ABSTRACT: Root aphids are a rising problem for nurseries growing ornamentals, field hemp stock, field hemp plugs, and other plants grown hydroponically. This group of aphids is frequently overlooked because they feed belowground. Soil-dwelling insects and insect pests associated with aquatic situations are difficult to manage with insecticides due to environmental concerns. We investigated the efficacy of chlorantraniliprole, cyantraniliprole, Chromobacterium subtsugae strain, Beauveria bassiana, and heat-killed Burkholderia spp. strain A396, M-306, and MBI-203 compared to pymetrozine, a commonly used insecticide targeting Rhopalosiphum padi (Sasaki), in a greenhouse trial with Juncus effusus plants. We found that pymetrozine significantly reduced R. padi populations at 14 days after treatment. Chromobacterium subtsugae and the heat-killed Burkholderia spp. strain A396 cells did not significantly reduce aphid populations in our experiment. Chromobacterium and cyantraniliprole, B. bassiana, M-306, MBI-203, and pymetrozine all significantly reduced aphid populations at 28 days after initial application. Insecticide efficacy against root aphids and potential impact on non-target arthropods should continue to be investigated.

INTRODUCTION

Root aphids are a rising problem in native plant nurseries, herbaceous perennial nurseries, aquatic plant nurseries, and greenhouse grown field hemp stock operations (Cranshaw and Wainwright, 2020). The root aphid involved in our trials in 2020 was the rice root aphid. The rice root aphid (Rhopalosiphum padi (Sasaki)) is a pest in North America that survives both indoor and outdoor environments. In our trial, we obtained infested plants from a native aquatic plant nursery. Growers may notice the plants are stunted and not growing well. The wax associated with root aphids becomes noticeable when you take the plant out of the pot. If the population builds up, your plants are stunted and not growing well. The wax associated with root aphids becomes noticeable when you take the plant out of the pot. If the population builds up, your plants are stunted and not growing well.

MATERIALS AND METHODS

We obtained 740 Juncus effusus from a native plant nursery to use in our experiment. We examined the root system of the 740 and narrowed the numbers down to 162 used in our trials. We selected plants with more than 2 to 3 aphids in the root zones. Some had as many as 30 - 40 aphids.

Four plants of each treatment in a plug tray represented one replicate of our trial. We had four replicates in our randomized complete block designed experiment. We conducted our pre-treatment counts on 23 June 2020 using dissection scopes and portable light sources. Prior to treatment, plants were grouped by relative densities of aphids on root masses. Plants were randomly assigned treatments after this grouping. Beauveria treatments were included afterwards as a biological treatment for the experiment; consequently, those plants had fewer aphids on root masses. Our M-306 SE1 and MBI-203SE1 treatments were applied on 23 and 30 June, and 7 and 14 July 2020. The remaining treatments were only applied on 23 June 2020. Plants were moved into a greenhouse after treatment and irrigated as needed to maintain the moist root masses. The plants were maintained with a 16:8 L:D cycle.

We took post-treatment counts 14 and 28 days after treatments (7 and 21 July respectively; DAT). Plant were pulled from plug trays and the outside of the root mass was examined for various stages of R. padi aphids. We recorded the number of aphids found on the plant tag for each plant. Aphids were counted on all plants again at 14 DAT and were returned to the greenhouse in the same pots until the final count at 28 DAT. Presence of natural enemies and other arthropods found on root masses were noted during the pre- and post-treatment counts. The average number of living aphids found on the root mass were analyzed using ANOVA and Tukey HSD means separation procedures.

RESULTS

Juncus root masses were infested with considerably high populations at the nursery and prior to insecticide treatments (Table 1.0; Figure 2.0). Cyantraniliprole and chlorantraniliprole-treated plants had significantly greater populations of root aphids per root mass at the beginning of experiment than other treatments, whereas Beauveria-treated plants had significantly fewer. We found an ant associated with the rice aphids in our field trial. These ants were more abundant during our pre-treatment data collection than later in the experiment. We did not observe the ants moving the aphids but did observe them defending and engaging spiders and rove beetles.

We found several soil predators active including mealybug destroyer, Cryptocephalus montrouzieri, rove beetle species, and Stathopea scimitus, in the Laelapidae family, which is a small light brown mite that usually lives in the top ½ in layer of soil. It is interesting to note that we found mealybug destroyers actively searching for root aphids in several plugs. After the trial, the grower reported heavy activity from mealybug destroyer in the root zone of the aquatic grasses.

DISCUSSION

We found that R. padi aphid populations decreased throughout our experiment regardless of treatment. Some insecticides in our experiment still significantly reduced aphid populations compared to untreated controls. Root aphid populations decreased significantly during the experiment regardless of treatment. Initially, the experiment was going to be conducted in April and May of 2020 when temperatures are typically between 15 – 25 °C; however, the lockdown associated with the pandemic pushed the dates of the experiment into June 2020 and later. Ambient temperatures during the experiment were above 25 °C, often exceeding 30 °C. The nursery supplying our infested plants also experienced population declines during the same timeframe in their hoop houses. We feel the high temperatures during our experiment help explain the drastic reduction of R. padi aphid populations infesting our control plants.

Greenhouse and nursery growers continue to struggle to manage soil-dwelling insect pests because they are difficult to detect, may have subtle impacts on the crops, and insecticides can be less effective against soil pests compared to pests feeding on above ground tissues. Our experiment showed efficacy of a few new insecticides as management options for R. padi root insect pests. We feel that applications of pymetrozine will reduce populations within two weeks of application. Chlorantraniliprole, cyantraniliprole, M-306, and MBI-203 all significantly reduced populations by 28 days after treatment. These products are newer insecticides available or soon to be available to growers. Compatibility of these products with natural enemies, such as the mealybug destroyer, should be further evaluated in future studies.

CONCLUSION

Our experiment found that pymetrozine significantly reduced R. padi aphid populations at 14 days after treatment. C. subtsugae and the heat-killed Burkholderia spp. strain A396 cells did not significantly reduce aphid populations in our experiment. Both diadime insecticides, chlorantraniliprole and cyantraniliprole, M-306, Beauveria bassiana, MBI-203 and pymetrozine all significantly reduced aphid populations at 28 days after initial application. Significant reduction of aphid populations by the numbered products and diadimes in this study suggest these products are insecticides that could be incorporated into a management strategy targeting root aphids. These insecticides provide alternate modes of action for growers to use in pest management programs. Any management may be more beneficial for growers that wish to include biological control in a successful management plan. Insecticide efficacy against root aphids and potential impact on natural enemies should be investigated in future studies.