

## **Hollow Heart Research- Filling The Gaps On What Is Known**

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Over my many years working with watermelon growers and colleagues in the watermelon industry, one of the most perplexing problems has been hollow heart. Recent research by Dr. Gordon Johnson at the University of Delaware has begun to shed some light on the topic through field-proven research. His research clearly points to poor pollination as the initial trigger that results in what we know as hollow heart in watermelon.

First, let's go over a little watermelon pollination background to set the stage. Watermelon and other cucurbit crops produce both male and female flowers on the same plant. The female flowers have the small fruit at the base of each flower, whereas the male flowers are born on a small stem, but male flowers have no fruit at their base. Pollen has to be transferred from the male flower to the female flower in sufficient quantity to fully pollinate the female flower. Pollen from other cucurbit crops such as squash, cantaloupe or cucumber cannot pollinate a watermelon flower, so no worries if these are all in the same field. The UF/IFAS publication, [Beekeeping: Watermelon Pollination](https://edis.ifas.ufl.edu/aa091), by Sanford and Ellis, describe several key points related to pollination of watermelon (<https://edis.ifas.ufl.edu/aa091>). It has been universally recognized that watermelons are insect pollinated, even as far back as the turn of the 20th century. Of utmost importance in watermelon pollination is the fact that at least 500 to 1,000 grains of pollen must be evenly deposited on the lobes of the stigma (the part of a flower that receives the pollen during pollination) if a uniform watermelon fruit is to result. Because the pollen grains produce pollen tubes directly downward with very little lateral movement, an insufficient amount of pollen on one stigma lobe will result in a poorly shaped watermelon. Thus, saturation pollination is an important consideration if uniform melons are to be produced. A pollinator such as a honeybee or commercial bumble bees or native pollinator species need to visit a flower eight or more times typically to fully pollinate a female flower of a standard seeded watermelon. However, the pollen produced by the male flowers in seedless watermelons is non-viable, so these types of plants need to be fertilized by pollen from some other source of pollen such as standard, diploid (seeded) plants or pollinizer 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 needed in seedless plantings. The most typical time of day for bees to visit watermelon flowers is in the early to mid-morning period, usually before 10 am. A watermelon flower opens early in the morning and is only open for one day. Bee flights are reduced significantly in rain and when winds are 15 mph or greater. Cloudy weather also reduces bee activity. Bees also do not fly much below 55°F, so on cold mornings, bee activity will not pick up until later in the morning. Unfortunately, female watermelon flowers open early in the morning, are most receptive before 10 am, and then close in the afternoon, so cold mornings early in the season can be especially problematic for pollination.

With all of that research information as important background, we can now associate Dr. Gordon Johnson's research with hollow heart in watermelon. Dr. Johnson set up large complex experimental blocks beginning in 2010 and continuing for several years later to try to create and repeat hollow heart

symptoms. The experiments were set up to be able to limit pollen to seedless female flowers. Basically, he designed studies where watermelons would be a longer or shorter distance from a pollen source. Johnson conducted the study on seedless watermelons – although hollow heart also occurs in seeded watermelons – because the bulk of the watermelon industry grows seedless varieties. He set up experiments to put seeded types at varying distances from the seedless, and he found that when you got further from a pollen source (wider ratio of pollinizer to seedless), he got more hollow heart. He has been able to repeat these experiments proving poor or incomplete pollination is the primary trigger causing hollow heart in watermelon. Over the years, many other theories have been thought to be the cause, such as too much nitrogen fertilizer, but those ideas have never been proven as a cause. Believe me, I have tried to create hollow heart from all types of excess nitrogen fertilizer tests, but have never been successful. Certainly, watermelon cultivars have been proven to vary in their susceptibility to hollow heart. The evidence points to dense fleshed varieties being less susceptible as are smaller fruited types. As the industry has pushed planting dates earlier and earlier in recent years, we have increased the risk of hollow heart because we force early female blooms into less favorable weather conditions and seedless varieties make it even more challenging. Since an individual flower is only open one day, we need good weather during the pollination period to prevent hollow heart. Even if we have plenty of bees and plenty of pollinator plants, bad weather can disrupt the process of full pollination from occurring. We typically see hollow heart in the first setting of fruit and rarely in late season fruit. This makes sense in that we get into warmer and better overall conditions for pollination later in the growing season.

Thanks to Dr. Johnson's work, we now have a much better understanding of the initial cause of hollow heart and with that understanding we have a better chance of making decisions to minimize the risk of poor pollination. We certainly need plenty of pollen to be available and we need plenty of pollinators as well. However, Mother Nature still holds the final say if we have the unfortunate timing of extended bad weather (cold, rainy, cloudy, windy) during critical periods when we need pollination. The recommendations noted by Dr. Johnson to limit hollow heart in early plantings would include: 1) avoid varieties with a history of hollow heart problems (if known), 2) more bees and multiple placements of bees (to deal with limited distance flights during poor weather) and possibly using some bumblebees in addition, 3) use extra pollenizers if possible, and choosing pollenizers that flower early and for a longer period of time.

Hopefully this information will help in "filling the gaps" of hollow heart in watermelon.