Agronomic Spotlight

Seminis grow forward

Proper Use of Bees for Optimal Pollination in Watermelon

- Watermelons require the activities of insect pollinators for flower fertilization and fruit formation.
- The appropriate number of managed honey bees and placement of colonies helps ensure adequate pollination.
- Hollow heart and other fruit problems can result from low pollination caused by various factors.

Watermelon Flowers and Pollination

Most watermelon plants produce separate male and female flowers. A few cultivars will also produce "perfect" flowers, with both female and male parts. The pollen is produced in a sticky mass and is not windblown, so even plants that produce perfect flowers require insects for successful pollination, with bees being the most common pollinators.

Watermelon flowers open in the morning and close in the afternoon, so managed honey bees forage for pollen and nectar most actively early in the morning, mostly before 10 a. m., which is when the stigma (the female part of the flower that receives pollen) is most receptive to pollination.[1] And because watermelon flowers are only viable for one day, managed honey bees and other pollinating insects need to be present every day during the pollination period to obtain the highest level of fruit set.

Once pollen has been deposited on the stigma, the pollen grains germinate and grow down the pollen tubes to reach the ovule, where fertilization takes place. As the fertilized ovule develops, hormones are released that stimulate the division and expansion of fruit cells and the accumulation of sugars in the fruit.[2] There is a strong correlation between the number of mature seeds and the number and weight of fruit produced. Even seedless varieties need to be pollinated for the fruit to develop properly.

Flowers of standard seeded watermelons need to be visited by bees seven or eight times for adequate fertilization, which promotes the development of large, well shaped fruit.[1,3] The pollen produced by seedless watermelons is non-viable, so these types of plants need to be fertilized by pollen from standard, diploid plants. Because bees foraging in seedless watermelon plantings carry a mix of viable and non-viable pollen, more pollination visits (16 to 24) to each flower are needed to deposit the amount of viable pollen necessary for adequate fertilization.[4]

Seedless watermelon plants are triploids, meaning they have three copies of each chromosome. As a result, they do not produce mature seed, and they are self sterile because their pollen is not viable. Diploid pollenizer plants need to be nearby to supply pollen for fertilization and proper fruit development. Care must be taken to select seedless and pollenizer cultivars that are synchronized to have the pollen on the pollenizer plants produced when the female flowers on the seedless cultivar are receptive to pollination, as some cultivar combinations work better than others.[5]

Figure 1. Wild and native bees can contribute to crop pollination. Courtesy D. Eastburn, University of Illinois.

Bees as Pollinators

Several types of bees can serve as pollinators for watermelons, including wild, native bees (Figure 1). In fact, although less commonly managed than honey bees due to cost and availability, individual bumble bees are more efficient than are individual honey bees at pollinating watermelon. Bumble bees begin foraging for pollen earlier in the day, when flowers are most receptive to pollination, and they visit flowers more times and deposit equal or more amounts of pollen per visit. However, these advantages are overcome by the much larger numbers of honey bees that are present when managed honey bee hives are placed in a field.[6]

There are a few beekeepers who manage commercial bumble bee colonies, but they are more expensive to rent. So they are usually used only for greenhouse or screened tunnel operations, mostly for tomatoes and peppers.[7] The

(Continued on page 2)

Proper Use of Bees for Optimal Pollination in Watermelon

(Continued from page 1)

actions of native pollinators and the work they do in field margins adjacent to their native habitat explains why fruit set and fruit size are often somewhat higher on the field margins, and growers can implement practices to promote native pollinator populations,[8] but managed honey bees are usually needed to adequately pollinate the interiors of large plantings.

Most large scale, commercial operations depend primarily on managed honey bee colonies for pollination because these are relatively easy to obtain, and a large number of bees can be introduced into a planting. Recommendations for the number of honey bee colonies per acre to provide adequate pollination for watermelon plantings vary, but the average of those recommendations is 1.3 colonies per acre, or about one bee for every 100 flowers. A standard hive is defined as one with six frames well populated with active bees. These should be distributed around the edges of the field in groups of three hives.[1]

Watermelon flowers are not nutritionally as attractive to honey bees as are some other flowers, which can out-compete watermelons for the foraging attention of honey bees. Attractants can be applied to lure more bees into the planting, but this does not necessarily result in greater foraging activity, just greater numbers of bees. Placing colonies downwind from plantings and regularly rotating colonies to introduce naïve bees to the field can help maintain adequate foraging activity in the target crop.

Pollination Problems and Hollow Heart

Inadequate pollination due to unfavorable weather conditions, low bee numbers or inactive colonies, or, in the case of seedless cultivars, an inadequate supply of pollenizer plants, results in not enough plant hormone production by developing fruit. This results in under-developed, misshapen fruit, and fewer fruit per plant. Cultivars that normally produce lower density fruit are often affected more than are cultivars that produce dense fruit types.[2]

A condition known as hollow heart is often associated with inadequate rates of pollination. With hollow heart, gaps or cavities form in the flesh on the interior of the fruit (Figure 2). This condition is most common in seedless (triploid) fruit, usually the result of problems with the number, spacing, or distance of pollenizer plants, or a bad synchronization of pollen production and female flower receptiveness to pollen.

Studies have shown that increasing the spacing between seedless cultivars and pollenizer plants or limiting the number of bee visits per flower increases the incidence of hollow heart. One study found that plants receiving 16 bee visits per flower had a higher incidence of hollow hart than did plants that received at least 24 bee visits per flower. For seedless varieties it is important that adequate numbers of bees are present and active in the crop, that enough pollenizer plants are planted in close proximity to the seedless cultivar, and that pollen production in the pollenizer plants is synchronized with the receptiveness of the female flowers of the seedless cultivar.[2]

Figure 2. Internal symptoms of hollow heart.

Sources:

[1] University of Georgia, Entomology: UGA honey bee program. http://www.ent.uga.edu/bees/beekeeping.html

[2] Johnson, G. 2014. Watermelon pollination, fruit set, and hollow heart. Weekly crop update. University of Delaware. https://extension.udel.edu/weeklycropupdate/?p=6579

[3] Boyhan, G. E., Granberry, D. M., and Kelley W. T. 2000. Commercial watermelon production. Bulletin 996. UGA Cooperative Extension Service. [4] Walters, S.A. 2005. Honey bee pollination requirements for triploid watermelon. HortScience 40:1268-1270.

[5] McGregor, C. E. and Waters, V. 2014. Flowering patterns of pollenizer and triploid watermelon cultivars. HortScience vol. 49 no. 6:714-721. [6] Stanghellini, M.S., Ambrose, J.T., and Schultheis, J.R. 2002. Diurnal activity, floral visitation, and pollen deposition by honey bees and bumble bees in field-grown cucumber and watermelon. Journal of Apicultural Research 41:27-34. [7] Hood, W. M. 1998. Bumble bees as pollinators. Clemson Cooperative Extension: Entomology insect information series.

[8] OMFRA Factsheet Best Management Practices for Pollination in Ontario Crops . www.pollinator.ca/bestpractices

Web sources verified 4/08/16.

For additional agronomic information, please contact your local seed representative. Developed in partnership with Technology, Development & Agronomy by Monsanto.