

Project: COTTON PRODUCTIVITY ENHANCEMENT THROUGH ECO FRIENDLY PINK BOLLWORM MANAGEMENT AND CAPACITY BUILDING PM EMERGENCY PROGRAM

Objectives:

1. Management of PBW through PB-Rope Technology
2. Capacity building of farmers and field staff of agriculture department for use of PB Rope
3. Monitoring PBW population buildup in various cotton growing districts
4. Monitoring the development of resistance in PBW through bioassay technique
5. Capacity building of cotton grower in identification of natural enemies of insect pests of cotton
6. To demonstrate and evaluate the performance of Leftover Boll Picking Machine developed by CCRI Multan for the management of PBW
7. To develop and publish training brochures, leaflets and extension material
8. To disseminate the extension messages about PBW and cotton production using IT techniques (SMS, Social Media etc)

Description

The adoption of biotech cotton in Pakistan provided relief from bollworms and offered an opportunity for farmers to divert their attention to counter the risk of Cotton Leaf Curl Virus disease by early sowing. However, this practice extended the crop period, which seriously disturbed the cotton agro-ecosystem while opening the door to other threats. The number of insecticide applications needed to control sucking insects increased plus the early sowing of cotton adversely affected non-target and friendly organisms, giving rise to new pest problems like insecticide resistance and pest resurgence. Meanwhile, climatic changes including high temperature and irregular rainfall pattern caused drastic increase in whitefly and pink bollworm population. In 2019-20, PBW and WF remained the significant pests and took toll of about 1-2 million bales. Development of resistance resulted in repeated application of pesticides thus increasing their cost of production and ended with no return in cotton.

Pink bollworm, *Pectinophora gossypiella* (PBW) re-emerged as a serious threat to cotton after about a period of 15 years. Losses due to PBW infestations smeared out to an estimated value of US\$1.2 billion (Rs. 187 billion) in annual cotton production in 2015/16. Inability to manage PBW properly and timely may bring a catastrophic crisis for 1.3 million cotton farmers in the country.

The sweet potato whitefly, *Bemisia tabaci* (Gennadius) (Homoptera: Aleyrodidae), is among insect pest species of greatest economic significance in cotton production in Pakistan. Whitefly is usually a serious pest during the vegetative growth stage. Whitefly adults and nymphs suck plant sap and transmit various plant pathogens including the begomoviruses such as the cotton leaf curl virus. Cotton leaf curl disease is endemic throughout Pakistan and in western India which is attributed to *B. tabaci* infestations. In addition, feeding damage reduces plant vigour & lint yield; and honeydew deposition can lead to significant reductions in lint quality owing to stickiness and discoloration from the growth of sooty moulds.

In Pakistan farmers rely exclusively on chemicals to control insect pests. More than 80% of US \$ 300 million are spent on pesticides in Pakistan to manage cotton pests. Due to sole and un-judicious use of insecticides, whitefly has developed resistance against conventional insecticides (e.g. organophosphate, carbamate and pyrethroid) as well as to neonicotinoid and insect growth regulators (IGRs).

Resistance in PBW has not been investigated in Pakistan until now, but if confirmed it would pose further threats to the sustainability of current pest management practices. The first generation GMO used in Pakistan is no longer giving protection against PBW and has resulted in successive outbreak of PBW for the last three four years. Saving cotton sticks with PBW infested bolls for fuel further aggravated the situation as growers opt early sowing to escape from CLCV. The early emergence of PBW adults from the infested bolls on cotton sticks flourish and build population on early sown cotton for afterward attack the seasonal cotton. This situation is threatening to cotton industry and also to the national economy. So there is a need to develop a strategic plan for its timely and effective management for improving cotton yield. Male desperation technique is well proven in the management of PBW in many countries. CCRI Multan has recently developed a Mechanical Boll Picking Machine for removing the left over bolls (infested with PBW or sound bolls) from cotton sticks before their storage for fuel purpose. Sound bolls picked by the Machine give extra yield and round off the cost of running this machine whereas collection of infested bolls ensure less likely buildup of PBW population in early sown cotton.

Combining both eco-friendly techniques would reduce the reliance on pesticides and enhance the return for the farmers. Such strategies, however, require substantial laboratory and field research to formulate, and considerable cooperation by researchers, policy-makers, industrialists and advisors to implement successfully.

Justification:

Pakistan cotton production dropped to merely 9 million bales in 2019-20 due to severe attack of PBW and WF. The available pesticides failed to give an effective control. The PB Rope were available in limited quantity and proved to be too expensive to be used by majority of farmers. Restricting early sowing seems quite difficult to implement so is the hibernating larvae management in infested bolls of cotton sticks. Male disruption technique has been in use for decades for the management of many insects. Its success mainly rely on proper installation, time of installation, monitoring of population buildup and duration of effectiveness of the chemicals. Missing any of the above mentioned parameters could result in failure of technology and heavy infestation of PBW. Repeated application of pesticides might have resulted in development of resistance, which needs to be explored in various cotton growing areas of Punjab.

Considering the above issues in sight, the present project was conceived to monitor the resistance levels, demonstrate and evaluate the Boll Picking Machine, capacity building of grower and field staff of AED in PB rope use, and dissemination of knowledge through IT based technologies.

Major Activities

Survey of cotton growing areas of Punjab: To determine population buildup of PBW, surveys will be conducted throughout the project period in cotton growing areas of Punjab. To see pink bollworm infestation 20 green bolls (14-28 days old) per acre will be collected from different district of Punjab brought back to laboratories at CCRI, Multan. After 3-4 days bolls will be dissected to see infestation.

Provision of PB Rope on subsidized price: Impact of PB ropes on pink bollworm incidence will be evaluated in 200,000 acres in Punjab. For this purpose PB ropes will be provided to farmers on subsidized rate (1000Rs/acre). To evaluate pink bollworm infestation 20 green bolls (14-28 days old) per acre will be collected from PB ropes installed areas will be compared with those collected from untreated areas (no PB ropes).

Insecticidal resistance monitoring: To monitor resistance against different insecticides, bioassays will be conducted on its field collected (different districts of Punjab) and laboratory reared population. Susceptible strain of pink bollworm already available in CCRI Multan will be further reared on artificial diet to get desired numbers. Pink bollworm collected from cotton fields (different districts of Punjab) will be bio-assayed and the most resistant strain will be kept as a resistant line for further selection and insecticide being used against Pink bollworm to generate highly resistant strain for further biochemical, genetic, binding and fitness cost studies.

Performance of Mechanical boll picker: Performance of mechanical boll picker by managing pink bollworm in leftover bolls in different districts of Punjab will be evaluated. For this purpose 10 machines will be manufactured in two years, and provided research facilities and AED for demonstration to farmers. Infestation in the areas, where left over bolls from cotton sticks removed by mechanical boll picker will be compared with the infestation in areas where manual cutting of stick having left over bolls as well as with the infestation in areas where grazing by sheep and goats is common practice.

To make cotton production cost effective for farmers: After providing subsidized inputs and subsidized machinery like PB-ropes and mechanical boll picker, evaluation will be made at the end of crop season. Cost-benefit analysis will be performed to make recommendations for cotton production cost effective for farmers.

Human resource development: Seminars and training programs will be arranged for farmers, academia, stakeholders, and extension workers. Trainings of the scientists of CCRI will be arranged for capacity building. Findings of the project will be disseminated via print and electronic media.