Japanese beetles in soybean: evaluation of insecticide seed treatments, sampling and deltamethrin coated netting

INTRODUCTION

The Japanese beetle (JB), *Popillia japonica (*Coleoptera: Scarabaeidae) was thought to have accidentally been introduced into the United States in the 1910's originating from Japan (Encyclopaedia Britannica, 1999). JB has one generation per year in the United States, with the exception of the northernmost regions of the country, where the cold temperature may extend development to two years (Potter and Held 2002). It is regularly found in Kentucky and affects over 300 species of plants ranging from trees and grasses to field crops. This scarab beetle species causes significant damage on fruit trees, vegetables, corn, and soybeans. Japanese beetle adults skeletonize leaves, and reduce yields by eating flowers in soybeans. Adult JB defoliate the leaves by chewing the soft tissue around the leaf veins and leaving a skeleton like leaf. Japanese beetle adults can also feed on the flower of the soybean and can cause problems with pollination. During its larval stage, this univoltine beetle is a pest in lawns of dwellings and golf courses feeding on the root hairs of grasses. Overall, JB causes significant yield losses in many economically commercial plants. To properly account for populations of JB, sampling must occur throughout the field due to their sporadic feeding patterns. Bucket and net-sweeping sampling are the two methods of sampling used in this study. The importance of proper management of this pest is magnified by the importance of soybean in the state of Kentucky. Soybean ranks first in Kentucky's crop receipts, and can account for over 1.7 million acres planted in Kentucky alone (Kuhar et al. 2017).

Our objectives in this project were:

a) to compare the populations JB on plants grown from insecticide treated seeds with Poncho™ (clothianidin) vs. untreated seeds,

b) to evaluate population densities using buckets and net sweeping, and

c) to evaluate mortalities of JB using deltamethrin impregnated nets in laboratory bioassays.

MATERIALS AND METHODS

Population density, sampling, and comparison of Japanese beetle population on plants treated with and without Poncho™

Insecticide treated seeds and untreated soybean seeds were planted 15 June, 2018. The treated seed was coated with the insecticide Poncho (clothianidin) and the nematicide VOTiVO (*Bacillus firmus)* (Bayer). Numbers of JB were recorded using the sweep net and bucket sampling methods. To calculate the population levels of JB sampling: Ten samples were collected from four, 30 inch row treated and untreated soybean (Caverndale Farms, Danville, KY) using five gallon buckets (Uline, Pleasant Prairie, WI.). These samples were collected randomly throughout 26 plots in the REC-Princeton. Japanese beetles were tallied and released immediately. The same process was repeated with sweeping nets (Forestry Suppliers). Samples of each collection method and seed treatment type was taken and converted into weekly averages.

Mortalities of Japanese beetle using deltamethrin impregnated netting

Three different treatments consisting of new Dead On Contact™ deltamethrin polyester net (AgBio, Inc., Westminster, CO), used Dead On Contact™ net (~90d weather exposed), untreated polyester net and a blank control. An approximately 78.5 cm2 netting piece was placed into 10 x 1.5 (diam.x height) cm petri dish (Corning, Inc. Tewksbury, MA). Then, 5 male and 5 female Japanese beetles were placed into the Petri dish. The effects of the pesticide were monitored every 5, 10, 20, 30, 40, 50, and 60, minutes. Each treatment was replicated four times.

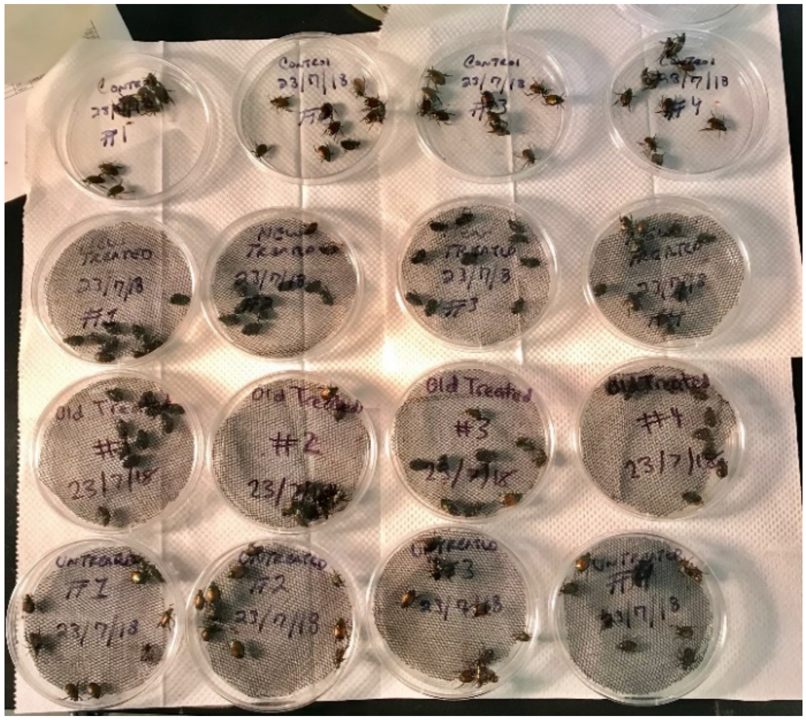

Figure 1. Bioassay to test efficacy of deltamethrin impregnated nets on Japanese beetles.

RESULTS AND DISCUSSION

Population density, sampling, and comparison of Japanese beetle population on plants treated with and without Poncho™

Independent of the sampling method (bucket or sweep net) the highest peak numbers of JB were found on the on plants grown from insecticide treated seeds during the first week of July. Later on the bucket sampling more JB were found in plants grown fron untreated insecticide seeds in most dates hereas, the opposite happened in the sweepn net sampling. Additionally, bucket sampling resulted in higher numbers of JB until middle of July.

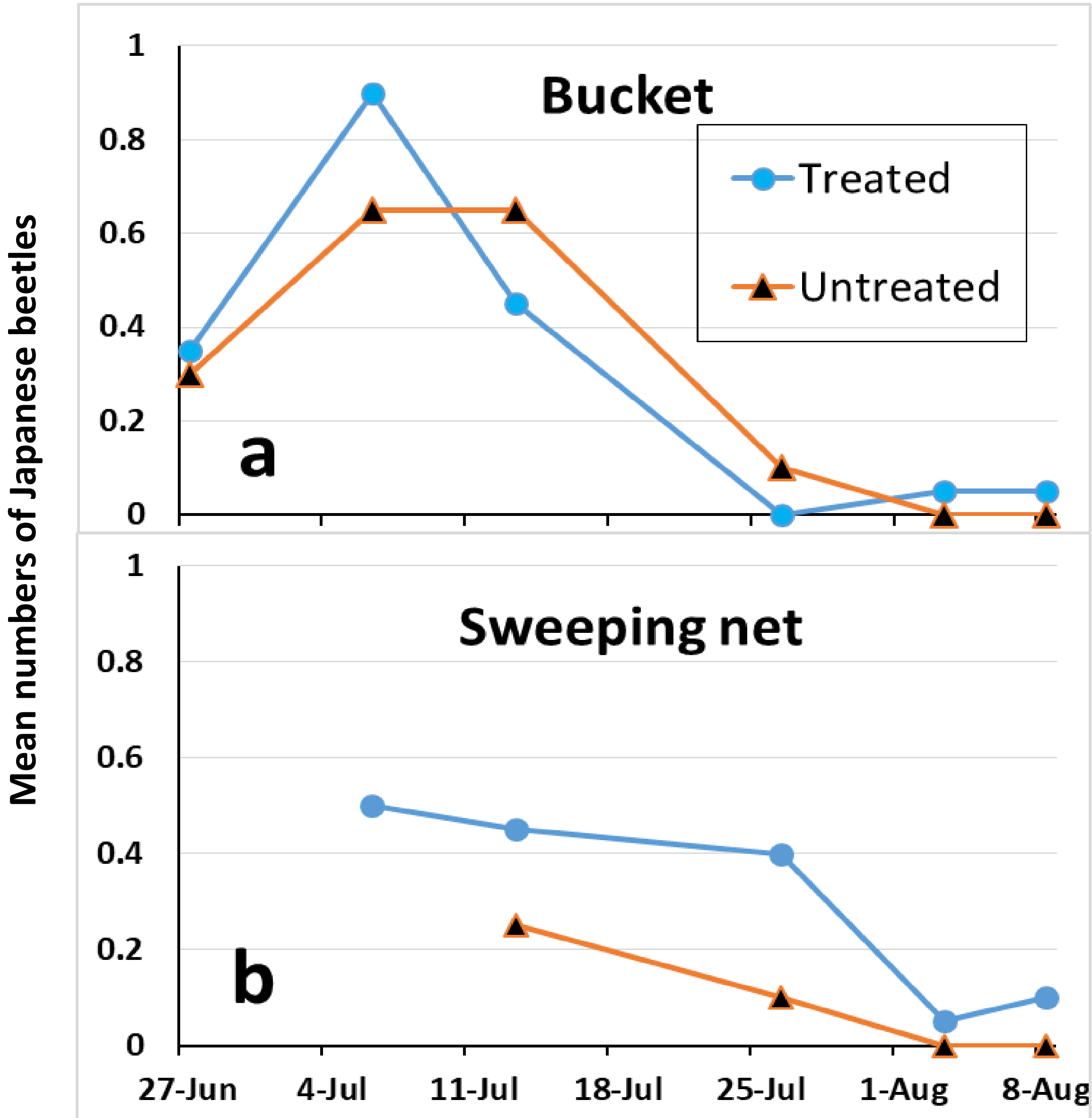

Figure 2. Mean numbers of Japanese beetles captured using (a) bucket, and (b) sweep net sampling methods in plants grown from insecticide treated and untreated soybean seeds.

b.) Mortality of Japanese beeltes in deltamethrin impregnated netting

The deltamethrin impregnated net assay showed that the netting caused 100% mortality in a replicated test bioassay in both, brand new and 90-day old field exposed netting. Mortality was not observed in the JB in the control (no net) or the untreated net Petri dishes. The older netting's effect on the beetles was a bit delayed but after 40 minutes its effect cause similar mortalities as the new nets and at 50 min all JB were dead. In both cases all JB in the deltametrhin impregnated netting were found dead after 1 h.

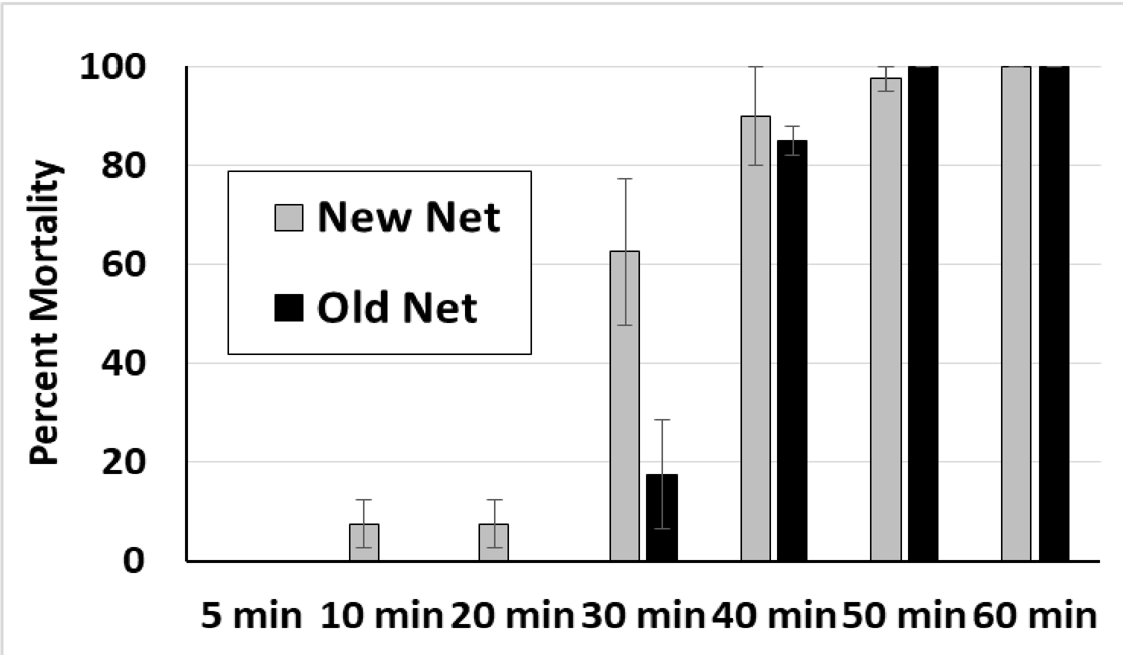

Figure 4. Percentages of cumulated mortality (±SEM) of Japanese beetles in the treated petri dishes over 60 min.

Although JB can be controlled by pyrethroid insecticide spray for short term efficacy (Hodgson et al 2011), our results in the bioassay showed that the deltamethrin treated net can be an option, not only for the management of JB but for other pests (Mexican bean beetle, Leaf bean beetle or Grape colaspis).

Implications for Future Work

Further research on the "Dead On Contact deltamethrin polyester net" will be necessary to be use this net by commercial farmers. Learning more about how other insects are affected will help us better understand the netting's effectiveness and if it affects beneficiary insects as well as pests. This netting can hopefully one day replace the need of frequent spraying and limit the environmental impact left by spraying and killing all insects, not just pests. In addition, this net can be used by consecutively for four years.

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