In trial 1, the shade cloth was installed on a high tunnel structure, while in trial 2, it was over a gable roof structure. Prior to HC application, branches were collected from 6-10 trees per treatment and taken to a growth chamber to force them to resume growth. After 10 days of forcing, reproductive spurs were counted. In the orchard, the trees applied with HC were also monitored during budbreak. Results indicate that slight changes in air temperature due to shading do not allow to confirm consistently increased chill accumulation (portions, hours, or units). Nevertheless, relevant differences in spur temperature were observed. Shading cloth affected the proportion of active spurs after forcing time and in the field. Shaded buds showed more winter chill accumulation, possibly due to lower spur temperature. Artificial shading could enhance winter dormancy in sweet cherry crops, aiding RBAs applications

in temperate zones with reduced chill due to climate change. However, it is necessary to improve our understanding of how different types of structures influence the microclimate of protected crops.

Keywords: Dormancy release, shade cloth, active spurs, bud break, BBCH scale, protected crop

S03-VII-O-3

Engineering Hortivoltaic systems for solar-protected berry crops

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As global demand for sustainable agricultural practices intensifies, the integration of renewable energy sources into traditional farming systems has become a significant solution. This study explores different kinds of engineering aspects as horticulture, electrical engineering, electronics, IT, and architecture, related to Agri-Photovoltaic, respectively hortivoltaic systems, tailored specifically for solar-protected berry crops, aiming to optimize resource utilization and enhance overall crop productivity. The hortivoltaic systems engineering goals intend to maximize the performances of solar energy generation and berry cultivation. By strategically positioning solar panels above berry crops and the add-value offered by the real-time data acquisition of a plant's living environment — soil moisture, temperature, solar radiation, and a lot of other variables, this innovative approach maximizes land use efficiency and minimizes the environmental impact associated with conventional energy-intensive farming. Key engineering considerations include the design of a robust support structure, efficient shadow management to avoid the high midday sun effects, the integration of monitoring systems for real-time data collection and intelligent control and analysis features. A pioneering Romanian hortivoltaic project, conducted by authors at the Experimental Station Moara Domneasca (Afumati, Ilfov County) under the Fruit Research and Development Station (FRDS) Băneasa, Bucharest, has yielded promising initial findings. The project demonstrates that hortivoltaic systems can be a sustainable solution for both energy production and improved berry crop (strawberry) conditions. The shading from the solar panels lowers ground temperature during peak sunlight hours, reducing heat stress on the plants and promoting optimal growth. Additionally, farmers benefit from reduced electricity costs and a smaller carbon footprint due to the dual use of land. This research delves into the design process for hortivoltaic systems specifically for solar-protected berry crops. By analyzing the original design of the PV plant and the preliminary findings from the first stage of the experiment, the study provides valuable insights for engineers,

agronomists, and policymakers seeking innovative and sustainable solutions for the future of horticulture.

Keywords: agrophotovoltaic, agrivoltaics, hortivoltaic, solar energy, shadow, berry crops, crop performance, strawberry

S03-VII-O-4

Effects of a rain exclusion cover on microclimate, wetness duration and fruit cracking in a cherry orchard in Northern Italy

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The cherry tree is particularly exposed to the issue of cracking: the emergence of fractures on the fruit surface, related to an imbalance between the water incorporated into the fruit via surface microfractures and fruit transpiration. Protection covers are increasingly used to alter this balance, especially aiming at reducing the fruit surface wetness. Nonetheless, beyond fruit wetness, the whole orchard and canopy microclimate is affected, with complex consequences also on plant physiology and fruit quality. In this study we examine the impact of rain exclusion cover on various aspects of microclimate and fruit quality of a young sweet cherry (*Prunus avium* L., cv Sweet saretta) orchard, located in the Modena cherry production area (Northern Italy). The orchard was divided in two blocks with trees i) left uncovered (control); and ii) covered at the top by a rain exclusion cover (PROTECTA ULTRA: 24% shading) and along the perimeter by a anti-insect net, starting from full bloom. The canopy micro-climate (rainfall, wind speed, air temperature and relative humidity, incident global radiation) and soil moisture were monitored at relatively high frequency in each block, during two growing seasons, contrasting in terms of microclimate. Wetness duration and its variability was monitored by replicated leaf wetness sensors located at different positions within the canopies. The daily pattern of incident global radiation and its interaction with the net were related to differences in wind speed, as well as to air temperature and humidity peaks. These, and the differences in rain interception, in turn affected leaf wetness duration. Absolute temperature and relative humidity differences between the two blocks spanned in the range ± 2 °C and $\pm 10\%$. The rain protection cover reduced the stronger wind speed intensities, while occasionally increased milder ones. Concurrently, it displaced the majority of rainfalls, especially the most intense ones. Leaf wetness intensity and duration were higher in the open field than under the cover. Fruit quality was affected differently depending on the climatic year, but included darker and more mature fruits, with significantly lower cracking, higher mass, firmness, and malic acid content.

Keywords: *Prunus avium*, protection, net, screen, extreme climatic events

S03-VII-O-5

Improvement the Fruit Growth by Photo-selective Covers in Protected Cherry Orchards

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The use of covers has become necessary to protect cherry orchards from rain-induced cracking, while at the same time maximize fruit size is a critical aspect of profitable cherry fresh market production. This research evaluated the use of high density polyethylene woven (HDPE) and low density polyethylene plastic (LDPE) photo-selective rain covers to improve fruit size in 'Santina' and 'Sweetheart' cherry orchards. Spectral light transmission, total (PPFD_{total}) and diffuse (PPFD_{diffuse}) photosynthetic photon flux density, and ultraviolet (UV) radiation were measured under covered and uncovered conditions. Absolute fruit growth rate (AGR, g day⁻¹) and fruit size categories were assessed at different days after full bloom (DAFB) and at harvest, respectively. LDPE reduced light transmission in the UV-A (350 - 400 nm) and increased it in the NIR (700 - 1000 nm) spectrum compared to HDPE. PPFD_{total} under LDPE was 5% and 12% higher than HDPE covers for 'Santina' and 'Sweetheart' cherry orchards, respectively. Both covers increased the PPFD_{diffuse} by 60% and 85%, in 'Santina' and 'Sweetheart' orchards, respectively. In 'Santina' at 67 and 71 DAFB, AGR under LDPE was significantly higher ($p < 0.05$) than HDPE. In 'Sweetheart' at 92 DAFB, AGR under LDPE and HDPE cover was significantly higher ($p < 0.05$) than under uncovered conditions. In 'Santina', LDPE increased the number of fruits >30 mm by 9% and 17% compared to uncovered and HDPE cover, respectively. In 'Sweetheart', LDPE and HDPE cover increased the number of fruits >30 mm by 20% compared to uncovered conditions. These results suggest that modification of UV, NIR and diffuse light composition by cover materials could be used as a tool to maximize fruit size in protected cherry orchards.

Keywords: Protected fruit growing, UV light, NIR spectra, diffuse light, fruit size, *Prunus avium* L.

S03-VII-O-6

Photo-selective netting as a tool to regulate the floral phenology of hazelnut orchards under changing environments

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The use of photo-selective netting is a technique that has become widespread in fruit trees to cope with climate change, but there is little information on its effect on hazelnut trees. This study evaluated the use of Pearl-grey (PG), Blue-grey (BG) and Black (B) photo-selective netting as a tool to regulate flowering phenology in 'Tonda di Giffoni' (TG) hazelnut orchard and its respective pollinator (P), leaving uncovered trees as a control (C). Male and female flower phenology progression was evaluated at BBCH 61-65 (fully

elongated catkins) and BBCH 651-655 (glomerulus with fully elongated styles) stages, respectively. Accumulation of chilling hours (CH, 7°C base model), growing degree-days (GDD, 4.5°C base model), photosynthetically active photon flux (PPFD) and UV radiation were quantified. The PG, BG and B netting reduced PPFD in the same proportion (26%) compared to C, although the PG and BG netting slightly increased PPFD intensity (2%). The PG netting showed the lowest and highest values of CH and GDD accumulation, respectively. In the TG cultivar, PG netting showed an advance of 27% and 28% in the development of male and female flowers at stages BBCH 61-65 and 651-655, respectively. BG netting delayed the development of male and female flowers by 37% and 18%, respectively and compared to the PG net. In the P cultivar, all nets advanced flower development compared to the control. These results suggest that the use of photo-selective netting is a useful tool to anticipate or delay flower development in hazelnut. The implications on pollination efficiency and fruit yield are discussed.

Keywords: Climate change, floral biology, protected fruit growing, *Corylus avellana* L.

SESSION VIII- NEW PESTS AND DISEASES AND THE RESILIENCE OF FUTURE FRUIT SYSTEMS

S03-VIII-O-1

Alternative plant protection strategies in fruit growing from agronomic, economic and environmental perspectives

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One of the challenges facing conventional fruit growing is to reduce the negative impact of plant protection products, while limiting economic losses. The aim of the Swiss project ArboPhytoRed is to run new strategies for reducing the use of synthetic plant protection products with particular risk potential by at least 30%, while limiting financial losses to less than 10%. On-farm trials have been set up in collaboration with fruit growers in Valais (Switzerland) to assess the effectiveness and feasibility of alternative plant protection strategies. In 118 apple, pear and apricot orchards, pests and diseases were monitored in reference plots and in alternatively treated plots. The results of the 3-year study showed that the use of alternative products can pose agronomic problems when pests and diseases pressure was heavy (particularly with scab and aphids). Besides, the use of alternative products required greater precision from the growers in terms of timing and techniques of application. The economic evaluation carried out in 2021 in apple orchards revealed a large reduction of the packout (part of 1st class fruits) and a slight increase in production costs resulting in a 56%-lower financial outcome for alternative strategies. On the contrary, the strategies implemented in the alternatively treated plots have led to a reduction of more than 30% in the number of phytosanitary interventions and of 57% in the quantity of synthetic active compound applied (all fruit species together). Additionally,

according to SYNOPSIS analysis, the risk potential for living organisms in surface water was reduced by 52% for alternative strategies. Thus, the environmental performance of alternative plant protection strategies has largely been achieved, but at the expense of agronomic and economic performances. Therefore, alternative strategies need to be adapted in order to rebalance the various performances.

Keywords: Environmental impact, Orchard performance

S03-VIII-O-2

Increasing orchard biodiversity for a resilient fruit production

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Modern conventional fruit production includes mono-varietal orchard plots, with the inter-row managed with traditional approaches, such as tillage or permanent grass cover, characterized by a low biodiversity and low provision of ecosystem services. Along with climate change, small farm holdings (< 5 ha), that account for about 50% of the total EU farms, foresee a risk of high economic instability. The project entitled: "Diversified orchards for resilient and sustainable farming systems" (DREAM) aims to test a new agroecosystem concept, adapted to local environmental, economic and social conditions in three fruit producing areas: Italy and Morocco for apple and Spain for pear. In 2023, the performance of apple orchard located in Italy was tested in terms of: i) physiological efficiency; ii) interrow coverage and intrinsic biodiversity; iii) pollinators characterization and abundance. Although still not in production, the 9 apple cultivars in the DREAM plot showed high variability in seasonal shoot growth, while no differences were found for stem and leaf water potential as well as for leaf gas exchanges. Soil coverage was decreased by a 36% in conventional system with respect to the DREAM one. In terms of interrow biodiversity, the DREAM system presented at the end of the first growing season 9 different species, with the predominance of *Medicago polymorpha* and *Sulla coronaria* while in the conventional system only 4 species were present, among which *Panicum miliaceum* and *Sorghum halepense* were accounting for the 89% of the total. The exploratory survey on pollinators conducted in July showed the presence of honey bees ten times higher in DREAM than in conventional system. Furthermore, DREAM system had a higher presence of hover flies, butterflies and wild bees. In conclusion, these preliminary results show that the DREAM system is able to increase orchard biodiversity. Future research will be conducted to monitor the plant responses under deficit irrigation conditions and its repercussion on fruit quality.

Keywords: apple; biodiversity; agroecosystem; physiology

S03-VIII-O-3

What makes pear leaves resistant to *Psylla sp.*? Anatomy of lamina, midrib and primary veins in some *Pyrus sp.* cultivars

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Pear production is particularly threatened by *Psylla sp.*, as it probes and feeds in the phloem, causes necrosis and premature defoliation, excretes honeydew, causes russetting, and transmits *Erwinia amylovora* and *Candidatus Phytoplasma pyri* (the agent of pear decline). Since mechanisms regulating resistance to pear psylla are not well understood, leaf anatomy may be one of the answers. The aim of this study was to compare morphology of lamina, midrib and primary veins of 'Santa Maria' (highly susceptible), 'Packham's Triumph' (susceptible), 'Bella di Giugno' and 'Abbé Fétel' (moderately resistant), and 'Jeribasma' (highly resistant) and to understand which of those may be responsible for the resistance/susceptibility of pear cultivars to this insect. Lamina anatomy (adaxial cuticle thickness, adaxial epidermis thickness, palisade thickness, spongy thickness, abaxial epidermis thickness, abaxial cuticle thickness and leaf thickness) and primary veins (distance from the adaxial surface to the xylem, distance from the adaxial surface to the phloem, distance from the abaxial surface to the xylem, distance from the abaxial surface to the phloem, xylem area, and phloem area) showed no clear line between resistant and susceptible cultivars. The measurement results showed that 'Santa Maria' has an extremely large central vein, which is characterized by a large average phloem and xylem area. In contrast, the cultivar 'Jeribasma', which is characterized by high resistance, had a significantly smaller average length and width of the midrib, as well as the smallest average phloem and xylem area (2-folds lower), making it less suitable for feeding the *Psylla sp.* This was favored by the fact that 'Jeribasma' had the smallest length of phloem sieve tubes in the midrib, while 'Santa Maria' and 'Packham's Triumph', the two most sensitive cultivars tested, had the highest averages. The results obtained can be used in the following breeding programs for the early selection of resistant seedlings against *Psylla sp.*

Keywords: xylem, phloem, resistance, morphology

S03-VIII-O-4

Unraveling the mechanism of resistance to apple blotch through genome-wide association studies

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Apple blotch, caused by the ascomycete *Diplocarpon coronariae*, poses a significant challenge in low-input cultivation and integrated farming systems in Europe, resulting in

reduced fruit quality and yield. One promising solution is the cultivation of apple varieties that are resistant to *D. coronariae*. To evaluate the level of susceptibility to the disease detached leaf assays and greenhouse tests were conducted with cultivars from the German Fruit Genebank (GFG). None of the 798 tested apple varieties tested were found to be resistant, but variations in the degree of susceptibility were obtained by the tests. The aim of this study was to conduct a comparative genome-wide association study (GWAS) with phenotypic data from both susceptibility tests. The samples were genotyped using the Axiom JKI50kMd SNP array. Our results indicate the presence of multiple marker-trait associations, suggesting a polygenic mechanism controlling susceptibility variation. The findings of the GWAS study will be presented and possible future applications to apple cultivation and resistance breeding discussed.

Keywords: *Marssonina*, *Malus*, *Diplocarpon*, robustness, GWAS

POSTER PRESENTATIONS

S03-P-I-1

Generation and trading on the voluntary market of carbon credits from olive growing

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The “OLIVER” (OLive tree for Verified Emission Reduction generation) project is funded by the European Union through the LIFE programme; it started in 2023 and will end in 2027. This project has the ambition to make a substantial impact on the Greenhouse Gas (GHG) balance of the Mediterranean olive crop. Considering that this crop covers about 4.6 million hectares in the EU (the tree crop with the largest area in the EU), an improvement in the GHG balance in this crop would have a significant overall impact. The project aims to: 1) calculate the avoided emissions and the increase in GHG sequestration achieved through the application of sustainable agronomic practices in olive tree cultivation; 2) calculate the related carbon credits achievable as a result of the previous aim; 3) sell these credits on the voluntary market, providing the farms with a positive economic return and image; 4) constitute a practical application case, suitable for the other tree crops. To achieve these objectives, the project will establish a regulatory framework and certification protocol for the agricultural sector, to access the voluntary carbon-credit market, involving in the project around one hundred olive farms located in Italy, Spain and Greece, with a total of around 900 hectares. It is expected that the concrete applicability defined in the project will induce many other olive farms and other tree crop farms to take the same path, greatly increasing the impact of the project.

Keywords: *Olea europaea* L., GreenHouse Gas balance, voluntary carbon-credit market.

S03-P-I-2

Fertilization, a significant factor on survival rate of grafting trees in the nursery

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The main purpose of this research is to establish the effect of fertilizers on a morphological character of plum in the nursery, respectively the grafting of trees. Sustainable fertilizers used in the nursery have become a priority, with the adoption of

management strategies that maintain satisfactory yields, thereby improving both fertilizer and water use efficiency. The research was carried out in the North- Western part of Romania, in a private nursery. The biological material was represented by rootstock seedlings. There were studied two plum cultivars, 'Stanley' and 'Cacanska Lepotica' and were used four doses of NPK fertilization. The placement of the variants was done in randomized blocks, in five repetitions, with fertilization as the primary factor and the cultivar as the secondary factor. Soil samples were also collected for laboratory analysis, to determine the initial content of trace elements in the soil. During the research, it was found the need for rational application of fertilizers to increase the yield and quality of the tree planting material. Thus, compared to the non-fertilized version, the application of different doses of NPK allowed a significant increase in the percentage of trees to be caught by 1.73-3.13%. Regarding the application of a dose of 24 kg of NPK, the grafted trees of the two cultivars utilized the fertilization equally. It is found that the most important principle of the fertilization efficiency consists in the maximum utilization and the correct combination of fertilizers on the horticultural lands.

Keywords: plum cultivar, fertilizer, planting material, grafting, fruit trees nursery

S03-P-I-3

Evaluation of the mulching attitude for potted olive trees of a blanket obtained from beached *Posidonia*

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Posidonia oceanica (L.) Delile is a seaweed that colonizes the seabed in the Mediterranean Sea near the coasts, playing an important role in the marine and coastal ecosystem. At the end of its life cycle, following autumn sea storms, it is deposited on the coasts of the entire Mediterranean Sea every year, giving rise to the characteristic heaps known as banquettes. This study considered the use a blanket obtained from *Posidonia* by the Rinnova start-up as a mulch for weed control in olive potted trees. To this end, six-year-old potted olive trees (Leccino cultivar) were used. The experiment was designed as a randomized block with three blocks each with 9 potted olive trees and 3 types of weed control (manual weeding, mulch with plastic film, and mulch with *Posidonia* blanket). The pH and electrical conductivity (EC) of the substrate's leachate and the leaves' relative water content (RWC) and chlorophyll content were monitored for one year. The pH of the substrate's leachate averaged around 7.3 in all the treatments. Initially, the EC values observed in the substrates mulched with *Posidonia* were 2660 $\mu\text{S cm}^{-1}$ higher than in the other two treatments (around 600 $\mu\text{S cm}^{-1}$). With time, a rapid lowering of the EC values was observed and at the end of the test for all three treatments,

the values were around 300 $\mu\text{S cm}^{-1}$. The RWC and leaves' chlorophyll content were not affected by the mulching with *Posidonia*, plastic film, and weed manual control. 50% of the *Posidonia* blanket began to deteriorate, showing cracks (a few mm) 5 months after the experiment was set up. However, the cracks did not increase in the subsequent period. Therefore, it can be stated that considering the related environmental advantages, based on the preliminary results obtained, the use of *Posidonia*-based mulching blanket for potted olive trees appears to be an alternative to weed manual control or traditional plastic films, despite having, as was to be expected, a shorter lifespan than the latter.

Keywords: *Olea europaea* L., weed control, seaweed, recycle.

S03-P-I-4

Preliminary results on improvement of hazelnut propagation through budding

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Increasing production based on the use of adequate cultivars and improving growing and propagation technologies is the main trend and orientation in hazelnut culture, both worldwide and in Romania. This was primarily due to the introduction of the intensive culture system, in which plants are trained as single trunk and where fertigation and mechanized harvesting is also applied. The improvement of planting material is aimed at shortening the time of obtaining it, by improving the propagation techniques applied in the field, in protected spaces and in vitro. This paper identifies and improves technological sequences through which to obtain larger quantities of high-quality planting material. Grafting and budding are less used in Romania due to the higher efficiency of hazelnut propagation through layers and because of the special technical and environmental conditions required during and after budding or grafting. Grafting or budding bring advantages regarding the single trunk training, very few or no suckers when adequate rootstocks are used and also may improve the yield and nut quality. When using the chip-budding method in the field, in the ecological conditions of Vâlcea area, the success rates varied between 62 – 68%. The chip-budding of hazelnuts, carried out in the field in August, registered higher average values (64%) compared to the T-budding method (61%). In the end of the 2nd year the trees in the nursery have average trunk diameter size ranging from 13.2-13.6 mm and length of 119-120 cm.

Keywords: *Corylus avellana* L., propagation, budding

S03-P-I-5

Study Regarding the Influence of Grafting Method on Walnut grafting Success in Protected Spaces

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The main means of obtaining walnut grafted planting material is represented by grafting and forcing it in protected spaces under controlled temperature and humidity conditions, followed by the passage of the material into the field. The good grafting success of walnut is influenced by numerous factors such as: the grafting method, temperature, atmospheric humidity, the content in phenolic compounds, the hormonal and nutritional conditions of the grafted varieties and the harvesting time of the grafted branches. The method of direct grafting in the field has been used by most nurseries in walnut-growing countries, but the results are variable, the success of grafting being strongly influenced by climatic conditions and the physiological state of the symbionts (scion and rootstock). Starting from the hypothesis that the controlled space offers the possibility of a much more effective control of these factors, studies were carried out with the aim of producing grafted walnuts directly in a protected space (polyethylene tunnel). The experiments were carried out during 2017-2019, and four Romanian varieties were used: 'Anica', 'Velnița', 'Miroslava', 'Grădinar'. The data obtained regarding grafting highlight the efficiency of the chip budding method, with a 51.4% grafting success, with a significant difference compared to grafting patch budding, where only 33% grafting success was obtained. Microscopic observations on the cross-sections made 15 and 25 days after grafting, at the grafting point, highlighted both the presence of callus and undifferentiated parenchyma tissues, as well as the restoration of vascular continuity between grafts and rootstocks, in all walnut varieties taken in study and grafted by the chip budding method.

Keywords: grafting, walnut, chip budding, protected area

S03-P-II-1

Influence of mulching materials on water storage capacity, weed control and growth of apple trees

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In a three-year project (Interreg V) the effect of covering materials on reducing evaporation and improving the water storage capacity of the soil was examined in apple

orchards. Four experimental sites with significantly different precipitation were involved: HSWT/ Schlachters and Agroscope (1400-1600mm), KOB (800-1000mm), LWG (450-600mm). In addition to reducing evaporation, mulch materials can improve the infiltration of water into the soil, and an increase in humus content can contribute positively to the water storage capacity. Three different materials were compared: Wood chips, grass silage and the application of biodegradable spray mulch, a spray-on covering material that was developed by the Technology and Support Center (TFZ) in Straubing. It consists mainly of starch and rapeseed oil and it is completely degraded during vegetation period. At two sites additionally treatments with low demanding underseeds (clover-grass mixtures) were included, aiming to suppress competing weeds, positively influence the nitrogen content and reduce silting and crusting of the soil. Measurements of soil water content were realized using a mobile device (Fieldscout TDR 300) at a depth of 12 to 20 cm. The weed-suppressing effect of the materials was determined (percentage of covered surface), vegetative growth and crop yield were measured annually, soil samples were taken for analysis of nutrients and humus content and the C:N ratio of the materials were analyzed. The results show that mulch materials such as wood chips and grass silage have both a potential to improve soil moisture and a weed-suppressing effect. Additional weed control measures (herbicide or mechanical) were significantly or completely reduced. Potential promotion of voles must be considered. In this respect, materials that are completely decomposed during season may offer advantages. The need to regularly renew the application of the mulch layer and the optimization of the application quantities are further points that need to be investigated.

Keywords: water, fruit production, apple, climate change, drought tolerance

S03-P-II-2

Evaluation of the environmental impact of two different soil management systems in olive growing through the Carbon Footprint analysis

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Olive (*Olea europaea* L.) is a widespread tree crop in the Mediterranean basin. Olive growing can play a vital role in mitigating climate change since if conducted with sustainable practices olive tree groves represent a strong carbon sink. In the present work, the environmental effects evaluated as Carbon Footprint (CF) using two different soil management systems (soil spontaneous green cover and green manure with *Faba minor* L.) in an olive grove in Central Italy (Umbria region) was evaluated under a Life cycle assessment (LCA) approach, internationally standardized by ISO 14040 (ISO, 2006) and ISO 14044 (ISO, 2018), allows to evaluate multiple environmental impact categories over the entire olive oil supply chain. In particular, the LCA analysis was conducted in an organic farm to determine the Carbon Footprint (according to ISO 14067, 2018) of the production of one liter of olive oil (functional unit) using the two soil management systems. The soil management with *F. minor* green manure resulted in a lower environmental impact (about 8.06 kgCO₂eq L⁻¹ oil), due to the reduced use of fertilizers and fuel, compared to the soil management with spontaneous cover crop (8.85

kgCO₂eq L⁻¹ oil). The total dry biomass of the green cover, grass height, average area covered by grassland, composition of the aboveground green cover biomass, soil moisture, olive tree vegetative and productive activity was also evaluated to evaluate also the increase in carbon sequestration. The total dry aboveground biomass was significantly higher in the cover crop with *F. minor* than in the spontaneous cover reaching values around 12 t ha⁻¹. The values on the green cover height and average area covered by the grassland showed a homogeneity of the grassland. At the same time a greater height and soil cover was observed for the green cover with *F. minor* than for spontaneous grassing. The aboveground biomass in the spontaneous cover crop is mainly represented by grasses and minimally by legumes and other botanical families. The opposite of the latter was observed in the treatment with *F. minor*. The soil management system did not affect soil moisture, olive tree vegetative and productive activities in the first year of the implementation of the two soil management systems.

Keywords: *Olea europaea* L., green cover, Life Cycle Assessment, green mulching

S03-P-II-3

Agroecological practices applied in a young olive orchard in Southern Italy

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Among the agro-ecological practices for olive, conservation agriculture (i.e. zero tillage and living mulch) represents a strategy that can improve soil fertility, limiting erosion phenomena and reducing agronomic management cost. The study was carried out for three years (2021-2023), in the 'Long term trial on organic Olive (BiOlea)', at the experimental farm of CREA – Research Centre for Olive, Fruit and Citrus Trees, located in East Sicily, Italy, (latitude 37.17" N, longitude 14.50" E, elevation 45 m a.s.l.). The experiment focused on a young olive orchard, planted with two Sicilian main olive cultivars 'Nocellara del Belice' and 'Nocellara Etnea', grafted onto seedling rootstocks. Inter-row minimum and zero tillage and four species of aromatic plants as living mulch along the row were tested. Morphological tree growth and physiological response were monitored. From a climate analysis of the last 30 years compared with the last 3 years, a significant difference was found in both temperatures and rainfall recorded in the summer period. The conservative soil management practice without tillage adopted for the study, did not interfere with the growth of the plants nor with their physiology, while the two cultivars differently responded to the zero tillage. Indeed, the 'Nocellara Etnea' reached larger dimensions showing greater growth potential in a condition of lower cultivation inputs, due to aspects linked to the genotype-environment interaction.

Keywords: minimum tillage, zero tillage, ASC, physiologic response

S03-P-II-4

Flower strips as living mulches in young apple orchard: effect on the tree growth, and soil microbial activity and biodiversity

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Sustainable management of apple orchards can be based on practices that are improving biodiversity, e.g. by using living mulches. Flower strips are considered a tool to increase orchard biodiversity and promote biological control of pests. We have established a trial to merge the two practices: living mulches with mixtures of plants used to set up flower strips and measured their impact on soil microbial activity and biodiversity as well as on tree growth and fruiting potential. An apple orchard (cv. Golden Delicious on M9 rootstock) was established in 2021 and two alternative mixtures of plant species (mix of *Festuca ovina* and *Trifolium repens* or a mix of 10 species used for flower strips, including several leguminous species) were assessed as understory living mulches and compared to natural soil cover as control. The apple plants were also treated or not with a formulation of arbuscular mycorrhizal fungi (AMF). The living mulches increased the soil nitrogen levels in summer, but competed with the tree for other mineral soil resources (especially for K during spring), inducing a lower nutrient amount in soil. This was less evident in plots with trees inoculated with AMF. This condition resulted in reduced blooming intensity and fruit potential, as well as limiting the tree growth measured as average length of one-year shoots, in comparison to untreated control. The soil microbial activity and diversity, measured by the microbial metabolic potential towards 31 different C-sources, were improved by the flower strip mixture (mix of 10 species) during the whole season, and only during the summer by the other mixture. The results suggest to modify the practice to avoid initial competition between living mulches and apple trees. However, the assessment of long-term effects of these living mulches on the whole orchard biodiversity and productivity is planned for providing fertilization and plant protection recommendations for orchards implementing such practice.

Keywords: arbuscular mycorrhizal fungi, soil bacteria, soil nutrients, sustainable horticulture

S03-P-III-1

Frost analysis in the main olive tree production areas of the Iberian Peninsula (1981-2020)

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Although the olive tree is a crop spread all over the world, the main growing area is the Mediterranean basin and especially the Iberian Peninsula. Temperature is a crucial factor that impacts the distribution and success of the crop. Low temperatures and frosts are an important limitation of this crop. Therefore, a spatiotemporal analysis of climatic variables is crucial to identifying viable areas for olive tree cultivation. In this study we analyzed the probability, intensity, and trends of frost in the main producing areas of the Iberian Peninsula, as well as the average dates of first and last frost. These variables were integrated into a geographic information system, which allowed the graphic visualization of their patterns. The mean daily minimum temperatures of thirteen meteorological stations from the European Climate Assessment & Data set (ECA&D) database, located in the main olive growing areas, were used, considering a period from 1981 to 2021. The Mann-Kendal test and Sen's slope were used to determine trends and their magnitude. Findings indicate a high probability of frost in all areas except one, with eight crop areas having a high probability (>50%) of severe frost. However, the data indicates a decrease in the frequency of yearly frosts accompanied by a rise in the average annual minimum temperature. Additionally, observations of frost dates reveal a delay in the first autumn frost and an advance in the last spring frost, resulting in a longer frost-free period. This occurrence may suggest an earlier onset and an extended duration of the vegetative phase.

Keywords: olive, growing season, temperature, trends, Spain

S03-P-III-2

Partial inhibition of flowering in peach tree 'Dulciflora 2' by gibberellic acid applications

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The main objective of fruit thinning in *Prunus persica* (L.) Batsch (peach, nectarine and their variations) is to obtain fruit of commercial size. Thinning is an operation traditionally done by hand, yet this procedure is not the most appropriate for early ripening cultivars due to their short reproductive cycle. In addition, hand fruit thinning is expensive and labor intensive. Chemical thinning has failed to establish itself as a reliable alternative for stone fruit crops, so mechanical thinning is one of the few possibilities available to growers to reduce labor costs. Unfortunately, the mechanical removal of fruitlets causes damages to the developing fruits and tends to remove the larger ones. Thus, for early maturing cultivars, farmers often rely on flower thinning at bloom using portable electronic devices to remove mechanically some flower buds and reduce flowering levels. In this experiment, we explored how applications of gibberellic acid (GA3) on nectarine trees (*Prunus persica* var. *nucipersica*) cultivar 'Dulciflora 2' can be of further

help reducing flowering levels. Treatments applied were 0 (control), 50, 100, 200 and 400 mg L⁻¹ of GA3. The experiment was repeated on three different dates (30 June, 16 and 29 July 2021) on different trees to explore the optimal dates for GA3 applications. The highest rates of GA3 (400 mg L⁻¹) significantly reduced flower number and, consequently, flower thinning time by up to 66% compared to control. Lower effects were obtained with lower doses. GA3 applications had the greatest effect at the earliest date, losing effectiveness later. Despite success reducing flowering, GA3 caused a phenological delay at doses of 100 mg L⁻¹ and higher. In conclusion, applications of GA3 at 200 and 400 mg L⁻¹ applied in June could be an alternative (or complementary) to traditional hand fruit thinning reducing labor costs in peach.

Keywords: *Prunus persica*, GA3, flowering inhibition, thinning, flower buds drops, phenology delay

S03-P-III-3

Morphological characteristics of cherry fruit-bearing branches as an element for determining pomotechnical treatments

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The morphological characteristics of the fruit-bearing branches were examined in nine of the most important cherry cultivars grown in Serbia ('Bigarreau Hatif Burlat', 'Carmen', 'Grace Star', 'Vega', 'Black Star', 'Sunburst', 'Cordia', 'Germersdorfer Grosse Kirsche', 'Regina'). The tests included three groups of fruit-bearing branches: fruiting spurs, short fruit-bearing shoots and long fruit-bearing shoots. The dimensions of the branches, the number of flower buds and vegetative buds and their ratio were examined. The morphological characteristics of the fruiting branches differed significantly between the tested cultivars. The number of fruiting spurs per 1 m length varied between 26.3 ('Cordia') and 36.4 ('Germersdorfer Grosse Kirsche'). The average length of the short fruiting shoots was 10.1 cm and varied between 6.5 cm for the cultivar 'Regina' and 12.9 cm for the cultivar 'Sunburst'. The number of flower buds on these branches was between 4.3 ('Grace Star') and 7.0 ('Black Star'). Long fruiting shoots provide the best fruit quality. Their length ranged from 22.9 cm ('Sunburst') to 36.7 cm ('Regina'). The number of flower buds per long fruiting shoot ranged from 5.3 ('Bigarreau Hatif Burlat') to 7.7 ('Vega'). The length of the branch part with flower buds was related to the number of flower buds per branch. The differences observed between the cherry cultivars studied in terms of the morphological characteristics of the fruit-bearing branches can serve as an important parameter for the implementation of pruning, especially in orchards with a high planting density.

Keywords: *Prunus avium*, cultivar, fruiting spurs, short fruiting shoots, long fruiting shoots, flower buds

S03-P-III-4

Climatic differentiation of olive-growing area in Extremadura (1990-2021), Southwestern Spain

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The Mediterranean basin is the area with the largest cultivated area of olive trees (*Olea europae* L.) due to its suitable climatic conditions. Temperature and precipitation are the main climatic variables that determine the distribution and viability of the crops. Within the Mediterranean basin, Spain is the main oil-producing country, with the most important olive-growing areas being located in the south and southwest of Spain. This work analyses the average, minimum and maximum rainfall and temperatures in the olive-growing area of Extremadura (south-west Spain), which have different climatic and topographical characteristics. Using the daily data from the 47 stations that the State Meteorological Agency (AEMET) has distributed in this region, a quality control and homogenisation process was carried out for the subsequent calculation of the temperature, minimum and maximum mean and total precipitation for the period 1990-2021. The data obtained were subjected to ANOVA statistical analysis to study the existence of significant differences. The results show large differences in rainfall, varying between 396-490 mm in the central part of the region and 667-757 mm in the northeast and northwest, with the highest altitude areas of the region standing out with 1033 mm. Regarding the average temperature, there are significant differences between the highest altitude zones in the north of the region, with average temperatures of 15.5-15.7 °C, and the lowest altitude zones with average temperatures of 16.9-17.1°C. The same behaviour is observed in the maximum and minimum temperatures, with the highest values in the central zone and the lowest in the northern zone. These differences have an important influence on the management in the different cultivation zones, as well as their sustainability in the context of climate change.

Keywords: Olive tree, temperature, rainfall, Extremadura.

S03-P-III-5

Identification of the S-RNase binding pollen proteins in Prunus fruit trees

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Many *Prunus* fruit tree species exhibit the S-ribonuclease (S-RNase)-based gametophytic self-incompatibility (GSI), which uses S-RNase as the pistil determinant, resulting in unstable fruit set. Recently, it has been recognized that the molecular mechanisms underlying S-RNase-based GSI system are not common among plant species. Identification of non-S specific factors essential to SI, also called as modifiers, would help to understand commonality and specificity of the *Prunus* S-RNase-based GSI mechanism. Several proteins interacting with the pollen or pistil determinant has been identified as non-S specific factors in plant species exhibiting S-RNase-based GSI. In this study, we performed protein-protein interaction assays to identify S-RNase binding pollen proteins in *Prunus*. First, a co-immunoprecipitation (co-IP) assay using the silkworm-expressed recombinant S-RNase against pollen extracts were performed and the immunoprecipitated proteins were identified by mass spectrometry. S-locus F-box protein like 2 and 6 (SLFL2, 6), S-haplotype-specific F-box protein like 2 (SFBL2), their SCF complex components, M-locus-encoded glutathione S-transferase (MGST) and uncharacterized DnaJ-like protein were commonly identified in the experiments using sweet cherry and Japanese apricot pollen. Second, the interactions of tobacco-leaves expressed MGST and DnaJ-like protein, newly identified S-RNase binding protein candidates, to recombinant S-RNase were tested by co-IP assay. The S-RNase binding ability of DnaJ-like protein was confirmed, whereas that of MGST was not. This indicated that MGST bound to S-RNase indirectly. Finally, molecular biological characterization of DnaJ-like gene of sweet cherry was performed. Phylogenetic analysis indicated this DnaJ-like gene arose after divergence between the *Maleae* and *Prunus*. These results support uniqueness of the *Prunus* S-RNase-based GSI mechanism.

Keywords: gametophytic self-incompatibility, non-S specific factor

S03-P-III-6

Correlation between Daily Trunk Diameter Oscillations, Weather Variables and Soil Water Potential for Redhaven Peach Tree Grown in Temperate Climate

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The objective of this work was to analyze the strength of relationships between trunk daily growth (DG), maximum daily shrinkage (MDS), some weather and soil variables (air temperature, relative humidity (RH), precipitation (P), global solar radiation (GSR), vapor pressure deficit (VPD), and reference evapotranspiration (ET_o) and soil water matric potential (SMP)) for two soil depths in peach (*Prunus persica* (L.) Batsch) trees grown on medium-textured soils under continental-temperate climate conditions in non-irrigated regime. The study was carried out in a 5-year-old peach tree orchard with the 'Redhaven' cultivar grafted on 'Adaptabil' semi-dwarf rootstock. Hourly micrometric trunk diameter fluctuations of two trees were automatically determined by DEX 100 Dynamax dendrometers, and SMP was continuously monitored with resistance blocks installed at two depths: 0.2 and 0.4 m during six (2017-2022) growing seasons (V-X months). DG

was significantly negatively influenced by MDS in all months of the year. Analyzing the intensity of the dependencies through the Pearson correlation coefficients, it was established that DG was positively influenced by the high values of P mostly in August, but also in May, July, and September, and by RH especially in May-September interval. The MDS was negatively influenced by high RH, mostly in the first and the last two months of the analyzed period. Frequently, GSR and VPDmax appeared to have a stronger negative effect on DG compared to other weather and SMP indicators, while GSR was the main responsible factor for increasing peach MDS (and therefore water stress), followed in May, September and October by VPDmax. The obtained relationships might be used in monitoring and early diagnosis of the peach tree water stress.

Keywords: *Prunus persica* (L.) Batsch, soil water stress, vapor pressure deficit, daily trunk growth, maximum daily shrinkage

S03-P-III-7

Trend of optimal temperatures for carbohydrate synthesis and vegetative growth of olive trees in the PDOs of Extremadura, Spain

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Climate is considered to be one of the most influential factors in the correct development of crops and in the formation of their fruit and therefore in their processed products. The study based on bioclimatic variables and indices, together with the orography of a territory, makes it possible to differentiate it, highlighting the particularity of each production area. This study shows the tendency of bioclimatic variables during the olive production cycle in the three Protected Designations of Origin (PDO) of olive oil in Extremadura (49,000 ha), Villuercas Ibores Jara (average altitude of 519 m), Gata-Hurdes (average altitude of 437 m), and Monterrubio (average altitude of 387 m). For this purpose, the average daily temperatures between 20°C and 30°C and between 10°C and 30°C were obtained from the climatic stations located in the PDOs, calculating the number of days with optimal temperatures for the of carbohydrates in leaves (NDSCH) and the number of days of vegetative growth (NDVG) respectively, during the phases of the olive tree production cycle (March-November) in the period between 1990 and 2021. The results showed an annual average of 103, 108 and 116 days for NDSCH and 258, 271 and 279 days for NDVG in the period studied for the PDOs Villuercas Ibores Jara, Gata-Hurdes and Monterrubio respectively. The Mann-Kendall test showed a decreasing slope trend of -0.11 and -0.05 for NDSCH and NDVG, respectively, in the Gata-Hurdes PDO region. In the Monterrubio PDO, the slope values were increasing, with 0.50 and 0.20 for NDSCH and NDVG, respectively. Only the PDO of Villuercas Ibores Jara showed significant values for NDSHC with a positive increase of 0.39 of the slopes, the value for NDVG was 0.21. It is concluded by confirming an average annual increase for both indices in the studied period.

Keywords: Olive tree, Protected Designations of Origin, Extremadura, carbohydrates synthesis, vegetative growth

S03-P-III-8

Interannual variation of stomatal traits in apple trees and the impact on environmental resilience

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Climate change is driving an increased demand for freshwater in agriculture and this highlights an important need to enhance crop water-use efficiency. Making these improvements in perennial crops, such as fruit trees, can be particularly challenging because of long generation cycles and difficulties in genetic transformation. Nonetheless, tree crops play critical roles in global food security and strategies for climate adaptation are strongly needed. Stomata are fundamental gatekeepers of plant-water relations and represent promising targets for crop improvement. Here, we investigated stomatal density (SD) and function in four consecutive years from 2019 to 2022 in a genetically diverse population of 269 apple accessions from across the globe (*Malus × domestica* Borkh.). SD exhibited a normal distribution within the population, showing significant differences among accessions that remained consistent across 2019, 2020, and 2021. From this population, we identified two subsets of 20 accessions with contrasting SD: the highest stomatal density (HSD) ranging from 370 mm⁻² to 500 mm⁻², and the lowest stomatal density (LSD) ranging from 192 mm⁻² to 316 mm⁻². These SD groups were used to compare stomatal function, leaf physiology, and crop productivity across two seasons in 2021 and 2022. While SD defined consistent differences in stomatal conductance (gs) and instantaneous water-use efficiency (iWUE) between groups, seasonal conditions defined the operational values. LSD had lower gs and greater iWUE in both years, but hotter and drier conditions in 2022 reduced gs to rates that constrained photosynthesis and ultimately reduced fruit yield compared with 2021. HSD experienced an equivalent gs decline in 2022, but photosynthesis and fruit yield were unaffected compared with 2021. Our results demonstrate a clear trade-off between water savings (LSD) and tree productivity (HSD) as driven by stomatal traits. Moreover, the consistency of SD across years makes it a reliable functional trait for predicting plant performance amidst environmental responses. Finally, in contrast to the prevailing literature that suggests LSD would be the preferred ideotype for climate adaptation in crops, HSD plants may actually provide greater resilience to climate variability in managed orchards and other agricultural systems.

Keywords: stomata, climate change, water-use efficiency, apple, tree crops

S03-P-III-9

Pawpaw (*Asimina triloba* L. Dunal) phenology stages under the influence of genotypes and local weather conditions

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Pawpaw [*Asimina triloba* (L.) Dunal] appears to be a promising fruit species for Romanian horticulture amidst the challenges of climate change in recent years. This new species exhibits resilience to extreme weather events, making it a valuable addition to orchards. The creamy pulp of the fruit offers a unique aroma, reminiscent of mango, pineapple, and vanilla, evolving into a caramel taste when over-ripe. Besides its exceptional taste, pawpaw is appreciated for its nutritional richness, boasting high levels of vitamins A and C, minerals, and amino acids. Thriving in a temperate climate, pawpaw cultivation proves possible in Romania, where research aims to delineate its chilling and heat requirements. The analysis of growth phenological stages contributes to optimizing orchard management strategies. Standardizing methodologies is imperative for broader cultivar applicability across different regions. The paper presents the behaviour of some pawpaw genotypes in Bucharest area – South Eastern part of Romania, regarding the vegetative and generative organs phenology stages.

Keywords: vegetative organs, generative organs, temperature, annual cycle

S03-P-III-10

Analysis of the spatial distribution of olive groves in Extremadura (Southwest Spain) using topographic variables

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Extremadura, located in the southwest of Spain, is known for its rich agricultural tradition, with olive cultivation playing a prominent role. The distribution of olive groves in this region is influenced by various factors, with topographic variables being a critical element in this dynamic. Topographic variables such as elevation, slope, and solar exposure play a significant role in determining the most suitable areas for olive cultivation. Elevation affects temperature and solar exposure, while slope influences drainage and water retention in the soil, which are essential factors for olive tree development. Understanding how these variables interact is crucial for analyzing and predicting the distribution of olive groves in the region. To achieve this, geospatial data will be employed, specifically the Digital Elevation Model (DEM), which provides detailed information about the region's topography. Additionally, surface data of olive groves provided by the Land Use Information System in Spain (SIOSE) will be used, allowing for the identification and extent of olive groves in the region. Through the use of Geographic Information Systems (GIS), a spatial analysis will be conducted to visualize and understand the relationship between topographic variables and the distribution of

olive groves. Thematic maps and charts will be generated to effectively illustrate how these variables influence the presence and extent of olive groves in different Extremaduran areas. This study will contribute to a better understanding of the factors that determine the distribution of olive groves in Extremadura, which, in turn, can be useful for decision-making in agricultural planning and the sustainable management of these valuable natural resources.

Keywords: Olive grove, topographic variables, elevation, slope, solar exposure, DEM, GIS, sustainable management

S03-P-III-11

Future Scenarios for Aridity in the Olive Groves within the Denomination of Origin for Extra Virgin Olive Oil in Extremadura, Southwestern Spain

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Assessing aridity conditions in semi-arid regions with warm climates is crucial for effective water management and planning strategies aimed at mitigating the risk of desertification. This study analyses the spatial distribution of aridity in the areas covered by the Denomination of Origin for Extra Virgin Olive Oil in Extremadura, Southwestern Spain, using the De Martonne aridity index (IDM). It considers a historical reference period from 1971 to 2005 and three future time intervals: 2006–2035 (near future), 2036–2065 (mid-century), and 2066–2095 (end of the century). Projections were calculated using a set of ten global climate model (GCM) and regional climate model (RCM) combinations, considering two representative concentration pathways (RCPs). A progressive strengthening of aridity conditions over the studied areas was evident until the end of the century, particularly under the fossil-intensive emission scenario (RCP8.5). More arid classes will spread during mid-century and later, reducing the less arid conditions to the highest elevations. These drier conditions will significantly reduce olive production in the studied areas, both in terms of quantity and fruit quality. Policies aimed at adapting to the anticipated conditions and controlling aridity in vulnerable areas will be essential to mitigate the negative impacts.

Keywords: Olive, Aridity, Extremadura, Climate Change.

S03-P-III-12

Characterising olive winter dormancy in producing regions of Spain (1981-2022)

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The olive tree is mainly cultivated in the temperate zones of the Mediterranean basin. The winter dormancy of this species and its characterisation are important for assessing the climatic suitability of land for olive cultivation. The study of the study of thermal catheterization and its temporal variation of the winter dormancy period makes it possible to define the most suitable areas for this crop and to evaluate the varieties to be grown. Spain has the largest area and production of olive groves in the world. This study identifies and characterises the winter dormancy of the olive tree and also analyses temperature trends in the 12 main production areas of Spain in the current context of global warming. Winter dormancy days (OWD) for olive trees were defined as the days when the daily mean temperature was 14.4°C or lower. The average daily temperatures of twelve meteorological stations of the European Climate Assessment & Dataset, located in the main olive-growing areas of Spain (more than 90% of the olive production is located in these areas), were used for the period analysed from 1981 to 2022. The results show that the winter dormant period is generally from November to March, although in some areas the start is delayed and the end is brought forward, and there are also areas where days in April and October are included. The average OWD is 125, ranging from 64 in Almeria to 170 in Albacete. In Málaga and Albacete, a significant reduction in OWD has been observed. The average dormant temperature in the areas is 10.9°C, ranging from 9.1°C in Ciudad Real to 13.9°C in Almeria, with a significant upward trend in 4 of the areas studied.

Keywords: olive, winter dormancy, temperature, dormancy days. trends, Spain

S03-P-III-13

Stone cell formation and lignin biosynthesis in the pedicel of pears and apples

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The fruit pedicel acts as a bridge between the fruit and shoot. The pedicel transfers water as well as inorganic and organic nutrients to the fruit. The pedicel adapts to the increasing fruit weight from flowering to harvest. Apples and pears have many differences in agronomic traits, especially the texture since stone cells have not been detected in the apple fles. There have been few reports on stone cell formation in pear and apple pedicels. The pedicel lignification and stone cell formation of pears and apple were characterized for the first time revealing their existence in the pears and their absence in apples. The stone cell formation degree of pear was much higher than that of apple. Total lignin and lignin non-condensed structure (G and S units) content in the pear pedicel outer part was much higher than that of the apple at harvest. Pedicel outer part

lignification was positively associated with flesh lignification, not with shoot lignification. The co-expression network and expression analysis of genes in apple and pear pedicels showed that the secondary cell wall master switch NST3 was linked to the ARFs, zinc finger C-x8-C-x5-C-x3-H-type family protein NAC027 and MYB46 TFs, lignin, cellulose, and xylan biosynthesis-related genes. These genes showed high expression level in the pear pedicel outer part but extremely low expression in the apple pedicel outer part.

Keywords: *Pyroideae*, Stone cell, pedicel, lignin composition

S03-P-III-14

Frost damages from bud burst to fruit set of apricot cultivars grown in southern Bulgaria

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The relatively warm winters in Plovdiv, Bulgaria, provoke the early development of apricot flower buds and the critically low temperatures in February, March and April cause frost injuries. Their severity depends on the phenophase of the apricot cultivars. In recent years, such situations have been quite common in the region of Plovdiv, Bulgaria and are the main limiting factor to fruit production. In this study, the frost injuries from 2021 to 2023 associated with low temperatures during and after bud burst were studied in a collection orchard at the Fruit Growing Institute - Plovdiv, for the introduced apricot cultivars 'Sweet Cot', 'Perle Cot', 'Flavor Cot', 'Tom Cot', 'Jenny Cot', and 'Lady Cot'. For the region of Plovdiv, the flowering phenophase of apricots used to start at the end of March- the beginning of April. In the period of this study, the "inflorescence buds swelling" in the region began in the first decade of February when the risk of temperatures dropping to critical for the apricot values is very high. Thus, a severe percentage of damages in 2021 and 2022 were caused in February. Frost injuries were observed in different phenological stages and floral structures. In the early phenological stages, BBCH 53, were damaged the pistil and the stigma of the flower.

Keywords: abiotic stress, climate, frost injuries, phenology, *Prunus armeniaca* L.

S03-P-III-15

Can fruit drop on avocado trees (*Persea americana*) be prevented?

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Avocado is now one of the most important crops in Europe. Initial fruit set is high, but gradual fruit drop leads to reduced yield. The study is about whether fruit drop in avocados can be reduced by using commercial products. For this reason, three solutions

of commercial products were foliarly applied on 6-year-old Fuerte, Lamb Hass and Hass avocado trees, according to the 4 following treatments: Control, Gibberellins (1 g/10 L, application at the "cauliflower" stage), Solution a (B 13%, Zn 4%, amino acids 40%, application when 10-20% of flowers have opened), Solution b (B 1%, CaO 12%, amino acids 40%, application when 10-20% of flowers have opened). Measurements were taken three months after application. Fruit number per inflorescence, fruit number per 4 inflorescences (on the same tree) and fruit diameter were recorded. According to the results, in Fuerte cultivar, fruit number per inflorescence and fruit diameter had the highest value in the "Solution a" treatment. Fruit diameter showed a significant increase both in "Solution a" and "Solution b" treatments. In Lamb Hass cultivar, fruit number per inflorescence and per 4 inflorescences, had a significant increase in the "Solution a" treatment. Fruit diameter increased in all treatments compared to the control, with the highest value in the "Solution b" treatment. In Hass cultivar, fruit diameter and fruit number per 4 inflorescences did not show statistical differences. Fruit number per inflorescence had a lower value in the "Solution a" treatment, compared to the Control. This research is the first study of commercial products' effectiveness for avocado fruit drop carried out in Greece. The presented results are the initial measurements of a series of monthly measurements, which will be completed upon the harvest of the cultivars and will have important information for the producers, towards the new economic and climatic challenges.

Keywords: Flowering, fruit set, yield, fruit size, fruiting

S03-P-III-16

Effect of foliar application of geomaterials on pear trees

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Pear cultivation in Italy is recently facing several adversities. Abiotic stress, as persistent high summer temperatures, can compromise productivity as well as fruit quality. Excessive increase in temperature leads to a limitation of normal photosynthetic and transpiration rates. This involves a loss of photosynthetic efficiency and consequently less thermal control due to limited transpiration, leading to photo-oxidative stress and photo-inhibition. The problem concerns the overall functioning of the plant with reduced sugars availability during the vegetative season, resolving in a limited redistribution of sugars to the roots and therefore with a possible overall collapse of the system. In addition to these abiotic factors, the spread of the *Halyomorpha halys* has been causing extensive damage to fruit growing and the spread of brown spot (*S. vesicarium*) in the pear production areas, a fungus capable of considerably reducing yields and for which current means of defense appear no longer sufficient. The increasingly high frequency of extreme events, the spread of alien insects and the resurgence of fungal diseases make it necessary to operate with innovative techniques, also considering the

progressive loss of effectiveness of traditional means of defense and the removal of various molecules by the EU. In this sense, different geomaterials were tested for their ability to create adverse conditions for the development of fungi and the presence of the *Halyomorpha halys*. Physiological response of leaves to the presence of geomaterials was also evaluated. These products proved to be effective in reducing brown spot and *H. halys* presence without reducing photosynthetic activity and can therefore help in reducing pesticide use and increase sustainability of agricultural businesses.

Keywords: gas exchange, heat stress, brown spot, *Halyomorpha halys*.

S03-P-III-17

The position of one year old shoots of apple tree can affect the chilling requirement of their tip buds

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Endo-dormancy of buds on temperate fruit trees is mainly overcome by chilling temperatures during autumn and winter. Cultural practices and rootstocks can either increase or reduce the effects of chilling temperatures. In tropical and subtropical zones the application of bending of shoots of temperate fruit trees has shown enhancement of bud break and the crop production. Apical buds of one-year-old shoots of these species may have different chilling requirement and strength to grow according to their position (horizontal or vertical) on the branches. On the branches of some apple trees horizontal and vertical one-year-old shoots were collected in separated bunches every week from December to February during six years. During the winter season one-year-old twigs were kept with their bases in water and in a growth chamber for 20 days at 21°C. Apical buds that grew were counted and evaluated as percentage of the total and bud development stage (BDS). Temperatures during the winters were recorded, and both the chilling units (Richardson) and the Dynamic Model chilling portions formulas were tested. The onset of bud break and the end of rest in the one-year-old shoots was assessed by means of the ratio between the chilling units (CU), the chilling portions (CP), and by the above mentioned indexes, applying two parameters (% bud break or burst and bud development stage BDS). Results indicated that the cultivars can be separated into three groups: one where the horizontal shoots are highly dominant to reach bud burst, another group where the vertical shoots are highly important to reach bud burst and finally a group where both kind of shoots reach bud burst with similar values. The behaviour of the tested horizontal and vertical shoots in relation to overcoming bud endo-dormancy is specific for each cultivar studied and this should be taken into consideration for: 1) the evaluation of the chilling requirement of the cultivars; 2) the application of some cultural practices, particularly pruning and training forms in apple trees grown in warm winter zones.

Keywords: Meristem, rest, blossom, assessment, chilling unit, chilling portion, bud break.

S03-P-III-18

Flowering and forced pollination in *Olea europaea* 'Ascolana tenera'

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Ascolana tenera is a table olive cultivar for table olives, typical of the Marche region (central Italy), which in recent years has also been highly appreciated for the production of monovarietal oil with peculiar characteristics. The experimental work aimed to investigate a low fruit set in an olive grove with Ascolana Tenera of "Il Conventino" farm (Monteciccardo, central Italy). The experimentation was set up to study the extent of fruit set and the effectiveness of natural pollination in comparison with forced pollination. In the olive grove there are a sufficient number of trees of the Pendolino and Maurino cultivars, indicated in the literature as possible pollinators of Ascolana tenera. The flowering phenograms of 2021 highlighted a high overlap between the three varieties. Since the Lea cultivar, historically used as a pollinator for Ascolana tenera, is not present, a forced pollination test was set up. Lea pollen was collected and redistributed after dispersion with *Lycopodium clavatum* spores in a ratio of 1:100. Forced pollination did not significantly increase fruit set, therefore indicating that the quantity and type of pollinators present are adequate. However, the poor average fruit setting is confirmed, with strong differences in the different portions of the olive grove depending on the slope and position along the hillside.

Keywords: fruit set, pollinator, Pendolino, Maurino

S03-P-IV-2

Influence of photoselective antihail nets on the physicochemical and biochemical parameters of the flesh of 'Florina' apple cultivar

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The present study determined the influence of differently coloured photoselective antihail nets on the physicochemical and biochemical performance of fruit flesh of the apple cultivar 'Florina'. In the Food Testing Laboratory at the Institute of Food Preservation and Quality in Plovdiv (Bulgaria), it was found that the physicochemical parameters water soluble dry matter and insoluble dry matter, as well as the biochemical parameters total sugars, sugar-acid coefficient, antioxidant activity and total polyphenols have maximum values in 'Florina' fruit flesh grown under red net. A positive linear relationship was found between the analyzed antioxidant activity and content of total polyphenols of the studied fruits grown under differently coloured photoselective nets, with a high coefficient of determination - $R^2=0.889$. Maximum values of the parameters active and total acidity

were determined in fruits grown under black net and minimal values of these parameters were determined in fruits grown under yellow net.

Keywords: apple, protective nets, physicochemical and biochemical parameters of the apple flesh

S03-P-IV-3

Influence of differently colored photoselective antihail nets on physical parameters of 'Pinova' fruits

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The aim of the present study was to determine the influence of different photoselective antihail nets on the physical parameters: fruit weight, fruit diameter, color of the skin and specifics of the russetting in handle fossa of 'Pinova' apple fruits. The results showed differences in fruit weight, fruit diameter, as well as, russetting around the fruit stalk in fruits grown under the differently colored nets. Maximum fruit diameter (76.97 mm) and weight (191.00 g) is reported in the fruits grown under the yellow colored net and with minimum average values are the fruits grown under the white colored net - 73.58 mm and 167.23 g respectively. All fruits correspond to extra and first quality according to REGULATION (EC) No. 1580/2007 OF THE COMMISSION of December 21, 2007 for laying down rules for the application of Regulations (EC) No. 2200/96, (EC) No. 2201/96 and (EC) No. 1182/2007 of the Council in the fruit and vegetable sector (OB L 350, 31.12.2007, p. 1) regarding the color and physical parameters of apple fruits. The fruits grown under the white net have the best color and quality parameters.

Keywords: apple, protective nets, fruit color, flesh color

S03-P-V-1

The reaction of peach to the use of ecological methods to control pathogens and pests in the climatic conditions of Romania

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The high-density systems in tree cultures have led to spreading a lot of damaging pathogens and pest for peach trees such as: *Taphrina deformans*, *Stigmia carpophilla*, *Monilinia laxa*, *Monilinia fructigena*, *Anarsia lineatella*, *Cydia molesta* and *Hedysia nubiferana*. The utilisation of pesticides as main tool of control of these diseases and insects had negative impact on environment, texture and structure of the soil. Also, pests and pathogens very resistant to that chemical products have appeared and the accumulation of toxic residues in soil and at humans risks are high. All

these aspects have led to the reorientation of research towards ecological products with intrinsic value. Thus, treatments with chemical products were reduced, being replaced by biological products and traps with synthetic pheromones. In the study years 2020-2022 were applied in a peach orchard, the biological fertilizers Cropmax and Biohumus together with some biological fungicides, insecticides and acaricides in four variants: V1= Cropmax + Konflic + Funres + Biohumus; V2= Cropmax + Oleorgan + Canelys + Biohumus; V3= Cropmax + Canelys + Mimoten + Biohumus; V4=untreated. The dynamics of the population of harmful microlepidoptera was realized with the help of AtraLIN, AtraMOL, AtraNUB pheromone traps. The results of the three-year study showed that in 'Liana' cultivar, the fruits had a higher average weight in the V3 variant, 88.5 g respectively, compared to the V4- 77.6 g, control untreated.

Keywords: *Prunus Persica*, biocenotic_stress, monitoring, feromonal_traps, ecological products

S03-P-V-2

Beneficial insects in fruit production: Reducing dispersal activity of beneficial insects by increasing orchard attractivity

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The Interreg VI project “Beneficial insects in fruit production” is focused on the introduction and the support of beneficial insects in fruit orchards. The main goal of this study is to get control over economically challenging pest organisms and consequently to reduce the use of plant protection products via a systematic introduction and/or the attraction of beneficial insects. For this, lab and field trials will be conducted. Leadpartner of the project is the Competence Center for Fruit Growing Lake Constance - KOB (DE). Further partners are the Chamber of Agriculture Vorarlberg (AT), Agroscope (CH), the Research Institute of Organic Agriculture - FiBL (CH), Education and Research Institute Arenenberg (CH), Institute for Agriculture Sankt Gallen (CH), Strickhof (CH) and the University of Applied Sciences Weihenstephan-Triesdorf – HSWT (DE). The main challenges of the use of beneficial insects in uncovered orchards are the attraction of beneficial insects from the surroundings and additionally to keep them in the orchards. Therefore, at the HSWT three approaches are under investigation: The first approach focuses on the attraction of surrounding beneficial insects and the extension of their stay by using artificial nectar sources like dispensers with sugar water, flower stripes or potted flowers placed in the orchards. The second approach also deals with an increase of orchards attractivity, using kairomones. First, the effect of kairomones like alarm pheromones of aphids on beneficial insects will be tested in lab trails using a Y-tube olfactometer. In case of positive reaction on studied kairomones, field trails trials will follow. The third approach will test the effect of an open rearing strategy. Here the effect on an early increase of beneficial insect population prior to pest populations will be tested. The effect of all methods will be proven by a pest and beneficial insect monitoring.

Keywords: beneficial insects, apple, fruit production, reduction of pesticides

S03-P-V-3

Observations on the influence of climate conditions on the biology of the apple worm -Lepidoptera- Tortricidae, in the conditions of the North-East of Romania

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The research was carried out in the period 2019-2021 at the Research Station for Fruit Growing Iasi, Romania in an apple plantation where the appearance of the species *Cydia pomonella* L. was monitored with the help of "AtraPom" pheromone traps (ICRR Cluj-Napoca). In order to determine the biological cycle of the species, the appearance of the pest was calculated according to the sum of the temperature degrees. The lower development threshold of the species being 9°C, in the years of study the first appearances were recorded on May 9 in 2019, May 1, 2020, in 2021 being recorded on May 7, a period in which the thermal constant (K) of the species *Cydia pomonella* L. of 624°C was not met (Rosca I. et al., 2011). These data help us determine the biological cycle of the species and the number of generations in the context of climate change.

Keywords: apple, atra pom traps, thermal constant, biological cycle

S03-P-V-4

Identification and symptomatology of apricot Chlorotic Leafroll Phytoplasma

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Time every year, in the South-Eastern part of Romania, an important number of apricot trees, dies from the causes unknown to the growers. This syndrome is known as apoplexy or premature dye back of the apricots. Recognition of the diseases complex responsible is very important for the study and control of the phenomena. If for the majority of the apricot diseases the symptoms are easy to be evidenced, the ones produced by Apricot chlorotic leafroll phytoplasma, a key pathogenic agent in premature dye back of the apricots, are more difficult to be distinguished. The researches carried out during last years in the South-Eastern part of Romania, were focused mainly on revealing of the disease symptoms, for early and right detection of this diseases. More over, during the study period were assessed the biochemical changes occurred in the cellular juice of the leaves sampled from the diseased trees, compared with leaves sampled from healthy apricot trees.

Keywords: *Prunus armeniaca*, symptoms, virulence, chemical analysis, pathogenic agent

S03-P-V-5

Durable use of fungicides for integrated control of some pathogens in apple orchards from Romania

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Due to the pedo-climatic diversity in Romania, many fruit species meet favorable conditions to be successfully cultivated. Apple crop is one of the most important of the national and European horticulture as well, Romania holding the 8th place as regard the apple production (593.700 t /year) and planted surfaces (53.820 ha) (FAOSTAT, 2021). Soils diversity, climate changes and different level of the applied technology are favorable for the strike of various pest and diseases. Among the most damaging apple diseases are fire blight - *Erwinia amylovora*, apple scab - *Venturia inaequalis*, powdery mildew - *Podosphaera leucotricha*, brown rot - *Monilia fructigena* and apple collar rot - *Phytophthora cactorum*, which, in absence of an integrated approach, can cause serious damages estimated between 3050 and 3344 Euro/ha/year. On the other hand, the improvement apple assortment and growing technologies, withdrawn of the hazardous fungicides and release of innovative ones became reality. This situation led to necessity to establish under concrete orchard conditions the protective spectrum of the products against main apple disease and their better position inside the apple phytoprotection technologies, using specific hardware, software and decision tools, in order to increase their efficacy in the orchard and diminish the impact of treatments on the environment. The paper presents the results of the studies carried, along two decades which reveal that among the registered fungicide tested and in use 18.52% were contact, 3.71% translaminar and 77.77% are systemic type. In addition, 37.04% are triazols 14.81% anilino-pyrimidine and compounds, the other 48.15% being distributed among 8 other chemical groups. Some active ingredients representing 14.81% are targeting fungi biological cycle on multiple sites, 11.11% on anilino-pyrimidines and phenylpyrole chain, 44.47% on inhibition of sterol biosynthesis and the other active ingredients 29.72% are acting against pathogens on different metabolically way.

Keywords: phytoprotection, diseases, active_ingredients, sustainable_use

S03-P-V-6

Effectiveness of foliar treatments with a blend of low copper titer and inducer resistance compounds for the control of *Pseudomonas savastanoi* pv. *Savastanoi*, the casual agent of olive knot disease

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Olive knot, caused by the *Pseudomonas savastanoi* pv. *savastanoi* (Psav), is a very widespread and serious disease in almost all olive growing areas. It significantly affects vegetative growth and olive yield and it can determine the progressive deterioration of the

trees. The disease symptoms are characterized by the formation of knots or galls on branches, shoots and leaves of the olive tree, which are mainly due to the bacterial secretion of phytohormones, such as indoleacetic acid and cytokinins. It has, also, been demonstrated that the hrp/hrc gene cluster the type IV secretion system, and quorum sensing intercellular communication system are involved in pathogenicity and virulence of Psav. Since the control strategies that can be used to contain the disease are limited and sometimes ineffective, it is essential to find alternative means. Recently, the use of biostimulants which are substances that have positive effects on crops is spreading. These products are in fact capable of inducing physiological, morphological and biochemical adaptations with positive effects on nutrient absorption, vegetative growth, quantity and quality yield and they can also have a positive effect inducing plant resistance against abiotic and biotic stresses. However, despite the growing diffusion of biostimulants, their mechanism of action remains largely unknown and therefore it is difficult to fully exploit their potential. The aim of this work was to verify the effectiveness of a mixture of low copper compound (Blok 5®, Cifo srl, Bologna) and inducer resistance (Ionifoss®, Cifo srl, Bologna). For this purpose, one-year-old olive trees (cv. Frantoio) were foliar treated 5 times with Blok 5® (3 g l-1) and Ionifoss® (2 g l-1), according the following scheme: the three treatment were carried out 21, 14 and 7 days before inoculation with the pathogen, while the other two treatments were carried out 7 and 14 days after inoculation (dpi). Olive plants subjected to 5 foliar treatments showed a statistically significant reduction in the severity of symptoms, expressed as knots volume. Further studies are ongoing to determine the population dynamics of Psav in planta.

Keywords: biostimulants, Low-copper-compounds, *Olea europaea* L., induced resistance, *Pseudomonas savastanoi*, olive knot disease.

S03-P-V-7

Contributions to limiting the attack of the skin moth (*Adoxophyes reticulana* Hb.) through specific methods of integrated control

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Research has been conducted over the years 2022-2023, at Voinești Research and Development station for Fruit Growing, in experimental and production apple orchards, in varieties: Jonathan, Golden delicious, Florina. The fruit skin moth (*Adoxophyes reticulana* Hb.) is a polyphagous pest that causes particular damage especially in apple orchards. It presents 2 generations per year between April and September. The most important and damaging is the 2nd generation. The monitoring of the skin moth, through the numerical expression and the risk of attack, as well as the optimal period of application of the treatments was established by using the pheromone trap ATRARET. The integration of bio-technical (pheromonal attractants) and biological means (biological preparations) into the technological sequences of integrated control, lead to obtaining less polluted fruits, beneficial to consumers. The products with the best results stood out: Bactospeine DF conc. 0.07% (biological preparation), with an attack of only

10.25% on leaves and young sprouts and 8.7% on fruit, followed by the chemical product Affirm SG conc. 0,25% + Horticultural oil conc. 0,1%, compared to the variant “Untreated witness” where the attack on leaves and young sprouts was of 29,25%, and on the fruits 39,25%. The biological product used for combating stands out for its good effectiveness and contributes to obtaining less polluted apple harvests, under conditions of maximum safety for humans and the environment.

Keywords: skin moth, degree of attack, pheromonal attractants, biological products.

S03-P-V-8

Effect of spider mite on *Malus domestica* Borkh. leaf performance and fruit quality

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Spider mite (*Panonychus ulmi*) is a well-known pest that can seriously affect apple production, and recent changes in climate dynamics only increased the problem. We evaluated the effect of spider mite on the performance of apple trees, both leaves and fruits, considering morphological and biochemical traits. We found significant differences in the color between control and affected leaves, and a significant reduction in net photosynthesis, transpiration rate, stomatal conductance, and chlorophyll content. The damage was also visible in the leaves' primary and secondary metabolism. In fruits, morphological differences between affected and healthy ones were not as evident as in the leaves. However, their primary and secondary metabolism was also affected to some extent. These differences were evident not only at the moment of the pest appearance – middle August – but also at harvest.

Keywords: apple; pests; spider mite; photosynthesis; leaves; fruits; metabolism

S03-P-VI-1

Research on organic waste from some horticultural farming vermicomposting

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Vermicomposting is the decomposition of plant matter and food waste through the joint action of earthworms and mesophilic microorganisms. It involves using epigeic earthworms that digest and recycle organic waste into worm castings, a good organic fertilizer. The research was conducted on vermicomposting of horticultural waste from ecological and conventional orchards with the help of two species of red composting worms (*Eisenia* sp.), the Californian red worm and the one native to Romania. The fruit tree species studied were plum, apple, walnut, and grape a species of vine. The research

objectives were: identification of horticultural waste that can be composted with earthworms (*Eisenia sp.*); obtaining vermicompost from horticultural waste from organic and conventional orchards; physico-chemical characterization of the vermicompost (N, P, K, M.O., pH, humidity), and phytopathological characterization of both the horticultural waste and in the resulting vermicompost, with the purpose of testing the possibility of reducing the presence of pathogenic fungi with the help of earthworms, as well as identifying the presence of beneficial fungi in the vermicompost. All horticultural species tested in the research could be composted with the help of earthworms. The average time for all the vermicompost trials to be ready was 6 months. The vermicompost had good texture, color, and structure. Significant differences in composting time were observed between horticultural species rather than between earthworm species. The phytopathological analyses found that both earthworms can eliminate the spores of the pathogenic fungi *Alternaria sp.*, *Fusarium sp.*, and *Venturia sp.* but not those of *Penicillium sp.* The presence of the genus *Trichoderma* in the resulting vermicompost demonstrates the ability of earthworms to enhance plant disease resistance by enriching the compost with microorganisms from their own microbiome. Both worm species reproduced better in eco-leaves. The vine grape had the best results overall. All populations have grown, at least doubled their numbers and the compost obtained can be used to fertilize orchards.

Keywords: *Eisenia sp.*, earthworms, pathogenic fungi

S03-P-VI-2

Preliminary results regarding the influence of the application on strawberry of some authorised products for organic agriculture

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The objective of this study was to assess the effectiveness of specific complex fertilizers registered for use in organic farming systems in enhancing the fruit quality of cultivated strawberry plants. In general, pre-harvest treatments, specifically the application of designated complex fertilizers, have demonstrated efficacy in improving post-harvest crop performance and, correspondingly, enhancing the quality of strawberry fruits. The study spanned two consecutive years (2022 and 2023) and was conducted on a strawberry crop situated in the southern region of Romania, specifically within the Vlăşia Plain. The study incorporated three strawberry varieties, namely "Onebor," "Premial," and "Sibilla." The cultivation method employed followed the traditional approach, involving field cultivation in double rows on plots covered with agro textile foil and irrigation facilitated through a drip irrigation system. Strawberry plants underwent treatment with various categories of biostimulants, including salts of humic acids, humic acids, fulvic acids, amino acids, micro and macro elements, live bacteria, and other readily absorbable substances. The application was administered from pre-flowering stages through berry maturation, adhering to commercially recommended dosages. The

experimental treatments consisted of two applied variants: V1, a combination of "Etamin" and "BioHumus Sol," and V2, solely "Etamin," in comparison to the untreated control variant. The fruit samples comprised 20 fruits collected for each repetition and each of the four harvests from each year. During each sampling event, measurements were taken for fruit weight, diameter, length, firmness, titratable acidity, total soluble sugars, and pH. According to the statistical analysis, no significant differences were observed among the three experimental factors regarding pH, titratable acidity, firmness, color parameters, fruit diameter, and length, as well as mean fruit weight. To obtain a more comprehensive understanding, the study will be extended to include additional detailed statistical analyses. The study was funded by FRDS Băneasa and is part of theme 2.10 of the within the Thematic Plan on the Implementation of the "ASAS Strategy on Research - Development - Innovation in Pomiculture" for period 2021 - 2027

Keywords: organic agriculture, strawberry, foliar treatments, biofertilizers, humic acids

S03-P-VI-3

Optimizing demand based irrigation control in apple orchards

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Due to increasing dry periods, especially during summer time, the possibility of additional irrigation, even in regions with higher precipitation such as Lake Constance, is an important adaptation strategy for fruit growers to ensure yield and fruit quality. At the same time, for economic and ecological reasons, there is a need to reduce water consumption to the actual demand of the plant. A three-year project (Interreg VI) is focusing on optimizing the determination of the real water demand and irrigation control in apple orchards. In addition to the HSWT experimental station in Schlachters, the Competence Center for Fruit Growing Lake Constance (lead partner), the Geisenheim University of Applied Sciences, Agroscope and FIBL (CH) and the Working group for Agricultural Technology and Structure in Bavaria e.V. (ALB) are involved. At the research station in Schlachter/ HSWT, soil moisture tension based treatments (irrigation start at 30kPa, 65kPa, 100kPa) and the ALB climate-based model are compared in a three-year trial. With a continuous, radio-based soil moisture measurement-system, both the switch-on times and the irrigation quantities adapted to the soil type per irrigation cycle will be determined. In addition, a comparison of different sensor-based systems is carried out in a container trial with apple trees. In this trial, in addition to measurements of soil water tension and volumetric water content, various systems for measuring sap flow and stomatal conductivity are validated with different water supply to the containers. The aim of the project is to optimize the exact determination of water demand and based on this to allow more precise orchard- and tree-specific irrigation recommendations.

Keywords: water, irrigation, fruit production, apple, climate change

Influence of soil additives on water storage capacity and growth of apple trees

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In a three-year project (Interreg V) the effect of soil additives on improving the water storage capacity in the soil or the drought tolerance of apple plants was examined. Four experimental sites with significantly different precipitation were involved: HSWT/Schlachters and Agroscope (1400-1600mm), KOB (800-1000mm), LWG (450-600mm). The idea of using soil additives is that the materials, due to their physical properties, can store soil water and release it to the plant when needed. All additives were applied according to the provider's manual, most at planting and some by repeated applications during the season. A treatment without and another with standard irrigation served as untreated control, both without additional soil additives. Soil moisture was continuously recorded using water content and tension sensors at a depth of 20 and 40 cm. Additionally shoot growth, trunk diameter, flowering intensity, fruit set, tree yield and fruit quality were determined. In addition, soil samples were taken annually and mineral samples of leaves and fruits were carried out. The different additives did not show any significant increase in soil moisture compared to the untreated control. Some additives even led to higher soil moisture tension at individual locations, despite higher volumetric water contents, which means that an additive can lead to slightly increased soil water contents, but this water is not necessarily available to the plants. Additional measurements of leaf water potential also showed no clear differences between the treatments. Also in terms of growth and yield no definite differences between or advantages of the additives were found. In practice, significantly larger amounts of additives would probably have to be applied in order to create a higher soil reserve of water for dry periods. In this case higher costs for the measure and possible effects on tree physiology and nutritional impacts have to be considered.

Keywords: water, fruit production, apple, climate change, drought tolerance

S03-P-VI-5

Irrigation plan for the olive tree during summer in central Italy

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In modern olive cultivation, the need for properly planning irrigation, even in central and northern Italy, is pivotal to compensate the increasingly frequent scarcity of summer rains and to balance the fruit yield during the years. The objective of this study aimed to evaluate the effects on fruits growth and shoot elongation of two variable deficit irrigation regimes applied during the summer. The experimental trial was carried out in Central Italy (Marche Region) in 2021, on the local cultivar Piantone di Falerone cultivated in a high-density olive orchard (4x2m), planted in 2012, on clayey-loamy soil. The deficit irrigation regimes applied with a drip system were a) medium deficit (30% of the E_t0 from June 4th to June 29th, 15% of the E_t0 from June 29th to September 1st, and 30% of the E_t0 from September 1st to September 16th) and b) low regime (half of the medium one). Rainfed trees were used as control. The mixed shoots bearing fruits in the 1-year portion produced a greater number of new nodes during summer when irrigated at the medium deficit regime. The fruits at harvest in both deficit irrigation regimes showed a similar dry weight, but significantly higher than the control. At harvest, despite the fruit retention force being higher in the medium irrigation regime, the oil yield of the medium and low regimes was higher than the control. From this preliminary study, it emerged that in central Italy, it is advisable to plan spring-summer irrigation to improve the oil production of the current year and the vegetative growth to enhance the potential productivity of the following year. A sustainable irrigation plan can consider a medium deficit regime until end of August and a low regime until harvest.

Keywords: shoot elongation, fruit growth, high density, irrigation, Piantone di Falerone

S03-P-VI-6

Apricot performance under foliar application of Cropmax under the changing climatic conditions of South-Eastern Romania

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The apricot tree (*Prunus armeniaca*) is one of the most important fruit species grown in the world, as the fruit is highly appreciated by consumers. Apricot plays an important role in human nutrition due to its good source of carbohydrate, protein and vitamins especially A and C. The excessive use of chemical fertilizers in orchards has led to many problems for the environment, product quality and food safety. The applying of nutritive elements by foliar spraying became a usual practice for many crops, with benefit part in balancing of plant nutrition. Also, foliar fertilization have a practical and economical importance and have a low risk for environmental pollution. Therefore, biostimulants have been used as ecological ways to increase yield, fruit quality and abiotic stress tolerance. The current

study was carried out between 2021 and 2023 to investigate the influence of with Cropmax foliar spraying of 0.5 L/Ha and 1.0 L/Ha compared to a control (untreated trees) regarding the performance of the apricot, respectively of the 'Olimp' cultivar. The obtained results show that spraying with Cropmax increased the production of fruits, as well as the physico-chemical characteristics of the fruits, compared to those untreated trees in the study years.

Keywords: *Prunus armeniaca*, abiotic stress, biostimulant, fruit yield, fruit quality

S03-P-VI-7

Combined Calcium fertilisation on apples via soil application and foliar sprayings to reduce bitter pit

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A sufficient calcium supply in apple production under the climatic situation in Central Europe north of the Alps mountain range is still challenging. Some of the modern crunchy apple varieties or as sensible known established cultivars show calcium deficiencies, if there are difficult growing seasons with cold temperatures or long-lasting rainy weeks. Periods with poor transpiration in the spring months sometimes lead to a lack of calcium availability for the apple trees. In this case especially the calcium demand of the developing fruits and their dividing cell tissue is not satisfied. The farmers usually spray foliar fertilizers containing calcium but in critical seasons often times the success is poor and the fruits show calcium deficiencies like bitter pit. Combining the foliar sprayings using calcium-salt products with additional soil application with calcium-sulfate based fertilizer might help to increase the calcium supply for the whole tree and the growing apple fruits. An investigation was carried out at the Schlachters Experimental Station for Pomiculture HSWT in the Lake of Constanze region (2021-2023) using an calcium-sulfate granulate fertilizer spread on the ground with additional foliar sprayings of soluble calcium fertilizer over the summer months. The soil fertilizer 'Verdecal-G' (22,5% Ca as CaSO₄) was spread two times. Once in winter with three months, resp. one month before flowering followed by a second application at begin of flowering using the bitter pit sensible apple variety 'Jonagored' (*Malus domestica* 'Burkh.'). The used amount of 'Verdecal-G' had been 200 kg/ha, resp. 300kg/ha placed on the soil surface underneath the apple tree rows. Additionally the salt calcium chloride (CaCl₂) was sprayed 5-6 times over the summer months with a soluted amount of 5,0 kg/ha - beginning with 10-15mm fruit diameter - as standard foliar calcium fertilizer. The powder 'Verdecal-F' was tested as a foliar fertilizer alternative. The results showed that the combination with soil-based CaSO₄-fertilizer Verdecal-G, spread two times with 200kg/ha at 3 months before flowering and with begin of flowering followed by the serie of five times foliar CaCl₂-sprayings during summer clearly reduced the bitter pit symptoms (> 40% less symptoms compared to untreated control) on 'Jonagored' apple fruits, when a year with a high calcium deficit was observed (2023).

Keywords: apple production, calcium deficiencies, calcium-sulphate fertilisation, foliar spraying, bitter pit on apple

S03-P-VI-8

Localized amendment in medium density olive orchard

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Conservative agriculture techniques are fundamental to reduce soil and nutrient losses due to the continuous tillage of cultivated land. In modern olive groves the presence of permanent grass cover is therefore essential. The roots of the grassing herbaceous plants establish diversified communities, alternating exploration and colonization of new soil niches and abandonment of exhausted niches which favor the accumulation of organic matter and regenerate the fertility of the soil for the olive tree. On the contrary, in bare and continuously tilled soils, the organic substance is more rapidly mineralized and the hospitality towards the newly formed roots of the olive tree becomes increasingly limited. To support root development and the growth of the aerial part without disturbing the natural grass cover of the olive grove, a localized fertilization system has been developed in a 20-years-old intensive orchard (6x6m) situated in central Italy. Fertilization with organic nitrogen was applied in 2 holes (diameter 20 cm), 100 cm from the trunk and 40 cm from each other. The treatments were repeated in two successive years, rotating the holes 90° around the trunk the second year. The two treatments with 2 holes and 4 holes per tree (100 and 200g of N per tree, respectively) were compared with a not fertilized control. The effect on the development of the aerial and root part was evaluated: the growth of the trunk was greater in the treated trees compared to the control in both years, with a greater effect of the double dose treatment (4 holes), without negative effects on fruit production. The analysis of root development showed a greater presence of fibrous and pioneer roots of the olive tree and herbaceous species inside the fertilized holes compared to the outside, in both treatments. The treatment with a lower dose (2 holes) highlighted a greater number of absorbent roots compared to the control, even outside the fertilized hole. It seems that the olive tree takes advantage of localized fertilization by exploring the fertilized niches in coenoses with herbaceous species. Finally, in some extent the localized fertilization functions as a "starter" for the occupation of neighboring unfertilized niches.

Keywords: *Olea europaea*, root density, root function, sustainability, soil conservation

S03-P-VII-1

Maturity dynamics of peach and nectarine fruits measured with Da-meter

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The peach fruit market is facing a constant decrease due to the poor fruit quality perceived at consumption, which might be greatly affected by the fruit ripening stage at harvest and post-harvest management. Technology for rapid, non-destructive, and accurate instruments for the determination of fruit quality and maturity is increasingly sought. This work aimed to define the most appropriate time for peach fruits harvesting using non-destructive quality indexes such as the index of absorbance (IAD), measured with the DA-meter, a hand-held instrument developed from vis/NIR spectroscopy that measures the index of absorbance difference correlated with the fruit flesh chlorophyll content. In this context, our research was conducted over three years on several peach and nectarine cultivars on two different planting systems, Trident and Vertical axis. For several cultivars, the planting system hastened fruit maturity and other quality parameters.

Keywords: fruit ripening, IAD, fruit maturity, fruit quality, postharvest performance.

S03-P-VII-2

Use of the Life Cycle Assessment as a tool to decide on scenarios built for an organic apple orchard

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Romania is in the top five at the European level in terms of the cultivated area and the apple production obtained, with a structure and a dispersion of the orchards at the national level that is reflected in the way and the degree of capitalization of the production. The agricultural field has a considerable contribution to environmental impacts. In this case, an analysis of the sector will follow the application of measures to improve yields at the farm level, simultaneously with measures to protect the environment imposed by the materials and the processes of the entire production chain. The paper aims to evaluate the environmental burdens of organic apple fruits produced in an experimental orchard and identify the most relevant impact categories, with the scope of revealing and extending the results at the sector level. Life Cycle Assessment (LCA) is a valuable method for identifying environmental impacts, which can help to address sustainability concerns. We have set up the system boundaries covering four main stages of the orchard life cycle, from the establishment of the farm, passing through the production and postharvest stages, and, finally, reaching the storage facilities by transportation. The inventory analysis's reference functional unit (FU) is 1 kg of fresh apple. The analysis was conducted by modeling two fruit valorization scenarios and evaluating the environmental impacts and sustainability. The paper's findings regarding, among other indicators, the level of greenhouse gas emissions (GHG) acidification, eutrophication, energy consumption, and global warming potential (GWP) were presented.

Keywords: LCA, sustainability, GHG

S03-P-VII-3

Impact of algae-based biostimulants on almond attributes

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To enhance almond performance in conditions of water scarcity, utilizing algae-based biostimulants could serve as a valuable strategy to mitigate drought stress. However, beyond their potential impacts on plant vitality, alterations in fruit characteristics must also be taken into account. This study undertook a preliminary investigation into the influence of two concentrations of an *Ascophyllum nodosum*-derived biostimulant on the chemical properties of fruits from rain-fed Marinada cultivar trees. The biostimulant, applied twice before harvest at both the recommended concentration and half thereof, led to a reduction in soluble sugars, starch, and proteins compared to both the half dosage and control treatments (water only). Conversely, while not statistically significant, untreated trees exhibited a trend towards increased levels of bioactive compounds such as ortho-diphenols, total phenolics, and flavonoids. Moreover, sensory evaluations of treated and untreated fruits revealed no discernible differences in perceived attributes, suggesting no adverse effects on consumer acceptance resulting from the biostimulant's application. Nonetheless, longitudinal investigations are warranted to validate these findings, including the monitoring of leaf gas exchange and tree water status parameters.

Keywords: *Prunus dulcis*; fruit traits; sensory analysis

S03-P-VII-4

Metabolite and oxidation rate during the growth period of non-browning apple variety 'Majda'

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Non-browning apple varieties are valuable but rare. The basis of this non-browning phenological trait is not uniform for each variety. For some non-browning varieties, the key is the lack of substrate for browning, and for others non-browning is the consequence of lower activity of the oxidating enzymes involved in browning. In recent years comprehensive research has been done on Slovenian non-browning variety 'Majda' and genetic and metabolic traits have been studied in detail. What was not yet investigated is the dynamics of metabolites and flesh browning through the growing season. In this study apple fruits from two varieties 'Majda' (MA) and 'Golden Delicious' (GD) were collected once a month from one month after flowering until harvest. Fruits were weighted, measured, colour change in time recorded and metabolites determined (sugars, malic acid and total phenolic content (TPC)). Throughout the growth period GD mostly contained more sugars than MA, but at the end there were no differences.

Interestingly higher content of malic acid was determined in GD at the first time point, but later MA surpassed it. Beside high malic acid, low TPC is the important characteristics of MA non-browning profile. The results show that lower TPC concentration starts from the beginning of the growth.

Keywords: fruit growth, malic acid, lightness of colour, total phenolic content, enzymatic browning

S03-P-VII-5

Hazardous element content and consumption risk of apple cultivars grown on contaminated soil

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In the present study, the concentrations of toxic metals, micro, and macroelements in the fruits of apple cultivars ('Super chief', 'Fujion', 'Enterprise', 'Pinova', 'Orion', 'Red Delicious Mestern', 'Geminy', 'Crimson crips'), all budded on 'M9', were determined by Inductively Plasma Emission Spectroscopy (ICP-OES) after microwave digestion. The experiment was conducted in Brestnik village, situated at a 3.5 km distance from the source of pollution - the Non-Ferrous Metal Works near Plovdiv, Bulgaria. The average concentration of the elements in the analyzed samples were found to be in the range of 1.60-4.95 mg/kg Fe, 0.57-0.94 mg/kg Zn, 0.35-0.69 mg/kg Mn, 0.34-0.97 mg/kg Cu, 1.62-4.92 mg/kg B, 0.02-0.03 mg/kg Se, 124.8 -226.5 mg/kg P, 36.2-64.0 mg/kg Ca, 57.3-110.3 mg/kg Mg, 780.9-1156.3 mg/kg K, 39.9-88.1 mg/kg Na, 0.01-0.22 mg/kg Cr, 0.01-0.19 mg/kg Ni, 0.36-2.1 mg/kg Al, 0.01-0.05 mg/kg Cd, 0.02-0.06 mg/kg As, 0.91-2.51 ng/g Hg and 0.06-0.21 mg/kg Pb. The highest concentrations of toxic metals were found in the fruits of cultivar 'Super chief'. The results obtained in this study showed that K, P, Mg, and Ca have the highest concentrations in all apple cultivars. The content of the highly toxic metals (Pb, Cd, and Hg) in the fruits of the studied cultivars was below the permissible limits set by different health organizations. Daily intake of metals, hazard quotient, and health risk index were calculated to reveal the health risk possibility of apple fruit consumption.

Keywords: apples, toxic metals, macro and microelements, health risk

S03-P-VII-6

Effect of pruning on productivity and fruit quality of re-grafted Gala apple

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The experiment with different pruning methods was conducted in 2023 in the apple orchard originally established in 2013 with the Red Jonaprince cultivar at a planting distance of 3.2 x 0.8 m and re-grafted in 2020 with the Gala 'Devil' cultivar. After grafting,

the canopy was formed as a bi-axis, with orientation in the row direction. Three types of pruning were used in the re-grafted apple orchard: standard, click, and mechanical + hand pruning. The yield and fruit quality parameters were measured as well as the time required for pruning fruit trees. Click pruning was the most time consuming, requiring 83.4 hours per ha. Significantly less time was spent on standard pruning (53.1 h ha⁻¹), and the least time was spent on mechanical pruning (24.4 h ha⁻¹). The number of fruits per tree and total yield were highest in trees with standard pruning and lowest in trees with click pruning, although the difference was not statistically significant. The yield of the smallest fruits, with a diameter below 65 mm, was significantly lower in trees with click pruning compared to the other two studied treatments, but the yield of the other fruit classes did not differ between the applied treatments. Average fruit weight was highest in click-pruned trees (158 g) and lowest in mechanically pruned trees (134 g). Other fruit quality parameters: total soluble solids, fruit firmness, starch content, and fruit coloration did not differ significantly among the treatments studied.

Keywords: click pruning, mechanical pruning, standard pruning, re-grafted apple trees

S03-P-VII-7

Effect of plant growth regulators on the yield and fruit quality of apple tree cv. 'Red Chief'

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The demands of apple consumers force producers, especially in weather anomalies, to use technologies that guarantee high-quality apples. The experiment examined the influence of plant growth regulators (PGRs), such as gibberellins, cytokinins and Metamitron on the quantity and quality of the 'Red Chief' apple yield, according to the scheme: T0 - control, T1 - double application of gibberellins and cytokinins during flowering and Metamitron at fruitlet diameter 12-16 mm, T2 - application of benzyladenine at fruitlet diameter 8-12 mm and Metamitron at fruitlet diameter 12-16 mm, T3 - double application of gibberellins and cytokinins during flowering, benzyladenine at fruitlet diameter 8-12 mm and Metamitron at fruitlet diameter 12-16 mm. Trees without PGRs application were the control. The most favorable treatment was T1, where gibberellins and cytokinins combined during flowering resulted in the best fruit set, the highest total yield with the largest length, diameter and mean fruit weight and additionally the most elongated fruits. Metamitron applied at the stage 12-16 mm of fruitlet diameter, did not show any thinning effect. Benzyladenine applied at the stage 8-12 mm of fruitlet diameter did not significantly improve fruit set, but increased the yield and improved its structure compared to the control. However, the effect of this treatment was much weaker than that using gibberellins and benzyladenine together during flowering.

Keywords: cytokinins, gibberellins, metamitron, size of fruit, fruit set

S03-P-VII-8

The use of preparations containing killer toxins from yeast *Debaryomyces hansenii* to support the regeneration of fruit after hail damage

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Hail damage is a serious problem in fruit production. Damage that can be regenerated allows the fruit to be used for processing purposes. This allows you to recover at least part of the income from the lost crop. Climate change is causing events such as strong winds or intense hail to become more and more frequent, even in areas previously less exposed to such phenomena. AFTER an intense hailstorm, three types of preparations containing mycotoxins from the yeast *Debaryomyces hansenii* were applied to apple fruit in the form of: post-culture fluid, dead cells and post-production fluid. All the indicated types of solutions, applied three times after the hailstorm, increased the healing of hail damage on apples. However, the influence of the selected solutions varied. Each treatment allowed for an increase in the percentage of fruit that could be used in processing. The preparations used did not allow the fruits to regain their qualities, which would allow them to be sold as dessert fruits.

Keywords: yeast, apple

S03-P-VII-9

InNoBaHort - a Nordic-Baltic project to tackle challenges in horticultural production

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Northern Europe faces the challenge of increasing local horticultural production following the European Green Deal goals, which focus on reducing the environmental footprint. The project aims to decrease the amount of mineral fertilizers and chemical pesticides used in horticultural production without compromising the yield and tackle European

canker, a devastating fungal disease on apple in northern Europe. In work package 1 (WP1), Estonian and Finnish researchers and advisors gather information about the nutritional status of strawberry production fields, test different fertilization levels, and find opportunities to convert current fertigation schemes into more sustainable ones. Estonia uses a novel energy-dispersive X-ray fluorescence (EDXRF) technique for rapid leaf analysis. First-year results show that Zn and Ca deficiencies are the most common ones in Estonian production fields, and 38% of samples have N levels above optimal, so a 30% reduction in nitrogen use per hectare in strawberry production should be possible. The activities in WP2 will primarily concentrate on developing new models and forecasting systems for European canker in apple and *Mycosphaerella* leaf spot in black currants by Norwegian and Finnish researchers. For apple scab and grey mould of strawberry, the Norwegian team will transfer knowledge from existing forecasting systems to Estonia, Finland, and Lithuania. The WP3 activities evaluate alternatives to chemical pesticides against the fungal pathogen *Botrytis spp.* in strawberries. The antifungal effect of alternative plant protection and plant extract on strawberry pathogen *Botrytis spp.* is evaluated. Swedish, Norwegian, and Estonian researchers unite their forces to improve breeding of new apple cultivars with high resistance to canker. WP4 aims to gain new knowledge on *N. ditissima* diversity in the Nordic-Baltic region and further develop current plant tests. Careful selection of fungal isolates and reliable plant tests will enable the evaluation of different resistance components in important cultivars and promising breeding selections.

Keywords: Resistance, apple, strawberry, black currant, fertilizers

S03-P-VII-10

Effect of prohexadion-Ca and paclobutrazol on vegetative and reproductive characteristics of hazelnut cultivar 'Tonda di Giffoni'

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Since hazelnut trees show strong growth at a young age, this study investigated the effect of plant growth regulators (PGRs) on growth suppression and reproductive traits in the first years of yield of hazelnut trees of the cultivar 'Tonda di Giffoni'. In 2022, the effects of the two growth inhibitors prohexadione-calcium (P-Ca) and paclobutrazol (PB) on five-year-old hazelnut trees were investigated. The treatments consisted of an untreated control, two foliar applications of P-Ca and one foliar application of PB. The treatments were applied twice for P-Ca (125 mg L⁻¹) and once for PB (250 mg L⁻¹). The study investigated the influence of P-Ca and PB on the extent and dynamics of young shoot growth, vigor, mass of wood removed during winter pruning, time required for pruning, yield and morphometric characteristics of the nut. Both regulators had an effect on the dynamics of young shoot growth, but only P-Ca had a significant effect on the reduction of shoot growth, with the average shoot length in PB and the control trees being 37.6 cm and 37.3 cm, respectively, while in P-Ca it was 27.1 cm. Both PGRs had some effect on nut morphometric characteristics, such as nut and kernel height, kernel

width and thickness, kernel roundness index, nut and kernel volume, and shell thickness. Although there was a significant difference in the mass of wood removed, the time required for winter pruning was not affected by the PGR treatments. There were no significant differences between treatments in terms of kernel percentage or yield.

Keywords: plant growth regulators, shoot growth, yield, nut and kernel characteristics

S03-P-VII-11

The application of bioregulators and the selection of rootstock aim to improve the quality of apricot fruit

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The correct choice of cultivar and rootstock, as well as the selection of appropriate pre-harvest treatments, can greatly improve the quality of the fruits. In intensive fruit production, the use of bioregulators regulates numerous physiological processes in fruit trees. This achieves better fruit quality, regulates fruitfulness, and controls tree vigor. The aim of the research was to examine the impact of bioregulator application on apricot fruit quality depending on the rootstock. In apricot cultivar 'Big Red', grown on rootstocks *Prunus cerasifera* Ehrh. (myrobalan)/Stanley and *Prunus domestica* L. (belošljiva), treatments with GA3 200 ppm, NAA 10 and 20 ppm, BA 50 and 100 ppm applied four weeks after full flowering (average fruit diameter 13 mm). The effect of the treatment on fruit quality depended on the choice of rootstock. A better impact of the treatment on fruit weight was achieved on the rootstock *Prunus cerasifera*. For all treatments, except GA3, greater fruit weight was achieved compared to the fruits from the control. For the belošljiva rootstock, only the application of NAA 20ppm resulted in greater fruit weight. A positive impact on fruit firmness was achieved through the application of BA treatments for both rootstocks. Based on the obtained results, it can be assumed that bioregulators could find application in intensive apricot fruit production with the proper selection of cultivars and rootstock.

Keywords: plant growth regulators, *Prunus cerasifera* Ehrh., *Prunus domestica* L., fruit weight, fruit firmness

S03-P-VII-12

Application of bioregulators in controlling overgrowth and increasing plum productivity

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In production practice plum is most commonly grown on generative substrates of *Prunus cerasifera* L. The problem of overgrowth is manifested in cases of intensive dense

planting and the use of anti-hail nets, where due to the intense growth of shoots, which grow through the net, additional labour costs are incurred and it also makes the harvest more difficult. In order to examine the influence of bioregulators on the control of overgrowth bioregulators paclobutrazol and prohexadione-calcium were used. Paclobutrazol was applied in three different concentrations through the root (fertigation) and foliar, also in three different concentrations (0,4, 0,7, and 1,3 L/ha-root and 1,0, 1,5, and 2,0 L/ha-foliar). Prohexadione-calcium was applied foliar in three different concentrations (1,0, 1,25, 1,5 kg/ha). In 2021 the best effect, that is, the shortest vegetative growth in prunes was recorded after the application of prohexadione calcium. The weakest effect was recorded in foliar treatment paclobutrazol. In 2022 (in previously untreated trees), the best effect was recorded after the application of paclobutrazol. The weakest effect in 2022 in trees treated for the first time was recorded after foliar treatment paclobutrazol. On the trees that were treated for the second time (in 2021 and 2022), the best effect was recorded in paclobutrazol, while the weakest effect was recorded after applied prohexadione calcium. The highest yield per tree in 2021 was recorded in foliar treatment of paclobutrazol. In both years foliar treatments with paclobutrazol and prohexadione calcium resulted in the increase of total soluble solids. Total acid content didn't have statistically significant differences between the treated and untreated groups, in both years.

Keywords: stone fruit, paclobutrazol, prohexadione calcium, vegetative growth, yield, acid content

S03-P-VII-13

Effect of 1-naphthaleneacetic acid on preharvest drop and quality of 'Gala must' and 'Idared' apple cultivars

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The normalization of the fruit load leads to obtaining large fruits in the crown of the trees, which can trigger pre-harvest drop in some cultivars that ripen earlier, without accumulating the color specific to the cultivar, and during the fruit harvesting phase. The aim is to study the effectiveness of applying 1-Naphthaleneacetic acid (Obsthormon 24a) to 'Gala must' and 'Idared' cultivars in different doses and treatment periods to maintain the physiological balance in the plant and keep the fruit in the crown as much as possible at the time of fruit harvesting. To achieve the stated goal, the following variants were studied: (1) the control (trees sprayed with water only); (2) NAA 15 ppm; (3) NAA 22.5 ppm; (4) NAA 30 ppm; (5) NAA 37.5 ppm; (6) NAA 15+15 ppm; (7) NAA 15+22.5 ppm. It was determined that the NAA can be included in the technological system to prevent premature fruit drop before harvest of apple production from the 'Gala must' and 'Idared' cultivars when the treatment was carried out in two rounds, in the dose of – 15+15 ppm and, respectively, 15+22,5 ppm. The first treatment to be applied in the first decade of July, when the differentiation of fruit buds on the apple starts, and the next one 15 days before harvest.

Keywords: firmness, fruit, NAA, productivity, solids substance, titratable acidity

S03-P-VII-14

Health risk assessment of heavy metals in plum fruits from Northeast Region of Romania

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The presence of heavy metals in fruits has become a major human health concern due to their potential impact on human health. This study aimed to assess the concentration of heavy metals (Pb, As, Cd, Cu, Zn) in plum fruits (*Prunus domestica* L.) varieties (Andreea and Carpatin), from „Adamachi” Farm district—Iasi University of Life Sciences (IULS). The samples of ripe plum fruits were collected from the orchards organic and conventional management systems from July to August 2023. The concentrations of metals in plum samples were determined using Flame Atomic Absorption Spectroscopy (fAAS) after wet digestion (HNO₃ 65%, H₂O₂, > 30% w/v). Specifically, the concentration (mg/kg fresh weight) range of Cd (0.01-0.03), Pb (0.02-0.03), As (nd), Ni (0.13-0.16), Zn (0.59-1.18) and Cu (0.67- 1.23) did not exceed the safe limits. The results indicated that the order of accumulated elements in plum fruits followed Cu > Zn > Ni > Pb > Cd > As. The potential health risks associated with consuming these fruits were evaluated (EDI, THQ, and HI) using the US-EPA probabilistic risk assessment model. However, the calculated THQ values for heavy metals were all found < 1, indicating that consuming plums from this area does not pose health risks to local consumers. Overall, the findings of this study demonstrate that plum fruit consumption in the study area does not present any health hazard associated with any of the selected heavy metals.

Keywords: health risk assessment, horticulture crops, plum fruits, safe consumption limits

S03-P-VIII-1

Pomological and biochemical characterization of some new almond cultivars fruits

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Almonds are known as a highly nutritious food, rich in proteins, unsaturated fatty acids, containing lots of essential mineral elements beneficial for human diet, vitamins, dietary fibre, and many others. Besides pests and diseases resistances, bearing and fruiting capacity, a valuable almond cultivar has also high quantity of oils and unsaturated fatty acids, proteins or mineral elements, thus in this study eight almond cultivars are analysed from a pomological and biochemical point of view. The fruits were grown in a super high-density trial almond orchard, in Greci, Tulcea, Romania. The protein quantity was determined by the CHNS elemental analysis. The oil content was determined using a

Soxhlet extractor. Quantitative fatty acids analysis was performed using a Gas Chromatography Mass Spectrometry method, determining six of the fatty acids methyl esters contained. The minerals presence and quantity was examined by an Inductively Coupled Plasma Mass Spectrometry technique. All of the cultivars had performed well in a certain criteria analysed, and misperformed in others, therefore cultivars have different recommended uses, based on their oil, fatty acids, proteins or minerals contained.

Keywords: protein content, oil content, mineral content, unsaturated fatty acids, nutrient content

S03-P-VIII-2

Completing the assortment with new varieties of pears obtained at SCDP Voinești Erculescu M.

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Since the beginning of the research activity of Voinești Research and Development station for Fruit Growing, assortment improvement strategies have been foreseen, taking into account growers' claims, market demands and ecological factors. In the first step, in the years 1950 – 1960, the guidelines were for obtaining varieties with high production potential and superior fruit quality. After 1960, resistance to the main diseases and pests was introduced as the main objective of selection, along with other agro biological and technological characteristics, by introducing into the hybrid combinations some biotypes with genetic ancestry in *Pyrus serotina*, along with varieties of pear from the valuable European assortment. Over the years, through breeding work, inter-specific elites were obtained in F1 and F2 with high biological value and which formed the basis of the sources of resistance to some diseases and pests in subsequent hybridisations for F3 and F4. From the vast biological material, 13 varieties of pear were selected and approved, with different maturing periods, falling into the varietal conveyor, for the area of influence of the Voinești Station. After the homologation and introduction of pear varieties into culture: Timpurii de Dâmbovița (1967), Republica (1973), Aniversarea (1974) and of the first interspecific variety Euras (1994), in the period 2004 – 2023 9 types of pear were approved: Orizont, Corina, Cristal, Tudor, Romcor, Aroma, Andrei, Silvia, Nicolas, the last 4, homologated in the period 2021 – 2023, which stands out for its high-quality fruits, with a biomass between 285-300g, demonstrating a good behaviour against the attack of diseases and pests specific to the pear. The presented pear varieties are recommended as parents in improvement programs, but also for cultivation in all areas favourable to pear culture, respecting the technological links.

Keywords: new varieties of pear, characteristics, varietal conveyor.

S03-P-VIII-3

The Opportunity For Cultivation of Exotic Species In Temperate Regions In The Conditions Of Climate Change

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The orientation in finding new crops is not a new area of research but the increased interest is closely linked to human development with main problems it involves as food security and malnutrition. Recent results of global research conclude that changes in the structure of climatic and vegetation areas at higher latitudes and altitudes will require considerable regional adaptations, especially in transition areas due to the climate change. The opportunity of underutilised crops is seen as an solution for increasing the regional cultivated assortment because some of these species have a high ecological plasticity and potential to adapt in the new environment. In this context, fruit growing in the temperate regions is undergoing an important change in zoning of the species and introducing new ones that can adapt in the new conditions of vegetation. Thus, exotic or underutilized fruit growing species have a high potential in finding sustainable production systems in temperate regions. The species we take into consideration are: paw paw (*Asimina triloba* (L.) Dunal), kiwi (*Actinidia deliciosa* A. Chev.), pomegranate (*Punica granatum* L.), kaki (*Diospyros kaki* Thunb.), ziziphus (*Ziziphus jujuba* Mill.), fig (*Ficus carica* L.) and medlar (*Mespilus germanica* L.). The considerable potential for introduction to culture of these species will be assessed. However, one of the reasons for introduction of these underutilized fruit species is Romanian's consumers increasing interest for food with high nutritional value and taste appeal especially, since new species such as goji (*Lycium chinense* Mill.) and saskatoon (*Amelanchier alnifolia* Nutt.) are already adopted by the Romanian market and growers. Even so, the main challenge these species will face in the temperate regions is low temperature during winter. Species mentioned above could also be considered an useful tool for the 'green revolution' movement which is already spreading in the last decades.

Keywords: fruits, exotic species, climate change, biodiversity.

S03-P-VIII-4

The field performance of sweet cherry cultivars 'Paula' and 'Artis' on the trees with restricted height

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The demand for sweet cherry orchards with restricted-height trees is growing, considering use of covering systems, work safety and effectiveness issues. Besides the introducing of vigour-reducing rootstocks, the lowering of existing vigorous trees has been applied. The aim of the research was to test newly developed Latvian sweet cherry cultivars 'Paula' and 'Artis' as well as control cultivars 'Radica' and 'Bryansk 3-36' for growing on the rootstocks *Prunus cerasus* (cv. 'Latvijas Zemais'), P7 and *P. mahaleb* in

the orchard where the trees were restricted at the height 2.5 – 3 m. In 2015 – 2023, the vegetative growth was characterized by trunk circumference and shoot growth. The health of trunk, canopy and leaf was evaluated. In 2020 – 2023, the yield and yield efficiency were determined. The trees of cv. 'Paula' showed good health of the trunk and leaves on all tested rootstocks. Cvs. 'Artis', 'Radica' and 'Bryansk 3-36' were prone to lightly more trunk or canopy damages on the rootstock P7. In the first yielding years, the productivity of cvs. 'Paula' and 'Artis' was higher than of control cultivars (10 and 7 kg per tree vs 5 and 4 kg per tree). In 2022 with low fruit set in cool spring, the productivity did not differ between the new and control cultivars. In 2023 with the spring frosts, the control cultivars showed higher productivity than the new ones (4 and 2 kg per tree vs 6 kg per tree). The yield of cv. 'Paula' did not differ between the rootstocks. Cv. 'Artis' on the rootstock P7 had the highest yield in favourable conditions for fruit set, but and the lowest one – in unfavourable weather which coincided with tree height restriction. Fruit mass of cv. 'Artis' (8.5 g) was higher than for other cultivars (5.1 – 6 g).

Keywords: *Prunus avium*, *Prunus cerasus*, *Prunus mahaleb*, rootstock, productivity

S03-P-VIII-5

The influence of cultivation technology on quality indices of 2 cherry varieties cultivated in the pedoclimatic zone of the Vlasia plain

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Cherry is a valuable species for horticulturists due to its nutritional and commercial characteristics. Priorities for cherry producers include improving fruit quality aspects such as size, appearance, firmness, aroma, sugar content, and acidity. The aim of the study was to assess the influence of planting distances on certain fruit cherry characteristics. The study was conducted at the Experimental Field of the Research and Development Station for Pomology in Băneasa, with the objective of investigating the impact of planting distances on quality indicators such as weight, height, small diameter, large diameter, pH, sugar content, and fruit firmness. A bifactorial experiment was established where Factor A was the cultivar with the gradations a1 – "Regina" cultivar and a2 – "Sweetheart" cultivar, both grafted on the "Gisela 5" rootstock, with a slender spindle tree crown form. Factor B was the planting distance of the trees, with the following gradations: b1 - 4x1.5 m, b2 - 4x2.0 m, and b3 - 4x2.5 m. The planting distance between rows is 4 m, while the distances between trees in a row are 1.5 m, 2.0 m, and 2.5 m. The determinations were carried out under the climatic conditions of the year 2022. Following the study conducted on the "Sweetheart" cultivar, the measurements (weight, height, small diameter, large diameter, sugar content, pH, citric acid) recorded higher values at the planting distance of 4x2.0 m. For the "Regina" cultivar, the highest average values for height, diameter of the fruits were observed at the planting distance of 4x2.5 m. The total sugar content values of the Regina cultivar fruits were higher at planting distances of 4x2.0 m. At planting distances of 4x2.0 m and 4x2.5 m, the Regina cultivar recorded higher values in all measurements compared to the Sweetheart cultivar. In variant b1, both cultivars showed similar quality indicators, with only the fruit weight of the Regina cultivar being

higher than that of the Sweetheart cultivar. For the "Regina" cultivar, the average fruit weight was 9.25 g/fruit, while the Sweetheart cultivar had a slightly lower average weight of 8.02 g/fruit. The results of the experiment, led to the conclusion that planting distances influence the quality of fruits and the achievement of satisfactory yields, both quantitatively and qualitatively, are meeting the requirements of producers, markets, and consumers. Thus, "Regina" cherry cultivar produced superior quality fruits compared to the "Sweetheart" cherry cultivar in terms of weight, height, diameter, sugar content, and pH.

Keywords: cherry, quality indices, biometric measure, varieties, technology

S03-P-VIII-6

Influence of cultivar/rootstock combination on the frequency and morphological characteristics of fruiting branches in sweet cherry

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The presence of types and morphological characteristics of fruiting branches can be of great importance for highly efficient and profitable sweet cherry production. The study was conducted over a period of two years (2021-2022) at the experimental field "Radmilovac" of the Faculty of Agriculture of the University of Belgrade on 17 cultivar/rootstock combinations. The morphological characteristics of all types of fruiting branches (short and long fruiting branches, and spur fruiting branches) were monitored, including length, thickness, number of flower buds, number of vegetative buds, flower/vegetative bud ratio, and internode length. In all combinations, spur fruiting shoots were the most common (60.03% to 90.79%), and the frequency of branches was not statistically significantly dependent on the cultivar/rootstock combination. No significant statistical difference was found in the effect of cultivar/rootstock combination on the length of short and long fruiting branches. For the long fruiting branches, the highest ratio of flower buds to vegetative buds was obtained with the combinations 'Kordia'/'Gisela 5' (2.18) and 'Kordia'/'Gisela 6' (1.71). In the short fruiting branches, the highest ratio of flower buds to vegetative buds was achieved with the combinations 'Carmen'/'Gisela 5' (3.72) and 'Kordia'/'Gisela 5' (3.18).

Keywords: *Prunus avium*, cultivar, rootstock, fruiting shoots, spurs, flower/vegetative bud ratio.

S03-P-VIII-7

Optimizing demand based irrigation control in apple orchards

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Due to increasing dry periods, especially during summer time, the possibility of additional irrigation, even in regions with higher precipitation such as Lake Constance, is an important adaptation strategy for fruit growers to ensure yield and fruit quality. At the same time, for economic and ecological reasons, there is a need to reduce water consumption to the actual demand of the plant. A three-year project (Interreg VI) is focusing on optimizing the determination of the real water demand and irrigation control in apple orchards. In addition to the HSWT experimental station in Schlachters, the Competence Center for Fruit Growing Lake Constance (lead partner), the Geisenheim University of Applied Sciences, Agroscope and FIBL (CH) and the Working group for Agricultural Technology and Structure in Bavaria e.V. (ALB) are involved. At the research station in Schlachter/ HSWT, soil moisture tension based treatments (irrigation start at 30kPa, 65kPa, 100kPa) and the ALB climate-based model are compared in a three-year trial. With a continuous, radio-based soil moisture measurement-system, both the switch-on times and the irrigation quantities adapted to the soil type per irrigation cycle will be determined. In addition, a comparison of different sensor-based systems is carried out in a container trial with apple trees. In this trial, in addition to measurements of soil water tension and volumetric water content, various systems for measuring sap flow and stomatal conductivity are validated with different water supply to the containers. The aim of the project is to optimize the exact determination of water demand and based on this to allow more precise orchard- and tree-specific irrigation recommendations.

Keywords: water, irrigation, fruit production, apple, climate change

S03-P-VIII-8

Research on the cold tolerance of some apricot varieties in Bucharest area

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The passage discusses the impact of the winter season on apricot cultivation in Romania, highlighting significant production losses due to the destruction of buds and/or flowers. These losses typically occur after the buds come out of the absolute rest period, influenced by temperature fluctuations exceeding the biological threshold, leading to the shifting of the trees. The study presents the results of the behaviour of six apricot varieties, including five new Romanian varieties compared to the old variety Meilleur d'Hongrie, known to be sensitive to winter conditions. Viability tests conducted before flowering showed varying tolerance levels depending on the variety and flowering time. Early-flowering varieties lost more buds than those flowering later. During flowering, a relatively high percentage of flowers with destroyed pistils was recorded. Additionally, temperature fluctuations contributed to a higher-than-normal physiological drop.

Keywords: blackberries, cold tolerance, production, viability.

S03-P-VIII-9

Characteristics of the newly created late peach cultivar 'Rosa'

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In this paper, the newly created late peach cultivar 'Rosa' was studied. It was recognized as a new peach cultivar in 2023. It was created from the crossing combination 'Flaminia' 'Autumnglo' at the Faculty of Agriculture, University of Belgrade. The 'Summerset' cultivar was used as the standard for the comparison. The study was conducted over a period of two years (2021-2022). The most important morphological traits, ripening time, yield, physical fruit characteristics, chemical fruit composition and sensory evaluation of fruit quality, were investigated. The 'Rosa' cultivar mostly has a medium red hue over a greenish yellow skin ground color, and yellow flesh. In relation the stone adherence to flesh, fruits are freestone. The 'Rosa' cultivar scored better than the standard for most characteristics. On average, it had a later ripening time (September 20) compared to the standard cultivar (September 16). The 'Rosa' cultivar had a yield of 9.41 kg/tree and a fruit weight of 144.47 g, while the 'Summerset' cultivar had a yield of 7.98 kg/tree and a fruit weight of 140.66 g. The soluble solids and total acid content of the 'Rosa' cultivar was 17.30% and 0.69%, respectively, compared to 13.47% and 0.61%, for the standard cultivar. The 'Rosa' cultivar also had a better fruit appearance and taste than the standard cultivar. The results obtained show that the 'Rosa' cultivar can be interesting as a late, high-yielding and high-quality cultivar for to spread in production orchards in Serbia.

Keywords: *Prunus persica*, late ripening, yield, pomological characteristics, fruit quality

S03-P-VIII-10

Rootstock effect on sour cherry cv. 'Zentenes' tree growth and health

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The sour cherry cultivar 'Zentenes' was recommended for producing fresh fruit in Latvia, but its major difficulty is the strong tree vigour. The aim of the research was to test the effect of several rootstocks on sour cherry cv. 'Zentenes' tree growth and health in different growing conditions. The trial was established in Dobele with high fertility soil and in Pūre with medium fertility soil conditions. The following rootstocks were tested: mahaleb cherry (*Prunus mahaleb*) seedlings as a control, P7, 'GiSelA 5', and the local sour cherry cv. 'Latvijas Zemais' clone no. 52 and clone Raunas. The vegetative growth was characterized by trunk circumference (TC) and annual shoot length (SL). The trunk and canopy damages were assessed visually using points from 0 (no damages) to 5 (overall damages). The chlorophyll index (CI) was detected in Dobele. In both sites, the rootstocks 'Latvijas Zemais' Raunas and 'Latvijas Zemais' 52 significantly reduced TC: it was 72 – 87% of the control whereas TC of trees grown on the rootstocks 'GiSelA 5' and P7 was 78 - 92% and 106 – 112% of the control respectively. The largest differences of

SL between the growing sites showed the trees on the rootstock 'Latvijas Zemais' Raunas with significantly longer shoots than control in Dobele. The SL of the trees on the rootstocks P7, Gisela 5 and 'Latvijas Zemais' 52 did not differ from control significantly. In both sites among all rootstocks, trunk health mostly was good (0 – 1.5 points), and canopy health was good too in Dobele. The annual shoots were damaged by spring cold in Püre in 2023, and the trees on the rootstocks 'Latvijas Zemais' Raunas and GiSelA 5 suffered more than others. In 2018 when dry weather conditions dominated, the trees grafted on P. mahaleb showed higher CI than others.

Keywords: Gisela 5, *Prunus cerasus*, *Prunus mahaleb*, trunk circumference, chlorophyll index

S03-P-VIII-11

Sustainable almond cultivation in the Mediterranean region

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Almond is one of the major mediterranean fruit crops. According to FAOSTAT in 2022. almond is cultivated on 1.495.758 ha of Mediterranean land. Traditionally it is grown on small areas, most comonly together with fig in olive orchards and vineyards. In 2021. programme Horizon 2020 by PRIMAMed initiative started project VALMEDALM („Valorization od Mediterranean almond orchards trough the use of intercropping strategies“) in which six mediterranean countries take part. Trough this project in Croatia we examined almond cultivation in consociation with rosemary, imortelle, sage and artichoke. Demo site is placed in Selca, island of Brač, on 1 ha of organic almond orchard. Orchard was planted in 2017. on ameliorated karst terrain and has instaled drip irrigation system. Experiment is designed as block experiment with five repetitions with almond cultivars Ferranges, Ferraduel, Texas and Ai. On almond trees grown with rosemary and artichoke no infestation with *Colletotrichum acutatum* and *Stigmina carpophila*, the major almond diseases, was recorded. Due to simultaneously almond and rosemary flowering, greater nubmer of pollinators were recorded in repetition with rosemary. During two seasons, the greatest growth of imortelle and the lowest of artichoke was recorded. By choosing the best intercrops for almond cultivation total cost of almond protection could be notably lower, while in the same time farmes could have additional income from, in this case, essential oil production. Also, outcomes of this project are step forward to sustainable almond cultivation due to lower use of pesticide.

Keywords: intercropping, morphological traits, imortelle, sage, rosemary, artichoke

S03-P-VIII-12

Prunus rootstock breeding, gene discovery and field testing for Armillaria root rot resistance in South Carolina

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Replant diseases affecting mature peach trees are becoming major obstacles for sustainable peach production in South Carolina and the southeastern U.S.A. The annual economic loss to the entire state and the Southeast is estimated at \$4 to \$8 million, respectively, or approximately 3 to 4% mature tree death annually on replant sites. Two diseases affecting replanting, the peach tree short life (PTSL) syndrome and Armillaria root rot (ARR), are the primary causes of replant issues in this region. Tolerance to both diseases is essential for the sustainability of the peach industry. Although several rootstocks are PTSL tolerant, options that offer resistance to both PTSL and ARR remain limited. The hybrid peach/plum rootstock 'MP-29' possesses genetic resistance to Armillaria root rot (ARR), which is inherited from its plum ancestors. All known peach species examined have been found to be susceptible to ARR. To understand the genetic basis of this resistance, we created a detailed, haplotype-phased genome assembly for 'MP-29'. We analyzed how genes in 'MP-29' were expressed when exposed to the pathogen causing ARR and under normal conditions, observing these patterns for up to 5 weeks. Our analysis revealed that certain resistance genes—specifically GST, cytochrome p450, among others—found only in the plum genetic material, were significantly more active, suggesting they play a key role in resisting ARR. Furthermore, we have discovered new sources of tolerance to ARR within *Prunus cerasifera* accessions, which we have utilized in breeding efforts with the standard PTSL-tolerant rootstock, Guardian®. The resulting hybrids, which demonstrated in vitro tolerance to ARR, have been included in field trials at replant sites to assess their resistance to both PTSL and ARR. Additionally, evaluations were conducted at non-replant sites to examine their horticultural performance and impact on the scion. Both progress and future directions will be discussed.

Keywords: *Armillaria mellea*, *Desarmillaria caespitosa*, *Prunus persica*, *Prunus cerasifera*, peach tree short life

S03-P-VIII-13

The impact of climatic conditions on the phenology and physiology of some *Prunus avium* L. cultivars from the North-East of Romania

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The sweet cherry (*Prunus avium* L.) is a tree species spread throughout the world, being completely adapted to the climatic conditions at middle latitudes and is specific to the temperate climate zone, known primarily for its special qualities of the fruits. The study was performed for two consecutive years (2022–2023) using as biological material three cultivars ('Van', 'Andreiaș' and 'Margonia') existing in the Romanian sweet cherry collection from Research Station for Fruit Growing (RSFG) Iași, Romania. The effect of climatic parameters on phenology was studied by recording phenological data according to the BBCH scales (Biologische Bundesanstalt, Bundessortenamt and Chemical Industry): 65 (full flowering); 78 (fruits approximately 80% of final size) and 89 (fruit ripening) by performing the heat requirement by calculating the sum of active temperature (SAT) and growing degree-days (GDD) and the light intensity (lux) of the studied period. Of great importance for the improvement of the phenological models of the sweet cherry crop are the evaluation of the physiological processes, thus the content of chlorophyll pigments of the leaves from two different areas of the crown (internal and external) was also studied. For the statistical analysis were applied the Duncan's test ($p \leq 0.05$) and Pearson correlation coefficient. The analyzed indices demonstrated a high degree of variability due to the climatic conditions of the studied years (2022-2023) which recorded average values of 11.4°C, the annual average temperature, +1.7 °C more than the multiannual average (2000-2020) and total precipitation of 440 mm, with a deficit of -77.5 mm from the multiannual values causing significant statistical differences between the results obtained.

Keywords: climate, chlorophyll pigments, leaves, phenophases, sweet cherry

S03-P-VIII-14

Preliminary study: Performance of two olive cultivars well-adapted to SHD orchards in conditions of Istria (Croatia)

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The economic sustainability of traditional olive orchards in Mediterranean countries is decreasing due to the increased production costs and the lack of work force. Therefore, in recent years a new growing system with a strong economic impact in the olive sector is being implemented: super-high-density (SHD) system with more than 1200 trees/ha using new, well-adapted cultivars. Olive cultivation is one of the main agricultural sectors in Istria, Croatia, where most of the olive orchards belong to the low or medium density systems. The main aim of this preliminary study was to test the performance of new cultivars and SHD system in the conditions of Istria. The olive orchard was planted in spring 2020 in Marčana, Croatia, and the measurements took place in 2023. The spacing was 1.2m x 3.5m for cultivar 'Oliana' and 1.4m x 3.5m for cultivar 'Lecciana'. Plants were drip irrigated during summer months and fertilized according to the soil needs. In the 3rd year after planting, the trees of 'Lecciana' reached 230 cm, on average, while the 'Oliana' trees grew up to 171 cm on average. Considering the trunk cross sectional area, the cultivar 'Lecciana' on average had 10.17 cm² while 'Oliana' 6.83 cm². 'Oliana' trees

already in the 2nd year after planting bore some fruits (0.20 kg/tree on average), while in the 3rd year the yield was more significant, on average 2.72 kg/tree and 3.29 kg/tree for 'Oliana' and 'Lecciana', respectively. Cultivar 'Lecciana' had 3% higher olive oil yield compared to 'Oliana' in 2023.

Keywords: Olive cultivation; Super-high-density growing system; new cultivars

S03-P-VIII-15

The behaviour of some new almond cultivars in northern Dobrogea

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The almond (*Prunus dulcis* (Mill.) D.A. Webb) grows in nowadays Dobrogea region, Romania, since ancient times. It is supposed that the Greek colonists brought and planted almonds, among other Mediterranean plants, near the fortresses build by them. The study examines the behaviour of eight almond cultivars grown in a super high-density trial orchard in Greci, Tulcea County. Different physical measurements applied on trees and fruits were performed and analysed, for identifying the most suitable cultivars for the region. The annual shoots were counted and measured, along with the tree height, canopy height and the cross sectional surface of the trunk, for two consecutive years. Length, width and thickness of the fruits for each cultivar were measured, length and width of the kernel, nut mass, kernel mass, shell percentage, double seeds and productivity, for two consecutive years. Lauranne, Marinada and Ana cultivars had the biggest growth, while Marinada, Vairo and Lauranne had the highest yield, in shell and Marinada, Supernova and Lauranne for kernel. This study may be of interest for the farmers that intend on developing an almond orchard.

Keywords: late blooming cultivars, phenology, spring frosts, early ripening

S03-P-VIII-16

Impact of environmental factors on the growth and fructification of some walnut varieties in Romania's North-East area

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Walnut (*Juglans regia* L.) is a fruit species with high demands on environmental factors, which is why breeding programs have focused on the study of genotypes tolerant to late spring frosts, the timing and type of flowering of these varieties being important factors that lead to increased production. The present paper follows the behavior of 10 walnut genotypes, analyzing the degree of dichogamy, flowering period, growth, and fruiting in the climatic conditions of the northeastern area of Romania. Observations made during two years of study (2022-2023) demonstrate that the flowering period is different from

one year to another, being directly influenced by environmental factors, especially temperature and precipitation. At the same time, the duration of the vegetation period is in direct correlation with environmental factors. In the two years of study, there were significant differences, so the Miroslava variety required 188 days in 2022 from the beginning of bud swelling to leaf fall and 214 days in 2023.

Keywords: walnut, flowering, growing season

S03-P-VIII-17

Influence of the rootstock on the growth of the root system, yield and quality of sweet cherry fruits

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To study the development of the root system of cherry trees of Kordia and Regina cultivars grafted onto the rootstock P. mahaleb and Gisela 6, root excavations were made using the monolith method. The research results showed that at the age of seven years, trees grafted on the Gisela 6 rootstock had a root mass of 13% and a length of 34% greater than in the control. In the root structure, fibrous and conducting roots with a diameter of less than 3 mm accounted for 92.7% of their length. The roots of this rootstock more uniformly cover the thickness of the soil horizon up to 60 cm deep, where up to 76% of the total number of roots is concentrated.

Cherry trees grafted onto Mahaleb are significantly uneven both in terms of growth vigor and in the ripening of fruits and the onset of flowering; in general, they enter fruiting later, increase their yield more slowly, and are inferior in productivity to the Gisela 6 rootstock. This rootstock promotes the formation of fruits larger in size and with denser pulp, however, it is inferior to Mahaleb cherry in terms of the accumulation of dry substances in the fruits.

Keywords: cherry, rootstocks, roots, placement in soil, yield, fruit quality

S03-P-VIII-18

The productive value of new apple (*Malus domestica* Borkh.) genotypes bred at the National Institute of Horticultural Research, Skierniewice, Poland

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The productive value of eleven new apple breeding clones: J-2002-05 ('Melfree' x 'J-79'), J-2002-25-03 ('Sawa' x 'Rubin'), J-2003-11-01 ('Gold Milenium' x 'Szampion'), J-2003-11-04 ('Gold Milenium' x 'Szampion'), J-2002-21-01 ('Rubin' x 'Gold Milenium'), J-2002-14-01 ('J-79' x 'Szampion'), J-2002-10-01 ('J-79' x 'Topaz'), J-2004-13 ('Melfree' x 'Retina'), J-2002-15-02 ('J-79' x 'Lobo'), J-2002-15-01 ('J-79' x 'Lobo'), J-2004-29 ('J-79'

x 'Rubinola') was evaluated at the National Institute of Horticultural Research (InHort), Skierniewice, Central Poland. The clones were compared to the standard cultivars 'Szampion' and 'Gold Milenium'. The plant material was produced by the hand-winter grafting of genotypes on M.9 rootstock. Trees, about 1.5 m height single shoots, were planted in 2016 in a medium fertile soil in the orchard. Trees in the experimental trial were planted at the density of 3.5 m x 1.0 m in the randomized block design (3 replications, 3 trees per plot). Studies and observations were conducted during six consecutive seasons (2018-2023). Tree vigour, flower intensity, ripening time, fruit yield and fruit quality (including: weight, skin color, shape, attractiveness and taste) were assessed. The studied apple clones were significantly different in terms of the evaluated traits. The most promising genotype, was the late ripening clone (J-2002-25-03), obtained from the cross combination of 'Sawa' and 'Rubin'. Its fruit yield was approximately 20 % lower in comparison to 'Szampion' standard cultivar, but surpassed it in fruit taste and attractiveness. Moreover, it is resistant to apple scab (*Venturia inaequalis*) and low susceptible to other economically important pathogens and pests. This clone was named 'Wars' and was submitted as the new apple cultivar to the Polish National List of Fruit Plant Varieties in 2022. The research was carried out in the frame of subsidy of the Ministry of Agriculture and Rural Development special-purpose – Task 3.13: „Developing of an initial apple plant material (*Malus domestica* Borkh.) with the solid skin color, annually fruiting and resistant to apple scab”.

Keywords: *Malus domestica*, apple breeding program, apple clones, fruit yield and quality

S03-P-VIII-19

Quality assessments of some apple cultivars grown under organic system in Norway

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Organic production of apples is increasing in Norway because consumers are developing a preference for this kind of production due to the environmentally friendly alternatives which encompass the sustainable use of energy and natural resources. Organic fruit production in Norway in total took up 292 ha in 2023, while apple production is carried out on 172 ha (58% of organic fruit production land). The aim of this study to do quality assessment of 11 cultivars (Discovery Rosette, Rubinstep, Santana, Red Ingrid Marie, Red Elstar, Red Aroma, Katja, James Grieve, Holsteiner, Elstar, and Discovery) from three growing locations (Ullensvang, Telemark and Viken) in two consecutive years (2021-2022). Averagely, fruit weight ranged from 114.93 g (Katja) up to 193.30 g (Red Ingrid Marie), while fruit diameter from 63.07 mm (James Grieve) to 81.60 mm (Red Ingrid Marie). Ground color was the most intense in Katja and over color in Red Ingrid Marie. Seed number was the highest in Rubinstep (9.91) and the lowest in Holsteiner which was the most firm apple of all, and had the highest level of soluble solids and acids

(13.19% and 1.14%, respectively) but one of the lowers soluble solid/acid ratio (11.57). Averagely, all cultivars had higher fruit weight and fruit diameter, ground and over color, starch and soluble solid content in the 2022, while in the first year (2021) fruits had higher firmness (on both sunny and shade side) and seed number. Regarding locations, apples in Telemark had the most intense ground and over color, fruit size, seed number and weight, apples from Viken the highest acids and firmness, while from Ullensvang the starch level. All examined cultivars had excellent pomological traits and all are recommended for organic production in Norway or in locations with similar agroclimatic conditions.

Keywords: *Malus domestica* Borkh., cultivars, organic production, fruit quality

S03-P-VIII-20

Influence of planting distances on the size and quality of nectarine fruit in the soil and climatic conditions of southern Romania

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Nectarine is a valuable species for fruit growers because of its nutritional and commercial properties. The anticarcinogenic qualities of nectarines, which contain seven times more beta-carotene than peaches, have been discovered and highlighted, and they are recommended in the diet of sick people and those prone to such diseases, so the demand has been and is increasing. The aim of the study was to determine the influence of planting distances on fruit weight and fruit size index. In conjunction with the proposed determinations, analyses of several quality indices - flesh firmness, sugar content, acidity - were also carried out. As a result, in the Experimental Field of the Research and Development Station for Pomiculture Băneasa, a bifactorial experiment was set up where factor A was the variety, with graduations a1- variety "Cora" and a2- variety "Romamer2", grafted on the rootstock Tomis 1, with a Bi -Baum® type crown management form, and factor B was the planting distance of the trees with the following graduations: b1- 4x1.5 m, b2- 4x2.0 m and b3- 4x2.5 m. The planting distance between rows is 4 m and between trees per row, distances of 1.5 m, 2.0 m and 2.5 m. The determinations were carried out under the climatic conditions of 2022 on a preluvosol soil type. In the experiment, the variety „Cora” was superior to variety „Romamer 2” for the planting distances 4 x 2.0 m and 4 x 1.5 m. The variety "Romamer 2", at the planting distance 4x2.5m recorded higher fruit weight values (80.09 g) compared to the variety "Cora" (68.03 g). As a conclusion, we can say that the variety "Cora" reacted better to shorter planting distances, while the variety "Romamer 2" is more favourable to longer planting distances. The study was funded by Fruit Research DevelopmentStation

Baneasa in the framework of the Thematic Plan on Implementation of the "ASAS Strategy on Research - Development - Innovation in Pomiculture" for period 2021 - 2027.

Keywords: variety, biometric measurements, diameter, firmness, sugar content, citric acid

S03-P-VIII-21

The influence of some technological factors on some quality indices of 2 cherry varieties cultivated in the pedoclimate conditions of the South - East area of Romania

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Cherry is a valuable species for fruit growers due to its nutritional and commercial properties. The priorities for cherry producers are to increase the quality of the fruits, such as size, appearance, firmness, aroma, sugar content, and acidity. The aim of this study was to determine the influence of planting distances on some characteristics of cherries. The study was conducted in the Experimental Field of the Research and Development Station for Pomiculture Baneasa, aiming to determine the influence of planting distances on quality indicators such as weight, height, small diameter, large diameter, pH, sugar content, and fruit firmness. A bifactorial experiment was established where factor A was the variety with the following graduations: a1- Regina variety and a2- Sweetheart variety, grafted on the Gisela 5 rootstock, with a slender spindle crown shape. Factor B was the planting distance of the trees, with the following graduations: b1- 4x1.5 m, b2- 4x2.0 m, and b3- 4x2.5 m. The planting distance between rows was 4 m, and the distances between trees on the row were 1.5 m, 2.0 m, and 2.5 m. The determinations were made under the climatic conditions of the year 2022. Following the conducted study, the Sweetheart variety's determinations (weight, height, small diameter, large diameter, sugar, pH, citric acid) recorded higher values at the planting distance of 4 x 2.0 m. For the Regina variety, the highest average values of height, small diameter, and large diameter were recorded at the planting distance of 4 x 2.5 m. The total sugar content of the Regina variety fruits was higher at planting distances of 4 x 2.0 m. At the planting distances of 4 x 2 m and 4 x 2.5 m, the Regina variety recorded higher values for all determinations performed, compared to the Sweetheart variety. At variant b1, both varieties had similar values for quality indicators, only the weight of the Regina variety fruits was superior to the weight of the Sweetheart variety fruits. For the Regina variety, the average fruit weight was 9.25 g/fruit, while the Sweetheart variety had a lower average weight of 8.02 g/fruit. The results of the experiment led to the conclusion that planting distances influence the quality of the fruits and the obtaining of satisfactory yields, both quantitatively and qualitatively, managing to meet the requirements of the producer, the market, and the consumer. In this way, the Regina variety produced fruits of superior quality compared to the Sweetheart variety in terms of weight, height, small diameter, large diameter, sugar content, and pH.

Keywords: biometric measurements, planting distance, bifactorial experiment, technology, cultivars

S03-P-VIII-22

Current status, opportunities and challenges for hazelnut production in Germany

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The yield performance of 14 hazelnut cultivars of different origin was compared from the second to the twelfth year after planting. The trees were trained as spindles with a planting distance of 4.5 m × 2.5 m, leading to a tree density of 800 trees per hectare. Yields > 1 kg/tree were achieved from the fourth year after planting, and > 3 kg/tree from the sixth year after planting. Substantial yield fluctuations between cultivars and years were observed. After reaching maturity a mean yield of 2.2 t/ha was achieved in the whole experimental plot, whereas the highest yielding cultivars, 'Barcelona', 'Webbs Price Cob' and 'Emoa 1' achieved average yields of 3.2 t/ha, 2.9 t/ha, and 2.6 t/ha, respectively. The cultivars differed significantly in fruit mass and kernel mass. The varieties 'Merveille de Bollwiller' (4.0 g) and 'Corabel' (3.8 g) had the highest fruit mass. The small-fruited cultivars 'Pauetet' and 'purple-leaved filbert' had the highest mass proportion of kernel to fruit of 52% and 49%, respectively. This relation was 42% when taking into consideration the average of all cultivars and years. The mean proportion of empty nuts was 2.6% in the whole experiment, but individual cultivars reached up to 16% empty nuts in some years. 'Corabel' and 'Barcelona' had less than 1% empty nuts. In the 4th, 6th and 11th year after planting, averages numbers of 16, 9, or 16 root suckers per tree were counted. The time required for winter pruning in the 6th and 7th year after planting was 22 h/ha and 62 h/ha, respectively. The experimental data shown in this paper demonstrate that it is possible to grow hazelnuts in a spindle system in the Central German region.

Keywords: *Corylus avellana*, *Corylus maxima*, fruit mass, pruning, training system, cultivar evaluation

S03-P-VIII-23

Productivity and vigor of Gala apple clones on M9 and B9 rootstock

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The starting point when designing a contemporary orchard of high density is choosing an adequate (low vigor) rootstock and variety. The experiments were conducted on four clones of Gala: Dark Baron® Gala, Red Devil Gala, Schnico Red and Gala Val®, on two different rootstocks: M9 (Malling 9) and B9 (Budagovsky 9). The aim of the research was to assess the impact of the rootstock on the growth and fruit properties of Gala clones. The average tree height in all three years and in all observed clones was higher on M9

than on B9. The clones on B9 rootstock had higher inflorescences per tree when compared to M9 rootstock, but fruits per 100 fruit set), was higher on M9 rootstock in both years. The average yield per tree and per hectare in 2022 and 2023 were higher on M9 rootstock. In both years the average fruit mass, in all clones, was higher on M9 rootstock than on B9 rootstock. Coloration in both years was equal on average regardless of the rootstock, but some clones had different coloration levels depending on the rootstock. All observed clones had equal firmness on both rootstocks. Total soluble solids were slightly higher in both years in clones on B9 rootstock. In 2022 acid content was the same in all clones on both rootstocks, while in 2023 the observed clones had slightly higher content on M9 rootstock.

Keywords: fruit growth, tree height, fruit mass, acid content, total soluble solids

S03-P-VIII-24

Evaluation of the vegetative-productive behavior of different olive cultivars for their adaptability to high-density cultivation

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To revive the Italian olive-growing sector, the national production of olives and extra virgin olive oil must be increased. For this, the productivity of current olive orchards needs to be improved by renewing part of the plantations and expanding the olive-growing areas, also by introducing new cultivation systems. Regarding the latter, in recent years, new high and very high-density models have been proposed which require cultivars with limited vigor. At present, the cultivars that appear best adapted to very high-density cultivation are Arbequina, Arbosana and Koroneiki and others are being added, mainly from genetic improvement programs. The aim of the present work was to evaluate the adaptability to high-density cultivation of Italian cultivars chosen from among those which, according to available information, could best adapt to such a cultivation system (also considering minor cultivars). The study was conducted in central Italy in an olive orchard of different cultivars planted at a distance of 5 × 2 m. The cultivars chosen for their low vigor and compact vegetative habitus and/or their high productive aptitude were: Borgiona, Don Carlo, FS17, Gentile di Anghiari, Gentile di Montone, Giulia, Leccio del Corno, Maurino, Moraiolo, Pendolino, Piantone di Falerone and Piantone di Mogliano. The cultivar Arbequina was used as the reference (control). In the period 2022-2023, most of the Italian cultivars showed greater vegetative growth (trunk section and pruned material) with respect to Arbequina, but it is very important to note that it was possible to maintain the crowns of the trees in the space available with selective pruning which thus far has not caused significant vegetative-productive imbalances. The cultivars FS17, Gentile di Anghiari, Leccio del Corno, Maurino and Piantone di Mogliano had a production and production efficiency (calculated on per unit of canopy volume) similar to that of Arbequina, with Leccio del Corno having the highest production and a production efficiency higher than that of Arbequina. Other interesting varieties were Don Carlo and Piantone di Falerone, which gave a slightly lower production. Regarding the quality of the extracted oils, all the Italian cultivars had higher contents of total phenolic substances than Arbequina. Overall, the results showed that several Italian varieties are promising,

having shown similar production behavior to the reference cultivar and high oil quality. Further information is needed for a long-term evaluation of the cultivars considered.

Keywords: high-density plantations, cultivar, olive oil quality, *Olea europaea* L., olive vigor, yield efficiency.

S03-P-VIII-25

Research regarding the influence of the cultivar/rootstock combination on the chemical composition of the fruits of some lesser-known peach genotypes, grown in the pedoclimatic conditions of the western part of Romania

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Peach represents one of the fruit species of great interest, both worldwide and in Romania, as a result of the quality of the fruits and the benefits they have over the human body. The researches carried out are part of a larger study that aimed to follow the behavior of some peach varieties from other countries, when grafted on rootstocks currently used in our country, in order to identify the cultivar/rootstock combinations that are suitable for cultivation in the conditions of the western part of Romania, in the context of climate changes that have left their mark on the growing and fructification of peach trees, in recent years. This paper presents the results obtained regarding the chemical composition of the fruits, more precisely the moisture content, soluble solids content (SSC), pH, mineral content and the total polyphenol content of 11 varieties with known origin and 3 hybrids from all over the world, grafted on cherry plum and Oradea rootstocks, grown in the pedoclimatic conditions of Lugoj Fruit Tree Nursery, in Timiș county. The moisture content varies between 81.65% for “Tokinostate” variety, grafted on cherry plum and 92.85% for “Piros Magdalena” variety, grafted on Oradea rootstock. The soluble solids content varies between 11.07 %Brix in the case of “Maria Delicia” variety, when grafted on Oradea, and 19.19 %Brix in the case of “Elbertina” variety, when grafted on cherry plum. The pH value varied between 4.11 for the “DR32-15” hybrid and 5.66 for the “Tebana” variety, both grafted on Oradea rootstock. The mineral content in the analyzed varieties is minimum for “Tokinostate” variety, grafted on Oradea, with a value of 0.156%, and maximum for the hybrid “DR 32-15”, grafted on Oradea rootstock, with a value of 1.538%.

Keywords: peach, variety, rootstock, soluble solids, mineral substances

S03-P-VIII-26

Morphological characteristics and fruit quality traits of three non-native plum cultivars grown in Cluj-Napoca

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Plum trees remain one of the most promising species for Romania. According to the latest FAO statistics, Romania was the second biggest producer of plums in 2021 after China, reaching up to 807,170 tons/year. The most important areas for plum production include Argeș, Vâlcea, Olt, Bihor, Sălaj, Dâmbovița and Caraș Severin. Several Romanian varieties were created and are still grown due to their resistance to biotic and abiotic stresses, and fruit quality. The main aim of this research was to investigate some promising plum varieties in order to compare to the currently cultivated one's marketing value. Therefore, in this research, morphological characteristics and various fruit quality traits were investigated in three different non-native plum varieties as follows: *Prunus domestica* 'Königin Victoria', *Prunus domestica* 'Presenta' and *Prunus domestica* 'President'. The selected genotypes revealed significant differences in all the measured characteristics. Fruit length ranged from 31.88 to 59.72 mm; ten-fruit weight from 18.19 to 48.06 g. Leaf length ranged from 9.27 to 11.25 mm; leaf width from 4.87 to 6.04 mm. Fruit weight was positively correlated with fruit length, fruit width, fruit pulp thickness, fruit stalk length, stone length, stone width, stone weight and also with leaf parameters such as leaf length and leaf width. Regarding fruit quality, fruit firmness varied from 1.25 to 2.86 kgf/cm², the total soluble solids' content ranged from 15.20 to 19.30% while the moisture content was the highest in President genotype (82.13%). Titratable acidity varied from 0.60 and 1.01%. The results of principal component (PCA) and multivariate analyses performed with the mean values of all morphological and chemical parameters highlighted interesting relationships and variations among the genotypes.

Keywords: *Prunus domestica*, fruit size; fruit characteristics, soluble solids, skin color

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Evaluation the frost tolerance of new apricot accessions

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Temperate climatic regions suitable for apricot cultivation in Central Europe are characterized by the occurrence of late spring frosts. Apricots are among the commodities sensitive to frost damage, whose damage can have fatal consequences for

fruit production. Therefore, this work deals with the evaluation of the resilience of several apricot cultivars to frost damage in flower buds. Over two years, 26 genotypes were evaluated, among which were 6 commercial cultivars ('Betinka', 'Candela', 'Harcot', 'Harogem', 'Leskora', 'Sophinka') and 20 new selections. Trees were grafted on St Julien A rootstock and planted at a density of 1,000 trees per hectare in Eastern Bohemia (Czech Republic) in 2016. The trees were left without an irrigation system. From each genotype, 15 buds were taken at the ballon bud phenophase BBCH 59 in 3 repetitions evenly from the crown volume. The sampling was preceded by spring frosts, which damage the generative organs of apricots. Air temperatures during the development of flower buds were recorded using a meteorological station. Damage to pistils was evaluated in the laboratory. The degree of damage to generative organs was expressed as a percentage. The date of flowering was recorded for each single tree. Among the commercial cultivars, 'Harogem' and 'Harcot' were the most affected, with 17.43% and 14.10% damage, respectively. Similar damage was observed in 5 genotypes, with the most serious damage in '00-008' (20.63%). Conversely, the least affected were genotypes 'Candela' (2.15%), 'VOJ 5/150' (2.15%), '96-599', and '08-015' both with a damage value of 3.26%. Cultivars 'Leskora' and 'Betinka', which were expected to have high tolerant of generative organs to frost damage, were found to have damage of 5.35% and 7.74%, respectively. These genotypes appeared to be better suited for growing in locations with a risk of spring frost occurrence.

Keywords: *Prunus armeniaca*, spring frost, generative organs, bloom, flower damage

S03-P-VIII-28

Use of biotechnological methods in sweet cherry (*Prunus avium* L.) breeding at the National Institute of Horticultural Research, Skierniewice, Poland

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The aim of sweet cherry breeding program carried out at the Research Institute of Horticulture in Skierniewice, Poland is to obtain new sweet cherry varieties with dessert fruit of high quality and tolerant to cracking. An important objective of breeding work is also obtaining genotypes with early fruit ripening time. A major problem in sweet cherry breeding aimed at obtaining early ripening genotypes is the limited possibility of use varieties with early fruit ripening as mother forms. The fruits of such varieties sometimes ripen even 6-7 weeks after flower pollination, and therefore the embryos contain in fruit do not have enough time to reach full physiological maturity. Immature embryos isolated from fruit are unable to germinate in conditions of traditional stratification. To achieve germination, these embryos have to be cultured in vitro (embryo rescue). Therefore, the research was undertaken to optimize the embryo culture method ensuring the proper development of immature sweet cherry embryos. Moreover, in order to eliminate closely related parental genotypes from the cross combinations and to verify the genetic identity of the best individuals selected from the evaluated seedling populations, the SSR (Simple Sequence Repeats) method is used. The use of SSR markers is recommended due to their uniform occurrence in the genome, high degree of polymorphism and

codominant nature of inheritance. The research was carried out in the frame of subsidy of the Ministry of Agriculture and Rural Development special-purpose – Task 3.10: „Creating of an initial sweet cherry (*Prunus avium* L.) plant materials with dessert fruit of high quality and tolerant to cracking with the use of the embryo rescue technique”.

Keywords: SSR-PCR, in vitro culture, embryo culture, genetic relationships, genetic identification

S03-P-VIII-29

Evaluation the frost tolerance of new plum accessions

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Temperate climate zones ideal for growing plums in Central Europe are distinguished by late spring frosts. Damage to plums from spring frosts is not as catastrophic in Central Europe as it is for plums, partly due to plums flowering later. However, spring frosts can still decimate harvests since the reproductive organs of plums are not immune to frost damage. Consequently, this study assesses the frost resistance of various plum cultivars in their flower buds. Throughout a period of two years, 16 genotypes were scrutinized, including the commercial cultivars ‘Tophit’, ‘Toptaste’, and 13 novel selections. The trees, grafted onto St Julien A rootstock, were set at a plantation density of 1,700 trees per hectare in Eastern Bohemia (Czech Republic) in 2016, without the aid of an irrigation system. For each genotype, 15 buds at the balloon bud stage BBCH 59 were collected in three replicates across the canopy. This collection occurred after spring frosts that afflict the plum’s generative organs. Temperature readings during the bud development phase were captured by a weather station. Pistil damage was analyzed in a lab setting. The extent of damage to the generative organs was quantified in percentage terms. The bloom dates for each tree were documented. Among the tested commercial cultivars, ‘Tophit’ experienced the highest damage at 19.03%. Two other genotypes showed comparable levels of damage, with ‘0600012’ suffering the most at 21.88% and ‘0900134’ (15.56%). In contrast, the genotypes ‘Toptaste’, ‘0900045’, each with damage rates of 0.00%, were the least affected. Such genotypes seem more adaptable to regions prone to spring frosts.

Keywords: *Prunus domestica*, spring frost, generative organs, bloom, flower damage

S03-P-VIII-30

Contributions and perspectives to the promotion of apple varieties with disease resistance in modern cropping systems

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Voinești Research and Development Station for Fruit Growing has a significant contribution to the promotion and expansion in culture of apple varieties with resistance to diseases in modern culture systems, in which batches of apples are obtained, with less polluted fruits, with a positive effect in protecting the environment. The setting in SCDP Voinești of some experimental modules with disease-resistant varieties from abroad or own creations, demonstrates the performance attributes capable of competing in terms of production potential and fruit quality, with classic varieties or those from abroad grown in modern orchards after the year 2000 to private producers, from the Dâmbovița Orchard Pool. The cultivation of disease-resistant apple varieties, in a high-density system, will greatly change the concept of the growers and the gradual replacement of the assortment, which for the new plantations are the rods of the performing economic technology, representing the main factor for the establishment of orchards that produce organic fruits. In the experimental module established in 2009, with the highest production potential recorded in the period 2019 – 2023, the variety that stands out is „Goldrush” with 42,1 t/ha, followed by „Topaz”, „Rubinola” and „Redix” varieties with 36,3 – 39,1 t/ha. Productivity test recorded at full production potential in 7 apple varieties with disease resistance, creations of SCDP Voinești, cultivated at the rate of 2857 trees/ha, nominate as the most productive varieties: „Iris”, „Real”, „Remar”, „Inedit”, „Valery”, „Cezar” and „Brumar”, with productions of 38 - 42 t/ha. The presented disease-resistant apple varieties lend themselves to promotion in modern cropping systems and certainly meet the demands of the producer, sensitive to economic efficiency, with high production potential, with quality fruit that will meet the ever-increasing consumer demands.

Keywords: apple varieties with disease resistance, vigour, productivity, fruit quality.

S03-P-VIII-31

Growth vigour and fruit yield of new sharka-resistant plum (*Prunus domestica* L.) genotypes bred at the National Institute of Horticultural Research in Skierniewice, Poland

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The breeding programme of European plum (*Prunus domestica* L.) at the National Institute of Horticultural Research in Skierniewice began in 1954. The main goal of this programme is currently to obtain new genotypes that will allow further intensification of fruit production through the use of combine harvesters and better adaptation to the climate and soil conditions in Poland. They should produce good quality fruit for fresh consumption and also for processing industries. A very important aim of our plum breeding is also to obtain new varieties resistant to the Plum pox virus. As a result of the recent conducted breeding works 14 hypersensitive (resistant) genotypes were selected: S-4 ('Common Prune' × 'Jojo'), S-14 ('Jojo' × 'Čačanska Rana'), S-24 ('Jojo' × 'Čačanska Rana'), S-39 ('Jojo' × 'Čačanska Rana'), S-48 ('Jojo' × 'Čačanska Rana'), S-72 ('Jojo' × 'Čačanska Rana'), S-77 ('Jojo' × 'Čačanska Rana'), S-84 ('Jojo' × 'Čačanska Rana'), S-100 ('Jojo' × 'Čačanska Rana'), S-107 ('Jojo' × 'Čačanska Rana'), S-109 ('Jojo' ×

'Čačanska Rana'), S-123 ('Jojo' × 'Čačanska Rana'), S-157 ('Jojo' × 'Čačanska Rana') and S-186 ('Jojo' × 'SPJ'). The clones were included in the field trial which was established in the Experimental Orchard in Dąbrowice (central Poland) in autumn 2014. 'Common Prune' and 'Jojo' cultivars were used as a control. The trees of the tested clones and standard cultivars were grafted on generative rootstocks - *Prunus cerasifera* seedlings. The aim of the study was to evaluate the productive value of new above-mentioned clones. The assessment of growth and fruiting of trees was conducted in 2017-2023. Among the assessed genotypes, the trees of clone S-186 yielded the best, similar to the control cultivar 'Jojo' and much better than the control cultivar 'Common Prune'. However, the trees of clone S-186 grew much weaker than trees of both control varieties, therefore the cropping efficiency index, expressed as a ratio of crop weight (kg) and trunk cross-sectional area (cm²), indicated high productivity of this clone. The fruit of S-186 clone ripened earlier than the fruit of control cultivars and had an average weight of 45.9 g. The research was carried out in the frame of subsidy of the Ministry of Agriculture and Rural Development special-purpose – Task 3.9: „Developing of an initial European plum (*Prunus domestica* L.) plant material suitable for combine harvesting of fruit and tolerant to sharka”.

Keywords: European plum, new cultivar, sharka, Plum pox virus

S03-P-VIII-32

Apple elites with disease resistance selected from hybrid combinations made at SCDP Voinești

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The major priorities addressed in the apple improvement program at SCDP Voinești are represented by the obtaining of genotypes with resistance to diseases, from which elites with performance characteristics are selected for the approval of new varieties. The biological material obtained from the hybrid combinations carried out in the years 2004 - 2005, have the Vf resistance gene and resulted from the selection of 3260 apple hybrids, initial breeding material, of great genetic diversity, from which 7 apple elites with resistance to diseases were selected and quality fruits. Maternal and paternal parents were involved in sexual hybridisations, respectively „Florina” variety and the elites selected at SCDP Voinești, H 3/5-90; H 1/53; H 1/12 and H 2/44 with the Vf resistance gene, „Generos” variety tolerant to radish, with the Poly resistance gene and sensitive varieties from the current assortment, „Idared” and „Goldspur”. From the 2004 hybrid combination, „Florina” x „Idared”, the following elites were selected: H 3/37; H 19/6 and H 2/3, with fruits that are on average over 160 - 165g and covered 2/3 of the surface with red and have good taste. H 4/17 elite from the 2004 hybrid series, as well as elites H 4/311 and H 4/38 from the 2005 hybrid series, obtained from the combination „Goldspur” x „Florina”, stands out for its quality fruits that have a biomass of over 165g, yellow in

colour, typical of the variety Golden delicious, with the ripening of winter fruits. H 4/17-04; H 19/6-04 and H 2/3-04 apple elites are registered at ISTIS for being tested for homologation. Disease-resistant apple elites, candidate for varieties, obtained at SCDP Voinești from the hybrid combinations carried out during 2004-2005, meet the producer's requirements, as production potential and quality fruits, demanded more and more by consumers.

Keywords: apple genotypes with disease resistance, vigour, productivity, fruit quality.

S03-P-VIII-33

Romanian pear cultivars' behaviour in the Bucharest area

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In Romania, the pear crop is important, being third after plum and apple in production value. For the economic importance of this crop, great efforts have been made, aiming to improve the cultivars by introducing valuable ones, as well as the results of the breeding programs. The priority objectives in improving the pear assortment remained the cultivars with quality fruits and resistance to the main diseases and pests. The purpose of this study is to present for the 2022-2023 period the behavior of new Romanian genotypes resistant to pear diseases planted in the Experimental Orchard of the Faculty of Horticulture within USAMV Bucharest. The study was conducted on six cultivars: Euras, Cristal, Romcor, Corina, Orizont, Tudor, and three new hybrids. Each cultivar is grafted on two types of rootstocks: quince and frank, the third variant being on its own roots. The paper presents the comparative biometric data for each genotype, respectively: average tree height, type, number, and average length of annual fruiting shoots and trunk cross-sectional area. Estimates of yield and fruit characteristics at the time of harvest are detailed.

Keywords: Euras, Cristal, Romcor, Corina, Orizont, Tudor

S03-P-VIII-34

Study of the influence of apple rootstocks M9-T337 and Supporter 4 Pi 80 on the growth and productivity of Granny Smith cultivar grown in South Bulgaria

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Genetic traits of each cultivar-rootstock combination and their physiological and biochemical interaction with the environment are unique. This requires a continuous process of researching and obtaining comprehensive information about their behavior. With this aim, we studied the influence of the less known in modern apple orchards rootstock 'Supporter 4 Pi 80', compared to the well-known 'M9 T-337' rootstock on the growth and reproductive characteristics of 'Granny Smith' apple cultivar. The trees were planted in the autumn of 2016 at the density of 2380 trees per hectare. They were well

branched (7+) in the nursery and no pruning was applied after planting. During the period 2017 – 2022 the rootstocks 'Supporter 4 Pi 80' and 'M9-T337' demonstrated no significant differences in tree height and canopy volume. There are no significant differences between both rootstocks regarding yield per unit area and crop productivity coefficients with this cultivar. The fruit weight of 'Granny Smith' cultivar was significantly higher when budded on 'M9-T337' in comparison to 'Supporter 4 Pi 80' rootstock. The less known rootstock 'Supporter 4 Pi 80' produces a significantly higher number of suckers than 'M9-T337', which is a great disadvantage. The attack of *Eriosoma lanigerum* at the end of the study was the same in both rootstocks.

Keywords: rootstocks, cultivars, growth, yield, productivity, fruit weight

S03-P-VIII-35

Comparative study on the productivity and quality of the sweet cherry fruits depending on the cultivar and growing conditions in the Republic of Moldova

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World sweet cherry production experienced a notable acceleration in the 1990s, a period marked by the adoption of new cultivars grafted on low- and medium-vigor vegetative rootstocks by fruit producers. The integration of these cultivars, coupled with advancements in tree management and pruning systems, contributed to a substantial increase in the number of cherry trees within plantations. This resulted in orchards that were both more productive and profitable, which also significantly reduced the workload, particularly in the fruit harvesting segment. The traditional practice of harvesting fruits from trees exceeding 4 meters in height using ladders became obsolete. Instead, innovative tree management systems emerged, enabling the harvesting of cherries from ground level without the need for ladders. This shift not only enhanced efficiency but also marked a fundamental change in the approach to cherry cultivation, emphasizing increased accessibility and ease of harvesting. Sweet cherry cultivation in the Republic of Moldova adopted modern technologies in the early 21st century, incorporating small and medium-vigor rootstocks from the Maxma and Gisela groups, along with a diverse array of approved varieties. This strategic approach aligned Moldovan sweet cherry plantations with the methodologies employed in the most modern orchards found in countries with well-developed fruit cultivation practices. Introducing a broader assortment of sweet cherry varieties positively impacted fruit producers by expanding the harvesting timeline and aligning products with current market demands. The purpose of this study was to evaluate the growth and fruiting parameters of the new sweet cherry varieties cultivated in the pedo-climatic conditions of the central fruit-growing area of the Republic of Moldova. For the analysis of the growth and fruiting characteristics of the new sweet cherry varieties under the conditions of the Republic of Moldova, 6 sweet cherry varieties were selected for study in the central pedo-climatic zone: SWEET ARYANA®, SWEET LORENZ®, SWEET GABRIEL®, CARMEN, GRACE STAR®, SWEET VALINA® and as a control option the variety KORDIA. The study's findings recommend fruit producers in the central region of the Republic of Moldova to use highly productive varieties from the Sweet group, namely Sweet Lorenz and Sweet Gabriel,

which demonstrated both early and high-quality productivity, leading to increased market value. The use of these varieties is advised for achieving a high profitability level of the sweet cherry production within the region.

Keywords: sweet cherry, rootstock, crown shape, climatic conditions, productivity, quality, economic efficiency.

S03-P-VIII-36

Variability of morphological characteristics in fruits of *Prunus spinosa* depending on environmental factors

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Morphological characteristics of fruits in some blackthorn (*Prunus spinosa* L.) genotypes were evaluated over three calendar years. The genotypes studied come from spontaneous flora of southern area of Romania, in Calopar and Gura Văii populations. Fruit volume, weight and dimensions, shape and size index were determined. Fruit weight and pulp percent ranged from 1.72 g (Gura Văii) to 2.16 g (Calopăr) and from 83.28% (Gura Văii) to 86.21% (Calopăr), respectively. The fruit dimensions varied by genotype and climatic year, the fruit height between 9.96 mm and 16.60 mm, the large diameter between 9.62 mm and 17.09 mm, while the small diameter varied between 10.85 mm and 16.87 mm. The current study shows that there is great variability from one year to the next in terms of fruit characteristics between blackthorn genotypes, an important variability for the selection of genotypes which are important in terms of fruit production and food value.

Keywords: blackthorn, environment, fruit, variability

S03-P-VIII-38

Increase of apple fruit phenol content in ARD soils depends on rootstock genotype

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In the frame of EUFRIN apple rootstock trials, seven apple rootstocks are being tested for their resistance to ARD (apple replant disease) in several European countries.

Current paper focus on the rootstock and soil type (ARD vs. fresh soil) effect on the accumulation of phenolic compounds in apple fruit. This research was performed at the Lithuanian trial site. Accumulation of phenolics compounds in fruit tissues was enhanced at replant soil. On the average of all rootstocks, total phenol content in fruit flesh increased by 25%, and in fruit peel by 31%. Hyperoside and rutin in fruit flesh and hyperoside, reynoutrin, phloridzin and procyanidin C1 were the most variable among detected phenolic compounds and their content in fruits from ARD soil was by 50 – 77 % higher than in fruits from the fresh soil. Content of (-) epicatechin in fruit flesh and (+) catechin and procyanidin B1 in fruit peel was similar in both ARD and fresh soil. Rootstock had a significant effect on the accumulation of phenolic compounds, but this effect was modified by soil conditions. Soil type had no effect on total phenol accumulation in fruits (flesh and peel) grown on Pajam 2 rootstock. Also, a stable phenol content in fruit flesh was on G.11 and M200 rootstocks, and in fruit peel on G.41. The highest increase of total phenol content at replant conditions was recorded on B.10 (by 66% in flesh and 60% in peel) and on G.935 (by 68% in flesh and 47% in peel) rootstocks.

Keywords: apple replant disease, *Malus x domestica*, rootstock, fruit quality, bioactive substances.

S03-P-VIII-39

Advantages of orchard systems for perspective cultivar candidates in the Nordic climate

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Performance of cultivars 'Alesya', 'Felicita', 'Lora', cultivar candidates DI 3-90-45, DI-93-4-22, and Nr. 28-97-4 was tested in four orchard systems, where the canopies were trained as an adapted slender spindle and two-axe trees on rootstock B.396, and UFO and flat pyramidal canopy with at least one pair of scaffolds on rootstock MM 106. The effect on the start of fruit-bearing was observed for each type of canopy in the sixth year, and training systems: slender spindle, two-axes, and UFO allowed to obtain comparable 4-year cumulative yield. The highest average productivity was obtained for slender spindle, while within UFO and two-axes, the data was comparable. The orchard systems had a different rate of filling the assigned area, at the same time productivity of slender spindle, 2-axis and UFO was not statistically different sixth season. In the seventh season, statistically comparable results were observed between slender spindle and UFO orchard systems. In all orchard systems most productive was 'Lora'. In UFO and two-axes systems trees had comparable yielding. Parametric and non-parametric data multiple regression analysis allowed us to observe trends of orchard systems' influence on productivity. Anyway, it is impossible to predict the capacity of orchard systems until the full production period.

Keywords: *Malus domestica*, scab resistant, productivity, orchard models

S03-P-VIII-40

Research regarding early, vegetative and generative development features of 'Tamara' sweet cherry cultivar on 'GiSelA 3' and 'GiSelA 5' rootstocks in irrigated mollic eutricambosoil in Northern Transylvania, Romania

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The growth responses of the 'Tamara' sweet cherry cultivar (*Prunus avium* L.) grafted on 'GiSelA 5' and 'GiSelA 3' rootstocks were evaluated under drip irrigation conditions in Bistriţa Fruit Region, in Northern Transylvania, Romania, during 2020-2021. The research was conducted in a high-density field trial with trees trained as spindle bush having a density of 1250 trees per hectare. The study assessed various parameters including trunk cross-section area, volume of the tree crown, leaf area, length of shoots, number of shoots, height of trees, leaf area/fruit, crop load, yield, number of fruits/tree, average fruit size and main quality characteristics of the fruits. The preliminary data showed that trees grafted on 'GiSelA 5' compared with those grafted on 'GiSelA 3' to be more vigorous when considering trunk cross-sectional area and canopy volume indicators. Both rootstock combinations produced a high number of fruits per tree, with the 'Tamara' cultivar having medium to large sized fruit. In order to achieve a good fruit size, different pruning treatments must be required to regulate crop load of 'Tamara' cherries on GiSelA rootstocks. Drip irrigation had a crucial influence on the vegetative development of the trees, especially during critical summer drought, by meeting the physiological needs of plants.

Keywords: sweet cherry, rootstock, scion, training system, drip irrigation