Non-ionic surfactants and arrested ear development

Principle Investigators

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Summary

Nonionic surfactants are commonly with pesticides to obtain better coverage on the leaf. There are studies showing that spraying NIS products in the pre-tassel stage of corn can cause arrested ear development. Arrested ear development is not a disease, but it can greatly affect yield. We tested different NIS products to determine if specific products can cause arrested ear development. The trial was set up with four NIS products, a non-treated control, and four replications in a randomized complete block design. The corn hybrid was sprayed with the four products at the V14 stage with a backpack boom. Photographs were taken weekly to record any visual differences. Four weeks after application, ears were sampled and measured for length to determine the effect of NIS on arrested ear development.

Rationale

A common disorder that can cause a reduction in corn yields is known as arrested ear development. Arrested ear development is not a disease; however, it can be caused by applying nonionic surfactants (NIS) before tasseling in corn (1). Nonionic surfactants are used to reduce the surface tension between the leaf surface and water droplet allowing the droplet to spread and cover more area on the leaf. This can mean better penetration of pesticides on the leaf. The growth stages that are most at risk for arrested ear development are when twelve to fourteen leaf collars are exposed (V12 to V14).

Arrested ear development can also depend on the corn hybrid and environment. Symptoms are seen on the ears, husks, leaves, and silks of the corn plant twenty-eight days after foliar applications of NIS. Symptoms result in shorter ears, fewer kernels, and dried ear tips (Fig. 1,2). Husks will have a hollow feel when squeezed and have a slender look following pollination (Fig. 2). Fewer silks on the ear is due to the underdevelopment of the kernels in the plant. Leaves will show discoloration when the corn ear is severely affected (Fig. 3)

Although NIS has been linked to arrested ear development for years, the damage is inconsistent, and questions remain on what products are more likely to cause arrested ear development. The objective of this research is to determine the effects of different NIS products on arrested ear development.

Figure 1. Comparison of a normal ear (left) and ears with arrested ear

Figure 2. Husk and silk symptoms of arrested ear development on the left ear and normal ear development on the right.

Figure 3. Purple discoloration in a plant severely affected by arrested ear development.

Methodology

The arrested ear development research trial was established in Princeton, KY at the University of Kentucky Research and Education Center in the summer of 2018. Treatments were sprayed in a randomized complete block design with four replications. The corn hybrid, AG6499, was planted in 30-inch row spacing at 32,000 seeds/A on May 9, 2018. NIS was sprayed at V14 on June 29, 2018, at the recommended rates for each NIS product. The nonionic surfactants were sprayed using a CO_2 pressurized backpack sprayer and a backpack boom with TJ-8002 flat fan nozzles spaced at 20 inches. Boom pressure was regulated at 41 psi which delivered 20 gal/A while traveling at 3 mph. A non-treated control was included along with four NIS products. The four NIS products used in this research are Preference®, Masterlock®, Class Act®, and Interlock®. Digital photographs were used to capture visual differences on the ears three weeks after spraying four different NIS products. Ears were collected from each treatment four weeks after application, approximately around the time NIS damage may occur. Ten ears were sampled from each plot within the research rows. Husks were removed and ear length was measured in cm to identify any NIS damage. Resulting data were analyzed using SAS v. 9.3 to determine if treatment affected ear length.

Results and Discussion

After statistical analysis, it was determined that treatment did not have a significant effect on ear length, indicating that treatment did not cause arrested ear development in this trial. Various factors could have affected why NIS damage was not seen in this trial. Ears may have been collected and data taken before any arrested ear symptoms could occur. Also, the timing of NIS application may have been sprayed too late at the V14 stage to cause arrested ear development. Western Kentucky has had various weather fluctuations this summer that may also have influenced the results. Some days were extremely hot and humid, while some days had severe thunderstorms. Previous studies showing that spraying NIS at pre-tasseling would cause arrested ear development used different, products, and it is possible that NIS products may have improved and are less likely to cause damage than those used previously.

Table 1. Effect of non-ionic surfactant treatment on ear length.

Treatment	Trade name	Ear length
Non-treated		20.61 A*
Alkylphenol ethoxylate, sodium salts of soya fatty acids, isopropyl alcohol	Preference®	21.24 A
Ammonium sulfate, corn syrup, alkyl polyglucoside	Class Act®	21.16 A
Modified vegetable oil, polyoxyethylene sorbitan fatty acid ester, vegetable oil)	Interlock®	21.16 A
Modified vegetable oil, polyoxyethylene sorbitan fatty acid ester, vegetable oil, soybean oil, ethoxylated	Masterlock®	20.96 A

*Values followed by the same letter indicate that treatments are not different at the $P = 0.05$ level.

Significance of findings

After data analysis, we concluded that there was no significant effect on ear length. Interestingly, the corn hybrid that was planted had put on an unusual amount of ears within several trials (Fig. 4). At first glance, we presume that this could be a symptom of arrested ear development; however, it was seen throughout the field, and in non-treated areas, indicating that it was a hybrid issue not related to treatment. With no indication of any arrested ear development symptoms in this trial, this may give producers the opportunity to spray NIS pre-tassel in the future. More research is needed to know when and where NIS may be sprayed.

Figure 4. Multiple ears on the corn plant.

Implications for future work

Future research can be established to determine if hybrid can affect NIS and arrested ear development.

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