Tree Fruit

Tuesday morning 9:00 am

Where: Ballroom D
MI Recertification credits: 2 (1C, COMM CORE, PRIV CORE)
OH Recertification credits: 1 (presentations as marked)
CCA Credits: SW(0.5) PM(1.0) CM(0.5)
Moderator: Brett Anderson, MSHS Board, Sparta, MI

9:00 am — Recovering from Severe Winter Injury -- Panel Discussion
- Gregory Lang, Horticulture Dept., MSU
- Bill Shane, Extension Fruit Specialist, MSU Extension, Benton Harbor, MI
- Amy Irish-Brown, Tree Fruit IPM Educator, MSU Extension, Grand Rapids, MI

9:20 am — Tree Fruit Commission Update

9:30 am — Critical Weed Management in High Density Orchards (OH: 2C / 3p, 0.5/0.5 hr)
- Deborah Breth, Cornell Univ. Extension

10:00 am — New Orchard IPM Tools for 2016 (OH: CORE, 0.5 hr)
- Julianna Wilson, Tree Fruit IPM Outreach Specialist, Entomology Dept., MSU

10:30 am — Roles of Cover Crop and Soil Health Assessment Systems in 21st Century Tree Fruit Production
- George Bird, Entomology Dept., MSU

11:00 am — Session Ends

Recovering from Severe Winter Injury - Panel Discussion

William Shane, Senior Extension Fruit Specialist, SW Michigan Research and Extension Center, MSU
Amy Irish-Brown, Senior Extension Tree Fruit IPM Educator, MSU Extension
Gregory Lang, Professor, Horticulture Department, MSU

The back-to-back severe winters of 2014 and 2015 were tough on Michigan tree fruit crops. Although the extent of long-term effects are yet to be seen, there are lessons learned and recommendations that can be made:

The 2014-2015 severe winters demonstrated that growers should have an on-going schedule of orchard removal and replacement so that production comes from a range of tree ages. Winters vary in their impact on different age trees—having a range of tree ages helps insure that at least some portion of the orchards will survive to have production and income next year.

The health of trees makes a big difference in their winter hardiness. For example, the impact of the 2014 winter was hard on some mature apple orchards that had trunks and scaffolds previously damaged by contact herbicides, mouse girdling, etc.

Tree vigor has a big impact on tree hardiness. For example, peach orchards with less than 1 or more feet of annual limb growth tended to have more problems with winter damage and subsequent canker problems.

Symptoms of fall and early winter cold damage often appears as branch end dieback and twig bark discoloration. Fall and midwinter low temperatures also may be seen as browning of the cambium, phloem, and the newest xylem tissue layers under the bark. Typically, slightly discolored cambium, xylem, and phloem will regain a healthy appearance, but if the color approaches cinnamon the tissue usually eventually dies, eventually causing poor tree performance.

Pruning practices have a huge impact on fruit tree midwinter hardiness and recovery from winter damage. Trees, even supposedly tough mature apple trees, are less winter hardy if pruned from September to early January, as such pruning delays or reduces cold acclimation. Summer pruning also reduces the carbohydrate reserves of a tree going into the winter.

Severe pruning in the spring following a harsh winter can be tough on tree recovery. Growers may be tempted to prune hard to reduce tree height in years of no crop, but this may be a mistake if a tree health is poor. If a limb is dead, it can be removed anytime.

However, corrective pruning in spring on cold-damaged trees that otherwise were healthy the previous season can remove mortally-damaged branches that would decline and die in subsequent months, further sapping growth resources. Timely, early pruning of significant damaged wood on such trees can provide more time and resources during the season for replacement growth.

The bark, cambium, and phloem layers provide a protective shield around the inner core of xylem. As a tree ages, the innermost layer of xylem (the heartwood) no longer is living, has no active defense against invaders, and has a primary role of supporting the tree. Cold damage reduces the ability of the outer layers to protect the heartwood from fungal and insect attack, and eventually the tree declines.

Critical Weed Management in High Density Orchards

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Weed control is a necessary component of high quality apple production systems to prevent competition for nutrients and water, and remove habitat for voles. Previous work done by Ian Merwin identified the critical weed-free period was May through July to get optimal tree growth in semi-dwarfing rootstocks planted at a density of 220 trees/acre. A previous project published in Fruit Quarterly (Vol. 22:4, Winter 2014) showed significant growth reduction and a reduced cropping potential in the 2nd year worth \$440 - \$1188 per acre if weeds were not controlled in the first two growing seasons in the life of the orchard. This project continues to document the great payback of such a small investment in weed control in the early life of high density apple orchards where early yields are important to recoup orchard establishment costs. The objective of this project is to study the effect of weed competition at different timings on tree growth and potential yield in new high density plantings. These are preliminary results of data analyzed for 3 seasons of growth.

Materials and Methods:
Two farms established new high-density plantings. Kast Farms planted Gala on M9/337 planted 3' x 12' on April 26, 2013 (1000-2000 trees per acre). A second site was established in the HV that year, but the deer damage was so bad, the trial was abandoned. A third set of plots was established in Western NY at Reality Research (RR) with Gala on M9 /337 planted on May 3, 2014. Irrigation was installed in the Kast site but not used until 2014. Reality Research site had no irrigation. Both Kast Farms and Reality Research sites had deer fencing.

The treatment timings tested included weed free 1) from planting through September, 2) planting through August, 3) planting through July, 4) June through August, 5) June through July, 6) July through August, 7) August through September, and 8) untreated control. Treatments were randomized in 4 replicates at Kast Farms and Reality Research. Each plot had 6 trees per plot, the 2 end trees in each plot were buffer trees.

After the first soil settling rainfall in 1st year plantings, herbicides were applied based on treatment timings using a CO_2 R&D backpack sprayer at 30 psi, .28 gpm, walking 2.0 mph, in 1.5 foot bands on each side of the tree rows. The first treatment in all plots in 2013 was Chateau (12 oz/a) plus Prowl H2O (4 qts/a). Gramoxone SL (2.5 pt/a) was included in the tank mix for the first application to kill any emerged weeds. Plots were treated subsequently with paraquat to keep the plots clean (<20% weed cover) as prescribed in the treatments. In 2014 and 2015, the initial residual herbicide for each treatment timing was Prowl H2O (4 qts/a).

The percent weed cover was evaluated by estimating the percent of ground covered with weeds in an 18" circle between trees in 3 locations in each plot. The weeds were identified in each plot. The percent weed cover was averaged for each date and averaged over the total season.

Immediately after planting trunk circumferences were measured at 30 cm above the graft union. Trunk circumference was measured again in October, 2013, at Kast, and October, 2014 and 2015, at Kast and RR. The trunk cross-sectional area (TCSA) was calculated in square centimeters (cm^2). Leader growth was measured (cm) for each tree. The number of shoots greater than 30 cm were counted and the current season growth was measured. The average shoot length was multiplied by the number of shoots, added to the leader growth, to calculate the total shoot growth for each season. In 2015 the total tree height above the graft union was also measured.

Soil and leaf analysis samples were collected in early August, 2013, 2014, and 2015. Treatment samples were pooled across reps, collecting 20 leaves from each replicate of each treatment.

To evaluate potential yield, the Robinson model (NY Fruit Quarterly 16(2):3-7) was used to predict 4 apples could be produced per cm^2 of trunk cross sectional area (TCSA) measured at 30 cm above the graft union. The resulting potential yield per tree was calculated as TCSA x 4 and multiplied by 1210 trees per acre and divided by 88 (fruit count per bushel) to estimate bushels per acre. To determine actual yield the apples were counted and weighed per tree and averaged over treatments at the Kast site in 2014 and 2015, and in Reality Research site in 2015.

Results and Discussion:

Percent Weed Cover:

At the Kast site, year one (2013) had little difference in percent weed cover among weed-free timings initiated in May or June. But weed-free treatments that were not initiated until July resulted in statistically more percent weed cover and competition. The best weed control was in the longest weed free treatment timings beginning late April and May and lasting 4-5 months through August or September. There was statistically more weed cover in treatment timings that were initiated in July and August. The untreated check, as expected, resulted in statistically more weed competition than any other treatment timings.

The first season at RR site in 2014, started with a May 3 planting date and the first settling rainfall on May 16. Early treatment timings initiated on May 22 and Jun 24 resulted in less percent weed cover with a seasonal average for the first five treatment timings holding less than 20%. Weed-free treatment timings initiated in July or later resulted in a range of 41-45% weed cover. The untreated check had statistically higher average seasonal weed cover of 62%. There was better separation in percent weed cover between treatments in 2015 ranging from 6-78%.

Impact on tree growth:

In Kast and RR sites, there was no difference in TCSA at initial planting time. Kast trees planted in 2013 had a TCSA of 2 cm^2, and RR planted in 2014 had a TCSA of 1.5 cm^2. Kast trees stayed nearly twice as large TCSA as those in Reality Research plots, showing a potential benefit in production when planting larger trees by as much as 100 bushels per acre by the 3rd leaf.

In 2013 at Kast 1st leaf, there was a significant increase in TCSA among treatments with weed control starting right after planting or as late as June, ranging from 93-108 % compared to weed control treatments initiated in late July (64 %) or plots with no weed control (47%). There was little statistical difference in the length of the leader among treatments except for the untreated check with 36 cm compared to 47-58 cm for all other treatments (30 centimeters = 12 inches). The average shoot growth for the season was 25-32 cm and total estimated shoot growth of 2.6-3.3 m in the early season treatments; both were longer, compared to 20 cm of average shoot growth and 2 m of total shoot growth in the late season treatment. The late season treatment was not significantly better than the untreated check with 16 cm average shoot growth and 1.4 m total shoot growth.

At Kast, 2nd leaf in 2014, the percent increase for treatments initiated in as early as April and as late as June ranged from 315 to 353% increase. Waiting until July to clean up weeds resulted in a smaller 269% increase in TCSA, and only 196% in the untreated check. The early season treatment timings resulted in 27-29 shoots longer than 30 cm; in late season timings there were only 22, not significantly different from only 18 shoots in the untreated checks. After year 2, the TCSA for early season weed-free timings were generally equal ranging from 8.8 to 9.6 cm^2 compared to 8.0 cm^2 if starting weed control in July, and 6.3 cm^2 after 2 years of no weed control. Table 5 shows the total percent increase in TCSA for the 1^{st} through 3^{rd} year. After the 3^{rd} leaf, the best numerical TCSA of 14 cm^2 was in May-Sept, May – Jul, and Jun – Jul treatments. The smallest TCSA were recorded in the latest treatment timing and untreated plots. The number of branches longer than 30 cm ranged from 15 in untreated plots to 23-27 in early treatments. The average shoot growth was significantly different, but showed that the fewer the branches, the longer the average shoot growth, with the exception of the untreated weedy check with the fewest branches. After 3 years, the untreated check trees were much shorter, 721 cm, than the plots with early and late weed control treatments, 795 - 850 cm.

Table 5. Kast Tree Growth - 1st through 3rd leaf					
Weed-free timing	2015 AVG % weed cover	TCSA Fall 2013	TCSA Fall 2014	TCSA Fall 2015	% Increase TCSA
May -Sep	6 e	4.1 b	9.7 a	14.7 a	607 ab
May-Aug	4 e	4.3 b	9.0 a	13.2 ab	516 ab
May-Jul	4 e	4.2 b	9.7 a	14.6 a	608 ab
Jun-Aug	19 d	4.1 b	9.0 a	13.5 ab	602 ab
Jun-Jul	20 d	4.6 a	9.5 a	14.1 a	627 a
Jul - Aug	39 c	4.0 b	8.9 a	13.1 ab	525 ab
Aug -Sep	59 b	3.4 c	7.7 b	11.8 b	473 b
Untreated	95 a	3.0 d	6.2 c	8.6 c	308 b

At the RR site first leaf in 2014, there was no difference in weed pressure among the early season treatments initiated in late May and late June, therefore, there was no expectation of differences in tree growth among those early treatments. The percent increase in TCSA among early season treatments ranged from 59-72%, the number of shoots longer than 30 cm was 5.2 to 6.5 compared to late season treatments and untreated check with only 2.9-4.2 shoots. The average shoot length in early treatments ranged from 22-30 cm with a total growth of 1.6-2.2 m. The late season treatments and untreated checks had significantly less shoot growth than early treatments. But late season and untreated checks were not statistically different from each other with 16-17 cm average shoot growth and 0.8-1.0 m in total shoot growth. In the 2^{nd} leaf, Table 6 shows the best increase in TCSA was in the treatments that began when weed-free timing started in May, but not statistically better than weed free timings starting in Jun or Jul, all ranging from 5-6 cm^2. Treatments that were weed free in Aug (217%) and untreated plots (152%) resulted in the smallest TCSA at the end of the 2^{nd} leaf. The total tree height was not different among treatments ranging from 650 to 809 cm but much taller than untreated checks only 429 cm.

Nutrient Analysis:

The leaf nutrient analyses are shown in Table 7. The leaf analysis results for the least weedy plots, the untreated check, and mid-season weedy treatments showed higher leaf N at Kast site in the longest weed-free treatment for first through third leaf seasons. The first season it was 2.4% N and the second season, 2.8%, and 2.28% in the 3^{rd} leaf. Other treatments showed slightly deficient N, from 2.2-2.3, according to standard recommendations in young trees (2.4-2.6%). The untreated check at Kast showed more yellow leaves with 1.87% N the 1st season, 2.03 % the 2nd leaf, and 1.52% in the third leaf showing serious N starvation with 3 years of no weed control. The same results were obtained in the RR site for the first season with 2.46% N in the longest weed-free treatment vs. 1.8% N in the untreated check. The second season, the N level was higher in the early season weed-free timings than late season weed-free treatments and untreated weedy check. There is a strong negative correlation coefficient of the seasonal average % weed cover and the % leaf N of .82431, the higher the seasonal weed cover, the lower the leaf N. There were no significant soil nutrient effects that stood out for either site.

Impact on fruit production:

If using a suggested guide of thinning to 4 apples per cm^2 TCSA, the potential crop for the 2^{nd} leaf was predicted at 12-13 apples per tree in the late season weedy treatments and untreated check compared to 16 apples per tree in early weed-free treatments; 165 bu/acre in “weedy” treatments compared to 233 bu/acre in the better early season weed control plots initiated in May or Jun. In 2014, the trees were harvested to see if there was an effect on yield. Since the trees were thinned with chemical thinners and handthinned uniformly (and not by TCSA), the average number of fruit per tree was not statistically different ranging from 12-16 apples per tree. Therefore, there was no statistical difference in fruit size or total weight per tree detected among treatments. After 2 seasons of growth, Table 8 shows the potential yields if thinned based on TCSA, the best treatments with good weed control could yield 495 bu/acre for 2015, a 12.5% increase over the late season weedy treatments, and 43% increase over the untreated check. That translates into a return (if $8 per bushel) of $3960/acre in good weed control treatments, $3520/acre in late weed control treatments, and $2772/acre in poor weed control treatments. The actual yield in the 3rd leaf Kast orchard was much higher than predicted in the early season and June treatments, and much lower than predicted in the late season weed free-timing and untreated weedy checks. Based on TCSA, treatments initiated in May or Jun resulted in higher potential yields for 4th leaf, compared yields in the treatments initiated in July or later.

Table 8. Kast 2015 potential and actual 3rd leaf yield, and potential yield for 4th leaf, based on 4 apples per cm^2 TCSA.

Weed-free timing	2015 Average % Weed Cover	3rd leaf Potential apples/ tree	3rd leaf Potential yield Bu/ acre	3rd leaf actual yield Bu/ acre 2015	3rd leaf actual apples/ tree	3rd leaf Tot fruit weight (lb.)/tree	Avg. apple weight (lb.)	4th leaf Potential yield Bu / acre
May -Sep	6 e	39	534	746	78 ab	25.9 ab	0.33 a	809
May-Aug	4 e	36	495	856	85 a	29.7 a	0.35 a	726
May-Jul	4 e	39	534	703	70 abc	24.4 ab	0.37 a	803
Jun-Aug	19 d	36	495	743	75 ab	25.8 ab	0.36 a	743
Jun-Jul	20 d	38	523	472	51 cd	16.4 c	0.33 ab	776
Jul - Aug	39 c	36	490	605	65 bc	21.0 bc	0.32 ab	721
Aug -Sep	59 b	31	424	300	34 d	10.4 d	0.30 ab	649
Untreated	95 a	25	341	58	7 e	2.0 e	0.24 b	473

Table 9 shows the potential and actual yield for the 2nd leaf and potential yield for 3rd leaf in Reality Research planting. Because there was no difference in % weed cover and TCSA in treatments initiated in May and Jun, there was no difference in potential yield among those treatments, but they were 20-40 bushels per acre higher than treatments initiated in Jul or later, an extra $160-320/acre. But with a late May frost, the actual yields were much lower in all treatments than the potential yields. The potential yield for 3rd leaf based on TCSA holds the trend for higher yields if weed free timing is initiated in May or Jun and runs most of the season.

Table 9. Reality Research potential and actual yield for 2nd leaf, potential yield for 3rd leaf, based on 4 apples per cm^2 TCSA.

Weed-free timing	Season Average % Weed Cover	2nd leaf Potential apples/ tree	2nd leaf Potential yield bu/ acre	2nd leaf actual apples/ tree	Tot fruit weight (lb)/ tree	Avg. apple weight (lb.)	3rd leaf Potential yield/ acre
May -Sep	6 d	10	135 a	2.4 abc	0.86	0.23 a	323 a
May-Aug	8 d	11	147 a	4.7 a	1.43	0.28 a	335 a
May-Jul	11 cd	9	130 a	1.6 bc	0.55	0.21 a	316 a
Jun-Aug	19 c	10	132 a	0.9 c	0.35	0.24 a	311 a
Jun-Jul	20 c	10	131 a	1.3 bc	0.4	0.18 ab	300 ab
Jul - Aug	50 b	8	109 b	0.1 c	0.04	0.04 b	290 ab
Aug -Sep	52 b	8	104 b	3.6 ab	1.3	0.29 a	255 bc
Untreated	78 a	8	113 b	2.4 abc	0.62	0.16 ab	225 c

Treatments cleaned up for the last 2 months and the untreated weedy check resulted in lower potential yields. The losses in returns to grower could be $600-800 per acre in the 3rd leaf.

Conclusions:

Although it was suspected that the new plantings of high density dwarf apple plantings are more sensitive to weed competition, the analysis of this data does not show any difference in tree growth or potential fruit production as long as the weed competition is eliminated in May and Jun after planting. If weeds are allowed to establish into July or later, there is significant growth reduction and a potential for $440-1188 per acre lost in yield in the 2nd leaf. The Kast Farms site had an actual reduction in return of $2500-5500 per acre in the 3rd leaf in the more weedy treatments, and a potential of $1200-2600 per acre loss in potential returns in the 4th leaf.

It is expected that in an unirrigated orchard, a dry season would demonstrate more differences in tree growth. Although the latest weed-free treatment in RR without irrigation showed the effects of weed debris in treatments started in Jul and Aug acted as mulch slowing weed growth in the following spring and held more water.

Acknowledgements:

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Literature cited:

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