IMPACT OF SEED FLOW LUBRICANTS ON SUGARBEET SEEDLING ESTABLISMENT AND YIELD

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Introduction:

Recently published research has implicated neonicotinoid seed treatment insecticides (e.g., Cruiser, Poncho, etc.) used for corn production in honey bee kills (Krupke et al. 2012). That research has generated a substantial amount of concern on a national scale, and has precipitated demands ranging from increased use restrictions to a complete ban on all uses of neonicotinoid insecticides. Those authors observed that seed flow lubricants, such as talcum, abrade seed-applied insecticides from seed coatings, and suggested that the resulting insecticide-laden dust is released into the air in exhaust plumes emitted from vacuum-based planters. As a result, they concluded that this subsequently either directly or indirectly exposes bees and other non-target pollinators to the insecticides. In response to public concerns and perceived risk to honey bees from these insecticides, the Environmental Protection Agency (EPA) issued a moratorium on any new uses of currently labeled neonicotinoid products in April of 2015.

Although the results of Krupke et al. (2012) may suggest valid concerns and implications in relation to neonicotinoid seed treatment deployment and associated hazards for pollinators, it should be noted that plots in that study were planted unrealistically late (July 12) for planting field corn or most any other row crop (e.g., sugarbeet) in the central and northern latitudes of North America. That late planting date would have resulted in planter talcum/insecticide releases occurring when honey bees and other pollinators were more actively engaged in foraging than if the study had been established on a normal Indiana planting date (i.e., April to early May). As such, the experiment favored the likelihood of bee exposure to pesticides.

Concerns relating to neonicotinoid insecticide “dust off” have raised questions regarding whether talcum or other seed flow lubricants are necessary during row crop planting. If lubricants are not needed in sugarbeet planting, or if a less-abrasive alternative to talcum could perform at least as well as talcum without negatively impacting seed delivery and seedling establishment, it may provide evidence to support continued federal registration of neonicotinoid seed treatment insecticides used in sugarbeet production systems.

This experiment was carried out to determine if seed lubricants (i.e., talcum, graphite, talcum/graphite mixture, or Fluency Agent®), used at commercially recommended rates, impact seed delivery, seedling establishment, or resulting sugarbeet yield parameters and revenue. This research could provide critical information to argue for maintaining neonicotinoid seed treatment registrations for use in sugarbeet if the EPA pursues a ban on using these materials in row crop production.

Materials and Methods:

A field site near Hillsboro (Traill County), ND was chosen to conduct this experiment during the 2015 growing season. Plots were planted on 11 June, 2015 by using a 6-row John Deere MaxEmerge II planter. The planter was adjusted to deliver seed at a depth of 1¼ inch and a rate of one seed every 4½ inches of row length. Betaseed 83CN, a glyphosate-resistant sugarbeet seed variety in two sizes (regular pellet [10.5/64-inch diam.] and Pro200, an extra-large pellet (12.5/64-inch diam.) was used for the experiment. Each plot was six rows (22-inch spacing) wide with the four centermost rows treated. The outer “guard” rows, one on the outer side of each plot, served as untreated buffer rows. Each plot was 35 feet long, and 35-foot tilled alleys were maintained between replicates throughout the growing season. The experiment was arranged in split-plot design with four replications of the treatments. Seed size was the whole-plot factor, and seed flow lubricant served as the sub-plot factor.

Treatment performance was compared using plant stand counts and yield parameters. Stand counts involved counting all living plants in all four 35-ft long rows of each plot. Counts were taken on June 25, July 2, and July 20, which was 14, 21, and 39 days after planting (DAP). All plant stand count data were converted to plants per 100 linear row ft.

Harvest: Treatment performance was also compared on the basis of sugarbeet yield parameters. Plots were harvested on 5 October. Immediately before harvest, the foliage was removed from all treatment plots by using a commercial-grade mechanical defoliator. After defoliation, all beets from the center two rows of each plot were extracted from soil using a mechanical harvester and weighed in the field using a digital scale. A representative subsample of 12-18 beets was collected from each plot and sent to the American Crystal Sugar Company Tare Laboratory (East Grand Forks, MN) for sucrose content and quality analysis.

Data analysis: All data from root injury ratings and harvest samples were initially subjected to analysis of variance (ANOVA) (SAS Institute, 2008) to determine whole- and sub-plot factor effects. Means were separated by using Fisher's protected least significant difference (LSD) test at a 0.05 level of significance.

Results and Discussion:

Plant population (i.e., stand count) results from initial whole-plot (i.e., seed size) comparisons are presented in Table 1. There were no significant differences in plant populations between the two seed sizes tested, irrespective of whether the counts were taken early (14 DAP) or more than a month after plots were planted (39 DAP). This suggested that seed size did not play a significant role in seedling establishment in this trial.

Table 1. Whole-plot effect of *seed size* on *plant populations* in a comparison of sugarbeet seed flow lubricants, Hillsboro, ND, 2015

Treatment/ form.	Stand Counts (plants / 100 row ft)		
	14 DAP	21 DAP	39 DAP
Regular pellet	206 a	209 a	208 a
PRO200	197 a	207 a	206 a
LSD (0.05)	NS	NS	NS

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD test).

[a]DAP = days after planting

Yield results from the whole-plot treatments in this trial appear in Table 2. There were no significant differences between seed sizes. The fact that there were no differences associated with seed size on plant populations or any of the yield parameters evaluated strongly suggests that seed size most likely had no measurable effect on the overall results of this trial.

Table 2. Whole-plot effect of *seed size* on *yield parameters* in a comparison of sugarbeet seed flow lubricants, Hillsboro, ND, 2015

Treatment/ form.	Recoverable sucrose yield (lb/ac)	Root yield (T/ac)	Sucrose content (%)	Gross return ($/ac)
PRO200	7422 a	24.4 a	17.08 a	902
Regular pellet	7291 a	24.0 a	17.07 a	887
LSD (0.05)	NS	NS	NS	

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD test).

Results from comparisons of seed flow lubricants on the basis of stand counts from this experiment are presented in Table 3. Although there were slight numerical increases (e.g., 5 to 10 plants per 100 row ft) in plant populations for most of the treatments from 14 DAP to 21 DAP, there were no significant differences in stand counts among seed flow lubricants. Additionally, none of the lubricants differed statistically from the no-lubricant control.

Table 3. Impacts of seed flow lubricants on sugarbeet *plant populations*, Hillsboro, ND, 2015

Treatment/ form.	Rate	Stand Count (plants / 100 row ft)		
		14 DAP	21 DAP	39 DAP
Talc/Graphite Mix (80:20)	1.3 ml	206 a	211 a	210 a
None	-	205 a	210 a	209 a
Fluency	7.4 ml	203 a	209 a	207 a
Graphite	1 ml	198 a	208 a	206 a
Talc	2.5 ml	195 a	201 a	202 a
LSD (0.05)		NS	NS	NS

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD test).

[a]DAP = days after planting

Yield results from this experiment are shown in Table 4. As observed in the stand count analysis, there were no statistical differences among lubricants or between any single lubricant and the no-lubricant control with regard to recoverable sucrose yield, root tonnage, or percent sucrose. Accordingly, there were only negligible differences in gross economic return among the entries tested.

Given the highly consistent results between repeated plant population assessments and all yield parameters that were measured in this experiment, it appears that seed flow lubricants do not impose a measurable impact on sugarbeet seedling establishment, yield, or revenue. However, it should be noted that these results are only preliminary, and this experiment should be repeated to determine the validity of the results. As such, the exclusion of a seed flow lubricant for use in sugarbeet planting is not recommended at this time. In addition to repeating this experiment, it is anticipated that this research will need to be expanded to large-scale, on-farm trials to further determine the repeatability of these preliminary findings.

Table 4. Effect of seed flow lubricants on sugarbeet *yield parameters*, Hillsboro, ND, 2015

Treatment/ form.	Rate	Recoverable sucrose yield (lb/ac)	Root yield (T/ac)	Sucrose content (%)	Gross return ($/ac)
Talc/Graphite Mix (80:20)	1.3 ml	7505 a	24.8 a	17.00 a	907
None	-	7423 a	24.3 a	17.09 a	906
Graphite	1 ml	7346 a	24.0 a	17.23 a	901
Talc	2.5 ml	7324 a	24.0 a	17.15 a	896
Fluency	7.4 ml	7186 a	23.9 a	16.91 a	860
LSD (0.05)		NS	NS	NS	

Means within a column sharing a letter are not significantly (P = 0.05) different from each other (Fisher's Protected LSD test).

References Cited:

Krupke, C.H., G.J. Hunt, B.D. Eitzer, G. Andino, and K. Given. 2012. Multiple routes of pesticide exposure for honey bees living near agricultural fields. PLoS ONE 7(1): e29268.

SAS Institute. 2008. The SAS System for Windows. Version 9.2. SAS Institute Inc., 2002-2008. Cary, NC.