Apple I

Tuesday afternoon 2:00 pm

Where: Ballroom D

MI Recertification credits: 2 (1C, COMM CORE, PRIV CORE)
CCA Credits: PM(1.0) CM(1.0)

Moderator: David Smeltzer, MSHS Board, Bear Lake, MI

2:00 pm  Honey Bees Running the Risk; Pesticide Exposure During Pollination?
   • Maryann Frazier, Entomology Dept., Penn State Univ.

2:30 pm  The Fruiting Wall: From Hedging to Window Mechanical Pruning
   • Alberto Dorigoni, Istituto Agrario Di San Michele All'Adige, South Tyrol Region, Italy

3:00 pm  Optimizing the Delivery of Crop Protection Materials for Apple IPM
   • John Wise, Entomology Dept., MSU

3:30 pm  Automation - Is Your Orchard Ready?
   • Jeff Cleveringa, Starr Ranch Growers R&D, Wenatchee, WA

4:00 pm  Session Ends
Traditional mechanical pruning (T.M.P.)

In the last 30 years, yields have grown steadily, passing in the best apple growing regions of the world from 30 to about 70 tons/ha. Now the main goal is to increase economic and ecologic sustainability of the apple industry by lowering production costs and moving towards environmental benign techniques that require less chemicals and labour. In other words the main goal now is to get these high yields with less input.

Traditional Mechanical Pruning (T.M.P.) was performed in the Sixties and Seventies in Europe on vigorous apple and pear trees in winter, but it resulted in excessive regrowth and poor fruit quality. Today, thanks to dwarfing stocks, multileader training where necessary and correct timing, a lot of orchards are suitable to mechanization: even on vigorous trees, for instance, summer pruning results in good growth control and fine crop quality.

The essential question before moving the first steps into this technique is which training system will be most needed in the future. Both long (centrifugal) and short (centripetal) are efficient in producing apples, but “short” implies several benefits that are likely to become increasingly important in a new vision. While long pruning systems require a certain amount of structural, unproductive wood, fruit wall systems have just 1 or more leaders as the only structural wood, with the rest as cropping wood. The fruiting wall system is based on two pillars: mechanical pruning on one hand and high density (HD) on the other, the latter being the result of either dense planting or multileader training (Fig. 1).

A short fruiting wall simplifies handwork, from winter and summer pruning, to any other cultural practices including harvest. The simplification is so remarkable that even machines can effectively execute traditionally handmade tasks, like pruning, thinning and weed control. The strong reduction of the tree row volume improves quality of spraying so much that fruiting walls can make use of tunnel sprayers commonly used in modern viticulture or other low-drift spraying techniques. The fruiting walls are also suitable to the multi-tasking nets that provide hail protection, bird and moth control, and possibly even thinning.

By diverting most of the sap, normally destined to the tips, toward the stipulary eyes at the base of the leaves, summer pruning is particularly interesting and results in new spur formation near the cut (Fig. 2). By repeating these cuts over the years the branches are encouraged to form new shoots and flower buds near the tree trunk. By doing so, summer TMP acts almost as a “centripetal resetting tool” for long branches, both in the side branches (hedging) and in the tree top (topping). The trials carried out in the last 7 years in two FEM experiment farms compared existing traditional hand pruned spindle to similar trees transformed into fruiting walls with summer pruning and also pruned by hand in winter. In terms of productivity and fruit quality, transformed spindle trees which were not planned to become fruiting walls, gave similar or slightly lower performances compared to standard pruning (Fig. 3, 4 and 5). The limited practical experience done without any hand correction in winter suggests that trees end up with excessive shading and quality loss.

Pre-requisite for mechanical pruning

Not any orchard can be transformed into a fruiting wall by TMP. The most suitable ones have narrow alleyways (<3.75m between rows) and high density planting (<1.0m between trees) or multi-
leader training. When applied to outsized canopies that after the transformation end up with excessively large alleyways, TMP inevitably results in crop loss. To get the most of TMP the majority of the branches should be horizontal and pointing to the outside of the canopy, a prerequisite of both HD and multileader training, but also a good indication to achieve fruit quality and growth balance. However even large canopies can be trimmed a bit by M.P. to facilitate the passage of tractors, but in this case the goal is not a fruiting wall. In particular summer topping is a growth control tool to prevent the tree from hitting the hailnets.

MP can be performed all year round with different aims and intensity, according to site, cultivar and year:
1) Winter: mostly in moderate-growing orchards, with the aim of shaping trees and make them suitable to the following “Lorette” pruning in early summer;
2) Pink bud: to prevent a little bit regrowth;
3) Early summer (8-14 leaves) is probably the best time to combine flower differentiation, wood ripening of regrowing limbs and control of growth;
4) Full summer when suppressing growth is the main aim, but in this case tip flower buds are lost and immature wood normally follows;
5) In pre-harvest or after the first pick to favour fruit colouring, without any regrowth;
6) In post-harvest, while leaves are still green and active, to reduce regrowth for the following year.

Window pruning machine WPM

WPM was recently developed to overcome TMP limits. TMP operates superficially on 2 dimensions (height and length) and does not enter the canopy, shaping a fruit wall that still needs about 40-70 hours/ha of winter pruning to get rid of excessive wood inside the tree. TMP is of little help in orchards whose alleyways are larger than 3.5 m (12 ft). Beside the outside hedging WPM, a 2011 patent of F.E.M., opens 1-4 “windows” inside the canopy, near the trunk, thank to a second layer of cutting units, each 36 cm long. The result is a 3D pruning, suitable for both thin and relatively large trees, with alleyways from 3 to 4.5 meters apart (9.8 to 14.5 ft). WPM’ goal is to mimic hand pruning in just 2-4 hours/ha and trigger a cycle of shoots. The resulting shape looks more similar to a hand-pruned spindle tree than to a fruiting wall. WMP offers greater flexibility than TMP. For instance it is possible to change over the years the height of the windows and therefore induce a cycle of new shoots. The number of cutting units can range from 1 or 2 (pre-pruning) to 3 or 4 (almost full pruning). The distance from the trunk of each cutting unit can range from 10 to about 70 cm. In fact the proper setting for each orchard can be reached by varying the angles of the outside and inside cutting bars. WPM can effectively operate also in post-harvest, thinning out branches before leaf fall and allowing the remaining spurs to get sunlight and nourishment. In general WPM works at best in well trained orchards with vertically tied trees and thus requires an adequate investment in trellis system, not different from a standard modern orchard on M9. Hand pruning time saved by WPM ranges from 20 to 60 hours/ha depending on machine setting, tree spacing and vigour. By removing the inside cutting units WPM becomes a traditional PM for summer pruning. In the first trials carried out in 2012 and 2013 on Golden, Gala and Fuji, the response of the tree in the following year was generally good with similar yields and quality (Fig. 6) and most of the cut branches regrowing in shoots of less than 20 cm, almost flat and ending with a flower bud in 55-75% of the cases (Fig. 7). Two years after the cut the first flower buds start to appear along the new shoots (Fig. 8).

Conclusions

M.P. is much more than just a labour-saving technique. It is an essential tool to achieve the fruit wall system and to shape tree architecture. TMP and its development, WPM, are powerful instruments to reset branches and trigger centripetal fruiting. Performed at proper time these techniques achieve a dwarfing effect greater than any other chemicals. In the end, beside improving any forms of mechanization known today, we can only speculate about the “doors” that are likely to be opened by mechanically pruned fruiting walls in a near scenario, in which reduction of all kind of input and safety will become primary issues.
References

Fig. 1: Fruiting walls are based on mechanical pruning and high density mechanical thinning, low-drift sprayers, tunnel sprayers, multi-purpose nets, and mechanical weed control.

Fig. 2: At the end of Summer, 3-4 months after the “Lorette” pruning, the terminal stipulary eyes at the base of the leaf on 1-year old wood produce new spurs near the cut.

Fig. 3: Yield / ha under different training systems (V. Adige)

Fig. 4: Fruit weight under different training systems (V. Adige)
Fig. 5: Fruit overcolour under different training systems (V. Adige)

Fig. 6: Yield of Gala under different pruning techniques (Val d'Adige, 2012)

Fig. 7: Effects of Window Pruning on vegetation of three cultivars (2012)

Fig. 8: Regrowth 2 years after WPM of a Gala branch