A 2014 multi-site field study on the effects of Clariva seed treatment on soybean yield and Soybean Cyst Nematode reproduction

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The soybean cyst nematode (SCN) is a serious pest of Minnesota soybean and has been managed with crop rotation and soybean varieties with resistance to SCN. Unfortunately, SCN populations virulent on (able to infest, reproduce on and damage) SCN resistant soybeans are increasingly widespread. Virulence on the PI 88788 resistance source is the most common, but numerous field populations virulent on Peking or both PI88788 and Peking resistance sources have been observed. The frequency of these virulent SCN populations has increased in Minnesota. Based on field collected samples, the percentage of SCN populations virulent on PI8788 increased from 13.6% to 72.4 % between 1997-1998 and 2007-2008 surveys. Those virulent on Peking increased from 3.4% to 15% over the same period (Chen, et al. 2011). Therefore, effective chemical or biological complements to resistant varieties would be helpful to soybean growers’ SCN management programs.

Seed applied pesticides for soybeans are being developed and marketed at an increasing rate. One of these is the bacterium Pasteuria nishizawai, a biological nematicide and a component of Clariva™ Complete seed treatment, Syngenta Crop Protection®.

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The Minnesota Soybean Research and Promotion Council funded a 2014 project to provide geographically and environmentally robust data on Clariva for SCN management. One specific objective of this study was to evaluate the effects of the new biological nematicide on soybean yield, including potential interactions with SCN host plant resistance, environment and an insecticide plus fungicide combination.

**Methods**
The study was co-located at University of Minnesota Soybean Breeding Project sites throughout Minnesota. These sites varied by geography, soil type, long-term field histories, SCN populations and planting date. Based on site location, a northern or southern set of soybean varieties was used (Figure 1). At each site, four replications of each of six treatments were planted with a plot planter. Individual treatment plots were 10-foot wide by 12-foot long at every site. Twenty sites were planted, many of which had difficult planting and spring weather conditions. The southern sites were planted from May 7 to June 5 and the northern sites from May 23 to June 4. One northern site was not harvested because of herbicide damage and one southern site was not harvested because of severe late season hail.

An SCN susceptible (NK S22-F8 southern sites, NK S06-R9 northern sites) and a PI88788 SCN resistant (NK S22-S1 southern, NK S06-H5 northern) variety were planted at each site. For each variety, seed was untreated, treated with Clariva Complete or treated with Cruiser Maxx + Vibrance, an insecticide/fungicide counterpart to Clariva Complete without the *Pasteuria* nematicide. Syngenta Crop Protection supplied the treated and untreated seed for each variety. For each variety, the treated and untreated seeds were of the same seed lot. Soil samples for fertility and SCN populations were taken from the center two rows at planting. SCN samples were also taken from the center two rows of each plot at soybean maturity. Additional mid-season samples were taken in sites known to have SCN populations in an attempt to detect any temporary suppression in SCN numbers. The SCN reproduction factor (Rf) was determined by dividing end of season populations (Pf) by initial populations (Pi).

Soybean aphid populations were scouted and several southwest and west central Minnesota plots were treated for aphids when populations in individual plots reached economic threshold.

A plot combine was used to obtain yields from the center two rows of each 4-row plot.

The factorial design of this experiment (2 variety x 3 seed treatment) allowed us to examine the contributions of both SCN resistance and seed treatments to soybean yield and SCN populations across multiple environments.

**Results**
The spring of 2014 was challenging for planting soybeans into a good seedbed on a timely basis. Additional heavy rains and ponded water after planting caused stand issues at several sites. Because both seed treatments contained several fungicides and an insecticide, assigning yield benefits was expected to be difficult.
We used a conservative (alpha = 0.05) level to detect significant differences in yield and SCN reproduction. Using a less conservative alpha value did not change interpretations of yield differences.

**Yield**

*Eight of 18 sites showed a significant yield difference by variety.* In the south, these differences were the SCN resistant variety out yielding the susceptible in sites with SCN present. In the north, where differences occurred, the SCN resistant variety out-yielded the susceptible including a non-infested site in Polk County. *As expected, there was an interaction between varietal yield differences and site where resistant varieties were most likely to yield more as compared with susceptible varieties in SCN infested sites.*

*Significant yield responses to either seed treatment, above the untreated controls, were not common in 2014. Two of 18 sites showed a yield increase with treated seed.* In a Norman County site, both seed treatments yielded more than the untreated seed control. In an Olmstead County site with undetectable levels of SCN eggs, both seed treatments yielded more than the untreated varieties with the Clariva Complete treatment yielding more than both the fungicides + insecticide and untreated varieties. We did not observe an interaction between SCN resistant varieties and seed treatment on yields. It is possible that the yield responses to seed treatments were due to microbial pathogens or early season soybean aphids. Stand differences by treatment were not observed. A significant correlation between soil fertility test values and yield or seed treatment response was not detected.

**SCN populations**

SCN populations are extremely variable within fields, even within relatively small areas, and these data were no exception. However, some consistent trends were observed. *The SCN resistant variety significantly (alpha=0.05) reduced nematode reproductive rates as compared to the susceptible at 11 of the 18 sites where SCN was detected.* Seed treatments did not change SCN reproduction compared to untreated seed. Using a much higher alpha (0.20) increased the differences detected for SCN reproduction by variety to 14 of 18 SCN infested sites. It also, found an effect for seed treatment at a single site where the fungicide/insecticide treatment without Clariva had the least SCN reproduction. The less conservation criteria for determining if treatment differences also increases the risk of erroneous conclusions.

Two SCN infested southern Minnesota sites showed an interaction with variety and seed treatment but these were not consistent across the sites. In some cases, the Clariva treatment had greater reproduction than the seed treatment without nematicide or untreated seed. Care in interpreting SCN reproduction factors is needed as they are in part related to SCN initial population density, and soybean root volume and health.

At least one of the trial sites had an SCN population virulent on PI88788 resistance, but reproduction was still less than the susceptible variety. These data show that SCN resistance reduces SCN populations compared to a susceptible variety.
Other work
During 2104, an additional greenhouse study on efficacy was conducted and long-term field studies examining the impact of Clariva Complete on SCN population dynamics were initiated. Weather induced variability was a factor in these 2014 data with respect to yields. This study will be repeated in 2015 but mostly limited to SCN infested sites.

References:

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