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Horticulture and Crop Sciences

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Managing "Pollen Drift" to Minimize Contamination of Non-GMO Corn, AGF-153

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Corn is a cross-pollinating crop in which most pollination results from pollen dispersed by wind and gravity. Pollen drift in corn has received considerable attention in recent years as the result of the development and widespread adoption of new seed technologies containing transgenes or genetically modified organisms (GMOs). Managing pollen drift has always been a major concern in the production of hybrid seed (to ensure genetic purity of inbreds) and specialty corn (to optimize expression of value-added traits, like high oil content). Pollen drift has now become an important consideration in the production of non-GMO corn as an Identity-Preserved (IP) grain crop. Producers of IP non-GMO grain are concerned that pollen drift from GMO hybrids will contaminate, by cross-pollination, nearby non-GMO corn. Farmers growing GMO hybrids approved for export also want to avoid contamination of their crops by GMO corns that have not yet received approval in overseas markets (Nielsen, 2003a).

A significant percentage of U.S. IP corn is earmarked for overseas markets with rigorous GMO restrictions. Japan has set a zero tolerance for seed and food imports containing *unapproved* GMO material, e.g. StarLink corn (containing the Cry9C Bt transgene); food products containing less than 5% of approved biotech crops like corn and soybeans can be labeled as non-GMO. The European Union (EU) guidelines require that foods, including grains, containing more than 0.9% biotech material be labeled as genetically engineered. Producers of non-GMO corn need to minimize pollen contamination by GMO corn if they are to obtain premiums associated with IP grain contracts. As GMO corn acreage in Ohio increases with the introduction of Bt rootworm corn and wider use of other types of Bt and Roundup Ready corn, the potential for contamination of non-GMO corn is increasing. If growers want to produce non-GMO IP corn successfully, they need to become familiar with some physical and biological characteristics of corn pollen, potential distances that pollen can travel, and planting practices that reduce the risk of pollen contamination by nearby GMO corn fields.

Characteristics of corn pollen affecting "drift"

Corn pollen is spherical and much larger than the pollen produced by most grasses (Burris, 2002; Gray, 2003). Corn pollen is among the largest particles found in the air. Although it is readily dispersed by wind and gravity, it drifts to the earth quickly (about 1 foot/second) and normally travels relatively short distances compared to the pollen produced by other members of the grass family. Pollen may remain viable from a few hours to several days. Pollen can survive up to nine days when stored in refrigerated conditions. However, under ambient field conditions, pollen is viable for only 1 to 2 hours. High temperatures and low humidity reduce viability. Elevated temperatures have a greater negative impact on pollen viability than humidity, with viability greatly reduced at temperatures above 100 degrees F. At flowering, 60% of pollen fresh weight consists of water; pollen longevity diminishes rapidly if the water content drops below 40%. Corn plants typically shed pollen for 5 to 6 days, whereas a whole field may take 10 to 14 days to complete pollen shed, due to the natural variation in growth and development among plants (Nielsen, 2003b). Peak pollen shed generally occurs 2 to 3 days after 50% of the plants have shed pollen. Individual corn plants produce 4 to 5 million pollen grains. Therefore, even if only a small percentage of the total pollen shed by a field of corn drifts into a neighboring field, there is considerable potential for contamination through cross pollination.

How far can corn pollen travel?

Many studies have been conducted to determine how far pollen will travel � some have evaluated the density of pollen at varying distances from a corn source, whereas others have measured pollen drift by measuring outcrossing in neighboring corn. This latter approach is probably more meaningful when it comes to assessing the impact of pollen drift from GMO corn fields.

Once released from the anthers into the atmosphere, pollen grains can travel as far as � mile with a 15 mph wind in a couple of minutes (Nielsen, 2003b). However, most of a corn field's pollen is deposited within a short distance of the field. Past studies have shown that at a distance of 200 feet from a source of pollen, the concentration of pollen averaged only 1% compared with the pollen samples collected about 3 feet from the pollen source (Burris, 2002). The number of outcrosses is reduced in half at a distance of 12 feet from a pollen source, and at a distance of 40 to 50 feet, the number of outcrosses is reduced by 99%. Other research has indicated that cross-pollination between corn fields could be limited to 1% or less on a whole field basis by a separation distance of 660 ft., and limited to 0.5% or less on a whole field basis by a separation distance of 984 ft. However, cross-pollination could not be limited to 0.1% consistently even with isolation distances of 1640 ft.

Several studies have been performed evaluating the impact of pollen drift from GMO fields on neighboring non-GMO fields. A Colorado study (Byrne et al. 2003) tracked the drift of pollen from blue corn and GMO Roundup Ready corn into adjacent conventional corn. Corn with marker traits (blue kernels or Roundup herbicide tolerance) was planted adjacent to corn without those traits. Cross pollination was greatest at the closest sampling site � up to 46% outcrossing about 3 ft. from the edge of the test plots containing blue corn. Cross pollination dropped off rapidly with only 0.23% cross pollinated kernels near the blue corn plot at 150 ft. Only 0.75% of the corn showed cross-pollination with the Roundup Ready plot at 150 ft. The farthest distance any cross pollination was detected was 600 ft. These results suggest that 150 ft. may be a reasonable buffer between GMO and non-GMO corn to prevent significant cross pollination due to pollen drifting from one field to another.

Planting practices to minimize GMO pollen contamination

Isolation and Border Rows

One of the most effective methods for preventing pollen contamination is use of a separation or isolation distance to limit exposure of non-GMO corn fields from pollen of GMO fields. The potential for cross-pollination decreases as the distance between GMO and non-GMO corn fields increases. Several state seed certification agencies that offer IP grain programs for corn programs require that non-GMO IP corn be planted at a distance of at least 660 ft. from any GMO corn. This isolation distance requirement may be modified by removing varying numbers of non-GMO border rows, the number of which is to be determined by the acreage of the non-GMO IP corn field. The border rows ensure that the non-GMO field is "flooded" with non-GMO pollen which will dilute adventitious pollen from a GMO source.

- For corn fields over 20 acres in size, the isolation distancc (of 660 ft.) may be modified by post pollination removal of 16 border rows if the actual isolation distance is less than 165 feet
- For corn fields over 20 acres in size, the isolation distance may be modified by post pollination removal of 8 border rows if the isolation distance is between 165 and 660 feet.

These isolation and border row requirements are designed to produce corn grain that is not more than 0.5% contaminated with GMOs.

Planting Dates and Hybrid Maturity

Use of different planting dates and hybrid maturities can also be used to reduce the risk of cross-pollination between fields of GMO and non-GMO corn. For example, planting short season non-GMO corn hybrids followed by full season GMO hybrids later will reduce the chance for pollen from the GMO field to fertilize the early planted, earlier maturity non-GMO hybrid in an adjacent field. However, there are shortcomings with this approach. Differences in maturity between the early and late hybrid may not be large enough to ensure that the flowering periods of each hybrid will not overlap, especially when certain climatic conditions may accelerate or delay flowering. Moreover this strategy will only work if you control the adjacent fields or can closely coordinate your corn planting operations with those of your neighbors.

Prevailing Wind Direction

In Ohio, the importance and consistency of relative wind direction during pollen shed has not been established. However, in states to the west of Ohio, the south and west edges of non-GMO fields are often more vulnerable to pollen drift because the prevailing winds during the summer are from the southwest. Therefore, it may be beneficial to follow recommendations regarding isolation distances and border row on these sides of non-GMO fields.

Other Considerations

Other factors that can negatively impact non-GMO grain purity are volunteer corn plants resulting from no-till or minimum till continuous corn, purity level of the seed planted, planting errors, and drought or flood conditions which stunt border rows and reduce desirable pollen production and flow.

Planting operations to control pollen drift are only part of the process of producing an IP corn grain crop. Other major issues include harvesting, drying and storage, along with thorough record keeping. Seed certification agencies like the Ohio Seed Improvement Association (http://www.ohseed.org/) offer IP programs for grain. These IP programs, which are similar to seed certification, assist in preserving the genetic identity of a product, and verify specific traits through field inspections, laboratory analysis, and record keeping.

References

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