Potential use of egg parasitoids to manage the Cherry and Cranberry Fruitworm in Blueberries

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Summary

Michigan is one of the largest blueberry producers in the USA with approximately 21,700 acres of blueberries cultivated in approximately 505 farms (Michigan Fruit Inventory 2019). In 2018, blueberries were Michigan's second largest fruit crop contributing around $132 million to the state's economy (MDARD 2019).

Until 2010, Michigan's blueberry IPM program was a sustainable system with a limited use of insecticides against what at that time was the main blueberry pest complex; Cranberry fruitworm, *Acrobasis vaccinii* Riley (CBFW), and Cherry fruitworm, *Graphoita packardi* Zeller (CFW) during and after bloom. Also, the blueberry maggot (*Rhagoletis mendax* Curran) and the invasive Japanese beetle (JB) (*Popillia japonica* Newman) at harvest time (Garcia-Salazar 2002). Before the arrival of the S**p**otted Wing Drosophila *Drosophila suzukii* Matsumura (SWD), the insecticide application program consisted of no more than 5 insecticide applications per season.

With the arrival of the Spotted Wing Drosophila (SWD) in 2010, insecticide applications per season increased to more than 10 applications at harvest time. According to a USDA survey of insecticide use in blueberries, in 2018, the amount of insecticides applied to blueberries jumped 30% in comparison with the amount reported by growers in 2011(USDA-NASS 2011, 2015, 2018). Phase out of Azinphos methyl (Guthion®) in blueberries in 2012 and its substitution for reduced-risk insecticides also increased pesticide exposure for pollinators and humans and for outbreaks of secondary blueberry pests such as the Blueberry Stem Gall Wasp (BSGW) indirectly controlled by Guthion. Guthion applications against fruitworms right after bloom suppressed the BSGW overwintering generation and prevented blueberry shoot infestations.

The increased number of insecticide applications at harvest also disrupted the natural biological control in blueberries. In Michigan, two parasitoid wasps, *Eurytoma solenozopheriae* and *Ormyrus vacciniicola* control the Blueberry Stem Gall Wasp (BSGW) *Hemadas nubilipennis* (Ashmead, 1887), by parasitizing its larvae inside the galls (Isaacs et al 2021). These parasitoids emerge simultaneously with the BSGW and have a second generation at summertime now eliminated by multiple applications against the SWD contributing to the resurgence of the BSGW (Isaacs et al 2020).

Relying solely on chemical insecticides to control the blueberry pest complex has become an important issue for the industry because of the high cost to the environment, workers, consumers,

and farm sustainability. However, transitioning to a more sustainable IPM program faces important challenges. The economic thresholds for pest damage in blueberries, is "zero", including insect parts creating limitations for the implementation of biological control tactics. Thus, we need to find instances where we can implement biological control tactics with greater impact in reducing the total use of chemical insecticides to help restore the natural biological control.

Two major IPM priorities for in Michigan blueberries are the fruitworm complex and the Spotted Wing Drosophila. Under a systems approach to IPM the ***incorporation or exacerbation of any pest mortality factor*** that contributes to decrease the impact of a pest is very welcomed.

Biological control agents, especially entomopathogenic organisms, and parasitoids are an alternative that we need to incorporate into our current blueberry IPM programs. Those agents can't solve the pest problem applied alone but incorporated into the current IPM program they will make a difference.

In Michigan, the fruitworm complex is attacked by the egg parasitoid *Trichogramma minutum* Riley (Murray et al. 1986, Pinto 1998, Wise et al. 20210). and some braconids such as *Pahanerotoma franklin*. Egg parasitism in unsprayed fields ranged from 10 to 17 %, and 7 to 8% in under reduced-risk IPM fields (Murray 1996; Garcia-Salazar 2010). In addition to egg parasitoids, Murray found 28% larvae parasitized by Ichneumonid wasps, mainly *Campletis patsuketorum* Viereek.

Field Trials were conducted at two locations in Allegan County, MI. The first one at Nye Farm, unsprayed blueberry field, Ganges, MI and the sec**o**nd trial at Coleman Farm, conventionally treated blueberry field, Glenn, MI (Ganges Township).

For our Michigan biological control program we considered the use of *Trichogramma platneri* Nagarkattiare. Distinction between *T. minutum* Riley and *T. platneri* is based on geographical range according to Richard Stouthamer (2000). *T. minutum* west of the Rocky Mountains and *T. platneri* to the east. Thus, what we have in Michigan blueberries is *T. platneri.*

Trichogramma platneri was selected based on: Searching behavior, known egg host preference and availability. For these trials we selected two types of blueberry fields: Unsprayed and conventionally treated:

Trial #1 (Unsprayed field, Nye Farm). Treatments: 1.Control: no insecticide and non Trichogramma 2. Treatment: *T. platneri* released *2 times 100 k/acre*

Trial #2 (Conventionally treated): 1. Control: no insecticide and non Trichogramma 2.Conventional: 1 application of Im**i**dan and 3. Treatment: *T. platneri* released 2 times 100 K/acre

Parasitism and fruitworm control (fruit damage): Before Trichogramma release and one week after Trichogramma release and one month after.

Our results in these first trials to introduce the use of biological control agents for fruitworm control in blueberries showed:

Promising results for control of CFW and CBFW with the egg parasitoid *Trichogramma platneri. T. platneri* seems to be equal to *T. minutum* prevalent in Michigan's blueberry fields. Inundative releases of *T. platneri* will supplement the natural biological control offered by *T. minutum* and other parasitoids.

Removing the first insecticide application against fruitworms and replacing them with BC agents will give a chance to natural biological control to bounce back and will decrease the reliance on chemical insecticides.

Conclusions

Our experience in this first attempt to use BC agents for CFW/CBFW control showed that TIMING is critical.

At Nye Farm, our results were not as expected. The reason was clear; we missed the window of opportunity for conducting the first egg parasitoid release. Nye Farm is approximately 3 miles from Lake Michigan shores. The emergence of overwintering fruitworm populations occurs one week earlier than at the Coleman Farm located ¼ mile from Lake Michigan shores.

Successful results at Coleman's Farm were as expected. Excellent control like that obtained with Imidan.

The difference between Nye's and Coleman's results was due to TIMING OF THE RELEASE of egg parasitoids. These results confirm that timing is CRITICAL if we want to have an excellent biological control using egg parasitoids.