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Research Article

TWO APPLICATIONS OF PB-ROPES AS AN EFFECTIVE MANAGEMENT TOOL FOR *PECTINOPHORA GOSSYPIELLA* (LEPIDOPTERA: GELECHIIDAE)

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ABSTRACT

The experiment was conducted to observe the effectiveness and working duration of PB-Ropes in the cotton season 2018-19. The gossyplure baited traps were installed in the last week of June for monitoring of pink bollworm (PBW) while application of PB-Ropes was done @ 120 ropes / acre at pin head square stage on 30 acres of cotton during 1st week of July. The percent infestation of PBW in green bolls and number of moth catches were recorded from the plots treated with 2 applications of PB-Ropes alone and 1 application of PB-Ropes + insecticide application. The PB-ropes provide mating disruption for the period of 90 days. The percent infestation ingreen bolls was decreased effectively by two applications of PB-ropes as compared to one application of PB-Ropes and Control Plot.The number of moth catches were highly reduced in the plot treated with two applications of PB-ropes (6.07 ± 0.70) as compared to one application of PB-ropes (28.05 ± 3.16) and control plot (40.439 ± 3.62). The further application of pesticides was done to decrease the % infestation of pink bollworm in the plots treated with PB-Rope + Triazophos @ 600 ml /acre (9.6061 ± 0.9873), PB-Rope + Bifenthrin 10 % EC@ 250 ml / acre (11.848 ± 1.4921) and PB-Rope + Spintoram 12 % SC (14.273 ± 1.5838). The results of this study also provided best and long term approach to farmers for the effective management of pink bollwormby the two applications of PB-Ropes to cover full cotton season as compared to one application of PB-Ropes. The use of two applications of PB-Ropes proved effective and provides cost benefit to farmer as compared to the use of insecticide for the management of the Pink bollworm.

Keywords: Cotton, gossyplure, Pheromone, Pink Bollworm

1. INTRODUCTION

Cotton, *Gossypium hirsutum* L. (Malvaceae) is cash crop of many cotton growing countries of the world (Jamshed et al., 2008; Anwar et al., 2009). The share of cotton in GDP, Agriculture sector of Pakistan and foreign exchange earnings is 1.6%, 7.8% and 63.9 % respectively (Tayyab et al.,2005). The recorded area under cotton cultivation was reduced due to attack of the pink bollworm in 2015 (US department of Agriculture). Pink bollworm is the most serious pest of cotton irrespective of Bt and non-Bt cotton (Economic Survey of Pakistan, 2016).

The pink bollworm has developed resistance against Bt and non-Bt cotton since 2015 which resulted in low yield of seed cotton. Pink bollworm is the most damaging chewing pest while whitefly is important sucking pest of cotton in Pakistan which becomes the cause of reduction in yield of seed cotton (Aslam et al., 2004). The decline of the cotton crop is 17.4 to 9.86 million

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bales (Economic Survey of Pakistan, 2018). The use of insecticides to control the pink bollworm has developed resistance in insect pests all over the world including Pakistan (Ahmad et al., 2006).

Cotton is the host of different insect pest species from the seedling to harvesting stage (Attique et al., 2000). The insect pest species associated with cotton crop are 93 in Pakistan (Yunus and Yusuf, 1979). The recorded damage of insect Pests in cotton is average 5-10 % while 30-40 % in case of high infestation (Haque, 1972).The cotton crop is susceptible to a number of insect pests and pink bollwormis the most serious among these insect pests (Amin and Gergis, 2006). *Pectinophora gossypiella* was described by W.W Saunders as *Depressaria gossypiella* in 1843. Pink bollworm has gained the status of major insect pest in the recent decade (Ghosh, 2001).The bolls affected from the pink bollworm rot and shed, remaining larvae enters into the plants and stained the fiber (Agarwal et al., 1984). The flowers, bolls and fruiting portion of the cotton plant is badly affected by the pest resulted in low quality and quantity of lint and seeds, about 30-40% losses in the late season (Hamed and Nadeem, 2010; Zaki, 2012).

Sex pheromone based mating disruption technique to control the insect pests of cotton was given by Knipling and McGuire (1966). A mixture of ZZ and Z, E-isomers of 7, 11-hexadecadienyl acetate was proposed as sex pheromone of pink bollworm and named as "gossyplure" (Hummel et al., 1973).The commercially available sex pheromone of Pink bollworm female is gossyplure, which has used in the developed and developing countries such as Egypt and Pakistan (Hummel et al., 1973; Shorey et al., 1974; Staten et al., 1987; El-Adl et al., 1988; Qureshi et al., 1988; Critchley et al., 1991). The mating disruption technique has a great potential for monitoring and reducing the bollworms population both in treated and control fields (Critchley et al., 1991).

2. MATERIALS AND METHODS

2.1. Experimental detail

The trial of this research was conducted at C-block, research farm of Muhammad Nawaz Shareef University of Agriculture Multan in cotton season 2018. Total area was 36 Acres. The experiment was done in the Randomized Complete Block Design (RCBD) with five treatments and three Replications. Area was divided into 6 equal blocks of 6 acres each. One block of 6 acre was kept untreated called control block and named as C. Treatment blocks were named as T1, T2, T3, T4 and T5 respectively.The treatment of the seeds was done with the Imidacloprid (70 % WP). The 1 kg of seed was treated with 5 g Imidacloprid.

2.2. Pink bollworm management

The management of pink bollworm was done by the use of sex pheromonebased mating disruption technique (PB-Ropes @ 120 Ropes / acre) and some insecticides were used for the control of insect pest complex of cotton. The effectiveness of the PB-Ropes dispensers for reduction of pink bollworm moth catches was calculated as (Critchley et al., 1991).The installation of PB-Ropes was done at pin head square stage @ 120 ropes / acre in the 1st week of July on the area of 30 acres transgenic Cotton. The diameter of the PB-rope dispenser was 2.5 mm while the length of the PB-rope dispenser was 200 mm. The twisting of PB-rope dispensers was done around the main stem of cotton plants above the ground below 3-4 leaves. Ropes were tied on 1st plant in 1st row then after five steps on 2nd plant in the same row and when the first line completed then ropes were tied on the 1st plant in the 8th row. Efficacy of PB-ropes decreased after 90 days which resulted in increase of pink bollworm population up-to ETL level. The 2nd application of PB ropes was done on 25th of September, 2nd treatment to cover full cotton growing season.The application of Triazophos, Pyrethroid and Radiant was done in 4nd, 5th and 6th treatment of PB-ropes on 25th of September to check the % infestation of *P.*

gossypiella in all treatments and control block till the end of cotton season.

2.3. Data recording

The Pink bollworm moth catches data was recorded on daily basis from gossyplure baited sex pheromone traps to check the effectiveness and working duration of the PB-Ropes while the data of % infestation in green bolls was recorded after every 10 days till the end of cotton season.

$$\% \text{ Infestation} = \frac{\text{Infested bolls}}{\text{Total bolls}} \times 100$$

2.4. Statistical Analysis

The effect of PB-ropes was observed by the comparison of pink bollworm moth population and % infestation in green bolls between the control and PB-rope treated blocks. Data of pink bollworm % infestation was analyzed with analysis of variance (ANOVA) in RCBD for significance of means and Tukey HSD test was used for pairwise comparison. Significant treatment means separated by the least significant difference at $P< 0.05$. Data of pink bollworm moth catches was analyzed with analysis of variance (ANOVA) in RCBD and Tukey's HSD test was used for pairwise comparison. Significant treatment means separated by the least significant difference at $P< 0.05$.

3. RESULTS

The long season efficiency of PB-ropes was tested by single application and 2 applications of the PB-ropes as compared to untreated (Control) Block. The analysis of data suggested that there was a significant difference of green bolls infestation in the plot treated with single application of PB-Ropes, 2 applications of PB-ropes and untreated block ($P \leq 0.05$). The means of all treatments were compared (at 5 % probability level) to check the infestation levels of Pink bollworm. The comparison of means concluded that % infestation of pink bollworm was more in the control block (24.56±1.91) as compared to the single application of PB-ropes (15.51±1.95/ 100 bolls), 2 application of PB-Ropes (4.60±0.51 100 bolls) (Fig 1).

There was a significant difference in pink bollworm infestation in all treatments ($P < 0.05$). The mean comparison of *P. gossypiella* infestation was done at 5 % probability level which suggested that the minimum level of % infestation was recorded in the plot treated with 2 applications of PB-ropes (7.33± 2.02 100 bolls) following single application of PB-Ropes (64.33±4.09 100 bolls) and control block (97.33± 8.67 100 bolls).

The comparison of means for *P. gossypiella* moth catches showed that the maximum population of the moth catches was recorded from the control plot (40.44±3.62 100 bolls). The lower level of Pink bollworm moth Population was recorded from the plots treated with 2 applications of PB-ropes (6.07±0.70) following single application of PB-ropes (28.04 ± 3.16) (Fig 2).

The long season efficiency of PB-ropes was tested by single application of the PB-Ropes in combination with Triazophos, Pyrethroid and Radiant. The comparison of means concluded that % infestation of Pink bollworm was less in the plot treated with PB-Rope + Triazophos (9.6061 ± 0.99) following PB-Rope + Bifenthrin (11.85 ± 1.49), PB-Rope + Radiant (14.27±1.58) and Control (24.56 ± 1.92) (Fig 3).

The effectiveness of 2 applications of PB-ropes was tested against pesticide applications. The comparison of means concluded that % infestation of Pink bollworm was less in the plot treated with 2 applications of PB-ropes (4.60 ± 0.52) following PB-Rope + Triazophos (9.60± 0.99) following PB-Rope + Bifenthrin (11.85±1.49), PB-Rope + Radiant (14.27±1.58) and Control (24.56±1.92).

The recorded cotton yield from the untreated (control) plot was minimum (680 kg / acres). The high yield was observed from the plot treated with 2 applications of PB-Ropes (PB-Rope + PB-Rope) (1400 kg / acre) followed by PB-Rope + Triazophos (1240 kg / acre), PB-Rope + Pyrethroid (1120 kg / acre) and PB-Rope single application (1000 kg / acre). The insecticides do not provide effective management against pink bollworm (Gressel

et al., 2004). The better management of the pink bollworm by gossyplure (ZZ / ZE - 7, 11 - Hexadecadienyl acetate) was recommended by several researchers. This technique proved effective for the management of the pink bollworm (Carde et al., 1998).

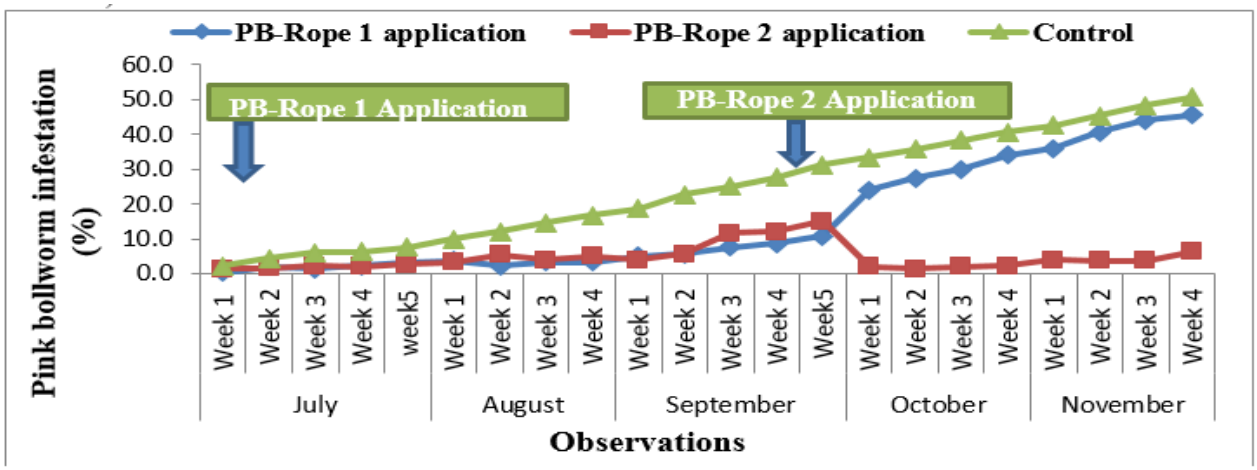

Fig 1: Comparison of Pink Bollworm % infestation in 1st and 2nd applications of PB-Ropes and control block from July to November in cotton season 2018.

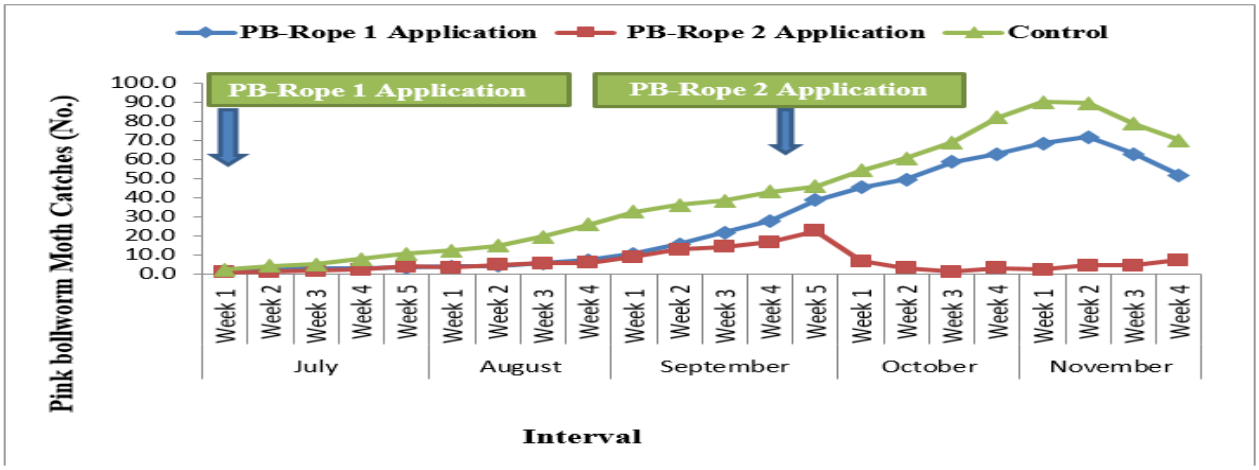

Fig 2: Comparison of Pink Bollworm Moth catches in 1st and 2nd applications of PB-Ropes and control Block in cotton season 2018.

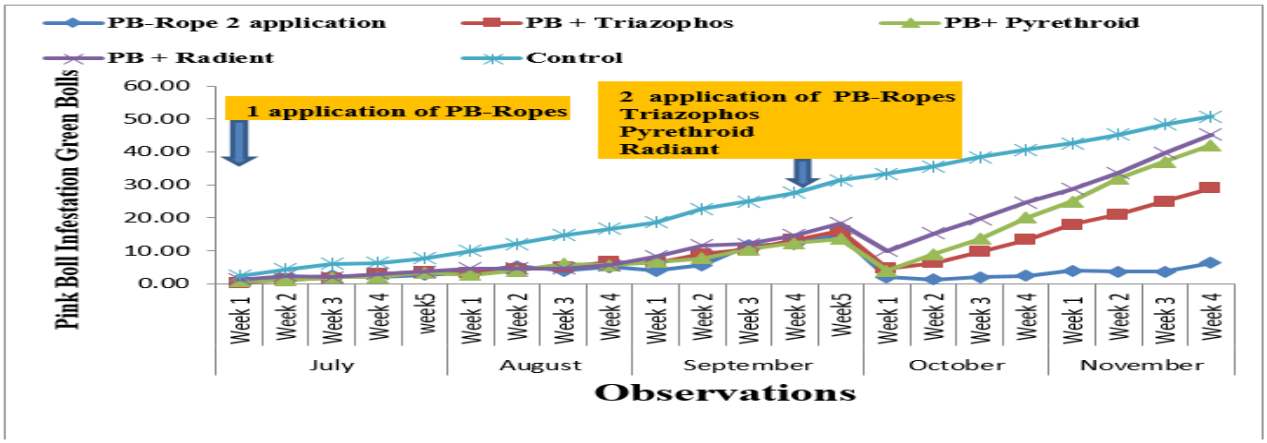

Fig 3: Comparison of Pink Bollworm infested green bolls in 2 applications of PB-Ropes, plots treated with PB-Ropes + pesticide applications and control block in cotton season 2018-19.

4. DISCUSSION

The results of our studies concluded that the use of two applications of PB ropes @ 120 ropes / acre proved effective, cost benefit ratio to farmers as compared to the use of one application of PB-Ropes and insecticide applications. The insecticides do not provide effective management against *P. gossypiella* (Gressel*et al.*, 2004). The best control of the pink bollworm population was done by the use of one application of PB-Ropes in combination with insecticide applications (Lykouressis *et al.*, 2004). The better management of the pink bollworm by gossyplure (ZZ / ZE - 7, 11 - Hexadecadienyl acetate) was recommended by several researchers. This technique proved effective for the management of the pink bollworm (Carde*et al.*, 1998). The 1 application of the PB-ropes with additional pesticide applications has given better results against pink bollworm while the results of our study concluded that % mating disruption of the Pink bollworm was up to 80 % in the plot treated with two applications of PB-ropes to cover full cotton season. The use of 2 applications of PB-ropes to cover full cotton season have no negative effect on the population of the natural enemies. The area wide management of the pink bollworm can be done efficiently by the use of these techniques.

5. CONCLUSIONS

This study concluded that the use of sex pheromone based mating disruption technique is environment friendly technique, reduce the number of pesticide applications and favors the multiplication of natural enemies (spiders, lady bird beetle and green lacewing) in cotton. The use of two applications of PB-Ropes from Pin head square stage to harvesting proved most effective for the management of Pink bollworm as compared to one application of PB-Ropes in combination with pesticide applications (PB-rope + Triazophos, PB-rope + Bifenthrin, PB-rope + Radiant). This study was conducted at research farm of Muhammad Nawaz Sharif university of Agriculture, Multan in cotton season, 2018-19.

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