DOWNLOAD PDF ORCHARD PLANTING SYSTEMS L. CORELLI-GRAPPADELLI AND R.P. MARINI

Chapter 1 : The peach: botany, production and uses.

Luca Corelli Grappadelli The yield efficiency of cv Loadel cling peach trees Damas was evaluated by comparing different training systems at medium density, eight years after planting.

 Abstract Consistency of fruit quality is extremely important in horticulture. Fruit growth and quality in nectarine are affected by fruit position in the canopy, related to the tree shape. The Index of Absorbance Difference is a new marker that characterizes climacteric fruit during ripening. A study on fruit ripening was performed by using the on nectarine to monitor fruit maturity stages of two cultivars trained as Tatura Trellis in Victoria, Australia. Fruit harvested at a similar ripening stage showed fruit firmness and soluble solid content homogeneity. The experiment showed that the Tatura Trellis training system is characterized by high homogeneity of nectarine fruit when coupled with a proper management of fruit density. It also confirmed that the could be used as new nondestructive maturity index for nectarine fruit quality assessment in the field. Introduction A tree training system is defined as a method of manipulating the tree structure and canopy geometry to improve the interception and distribution of light, for the purpose of optimizing fruit quality and yield [1]. In , a group of Australian researchers developed the Tatura Trellis [2], suitable for the complete mechanization of harvest in intensive peach orchards. Despite of the higher light available and photosynthetic rate that this tree shape allows, it was judged too expensive because of the intensive work needed to maintain the complex scaffold. Several aspects of the Tatura Trellis training system on apple and cherry trees were studied [4], but only a few experiments on tree productivity were available regarding peach fruit [5]. Numerous studies on different tree architectures pointed out that fruit position in the canopy represents one of the most critical factors for peach fruit quality development and homogeneity of fruit characteristics [6 â€” 8] related to the light availability [9]. The open center training systems increase the light available in the inner canopy, giving rise to a gradient of quality traits. Fruit that develops in the periphery and center of the canopy obtains higher light levels and is characterized by better quality attributes, while fruits located halfway between the tree center and periphery are more shaded and developed lower quality [8 , 9]. Final fruit size and quality may also depend on shoot length, fruit distribution on the shoot, and number of fruit per centimeter of shoot length [10]. The correct management of the fruit density in relation to the position and light exposure is required to get optimal fruit size [6 , 11]. Several studies in the past attempted to evaluate crop load and fruit quality distribution in different training systems [12 , 13]. For tree shapes that allow a uniform light distribution, fruit thinning has to be consistently performed in every part of the tree [14]. As well as the final commercial diameter, the quality traits commonly used as indicators of peach and nectarine maturity stage into the orchard are the changes in fruit firmness and background color turning from green to yellow [15]. The changes observed in the appearance and quality traits are related to the time course of ethylene production in ripening, since peaches and nectarines are climacteric fruits. Peach fruit characteristics such as soluble solids content, red color, and background color show a clear gradient related to fruit position in the canopy [6 , 7 , 9]. Changes in the background color and fruit firmness in peaches are generally linked, but light interception or canopy position may alter the relationship between these two parameters [7]. In fact, while recent studies on peach fruit observed that as firmness declines, background color became more yellow and less green; it was also pointed out that fruit with similar background color harvested from different positions into the canopy may not have the same fruit firmness [7 , 16]. Instead, background color is an informative harvest index as it reflects the chlorophyll content of the fruit [18]. The could be used for individual cultivars to define the ideal time to harvest in accordance with consumer preferences, as shown by its higher correlation with consumer acceptance than with the traditional quality parameters found by Gottardi et al. However, few results are available regarding the use of the as a ripening index for peach and nectarine fruit. The objectives of this study were a to evaluate the possible application of the as a nondestructive maturity index to follow fruit ripening in the field and objectively define the ideal harvesting time, b to characterize the performance of the Tatura Trellis training system for nectarine in affecting fruit quality, maturity, and homogeneity. Materials and Methods Trials were conducted in on two six-year-old yellow flesh nectarines Prunus persica [L. Industry standard management techniques were applied throughout the season in terms of pruning, irrigation, fertilization, and pest control. No summer pruning was applied, neither reflective mulches were used in the orchard under study. To understand intracanopy variability, the canopies were divided in three parallel horizontal areas of equal size representing the top T , middle M , and bottom B canopy layers as described by He et al. Fruits were individually placed in sealed 1 L jars, and a 1. The ethylene production was calculated as the difference between the result of the second and the first injection. For both cultivars at harvest, twenty to fifty fruits per class were assessed with the standard quality trait measured: Fruit firmness was measured on the two opposite cheeks using a FT hand-operated Effegi penetrometer Effegi, Ravenna, Italy equipped with an 8 mm diameter Magness-Taylor probe and mounted on a hand-operated drill press. The and color-component dimensions, based on nonlinearly compressed coordinates, were measured with a CR Minolta digital colorimeter Konica-Minolta, Tokyo, Japan. Five fruits per each canopy layer bottom, middle, and top from the east and west sides of the canopy of every tree were tagged ninety fruits in total and followed during the growing season. To evaluate the influence that fruit position within the canopy had on nectarine development, fruit growth diameter and ripening were weekly monitored on tagged fruits from 83 to days after full bloom DAFB. Fruit ripening distribution was measured with the DA-meter on a total population of randomly selected fruits picked from the trees under study at the main harvest. The previously described standard laboratory quality assessments were performed on a sample of twenty to fifty fruits per class. By inputting the collected data in the 3D graphic software PlantToon [23], the architecture of the tree was recreated and modeled in order to link the relative position of each fruit with the information collected from the field. Six branches with similar length around 40 to 50 cm , one branch per each canopy layer bottom, middle, and top , and orientation East, West were selected and tagged on each of the six trees in trial thirty-six branches in total , based on the assumption that peach tree branches behaved as functionally autonomous units, as demonstrated by Volpe et al. All tagged branches from three trees were hand thinned to 4 fruits per branch 1 fruit every 10â€”12 cm of shoot length 15 to 20 DAFB as suggested [10] , while all the tagged branches from the remaining three trees were left unthinned with roughly 8 fruits per branch 1 fruit every cm of shoot length. Fruit growth diameter and ripening were monitored weekly from 68 to 89 DAFB on the fruit from all tagged branches. As previously described, to assess the correlation between the fruit ripening stage and SSC, during fruit growth a sample of fifteen fruits was collected weekly. Harvest was performed in two picks one week apart main harvest was at 89 DAFB. The study was organized as completely randomized design. Fruits at commercial maturity show the onset of the climacteric with the starting of ethylene production values of 0. At DAFB, fruits in the outer canopy appeared riper than fruits in the inner and bottom canopies as shown by the light gray and white circles representing the riper fruit. The white circles as well as the circles colored with the lighter shade of grey represent fruits at their physiological maturity stage PM. The higher the value and the more unripe the fruit, the darker the shade of grey. The most unripe fruits are represented by black circles. At every sampling, fruit ripening distribution between classes was concentrated in a narrow range of values Figure 2 , showing a high fruit ripening homogeneity. The three curves seemed to maintain the same shape over time and only sliding toward lower values when the fruit became riper DAFB. The maturity stage of the fruit was not different between the three horizontal canopy layers, bottom, middle, and top, over time data not shown , while fruit growth during the season was significantly affected by fruit positioning in the canopy Table 3. For the rest of the season and up to the first harvest DAFB , fruits in the B canopy layer had on average 2 to 4 mm smaller diameters than the M and T canopy layers Table 3. Immature fruits that were east exposed had less blush than west-oriented fruits data not shown. No significant differences between ripening classes and canopy layers in term of and components of both blush and background color were observed data not shown , while traditional destructive quality parameters were differently affected by the fruit ripening stage and the position in the canopy, as shown in Table 4. No differences were observed for fruit firmness between fruits within the same ripening class, coming from the three canopy layers. If we consider the canopy layers, only the top showed variation between ripening classes, with riper fruit PM measuring the lowest fruit firmness and immature fruit I the highest Table 4. Fruits of both the PM and CM classes developed the highest SSC at the top of the trees, while no differences were noticed between tree canopy layers within the immature class. When comparing fruits within the same canopy layer, fruits at the PM and CM ripening stages showed higher SSC values than I fruits, while no differences were noticed between ripening classes in the bottom canopy layer Table 4. When considering fruit density hand thinned and unthinned inside each canopy layer, the diameter of the hand-thinned fruit did not differ between canopy layers at any sampling date. The unthinned fruits were bigger in the top than in the other canopy layers at most sampling dates. Only at 89 DAFB, all fruits from the three canopy layers reached the same diameter in the unthinned trees, and no statistical differences were observed. Table 6 shows the values decreased during the season for both the hand-thinned and thinned treatments. Within fruit densities for every sampling time, no differences were observed between the three canopy layers. Fruit density had an interactive effect with canopy layer on fruit values. Higher fruit densities at 68 and 75 DAFB resulted in delayed ripening values in fruit from the middle and bottom canopy layers but not from the top canopy layer. In all subsequent sampling dates, unthinned fruits showed delayed maturity lower values when compared with the hand-thinned fruits reaching the point at 89 DAFB harvest in which unthinned fruits were still at a preclimacteric stage while hand-thinned fruits were already at the onset of climacteric Tables 1 and 6. The east or west orientation did not affect the fruit growth or ripening data not shown. Unripe fruit with an between 1. Discussion Recently, Reig et al. In fact, as demonstrated by Ziosi et al. The can be regarded as a marker for peach fruit ripening that is more sensitive and confident than the physicochemical parameters commonly used to describe physiological condition including firmness, which was the most reliable measurement until now [26]. Prior to the CM ripening stage, at the immature stage, the probably better correlates with chlorophyll content than with the ethylene production, though still remaining cultivar specific [27 , 28]. The nondestructive DA-meter, coupled with the 3D representation of the tree, permitted objective observations of fruit ripening in their exact location within the canopy Figure 1 , without removing them from the tree Costa et al. This is probably due to the open shape of the training system that allows better exposure of fruits in the inner and bottom parts of the canopy to direct sunlight, especially during the latter stages of fruit development [30]. A similar behavior was observed on peach and apple fruits grown on a Y-trellis [1], characterized by a wider angle between branches All these training systems showed greater levels of intercepted radiation than the delayed vase and free palmette for the life of the orchard [31]. Several studies on peach trees have demonstrated that the fruit position in the canopy was an important factor affecting fruit growth and size [32 , 33]. At every sampling, fruits of SF34 located at the top of the canopy were consistently bigger than the fruits in the bottom Table 3. This behaviour could be due to a change in fruit diameter gradient in the canopy described by Basile et al. A possible explanation of the opposite trend early in the season of fruit growth could be related to the time of blooming that starts from the tree bottom to the top of the tree [35]. Alternatively, part of the variability in fruit growth appeared to be related to carbon C source limitation due to the insufficient area of leaves per fruit early in the season [10 , 14]. In peach, which carries vegetative and reproductive buds at most nodes, the competition may be stronger for young fruit, and this may cause stronger early fruit-to-fruit competition in the top compared to the bottom of the canopy and a slow growth in the upper part of the trees [10]. Subsequently, when fruits become a stronger competitor for the photosynthates, they start to use the leaves in the vicinity as C-sources. Thus, fruits in the tree top are at an advantage because they are more exposed to light [34]. An additional explanation could be that the removal of larger fruits, often harvested in the first pick and mainly located in the top or outside of the canopy, allows the remaining fruits to reach similar diameters. This observation is in accord with other authors, who reported a rapid decline of fruit firmness after ethylene production inside the fruit has begun [37 , 38]. Conversely, Lewallen and Marini [9] observed that fruit with similar background color, as an indication of fruit ripening, harvested from different positions within the canopy did not have the same fruit firmness, with firmer fruit in the inside positions of which the nearby leaves would be the least exposed to light. Our findings were somewhere in the middle since fruit from the bottom and middle canopy layer were found having similar firmness independently of their ripening stages Table 4 while fruit from the top of the canopy showed that less ripened fruit were more firm, probably also due to a combined effect of light and position as suggested by Marini and Trout [39]. In fact, a relatively low correlation between and SSC was observed Figure 3. These results were also in agreement with Hale et al. Overall in our experiments, it seems that there was a low interaction between canopy position and fruit ripening stage in regards to SSC Table 4 , and most of the effects were probably due to the higher exposure to light for fruit in the upper parts of the canopy than to their specific ripening stages, since only the immature or less exposed fruit of the bottom canopy layers had lower SSC. This hypothesis is supported by other research that found a strong influence of light on peach fruit quality [1] and, consequently, of tree growth trends, reproductive habits, training systems, and pruning techniques for light distribution [42 , 43]. There could also be a variety component influencing the overall correlation between SSC and and more research is necessary to validate this. The highly uniform tree structure created by the Tatura Trellis system seemed to be the reason for the relatively high fruit uniformity found in our experiment, in terms of fruit maturity level, SSC, and firmness.

Chapter 2 : Luca Corelli Grappadelli â€" UniversitÃ di Bologna â€" Pubblicazioni

Corelli Grappadelli and Marini () concluded that the yield of trees planted at high densities is eventually limited by the amount of light than can be intercepted by the orchard.

Publications are prepared following the fifth and tenth years. Other objectives are researched at one or more locations. Evaluate the performance of pome and stone fruit rootstocks in various environments under different management regimes Pear Rootstock Trial: Anita Azarenko This trial is completed and a manuscript will be submitted for publication in A brief report was presented at an international meeting in Italy in the summer of Bob Anderson This trial is completed and a manuscript is being prepared. Rich Marini This trial was terminated in and the first draft of a manuscript was passed out at the meeting to the 8 cooperating states. The final version of the manuscript will be submitted for publication in early Rich Marini Data collected from 8 locations showed slender spindle to be the most productive overall, but fruit was poorly colored. Vertical axe was intermediate in productivity with M. The central leaders system on M. This trial was completed in and a manuscript was distributed at the meeting. It will be submitted for publication in early Wes Autio This trial was terminated in and a manuscript on overall results was distributed at the meeting. The main paper will be submitted for publication by March 1, Terence Robinson The planting will be discontinued following the season and the planting following the season. Data are currently being compiled for a 5-year summary of this trial. Rich Marini A 5-year report was published in Tree survival has been good in this trial, although G. At some sites, all trees have been lost. At others, all have survived. Alternate bearing is a problem at some sites. Survival has been good at most of the 25 locations. Biennial bearing is a problem at some sites. At the 11 sites that have Fleuren 56, it tends to be the smallest clone. Greg Reighard A 5-year report was reported at an international meeting in New Zealand and will be published in Acta Horticulturae. A more complete report will be submitted to the Journal of the American Pomological Society in Trees have survived well and the rootstocks have generally performed similarly to each other. Therefore, this planting may not be continued for the full 10 years. Frank Kappel Tree losses are high in the West with Bing as the scion. Largest trees are on Gisela 6 and Giessen There are fruit size differences related to tree size. Mahaleb is the largest tree and has the smallest fruit size. W53 has good fruit size, yield and sugar levels. Preliminary summaries will be presented at the international cherry symposium in June Terence Robinson Flowers were removed in , but trees will be allowed to crop in Year 4 should be a good crop year. Trees will be thinned to a moderate crop load. If trees are not vigorous, all fruit will be removed. Wes Autio Data are still being collected and compiled for both and To assess and improve asexual techniques of pome and stone fruit rootstocks. Two states are working on techniques for the improved propagation of apple NY and pear OR rootstocks. To improve the ability to identify pome and stone fruit rootstocks through morphological, biochemical and genetic differences Efforts are continuing to confirm the identity of Cornell-Geneva series rootstocks around the world through DNA testing NY. To develop new and better pome and stone fruit rootstocks through breeding and genetic engineering AR â€" An ongoing breeding program for both apple and peach rootstocks is being carried out in Arkansas. Twelve apple selections were budded to Smoothee Golden Delicious in and will be planted in a replicated trial in For peach rootstocks, 24 in and another 20 in were selected for further evaluations. CA â€" A peach rootstock breeding program is being conducted to combine disease resistance with dwarfism and other desirable horticultural traits. NY â€" The apple rootstock breeding program at Cornell-Geneva will be releasing 4 new rootstocks over the next 3 years. In additional, new rootstocks from around the world are being gathered. In , 16 rootstocks from 3 European breeding programs were established. OH â€" Five selections of the Morioka series of rootstocks have been obtained and are being cloned for further evaluations. Ontario â€" The Vineland series of apple rootstocks together with several standard are being evaluated for fire blight resistance. The results indicate that wide differences in rootstock susceptibility exist. To determine biotic and abiotic stress tolerance of pome and stone fruit trees in relation to new and existing rootstocks. New

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Brunswick â€" The Cornell-Geneva apple rootstocks are being screened for cold hardiness. NY â€" The Cornell-Geneva rootstocks, as well as many others from around the world, are being screened for tolerance to such biotic and abiotic factors as replant disease, late winter cold temperatures, Phytophthora root rots and fire blight. Three-year-old Gala trees on various rootstocks were inoculated with fireblight in During , most of the standard rootstocks died, whereas most of the Cornell-Geneva rootstocks have survived so far. OH â€" A visiting scientist from China is studying the interaction of soil compaction and water stress on apple physiology using M. Ontario â€" Studies are continuing the evaluate the fireblight sensitivity and cold hardiness of the Vineland series of apple rootstocks compared to several known standard rootstocks. UT â€" Field studies have been conducted to evaluate fireblight sensitivity and bud union breakage under high winds of Gala apples on different rootstocks. Experiments on cherry bud cold hardiness in the fall have shown that Colt rootstock are 2 to 4 degrees C less hardy than buds on trees growing on GM. Nearly all states indicate the importance of the results from these trials as the primary source of information for recommendations made by research and extension personnel. Fire blight continues to be a major limiting factor for apple rootstock selection and several sites are actively involved in screening and other studies to determine sensitivity and reduce tree losses. State surveys of tree planting indicate a dramatic shift to trees on more dwarfing rootstocks in recent years. A rewrite committee was formed to prepare a draft for the next annual meeting. Existing trials will be maintained following the protocols developed by the respective technical committees. Current and supplemental data will continue to be collected and summarized by the planting coordinator, who will prepare the five- and ten-year reports for publication. Individual state project leaders will, wherever possible, expand the data collection on a particular planting beyond that of the uniform data set so as to gain further information on rootstock performance, or how the rootstocks respond to training and local conditions. As new, not as yet commercially available, rootstocks are wanted for the trials, plantings must be planned three to five years prior to the actual planting being made. The following new trials are in the planning stage: Greg Reighard This trial had problems with poor performance of some rootstocks and budded trees in the nursery. The decision was made to salvage the rootstocks that had reasonable bud take and put out a limited trial in The remaining rootstocks will be propagated again for the planting. Gene Mielke Nine sites have been identified for planting this trial. In there will be 9 stocks and in another rootstocks will be planted. Terence Robinson This trial was originally planned for but there was very poor take of some of the rootstocks in the nursery. The plan now is to delay until and have a slightly larger trial. There are over 40 rootstocks on the list but this will be reduced by factors such as availability, fire blight resistance, etc. Frank Kappel This planting has also been delayed a year because of problems with obtaining the desired rootstock and getting them through virus sensitivity testing in time for planting. There are about 30 stocks on the list from Europe, Russia and California. Recommendation based on compatibility groups and bloom time. Refereed in press Al-Hinai, Y. Refereed abstracts Autio, W. Rootstock and scion interact to affect apple tree performance: Results from a year trial by the NC Technical Committee. Non-Refereed Proceedings Aldwinckle, H. Controlling shoot blight with Apogee. New York Fruit Quarterly 8 l: Genetic engineering of apple for resistance to fire blight. A summary of twenty years of trial. Fruit Notes 64 2: Final evaluation of the NC national rootstock trial. Selecting an orchard system for apples. Compact Fruit Tree 33 3: Fruit and Vegetable Crop Research Report â€" University of Kentucky publication PR The orchard planting systems puzzle. Production, fruit quality and labor requirements of five high-density apple orchard systems over 10 years.

Chapter 3 : Horticultural Science & Technology

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Alternate bearing and incidence of marssonina blotch were observed in both treatments after 5 years of planting. There was often vegetative imbalance in the trees however, the degree of yield loss and vegetative imbalance of the tall spindle trees was lower than those of the slender spindle trees. Soluble solid content and fruit red color of the tall spindle trees were higher than that of the slender spindle trees in 5 year after planting, resulting from increased light penetration in the canopy due to even distribution of lateral branches and from fruit bearing in different height locations of the trees. In conclusion, increasing the tree height to about 3. Orchard management systems for Fuji apples in Washington state. Selecting the orchard site, site preparation and orchard planning and establishment. C Ferree and I. Apples; botany, production and uses. Influence of apple tree height on yield and fruit quality. Effect of tree density, tree height and rectangularity on growth, flowering, and fruit production. High density planted apple orchards: Effects on yield, performance and fruit quality. Varying density with constant rectangularity: Effects on apple tree performance and yield in three training systems. Effects on apple tree growth and light interception in three training systems over ten years. Effects on apple tree yield, fruit size, and fruit color development in three training systems over ten years. Light interception and utilization by orchard systems. Productivity and fruit quality of four apple cultivars on three different rootstocks and at different planting densities. Effects of apple tree spacing and summer pruning on leaf area distribution and light interception. Bases of yield and production efficiency in apple orchard systems. The tall spindle apple production system. New York Fruit Quarterly. Yield and light efficiency for high quality fruit in apple and peach high density planting. Spacing and rootstock studies with central leader apple canopies in a high vigour environment. Influence of light interception on apple yield and fruit quality related to arrangement and tree height. Light distribution in apple orchard systems in relation to production and fruit quality. Planting system and tree shape. Fundamentals of temperate zone tree fruit production. Korean Society for Horticultural Science Volume:

Chapter 4 : Orchard Production Systems for Tree Fruits - N Y AGRICULTURAL EXPT STATION

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Advanced Search Abstract We evaluated the effects of mineral and organic fertilizers on peach root dynamics in the growing season from to in a nectarine Prunus persica L. Very few studies have conducted long-term investigations of root dynamics of fruit crops. Our main objective was to determine whether organic fertilizers affect root dynamics differently than mineral fertilizers. The experiment was a completely randomized block design with four replicates of three treatments: Both root growth and survival were evaluated at day intervals during the growing season by the minirhizotron technique. Variation in root lifespan with method of fertilization could be accounted for by variation in soil nitrate concentration as indicated by no effect of fertilizer treatment on root lifespan when soil nitrate was included as a covariate. These results reveal how shifting from mineral to organic fertilizers may shift both soil properties and nutrient availability, leading to changes in both root production and lifespan. Introduction Although many studies have contrasted in detailing the effects of organic fertilizers when compared with mineral fertilizers on aboveground traits of fruit trees Gallardo-Lara and Nogales , there is very little understanding of how these treatments differentially influence root production and root lifespan in belowground traits. Moreover, studies examining the effects of nitrogen N fertilizers on root dynamics in fruit trees and nut crops are quite limited, in contrast to the numerous studies in forest trees. In most agricultural regions, soil organic matter SOM has diminished Burke et al. The recycling of composted organic materials from agri-food industry and from municipal solid waste represents a sustainable source of organic matter OM that is now used broadly to both rebuild the SOM pools and replace chemical fertilizers in low-impact agricultural systems. However, the effects of this shift to organic materials on soil fertility and root dynamics are poorly understood. The study of root dynamics needs to account for the heterogeneity of the root system. The root system has diverse functions, including nutrient and water absorption, anchorage and storage. Fine lateral roots associated with the absorptive portion of the root system may be replaced once or several times per year. Typically, only the finest two orders of roots have an important role in nutrient absorption and represent the most dynamic portion of the root system Pregitzer et al. In most woody species, these roots seldom undergo secondary development of the vascular tissue or of the periderm, contributing to their ephemeral nature Brundrett and Kendrick , Eissenstat and Achor However, first- and second-order roots using a stream-based ordering nomenclature, Pregitzer et al. Pigmented roots often exhibit considerably lower respiratory and nutrient-absorptive capacities than white roots Comas et al. Among temperate fruit crops, root production has strong seasonal patterns Eissenstat et al. Although there are limited investigation on the effects of compost and mulching on root dynamics, the effects of N addition has been relatively well studied. Root standing crop or root density can be affected by the N supply, but the direction of the effect is inconsistent. Some studies in temperate forests indicate a negative relation between soil fertility or the N supply and fine root biomass Aber et al. These contradictory results represent the complex interplay between factors affecting root production, including positive effects of N addition on whole plant photosynthesis but reductions in carbohydrate allocation to the root system Ingestad and Agren , and factors affecting lifespan, which has been shown to be both positively Burton et al. Nitrogen availability to the root system strongly affects the growth rate and proliferation of roots. Moreover, mineral fertilizers may lead to pulses high in nitrate, whereas organic fertilizers release N more slowly and may supply ammonium for varying lengths of time, depending on the rates of nitrification. The root growth responses to these different forms of N are strongly influenced by spatial and temporal patterns of the N supply. Uniform increases in the N supply often reduce the root growth whereas localized increases in N supply may strongly stimulate root growth reviewed by Robinson , Hodge Unlike mineral fertilizers, application of compost may affect root growth not only by increasing inorganic ions in the soil but also by the presence of humic substances released by the decomposing OM. Humic substances may modify root morphology, inducing proliferation of lateral roots and root hairs and causing a higher differentiation rate of root cells Concheri et al. Indirect evidence suggests that this may be the result of auxin-like effects in certain humic substances Muscolo et al. The aim of the present study was to evaluate, in a commercial nectarine orchard, the effects of compost on root growth and turnover. In particular, we wished to separate just nutrient addition associated with mineral fertilizers from the addition of nutrient-rich OM. We hypothesized that trees grown in compost-amended soil would increase root growth and have a longer root lifespan than those of trees grown in mineral-fertilized soil and that variation in soil nitrate-N would not entirely account for the variability in root dynamics. Materials and methods The study was conducted from to in a nectarine Prunus persica Batsch var. As typical of commercial practices in this region, soil was tilled three times a year to a cm depth in the tree rows the soil close to the tube was manually tilled at the same depth as the mechanical tillage , while the alleys were untilled and covered with grass. Average annual air temperature was After the orchard was planted, the three fertilization treatments unfertilized control, mineral fertilized and composted were compared in a randomized complete block design with four replicates. Compost was split into two applications, one in spring and one in fall, similar to that for the mineral N fertilization. New root production growth and lifespan were determined using the minirhizotron technique. Tubes were inclined toward the center of the row. The bottom of each minirhizotron was sealed to prevent water from entering the tube, whereas the top was closed with a rubber stopper and the portion of the tube above the ground was painted black to prevent light intrusion. Each tube was covered with a white can to prevent radiant heating. On the side of each tube, a green line was drawn and a progressive number was written at a 1. During each growing season , , and , videos were collected from March to November and later converted to digital images Studio DC 10 Plus, Pinnacle Studio version 8, Mountain View, CA, USA that were catalogued according to ICAP Bartz nomenclature in order to have a sequence of the same minirhizotron window positions over the time of investigation. Root birth was considered the date when a root was first observed, whereas root death was identified by disappearance from the window or evidence of root shriveling and decay. Root lifespan was calculated, in days, as the difference between date of death and of birth. During the entire experiment, trunk diameter and fresh weight of pruning wood were measured in winter. Tree yields were measured at commercial harvest. Statistical analysis All data were statistically analyzed using a completely randomized block design with four replications trees using soil fertilization three levels: The effect of fertilization on the risk of root pigmentation and mortality was evaluated using a Cox proportional hazards regression approach SAS Version , where other covariates of depth, time of birth, root diameter and soil nitrate were included, depending on the model Wells and Eissenstat In addition, correlation analyses were performed to evaluate the relationships between root responses and soil nitrate-N concentration. In early years of the study â€” , no significant differences in pruning weights were observed. Effect of fertilization practice on plant trunk circumference, pruning wood FW and fruit production FW in a nectarine orchard in northeastern Italy.

Chapter 5 : Yield and Profitability of Modified Spanish Bush and Y-trellis Training Systems for Peach

Orchard planting systems. In this chapter, the evolution of training and pruning techniques for peach, as well as the scientific bases underpinning these technical achievements, are reviewed. A detailed discussion of the most widely adopted training systems and a forecast of future trends in this important part of peach cultivation are presented.

Develop and evaluate orchard production systems for apples, cherries, peaches, plums apricots and pears that result in increased profitability for New York fruit growers. Evaluate apple, cherry, pear, peach, and plum rootstocks for adaptability and performance under New York conditions. Study factors influencing the growth and cropping of young fruit trees to maximize early tree performance and reduce the turn-around time and investment associated with orchard renewal. Develop improved thinning practices, thinning prediction models and crop load management practices to enhance fruit size and ensure return bloom by understanding the environmental and physiological principles underlying tree response. Develop improved canopy management practices to manage mature apple, cherry, peach, plum, apricot and pear tree canopies at a variety of tree densities. The impacts and expected outcomes are: This project will help NY fruit growers compete in the world fruit market. This project takes advantage of new varieties, new rootstocks, intensive management in high density plantings and rain crack prevention technology that create a new opportunity for apple, pear, cherry, peach, plum and apricot production in NY. The production systems developed by this project will allow growers to have improved production efficiency, better fruit quality and lower labor costs. Increased sweet cherry, peach, plum apricot and pear production would allow apple growers to diversify and to utilize much of the apple industry infrastructure which is idle in July and early August. The primary beneficiaries of this project will be the fruit growers in New York and elsewhere in the world. However, the results of this project will also be of interest to fruit marketers since the reliability and quality of NY grown fruits will improve. Lastly, the consumers in the Northeast will also benefit by having high quality locally grown fruits available at reasonable prices. Project Methods Studies will mostly be comparative field experiments with different tree forms, planting configurations and rootstocks followed by economic analysis of the data. We will evaluate in field trials new apple, cherry, pear, peach and plum rootstocks from around the world. We will investigate nursery strategies to improve branching and orchard management strategies such as irrigation, fertilization, tree quality and fumigation, to improve tree growth in the first three years and cropping in years two to seven. We will conduct chemical thinning field trials that will focus on factors that affect thinning chemical response. These will include chemical thinner dose, time of thinning, temperature and sunlight. We will focus on the effect of pruning and training on tree growth, yield and fruit quality. Experiments will focus on the concept of renewal pruning for apple, cherry and peach. The effect of time of year and type of thinning on tree growth and regrowth will be studied. The commercial apple, peach, cherry, pear, plum and apricot growers of NY State and the northeastern USA are the primary target audience of this project. Nothing Reported What opportunities for training and professional development has the project provided? A postdoctoral scientist was hired to work on this project in How have the results been disseminated to communities of interest? Results of our work on orchard systems have been presented to fruit growers in NY State, the US and the world in numerous grower presentations and in published articles and on the web. Each year we have given presentations to growers and have published articles for growers. In our published articles were 11 and our presentations to scientists where there was a published abstract were Our presentations to growers were: Rootstocks and training systems for sweet cherry, NC trial. Training systems and rootstocks for pears, NC trial. NC rootstocks trials on Honeycrisp. Strategies to control bitter pit. Thinning Considerations for Apple Crop Condition and Thinning. NY Spanish Winter Schools. Results from our plant growth regulators trials at Geneva. How and why we should irrigate. PGR strategies for improving production practices. Precision chemical thinning of Honeycrisp and Gala: Empire State Producers Expo. Apples of the world II - Orchard systems - Brazil. Apples of the world II - Orchard systems - Spain. Apples of the world I -

Varieties and preferences - Apple varieties of the world: Precision chemical thinning - an overview of the season. Efficacy of Metamitron as a post-bloom thinner in western NY. The efficacy of ACC for peach fruit thinning. What do you plan to do during the next reporting period to accomplish the goals? Nothing Reported Impacts What was accomplished under these goals? This project has developed and evaluated several high density planting systems for apple, pear and cherry and evaluated production systems for peach and plum. With apple the major accomplishment was the development of the Tall Spindle production system and the development of management strategies for improved early production and mature production, simplified pruning rules, which improved fruit quality and partially mechanized several labor requirements using motorized platforms to position workers for greater labor efficiency. Also a major accomplishment was the development of economic data based on lifetime orchard production 20 years that compared this system to other systems. These data showed the economic superiority of the Tall Spindle system, which allows lifetime orchard profitability of almost double the profitability of traditional production systems. In we completed a year orchard field trial of various orchard systems. This system has rapidly been accepted by fruit growers in the US and is now the dominant new orchard system in NY State. A second aspect of our work on high-density orchard systems for apple has been the development and evaluation of new improved rootstocks, which offer improved disease resistance and greater production efficiency. These rootstocks are named Geneva apple rootstocks and they are rapidly gaining acceptance by fruit growers. A third aspect of our work has been to develop a suite of production technologies we call precision orchard management. They include precision crop load management which involves precision pruning to pre-calculated flower bud loads, precision chemical thinning using our carbohydrate model and our fruit growth rate model to time and measure thinning response and precision hand thinning to leave a predetermined fruit number per tree that will optimize fruit size and optimize returns. We have also developed precision irrigation management to ensure optimum fruit size despite the variable rainfall received in the Eastern US. Lastly we have developed precision harvest management strategies to allow decisions on storage and market timing to ensure optimum fruit quality and consumer eating experience. With pear a similar Tall Spindle system has been developed but without the optimum rootstocks. With high-value fruit crops such as cherries, apricots and plums there is a high risk of crop loss due to rain-induced fruit cracking, spring frost damage to flowers and susceptibility to debilitating diseases that are disseminated by rain. We have developed a suite of production technologies that mitigate the climatic risks of growing these fruit crops. These technologies have been integrated into an economically and environmentally sustainable production system. We have determined that the integrated system is both horticulturally and economically feasible and reduces risk of growing these crops in the Eastern US. We believe this integrated package will be critical for consistent commercial production of high-value cherries, apricots and plums for direct farmer retail sales to meet growing consumer demand for locally grown high-quality stone fruits. The high value of these fruit crops will significantly improve small farmer income and strengthen rural economies. Over the last several years we conducted replicated field plantings where we developed production, fruit quality and labor usage data to determine the economic feasibility of various crop production tunnels and orchard covers that improve consistency of production for cherries, apricots and plums in the Eastern US. Apple rootstock evaluation for apple replant disease. Journal of the American Pomological Society 70 2: Managing fruit abscission in apple. New York Fruit Quarterly 24 1: Progress report - Evaluation of the Cornell-Geneva apple rootstocks and other promising apple rootstocks. Compact Fruit Tree 49 1: Miranda Sazo, and E. New York Fruit Quarterly 24 2: Mechanical blossom thinning followed by 6-BA shows promise as an alternative to chemical thinning without Carbaryl. New York Fruit Quarterly Robinson, and Miranda Sazo, M. Benefits and procedures for precision hand thinning. Lake Ontario Fruit Newsletter Fertilization and irrigation for the on-farm apple nursery the first season. Pest management guidelines for commercial tree-fruit production , p. Conference Papers and Presentations Status: Modeling and monitoring post-bloom fruit growth and drop in apple; prediction of sensitivity and assaying effects of chemical thinners. Integrating sweet cherry canopy architectures and rootstocks in difference environments: Performance of pear rootstocks in North America. Effects of apple rootstocks on vigor, bud-break, yield, and hormone profile on the scion. We also published 4 articles in the NY Fruit Quarterly on rootstocks and orchard systems. These results helped tree fruit growers understand high density planting systems and the value of new rootstocks and which ones they should plant. We plan to continue our apple and cherry orchard systems field trials and plant a new apple systems trial in We also plan to conduct experiments on the effect of soil pH on rootstock performance and the effect of grafting method on graft union strength with various rootstocks. Impacts What was accomplished under these goals? The high initial investment of a tree fruit orchard requires an analysis of the optimum rootstock and planting density to maximize profitability. Additionally with high-value fruit crops such as cherries, apricots and plums there is a high risk of crop loss due to rain-induced fruit cracking, spring frost damage to flowers and susceptibility to debilitating diseases that are disseminated by rain. We have determined that the system is both horticultural and economically feasible and reduces risk of growing these crops in the Eastern US. Cumulative yield over 6 years was highest for the Tall Spindle trees and lower for the Modified Spanish Bush. The use of a high plastic tunnel to grow high-density sweet cherries has resulted in increased yield, reduced fruit cracking and improved cumulative crop value regardless of system, rootstock or cultivar.

Chapter 6 : Orchard planting systems.

Summarizes our knowledge of peaches and their production worldwide and includes a colour plates section. This book includes chapters which address botany and taxonomy, breeding and genetics of cultivars and rootstocks, propagation, physiology and planting systems, crop and pest management and postharvest physiology.

Influence of vineyard peach selections on vigour and initial yield in peach and nectarine. Genetika, Vol 45, No. Seedlings progenies of eight selected vineyard peach genotypes obtained by self and open pollination were examined in this study during three consecutive years. Two progenies from unselected vineyard peach genotypes with different geographic origin were used as a standard. Autumn Glo and nectarine cv. Stark Red Gold were grafted on F1 generation of eight vineyard peach selections and two standard progenies. Analysis of variance indicated statistically significant differences in vigour and fruit productivity between fruit trees grafted on different progenies of vineyard peach selections. A high correlation was found between rootstock vigour and fruit production of grafted cultivars. In addition, the principal component analysis made it possible to establish similar groups of rootstocks, depending on its influence to vigour, productivity and indexes of efficiency of grafted peach and nectarine cultivar. The most promising rootstocks for those two cultivars were PSK and 7S because grafted AG and SRG have high fruit weight, initial yields and very satisfactory rootstock, scion and canopy efficiency. It is well known that some traits of the grafted peach cultivars, such as vigour, ageing, ramification angle and cropping significantly depend on a rootstock influence, and it is, therefore, a factor of quality and profitability for the orchard SALESSES et al. The vineyard peach Prunus persica L. Because of its low-temperature resistance, drought tolerance and disease resistance e. Its also achieve satisfactory cumulative fruit production and medium tree growth rate. Non-uniformity of vegetative growth and its diverse influence on peach fruit trees and yield level in commercial orchards, where vineyard peach seedling is used as a rootstock, is the result of utilization of unselected seeds in nursery production ZEC et al. The aim of this manuscript was to investigate the influence of progeny of selected vineyard peach genotypes, as a generative rootstock, to grafted peach and nectarine cultivars. Also, the goal was to determine the correlation among the traits, to identify the most useful variables for discrimination among the genotypes and to detect relationships between the genotypes. Genotype 6S was obtained by self-crossing of genotype 2, 7S by self-pollination of genotype 5 and 8S as an offspring of self- pollinated genotype 3. Two progenies JIS and PSK derived from uncontrolled pollination of a great number of genotypes with different geographical origin that are mostly utilized for peach or nectarine rootstocks, were used as the references. The rootstocks were planted in the trial field in Padinska Skela near Belgrade in Containers with vineyard peach trees were planted at the fixed places, at the beginning of June, at a 3. Each progenies was represented with 30 plants, where 15 three replication per five plants were grafted with peach and the rest with the nectarine cultivar. Nine variables were recorded for ten progenies of vineyard peach, grafted with peach and nectarine cultivar, for three consecutive years Following variables were studied: Rootstock trunk diameter RTD and scion trunk diameter STD were measured just before vegetation started 10 cm below and 10 cm above the grafting place, respectively, and are presented by the scale in mm. Tree height H and crown width CW were measured by the scale in cm. Initial yield Y is presented as an average for three years; data are given in kg tree-1 6. Fruit weight FW was measured by the scale in g. Canopy efficiency CEF was established on the basis of relation between yield per tree and surface of canopy projection; data are given in kg m Rootstock trunk efficiency REF and scion trunk efficiency SEF were established on the basis of relation between yield per tree and trunk cross-sectional area of rootstock or scion, respectively; data are given in g cm The least significant difference LSD 0. Common components coefficients, eigenvalues, and relative and cumulative proportions of the total variance expressed by single traits were calculated. The first two components having maximum variance were selected for creating scatter plots for all accessions studied. Lower initial yields of groups 2, 3, 5 and 6S were influence by lower vigour of rootstocks. Correlations of interest both in determining how improvements in one trait may affect other traits and choosing candidates for indirect selection are presented in Tables 2 and 3. Correlation coefficients between tree attributes were significant and similar for peaches and nectarines. When AG was a scion, the RTD correlated highly significant and positive with the tree vigour of the grafted cultivars. Correlation analysis of parameters for SRG produced very similar results. Autumn Glo AG and nectarine cv. Component scores for the accessions evaluated in peach are shown in Table 4. The group of rootstocks 5, 6S and 8S with the lowest negative PC2 values stands out especially due to their low FW, Y and all variables connected with the tree efficiency. The highest PC3 values point out the rootstocks with the highest CW. Negative values for PC3 have rootstocks from groups 9 and 7S, with the highest canopy efficiency. Rootstocks with the highest crown width 7S and 8S have the highest PC3 values. The scatter plots Fig. For peach, two groups of related accessions were separated. Second, group B, consisted of two genotypes that corresponded with strong positive PC1 and highly negative PC2 value. For nectarine, only one group of related accessions was separated. For further evaluation it is quite enough to take just one rootstock for each group, while the rest of them can be considered a unique item. Segregation of 10 vineyard peach rootstocks grafted by peach cultivar AG left and by nectarine cultivar SRG right according to their characteristics determined by PCA G. This is quite satisfactory population from which to study the behaviour of various vineyard peach genotypes as rootstocks, mainly because the genotypes were collected from different country regions. According to the RTD value, during initial production, the groups of trees can be divided into the sections as follows: Statistically significant differences between RTD and STD emerged because of the large divergence of various vineyard peach genotypes whose progenies were used as rootstocks. In addition, low vigour could be the result of a reduced space for root system development in a high-density planting system that was confirmed by CARUSO et al. Flordaprins grown at different distances, which was explained by reduced space for tree growth. Differences in H occurred due to influence imparted by rootstocks of various vigour levels, but also due to effects of winter and summer pruning. Regardless the fact that fruit weight can sometimes be significantly influenced by rootstock, cultural practices pruning and thinning and environmental factors water and sunlight often obscure or negate those effects, especially when vineyard peach seedlings are used. One of the important factors determining CW is the training system. High-density planting system applied in the experiment required the corresponding pruning. CW was formed by pruning and did not correlate with other parameters. No matter the fact that the Y is initial it must be considered as valid since experimental orchard peach entered the full maturity in the second year of the investigation. The highest efficiencies indexes had rootstocks from groups 2, 6S, 7S and 8S. This situation confirms the suitability of using efficiency of rootstock, scion and canopy of grafted cultivars as a basis for selecting suitable rootstock for peach production. Environment plays an important role in correlation. In some cases, ecologic conditions affect both the traits simultaneously in the same direction or sometimes in different directions. Correlation coefficients among vigour characteristics in this study are mostly high. Considering the established statistically very significant correlation, a strong influence of rootstock vigour to initial yield in the studied cultivars was found. All of this can be explained by the fact that evaluation represented in this study was obtained from the young orchard first three years of productivity , and that trees were not fully formed. It is expected that stronger correlation will appear in the following years. Principal component analysis Table 4 model was performed to provide an easy visualization of the complete data set in a reduced dimension plot. PCA has been previously used to establish genetic relationships among cultivars and to study correlations among traits within sets of peach genotypes WU et al. Also rootstock 7S can be recognized as promising because nectarine cultivars grafted on it have satisfactory FW and Y and the highest CEF. This means that vineyard peach genotypes from mentioned groups are well adapted to the applied high-density planting system. Trunk diameter of vineyard peach used as a rootstock can be employed as an indicator for grafted cultivar vigour and used as a basis for planning its optimal yield loadings. Positive correlation confirmed the assumption that vigour and medium vigour vineyard peach seedlings used as a rootstock in high-density planting system, influence higher yield in SRG and higher yield and fruit weight in AG during initial fruit productivity period. No matter the fact that this trial demonstrated strong positive correlation between those traits, our conclusion needs to be proven in further trials set on grafted rootstocks with numerous commercial peach and nectarine cultivars and in several locations. Principal component analysis PCA was used to establish similar groups of vineyard peach seedlings, according to their characters, as well as to study relationships among its traits. The most promising and especially interesting rootstocks for peach and nectarine were 2, PSK and 7S because peach and nectarine cultivars grafted on them have high fruit weight, yields and efficiency indexes. In this study, the vineyard peach seedlings from groups 2, 3, and PSK were found to be divergent from the rest of the genotypes, which can be used in hybridization programmes for the genetic improvement of peach and nectarine rootstocks. Further self-pollination of genotypes 6S, 7S and 8S could help us creating rootstock that G. However, characterization and quantification of vineyard peach genotypes diversity has long been a major goal in germplasm conservation, as well. The peach Layne, D. Segregation of peach and nectarine [P. Batsch] cultivars according to their organoleptic characteristics. Characterisation of vineyard peach biodiversity. New peach x almond hybrid rootstocks for peach. Preliminary observations on nine peach rootstocks grown in a replant soil. The Peach in Serbian. Multivariate analysis of vineyard peach [Prunus persica L. Selection of vineyard peach and myrobalan seedling rootstocks. Peach rootstocks for the United States: Are foreign rootstocks the answer. Present and future trend in peach rootstock breeding worldwide. Interspecific hybridization and rootstock breeding for peach. Analysis of genotypic variation of sugar and acid contents in peaches and nectarines through the principal component analysis. Variability and correlation analysis of fruit traits of selected genotypes of vineyard peach Prunus persica L. Variability of vineyard peach tree characteristics. Breskva Autumn Glo i nektarina Stark Red Gold su okalemljene na F1 generaciju osam selekcija vinogradske breskve i dva standardna potomstva. Okalemljene sorte su imale umerenu bujnost i najbolje proizvodne rezultate na podlogama selekcija PSK i 7S.

Chapter 7 : NC_OLD ROOTSTOCK AND INTERSTEM EFFECTS ON POME- AND STONE-FRUIT TREES

Jack Hughes, Fruition Horticulture (First seen in The Orchardist Magazine) Plant and Food's Future Orchard Production System (FOPS) research programme is working on a step change in new orchard design.

The crop load was assigned to five different object ranges as follows: TCA increment, total shoot growth, return bloom, yield per tree, and yield efficiency tended to increase as planting density decreased, and fruit weight and soluble solid content tended to increase as the object range of crop load decreased. Fruit red color tended to increase as shoot growth decreased. For apple trees planted with trees and trees per 10a, biennial bearing occurred when the crop load was over and fruits, respectively. However, biennial bearing did not occur when the crop load was fruits in apple trees planted with trees per 10a. Accumulated yield tended to increase as planting density and crop load increased, but that of biennial bearing did not show such a difference. Selecting the orchard site, site preparation and orchard planning and establishment, p. Apples; botany, production and uses. Orchard management systems for Fuji apples in Washington state. Influence of apple tree height on yield and fruit quality. Influence of orchard management system on yield, quality and vegetative characteristics of apple trees. High density planted apple orchards: Effects on yield, performance and fruit quality. The relationship of Granny Smith apple tree growth and early cropping to planting density and rectangularity. Fruit quality and yield of different apple cultivars as affected by tree density. Changes in apple leaf water status and vegetative growth as influenced by crop load. The relationship between vegetative growth and fruiting in apples. Effects of crop load on apple photosynthetic responses and yield. Effect of planting densities, rootstocks and training systems on the spartan apple cultivar. Varying density with constant rectangularity: Effects on apple tree performance and yield in three training systems. The influence of planting density on sugar and organic acid content in apple Malus Domestica Borkh. Productivity and fruit quality of four apple cultivars on three different rootstocks and at different planting densities. Apple-orchard planting systems, p. The tall spindle apple production system. New York Fruit Quarterly. Yield and light efficiency for high quality fruit in apple and peach high density planting. The relationship between spacing and rootstock effects in an intensive planting trial of two apple cultivars. A method for assessing the relationship between crop load and crop value following fruit thinning. Spacing and rootstock studies with central leader apple canopies in a high vigour environment. Influence of light interception on apple yield and fruit quality related to arrange-ment and tree height. Light distribution in apple orchard systems in relation to production and fruit quality. Optimizing the tree density in apple orchards on dwarf rootstocks. Productivity and fruit quality of apple in single-row and full-field planting systems. Planting system and tree shape, p. Fundamentals of temperate zone tree fruit production. Korean Society for Horticultural Science Volume:

Chapter 8 : Luca Corelli Grappadelli â€” University of Bologna â€” Publications

Publications of Luca Corelli Grappadelli. Professor at Department of Agricultural and Food Sciences â€” DISTAL.

However, increasing planting density alone does not provide an efficient tool to increase yield and improve fruit quality, as planting density and yield are not linearly related and a threshold can be found beyond which a further increase in density may not result in greater yield Sansavini and Corelli-Grappadelli, Indeed, with age high-density orchards may pose serious problems for canopy management and ultimately compromise fruit quality Caruso et al. Over the past 30 years, double wall systems such as Tatura trellis and its variants [Y-trellis Y , perpendicular V, Kearney Agricultural Center perpendicular V, etc. The primary advantage of V or Y systems is high yields per hectare Caruso et al. Perpendicular V or Y systems typically allow for higher tree densities than other open center or vase-shaped canopies; they also show better light interception than spherical canopies or vertical systems and improve light distribution within the canopy because of their two-dimensional light exposure Caruso et al. On the other hand, labor efficiency or yield per unit of labor is generally low in those systems due to the high establishment and management costs, which offset fruit yield and quality improvements over similar crop values and profits of vase-shaped systems DeJong et al. In addition, open-vase systems are more profitable than central leader systems Marini and Sowers, A recent modification of the standard vase is the spanish bush, initially developed in Spain for cherry Prunus avium L. In this variant, trees are trained to open center by leaving initially six to seven branches, gradually reduced to a final number of four main branches by the 5th year. The vase-shaped canopy is contained within 2. Spanish bush has been recently modified and adapted to cultural conditions of southern Italy; the resulting modified spanish bush MSB system seems to be a promising choice for new peach plantings across similar regions. Although to date no yield data are available in the literature for the spanish bush or its modifications, trials on similar compact, open-shaped systems have shown greater production per hectare and fruit size under protected culture Bellini et al. The right choice of training system and planting density must take into account the costs involved for orchard establishment and management. In this study, a yield and economic analysis was performed on peach and nectarine cultivars to compare Y and MSB orchard systems. The observations included two peach Rich May and Summer Rich and two nectarine Big Bang and Nectaross cultivars and were carried out on four plots of size ranging from 3. Within each cultivar plot, two neighboring subplots were selected, one with trees trained to MSB and the other with trees trained to Y. The MSB system in this study is a modification of the spanish bush developed with the collaborative effort of the cooperative and extension services of southern Italy. In this system, canopies were trained to four main branches since the 2nd year, while in trees trained to the spanish bush a higher number of branches is left initially to be gradually reduced to four by the 5th year. As a consequence, the MSB variant produces less, but better quality fruit and is less labor intensive in the first years compared with the spanish bush. In addition to the two main branches perpendicular to the row direction, two secondary branches were left on each side running parallel to the row but in opposite directions; these branches were located within 1 m from the main scaffold and renewed every year to maintain production in the lower portion of the canopy. Because of crotch angle, length of main branches, and presence of secondary branches, the Y was supported by a system of poles and three levels of wiring. All trees were planted in , grafted on Cadaman rootstock and received conventional cultural practices and integrated pest management. Trees were drip irrigated via a single line per row using two drippers per tree and fertilizers were supplied in the irrigation water. MSB trees were chemically weeded along the row and irrigation lines were laid on the ground. Integrated pest control was performed using low-volume sprayers at 1 or 1. MSB trees were topped mechanically, twice a year during the first 2 years from planting, once a year thereafter; selective hand pruning followed topping. Y trees were winter and green pruned only by hand leaving 80â€” fruiting shoots 60 cm long per tree depending on cultivar fertility. Fruit of MSB trees were hand thinned leaving one fruit every 15 cm of shoot in early-ripening cultivars small fruit and one fruit every 10 cm in late-ripening cultivars large fruit. In Y trees, differential thinning Caruso et al. Harvest operations were carried out by hand, from the ground in MSB and with the aid of picking platforms in Y. As indicated, different levels of mechanization were involved in the cultural management of the two training forms. Labor efficiency was calculated as the amount of fruit produced divided by the total amount of labor requested for all annual operations. Yield included also unmarketable fruit. Data were collected for six consecutive years from to The experimental design was a randomized plot with year as a random replicate. Yield and labor data were analyzed using R The R Foundation for Statistical Computing, Vienna, Austria procedures with training system and cultivar as main factors, their interaction as the sole interaction, and year as a random replicate factor in the model. Labor, yield, production value, and profit data were also cumulated over the 6 years and means of the two training forms were compared by t test. Distribution of fruit into size categories was analyzed by fitting Gaussian models with QtiPlot software Vasilief, and comparing curve centers peaks by t test between training systems or analysis of variance ANOVA among cultivars. The Gaussian model adopted to fit data was: In this case, model parameters were estimated using a continuous scale from 1 to 7 from small to large fruit in place of the seven size categories. Differences of fertilization and pest management costs were due to differences in planting density and canopy height, respectively. Also, planting operations were entirely mechanized for MSB, although done by hand, and therefore more expensive, in the Y system because of the presence of the trellis structure. This result was mostly due to the cost of labor and support structures needed to establish the trellis, as well as to higher tree density and bigger canopies associated to the Y compared with the MSB system. In a new window Table 1. As for partitioning of labor among main cultural practices, labor needed for fruit thinning was similar in both systems, whereas a greater percentage of labor was used for pruning in the Y system and for harvesting in the MSB system Table 2. Pruning generally requires more skilled labor than harvesting, making the Y system management even more difficult and expensive. Overall, establishment costs affected the training system economy more than management costs because of expenses associated with trellising; higher planting density and taller canopies in the Y than in the MSB system determined most of the cost differences during management. In a new window Table 2. Data are averages of the 6 years. In a new window Table 3. Previous studies had already documented higher yields in the Y system compared with central leader Caruso et al. Yet, it is worth to mention that cumulated yields i. In a new window Fig. Yield trends of the four cultivars in trial trained to modified spanish bush MSB and Y-trellis Y systems near Castrovillari, Italy, from the first to the 6th year from planting. Error bars represent standard errors of the means. Fruit distribution into size categories followed Gaussian trends with peaks generally centered on intermediate size classes Fig. This is a genetic difference mostly associated to fruit maturation precocity, i. Distribution of peach fruit average of year 4â€"6 into various size categories for the four cultivars in trial trained to modified spanish bush MSB and Y-trellis Y training systems near Castrovillari, Italy. In a new window Table 4. Curve peaks centers of fruit distribution models into size categories for the four cultivars in trial trained to modified spanish bush MSB and Y-trellis Y systems near Castrovillari, Italy. Means are expressed on a continuous scale from 1 to 7 corresponding to the seven size classes monitored and going from small to large fruit. Generally, trees trained to the MSB system produced a greater percentage of fruit of the larger size categories Fig. Further proof of the latter is the greater curve center value for MSB compared with Y in all cultivars Table 4 , indicating peaking of the MSB system at larger size categories than the Y system. Greater fruit size and lower yields in the MSB compared with the Y system suggest that there were fewer fruits on the tree, and probably a better leaf to fruit ratio, in the MSB than in the Y system. An inverse relationship between peach crop load and fruit size is expected and it has been documented in several studies Berman and DeJong, ; Blanco et al. In a new window Table 5. Unit crop value was similar in the two training systems, but different among cultivars with values somewhat inversely related to yield Table 6. These unit crop values were calculated after real market sales and were the result of several variables, including but not limited to fruit grade. Other factors affecting unit value were related to fruit type nectarine vs. Contrary to yields, there was no significant difference between the two systems in terms of average production values, but a nearly significant difference in terms of cumulated production value. The resulting profits varied greatly and no statistical difference was found among cultivars or training systems Table 7. In a new window Table 6. In a new window Table 7. Even for the most profitable cultivar under the Y system i. Such timing is definitely unsustainable for any fruit grower. In addition, the high amount of labor, fuel, and materials involved in the establishment and management of the Y system clearly indicates more environmentally sustainable conditions in the MSB than in the Y system. Expected trends for the years following the sixth and up to the average peach orchard life 12thâ€”15th are likely to confirm the observed results, or even increase the economical advantage of the MSB over the Y because MSB trees may reach their full productive potential later than Y trees. Received for publication April 21, Accepted for publication May 29,

Chapter 9 : Nectarine Fruit Ripening and Quality Assessed Using the Index of Absorbance Difference ()

the performance of 'jonagold' and 'empire' apple in an nc rootstock and orchard systems trial in michigan Ronald L. Perry LABOR REQUIREMENTS FOR 'EMPIRE' AND 'JONAGOLD' AFFECTED BY ROOTSTOCK AND THREE ORCHARD SYSTEMS IN THE MICHIGAN NC TRIAL.

Various measures of tree vigor, yield, and yield efficiency of apple trees in the NC systems trial as influenced by location, cultivar, and orchard system. Variable fruit set in self-fertile sweet cherry. Identification of self-incompatibility alleles and pollen incompatibility groups in sweet cherry by PCR based s-allele typing and controlled pollination. Survival of apple rootstocks to natural infections of fire blight. Hort Technology 12 2: Ten-year summary of the NC rootstock trail. Performance of ten apple orchard systems: Ten-year summary of the NC systems trail. Five-year performance of 19 peach rootstocks at 20 sites in North America. Low temperature susceptibility of Redhaven peach floral buds on various rootstocks in the NC trial. Non-refereed Publications Allen, R. Plum variety picks for New York. NY Fruit Quarterly 9 2: Rootstock research in Massachusetts. UMass Extension Factsheet, 21 pp. Performance of the V Series apple rootstocks during six growing seasons. Fruit Notes of New England 67 3: Apple quality for consumers. Compact Fruit Tree 34 2: Apple varieties, quality and consumers. Good Fruit Grower 53 New apple varieties as marketable products. University of Kentucky publication PR Pennsylvania Tree Fruit Production Guide. Progress report on the Iowa planting of the NC Cornell-Geneva apple rootstock trial for Progress report on the Iowa planting of the NC dwarf apple rootstock trial for Progress report on the Iowa planting of the NC semi-dwarf apple rootstock trial for Progress report on the Western Iowa apple cultivar x rootstock trial for Blossom and Fruitlet Thinning Trials Report. Stocks for Apple and Pear March Prepared by the Atlantic Committee on Fruit Crops. An evaluation of tree density and support systems for speciality cutlivars. Influences of rootstocks on the growth, productivity, and longevity of apple trees. Penn Fruit News 82 2: Gaining on Gisela cherries. Fruit Grower 1: High density sweet cherry management: Compact Fruit Tree Performance of four semi-dwarf apple rootstocks after five years at 24 locations. Compact Fruit Tree 35 1: Does rootstock influence apple fruit size? The effect of rootstock on apple fruit size in Virginia. Virginia Fruit 1 Peach and nectarine varieties of special interest in Ontario and New York. NY Peach News 2 1: Ginger Gold - rootstock update. Proceedings from the Nova Scotia Horticultural Congress. Proceedings from the New Brunswick Horticulture Congress The New York state apple research and development program: Ten years of successful research support for the apple industry. New York Fruit Quarterly 10 2: Principios de manejo de huertos de alta densidad. Principios de manejo, de poda y portainjertos de huertos de alta densidad. Compact Fruit Tree 35 4: Processing apple planting systems trials. New York Fruit Quarterly 9 4: Early Performances of Peach Rootstocks in Arkansas. Clark eds , Horticultural Studies New Training Systems for Peach - Summary of a 9-season study: Success with the Perpendicular V system. Fireblight symptom expression in apple research orchards - Chill and Heat accumulation at four sites in Arkansas, Breeding and genetics - Sweet cherries, New Sweet Cherry variety and selection showcase: Cornell, New York program. Breeding and genetics - International S-allele Workshop. S-allele repository, pollination groups. A communications model NY Peach News: A preliminary study of physiological and S-allele specific breakdown of self-incompatibility in sweet cherry. The influence of accelerated flower development on pollen quality in sweet cherry. Early Field Performance of Honeycrisp on M. International Horticultural Congress, Toronto, Canada. Natural growth habit of sweet cherry maiden trees. Initial eight-year evaluation of thirteen Horner pear rootstocks. Cultivars used as interstems still show promise after eight years on two Oregon locations.