XIII 2025 ORCHARD SYSTEMS

POSTER ABSTRACTS

Genotype main effect contribution to bud break and vegetative growth characteristics of young apple (*Malus x domestica* Borkh.) trees in response to diverse environmental conditions in South Africa

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The lack of winter chilling and variable growing conditions in South Africa, compounded by anticipated climate change effects, led to the investigation of Genotype-by-Environment Interaction (GEI) of ten apple genotypes with varying chilling requirements planted in a multi-environment trial (MET). Data on bud break and vegetative growth characteristics were collected from trees planted in three distinct growing regions with variable winter chilling levels (679–1500 PCU) during the first two growing seasons after planting in 2019. Trees were stored in a commercial cold room before planting so that their chilling was satisfied. Combined analysis of variance (ANOVA) revealed the considerable contribution of the Genotype main effect (G) on distinct bud break and vegetative growth traits. This contribution was observed to be more substantial compared to the variance ascribed to the Environment main effect (E) and the GEI. Lower contribution of the environment and the interaction to the variability indicates that the response of the genotypes to different growing conditions was relatively consistent, with environmental differences having a smaller overall effect on timing, amount, and distribution of bud break as well as leader growth after planting. The genotype also contributed substantially to the date of bud break, long shoot distribution and leader growth during the second growing season. This study aims to describe bud break and vegetative growth characteristics within the broader context of adaptation to varied growing conditions in South Africa. Furthermore, it lays the groundwork for subsequent investigations into the genotypic variations underlying the ontogeny of apple trees.

Genotype x environment interaction, adaptability, dormancy, chilling requirements, tree architecture, phenotypic variation

Use of anti-hail nets for maintaining quality and productivity of apple fruits in the Catarinense Plateau Serra in Southern Brazil

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The occurrence of hail in the apple-producing region of Southern Brazil has become more frequent. This study aimed to quantitatively and qualitatively investigate the impact of anti-hail net colour on the development and productive yield of apple trees. The research was conducted on the 'Gala' and 'Fuji' cultivars in an orchard located in São Joaquim state of Santa Catarina in Brazil, over the production cycles of 2022/23 and 2023/24. Anti-hail nets made of polyethylene monofilament were used, with the following colours: yellow, blue, red, pearl, clear, grey, and black. Field measurements of tree vigour, return bloom, productive performance, photosynthetically active radiation, and light spectra were completed. Fruit samples were collected to assess maturity, size and skin colour. In 'Gala', the red net increased yield by 29.8 % compared to the clear net. For yield efficiency, the red net was the highest of all, with 2.01 kg/cm^2 TCSA (trunk cross-sectional area). The pearl net produced a flesh firmness of 82.9 N, while flesh firmness under the yellow net was 71.6 N. For soluble solids content (SSC), the clear net increased SSC (12.1 °Bx) compared to the grey net (10.9 °Bx). In 'Fuji', the grey net resulted in the highest productivity, compared to the others, reaching 86.3 t ha^{-1}. In contrast, fruit under the blue net had the highest flesh firmness amongst the treatments (69.3 N). In both cultivars, the clear net resulted in fruit with a higher intensity of red colour, especially compared to the black net. These findings highlight the importance of selecting the colour of anti-hail protection nets and considering their impact on fruit development and quality.

Malus domestica Borkh, fruit coloration, photomorphogenesis, light dissipation

Ecophysiological performance of a new orchard agroecosystem aimed at increasing the resilience of fruit farms

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Due to climate change, conventional orchards are increasingly threatened by abiotic and biotic stressors. Therefore, new cultivation approaches are required to increase the resilience of farming systems. The DREAM project proposes a new approach, with the aim to improve small farms' resilience, promote biodiversity and economic stability. This agroecosystem is characterised by the following basic principles, which go beyond conventional systems: i) a multi-variety orchard, with different phenologies and exploiting a range of genetic resistances to biotic and abiotic stressors; ii) consociation with cover crops, able to prolong blooming and increase soil nutritional and water status; iii) adoption of Regulated Deficit Irrigation (RDI) protocols aimed at increasing water use efficiency (WUE). The DREAM orchard was planted in 2023 and included 9 different cultivars, including 'Pink Lady' as a reference. At the same time, a control conventional 'Pink Lady' orchard was planted nearby and managed according to conventional practices. During the second year, both in the control and in the DREAM orchard, RDI was also applied to a subset of trees for each variety, with a 50% ETc reduction in water supply for about one month during the cell expansion stage. During the two seasons, treatments were compared for: i) vegetative growth; ii) leaf gas exchanges and iii) midday stem and leaf water potentials. Results showed how varieties from the DREAM system presented a wide variability in terms of vegetative growth and ecophysiological performance. However, no clear-cut differences were detected between the two systems. We suggest that possible competition with cover crops did not significantly compromise the ecophysiological performance of trees for all cultivars. In addition, RDI affected the vegetative growth of only some varieties, thus providing interesting suggestions on the most tolerant varieties to drought stress. However, further measurements are needed to assess the effect of the RDI on the production of the different cultivars.

Apple, cover crops, leaf gas exchange, water use efficiency, water potential

Maximising cherry quality and yield: the effect of light transmission in narrow-row planar cordon canopies

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The growing system in many perennial fruit crops has an important effect on light transmission within canopies. This study examines how light transmission through planar cordon cherry tree canopies affects yield and fruit quality. This growing system uses reduced inter-row spacing and two-dimensional planar architecture to enhance light distribution and increase overall light interception, aiming to increase fruiting potential and fruit quality. Eight-year-old 'Sweetheart' cherry trees, trained as planar cordons and spaced at either 1.5 m or 2 m between rows, were used to study the effects of the light environment within canopies during the 2020/2021 season. As the canopy developed, light transmission decreased rapidly early in the season and then stabilised. Throughout the growing season, there tended to be a greater average daily light integral (DLI) in 2 m row spacings, significantly so in the later season when the canopy was fully developed. Light transmission was greatest in the upper canopy positions and least in the lower positions, particularly in the late season. The study also evaluated how the light environment affects fruit set and quality. Greater DLI associated with canopy position positively influenced yield, fruit soluble solids content (SSC), fruit set and leaf area, while slightly negatively affecting fruit diameter. A correlation matrix revealed that early-season DLI had the most substantial effect on yield, and mid-season DLI had the greatest influence on SSC. The findings suggest that optimising light penetration during the early and mid-season is crucial for achieving the best orchard outcomes for sweet cherries. These results highlight the potential benefits of adopting new planting systems with reduced row spacing compared with traditional planting systems, and planar architecture to improve light distribution, thereby enhancing fruit quality and yield throughout the canopy.

Prunus avium, sweet cherry, two-dimensional trees

Effects of salicylic acid, abscisic acid, and methyl jasmonate on heat and drought stress in sweet cherry cultivars ‘Santina’ and ‘Regina’

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Global warming conditions are increasing temperatures and decreasing the water availability for fruit crops. Sweet cherry is the largest export fruit crop from Chile and is suffering productivity problems due to the extreme summer conditions. This research aimed to investigate the impact of different concentrations of salicylic acid (SA), abscisic acid (ABA), and methyl jasmonate (MJ), applied under controlled conditions at two temperatures (25°C and 35°C) and two water regimes (100% and 40% of requirement) in the sweet cherry cultivars ‘Santina’ and ‘Regina’. Physiological parameters and normalised difference vegetation index (NDVI) were assessed. Under conditions of 35°C and 40% water application, assimilation rate (An), transpiration (E), and conductance (gs) decreased between 21 and 65%, water use efficiency (WUEi) decreased between 30–52%, and xylem water potential (Ψx) increased between 46 and 50%. ABA applications decreased the An, gs, E and Ψx between 41 and 91%, while WUEi improved between 50 and 70% compared to the control. SA increased An by 52% and improved the rates of gs, E, and Ψx compared to ABA. A similar trend was observed with MJ, improving physiological parameters compared to ABA except for WUEi. NDVI was not affected by temperature, water regime or plant growth regulator (PGR) application. This study highlights the potential of ABA to mitigate the negative effects of heat and drought stress in sweet cherry and shows the effect of SA and MJ as tools to balance stress mitigation and plant function. Further research is needed to determine the optimal concentrations and timing of PGR application for different cherry cultivars under environmental stress.

Heat stress, plant growth regulators, assimilation, transpiration, water use efficiency

The comparison of sugar distribution within the apple tree canopy in response to production system

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Sugars are the product of primary metabolism, and their concentrations influence nearly all processes in plants including growth, development of vegetative and reproductive organs, precursors for aroma compounds, responses to all kinds of biotic and abiotic stresses, and the synthesis of pigments. We compared the sugar profile of leaves from different shoot types and canopy positions of 'Golden Delicious Reinders', and 'Granny Smith' apples, growing in two plots with or without irrigation and anti-hail net. Yield in the plot with irrigation and hail net was 57 t ha^{-1} for 'Granny Smith' and 68 t ha^{-1} for 'Golden Delicious', while in the plot without irrigation and hail net, it was 31 t ha^{-1} and 33 t ha^{-1}, respectively. Leaves from the top of the canopy of both cultivars had a higher concentration of glucose, sorbitol and stress-signalling sugars than leaves from the bottom of the tree, regardless of the irrigation/hail net plot. The concentration of fructose and sucrose varied by cultivar and the presence of irrigation/hail net. Sorbitol concentration was similar in leaves from all shoots, cultivars, and regardless of the irrigation/hail net. Glucose concentration was highest in the leaves of bourse shoots from both cultivars regardless of the irrigation/hail net. Bourse shoots had the greatest concentration of fructose when grown under irrigation/hail net for both cultivars but was greatest in long branches without fruit without irrigation/hail net. Sucrose content was the greatest in long shoots without fruit when cultivars were grown with net and irrigation, while was cultivar dependent without net and irrigation. The concentration of stress sugars varied by cultivar, shoot type and production system. The results of this study can be used to adjust pruning, yield planning and fruit quality control.

Leaf, fruiting shoots, stress, Malus domestica, glucose, fructose, sucrose, sorbitol, arabinose, raffinose, trehalose and rhamnose

Canopy-cooling systems applied on avocado trees to mitigate heatwave damage

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With climate change, spring heatwaves have become frequent in the Mediterranean region. High temperatures combined with wind and low humidity are problematic for subtropical crops adapted to high humidity and mild climate. Avocado is a valuable crop – nutritionally and economically – and many new orchards are planted in Mediterranean areas. Spring heatwaves increase avocado fruitlet drop, severely decreasing yields. Addressing and solving this problem is necessary to maintain the crop's profitability. This study presents a sprinkler-based canopy cooling method that uses the existing pressurised irrigation system. The study aimed to test the system's performance during spring heatwaves after the flowering season in avocado orchards cultivated in a semi-arid region. The experiments examined the effect of various sprinkler types with varying flow rates and installation methods: sprayers, sprinklers and pulsing sprinklers, on foliage temperature, stem water potential, salt accumulation in the leaf, fruitlet survival and fruit yield. The system reduced leaf temperatures by approximately 10°C, significantly decreasing the trees' drought stress and increasing yields by 8–12%. Using low-quality water is possible but requires adjustments to avoid salt damage to the leaves. The system can mitigate heat stress and provides a relatively simple solution for handling spring heatwaves. The evaporative cooling system is modelled for semi-desert and desert conditions; a dry, windy climate contributes to the method's effectiveness.

Climate change, evaporative cooling, heatwave, heat stress

Using hyperspectral remotely imaging technology for characterisation of high-density hedgerow olive orchards

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High-density hedgerow orchards are the most widespread growing system for olives in recent years due to the advantages of early crop and harvesting mechanisation. Most of these new orchards were initially established under irrigated conditions, although more recently, rainfed plantations have been also developed under this system in the context of climate change and water limitations. Due to the novelty of this growing system, there is a need to identify the most adapted cultivars under both irrigated and rainfed conditions. In 2020, two comparative trials were established in Cabra (Cordoba, Spain), both under deficit irrigation and rainfed conditions, including the most widely planted cultivars for this system until now: 'Arbequina', 'Arbosana', 'Koroneiki', and 'Sikitita'. The primary objective was to evaluate and compare the vegetative and reproductive development of each cultivar to determine their adaptability to the environmental conditions of the trials. The plantation was monitored using remote sensing technologies with an uncrewed aerial vehicle (UAV) equipped with different spectral range sensors. Among the sensors employed, this study presents the results obtained in the summer of 2022 using a hyperspectral sensor with a spectral resolution of 274 spectral bands within the 400 to 1000 nm range. Differential spectral signatures were observed both according to irrigation treatment and cultivar, mainly due to the visible range of the spectra, particularly for 'Arbosana'. Partial least squares (PLS) models allowed accurate prediction for canopy volume, and interesting results for other traits such as nitrogen concentration in leaves, fruit moisture and yield of the coming harvesting season. These results demonstrate the feasibility of using a hyperspectral sensor on-board UAV to obtain information on high-density hedgerow orchard characterisation, which could be particularly useful for high-throughput phenotyping in olive breeding programs, among other agronomical objectives.

Remote sensing, 3D models, phenotyping, digitalisation, Olea europaea

An analysis of three methods to adjust fertilisation of walnut (*Juglans regia* L.) orchards in Southwestern France

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To date, three principal methods are used to evaluate tree mineral composition in commercial walnut orchards and manage mineral inputs in southwestern France. These methods are (1) soil analysis, which aims to lead growers in their general orchard fertilisation management and is used to correct soil quality over several years, (2) leaf analysis, which helps growers quantify the mineral content at a specific point in time (from the leaf initiation to the leaf sample), and (3) sap analysis which could be applied to individual leaves and help growers to identify mineral deficiency for rapid correction by foliar fertiliser application. This work aimed to evaluate the synergies and the differences between these three methods and evaluate the complementarity or redundancy of leaf and sap analyses. This evaluation was undertaken in four walnut orchards in southwestern France in 2024. Five phenological stages were chosen to compare these methods: flowering, fruit development, kernel growth, fruit ripening, and post-harvest. For each method, the dynamics of mineral concentration over the growing season were plotted and compared. The nitrogen dynamic between flowering and fruit growth seemed similar between leaf and sap analysis with a decrease of 22% of N observed in leaf analysis and 67% in sap analysis. During the same time, a slight increase in soil nitrogen content of 12%, from 1.15 g kg^{-1} to 1.29 g kg^{-1} was observed. The potassium decreased by 58% and 59% respectively in leaf analysis and sap analysis and was stable in soil analysis (3% variation) between flowering and fruit growth. As a last example, magnesium increased by 35% and 34% for leaf analysis and sap analysis between flowering and fruit growth and was stable in soil analysis (2%). Data will continue to be collected throughout 2024 and will be consolidated for presentation.

Sap analysis, leaf analysis, soil analysis, orchard management, mineral inputs, mineral uptake

Biostimulants for colour enhancement of apple (*Malus domestica* Borkh.) cv. 'Idared'

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Improving the colouration of apple fruit is crucial for consumer acceptance. However, factors such as the increasing use of hail nets, limited sunlight and warm autumn temperatures often lead to below-average colouration, especially in late-ripening apple varieties. This research investigated how different biostimulants can improve fruit quality, with a focus on fruit colouration, firmness and sugar content. The effects of different biostimulants on fruit quality, including colour parameters, soluble solids content and firmness, were investigated in a commercial orchard in Bistrica ob Sotli (Slovenia) using the 'Idared' cultivar. In the trial, five treatments were carried out: 1) treatment of the trees with ChromaFruit (Stoller, USA) 6 L ha^{-1},17 and 10 days before harvest 2) treatment of the trees with Phostrade Ca (Rovensa Next, Spain) 5 L ha^{-1}, 10 days before harvest 3) treatment of the trees with Biimore (Rovensa Next, Spain) 0.2 L ha^{-1},10 days before harvest 4) trees treated with Plonvit® PK 49:12 (Intermag, Poland) 5 L ha^{-1} + Mikrochelat Zn-15 (Intermag, Poland) 0.5 L ha^{-1} ,17 and 10 days before harvest and 5) control trees that were not treated with biostimulants. The treatments had a significant effect on fruit height and width. The control fruit had a greater height than the ChromaFruit-treated fruit, while the width was greater in the control fruit than in the Biimore-treated fruit. However, no statistically significant differences in fruit weight were observed between the treatments. The treatment with all four biostimulants had a positive effect on fruit firmness, while the control fruits were less firm. In addition, the fruits treated with Plonvit® PK 49:12 + Mikrochelat Zn-15 had a lower soluble solids content compared to the control fruits. Furthermore, no significant differences were found between the treatments in the colour parameters (a*, b* and C*).

Fruit colouring, soluble solids content, firmness

Effect of crop load on yield, fruit growth, and fruit quality of soursop (*Annona muricata* L.) in Taiwan

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To establish the cultivation technology of soursop in Taiwan, this study explored the effect of the crop load on soursop yield, fruit growth and quality from 2021 to 2023. Both winter and summer fruit were assessed each season. Crop loads were set at 10, 20, and 30 fruits per tree, taking care to select trees with similar trunk-cross-section areas (TCSA). The results showed that the crop load did not affect the time of fruit development or fruit quality, but did influence the fruit drop rate of winter fruit and the yield for both winter and summer fruit. For winter fruit, the higher the crop load, the higher the fruit drop rate. The fruit drop rate of the 10- and 20-fruit crop loads were 6.7% and 9.5%, respectively, but the 30-fruit crop load could reach 31.9%. However, there was no difference in the yield between the 20- and the 30-fruit crop loads, with harvests of over 50 kg per tree. The yield for the 10-fruit crop load was significantly lower at only 27.6 kg per tree. For summer fruit, the fruit drop rate was not affected by crop load, but it was generally higher than winter fruits, averaging from 42.4% to 56.2%. This was likely due to the sink-source relationships between the fruit development and shoot growth periods in spring. The yield of the 20- and 30-fruit crop loads were 28.8 and 30.1 kg per tree for summer fruit, which were significantly higher than the 10-fruit crop load. It is recommended that the crop load of soursop in Taiwan should be controlled between 20 to 30 fruit per tree to achieve greater yield, with a yield efficiency between 0.10 to 0.12 kg cm^{-2} of TCSA.

Sink-source interaction, fruit drop, yield efficiency

What determines tree vigour? A multi-environment exploration of genotype, environment and G x E interactions in apple, Japanese plum, and sweet cherry

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Tree vigour, encompassing both tree health and growth capacity, is a critical yet loosely defined botanical concept. This study aimed to develop a quantitative definition of tree vigour and explore the relative contributions of genotype (G), environment (E), and their interaction (GxE) for apple, Japanese plum and sweet cherry trees. A multi-environment trial (MET) was established in climatically contrasting zones within the Western Cape, South Africa to create a gradient of microclimates with varying heat accumulation. The genetic component involved ten genotypes for each species, each selected for diverse chill requirements (apple and cherry) or flowering times (plum) and grafted onto a common rootstock. Trees were stored in a commercial cold room before planting to ensure sufficient chilling. During the first growing season, correlation analysis, combined analysis of variance (ANOVA) and multivariate techniques were employed to elucidate traits commonly associated with vigour, including apical and lateral shoot growth and radial growth (Trunk cross-sectional area; TCSA). Plums exhibited the most substantial growth overall, exceeding apples by a factor of three, and cherries by a factor of five. Apical growth was most associated with the *Prunus* genus, particularly cherries. Conversely, TCSA proved a useful metric to describe total shoot growth for apples and cherries, but not for plums. Analysis of phenotypic variation showed that the influence of genotype and environment varied across the different species. For plums and cherries, genotype exerted the greatest influence in shaping traits associated with vigour whereas for apples, environmental factors played a primary role in influencing vigour. In fact, apples exhibited a clear linear relationship with total growth and increasing heat, while the correlation was less evident for cherries and plums. This research aims to establish a new, data-driven understanding of tree vigour and its influencing factors, benefiting breeding programs and orchard management.

Multivariate analysis, phenotypic variation, deciduous fruit tree growth, climatic influences on growth

Mitigating low chill accumulation in different pistachio cultivars by winter oil application

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Pistachio trees are best grown in regions with hot, dry summers and cool winters. Winter chill requirement for successful and uniform bud burst in pistachios varies from about 48 to 70 dynamic chill portions, depending on the cultivar, making it the most critical climatic determinant of agronomic success. Apart from the major growing areas of Iran and the US, pistachio is an important nut crop in some Mediterranean countries such as Greece, Italy, Spain, Tunisia and Turkey. In many regions of these countries, pistachio growing is limited by lack of sufficient chill resulting in delayed or complete absence of bud burst, and heterogenous leafing and blooming. This causes synchronisation issues between female and male cultivars and shortens the active growing period during spring-summer, which is crucial for new shoot and bud formation for the following season, therefore significantly limiting yield potential. Low chill accumulation can be partially mitigated through winter oil applications, which are routinely performed in some growing regions and certain cultivars, such as 'Sirora' in most Australian farms or 'Kerman' in California. However, this practice is not widespread in mediterranean conditions. In this study, the efficacy of winter oil application to homogenise bud burst was evaluated in a field trial in southern Spain, using cultivars 'Aegina', 'Larnaka', 'Kerman' and 'Sirora'. Winter oil treatment was applied at the end of winter to individual branches in several trees at 6% concentration at 0.4 L/m^2 water volume, with control branches in the same trees. Results show oil application was highly effective, especially for cultivars with medium or high chill requirements ('Kerman' and 'Sirora') where blooming and leafing began significantly earlier and was more homogeneous compared to the control branches. Additionally, budburst advance in treated branches did not promote a similar effect in other parts of the tree.

Pistacia vera, low chill, chill requirement, varieties, warm winters

Nitrogen and phosphorus fertilisation of first-year pistachio trees

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Nitrogen and phosphorus fertilisation rates for non-bearing pistachio trees have not been experimentally determined in California. Nitrogen is of particular interest due to the negative impacts of nitrate once it leaves farmland and enters surface water or groundwater. Two fertilisation trials were conducted in the Central Valley of California in a pistachio orchard in the first year after planting. The nitrogen trial examined the effects of 21, 28, 57, or 113 g of nitrogen per tree in the form of urea. No phosphorus was supplied to these trees. The fertiliser was split into multiple applications from April through mid-August. In the second trial, 0, 37 or 74 g of phosphorus in the form of triple superphosphate were supplied to each tree within two weeks of planting. Each tree that received phosphorus fertiliser was given 57 g of nitrogen per tree. Trees receiving 21 g of nitrogen per tree grew as much as trees receiving higher rates of nitrogen. Phosphorus fertiliser did not increase tree growth, but a regression analysis showed that phosphorus fertiliser increased the phosphorus content of leaves. This research suggests that newly planted pistachios require low rates of nitrogen fertiliser and do not benefit from phosphorus fertiliser.

Fertiliser, tree establishment, leaf nutrient content, growth

Integrated weed management strategies in apple and pear orchards: effects on weed composition, fruit, soil, fauna, fungal pathogens and economics

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Conventional chemical weed management in Belgian apple and pear orchards is under increasing pressure, as several key herbicides have lost their authorisation status in recent years. Hence, future weed management strategies would benefit from an integrated approach. The research presented here compares the direct (competition for water and nutrients) and indirect (fauna and pathogenic fungi) effects on tree and fruit associated with weed presence and techniques used in both standard and novel weed management strategies in 'Golden' apple and 'Conference' pear orchards. These strategies include untreated control, conventional chemical weed management, conventional organic weed management and various combinations of mechanical-physical (wire mower, hot air) and/or reduced chemical management. Also, treatment effects on weed flora composition and economic feasibility are compared in this 2-year study. Direct effects of increased weed presence (after flowering) associated with the different treatments were minimal. Under weather conditions that favour weed growth (no lack of moisture in the upper 10 cm soil layer and average daily air temperature above 15°C) weed control strategies that solely rely on non-chemical methods cannot keep the weed coverage under control for more than 4 weeks, which is a several times shorter period than that achieved under conventional chemical weed control. Careful consideration should be given to the adoption of non-chemical management or physical-reduced chemical management, as these approaches are associated with nearly three times the time requirement and thus cost, an unintended build-up of perennial weeds and possible negative effects on beneficial fauna.

Conference, economic cost, Golden, herbicides, conventional weed control, mechanical weed management, soil moisture

A facility cultivation system for mango fruit in Taiwan

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Mango (*Mangifera indica* L.) is a popular tropical fruit worldwide and is Taiwan's greatest cultivated fruit tree. It requires a dry and low temperature environment during winter to stimulate inflorescence development. However, as the climate changes, intense cold weather in winter and sudden rainfall in spring occur more frequently, which causes severe drop of flowers or young fruit. In addition, continuous rain in early summer can also increase diseases including anthracnose and stem rot before harvest. In recent years, with the increasing demand for mango exports, the question of how to maintain stable production of high-quality quality fruits has become an essential issue. In this research, we constructed covered cultivation facilities with a plastic membrane roof on the open-air orchards of the mango cultivar 'Irwin'. The result showed that the trees cultivated inside the facility had greater fruit set (80%) and lower anthracnose infection (7%) than those in the open-air environment (21% and 37%, respectively). The membrane cover effectively blocked out pests such as brown mango leafhopper (*Idioscopus niveosparsus* Leth), mango shoot borer (*Chlumetia transversa* Walker), and oriental fruit fly (*Bactrocera dorsalis* Headel), while maintaining good ventilation. However, the colour change of mango fruit inside the facility was poorer than those cultivated in the open air, which suggests additional light may be needed. Covered orchard cultivation can reduce the main costs of production (fertilisers, pesticides and labour), by up to 44.6–48.4% compared to that in the open-air orchards. Nevertheless, improved harvest and fruit quality help create profits up to about US$14,200 per hectare. Thus, facility cultivation is a commercially feasible production system to improve the stability of production and quality of mango.

Tropical fruit, climate change, orchard management, fruit quality, cost management

Evaluation of efficiency of pollinisers for five apple cultivars in Western Norway

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The apple (*Malus domestica* L.) is the most prominent fruit species in Norwegian fruit production. Norwegian apple production is affected by climatic constraints, different flowering times, the need for better-adapted cultivars, and suitable pollen donors for cultivars that can be grown in Western Norway. In this study, different reproductive parameters were investigated in five apple cultivars: 'Discovery', 'Rubinstep', 'Red Aroma', 'Elstar', and 'Asfari'. The parameters included *in vitro* pollen germination, the progamic phase of fertilisation (up to ten days after pollination), and fruit set. The cultivars were artificially pollinated using different pollinisers, such as 'Dolgo', 'Summerred', 'Katja', 'Red Aroma', 'Discovery', 'Rubinstep', 'Asfari', 'Professor Sprenger', 'Fryd', and 'Eden', as well as self- and open pollination. The investigations of the reproduction parameters indicated different adaptability of the recipient and donor cultivars to the specific ecological conditions in Western Norway. On average, the lowest in vitro pollen germination was found in 'Summerred' (35.5 %) and the highest in 'Fryd' (87.8 %) for all cultivars studied. Our investigations showed that 'Asfari' had the highest number of pollen tubes (60–100) in the upper third of styles when cross-pollinated with 'Fryd' and 'Eden', and 'Discovery' when pollinated with 'Red Aroma'. In addition, 'Asfari' showed the highest average number of pollen tubes in the ovaries when pollinated with 'Professor Sprenger', 'Fryd', and 'Eden', which was between 10 and 15. Ten days after pollination, the apple cultivars 'Discovery', 'Red Aroma', and 'Asfari' showed complete penetration of the pistil by the pollen tubes in the ovary locules for all pollination combinations, except self-pollination. When used as a pollen recipient, the cultivar 'Red Aroma' displayed the highest average fruit set (36.1%) across all pollination combinations, while 'Elstar' showed the lowest fruit set (12.4%). The combination 'Red Aroma' x 'Discovery' resulted in the highest fruit set (58.3%), while 'Discovery' x self-pollination resulted in the lowest fruit set (2.4%). The research findings provide valuable insights into the efficiency of pollinisers and their role in increasing the yields of the five apple cultivars studied under the climatic conditions of Western Norway.

Pollination, pollen germination, pollen tube growth, fruit set

Salicylic acid, abscisic acid and methyl jasmonate application and summer stress mitigation in sweet cherry cv. 'Sweetheart'

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This study investigates stress responses in sweet cherries, focusing on the impact of drought stress, during Chilean summer conditions, on photosynthesis and plant water status. Specifically, the research assesses the efficacy of salicylic acid, abscisic acid and methyl jasmonate applications in alleviating plant stress, enhancing water status, and improving photosynthetic activity. The presentation highlights the significant implications of the findings, demonstrating how salicylic acid treatments can effectively attenuate summer stress in sweet cherries. The study provides valuable insights into the physiological responses of sweet cherry plants to drought stress and presents salicylic acid, abscisic acid and methyl jasmonate as a promising solution to mitigate the detrimental effects of summer stress. Overall, the presentation emphasises the importance of managing summer stress in sweet cherries and underscores the potential of plant hormone applications to enhance plant resilience and productivity in the face of adverse environmental conditions.

Water status, photosynthetic activity

Application of ozone and 1-methylcyclopropene for reducing surface pitting disorder in sweet cherry

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As sweet cherries are commodities traded globally, storage is a crucial component of the market chain. Fruits are prone to mechanical damage from pressure during harvesting, sorting, or packaging. Damage symptoms are not immediately visible but become apparent after several days in a refrigerated storage facility. Affected fruits develop surface pitting disorders, reducing their shelf life. Consequently, it is essential to focus on resistant genotypes where surface pitting does not occur, as well as on post-harvest conditions that could minimise the disorder's incidence. We evaluated genotype resistance at the Research and Breeding Institute of Pomology Holovousy Ltd., Czech Republic, using the sweet cherry cultivar 'Tamara'. Fruits were stored in a chilled box for 21 days at 1.5 °C using modified atmosphere packaging (MAP) in Xtend® bags (type Cherry 5 kg, StePac, Israel) as a control variant. These bags reduce oxygen levels while increasing both carbon dioxide content and relative humidity to 90–95%. Other variants for comparison to untreated control fruits included fruits treated with ozone and 1-methylcyclopropene (1-MCP), which were then stored in MAP. Applications of ozone and 1-MCP were performed both before and after inducing damage to the fruits to compare the effects of treatment timing. Damage was induced by applying a pressure of 0.5 N to the fruits before storage. The resistance of all genotypes to surface pitting after storage, expressed through the fruit damage index, was evaluated. It was observed that treating the fruits with 1-MCP before inducing damage increased their resistance, with a damage index of 2.50 compared to 2.70 for fruits treated after damage induction. Similarly, better results were achieved by applying ozone before damage induction, with an index of 2.66 versus 2.75 for fruits treated with ozone after induction. These findings offer opportunities for further research and practical applications in the field of post-harvest technology for cherries.

Prunus avium, storage, post-harvest, fruit quality, cultivar, disorder

Characterisation of phenolic compounds of olive cultivars under irrigated and rainfed high density growing systems

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New high-density olive orchards require cultivars suitable for these growing systems. Only a few cultivars have been widely grown under these growing systems until now, due to their specific growth habits, and there is limited information regarding the quality of oils produced. The objective of this study was to characterise the phenolic composition of fruit and oil from 'Arbequina', 'Arbosana', 'Koroneki', and 'Sikitita' cultivated in hedgerows across different agroclimatic environments in Andalusia, Spain: irrigated orchards in Granada and Jaen, and both irrigated and rainfed orchards in Cordoba. Significant genotype x environment interactions were observed for the total amount of phenolic compounds both on fruit and oil. 'Koroneiki' showed the highest values in both fruit and oil in almost all environments, but results for the other cultivars were highly dependent on the environment. The effect of cultivar was more noticeable regarding the percentage of individual compounds both in fruit and oil. The percentage of oleuropein in fruit was significantly higher in 'Koroneki' and 'Sikitita' compared to 'Arbequina' and 'Arbosana'. 'Koroneki' also stands out for its higher percentage of aldehydic forms of oleuropein aglucone (3,4-DHPEA-EA) in oil, therefore, higher bitterness could be expected. Overall, taking into account the entire dataset available, a clear grouping of samples according to cultivar was observed. The results obtained are of great importance for recommending the most suitable cultivars for high-density plantations in specific environments or geographical areas.

Genotype x environment, Olea europaea, fruit quality

‘Dundee’ rootstock affects growth of three hazelnut cultivar scions in Southwestern France

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Corylus avellana L. is the main species of hazelnut grown in orchards to produce nuts. This species is naturally a shrub, but under orchard management is grown under single-trunk training, where sucker emission is a disadvantage. Sucker emission could be limited using non-suckering rootstocks in orchards. This study aimed to evaluate the ability of ‘Dundee’ rootstock to reduce sucker emission as compared to own-rooted hazelnut cultivars, in southwestern France. Three hazelnut cultivars scions (‘Corabel’, ‘Segorbe’ and ‘Lewis’) were grafted on ‘Dundee’ rootstock. Grafted vs. own-rooted cultivars were compared for sucker emission, plant growth, productivity, and nut quality. The trial was established in 2012. Growth traits were evaluated yearly from the second to the ninth growing season. Suckering was monitored during the 2nd to the 5th and 9th growing seasons. Harvest was undertaken in the 3rd, 7th and 8th growing seasons. Only during the third growing season was a graft effect on sucker emission observed, where the own-rooted cultivars had the highest number of suckers. No grafting effects on suckering, whatever the cultivar, were evidenced during the other years of the trial. At the first harvest (third growing season), own-rooted cultivars produced significantly more fruit than the grafted cultivars. Regardless of the scion, rootstock did not impact tree productivity. Contrary to other studies, grafting seems not to have any effect on sucker emission in southwestern French orchards. However, ‘Dundee’ rootstock induces various responses on tree growth depending on the grafted cultivar. Scion growth differed according to the original vigour of cultivars. Indeed, high-vigour trees were dwarfed, medium-vigour trees were unimpacted and low-vigour trees were enhanced by rootstock. The use of ‘Dundee’ rootstock has the potential to reduce tree vigour of high-vigour cultivars without decreasing yield, and thus enhancing yield efficiency.

Corylus avellana, filbert, productivity, dwarfing

Adaptability of plum rootstocks across contrasting South African environments

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The South African Japanese plum industry prospers through the exportation of high-quality produce, but its optimal production can become limited by South Africa's highly diverse microclimates and soil conditions. Newly bred and imported rootstocks offer potential solutions to address adaptability limitations of 'Marianna', a long-standing industry standard rootstock for plums. This eight-year study evaluated untested commercially available rootstocks with potentially superior tolerance against biotic and abiotic stresses and improved productivity across two orchard sites, one in a high potential clay type soil in the Klein Karoo region and low potential sandy type soil in the Berg River region. Both trials were conducted using a randomised complete block design and data collected included tree mortality, vigour, productivity, and fruit quality. In both environments, rootstocks differed in their mortality rates and showed significant differences in tree vigour, yield, yield efficiency and fruit weight. GF677, Atlas and Garnem were superior rootstocks for clay type soils with high pH soil (high potential) whilst GF677 and Atlas were shown as improvements over the industry standard rootstock in a low growth potential sandy soil commercial orchard characterised by strong biotic and abiotic stresses known to cause plum dieback. Overall, the environmental effect had a greater impact on the variation of yield and yield efficiency, whereas rootstock selection was a significant determinant of tree vigour. These findings showed the influence of a complex genotype (rootstock) and environment interaction on rootstock performance and underscored the importance of new rootstock selections to address limitations of the current standard rootstock in South African plum production. Further research is recommended to understand the underlying mechanisms responsible for the stress tolerance and superior performance exhibited by the tested rootstocks.

Prunus domestica, tree vigour, yield, yield efficiency, fruit size

Screening for genetic resistance in advanced selections of almond rootstocks for the recognition of genotypes resistant to fungal root pathologies

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Almond crops require the adoption of strategies to minimise the effect of stresses that, in the context of climate change, will limit the yields of new orchard plantings. Thus, the present work conducted screening and selection of rootstocks tolerant to specific biotic stresses associated with two important fungal diseases affecting plant roots, namely root rot caused by *Armillaria mellea*, or trophic stem and root rot caused by genus Phytophthora. Several selections belonging to the Prunus-rootstock breeding program of CITA – Agromillora (Spain) were evaluated for their level of resistance against Phytophthora spp. (10 genotypes) and Armillaria (11 genotypes) during two-year bioassays. In addition, five commercial rootstocks were evaluated as controls: 'GF-677', Garnem® and Rootpac® R as controls in Phytophthora tests (artificially inoculated on wounds made at the base of the stem/root collar); and Rootpac® 20 and Rootpac® R for Armillaria (inoculated along with the roots as colonised oak acorns). The genotypes employed in each bioassay were distributed in 30 pots of 3 m^3. Trials were conducted outdoors with an irrigation and fertilisation regime as needed for 120 days. In the Phytophthora trials, the presence and length of cankers were recorded and compared, together with leaf desiccation and wilting, while for *A. mellea*, lesions in root and crown and aerial symptoms were considered. Results showed differential response among the genotypes employed, but as a rule, accessions 'ACI81042-01' (*P. insititia x P. dulcis*) and 'ACI51406-07' *((P. dulcis var. 'Marcona' x P. persica var. 'Nemaguard') x P. fenzliana*) exhibited little or no symptoms associated with both *A. mellea* and Phytophthora, giving them great potential for use as resistant commercial rootstocks. Tests to identify sources of resistance to diseases contribute to the incorporation of new descriptors in a breeding program.

Fungal diseases, hybrid rootstock, phenotyping, artificial inoculation, root-associated pathogens

A multi-environment trial to identify superior rootstocks for South African peach production

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Rising production costs and stricter regulations on orchard chemicals necessitate the selection of stress-resistant rootstocks for sustainable stone fruit production. Selecting appropriate rootstocks is particularly challenging in South Africa due to its diverse production regions, each with unique environmental conditions. A multi-site field trial was established in three distinct micro-environments within South Africa. Two trial sites were planted with 'Snow Angel' peach grafted onto various rootstocks in Vaalwater, Limpopo, a low-chill production region with contrasting soil types. An additional trial site located in the Slanghoek Valley, Western Cape, evaluated 'Early Blush' peach performance on different rootstocks in a sandy (>80%) soil environment. All trials utilised a randomised complete block design within commercial orchards with 10 single tree replications. Data collection across eight seasons included tree mortality, vigour, productivity, and fruit quality. The study applied Analysis of Variance (ANOVA) and Genotype-plus-Genotype-by-Environment (GGE) biplot analysis to investigate the interaction between rootstock genotype and environment on peach performance. ANOVA and GGE biplot analysis revealed significant rootstock effects on tree vigour across all sites, suggesting a stronger genetic rather than environmental influence on growth. Differences in cumulative yield between rootstocks were more apparent in the sandier soils, however the largest differences occurred between different production regions. Similar patterns were also observed for yield efficiency, with rootstock effects present but subordinate to the environment. Fruit weight under low-chill conditions showed significant variation in response to rootstock. This study highlights the complex interaction between rootstock genotype and environment on stone fruit tree performance. Rootstock selection significantly influenced vigour and yield, more so in challenging sandy soils. GGE analysis identified superior rootstocks for commercial adoption, both within and across each environment.

Prunus persica, tree vigour, yield, yield efficiency, fruit size, adaptability, genotype x environment interaction, GGE analysis, phenotypic variation

Vascular reconnection dynamics in grafted olive seedlings

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Rootstock use in olive is currently not widespread due to the plasticity and easiness of cutting propagation of this species. However, olive rootstocks could provide improved adaptation to specific environments, abiotic and biotic resistance and other desirable characteristics. Using plant breeding, it is possible to generate new rootstocks with desired traits, but the process is usually very long. In this sense, one of the challenges is the development of tools and methodologies that allow an early evaluation of the genotypes generated in the breeding process, therefore reducing the cost and time required in rootstock breeding. In that regard, the objectives of this work were to design a methodology to graft young olive seedlings and to determine the reconnection dynamics in the olive grafting process. The reconnection of vascular tissues after grafting was monitored using a fluorescent marker (CFDA) applied to the root and visualised in the grafted scion of the plant using a microscope to identify whether reconnection of xylem tissues had occurred. A similar procedure was also used to confirm phloem reconnection. Using specific conditions of plant size, humidity, temperature, and light, the methodology successfully enabled grafting of various types of plant material, including seedlings, micro-propagated plants, and apical shoots of clonal plants onto seedlings. Tissue reconnection dynamics were studied in grafted olive seedlings and reconnection has been demonstrated to occur in less than 10 days after the grafting procedure, with xylem reconnection occurring before phloem. Additionally, the methodology also allows an early determination of compatibility relationships. In this study, no graft incompatibility mechanisms have been identified when grafting olive seedlings (*Olea europaea*) with plants of the subspecies cuspidata *(Olea europaea subsp. cuspidata)*.

Olea europaea, rootstock, compatibility, plant breeding, fruit tree, xylem, phloem

Tolerance of almond rootstock-scion combinations to transient water stress

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Short periods of water stress, for example, due to power outage or irrigation system breakdown, can have an irreversible impact on the growth and development of almonds. Rootstocks and varieties may vary in their ability to tolerate short periods of water stress. Through the 2023/24 season, a duplicate irrigation system was established in a high-density rootstock compatibility experiment to investigate genotype response to transient water stress. Two treatments (full and zero irrigation) were applied for a period of four days, across a total of 70 scion/rootstock combinations (5 scions on 14 rootstocks). The trial planting was composed of single plots of each scion/rootstock combination which were split for the irrigation trial. Data were analysed by treating the 14 rootstocks as replicates for analysing scion effects and 5 scions as replicates for analysing the rootstock effects. This precluded the analysis of scion/rootstock interactions. Response to transient water stress was evaluated through frequent (often daily) measures of leaf stomatal conductance and stem water potential, complemented by soil moisture monitoring, light interception and thermal imagery. These measures were collected before, during and after the stress event. The concentrated campaign of physiological measures concluded with the collection of yield and kernel quality attributes. 'Nonpareil' trees showed yellowing and dropping of internal leaves with a degree of shoot-tip death that may have impacted nut development. The stomatal conductance of 'Nonpareil' took longer to recover than 'Shasta' or 'Vela'. 'Vela' trees showed yellowing and dropping of leaves, with no shoot tip death, while 'Shasta' showed no leaf senescence and appeared better positioned to maintain nut growth after the stress period. The less vigorous rootstocks, with smaller canopies, generally exhibited lower levels of water stress and across all the stock-scion combinations stem water potential recovered faster than stomatal conductance.

Rootstock, cultivar, canopy, yield, irrigation

Almond rootstock compatibility and performance traits in Australian growing conditions

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The aim of this work is to provide information to support the uptake of new varieties and rootstocks across the Australian Almond industry. Most Australian almond orchards are planted with traditional varieties on vigorous rootstocks established at low densities (<350 trees ha^{-1}). However, there is increasing interest in higher-density plantings (>600 trees ha^{-1}) using self-fertile varieties on new rootstocks that promise improved production efficiencies. Whilst Australian almond growers can now access many new rootstocks and scion varieties of foreign and domestic origin, the availability of local performance metrics remains scarce. Growers are therefore making planting decisions predominantly based on advice sourced from overseas, which is collected under growing conditions different to those experienced in Australian almond growing regions. There is a clear need for the most promising varieties to be screened on tailored panels of rootstocks, including industry standards. This will evaluate incompatibility risks and provide information to guide the selection of rootstocks suitable for new growing systems. The South Australian Research and Development Institute (SARDI) has established an almond rootstock scion compatibility trial at Loxton, South Australia aimed at studying the performance of new rootstock and variety combinations under Australian growing conditions of alkaline shallow sandy loam soils over limestone. The 2.2 ha orchard, containing 148 distinct combinations at medium and high planting densities, including the industry benchmark 'Nonpareil' on Nemaguard, was established in 2018 and 2019. Five seasons of performance metrics, including yield and kernel quality, canopy vigour and architecture, disease susceptibility and graft compatibility have been collected. New rootstocks including Barrier 1, Cornerstone and Garnem, performed well under South Australian conditions across a range of varieties. Krymsk-86 and Atlas rootstocks performed well under select varieties and typically at higher planting densities and the size-controlling rootstocks Rootpac-40 and Controller-6 also showed promise under those conditions.

Cultivar, yield, self-fertile, high density

EUFRIN rootstock trials: Evaluation of new pear rootstocks in the young orchard

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European Fruit Research Institute Network (EUFRIN) has started coordinated apple and pear rootstock trials across Europe in 2017. The first pear rootstock trial was established in 2019 where quince rootstocks from the NIAB (UK) breeding program ‘QR196-9’ and ‘QR530-11’ were compared with rootstocks ‘Adams’ and ‘Sydo’. Investigations were conducted with the pear cultivar ‘Conference’ in Spain, Romania, Poland and Norway during 2019–2023. In all sites, the most vigorous pear trees grew on ‘QR196-9’ rootstock. Across the four trial sites, the weakest growth was recorded on ‘QR530-11’, except the Spanish site. Pear trees on rootstock ‘Adams’ produced the highest cumulative yields. Cumulative yields on other rootstocks were significantly lower by 16–23% without significant differences between them. However, site geographical position, climate and soil properties had a significant effect on rootstock performance. Similar to trees on ‘Adams’, a high pear yield in Spain was harvested from trees on ‘QR196-9’; on ‘QR530-11’ rootstock in Poland, but ‘Sydo’ and ‘QR530-11’ rootstocks gave the highest yield in Romania. Across all sites, the least cumulative fertility index was recorded on ‘QR196-9’. However, significant rootstock site interactions were revealed: rootstock ‘Adams’ had the highest cumulative fertility index in Spain and Norway, while rootstock ‘QR530-11’ in Poland and Romania.

Quince rootstocks, tree vigour, productivity, fruit quality, rootstock site interaction

Evaluation of apple rootstocks on vigour and yield response on STORY® 'Inored' under Catalunya climatic conditions

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'Inored' (STORY®) has good colour development with a blushed and attractive intensive red skin and is better adapted to hot fruit-growing regions. Consequently, it has been widely planted in Catalunya over the last 10 years. However, the recent popularity of new cultivars, such as 'Inored', requires a re-evaluation of which rootstocks improve scion performance. For instance, this cultivar has a weak habit, and typically, when grown on common rootstocks such as M.9 T337, struggles in replant situations. This work aimed to assess how different rootstocks may affect the vigour and yield of 'Inored' under the growing conditions of Catalunya. The trial was undertaken at IRTA Mas Badia research experimental station (La Tallada d'Emporda, Spain) over ten seasons, from 2014 through 2024, and compared four Geneva ® rootstocks (G.202, G.935, G.11 and G.41), one Pillnitzer rootstock (SUPPORTER® 4 PI.80) and one East Malling rootstock (M.9 EMLA). G.935, M.9 and G.202 had the lowest vigour (between 25 and 26 cm^2 TCSA), followed by PI.80, G.11 and G.41 (between 30 and 32 cm^2 TCSA) with greater vigour. The highest cumulative yield was with G.11 (590 T ha^{-1}), followed by G.41 (546 T ha^{-1}). All other rootstocks showed cumulative yields lower than 500 T ha^{-1}. Moreover, fruit size was higher for G.11 (149 g/fruit and 71.3 mm) followed by G.41 (144 g/fruit and 70.9 mm) and M.9 (143 g/fruit and 70.7 mm). There were no significant differences among rootstocks regarding fruit skin colour. Overall, G.41 and G.11 were the best options in terms of yield and fruit size compared with all other dwarfing rootstocks evaluated under Catalunya climatic conditions.

Malus x domestica, rootstock, Geneva®, crop load, fruit size, yield efficiency, fruit quality

The potential for rootstocks to devigorate kiwifruit polliniser scions

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Kiwifruit pollinisers can occupy between 2% and 10% of an orchard's area. While required to produce a crop, the loss of orchard production area to these plants represents a loss in potential orchard productivity. In addition, excessive canopy vigour of pollinisers creates shade, reducing the floral fertility of adjacent vines and requiring labour intensive management practices in both summer and winter. Dwarfing rootstocks could provide a means to reduce the canopy size of kiwifruit polliniser scions, reducing the area they occupy in the orchard and the need for extensive shoot management. We assessed polliniser scion vigour during the seventh season of growth for the male cultivars 'Bruce' and 'Sparkler' grafted to 26 different rootstocks. Scion vigour, assessed as trunk cross-sectional area ranged from 3.3 to 24.8 cm^2, demonstrating the potential of rootstocks to devigorate polliniser scions. Scion trunk cross-sectional area was found to be an adequate predictor of estimated canopy volume. This demonstrated the potential of rootstocks to devigorate kiwifruit polliniser scion vigour, which could allow the development of new training systems, enabling substantially reduced polliniser canopy area and requiring less canopy management, without reducing polliniser effectiveness.

Actinidia chinensis, canopy volume, vigour

Quantitative effects of twelve regional pecan rootstocks on growth and phenology of 'Pawnee' scions

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Pecan (*Carya illinoinensis*) is a native North American tree species that thrives across a wide range of latitudes and longitudes in the United States. It holds the highest economic and agricultural importance among the Carya genus. Grafting onto established rootstocks is essential to ensure uniformity, achieve large nut production, and enhance overall nut yield. We hypothesise that rootstocks promote scion growth and influence soil microbial composition. To investigate the impact of rootstocks on scion growth, the USDA ARS Pecan Breeding Program conducted a trial in 2014, grafting twelve rootstocks with the 'Pawnee' scion cultivar. From 2017 to 2023, we evaluated scion performance, yielding the following findings: 1) Tree size: Southern seedstocks generally outperformed northern ones, with Mexican seedstocks significantly increasing scion plant height, trunk diameter, and canopy width. Eastern and western rootstocks showed intermediate performance; 2) Leaf size: Average leaflet sizes were larger in eastern and northern provenances compared to southern and western provenances; 3) Leaf photosynthesis: Scion leaf photosynthesis did not significantly differ among the twelve rootstocks. 'Elliott', a popular rootstock in southeastern and southern pecan growing regions, exhibited the lowest photosynthesis rate and water use efficiency; 4) Leaf nutrition: Most leaf nutrients were unaffected by rootstocks, except for K, Mg, and Na. Northern provenances had the highest K levels and lowest Mg levels, while western provenances showed the opposite trend. Southern provenances had the highest Na content, whereas northern provenances had the lowest; and 5) Soil microbial community: 'Peruque', a northern provenance, exhibited a higher relative abundance of saprotrophic fungi, while the southern provenance '87MX5-1.7' showed higher levels of nitrogen-fixation-related bacteria. In summary, rootstocks significantly influence scion performance across various aspects including tree and leaf size, leaf photosynthesis, nutrient accumulation, and soil microbial community diversity. These insights will aid pecan growers in selecting and utilising appropriate rootstocks for optimising nut production in their orchards.

Carya illinoinensis, pecan, rootstock, scion, horticultural traits, microbial diversity

The genetic bottleneck for intensifying avocado orchard systems in a subtropical environment

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The Australian avocado (*Persea americana*) industry has grown significantly over the past decade, prompting interest in methods to increase profitability. In other tree crop species, the development of intensive high-density orchard systems offers substantial advantages and increased production. These systems rely on dwarfing or low-vigour rootstocks, as well as appropriate scion varieties. To identify avocado genetics that may facilitate orchard intensification, we evaluated nine different rootstocks grafted with a 'Hass' scion in a high-density trellis system (4.5 x 2 m; 1111 trees/ha) over seven years. The rootstock 'Ashdot 17' yielded a substantially higher crop compared to the other evaluated rootstocks. The superior performance of 'Ashdot 17' may be attributed to its relatively lower vegetative vigour, which is better suited to the high-density planting of the trial orchard. In a parallel assessment, a comparison of different scions showed the advantages of the scion cultivar 'Maluma' over 'Hass' in an intensive orchard system, potentially due to lower pruning requirements. Despite the better performance of 'Ashdot 17' and 'Maluma', production levels started to decline in both assessments after peaking around the third year from planting. We hypothesise that the decline was due to the excessive pruning dictated by the high planting density. In conclusion, further selection for suitable genetic resources and the development of specific canopy management strategies are essential for avocado orchard intensification in a subtropical environment.

Intensification, rootstock, scion, Hass, Maluma, Ashdot

Interaction between pruning and canopy calcium chloride applications on sweet cherry cv. 'Lapins' trained in the Kym Green Bush training system

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The Kym Green Bush (KGB) training system enables a pedestrian orchard with minimal agronomical labour. For some cherry cultivars, crop load regulation to achieve an optimal leaf area to fruit ratio (LA:F), is required. We hypothesised that fruit quality might be maximised not only by adjusting the LA:F ratio, but also by applying calcium to the canopy. An experiment using 7-year-old trees of 'Lapins'/Colt, trained as KGB, was carried out. Two pruning treatments, combined with foliar $CaCl_2$ (0.8%) sprays, were compared: Top pruning, where vertical branches were pruned to shorten their length by one-third, and an unpruned control. Both pruning treatments were sprayed twice with $CaCl_2$ at 20 and 27 days after full bloom. Trees were measured for number of branches/tree, number of fruiting spurs/tree, LA:F ratio and yield/tree. Fruit quality (i.e. soluble solids concentration, firmness and colour) was measured at harvest, plus internal browning and orange peel disorders after 40 days of cool storage at 0°C plus three days shelf life (20°C). Top pruning reduced yield (36%) and increased fruit size (4.8%). In addition, pruning reduced fruit internal browning from 23% to 6% after 40 days at 0°C and, from 30% to 15%, after shelf life. Foliar $CaCl_2$ increased total calcium in fruit by 12%. Firmness at harvest significantly improved in pruned trees, increasing from 270 to 305 gf mm^{-1}. Regardless of pruning, after cool-storage, $CaCl_2$ sprays effectively retained fruit firmness; however, a significant increase in the proportion of fruit with brown pedicel (5.3%) was measured. We conclude that top pruning in the KGB system improved fruit size, while foliar $CaCl_2$ mitigate the effects of high crop load by reducing fruit softening at harvest, during storage, and throughout the shelf-life period.

Fruit quality, leaf area, fruit, storage, firmness, internal browning, pedicel, calcium, postharvest, crop load

Converting conventional high-density navel orange orchards to a 2D planar growing system increases yield efficiency

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The inappropriate combination of vigorous navel orange scion and rootstock in a conventional high-density planting can lead to reduced productivity once trees outgrow their allocated space. A block of high-density 'Atwood' navel oranges planted on citrange in 2008 at 3.5 x 4.9 m had an average yield of 25 t ha^{-1}. The reduced productivity in recent years was likely due to shading and the removal of fruiting wood through intensive annual hedging to maintain row access. We applied five different pruning treatments to five rows of trees from August 2020 to 2024. Yield within the pruning trial was approximately 10 t ha^{-1} in 2024, with an average canopy volume of 12,000 m^3 ha^{-1}. Trees in this trial intercepted an average of 52.9% of incident solar radiation in 2024. To explore the potential of alternative training methods compared to traditionally pruned trees, we conducted a separate trellis experiment. In July 2020, 105 'Atwood' trees were stumped in three immediately adjacent rows and converted to a trellis system. Trees were trained as palmate, espalier, or cordon systems beginning in July 2021. The trellis systems yielded around 20 t ha^{-1} in 2024. The canopy volume of trellis systems was around 4,000 m^3 ha^{-1}, indicating higher canopy efficiency compared to the pruning trial. Trellised trees intercepted an average of 39% of incident solar radiation in 2024 but have not yet filled their allotted space, requiring more training over the next two years. Both trials produced fruit with an average size of 84.5 mm and showed an increase in first-grade fruit in 2024 compared to previous years. The trellis systems demonstrated the potential for improved yield and canopy efficiency compared to traditionally pruned trees. Further research is needed to evaluate the long-term benefits of trellising as the trees continue to develop.

Citrus, high-density planting, rootstocks, trellis systems, productivity

Fig fruiting hedge, a sustainable planting system for cold production areas

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Fig is an antique and iconic crop for Mediterranean-like climates and regions. However, in r temperate climates, winters with temperatures below -15°C are fatal for the aerial fig tree organs. For solitary trees, several protection systems, generally with low efficacy, are used. The "Fig fruiting hedge" (FFH) offers a solution for fig cultivation in continental temperate climate areas, with cold winters and hot summers. The planting material (one year shoot) is planted within rows at 0.75 to 1 m with the shoot tip facing north at an angle of 30–45°. The recommended distances between rows are 2.5 to 4.0 m depending on genotype vigour and the crop management technology. At the end of the first season, the main shoot is laid horizontal forming a cordon, while the annual shoots are left vertically. The entire row is then covered with a 50–60 cm high thermal protection layer of mulch (e.g. chipped strow, wood chips, saw dust, sand, perlite, etc) mixed with soil. Every spring, the protection layer is removed mechanically, and the vertical annual shoots are kept to produce fruit. After mild winters, breba can be produced on the last year shoots at the beginning of July, while the main crop is obtained on the growing shoots starting from August. Every autumn, before the row covering for winter protection, two-year-old shoots are cut off. Low vigour shoots or those affected by low temperature, pests or diseases, are eliminated. The supernumerary one-year shoots are thinned at 15–25 cm between them, by cutting to stubs of 2–3 buds. After cold winters, all annual shoots chosen for production are reduced to stubs of 2–3 buds to stimulate fruiting shoot growth. The FFH was designed and tested with good results at the Faculty of Horticulture in Bucharest on local and foreign fig genotypes, and the technology has a patent pending.

Ficus carica, fruiting strip, growth, yield, fruit quality