



**XII INTERNATIONAL SYMPOSIUM ON
INTEGRATING CANOPY, ROOTSTOCK AND
ENVIRONMENTAL PHYSIOLOGY IN
ORCHARD SYSTEMS**

**POSTER
ABSTRACTS**

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ENVIRONMENTAL PHYSIOLOGY poster session (07/27/2021)

POSTER NUM: P1

ROSA NUM: 170

PRESENTER: Louw, Esme Denise

TITLE: Alternative rest breaking agents and vigour enhancers tested on 'Fuji' apple shoots under mild winter conditions

ABSTRACT:

The use of rest breaking agents is essential for successful budbreak of apples in areas with insufficient winter chill. Hydrogen cyanamide (Dormex®) and mineral oil is currently the industry standard for rest breaking in apples produced in South Africa. As this treatment is becoming more controversial and under continuous scrutiny for its hazardous effects on man and environment the need for alternative compounds increases. This study investigates the rest breaking capabilities of nitric oxide (produced chemically and enzymatically), in the presence of oil, as a safer more environmental friendly alternative to Dormex®. The use of growth enhancing compounds (hormones and N-containing) to restore the vigour of apple shoots effected by insufficient winter chill is also included. One-year old 'Fuji' apple shoots, from a mild winter area, were treated with a selection of growth enhancing and potential NO producing compounds and exposed to growth forcing conditions (12°C / 20°C, day/night cycle). Onset, rate and percentage budbreak was use as indications of rest breaking potential. Over the two seasons (2014 and 2015) all the vigour-enhancing compounds tested equal to that of Dormex® and oil. Promalin® and Maxcell® showed some potential, as they were consistently the top performers. No conclusive evidence was found for improved budbreak using the vigour enhancers. All the NO producing rest-breaking alternatives had budbreak percentages equal or higher to that of Dormex® and oil but showed a prolonged onset to budburst and an extended time period to completion. KNO₃ was the most promising with positive results at the lowest concentration tested and NaNO₂ the least effective with some contradicting results and lethal activity higher than 1M. The use of combinations of vigour enhancing compounds and nitric oxide producing alternatives did not deliver favourable results. In conclusion, it was found that NO acted as a RBA in apple buds with its potential equal to that of Dormex® and oil but is slow acting.

ENVIRONMENTAL PHYSIOLOGY poster session (07/27/2021)

POSTER NUM: P2

ROSA NUM: 81

PRESENTER: Reginato, Gabino

TITLE: A model for 'Gala' apple crop value grown in Chile: an approach that includes main weather condition effects

ABSTRACT:

In central Chile, the size of the fruit and yield of 'Gala' apples depend mainly on crop load, but also on maximum temperature during winter (WTmax) and the length of the growing season (SL). Therefore, to optimize the crop value differential regulation of crop load is required depending of growing area. The objective of this study was to develop a model to estimate crop value that includes important weather characteristic for 'Gala' productivity (Reginato et al., 2019). The model includes fruit size distribution and farm gate prices for different fruit sizes (average for seasons 2015-2018). The data was obtained from thirteen thinning trials performed in different apple growing areas during seasons 2012 to 2016, from orchards located between latitudes 34° 20'S and 37° 40'S. The prediction models for yield ($R^2 = 0.86$; RMSE = 0.57) and fruit size ($R^2 = 0.58$; RMSE = 215.27) were constructed from multiple regressions analysis based on the WTmax (12 ° C to 14.5° C), SL (122 to 146 days) and crop load (210.000 to 560.000 fruits/ha intercepting 70% PAR). The proportion of fruit in each commercial category (11) was estimated as a function of the average fruit weight. Simulations for contrasting growing areas according winter weather (cold, 12°C WTmax; warm, 14.5°C) were carried out with an average season length of 136 days. The results show that under the current price scenario, the crop value in areas or years with warm winters is optimized with an average fruit size of ~138 g, which is reached with ~360,000 fruits/ha that intercepts 70% PAR (~50 t/ha); while with colder winters it is optimized with an average fruit weight of ~167 g, ~560,000 fruits/ha that intercepts 70% PAR (~90 t/ha). Then, the crop value decreases by 60% for warmer condition, respect to the colder condition. Although the validation of the model has not been tested yet, the model can be a promising tool to determine pruning and thinning assessing the crop profitability under changing climate scenarios.

ENVIRONMENTAL PHYSIOLOGY poster session (07/27/2021)

POSTER NUM: P3

ROSA NUM: 123

PRESENTER: Lodolini, Enrico Maria

TITLE: Comparison of frost damages in 11 olive cultivars after two freezing events in central Italy

ABSTRACT:

Olive is very sensitive to frost damages. Symptoms on the tree can range from shoot tip burns and defoliation up to bark split on branches or trunk in case of intense injury. Frost conditions occur quite recurrently in central Italy and the selection of the less susceptible olive cultivars represents an effective method to avoid frost damage in such climates. The objective of the present study was to compare frost damages in 11 olive cultivars after two freezing events occurred in Marche Region (central Italy) in 2012 and 2018. The studied cultivars were 'Nebbia del Menocchia', 'Rosciola Colli Esini', 'Sarganella', 'Capolga', 'Oliva Grossa', 'Piantone di Mogliano' and 'Piantone di Falerone' locally diffused in the Marche Region; 'FS17[®]', 'Don Carlo[®]' and 'Giulia[®]', nationally spread; and 'Arbequina' internationally used for high-density olive orchards. At the moment of the freezing events, the trees were respectively three and nine years old and two visual indexes were used for defoliation (from 0: no leaf drop to 3: totally defoliated) and frost damage (from 0: no bark split to 4: bark split extended to the trunk). During the following growing season, the recovery ability of the cultivars (re-sprouting in the apical, central and basal portion of the tree) was studied using a visual index from 0 to 3. Results about damage level and recovery ability of the studied cultivars were compared for the two years in order to identify less and more sensitive varieties. This study confirmed that the level of damage might depend also on the physiological status of the trees during frost conditions and supplies useful information to select the most suitable varieties for cold areas.

ENVIRONMENTAL PHYSIOLOGY poster session (07/27/2021)

POSTER NUM: P4

ROSA NUM: 86

PRESENTER: Sheick, Ryan

TITLE: Evaluating susceptibility of crabapple cultivars and selections (*Malus* spp.) to fire blight (*Erwinia amylovora*)

ABSTRACT:

The apple (*Malus ×domestica* Borkh.) is one of the most economically important temperate fruits in the world. Due to self-incompatibility in *Malus* spp., apple cultivars must be planted nearby another genetically distinct pollinizer variety to ensure cross-pollination. Crabapples are often used as pollinizers and are planted in-row with the cultivar. This strategy enables more efficient use of land, labor, and resources in comparison to lower density mixed block plantings but may also result in issues with pest and disease pressure. Previous work has suggested that the Manchurian crabapple, which has been widely planted in the Pacific Northwest since the 1980's, is susceptible to some canker-inducing post-harvest storage rots with quarantine status among some important importers of American apples. Other popular crabapple pollinizers, such as Snowdrift, have been reported to be susceptible to fire blight, caused by the bacterial pathogen *Erwinia amylovora*. Pollinizer disease susceptibility is a concern to apple production because elevated levels of inoculum in the orchard can increase the risk of infection in trees and fruits of the cultivar. Thus, in an effort to identify new potential pollinizers for the apple industry, we investigated the disease susceptibility of over 20 crabapple selections. First-year shoots of each selection, grafted on Antonovka seedlings, G.41, or P.18, were challenged with *E. amylovora* strain 153n, and shoot necrosis was measured. Analysis of the results over two years revealed some highly susceptible selections, including *Malus baccata* var. Columnaris, and some selections displaying tolerance to infection, such as Evereste. In some cases, varieties with known susceptibility to fire blight produced variable results, which suggests additional factors are involved with pathogenesis. Some promising crabapple selections with low levels of susceptibility were identified, but further work should be done to evaluate disease susceptibility under normal field conditions and via alternative routes of infection.

ENVIRONMENTAL PHYSIOLOGY poster session (07/27/2021)

POSTER NUM: P5

ROSA NUM: 103

PRESENTER: Sterle, David

TITLE: Peach floral bud cold hardiness of eleven cultivars in western Colorado

ABSTRACT:

Frost damage to floral buds is the main yield limiting factor for peach growers in Colorado and other cold climate regions. Hardiness is a dynamic attribute which includes acclimation rate, responsiveness to weather conditions, as well as maximum potential to withstand low temperatures once fully acclimated. Differential thermal analysis was used to provide up to date assessments as to the hardiness of floral bud tissue. Monthly throughout the dormant season, forty floral buds per date from 14 cultivars were sampled and analyzed to identify critical temperatures as well as acclimation trends in different genotypes. Observed lethal temperatures throughout the 2019-20 dormant season were compared. Throughout this critical period, the varieties performing best, with the lowest lethal temperatures for 50% floral bud loss (LT50) were: 'Glohaven', 'Cresthaven', 'PF-19007', and 'Redhaven' with average LT50 of -21.6°C, -21.6°C, -21.5°C and -21.4°C respectively. On January 2, 2020 following five continuous days of subfreezing days, the hardiest cultivars were 'Cresthaven' and 'Redhaven' with LT50 of -23.6°C and -23.1°C respectively. Least hardy varieties on this date were 'Blushingstar' and 'New Haven' with LT50 of -18.4°C and -19.6°C respectively. Continued analysis was conducted throughout the dormant season to establish trends among different genotypes, with relation to weather conditions.

ENVIRONMENTAL PHYSIOLOGY poster session (07/27/2021)

POSTER NUM: P6

ROSA NUM: 119

PRESENTER: Blanke, Michael

TITLE: Can forcing partially substitute for lack of chilling?

ABSTRACT:

Lack of chilling, a cold temperature period during winter, is a pre-requisite for most temperate zone fruit trees such as apple, pear, plum, peach, cherry and apricot. With the onset of recent climate change, horticultural production of these fruit crops has been hampered or affected due to milder, warmer winters and lack of chilling, but possibly more forcing. The Mediterranean climate zones have been particularly affected by this phenomenon. Year to year variation is still abundant and provides years with and without lack of chilling, with a tendency to more years/winters with a lack of chilling. The research presents 4 year experiments with 160 potted intact cherry trees of three cultivars with a 3fold difference in chilling requirement (500, 1000, 1500 CH) exposed to 8 scenarios. In the literature, substitution of chilling by forcing and versa vice is often postulated, but no proof and/or exact figures of their magnitude given. Hence, the objective of the research was to investigate how much lack of chilling can be substituted by more forcing and elaborate practical means of overcoming lack of chill in the orchard with emphasis on med climate.

ENVIRONMENTAL PHYSIOLOGY poster session (07/27/2021)

POSTER NUM: P7

ROSA NUM: 42

PRESENTER: Petri, José Luiz

TITLE: Increasing on fruit set and yield of 'Monalisa' apple trees using plant growth regulators

ABSTRACT:

"Monalisa" is a new apple cultivar with high flowering density, disease resistance and excellent fruit quality. A disadvantage is that it has low fruitset under adverse conditions to pollination, reducing yield. Under these adverse conditions, the use of growth regulators may contribute to increased fruitset and yield of apple trees (LEITE et al., 2010). An experiment was carried out in an experimental orchard located in Caçador, SC, Brazil (latitude 26°82 'S, longitude 50 °99' W, altitude 960 meters) during the production cycles 2016 to 2019. 'Monalisa' / M-9 apple trees were used in order to verify the effect of growth regulators aiming to increase fruitset and productivity.. The treatments were 1. Control; 2. 1-naphthalenoacetic acid (ANA) 15 ppm; 3. Benzyladenine (BA) 80 ppm; 4. Etephon 360 ppm; 5. Thidiazuron (TDZ) 10 ppm + Prohexadione calcium (PCa) 110 ppm + Aminoethoxyvinylglycine (AVG) 90 ppm; 6. (BA + gibberellic acid) 28.2 ppm; 7. 1.5% ammonium thiosulfate (ATS); 8. TDZ 20 ppm; 9. TDZ 30 ppm. A second experiment tested AVG concentrations. Fruitset, return flowering, yield per plant, average fruit mass and fruit alternation index were evaluated. TDZ increased the fruitset and productivity of the "Monalisa" apple tree when applied at full bloom but reduced the return flowering due to higher yield. TDZ 20 and 30 ppm applied at full bloom increased the accumulated yield over a four-years-period. TDZ mixed with PCa and AVG increased the fruitset of the apple tree and did not cause production alternation. Only AVG increased fruitset, but lower than TDZ. BA + GA and ATS reduced fruitset but did not increase productivity. The results showed that reducing the flowering intensity there was no response in increasing yield.

ENVIRONMENTAL PHYSIOLOGY poster session (07/27/2021)

POSTER NUM: P8

ROSA NUM: 177

PRESENTER: Elsysy, Makhles

TITLE: Enclosure of apple canopies with insect exclusion, anti-hail nets during early bloom stages reduces fruit set and seed content of 'Honeycrisp', 'Sweet Tango' and 'Fuji' but does not affect fruit size or shape

ABSTRACT:

Thinning is a critical but challenging practice in apple production, especially for organic producers. In a previous experiment, we demonstrated a benefit to using anti-hail, insect exclusion netting to reduce fruit set by enclosing canopies at various percentages of open bloom; however, the response proved cultivar dependent. Fruit set and yield of netted 'Honeycrisp' trees in Washington did not significantly differ from hand-thinned, netted control trees, but fruit set of 'Gala' trees in Michigan was unaffected by netting treatments, irrespective of the timing. Net enclosure significantly reduced seed content of fruit, irrespective of cultivar. The objective of the current experiment was to determine if anti-hail, insect exclusion netting could reduce fruit set and thinning requirements of 'Honeycrisp', 'Sweet Tango' and 'Fuji' apple trees in Michigan, U.S.A. In spring 2019, whole canopies were enclosed at multiple timings according to the percentage of open flowers. Netted trees set fewer fruit than non-netted trees and the response was highly dependent on the timing of net enclosure. 'Honeycrisp' set the fewest percentage of fruit under nets. Delaying the timing of net enclosure only slightly improved fruit set. Fruit set of 'Fuji' and 'Sweet Tango' trees, on the other hand, responded linearly and positively with increasing delays in the timing of enclosure. At ~20% and 50% open bloom, 'Fuji' and 'Sweet Tango' set ~ 50% of non-netted fruit. Compared to non-netted controls, fruit was significantly larger for netted trees, regardless of cultivar, primarily due to the reduced crop load. However, seed content of all cultivars was also markedly reduced under nets. Variation in seed content for an equivalent net enclosure timing was observed among cultivars. Despite very low seed content, the percentage of misshapen fruit was not increased in net treatments. Further, the relationship between fruit size and seed content was not affected by net treatments, irrespective of cultivar. These findings implore a re-examination of the influence of fertilization and seed content on apple fruit size, shape and quality. The data also support the potential of netting to manage fruit set and reduce apple thinning.

ENVIRONMENTAL PHYSIOLOGY poster session (07/27/2021)

POSTER NUM: P9

ROSA NUM: 125

PRESENTER: Curetti, Mariela

TITLE: Metamitron application could replace Carbaryl treatment for chemical thinning in apple `Red Delicious`

ABSTRACT:

There are around 11.000 has of apple Red `Delicious` in Argentina. Due to environmental concerns about Carbaryl application for chemical thinning, there is a need to find alternatives for this purpose. The objective of this work was to evaluate the thinning efficacy of diverse strategies of Brevis (15% metamitron) applications in the apple Red `Delicious`. Experiments were conducted in a commercial apple orchard of Red `Delicious` located in Rio Negro (Argentina) during four seasons (2014-2018). One or two application with metamitron (MM) were made, when central fruit in the clusters were 8-10 mm and 12-14 mm in diameter. First, MM was evaluated at three concentrations (165, 248 and 330 mg.L-1). Secondly, single applications (165 and 248 mg.L-1) and double applications (82.5 and 124 mg.L-1) were tested. All treatments were compared with an untreated control and carbaryl application at 1200 mg.L-1. Spraying volume was 2000 L ha-1 in all treatments. Fruit set, yield, fruit size, maturity indexes, phytotoxicity symptoms and return bloom were assessed.

Under trial conditions, all MM treatments resulted in a significant reduction in crop load, fruit set and number of fruits per tree. Highest MM concentrations (248 and 330 mg.L-1) generated an excessive thinning effect in some seasons. On the other hand, Carbaryl treatment was sometimes ineffective. Double applications increased the thinning efficiency but did not always promote fruit size at harvest. MM treatments only generated slight chlorosis of the leaves and did not negatively affect fruit size and bloom return. Thinning treatments did not affect maturity indices. Therefore, single treatment with MM at 165mg.L-1 (\pm Brevis 2.2 Kg.ha-1) with 8-10 mm fruit diameter is recommended to chemical thinning apples Red `Delicious` and can be as effective as Carbaryl application.

ENVIRONMENTAL PHYSIOLOGY poster session (07/27/2021)

POSTER NUM: P10

ROSA NUM: 77

PRESENTER: Petri, José Luiz

TITLE: Concentration and time of application of Metamitron as an apple post flowering thinning agent in apple tree

ABSTRACT:

Reducing fruit set, particularly in years when climatic conditions favor excessive flower induction, is necessary to regulate yield and increase fruit size and quality. Due to the climatic conditions of southern Brazil, the fruit set from year to year is very variable and, in these conditions, the adoption of thinning in flowering becomes a practice of greater risk for the producer, since it is only possible to assess the need and thinning intensity after fruit fertilization. Recent works has demonstrated the effectiveness of Metramitron alone or in combination with benzyladenine in post-bloom thinning of apples. The experiments were conducted in an experimental orchard located in Southern Brazil (latitude 27°04'S, longitude 50°52'O, altitude 960 meters), with cultivars Fuji Suprema / M-9 and MaxiGala / M-9, in 2018/19 and 2019/2020. Three Metamitron concentrations were tested at three application times (fruits with 8-10, 12-14 and 16-20 mm) compared with BA and hand thinning. The variables evaluated were: fruit drop (%), floral clusters with 1, 2, 3, 4 or more fruits (%), yield (fruits plant⁻¹ and kg planta⁻¹), average fruit fresh mass (g), fruit classification, russeting incidence and estimated yield (t ha⁻¹). Brevis applications, applied on fruits with 8 to 18 mm in diameter, reduced yield to desirable levels in the cultivar Fuji Suprema and 'Maxigala'. Applications in fruits with smaller diameter (8-10 mm) in 'Maxigala' caused excessive thinning. The effect of reducing yield in 'Maxigala' provided a great increase in the average fruit mass. These results show that Brevis may be an important alternative in chemical thinning of apple trees and one single application may be sufficient for thinning even in cultivars with more difficulties in response to chemical thinners.

ENVIRONMENTAL PHYSIOLOGY poster session (07/27/2021)

POSTER NUM: P11

ROSA NUM: 133

PRESENTER: Luz, Alberto Ramos

TITLE: Hand flower thinning strategies and their effect on production and fruit quality of 'Maxi Gala' apple in Southern Brazil

ABSTRACT:

In apple crop, thinning aims to increased fruit size and quality, besides providing constant production over the years. The flower thinning is considered one of the most effective methods to decrease the competition between productive and vegetative organs in plant in the early stage of fruit development, improving the proportion of fruits in higher size categories. The aim of this study was to evaluate different hand flower thinning strategies and their effect on production and fruit quality of 'Maxi Gala' apple in Southern Brazil. The work was carried out in an experimental orchard located in São Joaquim/Santa Catarina State (28°16'30"S, 49°56'09"W, altitude 1,400m). Three strategies of hand thinning during full bloom were tested: keep the queen flower, keep the second flower and keep both the queen and the second flower. Besides of the flower thinning, two more treatments were evaluated: hand thinning of fruits (12 mm) and chemical thinning (Maxcel®, 200mL/100L, 5-8 mm) + hand thinning of fruits (12 mm). At harvest, number of fruits per tree, production per tree and yield were evaluated; also the fruits were classified in size classes and evaluated for maturity attributes. The thinning that kept both the queen and the second flower provided higher production than the one that kept only the queen flower, and a higher number of fruits than chemical thinning (5-8 mm) + hand thinning (12 mm). On the other hand, this treatment provided to fruits a lower fresh mass, as well as decreased the proportion of fruits classified as big (> 161 g), and increased the proportion of fruits classified as industry (< 101 g) when compared to the trees submitted to the thinning that kept only the second flower and the chemical thinning (5-8 mm) + hand thinning (12 mm).

ENVIRONMENTAL PHYSIOLOGY poster session (07/27/2021)

POSTER NUM: P12

ROSA NUM: 212

PRESENTER: Bradshaw, Terence

TITLE: Effects of summer applications of NAA and Ethephon on return bloom, yield, tree growth, and juice quality of cider apple cultivars

ABSTRACT:

For commonly grown dessert cultivars chemical thinning or the removal of some fruit each season helps maintain fruit size, quality, and annual bearing characteristics. Chemical thinning is achieved with applications of carbaryl at petal fall alone or in combination with other plant growth regulators (PGRs). This traditional thinning program used for dessert fruit, does not adequately thin European-origin cider apple cultivars, resulting in insufficient return bloom or inconsistent cropping from year to year. On dessert apple cultivars with biennial bearing tendencies, midsummer applications of PGRs is used to enhance fruit bud development for the following year. In 2019, experiments were conducted in two apple orchards in Vermont, U.S.A with the primary objective to evaluate the effects of naphthaleneacetic acid (NAA) and ethephon alone and in combination with carbaryl on return bloom, crop yield, and fruit and juice quality. Although there were no differences among treatment groups, 'Harry Masters Jersey' and 'Kingston Black' both demonstrated biennial tendencies producing few flowers and fruit in 2020 and a full return bloom in 2021. Ethephon applications alone and in combination with carbaryl showed advanced ripening and fruit softening in 'Somerset Redstreak' during the year of treatment. 'Kingston Black' had increased fruit softening with ethephon only applications. Growth regulator treatments did not have a consistent effect on juice quality between cultivars. During the treatment year, 2019, all ethephon treatments on 'Somerset Redstreak' had a higher pH and juice from trees treated with Ethephon and carbaryl had a lower titratable acidity. 'Kingston Black' juice was unaffected by PGR applications.

TRAINING SYSTEMS poster session (07/28/2021)

POSTER NUM: P13

ROSA NUM: 193

PRESENTER: Cabrera, Carlos Danilo

TITLE: Performance of different training systems in a pedestrian orchard for an efficient apple production

ABSTRACT:

Fruit Wall training system in apple cultivation is proving to be efficient, producing good yields with high quality fruit. Given the production conditions of Uruguayan family growers, it is necessary to move forward and evaluate the possibility of low fruit walls - MURBA. This pedestrian system allows to perform all cultural practices from the ground, including mechanization (pruning, thinning, weed control and in the future, the harvest). With the objective of evaluating the potential of MURBA system, a trial with 'Gala Baigent' (Brookfield®) apple, on M9 Pajam 2 rootstock, was installed at INIA Las Brujas, 'Wilson Ferreira Aldunate' Experimental Station, Canelones, Uruguay, in 2014. Five training systems were evaluated. Four were multi-leader plants: three leaders, four leaders, 'Guyot', horizontal palmette; and one leader as control. Planting distances were 3 m between rows with a variable distance between plants: 0.75 m in one leader, 1 m in three leaders, and 1.5 m in four leaders, 'Guyot', and horizontal palmette, giving different quantity of leaders per unit of area. Plants were laterally pruned and topped at 2.20 m after harvest with pruning machine. Plants also were hand pruned in winter, eliminating vigorous branches. Consistent differences in fresh weight of pruned branches have been identified and correlated negatively with number of leaders per hectare. Cumulative production of different treatments was between 50 and 70 ton per hectare, considering the first three harvests (2017-2019). Although the one axis was the most productive treatment in MURBA, those with multileader plants were more balanced and required less hand labor for pruning. Despite the fact that the economic analysis is still in process, MURBA appears to be, a productive and suitable system for handling pedestrian apple crop in the Uruguayan conditions.

TRAINING SYSTEMS poster session (07/28/2021)

POSTER NUM: P14

ROSA NUM: 147

PRESENTER: Ibell, Paula

TITLE: "Canopy characteristics in a three-year old high-density mango (*Mangifera indica*) orchard with different training systems"

ABSTRACT:

Mangoes (*Mangifera indica*) are typically grown as large trees, in wide-spaced orchards using open or closed vase training system. In Northern Australia, planting mango orchards at high density with different tree training systems has shown an improvement in orchard productivity and fruit quality. However, there is currently little information on how variety, planting density and tree training influence canopy size and leaf distribution and composition within canopies. We report on the effects of three planting densities (low density (208 tree/ha), medium density (416 tree/ha) and high density (1250 trees/ha)) and three tree training systems (conventional), single leader and espalier in the mango varieties 'Keitt', 'Calypso' and 'NMBP 1243' on canopy development up to 5 years of age. Canopy development was evaluated by using canopy length, width and height, the total number of leaves, individual leaf area, the leaf area index (LAI) and the leaf area density (LAD) measured at the lower, middle and upper portions of the canopy. Trees planted at the high density had narrower (across the row) and shorter (along the row) canopy dimensions, although this varied with variety, planting density and tree training system. Variety had a main effect on the number of leaves in the canopy. Canopy portion, training system and planting density interacted to influence the distribution of leaves in the canopy. While canopy portion influenced individual leaf area and LAI, variety influenced the individual leaf area and LAI in combination with the different training systems and planting densities. Trees planted at high density had the greatest LAI compared to medium and low-density trees, indicating a more efficient use of orchard space. In all varieties, leaf area density was higher in the single leader and espalier trees compared to the conventionally trained trees. Variety, planting density and training systems influenced tree size by changing the distribution and composition of leaves in mango canopies in intensive mango orchards.

TRAINING SYSTEMS poster session (07/28/2021)

POSTER NUM: P15

ROSA NUM: 19

PRESENTER: Xu, Hao

TITLE: Fruit quality in relation to leaf area index, leaf wetness and crop load in two canopy training systems of sweet cherry *Prunus avium* var. Skeena on Gisela 6 rootstock

ABSTRACT:

Innovative canopy training systems have been implemented in sweet cherry production by a rising number of orchards in North America, to achieve high yield efficiency and to improve fruit quality through less labor-dependent horticultural management. Quantitative comparison between Tall Spindle Axe (TSA) and Upright Fruiting Offshoot (UFO) can improve our understanding of the differences and advantages of the two systems. In this study, TSA and UFO of Skeena cherry (*Prunus avium* var. Skeena) on Gisela 6 rootstock grown under the semi-arid climatic condition in Summerland (British Columbia, Canada) were evaluated in canopy leaf area index, leaf wetness, crop load and fruit quality attributes. TSA and UFO did not differ significantly in tree trunk vigor in the 9th or 10th years of planting, or in canopy light interception, leaf area index or monthly wetness duration in the growing season of 2019. TSA showed higher yield potential at the cost of compromised fruit quality. UFO led to more consistent fruit quality within the population and between the years, possibly attributed to its less variation in yield and more uniformed canopy light conditions. In both systems, frost injury in the early spring led to the decrease in yield in 2019, with the decrease in TSA being more drastic. Under similar crop load in 2019, TSA and UFO showed no difference in susceptibility to fruit cracking. Crop load higher than 20 fruits per cm² of TCSA had negative impacts on fruit weight and SSC, and therefore, should be avoided in both systems. When the ultimate goal is high yield, TSA could be a preferred structure for Skeena and cultivars of similar fruiting habits. On the other hand, UFO presented some advantages in maintaining fruit quality consistency.

TRAINING SYSTEMS poster session (07/28/2021)

POSTER NUM: P16

ROSA NUM: 93

PRESENTER: Pieper, Jeff

TITLE: The influence of rootstock vigor and fruit position in the canopy on internal peach fruit quality

ABSTRACT:

Inadequate light penetration throughout the tree canopy can negatively influence fruit quality. Varying levels of peach rootstock vigor create distinct light environments for developing fruit. Five rootstocks of differing vigor: vigorous ('AtlasTM' and 'Bright's Hybrid #5[®]'), moderate ('Krymsk[®]86' and 'Lovell') and dwarf ('Krymsk[®]1') with cv. 'Red Haven' as scion were studied for their impact on internal fruit quality and maturity. Prior to harvest, the canopies from each rootstock were divided into two zones: upper (>1.5 m) and lower (<1.5 m) canopy and were assessed for photosynthetic active radiation interception (iPAR) and transmission (tPAR) with a line quantum sensor. Fruit physiological maturity (index of absorbance difference, IAD) and dry matter content (DMC) were assessed pre-harvest by scanning 10 fruit in each zone using a non-destructive handheld near-infrared (NIR) sensor that was calibrated by our group. Upper canopy advanced fruit maturity and elevated DMC due to higher tPAR values when compared to the lower zone, across all rootstocks. However, the relative Δ DMC% and Δ tPAR% among canopy positions was lower in the dwarf rootstock. A detailed fruit quality analysis at commercial harvest stage on fruit of equal maturity coming from mid-canopy characterized the true impact of rootstock vigor on peach quality. There was no significant difference in crop load (fruit no./trunk cross sectional area (TCSA) cm²) between rootstocks. Yield (kg/tree), fruit weight and size increased significantly with increasing vigor (TCSA) and iPAR levels. However, DMC and SSC increased significantly with decreasing vigor and iPAR levels, potentially due to reduced intra-tree shading and better light distribution within the canopy. These outcomes show that while rootstock genotype and vigor are influencing peach fruit development and quality, their effect on light distribution may play a more significant role in achieving optimal yield and fruit quality.

TRAINING SYSTEMS poster session (07/28/2021)

POSTER NUM: P17

ROSA NUM: 128

PRESENTER: Sousa, Miguel Leão de

TITLE: Effects of planting density on light interception and distribution, physiological and agronomic performance of 'Gala' apple orchards

ABSTRACT:

Portuguese apple orchards located in the central west region, registered as 'Maçã de Alcobaça' protected geographical indication (EC 1107/96), have grown under managing practices according the principles of precision and integrated production. High density orchards have spread, however without a well-defined and uniform model. Four orchards of *Malus domestica* Borkh 'Gala Schniga', grafted in M9 rootstock, with 1481 (4.5x1.5 – O1), 3704 (3.0x0.9 – O2), 4082 (3.5x0.7 – O3) and 4762 (3.5x0.6 – O4) trees per hectare were analyzed in order to compare light interception and distribution, photosynthesis, stomatal conductance, intrinsic and instantaneous water use efficiency (WUE), specific leaf area (SLA), reflectance parameters, yield, fruit distribution and weight per position and harvest. Orchards O4 and O2 intercepted more light at solar noon, with maximum intercepted fractions near of 0.50 and 0.45 respectively. O3 is the youngest orchard and the one with less tree volume (9282.6 m³ ha⁻¹), reflected on maximum intercepted fraction similar to O1 at solar noon (below 0.35). Along the basal branch, O2 intercepts more than 50 and 75% of the incident radiation after the first 55 and 65 cm nearest of the trunk, whereas O1 achieved these values at 65 and 81 cm respectively. O1 and O3 showed the highest photosynthetic rates and stomatal conductance in outside leaves at 1500 and 150 μmol m⁻² s⁻¹. O4 showed the best intrinsic and instantaneous WUE, SLA in the beginning of the season, normalized difference vegetation index (NDVI), maximum quantum yield of the PSII photochemistry, performance index (PIabs) in the leaves located outside and higher productivity (110 t ha⁻¹). Average fruit weight and among of fruits from the first harvest were also higher in O4 and O2, as a consequence of light exposed surface area. On the contrary, although high productivity, O1 had the higher fruit number per tree and the smaller fruit weight. This work pretends to clarify the most appropriate range of tree densities to use in modern orchards, benefits and special cares in high density orchards management.

TRAINING SYSTEMS poster session (07/28/2021)

POSTER NUM: P18

ROSA NUM: 140

PRESENTER: Mac An tSaoir, Seán

TITLE: Pear systems trial, Conference on Adams and KWC rootstocks in Ireland.

ABSTRACT:

Four pear growing systems were evaluated for yield - V -system (four stems), four branch candelabra with one main stem (five stems), four branch candelabra with two main stems (six stems) and the traditional system (one main stem). The trial ran from 2011 until 2018. In 2012 and 2013 there was no fruit set, despite an abundance of flowers. In 2014 and subsequently, artificial bumble bee hives were obtained three weeks before the normal supply date for the apple orchards. Thus fruit set and yield were obtained from 2014 on. The accumulated yields (tonnes per hectare) for the four systems at the end of the trial were: traditional - 41.2; V system- 96.4 ; 5 stems - 63.4 ; and 6 stems - 68.1 respectively. The V system was significantly superior to the others and the 5/6 stem systems were significantly superior to the traditional. There was no significant difference between the two rootstocks.

TRAINING SYSTEMS poster session (07/28/2021)

POSTER NUM: P19

ROSA NUM: 207

PRESENTER: Bortolotti, Gianmarco

TITLE: Individual upright physiological traits in an apple 'Guyot' training system

ABSTRACT:

Light intercepted by the tree drives photosynthesis and seasonal light integrals have been correlated to yields. Innovative training systems have recently been proposed, that share the concept of forming a 2D instead of a 3D canopy. This shift towards ultra-thin hedgerows allows making the orchard better suited for automation/robotization while increasing light interception to further boost yields. Examples of such innovative training systems are the UFO, the "Planar Cordon", and the "Double-Guyot". The latter two are based on 2 horizontal permanent cordons from which several semipermanent shoots (uprights) are grown vertically, to form a very thin, 2D fruiting wall. For the precise management of such trees, it would be useful to know whether the uprights are physiologically independent of each other or not. We report results from a 4-year-old Rosy Glow orchard trained as "Guyot", grafted on Pajam 2 rootstock, at 1443 trees ha⁻¹, growing in the Po Valley (Ferrara) - Italy. Fruit number and development along the season, upright dimensions and leaf gas exchanges were measured on uprights with contrasting, naturally occurring crop loads (high and low); a number of uprights with the different crop loads were girdled. Initial results indicate that the uprights are physiologically connected, since in the girdled ones, photosynthesis is lower; crop load appears to stimulate photosynthesis, in both types of uprights. Fruit skin colour from the girdled uprights at harvest was superior, both as intensity and extension as well as Brix° parameter. Flesh firmness resulted lower for this treatment, highlighting an earlier maturity. Correlations between yield, quality, and upright size (length, cross sectional area), trunk cross sectional area (TCSA) and leaf area (LA)/leaf area index (LAI) are under investigation. Preliminary results indicate interesting relations between some of these parameters and yield. We conclude that the uprights should not be considered independent of each other, and that accurate crop load control for each upright is necessary for precision orchard management of these novel training systems.

TRAINING SYSTEMS poster session (07/28/2021)

POSTER NUM: P20

ROSA NUM: 47

PRESENTER: Rubauskis, Edgars

TITLE: Preliminary evaluation of mechanical pruning of apple canopy at various environments

ABSTRACT:

In the last decades the orchard mechanization has become important due the lack of specialized labour and the increase of production costs. This situation leads to an investigation about cultivars adaptability to mechanical pruning. The aim of this trial was to investigate various pruning technologies, and the possibility to apply them in Latvia conditions. This research was carried out on three farms in different regions of Latvia and is supported by the project “Innovative, economically substantiated solutions to improve the efficiency of apple and raspberry yield and quality” funded by the European Agricultural Fund for Rural Development. Depending on locations two to four apple cultivars were compared taking in account the rootstocks and the planting density utilized by the farmer. In two of three trial sites the rootstock was B.396 while in the third was MM106. The following pruning technique were compared: hand pruning at the beginning of vegetation (control), hand pruning combined with hand summer thinning of canopy, mechanical pruning at spring combined with additional hand pruning at spring and summer time, as well as the mechanical pruning during vegetation combined with manual pruning. The time necessary for each procedure and number of manual cuttings were counted. The yield and fruit quality have been recorded. The economic efficiency of mechanical pruning was calculated based on the data obtained. Farm expenditures were modelled based on various development scenarios (increase in labour costs, increase of orchard areas, etc.).

TRAINING SYSTEMS poster session (07/28/2021)

POSTER NUM: P21

ROSA NUM: 189

PRESENTER: Marino, Giulia

TITLE: Plant-based water stress sensing in two olive cultivars with different physiological response to drought

ABSTRACT:

A large portion of modern olive plantings is dominated by one main genotype (Arbequina) grown at super high density (SHD, 1500 tree/ha), leading to a dangerous reduction in olive biodiversity. Very few cultivars have growth and productive patterns that fit the SHD system requirements. Partial intensification and mechanization with several cultivars may represent the safest and easiest alternative. The efficient use of limited natural resources, such as water, in SHD requires precise management. Continuous plant-based sensing is a promising approach to manage water so far mainly tested on the cultivar Arbequina. In this study, we evaluated the sensitivity of two promising indicators of plant water status in two Sicilian olive cultivars different for their degree of drought resistance: 1) the minimum daily output pressure (Ppmin) measured with the leaf patch clamp pressure (LPCP) probe and 2) the maximum daily relative growth rate difference (RGRDelta) measured with fruit gauges. Both indicators were able to detect drops in midday stem water potential (Ψ_{STEM}) below the value of -2.0 MPa. The sensitivity of these indicators to changes in Ψ_{STEM} below this threshold was higher in the most drought resistant cultivar. The need to tailor plant-based water management protocols on genotype-specific physiological responses to water deficit is discussed.

TRAINING SYSTEMS poster session (07/28/2021)

POSTER NUM: P22

ROSA NUM: 16

PRESENTER: Kviklys, Darius

TITLE: Pruning Type and Tree Growth Control Methods Determine Apple Yield and Fruit Quality

ABSTRACT:

The study was performed with apple cv. 'Rubin' grafted on dwarf P 60 rootstock at the experimental orchard of the Institute of Horticulture, Lithuanian Research Centre for Agriculture and Forestry in 2017-2019. Orchard planted in 2010. Planting distances 1.25 x 3.5 m. Seven treatments of tree vigour control were established including combinations of mechanical pruning, tree trunk incision and application of prohexadione-calcium. The strongest growth was recorded at control treatment where slender spindles were maintained manually. Significantly the shortest shoots grew where mechanical pruning was applied. Tendency of higher yields was recorded at mechanical pruning treatments. Trunk incision and summer pruning determined significantly lower fruit mean weight and diameter. Multiple application of prohexadione-calcium increased fruit weight. Less coloured fruits were at mechanical pruning treatments except for combination of mechanical pruning and tree trunk incision.

TRAINING SYSTEMS poster session (07/28/2021)

POSTER NUM: P23

ROSA NUM: 22

PRESENTER: Lordan Sanahuja, Jaume

TITLE: Use of Click Pruning to Improve Fruit Quality of 'Gala' Orchards

ABSTRACT:

Fruit quality is among the main factors that drives orchard profitability. In recent years, the use of bi-axis systems in 'Gala' orchards have significantly improved yield and color. However, since 'Gala' has a type III growth habit, aging of long pending branches reduces fruit quality. In order to address that, a field trial was planted in 2015 at the IRTA Mas Badia Agricultural Experiment Station in La Tallada d'Empordà, Spain. This trial compares 2 pruning strategies (long vs click) on Bibaum® trees planted at 3 m x 1.2 m with 'Annaglocov' as the scion cultivar and M.9 as the rootstock. At 3rd leaf, long pruning provided higher yields than click pruning (13.3 vs 9.9 kg/tree). After that, click pruning exceed long pruning: 14.6 vs 10.0 kg/tree at 4th leaf, and 19.2 vs 16.2 kg/tree at 5th leaf, with a cumulative production of 121.4 vs 109.7 t/ha, click vs long pruning respectively. Overall, fruit weight and fruit size tended to be larger for click than long pruning (176.2 g vs 154.4 g and 73.7 mm vs 71.3 mm). At 3rd leaf, fruit caliper was also larger for click pruning, with higher percentage of fruits between 70-80 mm (79% vs 67%). The percentage of fruits > 80 mm for click pruning was 7%, whereas for long pruning it was < 1%. At 4th leaf, fruit caliper was also larger for click pruning, with higher percentage of fruits between 70-80 mm (76% vs 68%). The percentage of fruits > 80 mm was very similar in this case, (1.7% vs 2.1%, long vs click respectively). Overall no differences were observed between both pruning techniques regarding color. However, this may change as the orchard matures. Click pruning seemed to be a good alternative to long pruning, by increasing yield and fruit size during the early years of the orchard life. However, these observations may shift in the upcoming years, as the trees mature and sustain high yields over the seasons. Therefore, these results need to be confirmed in the future.

TRAINING SYSTEMS poster session (07/28/2021)

POSTER NUM: P24

ROSA NUM: 48

PRESENTER: Rubauskis, Edgars

TITLE: Performance of orchard systems in Nordic climate

ABSTRACT:

The efficient usage of sunlight becomes an important factor when related to the productivity, fruit quality and labour efficiency in orchards. The efficient usage of the daylight is significant especially in the Nordic conditions where sunlight is limited. To improve usage efficiency of the daylight various training systems were developed and tested for apple trees in the past decades. Performance of cultivars differ due to the various growth and production habits. It is important that the effectiveness of training and even orchard system tests should be combined with resistant cultivars in order to improve eco system sustainability. The aim of the trial was to evaluate the suitability of orchard and canopy training systems combined with perspective cultivars for growing in Latvia. Performance of different origin cultivars 'Zarya Alatau', 'Alesya' and 'Monta' (Vf) on B.396 rootstock were tested for Nordic climate conditions in four orchard systems, where the canopy of trees were trained by adapting principles of vertical axis (2500 trees per ha), slender spindle (1666 trees per ha), U.F.O. and trees with two axis (1265 trees per ha). The beginning of fruit production varied by cultivars. Regardless of the orchard system the cultivar 'Zarya Alatau' had the third yield contrary to 'Alesya' which the first fruits had only at the fourth vegetation. Influence on the introduction of the fruit bearing had training process of basic elements of each type of canopy when unbranched one-year old trees were used as planting material. At the fourth season 'Zarya Alatau' and 'Monta' had the highest productivity in combination of U.F.O. system following by both cultivars performed like slender spindle. In a young orchard the highest average productivity was found for trees performed into form of vertical axis and slender spindle. The calculation of the trunk cross sectional area which characterizes growth of trees shows no difference among U.F.O., two axis and slender spindle systems. The fruit size is strongly depended on the cultivar and the volume of yield.

TRAINING SYSTEMS poster session (07/28/2021)

POSTER NUM: P25

ROSA NUM: 124

PRESENTER: Lodolini, Enrico Maria

TITLE: Canopy recovery in traditional olive groves

ABSTRACT:

Traditional olive groves still represent the majority of the Italian oliviculture. They are generally characterized by low planting density, considerable age of the trees, often multi-trunk training systems, large size and senescence of the canopies, alternate bearing, absence of mechanization and phytosanitary problems. All these factors, combined with orographic and climatic limitations, often lead to low productions and high management costs, thus increasing abandonment. It is, therefore, necessary to develop efficient agronomic techniques to recover those with good production potential and prepare them to the mechanization of some practices. A three-year research project was initiated in 2018 with the aim to develop innovative techniques to recover and manage traditional olive orchards, with particular emphasis on the rejuvenation of the canopy. Five traditional olive groves were chosen in different Italian Regions (Umbria, Latium, Apulia, Calabria and Sicily) with a representative variety in each area ('Moraiolo', 'Leccino', 'Cima di Bitonto', 'Carolea' and 'Nocellara del Belice', respectively). Research activities are underway to rejuvenate the trees according to a final polyconic vase training system by recovering the functionality and organization of the canopy and simplifying the skeletal structure for a possible use of mechanical equipments. Two different pruning intensities are compared: i) intense, by immediately selecting the final primary branches and ii) light, by reducing gradually the number of branches. Unpruned trees were used as control. Pruning was performed in the spring of 2019, the amount of removed wood was recorded, and morphological and biometric parameters are measured periodically on the trees to monitor vegetative response and fruit production. Results of the first season are presented. The project will provide knowledge on the time required for canopy recovery in terms of vegetation and production for the different varieties studied in each location. This information will help local producers interested in recovering traditional olive orchards.

TRAINING SYSTEMS poster session (07/28/2021)

POSTER NUM: P26

ROSA NUM: 161

PRESENTER: Meyer, Geraldine

TITLE: Impact of the use of biostimulating agents on the establishment of "Maxi Gala" grafted G213 and G212 in a definitive orchard in Southern Brazil

ABSTRACT:

The introduction of the Geneva® series of rootstock in Southern Brazil occur only few years ago. The Brazilian weather conditions induced a high level of abiotic and biotic stresses that are affecting the survival of young apple trees in the nursery and in the orchard. Applications of biostimulants have been used to mitigate plant stress. The aim of this experiment was to verify the impact on of applications of products with biostimulant agents on Maxi Gala apple trees, grafted on rootstocks G202 and G213 to get better survival rates. Young apple trees of G213 and G202 were treated with successive applications of the products with biostimulant agents (Seed® one application of 0.5 L ha⁻¹, and Crop+®, six, at the doses of 0.5 L ha⁻¹ and 1.0 L ha⁻¹). The treated plants were compared with the untreated samples, in each apple rootstock. The results showed that the effects of the treatments were more evident in G213 than G202. In the G213 the treatment increase the bud break of 10% after 17 days of planting. Further, the length of branches at 30 dap until 150 dap was twice that in the control. An increase of 27% in the number of shoots have been noticed. We observed an increase of trunk cross-sectional area. Our data showed an increase in photosynthetic efficiency from 3% to 5% 2 days after treatment. In G202, the treatments increase 12% the bud break and 8% the number of shoots. Treated apple trees presented less severity to Glomerella leaf spot at the end of the cycle, suggesting some tolerance/resistance induction. The rapid establishment of the young apple trees in the orchard with the use of these products guaranteed the success of the planting and the better conditions when subjected to biotic and abiotic stress.

TRAINING SYSTEMS poster session (07/28/2021)

POSTER NUM: P27

ROSA NUM: 213

PRESENTER: Bradshaw, Terence

TITLE: Effect of summer hedging on return bloom, yield, tree growth, and juice quality of apples grown for hard cider

ABSTRACT:

As U.S. growers have increased planting of specialty cider apple cultivars grown specifically for the production of fermented cider, new information is needed to understand how to maintain adequate annual crop yields and improve return bloom. Cider apple cultivars of European origin have been found to respond poorly to traditional crop load management methods using plant growth regulators and traditional return bloom sprays. In this study, tall spindle-trained cider apple cultivars 'Somerset Redstreak' and 'Harry Masters Jersey' and traditional dessert apple cultivars 'McIntosh' and 'Empire' were mechanically hedged in summer 2019 and 2020 to evaluate response on return bloom, yield, tree growth, and juice quality. Treatments consisted of 1) normal winter dormant pruning; 2) mechanical winter dormant pruning with a hedger; 3) mechanical pruning at pink (pre-bloom) bud stage with hedger, and; 4) mechanical pruning at 12-14 leaf stage, in mid-June. In 2020 dormant hand pruned 'McIntosh' had more flower clusters compared to mechanically pruned treatments. 'Harry Master Jersey' essentially did not flower in 2020, and then flowered in 2021 showing a biennial pattern with no differences among treatment groups. There was a noteworthy difference in canopy size for all cultivars the first season, with most hedging treatments being reduced nearly by half. Juice quality was unaffected by hedging treatment for soluble solid content, pH, titratable acidity, and total phenolics. Continued evaluation is needed to understand the long terms effects hedging has on return bloom.

TRAINING SYSTEMS poster session (07/28/2021)

POSTER NUM: P28

ROSA NUM: 168

PRESENTER: Stanica, Florin

TITLE: Vertical axe and Trident canopies influence on several peach and nectarine cultivars

ABSTRACT:

Two canopies and planting systems were tested for 16 peach and 17 nectarine cultivars planted in the Experimental Orchard of the Faculty of Horticulture within the University of Agronomic Sciences and Veterinary Medicine of Bucharest. Trees grafted on Myrobalan 29C, Saint Julien A, Adesoto and GF677 rootstocks, were planted at 4.0 x 1.5 m, for Vertical axe and 4.0 x 2.0 m, for Trident canopy, respectively. For canopy formation, a trellis with 3 wires and 4,0 m high concrete poles was installed. An integrated orchard technology was applied and the interrow was covered with grass mixture, mowed periodically, while the tree row was kept cleaned with herbicide and mechanical tillage. Irrigation was applied with a drip line with self-compensating drippers, installed on the first wire. For each cultivar/rootstock combination and canopy, tree vigour expressed as tree height, trunk and vertical axes cross sections, total and average shoots length was measured. Fruit set, yield and several tree productivity indexes were also determined. At picking and ripening moment, several fruit characteristics as: fruit size, fruit weight, flesh firmness and the content in soluble sugars and dry matter have been measured. The results showed a significant difference between varieties, rootstocks and the two studied canopies.

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P29

ROSA NUM: 88

PRESENTER: Baldassi, Claudia

TITLE: Evaluating different rootstock-crop load combinations to control biennial bearing and fruit quality of Honeycrisp' in Washington State

ABSTRACT:

Modern apple orchards combine dwarfing rootstocks and crop load management to achieve high yields and optimize fruit quality. Precision crop load management is particularly relevant for apple cultivars with marked biennial bearing tendencies, like Honeycrisp™. Previous studies have been conducted to define optimal crop load thresholds for Honeycrisp™ in Washington State, however, none evaluated at the same time the impact of different size-controlling rootstocks and crop load adjustments. This research was designed to investigate the effect of different rootstock-crop load combinations on Honeycrisp™ fruit quality and return bloom. In Winter 2013 'Cameron Select' Honeycrisp™ trees grafted on five rootstocks (M.9T337, B.9, G.935, G.41, and G.11) were planted in a commercial orchard in Quincy (WA) and trained on a 4-wire V-trellis. In 2019, experimental trees with uniform trunk-cross sectional area (TCSA) were hand thinned to three crop loads (3, 5 and 7 fruit/cm² TCSA) after June drop. At commercial maturity in September all fruit were harvested, sized and assessed for defects, while two subsets were set aside for fruit quality analysis, respectively after a one-month and a six-month storage period (1 °C, regular atmosphere). Overall, crop load had a significant effect on production, which ranged from 21.26 (crop load 3 fruit/cm² of TCSA) to 34.03 Mton/acre (crop load 7 fruit/cm² of TCSA). Fruit quality assessment after one-month storage showed that both rootstocks and crop loads impacted maturity and quality parameters, including size, weight, firmness and soluble solid content (SSC). These results, combined with quality analysis data after six months of storage, return bloom data and another season of investigation, will help determine some well performing rootstock-crop load combinations for Honeycrisp™ orchards in Washington State.

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P30

ROSA NUM: 186

PRESENTER: Einhorn, Todd

TITLE: A 30-year summary of NC-140 pear rootstock trials

ABSTRACT:

Pear rootstocks have been extensively evaluated over the past 30 years in the US. Independent research efforts led to advancement of several selections for field testing in the USDA multi-state collaborative project, NC-140, currently titled "Improving Economic and Environmental Sustainability in Tree Fruit Production Through Changes in Rootstock Use". These field trials also included imported rootstocks from international breeding or selection programs. Plant material primarily consisted of *P. communis* clones and only rarely included clones of alternative genera, such as *Cydonia* sp. (Quince), likely due to their limited cold hardiness for northern US production regions. The objective of these coordinated rootstock trials was to evaluate the performance of major US commercial cultivars, 'Bartlett' (i.e., Williams'), 'Bosc' or 'd'Anjou' and to a limited extent varieties of minor commercial importance, over a wide range of sites and climates. Historically, trials persisted for the first 10 years and experimental designs comprised single-tree replicates established at relatively low to moderate densities (3.5 × 5 m), in part due to the relatively poor vigor control of *Pyrus* sp. rootstocks. The traits typically evaluated were survivability, trunk size as an integrative measure of dwarfing, suckering, precocity, fruit size (target of ~200 to 250 g) and productivity. Incidence of pear decline and fire blight were observed. The first coordinated trial was established in 1988 on 14 sites throughout North America and evaluated 9 rootstocks (Bartlett seedling, *P. calleryana*, *P. betulifolia*, Quince C and five *P. communis* Old Home × Farmingdale [OH×F] clones [40, 217, 333, 339, and 519]). *P. calleryana* and *P. betulifolia* were excessively vigorous. OH×F 40 and 333 had the highest yield efficiency; however, the former was not sufficiently size controlling and the latter produced small fruit. In 2002 and 2005, an assemblage of internationally-sourced *P. communis* clones were evaluated (Pyrodwarf, Pyro2-33, Fox 11, Fox 16, Pi-BU 3, 708-36 and BM2000) with OH×F 87, OH×F 40, Horner 4 and a seedling of 'Winter Nelis'. Different tree densities were tested with spacings ranging from 1.5 m × 3 m to 2.7 × 4.6 m. In general, Pyro2-33 and OH×F 87 had the best overall performance (high yield efficiency with good fruit size). Based on these data, a 2013 factorial design was established with Pyro 2-33, OH×F 87 and OH×F 69 (inclusion of the latter due to improved micropropagation) in high-density plantings of varied in-row spacing (1, 1.5 and 2 m × 3 m alleys) trained to multiple systems (V, bi-axis, spindle). Preliminary data indicate greater dwarfing on Pyro 2-33 and OH×F 87 compared to OH×F 69. The leaders of bi-axis trees are ~50% smaller than single axis trees. Differences in the productivity of cultivars varied with training system and in-row spacing but indicate that orchards on *P. communis* rootstocks can be effectively managed in high-density plantings. Future NC-140 trials will assess *Amelanchier* sp. and cold hardy quince clones based on preliminary field evaluations.

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P31

ROSA NUM: 210

PRESENTER: Reighard, Gregory L

TITLE: Solutions to the Armillaria Root Rot Affecting the U.S. Stone Fruit Industry

ABSTRACT:

Stone fruit and nut crops (peach, almond, and cherry) provide vital contributions to human health, communities, and economies across the U.S. These crops are facing an increasing uncertainty of economic stability in their traditional growing regions due to significant tree losses from a devastating fungal threat called Armillaria Root Rot (*Armillaria* spp. aka ARR). U.S. stakeholders and industries that span these crops have given ARR the highest priority for the development of short and long-term solutions to preserving these critical crops and industries. The most sustainable and effective approach to mitigate the ARR threat to peach, cherry, and almond production in the U.S. is to develop genetically durable ARR-resistant rootstocks. While long-term solutions are required, short- and medium-term solutions are necessary, which is why the U.S. Prunus community developed a large-scale USDA grant proposal. This project, funded for four years from September 2020, includes a trans-disciplinary (-omics, breeding, plant pathology, plant physiology and propagation, horticulture and extension, agricultural mechanization, socio-economics), multi-crop, multi-institutional team of researchers, partnered with growers and tree-fruit nurseries. The collaborative will identify resistant germplasm, characterize the mode(s) of resistance and understand the genetic basis of resistance by linking the genome with phenome through systems-scale datasets, such as transcriptomics and metabolomics, to enable genomic solutions and translational breeding to incorporate and combine natural sources of ARR resistance for new ARR resistant rootstocks in the longer term. In the shorter term, industries will receive an immediate benefit with new cultural practices and direct utilization of new sources of resistance in nurseries. Socio-economic research will determine economic effects of ARR and impact of proposed solutions to provide guidelines for growers, while outreach and extension activities will target peach, cherry, and almond growers affected by ARR and tree-fruit nurseries, so that new knowledge can be quickly disseminated and feedback obtained.

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P32

ROSA NUM: 24

PRESENTER: Suran, Pavol

TITLE: Sweet cherry rootstocks in high density orchard without irrigation in Central Europe

ABSTRACT:

Climatic conditions have started to change also in the Central Europe. Big issue is hot and dry weather in summer and moreover water management. Although, lack of precipitation could be substituted by irrigation, water use is limited in dry summer. This is the reason why some orchards stay un-irrigated. Research on the influence of the weather on the growth and yield of cherries in the non-irrigated orchard has been launched in Research and Breeding Institute of Pomology Holovousy. Czech late ripening sweet cherry varieties 'Justyna', 'Kordia' and 'Tamara' were chosen to evaluation. These varieties were grafted on rootstocks Weiroot 720, PiKu 1, Gisela 3, Gisela 5 and Krymsk 6 in a plant spacing 4 x 1.5 m. Trees grafted on Gisela 6, Krymsk 5, Colt and Alkavo rootstocks were planted in a spacing 5 x 1.5 m. Yield, yield efficiency, flower set, fruit set, start of blossoming, length of one-year shoots (cm) and TCSA (cm²) were evaluated. The highest harvest was 4.0 kg/tree, 4.67 kg/tree, 5.17 kg/tree in 'Justyna' on PHLA, 'Kordia' on Krymsk 5, 'Tamara' on Gisela 3, respectively.

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P33

ROSA NUM: 49

PRESENTER: Rubauskis, Edgars

TITLE: Evaluation of dwarf rootstocks for sustainable orchards in Latvia

ABSTRACT:

It is difficult to find the exact cultivar/rootstock combination for the growing conditions of different areas of production. The most common rootstock M.9 has no winterhardiness and is susceptible to several pests. The breeding programs of apples aim to select new disease-resistant cultivars, to use in combination with dwarfing rootstocks. The goal of this study was to evaluate dwarf rootstock and selected compatible and suitable cultivars for the climatic conditions of Latvia. Performance of different origin cultivars 'Gita' (Vf resistant), 'Pamatj Semakinu', 'Alesya' and 'Alwa' on rootstocks B.9 and PB 4 were tested for orchard system planted with a planting density of 1,923 tree/ha. In general, during the last ten years, small growth has been observed for cultivars 'Pamatj Semakinu' and 'Alesya'. This low level of growth impact the productivity. Yield efficiency differ on the basis of the rootstocks. For 'Pamatj Semakinu' yield efficiency was higher on B.9, while the scab resistant cultivar 'Gita' perform better on rootstock PB 4. The fruit size was cultivar dependent only. Larger fruits has been recorded on cv 'Pamtj Semakinu', while the smallest on cvs 'Alesya' and 'Alwa'. Some interaction between rootstocks and cultivars combination was observed. Alternate bearing has been noticed between years 7 and 8 of the trial. Bienniality was less evident on cv 'Pamatj Semakinu' and cv 'Alwa' grafted on B.9 compare to the combinations with PB 4. In the case of cultivars 'Gita' and 'Alesya' the behaviour was opposite.

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P34

ROSA NUM: 50

PRESENTER: Farinelli, Daniela

TITLE: First selection of non-suckering rootstocks for the hazelnuts cultivars

ABSTRACT:

One of the problems of hazelnut growing is the suckering habit of the species, which varies according to the cultivar. Sucker removal is a major source of costs and environmental pollution, when it is performed by herbicides. Further to the lack of sucker emission, rootstocks can improve pest and disease resistance, drought tolerance and kernel quality. The use of non-suckering rootstocks (*C. colurna*) proved to be a solution in the Balkan countries, although it is currently based on seedlings. Recently, some Italian nurseries started to produce clonal rootstocks by in vitro propagation, starting from genotypes not selected for specific traits. A trial to select non-suckering rootstocks was carried out by comparing trees of the main Italian cultivars (Tonda Gentile, Tonda di Giffoni, Tonda Romana and the newest released Tonda Francescana[®]) grafted on a population of *C. colurna* to own - rooted ones. After four years of study a first selection of the rootstocks was performed, based on tree vigor, early bearing and on yield efficiency that resulted higher or similar to the best control trees of the same cultivar. The rootstock TGF2P4 resulted to be the best for Tonda Giffoni cv, for vigor and yield efficiency; TRF7P5, followed by TRF5P1 and TRF6P3 for Tonda Romana cv, for higher yield and vigor; TGLF2P17 and TGL2P20 for Tonda Gentile, for higher yield; TFF7P16 and TFF718 for Tonda Francescana[®] for vigor and yield similar to the control trees. These rootstocks will be in vitro propagated to have clonal rootstocks with improved agronomic traits.

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P35

ROSA NUM: 75

PRESENTER: Lepsis, Janis

TITLE: Preliminary results of sweet cherry rootstock evaluation for cultivar 'Arthur'

ABSTRACT:

High winter-hardiness of sweet cherry cultivar-rootstock combinations is required for growing in Latvia. The necessity of rootstocks suitable for intensive growing and having a beneficial impact on cultivar winter-hardiness becomes more actual in the conditions of increasing temperature variation and cold extremes. The most widespread rootstock for sweet cherries in Latvia is *Prunus mahaleb*, however, this rootstock is not suitable for intensive sweet cherry orchards due to its vigorous habit. Therefore it is necessary to find new rootstocks adapted to local climate. In 2014, the trial was established in the Institute of Horticulture (LatHort), in Latvia, where five clonal rootstocks: 'Piku 1', PHL-A', 'Gisela 5', Gisela 6', 'VSL 1', and generative rootstock *P. mahaleb* (control) were tested for sweet cherry cultivar 'Arthur' (Estonian breeding). Cherries were planted at the distances of 5×3.5 m with three trees per plot in three replications. Flowering intensity was estimated by scoring, and tree health status was evaluated based on visual observations of the trunk and shoot development and/or damages after overwintering, and tree viability was observed during the vegetation period. During the first five investigation years, trees on the rootstock 'Gisela 5' had the highest viability and the best health status. The highest flowering intensity was observed for trees on the rootstocks *P. mahaleb* and 'Gisela 5'. The highest tree mortality was observed for rootstock 'Piku 1'.

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P36

ROSA NUM: 110

PRESENTER: Fazio, Gennaro

TITLE: Selection of apple rootstock breeding families for *Phytophthora* crown rot resistance

ABSTRACT:

Crown and root rot of apple rootstocks caused by *Phytophthora* species is an important disease that causes major losses in apple production areas. Crown and root rots are often associated with major abiotic stresses like prolonged water submergence and poorly drained or compacted soils. *Phytophthora* species are also implicated in the replant disease complex. Resistance to crown and root rots caused by *Phytophthora* species exists within the apple rootstock germplasm. The Geneva® apple rootstock breeding program has been active in the selection for crown rot resistance within its germplasm. In 2009 we conducted a replicated experiment featuring 16 full sib families representing crosses between elite rootstocks and wild *Malus* species to validate the reliability of the selection method that we had been using. The method established in the 1970's, required the inoculation of young seedlings, 2 weeks after emergence, with a mixture of several *Phytophthora* strains collected throughout the U.S.A. and subsequent root submergence with cool water for 76 hours. The experiment was set up with four replicates of 40 full sib seedlings per flood basin. Full sib family percent survival and flood images were collected three weeks after inoculation. The results indicate that in general the inoculation was successful as the difference between the control flooded non-inoculated treatment (~83% survival), the control non-flooded/non-inoculated (~87% survival) was minimal while the flooded treatment had a survival of ~26%. While the treatment seemed to work overall, there were for the most part no significant differences between full sib family survival means, probably caused by localized variation within inoculation bins and between bins where one full sib family would display. Only one family (G.41x*Malus sieversii* pool 4) displayed higher than normal survival (~47% survival). This may indicate an improved source of resistance to crown rot within the pollen parent of that family. However the variance within inoculated family replications was high and may indicate potential escapes up to 15% of the total survivors. More research is needed to improve the inoculum type and reliability of this important selection parameter within Geneva® apple rootstocks.

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P37

ROSA NUM: 111

PRESENTER: Fazio, Gennaro

TITLE: Apple rootstocks can modulate the chilling requirements of grafted scions

ABSTRACT:

Apple rootstocks modify scions at the molecular level modulating gene expression and hormone flux. Reports about some of the Geneva® apple rootstocks showing increased productivity in low chill environments by causing more floral and vegetative buds to break in the top 1/3 of apple trees featuring high chilling requirement scions like Gala (~890) and Fuji (~1150) stimulated us to validate these observations. We used an existing, mature (8th leaf) orchard featuring a full sib population of rootstocks derived from the cross between 'Ottawa 3' and 'Robusta 5' that had been grafted with Gala scion. We harvested 30 cm one-year growth shoots for a replicated experiment to measure the effect of rootstocks on bud break. In 2017 we tested one level of chilling hour accumulation (800 hours) measured according to the North Carolina model to see if we could observe the phenomenon in Geneva, NY. In 2018 we tested three chilling hour accumulation levels (Treatment 1: 585 hours, Treatment 2: 702 hours, Treatment 3: 906 hours). In 2017 shoots were harvested when the trees had accumulated 800 hours of chilling were then placed directly into a greenhouse environment (20° C day/17° C night). In 2018 shoots were harvested on November 22 when the trees had accumulated 585 chill hours and shoots in treatment 1 were placed in the greenhouse at 20° C day/17° C night while shoots from treatment 2 and treatment 3 were stored at 5° C until they had reached the desired chilling hour accumulation and then were placed in the same greenhouse environment for pushing. Bud break was recorded at 15 and 30 days after introduction on the greenhouse. The rootstock genotype and chilling treatment had a significant effect on apical and lateral bud opening in both years. In general, apical buds opened first and were followed by laterals. In 2017 approximately 50% of the rootstock genotypes had one or more buds open after 30 days indicating a significant rootstock effect on the scion chilling requirement. In 2018 the proportion of rootstock genotypes displaying open buds after 30 days increased with increasing chilling hours (585h=10%; 706h=20%; 906h=38%) perhaps indicating a quantitative trait effect. Chilling requirement is related to endodormancy while the ability of buds to open when placed in a warm environment is related to ecodormancy (accumulation of heat units). The number of buds open after 30 days is interpreted as a genotype effect on endodormancy while rootstock effects on ecodormancy could be interpreted as the differences in the proportion of open bud genotypes between the first and second observation times in the greenhouse. Although these are preliminary results, they show that in the germplasm tested, there is a definite effect by apple rootstock on scion chilling requirement.

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P38

ROSA NUM: 112

PRESENTER: Fazio, Gennaro

TITLE: Interstems reveal scion variety potential to transport nutrients

ABSTRACT:

An experiment aimed at understanding the genotypic potential of certain widely planted scion cultivars to transport nutrients in their vascular systems (stems) was set up by generating apple trees that featured interstems of different scion cultivars. Four rootstock replicates of the vigorous rootstock B.118 were bench grafted with scion varieties 'Empire', 'Golden Delicious', 'Honeycrisp', 'Ida Red', 'Jonagold', 'Liberty', 'Mutsu' and 'Red Delicious' in March of 2016 and planted in a nursery. Grafts were trained to a single shoot which was chip budded with B.118 buds 15 cm above the graft union in August 2016 to generate consistent interstems of the various cultivars 15 cm long. The healed dormant buds were forced by topping the trees 2 cm above the chip bud in May 2017 and the B.118 shoot was trained to a single stem. Fully expanded leaves from the top 1/3 of the tree were harvested in September 2017 and processed for nutrient analysis which yielded concentration values of N, P, K Ca, Mg, S and other micronutrients. Trees were planted in an orchard in Geneva, NY in June 2018. In November 2019 an XRF instrument was used to monitor relative concentration of P, K, Ca, S and some micronutrients like Fe, Mn, and Cu in one and two-year-old stems. While the variances for some nutrient genotypic means were too large for mean separation at less than 0.05 significance level – probably because more replications were needed – we were able to notice some general trends for each of the nutrients when comparing the genotypic mean to the overall mean. From the leaf analysis data we found that leaf calcium concentration means ranged from 0.8% to 1.1% with values for Red Delicious, Liberty, Honeycrisp and Empire interstems were below the overall mean (0.99%) while the values for the rest of the cultivars were above the mean. For leaf potassium, Honeycrisp displayed the highest values (1.8%) whereas Empire and Liberty had the lowest values (1.3%). Leaf sulfur and leaf nitrogen were highly correlated variables and among cultivars Honeycrisp had the highest means (1.88% N and 0.13% S) and Liberty had the lowest means (1.61% N and 0.11% S). These results show that the vascular system of each scion cultivar displays differential capacity to transport some nutrients. This work has implications for the practice of top-working older orchards with new scion varieties. It also has implications with regards to using interstems. This work is part of a larger project aimed at understanding the connection between rootstocks and fruit quality being studied in the USDA NIFA Specialty Crop Project "AppleRoot2Fruit".

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P39

ROSA NUM: 121

PRESENTER: Mészáros, Martin

TITLE: Performance of apricot cultivars 'Harcot' and Goldrich' on different rootstocks in young orchard when using various grafting height

ABSTRACT:

Two apricot cultivars 'Harcot' and 'Goldrich' were grafted on rootstocks Adesoto, Kuban 86, Myrobalan 29C (M29C), MY-KL-A, St. Julien A and Wavit and were evaluated in the years 2017–2019. All the rootstocks were grafted 10 cm above the ground. In addition, both cultivars were grafted on Myrobalan 29C and St. Julien A in 60 cm height. The trees were planted in the experimental orchard of the Research and Breeding Institute of Pomology Holovousy in the Czech Republic in autumn 2014. The cumulative yield, average fruit weight, trunk cross-sectional area (TCSA), crown volume, yield efficiency related to TCSA and to crown volume, and suckering of the rootstocks were assessed. For cultivar 'Harcot', the trees on St. Julien A were the most productive with similar yields but lower vigour and crown volume in comparison with M29C. Adesoto was characterized by higher suckering combined with 'Harcot'. For cultivar 'Goldrich', the trees on M29C were the most productive even though rather more vigorous than St. Julien A and with just moderate fruit weight. The suckering of rootstocks in combinations with 'Goldrich' was overall low. For both cultivars, interesting results were found with Wavit giving the trees low vigour, small but very productive crown and good fruit weight. Grafting in a higher position did not bring significant effect on the yield, fruit quality and crown volume of the cultivars on both rootstocks in the first years of observation.

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P40

ROSA NUM: 129

PRESENTER: Luz, Alberto Ramos

TITLE: Yield of apple trees grafted on Geneva series rootstocks grown on different locations in Brazil

ABSTRACT:

The development of apple orchards is associated with the increasing orchard density using dwarf rootstocks, aiming to control the tree growth, increasing the yield and economic viability of the orchard. Therefore, the objective of this work was to determine the vegetative and productive performance of different apple cultivars grafted on different Geneva series rootstocks grown on replanting areas in southern Brazil. In 2017, apple orchards were implanted in the State of Santa Catarina (Painel and Urubici cities) and in Rio Grande do Sul (Vacaria and Caxias do Sul cities) with the cultivars Gala Select and Fuji Suprema grafted on the rootstocks G.202, G.814, G.210, G.213 and CAT 16. The trees were trained in Tall Spindle system, with spacing of 3.5 m between rows and 0.90 m between trees for the Gala Select cultivar and 1.00 m between trees for Fuji Suprema cultivar. The experimental design was randomized blocks with four replications of five trees per plot. In both cultivars, the dwarf rootstocks G.202, G.213 and CAT 16 were on average 28% more efficient in controlling tree vigor compared to 'G.814' and 'G.210'. In the first season, the Geneva series rootstocks were on average 99% more productive than the CAT 16 rootstock in the cities of Painel - SC and Caxias do Sul - RS. The fruits were classified as high quality fruits (CAT1) in the 2018 season. These initial results demonstrate the productive potential of the Geneva series rootstocks sustained in compact trees, enabling the increase of tree density in the orchards with good yield and fruit quality at Brazilian replanting conditions.

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P41

ROSA NUM: 139

PRESENTER: Pina, Ana

TITLE: Graft compatibility between new red apricot cultivars and different Prunus rootstocks

ABSTRACT:

Apricot production is limited by the soil conditions of the different growing areas, such as heavy, calcareous soils with iron chlorosis and waterlogging problems, very frequent in the Spanish Mediterranean area (Aragon, Murcia and Valencia) and suffers from incomplete compatibility. To overcome this problem, a wide array of species have been used, such as apricot, peach and plum seedlings or interspecific hybrids as Marianna 2624 (*P. cerasifera* L. × *P. munsoniana* L.). However, the introduction of new apricot cultivars and rootstocks requires knowledge of the extent and nature of (in)-compatibility reactions before releasing these cultivars on the market, providing both growers and nurseries valuable information about the risk of the weakness of the graft interface and breakage of the rootstock/scion union. In this study, the evaluation of graft compatibility was carried out in new red apricot cultivars (5 cultivars introduced by different breeding programs) grafted onto four different 'Prunus' rootstocks, 'Marianna2624' (*Prunus cerasifera* x *Prunus musoniana*), 'Miragreen' (*Prunus cerasifera* x *Prunus davidiana*), 'Mirared' (*P. cerasifera* x *Nemared*) and 'Monctlar' (peach seedling). Phenotyping of graft compatibility was done at different time points, one and three months after grafting and one year after grafting in Mediterranean conditions. Anatomical and cytomorphological characteristics related to graft incompatibility were evaluated for all scion/rootstock combinations. In addition, the induction of the expression of transcripts encoding phenylalanine ammonia lyase (PAL) were also measured by qRT-PCR. Correlations between all the characters studied for screening genotypes for graft compatibility and the degree of compatibility will be presented for all combinations based on the different approaches applied. This study confirmed the interest of the rootstocks 'Miragreen' and 'Mirared' as commercial rootstocks for apricot industry.

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P42

ROSA NUM: 142

PRESENTER: Mac An tSaoir, Seán

TITLE: Comparison of a range of rootstocks (Malling and Geneva) on Bramley apple growth and production in clean and replant soils

ABSTRACT:

The Irish climate is predicted to change towards wetter winters and drier summers. The Irish apple industry is based mainly on the M9 rootstock, which suffers in wet conditions. Alternative disease resistant rootstocks must therefore be tested for their compatibility with 'Bramley' in terms of growth, form and function to prepare the industry for ongoing climatic changes. 'Bramley' scions have been grafted onto a selection of rootstocks from the Geneva series in addition to Supporter 4 and M116. These new combinations have been planted with their reference Malling equivalents in a replicated trial at Loughgall. The Geneva series is fire blight resistant and Ireland has now lost its fire blight free designation. The trees were planted in Spring 2009. In 2012 (4th leaf) the crop failed due to weather conditions. Growth and Branch angles were recorded in 2012. No graft incompatibilities were observed for Bramley with any of the rootstocks. CG 7 is more vigorous than M26 where as CG 11 is comparable to M26. CG 13 and 16 are comparable to M9 as is Supporter 4. CG 202 is comparable to M26 as is M116.

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P43

ROSA NUM: 182

PRESENTER: Brar, Gurreet

TITLE: Rootstock influences nutrient uptake and water use efficiency in trees of two almond cultivars

ABSTRACT:

Almonds (*Prunus dulcis*) is one of the very important nut crops worldwide. The central Valley region of California produces more than 3/4th of worlds almonds, however, with the recent droughts, the region faces a challenge to keep up production with dwindling water resources. In this scenario, there is a dire need to evaluate different rootstocks and cultivars with improved water and nutrient use efficiency. This study was conducted to evaluate two almond cultivars and seven rootstocks for their effect on growth and yield characteristics, water use efficiency, nutrient uptake efficiency and leaf photosynthetic parameters. The research plot was planted in 2017 at the California State University Campus orchard and consists of two cultivars Non-pareil and Monterey, on these seven rootstocks: Guardian, Nemaguard, Emyrean 1, Lovell, Rootpac-R, Rootpac-20 and Cornerstone. The trees were trained to open center training system and all agronomic practices were carried out as per industry standards. The experiment was designed as a Randomized Complete Block Design with three replicate trees in each treatment unit and 3 replicated blocks. Significant differences among rootstock were found in terms of canopy growth, height, trunk girth, and nutrient uptake. Emyrean 1 showed highest girth in the second year (84.58 mm) and Rootpac-20 showed the lowest (67.14 mm). Trees on Rootpac R had the smallest nuts (118.01 nuts/lb) while trees on Cornerstone, Emyrean 1 and Rootpac 20 gave the largest nuts (102, 99.92 and 98.17 nuts/lb, respectively). Leaf photosynthetic traits were also compared and Non-pareil trees on Rootpac-20 showed highest Vcmax and Jmax, while Non-pareil on Cornerstone showed the lowest. Trees on rootpac 20 also showed highest Net Instantaneous Photosynthesis as well as significantly higher stomatal conductance. All rootstocks showed significant differences in nutrient uptake efficiency. High leaf Mg levels (0.6-0.8%) were the strongest predictor of growth and yield during the third year. The overall tree performance was in the order of Cornerstone > Nemaguard = Guardian > Rootpac-20r = Emyrean1 > Rootpac R = Lovell.

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P44

ROSA NUM: 202

PRESENTER: Brar, Gurreet

TITLE: Growth Responses of pistachio rootstocks to irrigation water Salinity

ABSTRACT:

Pistachio (*Pistacia vera* L.) is considered a relatively salt tolerant crop in comparison to other crops suitable to California climatic zones. Over the past ten years, pistachio acreage in California has more than doubled and is now expanding to more marginal soils on the westside of the Central Valley region. Rootstocks are the primary line of defense for the plant against salinity. Many new pistachio rootstocks are being planted on marginal soils in California but scant research is available on their salt tolerance. This study was conducted to compare two pistachio rootstocks- USB-1 and Platinum for their growth responses to varying levels of irrigation water salinity. The study was conducted in a greenhouse at California State University campus in Fresno using one-year old trees of both rootstocks. The seedling trees were acclimated to greenhouse conditions for two weeks before being transplanted into 15 gallon pots using peat:perlite:vermiculite mixture in 60:30:10 ratio. The following treatments were applied: Irrigation water with Electrical Conductivity of < 1 dS/m; 5 dS/m; 10 dS/m and 15 dS/m. Watering demand was calculated using gravimetric method and equal amount water was applied every other day with a measuring cup. The trees were grown for 12 weeks under these treatments. UCB-1 showed significantly higher tolerance to the salinity levels in terms of total shoot growth, number of leaves, leaf area, and chlorophyll content. The overall health and growth of trees was also evaluated for visual evaluation based on leaf symptoms of salinity damage on a scale of 1 to 5 with 1 being a dead tree and 5 the healthiest one without any salinity damage. UCB-1 trees performed significantly better on the evaluation scale. The UCB-1 seedlings also had significantly greater root volume and root fresh and dry weight in comparison to Platinum trees.

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P45

ROSA NUM: 143

PRESENTER: Bujdosó, Geza

TITLE: Some preliminary data about Köpcös, the new persian walnut rootstock candidate

ABSTRACT:

Unfavourable conditions and stresses are the major limiting factors in Persian walnut (*Juglans regia* L.) growing worldwide. Because of continuous increase in drought and damage of the soil borne pathogens, it is necessary to improve new walnut rootstocks. The rich available *J. regia* germplasm in Hungary is a good genetic resource for the improvement. Our hypothesis is that there are some genotypes in our collections, which are suitable for rootstocks. For the rootstocks we are searching for medium vigorous genotypes with tolerance to the fungi pathogens of the soil and to drought as well as which can turn the grafted trees to bear as early as possible, indicate good fruit quality. Selection of superior genotypes as rootstock is doing at NARIC, Hungary. The genetic background, propagation possibilities, adaptability of scion/rootstock combinations, resistance/tolerance to drought conditions, resistance/tolerance to diseases are being evaluated. The research was supported by National Research, Development and Innovation Office in the frame of "Walnut breeding in order to release new late leafing and lateral bearing cultivar(s) project (project no. 123311).

ROOTSTOCKS poster session (07/29/2021)

POSTER NUM: P46

ROSA NUM: 175

PRESENTER: Robinson, Terence L

TITLE: Rootstock evaluation should not only measure yield efficiency but also potential yield and crop value at the optimum projected spacing

ABSTRACT:

Rootstock trials usually rank rootstocks based on yield efficiency calculated as cumulative yield per unit of trunk cross-sectional area. Over the many trials we have done we have almost always seen a positive correlation of dwarfing and yield efficiency. Using yield efficiency as the primary criteria of selecting superior rootstocks generally results in the most dwarfing rootstocks being judged superior to the more vigorous rootstocks. However, with the weak growing cultivars 'Honeycrisp' and 'Snapdragon' often the most dwarfing rootstocks do not grow enough to fill the space and thus are not the best practical choice for apple growers. To better evaluate the commercial value of rootstocks we have begun to estimate the optimum planting density of any given rootstock based on its trunk cross-sectional area. We then calculate a projected cumulative yield per hectare at the optimum spacing. This effort has shown that some of the most dwarfing rootstocks would not produce the highest cumulative yield even when planted at very high densities. The economic differences in estimated crop value using the projected yield differences has shown very large differences among rootstocks, especially with high priced varieties like 'Honeycrisp'. The difference can be as high as \$450,000 per ha over 8 years. Thus the practical decision of which rootstock to use for a new orchard can have very large economic consequences that often are not appreciated by growers.

FRUIT QUALITY and PRECISION FARMING poster session (07/30/2021)

POSTER NUM: P47

ROSA NUM: 208

PRESENTER: Ben Abdelkader, Ahmed

TITLE: Automatic irrigation scheduling in an apple orchard based on soil water potential thresholds continuously detected by digital tensiometers

ABSTRACT:

Efficient Irrigation scheduling in orchards requires effective tools to understand water status in the soil-plant system. Home-made Arduino-monitored tensiometers (range of 0 to 90 kPa), capable to digitally record the trend of soil water potential (SWP) continuously, were used in this study. They were installed in a mature apple orchard (cv. Nicoter Kanzi® grafted on M9 rootstock) at 30 cm soil depth and 20 cm far from the drippers. We tested four treatments differing as to the SWP threshold used to trigger the irrigation (-30kPa or -60kPa, measured in the wet bulb) and/or to irrigation volumes (1, 2 and 4 drippers per tree). The tensiometers demonstrated a fast and reliable response to the changes in soil water availability and allowed to keep SWP in the desired range between field capacity (-16 kPa) and the threshold fixed for each treatment, triggering irrigation accordingly. Soil water content (SWC), measured via independent FDR probes, increased in the upper soil layer by 2 to 5% with irrigation, while at 40 cm depth SWC was affected only when 4 drippers per tree were used, a treatment that allowed also to increase the area of wetted soil surrounding the trees. Physiological performances and fruit growth did not show any difference among treatments. Likewise, the post-harvest outcomes revealed that both yield ($90 \pm 6 \text{ t ha}^{-1}$ on average) and the fruit quality attributes (acidity, fruit firmness, percentage of red color) were not affected by the irrigation treatments. Both partial rootzone drying (PRD) and regulated deficit irrigation (RDI) allowed to save up to 72% and 68% of water when compared to control, respectively. These findings revealed that a margin of water-saving, by lowering SWP threshold to -60kPa (RDI) or by wetting only half of the root apparatus (PRD), exists also for water demanding crops such as the apple.

FRUIT QUALITY and PRECISION FARMING poster session (07/30/2021)

POSTER NUM: P48

ROSA NUM: 206

PRESENTER: Wenter, Andres

TITLE: A pilot study of sensor-based soil moisture assessment for precise irrigation scheduling in apple

ABSTRACT:

Irrigation is an essential agronomical practice in intensive apple production. Under the predicted scenario of climate change and increased pressure for sustainability in the future, irrigation is becoming more important. The practical use of soil moisture sensors could support the farmers in improving irrigation scheduling. Recent technical advances in wireless communication such as Long-Range Wide Area Network (LoRaWAN) allow a real time data transfer from field sensors to the user. The management of such sensors is facilitated by their low power requirement and absence of direct data storage on site via data loggers. The main goal of the pilot study "Smart Land South Tyrol" was to test the implementation of a system of soil moisture sensors, data transfer by LoRaWAN and data visualization on a Smartphone Application. The project partners Research Center Laimburg, Advisory Service Beratungsring and the company Alperia worked on this goal from 2019 onward. A sensor network of 120 soil moisture sensors was established within the apple growing area of South Tyrol near Bolzano, Italy. Data were collected during the growing seasons 2019 and 2020. In the same period the data flow system from the sensors to the database was technically improved

FRUIT QUALITY and PRECISION FARMING poster session (07/30/2021)

POSTER NUM: P49

ROSA NUM: 184

PRESENTER: Hergarten, Heidi

TITLE: Rootstock genotype and soil amendment influence on fruit quality in 'Gala' apple

ABSTRACT:

Production of high-quality tree fruit requires management of tree health and vigor during orchard establishment, especially regarding soil borne pathogens. Available strategies for the mitigation of soil borne diseases, such as apple replant disease, include chemical fumigants, Brassicaceous seed meal (SM) soil amendments, and the use of disease resistant rootstock genotypes. Chemical fumigants are effective inhibitors of soil pathogens, but Brassicaceous SM amendments are an alternative treatment that has been documented to provide longer term pathogen suppression than traditional fumigation treatments. This means that it is possible to achieve superior disease suppression using specific combinations of rootstock genotype and soil amendment. However, Brassicaceous SM contains potentially phytotoxic compounds, and it has been shown that the SM amendments and root stock genotype provide disease resistance in part by altering the soil microbiome. Yet the effects on fruit quality of SM amendments and the resultant restructuring of the soil microbiome are not well studied. Further, regardless of soil amendment strategy or rootstock genetics, sub-lethal levels of phytotoxic compounds are known to have negative effects the reproductive output of plants. Our objective was to explore the effects of pathogen suppression strategies using rootstock genetics ('M.26' vs 'G.41') and soil amendment strategy (fumigation vs SM) on at-harvest and postharvest fruit quality of 'Gala' apples.

FRUIT QUALITY and PRECISION FARMING poster session (07/30/2021)

POSTER NUM: P50

ROSA NUM: 95

PRESENTER: Fallahi, Esmaeil

TITLE: Effects of size-controlling rootstocks on productivity, fruit quality attributes, and leaf nutrients in 'Aztec Fuji' apple over several years

ABSTRACT:

The impact of several apple rootstocks on fruit yield, fruit quality attributes over 2012-2015 and leaf mineral nutrient concentrations over 2012-2014 were studied under climate and soil conditions of southwest Idaho between 2010 and 2015. Averaging over these years, trees on B.70-20-20, B.67-5-32, CG.3001, B.64-194, PiAu51-11, CG.5222, and CG.4004 had the largest trunk cross sectional area (TCSA) but those on B.7-20-21 and B.71-7-22 and CG.4003 had the smallest TCSA. Cumulative yields in trees on CG.4004, G.41, CG.3001, and G.935N were higher while in trees on PiAu9-90 and B.71-7-22, CG.4003 and B.7-20-21 were lower than trees on all other rootstocks. Cumulative yield efficiencies in trees on G.935N, CG.4214, CG.2034, M9T337, and B.9 were highest, while trees on B.70-20-20, B.7-20-21 and PiAu9-90 were among the lower ones. Trees on CG.3001, CG.4004, CG.5222, G.41N, B.70-20-20, M.26.EMLA, and PiAu51-11 had the largest fruit while those on B.7-20-21, CG.4003 and PiAu9-90 had the smallest fruit. Fruit color was the best in trees on CG.4814 and CG.5087 rootstocks. Fruit from trees on B.7-20-21 had the highest soluble solids concentration (SSC) and firmness because of their smallest size. Trees on B.70-20-20 were among those with the least color, SSC and firmness. Fruits on G.935N, G.935TC, Supporter 3, and CG.4214 had more advanced starch degradation pattern (SDP) while those on CG.5087 had the lowest SDP than those on other rootstocks. Trees on B.20-20-21 and CG.5087, and G.11 had higher concentrations of leaf N but those on CG.2034, PiAu990, and Supporter 3 had lower leaf N than those on other rootstocks. Trees on B.64-194 and B.70-20-20 had higher concentrations of leaf K but those on G.935T, G.935N, and G.4003 had lower leaf K than those on other rootstocks. Differences also existed among rootstocks for some of the scion leaf microelements, fruit russet, bitter pit, and water core. Overall, Geneva 935, CG.4004, and Geneva 41 rootstocks were found to be suitable for conditions of this study.

FRUIT QUALITY and PRECISION FARMING poster session (07/30/2021)

POSTER NUM: P51

ROSA NUM: 120

PRESENTER: Lodolini, Enrico Maria

TITLE: Bioagronomic traits of eighteen apricot cultivars grafted on GF677 with *Prunus persica* L. as intermediate stock in a semi-arid environment in Sicily

ABSTRACT:

Apricot cultivation is of great interest in Southern Italy, due to the wide harvest period by using both early and late ripening cultivars. Indeed, the recent breeding programs improved the germplasm platform of this species also for the low latitude areas. However, the introduction of several cultivars in these areas was realized in absence of a long and specific evaluation activity of the productive characteristics. In this study, we report the pomological and qualitative traits of 17 international apricot cultivars and an Italian one (Ninfa), all grafted on GF677 and *Prunus persica* L. as intermediate stock. The study was carried out in Sicily, in the Mazzarrone (CT) district. The orchard was trained following principles of the organic farming. The studied traits were: fruit weight and volume, pulp percentage, firmness, geometrical mean diameter, sphericity coefficient, skin and pulp color and color index, total soluble solid, pH, total acidity, ascorbic acid, total phenolic content, antioxidant activity. Principal component analysis (PCA) has been performed to study correlation among fruit quality parameters and to analyze relationships among genotypes as a tool for germplasm characterization. The biggest fruits were harvested from the international cultivar Megatea. The firmness was higher compared to the Italian cultivar Ninfa. The color intensity was higher in some mid-late and late cultivars. The qualitative traits, in particular the total soluble solid and the total phenolic content were higher in the late cultivars than others. The research contributed to identify the most promising cultivars to be successfully spread within the southern regions of Italy under organic system.

FRUIT QUALITY and PRECISION FARMING poster session (07/30/2021)

POSTER NUM: P52

ROSA NUM: 205

PRESENTER: O'Connell, Mark

TITLE: Evaluation of a portable impact probe for rapid assessments of flesh firmness in peaches and nectarines

ABSTRACT:

Flesh firmness (FF) is a widely used index to assess maturity in fresh stone fruits. The traditional method for FF measurement involves destructive sampling of fruit and the use of penetrometers. However, measurements with penetrometers have relevant flaws — (i) they usually require more time than non-destructive assessments, (ii) the error of the measurement increases when flesh is soft, (iii) measurements cannot be rapidly and non-destructively collected in situ prior to harvest, and (iv) data collection and management often requires scribing in a notebook or specific computer software. This study aimed to assess the accuracy and user-friendliness of a Bluetooth, non-destructive impact probe to detect FF in peach and nectarine cultivars near harvest. The study was carried out at the Tatura SmartFarm during summer 2019/20 on fruit of three nectarine ('August Bright', 'Autumn Bright' and 'September Bright') and four peach cultivars ('August Flame', 'O'Henry', 'Redhaven' and 'September Sun') (n = 200 for each cultivar). FF was measured with a handheld penetrometer and with a non-invasive device based on an impact probe interfaced with a smartphone via Bluetooth. The device measured the impact probe's acceleration profile when hitting the fruit surface. The device generated two measures of the bounce profile — the peak acceleration (PA) and the full width at half maximum (FWHM). The relationship of peak acceleration and FWHM with FF was characterized by power functions in all the peach and nectarine cultivars. Both PA and FWHM showed similar robustness in their relationship with FF in terms of coefficient of determination (R²). Although the power models showed similar functions in all the cultivars, the R² of the regression models varied based on maturity and fruit softness. Our results showed that the impact probe was a good indicator of FF when fruit were softer and more mature. The device improved FF estimation when penetrometer readings approached low values (≤ 4 kgf) but lost accuracy when fruit were unripe and hard. Hence, the impact probe used in this study is less suitable for early, pre-harvest in situ FF determination in peaches and nectarines. Our results suggest that the impact probe improves FF estimation in soft fruit, where traditional penetrometer-based measures become difficult and less reliable. Overall, the device was user-friendly, and its adoption reduced data collection time and avoided fruit sample destruction, showing great potential for generating larger volumes of data per unit of time.

FRUIT QUALITY and PRECISION FARMING poster session (07/30/2021)

POSTER NUM: P53

ROSA NUM: 105

PRESENTER: Marlene Ayala

TITLE: Effect of protected cultivation on agro-physiological response, fruit quality and postharvest storage of two sweet cherry (*Prunus avium* L.) early cultivars in the central valley of Chile

ABSTRACT:

The introduction of protected cultivation using plastic covers such as high tunnels (“HT”) and three-wire systems (“TWS” = “tents”) on sweet cherry orchards has been described as an effective method to avoid rain-induced fruit cracking, prevent frost and promote early harvest. Protected sweet cherry orchards have rapidly increased over the last decade in the Mediterranean climate of Central Valley of Chile (34° 58’ S, 71° 13’ W). Considering the lack of knowledge in this area, the effect of HT and TWS on the physiology, yield, fruit quality and storage potential of two early harvest sweet cherry cultivars (‘Royal Dawn®’ and ‘Santina’), were evaluated during 2017/2018 and 2018/2019 seasons. The combinations ‘Royal Dawn®’/‘MaxMa14’ (8-yr-old trees, 1,111 trees ha⁻¹, Y-trellis) was evaluated under HT and open field (“OP”) conditions, while the combination ‘Santina’/‘Colt’ (5-yr-old trees, 1,136 trees ha⁻¹, KGB) was measured under HT, TWS and OP. Environmental parameters such as temperature (T°, °C) and relative humidity (RH, %) were measured inside and outside the plastic covers between bloom and harvest. Fruit quality parameters, cracking incidence at harvest and cracking potential were determined for both cultivars. ‘Royal Dawn®’ and ‘Santina’ under HT were harvested 8 and 10 d before than OP trees, respectively. HT registered higher maximum temperatures than outside (>5°C difference). Slightly higher temperatures in HT did not decrease fruit yield in ‘Royal Dawn®’ (15 kg tree⁻¹) and fruit was larger than outside. However, in ‘Santina’ under HT excessive high temperatures during bloom and fruit set resulted in negligible yield indicating the importance of ventilation. On the other hand, ‘Santina’ trees under TWS were harvested 5 d earlier and yield was 30% higher (12 kg tree⁻¹) than OP trees. For both cultivars, plastic covers promoted less sweet and firm fruit, particularly at the top of trees, but quality was adequate to export.