NGWB GRANT FINAL REPORT

2012-2013

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Issue of Interest

It has been well documented that the multiple application of Amigo Oil to dormant grapevines, will in fact delay bud break anywhere from several days to almost three weeks depending upon the winter and the specific cultivar (Mac's Creek, 2007-2012). This amount of delay can mean the difference between a bountiful harvest and catastrophic loss due to early spring warm-up and late spring freezes.

Similar potential catastrophic loss also plagues the small fruit industry, i.e., much fruit is lost in Nebraska due to spring freezes, even though producers select cold hardy trees. This proposal will address the question, will the application of Amigo Oil (in a manner similar to vineyard application) delay bud break and thus avoid the majority of frost damage in an ORCHARD application.

Finding techniques to minimize winter damage to fruit trees in Nebraska could make the difference between devastating damage, which negates any profitability and a consistent, quality fruit industry. It is not difficult to remember how recently a year's entire fruit crop, be it wild fruit or commercially produced fruit, has been completely lost (90%-100%) because of late spring freeze or frost. Perhaps even more important can be the longer term loss, i.e., 50%-75% of these trees continuing to under-produce for at least one additional year. Additional intangible loss, i.e., consistency of crop quality (i.e., ripeness, maturity of trees, length of growing season being hampered by late bud break of secondary or tertiary buds) is even more profoundly felt by the producer trying to produce quality juice or wine from questionable fruit. Further, countless additional orchard management hours are incurred in retraining new shoots, pruning, disease control, etc.

The primary problem is not one of a lack of varieties that can withstand ambient winter temperatures in Nebraska. The problem is one of minimizing winter damage from extensive temperature swings, which can result in an early dormancy break and early bud break, which

can be accompanied by a late frost or freeze. ***Therefore, the purpose of this research is to evaluate techniques designed to enhance fruit tree cold hardiness, specifically, effects of late winter spraying of dormant trees with products designed to delay bud break from two to four weeks (thus avoiding most damage from late freeze/frost).***

Five years of research (McFarland, 2007-2012) has investigated the efficacy of spraying dormant grapevine cultivars with a vegetable based oil/surfactant (Amigo Oil). The data show profound effects of delaying bud break ranging from five days to three weeks. It is hypothesized that comparable outcomes can be generalized to fruit trees. The ramifications of similar positive outcome could be equally as profound. Production could increase, quality could increase, cost of production could be significantly lowered, and profitability could significantly increase. Moreover, producing such fruit successfully could be expanded across the state of Nebraska beyond the southeastern most corner to include central, western and northern microclimates within our state.

Approach to Problem

Sample: Four groups of orchard trees will be identified including two cultivars (Crab Apple and Pear); i.e. Control group (no treatment) N =3; Tx1 (1 Application Early -Amigo Oil treated group-10% solution) N = 3; Tx2, (2 Applications); Tx3 (3 Applications). Each group will be selected by rows in a block style method.

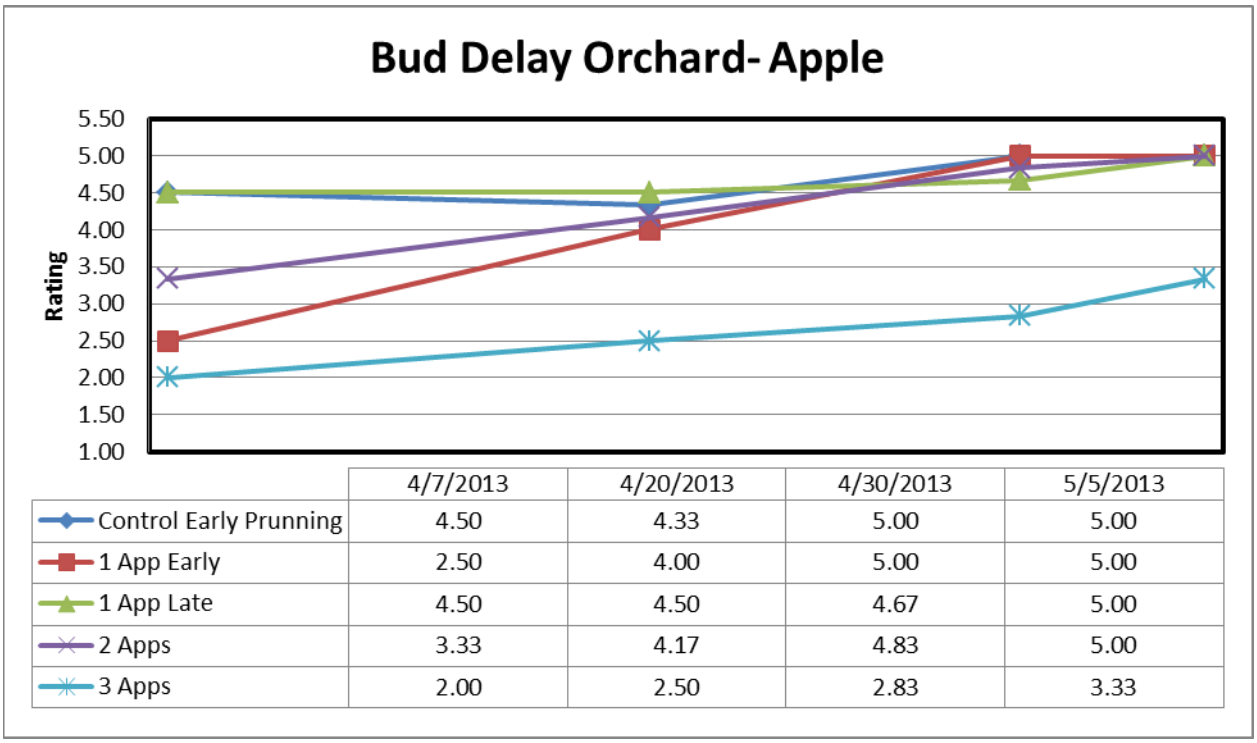
Procedure: Sample trees were pruned prior to the first application of Amigo oil. The control group received no treatment. The initial treatment was applied on or about March 1, 2013 and re-occurred approximately once every two weeks after until bud break (i.e. approximately May 1st, 2013).
The orchard manager involved in the research project was trained as to the preparation of the Amigo oil in a 10% water solution to assure consistency of the treatment. The Research Assistant was trained in using bud rating scale. Approximately 10% of vines were also rated by one additional researcher to assure reliability of ratings at ≥ .80.
Adequate inter-rater agreement was maintained r>.95.

Goals/Achievement of Goals

Research Question #1: Is there a difference in delayed bud break ratings when comparing the four groups within each cultivar? Average delayed bud counts were determined for each group and these means compared using a One Way ANOVA.

Results, Conclusions, Lessons Learned

Average ratings on all trees within each of the four groups (Control, Tx1,Tx2, Tx3, Tx4) for each of the two cultivars were analyzed and compared weekly (see graph below).



	4/7/2013	4/20/2013	4/30/2013	5/5/2013
Control Early Prunning	4.50	4.33	5.00	5.00
1 App Early	2.50	4.00	5.00	5.00
1 App Late	4.50	4.50	4.67	5.00
2 Apps	3.33	4.17	4.83	5.00
3 Apps	2.00	2.50	2.83	3.33

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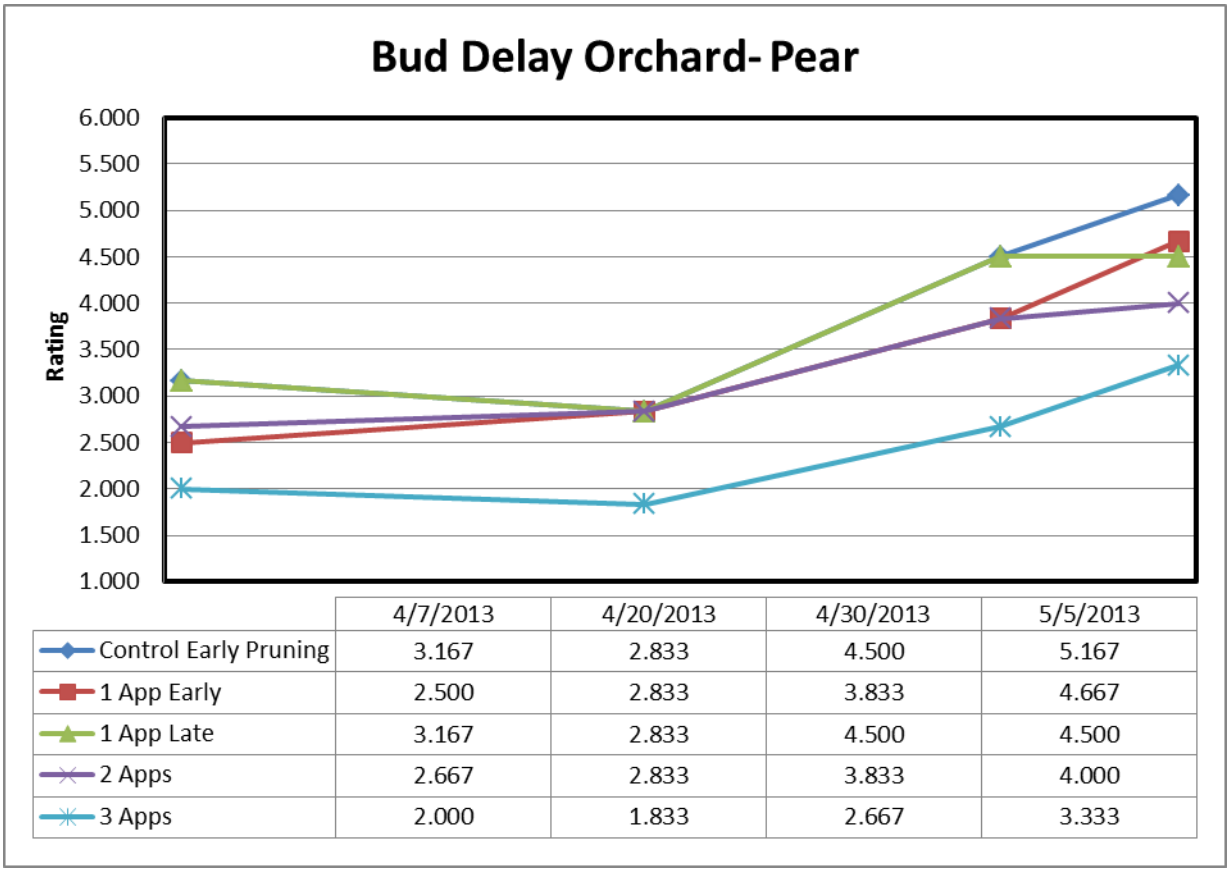

	4/7/2013	4/20/2013	4/30/2013	5/5/2013
Control Early Pruning	3.167	2.833	4.500	5.167
1 App Early	2.500	2.833	3.833	4.667
1 App Late	3.167	2.833	4.500	4.500
2 Apps	2.667	2.833	3.833	4.000
3 Apps	2.000	1.833	2.667	3.333

Note: Due to unavoidable weather conditions, it was not possible to apply the "1 Application Late trial. Therefore, that trial (green line on graphs above should be considered comparable to the Control group, i.e., no spray applied at all.

1) Single App. Early (first of March): no significant delay observed for apples; only a slight delay (2 days) for pears.
2) Two Applications: no delay for apples; 7 -9 day delay for pears.
3) Three Applications: 14+ day delay for apples; 14+ day delay for pears.

Conclusions

Significant delay of bud break was obtained with three applications of Amigo Oil. This resulted in at least a two week delay. Unfortunately, the 1 Application Late trial was not possible due to weather. Delays of this magnitude can mean the difference between harvesting a full crop on primary buds or reduced or even no crop at all. It is hypothesized that perhaps one factor that

may account for the variability of amount of delay from year to year in addition to the weather, may be the number of applications of Amigo Oil that are applied. This has been found to be the case in research on delaying bud break in grapevines (McFarland, 2012; Schwappach, 2011) For example, in one given year, five applications were made while during another year (due to weather constraints) only three applications were possible. Moreover, significant delay was found for a single application (late), comparable to the delay observed in the four application trials. These findings are significant in that prior to this study, it was assumed that "the more applications the better" when it come to bud delay. The preliminary results with grapevines, however, suggest that perhaps equal positive benefit may result from many fewer applications. These data should be considered as preliminary at best.

Progress Achieved According to Outcome Measures

1. **Late frosts/freezes** are a way of life in central Nebraska and they annually take their toll on row crops (e.g., corn) as well as small fruit crops. Such frosts are expected in early and even mid-May. However, the late May freeze (third week) and extent of freeze (e.g., 22 degrees F) were devastating (i.e., grape crop loss in our vineyard was documented at >95% loss with primary, secondary, and tertiary bud loss, and approximately 10% loss of plants.
   Thus, the problem is not one of a lack of cultivars that can withstand Nebraska winter temperatures; rather the problem is one of minimizing winter damage from extensive temperature swings resulting in early dormancy break (de-acclimation) and early bud break accompanied by late frost/freeze.

   Benefits to Nebraska horticulture could be quite significant. With our small orchard, (60 trees) suffering a 95% loss (estimated crop loss of approximately 10-12 tons) the one year crop income loss (average price this year being $1000/ton) is estimated at $10,000-$12,000.
   Perhaps even more importantly is the longer term loss, i.e., one half to two thirds of these trees continuing to under-produce for at least one additional year (estimated $5,000-$8,000 loss second year), and, finally the loss of 10% of the trees resulting in a 3-4 year loss. (Thus, total crop loss translates to $23,000-$28,000.
   Additional intangible loss, i.e., consistency of crop quality (i.e., ripeness, maturity of trees, length of growing season being hampered by late bud break of tertiary buds) is even more profoundly felt by the producer trying to produce quality fruit.
   Further, countless additional orchard management hours are incurred as many of these trees require re-pruning/positioning after bud kill.

Expected Benefit to the State of Nebraska

As stated earlier, the potential impact for small fruit horticulture in the state of Nebraska is huge:

a. Data from a vineyard application has documented that the usage of Amigo Oil results in significant bud delay when compared to non-treated controls. No research has been found that investigates the effect in an orchard application.
b. If the data are supportive, then it is hoped that this study can be expanded and replicated via a second and third year grant (USDA).

c. Should Amigo Oil prove to effectively and safely delay bud break, the producer could significantly increase her/his production and the consistency/reliability of production from year to year.
d. Should Amigo Oil prove to effectively and safely delay bud break, small fruit production could occur more consistently STATE-WIDE in Nebraska, and not be limited primarily to the southeastern corner of the state.

Financial Report

This project was funded in the amount of $6605. These funds were spent as follows: Supplies = 1500; Research Assistant = 825; Research Consultant = 500, Plant Pathologist/Sprayer Consultant = 2200, Data Analyst = 1080, Site Manager = 500