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Research Article

REDUCED INSECTICIDE APPLICATIONS CAN ENHANCE NATURAL ENEMIES OF *BEMISIA TABACI* IN COTTON

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ABSTRACT

Excessive amount of insecticides destroys natural enemies of cotton pests and consequently the population of whitefly flares up. The present research focused on the use of PB ropes to reduce application of insecticides and to investigate the ecological impact on *Bemisia tabaci* and beneficial fauna in cotton fields. Two cotton varieties (BS-15 and NIAB-878) were sown in research area of MNS University of Agriculture, Multan during 2018 on 30 acres. PB ropes dispensers (PB-ropes L®) were installed at 120/acre at pin head square stage of cotton. It was observed that application of PB ropes reduced need for insecticide applications, thus helped conservation of beneficial fauna in cotton fields throughout the season, which kept whitefly populations below EIL. Population of whitefly nymph was reduced after application (0.9/leaf-seasonal average) in PB ropes treated fields as compared to untreated check (8.1/leaf-seasonal average). Furthermore, higher population of green lacewing (4.00/plant) was observed in PB ropes treated field. It was concluded that populations of whiteflies were kept below EIL due to conservation of green lacewing. This positive effect of PB ropes is presumably due to increasing the number of cotton insect pest biological agents. This indirect effect of mating disruption (PB ropes) is of great value within the framework of IPM in cotton.

Keywords: PB ropes, *Gossypium hirsutum*, *Bemisia tabaci*, *Chrysoperla carnea*.

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INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is main input in textile manufacturing, which also produces seeds and different type of products for animals such as hulls, oil, lint, and as a food purpose (Ozyigit *et al*., 2007). Cotton is mostly grown in Punjab and Sindh province, both with highest temperature and dry zones of the country (Malik and Ahsan, 2016). It is the economically most important crop of Pakistan, because it meets the food and fiber needs. Pakistan is the 4th largest cotton producing country after China, USA, and India (Abro *et al.*, 2004).

According to survey of Pakistan in 2016–2017, textile sector is the largest sector which includes 40% of industrial labor; it is also source of income for 10 million people. Cotton and textile sectors of Pakistan comprise of 1.200 ginneries, 523 textile units, and 400 cotton seed crushers and oil purifiers (Rehman, 2018).

Number of insect pests attack on cotton crop which cause yield reduction by sucking cell sap as well as eating different plant parts (Sattar and Abro, 2011). Insect pests also affect the germination of cotton. Hence, cotton crop is considered as most sensitive crop (Sarwar, 2013a). Both sucking and chewing insect pests attack on cotton and feed on different parts of plants such as leaves, buds, flowers, and bolls and sucking pests categorized such as *Bemisia tabaci*, *Thrips tabaci*, *Aphis gossypii*, *Amrasca devastans,* and mites chewing insect pests; *Helicoverpa armigera*, *Pectinphora gossypiella*, *Erias insulana,* and *Spodoptera litura* on the basis of their feeding habits (Din *et al.*, 2016).

Whitefly is found all around the world and almost 1550 species has been reported (Liu *et al*., 2015). *B. tabaci* causes severe losses in yield by damaging cotton bolls through sucking cell sap (Ahmad *et al*., 2002). Severe damage of *B. tabaci* reduces the development of plant, discoloring of leaves, and irregular ripening of bolls. *B. tabaci* nymphs decrease the photosynthetic abilities of plants by excreting honey dews on which black sooty mold grow. It also causes dwarfing and loss of vigor in plants as well as spoil the lint quality. *B. tabaci* is involved in transmitting cotton leaf curl virus disease, as a result cotton production is reduced (Rafiq *et al.,* 2008).

For the control of whitefly farmers mostly use chemical methods and apply numbers of insecticide sprays. However, insecticidal sprays only targets the *B. tabaci* adults and provide temporary reduction in population (Gerling, 1967). Insecticide sprays are not evenly distributed on plant as eggs and nymphs dispersed on the lower leaves of plants. As a result, *B. tabaci* re-emerges rapidly (Ohnesorge *et al.,* 1980). Insecticides that are used to suppress the population of *B. tabaci* are not effective anymore, because *B. tabaci* has developed resistance against most of them due to repeated use of same insecticidal group (Cuthbertson, 2013). Therefore, the present study was conducted to reduce insecticides application in PB ropes treated field against whitefly which may enhanced natural enemies of cotton insect pests. The aim of this research was to evaluate indirect effects of PB ropes on *B. tabaci* and conservation of beneficial fauna using PB-ropes against PBW. Fewer insecticidal applications are required especially of pyrethroids which are destructive for beneficial fauna.

METHODS

Experimental detail

The study was conducted during the Kharif season 2018 at 30 acres experimental area of research farm of MNS University of Agriculture, Multan (30.140242 N, 71.443662 E). Cotton was sown with P×P of 9 inch and R×R distance of 2.5ft. Entire field was divided into six blocks of five acres each. A block with no application was used as control. Treated blocks were named as T1 (PB Ropes + Insecticides), T2 (PB Ropes + PB Ropes), and T3 (Untreated), respectively. In T1 field, insecticides; Polo (Diafenthiuron 50% WP provided by Syngenta Pvt Ltd), Ulala (Flonicamid 50% WG provided by ICI Pvt. Ltd. Pakistan) and Buprofezin (25% WP provide by Jaffer Pvt. Ltd. Pakistan) were used. During the whole cropping duration, all recommended agronomic practices were

carried out uniformly in all treatments. Both cotton varieties BS-15 and NIAB 878 were sown on May 12 according to standard agronomic practices.

PB ropes installation

The PB ropes dispensers (PB-ropes L®) (Shin Etsu Ltd, Tokoyo Japan) were installed in 120/acre on June 25 at pin head square stage of cotton. First observation was made after 1 week of PB ropes installation and continued until the harvest time. PB-ropes dispensers were tied by hand around the main stem of cotton plant below 3–4 upper leaves. PB-ropes installed on first plant then after 5 steps on 2nd plant in first line. When first line completed, 7 lines left, go on 8th line, and continue installation.

Data recording

Data recording of B. tabaci population

The population of *B. tabaci* was monitored by random selection of 20 leaves (upper, middle, and lower leaves of different plants) in each block. Data were recorded according to sampling procedures adopted by Naranjo and Flint (1995). Observations were recorded continued from July 6, to October 12, 2018. All monitoring activities were completed between 06.00 and 08:00 am when insects were expected to be actively feeding.

Data recording of Chrysoperla carnea

Population of *C. carnea* was observed per plant and recorded by randomly selected ten plants in each block and average was taken.

Statistical analysis

Experiments were laid out according to RCBD with three treatments and three replications. Data taken on weekly basis were analyzed using statistical software 8.1 Version. Analysis of variance (ANOVA) was used for representation of results and conclusions. Treatment significance was determined by Tukey's HSD (α=0.05) to separate the means. Correlation between population of *B. tabaci* and beneficial insect was determined by ANOVA in "Statistix v8.1" (Analytical Software, 2005).

RESULTS

Results revealed that maximum population (3.35 individuals/leaf) of *B. tabaci* nymphs were recorded at the 2nd week of September, while the minimum population 0.9 individuals/leaf was observed at 1st week of July in T1 field (PB ropes + insecticides). However, in T2 (PB ropes + PB ropes) field *B. tabaci* nymph, populations were recorded maximum 3.3 individuals/leaf at 1st week of September, whereas lowest population was 1.6 individuals/leaf during 1st week of July, respectively. In T3 (control) field, lowest population of *B. tabaci* adults were recorded at 3.38/leaf and maximum 8.1 individuals/leaf were observed at 2nd week of October. Hence, results of different treatments showed that population of *B. tabaci* adults were reduced in PB ropes treated field as compared to untreated field (Fig. 1).

Correlation between *B. tabaci* and *C. carnea*

B. tabaci nymph population was found positively correlated with *C. carnea* in T1 treatment (Pb ropes + insecticides) and T2 (PB ropes +PB ropes) (Figs. 2 and 3). The T1 results show that highest population (3.87/plant) was recorded during the 3rd week of September, while lowest population of green lacewing was recorded (0.32/plant) during 1st week of July, respectively. The highest population of *C. carnea* in T2 (PB ropes +PB ropes) field was recorded in 4th week of September (3.70/plant), while lowest population was observed 0.50 in 1st week of July and 3.27 was recorded during 4th week of August and in October 4.00/plant during 1st week, respectively. In T3 (untreated), maximum population of *C. carnea* recorded in 2nd week of October 0.79/plant, whereas minimum population was observed in the 1st week of July 0.07/plant, respectively.

DISCUSSION

In the light of present investigations, results showed that in first treatment T1, only one PB ropes application and few insecticidal sprays were applied. The first application of Ulala was done according to requirement in 4th week of July for control of sucking pests in cotton field and 2nd insecticide (ulala + buprofezin) was applied in 3rd of August for whitefly eggs and nymphs, third application of polo (diafenthiuron) was applied in 1st week of September for the management of whitefly. In T2, PB ropes application was applied 2 times during whole cropping season for management of *P. gossypiella*. According to studies, PB ropes remained effective for 90 days in field so when the effect of first application was reduced in cotton field, 2nd application of PB ropes was applied in 2nd week of September. First application of PB ropes was applied at past week of June 2018 at pin head square stage of cotton. T3 (control) treatment was untreated throughout the season.

Our results concluded that PB ropes are helpful tool to minimize the population of cotton sucking insects especially *B. tabaci* population. Farmers are used excessive amount of pyrethroids for management of *P. gossypiella*. Pyrethroids destroy beneficial fauna of cotton, as a result population of *B. tabaci* flares up. Due to less use of insecticides, resistance problems can also be decreased and save the natural fauna of cotton insect pests which can destroy the whitefly nymphs population.

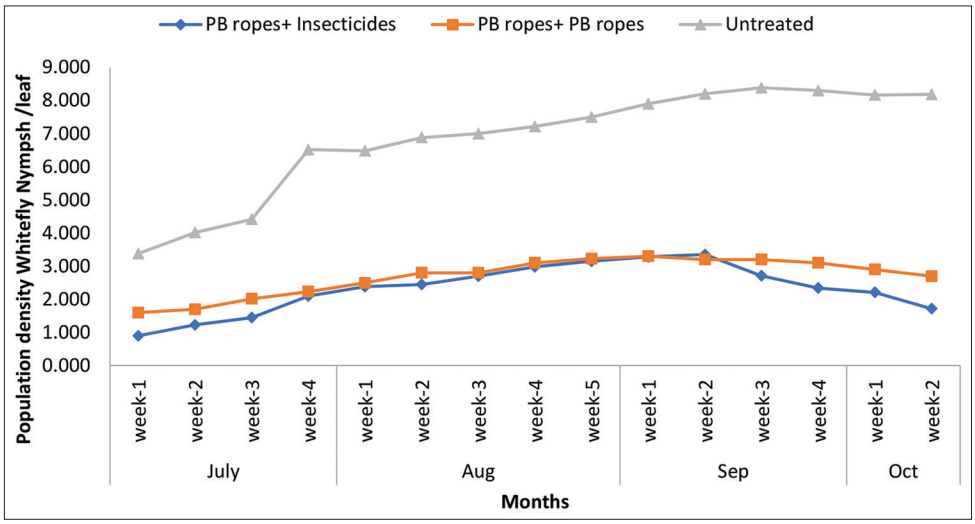

Fig. 1: Mean population density of *Bemisia tabaci* nymphs after application of PB ropes + Insecticides; PB ropes + PB ropes and Untreated field in cotton crop at MNSUAM, Research Farm, during 2018

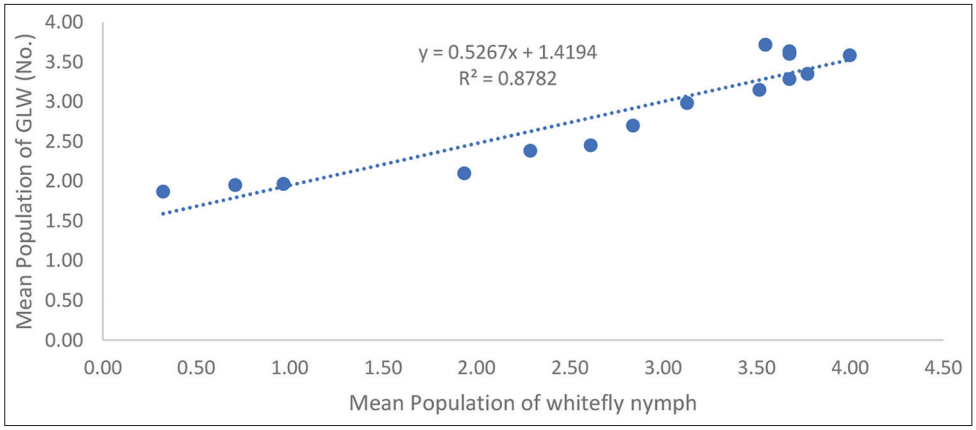

Fig. 2: Correlation between green lacewing and whitefly nymph in PB ropes +Insecticides field at MNSUAM, Research Farm, Block-c, during 2018

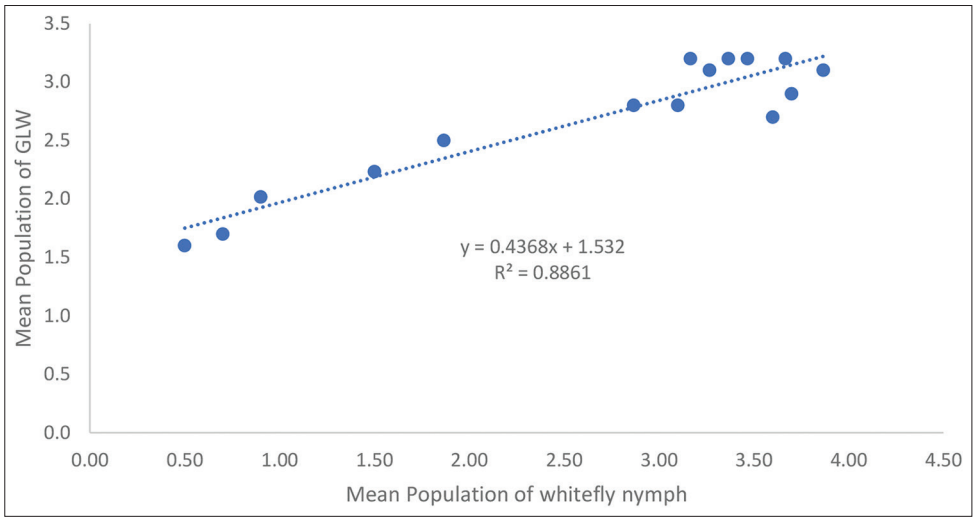

Fig. 3: Correlation between green lacewing and whitefly nymph in PB ropes + PB ropes field at MNSUAM, Research Farm, Block-C, during 2018

On the other side, when PB ropes were used for the management of pink bollworm in the field PB ropes helped to reduce the excessive applications of pyrethroids, because PB ropes manage the pink bollworm effectively and no more numbers of insecticides require. PB ropes helped to conserve the population of natural enemies consequently whitefly population reduced. With the application of PB ropes, we were minimized the application of insecticides in present study. Only the Ulala, Ulala+buprofezin and Polo were applied during the whole cropping season of cotton for sucking pests. Our results agreed with Lykouressis *et al*. (2004) who applied PB rope dispensers in cotton field and observed that population of pink bollworm reduced effectively and populations of other cotton pests, such as whiteflies and aphids, were also reduced in those experiment areas. Similar observations were recorded by Lykouressis *et al*. (2005) who conducted experiment and the one field was applied with PB ropes and in the other insecticide was applied. He observed that the results of PB ropes treated field sowed that PB ropes managed the population of pink bollworm as well as other sucking insect pests including *B. tabaci* and aphid populations can be reduced. However, it was reported that only insecticides were not enough for the management of these pests. Naranjo (2001) observed effectiveness of natural enemies of whitefly as compared to chemical control in his experiments study and described the predators and parasites of *B. tabaci*.

CONCLUSION

It can be concluded that PB rope is helpful tool to minimize the population of sucking insect pest of cotton especially whitefly populations. Relative study showed that although PB ropes are used for management of pink bollworm in the cotton field but using PB ropes that we can manage the whitefly population throughout the season. Consequently, farmers used excessive amount of pyrethroids for management of *P. gossypiella*. Pyrethroids destroy beneficial fauna of cotton, at the result of *B. tabaci* population flared up. The PB ropes have indirect effect on sucking insect pest's population and its natural enemies. Due to less use of insecticides, resistance problems can also be decreased and save the natural fauna of cotton insect pests which can destroy the whitefly nymph populations.

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