NGWB GRANT FINAL REPORT

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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).***

.APPROACH TO THE PROBLEM

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.

The efficacy of spraying Amigo Oil (a vegetable oil surfactant) onto dormant grape vines in order to delay bud break has been proven repeatedly. In previous research conducted by this researcher at Mac's Creek Winery & Vineyards (2008 – 2011) data have documented that depending upon the year, and the specific cultivar, bud break has been delayed anywhere from five days to three weeks. 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 to the vines. For example, in one given year, five applications were made while during another year (due to weather constraints) only three applications were possible. A review of the literature has found no studies that have systematically investigated this question.

Mac's Creek has just completed a Year 1 Pilot Study which investigated this issue. Preliminary results suggest that one application resulted in no significant bud delay. Due to the weather constraints, only two applications were possible. However, two applications resulted in significant bud delay when compared to Controls (no treatment), and significant bud delay when compared to the one application group. This delay was found to be an approximate 14-day delay. Moreover, anecdotal findings (non-research based) reported from a single application of Amigo Oil in Minnesota in the spring of 2012 suggested significant delay in bud break on that site. Given the profound significance of these findings combined with the extremely unusual winter/spring weather (resulting in one of the cultivars budding out a full month earlier than ever recorded at this site), it is recommended that this study be replicated for at least a second year in order to determine whether such results can be replicated across differing winters/springs in central Nebraska.

Project design and methodology is as follows:

Method

Sample: Three groups of trees were identified on each of two orchard sites; i.e. control group (no treatment) N =3; Tx1, treatment group (Amigo Oil treated with one application) N = 3; Tx2, treatment group 2 (Amigo Oil treated with two applications) and for each of three cultivars (i.e. Crabapple, Pear and Peach). Each group was 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 March 1, 2014 and the second application on March 29, 2014.

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 a bud rating scale used in previous bud delay studies (McFarland & McFarland). Approximately 10% of ratings were also rated by one additional researcher to assure reliability of ratings at ≥ .80.

Instrumentation

A Bud Rating Form (developed by the researcher and used in the five years of previous study) was used to rate the extent of bud development. Buds were rated by a research assistant on a scale of 1 – 5 (1 = no bud swell; 5 = bud break, one leaf unfurled). Reliability checks were conducted with a second rater and inter-rater reliability was maintained at r>.90.

Procedure

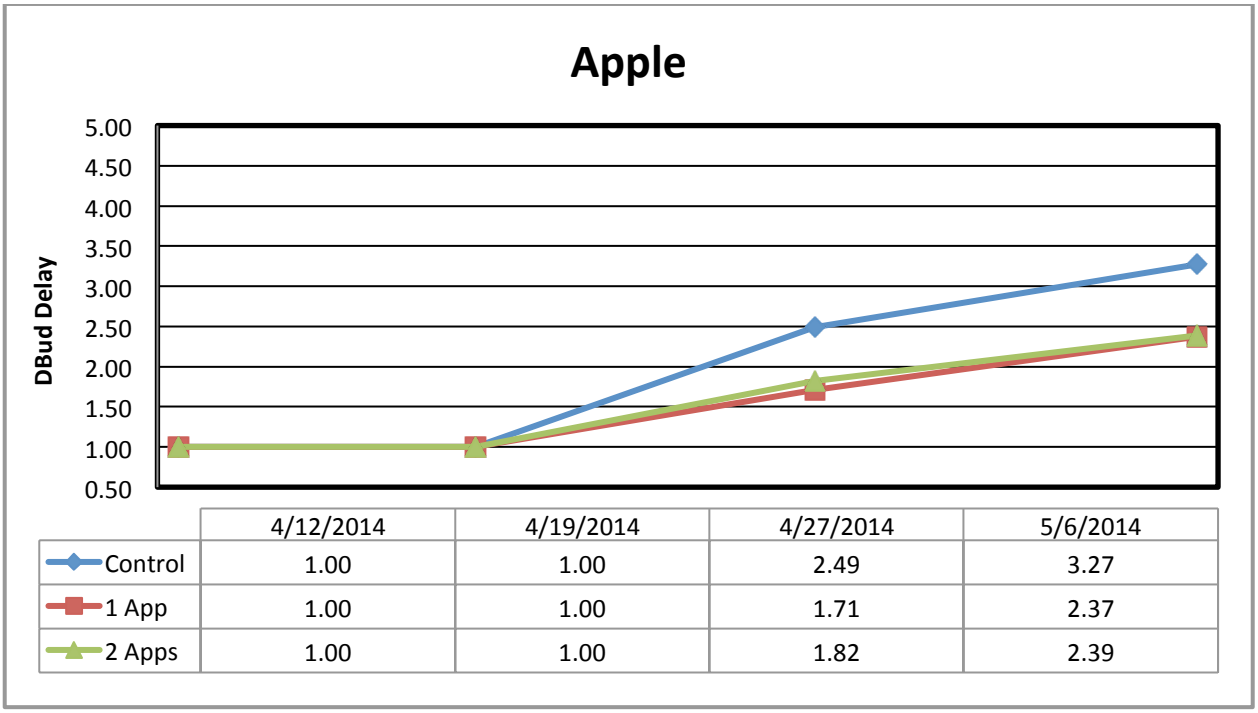
The research assistant identified each of the three sample groups. The first Amigo Oil application was applied March 1, 2014 and the second application was made March 29, 2014 . Once bud swell began (approximately late April), the research assistant rated buds every week until most all buds were rated at "5" (approximately four weeks).

GOALS/ACHIEVEMENT OF GOALS

Goal # 1: To investigate the efficacy of Amigo Oil application to delay bud break in a commercial ORCHARD application.

RESULTS, CONCLUSIONS, LESSONS LEARNED

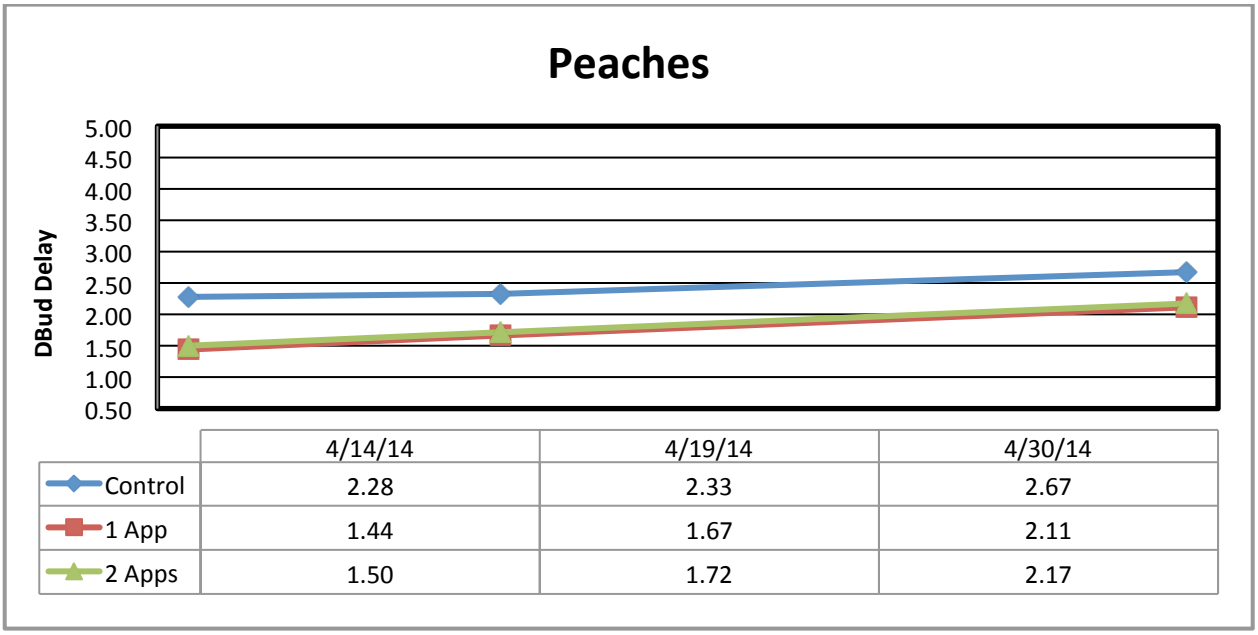
Apples: Mean bud development for the data recording dates for Apples are plotted (see Figure 1). As shown in Figure 1, extrapolated mean bud development for the Amigo Oil group (single application) reaches bud break on May 27 (*M* = 4.0) whereas the mean development for the Control Group reached bud break on May 20 (*M* = 4.0). Thus, it can be determined that bud development has been delayed by at least 7 days. There is no difference in delay when comparing single vs two applications.



	4/12/2014	4/19/2014	4/27/2014	5/6/2014
Control	1.00	1.00	2.49	3.27
1 App	1.00	1.00	1.71	2.37
2 Apps	1.00	1.00	1.82	2.39

Figure 1. Mean bud development for Crabapples.

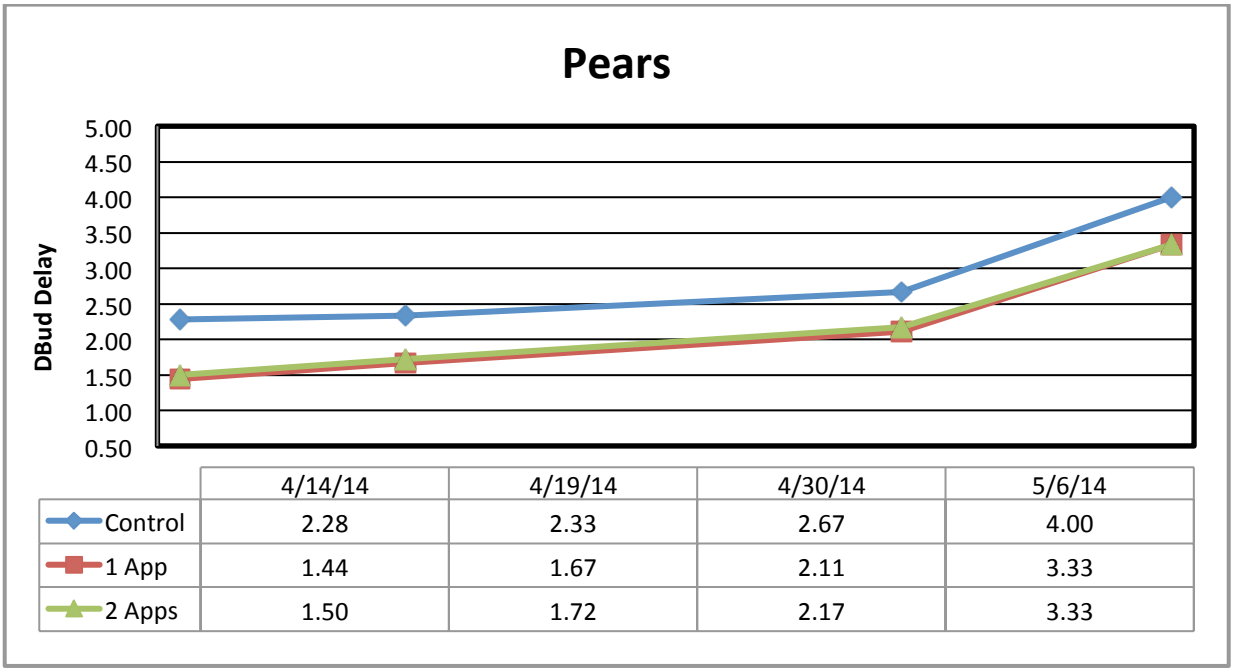
Peaches: Mean bud development for the data recording dates for Peaches are plotted (see Figure 2). As shown in Figure 2, extrapolated mean bud development for the Amigo Oil group (single application) reaches bud break in late May (a severe storm destroyed the sample of peach trees in early May) whereas the mean development for the Control Group reached bud break significantly earlier. Thus, it can be estimated that bud development has been delayed by at least 7-14 days. There is no difference in delay when comparing single vs two applications.



	4/14/14	4/19/14	4/30/14
Control	2.28	2.33	2.67
1 App	1.44	1.67	2.11
2 Apps	1.50	1.72	2.17

Figure 1. Mean bud development for peaches.

Pears: Mean bud development for the data recording dates for Pears are plotted (see Figure 3). As shown in Figure 3, extrapolated mean bud development for the Amigo Oil group (single application) reaches bud break on May 13 (*M* = 4.0) whereas the mean development for the Control Group reached bud break on May 6 (*M* = 4.0). Thus, it can be determined that bud development has been delayed by at least 7 days. There is no difference in delay when comparing single vs two applications.



	4/14/14	4/19/14	4/30/14	5/6/14
Control	2.28	2.33	2.67	4.00
1 App	1.44	1.67	2.11	3.33
2 Apps	1.50	1.72	2.17	3.33

Figure 1. Mean bud development for pears.

PROGRESS ACHIEVED ACCORDING TO OUTCOME MEASURES

These results are quite consistent with similar studies evaluating the efficacy of delaying bud break in grapevines. The similarities are remarkable. First, a significant delay in bud break has been found when applying Amigo Oil to dormant fruit trees. These delays range from 7 days to over two weeks. Moreover, a single application of Amigo Oil is equally effective as multiple applications (two applications). Significant bud delay also has been found across three cultivars (apples, peaches and pears) and across two differing microclimates.

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.

FINANCIAL REPORT

Grant expenditures aligned with projected budget and were expended as follows:
Supplies = $600
Equipment Leasing = $720

Plant Pathology Consultant = $1200
Research Consultant = $500
Research Assistant = $780
Data Analyst = $500
Site Coordinator = $500