Evaluation of frontline demonstrations on management of whitefly in cotton

RAM KARAN GAUR*, MEENA SIWACH and MEENAKSHI SANGWAN

ICAR – Krishi Vigyan Kendra, CCSHAU, Rohtak 124001 Haryana, India
*Email for correspondence: drramkaran1965@gmail.com

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ABSTRACT

Evaluation of frontline demonstrations on cotton crop at farmers' fields in Rohtak district was carried out during kharif 2021 and 2022 by ICAR – Krishi Vegyan Kendra, CCS HAU, Rohtak, Haryana. Among the several constraints experienced by the farmers, increased infestation by sucking insect pests viz aphid (*Aphis gossypii* Glover), leaf hopper (*Amrasca biguttula biguttula* Ishida) and whitefly (*Bemisia tabaci* Gennadius) were the most important. The farmers used monocrotophos 36 SL and imidachloprid 17.8 SL for the control of whitefly, whereas, nimbicidine 300 ppm and flonicamid 50 WG were applied in demonstration fields for the control of whitefly. The results revealed that average yield in farmers' fields was 10.0 and 12.0 q/ha, whereas, the yield in demonstration fields was 12.0 and 14.0 q/ha during 2021 and 2022 respectivley. The findings showed significant increase in the average yield of demonstration fields ie 2 q/ha during 2021 and 2022 over the control. Considerably, lower yield was observed under farmers' practice because of application of non-recommended insecticides during both the years. Population of whitefly was recorded as 18-24 adults/3 leaves in farmers' fields and 9-12 adults/3 leaves in demonstration fields during kharif 2021 and 21-27 adults/3 leaves at farmers' fields and 9-15 adults/3 leaves in demonstration fields during kharif 2022 after applications of insecticides. It was observed that nimbicidine 300 ppm and flonicamid 50 WG were found effective in reducing whitefly population in cotton field. This treatment also resulted in higher cotton yield as compared to farmers' practice. The farmers possessed highest knowledge regarding high yielding varieties of cotton crop (100%) followed by time of sowing (80%). They possessed less knowledge regarding the use of hormones (10%) followed by sowing of refugea (20%) aspects of cotton cultivation.

Keywords: Frontline demonstrations; whitefly; management; farmers' practice

INTRODUCTION

Frontline demonstration (FLD) is a proven extension mechanism with the objectives of demonstrating the usefulness of the latest improved crop production and protection technologies to the farmers as well as extension workers with a view to reduce the time gap between technology generation and its adoption. It also enables the scientists to obtain direct feedback from the farmers and suitably reorient their research programmes, develop appropriate technology packages and create effective linkage among scientists, extension personnel and farmers.

Cotton (*Gossypium* sp) is one of the most important commercial crops of India and popularly known as King of Fibre, which is primarily grown during kharif season. Though India has the largest area under cotton cultivation, yet the productivity is much lower as compared to other important cotton growing countries like Brazil, USA, China etc. The area under cotton in India was about 132.85 lakh hectares, with a production of about 352.48 lakh bales during 2020-21 and productivity of 451 kg per hectare (https://cotcorp.org.in/national_cotton.aspx?AspxAutoDetectCookieSupport=1).

Gujarat is one of the major cotton growing states in India. In major growing states of Punjab, Haryana and Gujarat, cotton production is likely to decline by 0.5 and 2.0 per cent and rise by 2.5 per cent respectively (Anon 2022). With the introduction of *Bt* cotton in the country during 2002, the farmers widely accepted the transgenic cotton due its ability to control bollworm damage. But the incidence of sucking pests has remained as such in both *Bt* and non-*Bt* cotton

hybrids till now (Rekha and Pradeep 2012). Cotton pest management has always been an immensely challenging task for entomologists all over the world. About 1,326 species of insect pests have been reported in cotton across the world of which whitefly (*Bemisia tabaci* Gennadius), leafhopper (*Amrasca biguttula bigutulla* Ishida) and thrips (*Scirtothrips dorsalis* Hood) are widely distributed polyphagous pests in tropical and sub-tropical regions of India (Puri et al 1998). In India, around 162 insect pests have been reported to cause damage to the cotton crop (Dhaliwal and Arora 1996). Among several sucking insect pests of cotton, whitefly is very important and dangerous cotton pest that also transmits cotton leaf curl virus (CLCuV). It damages the cotton plant by sucking cell sap resulting in 50 per cent decrease in boll yield (Ashfaq et al 2010). Whitefly feeds on cotton leaves, causes damage to the cotton crop by sucking the cell sap from under surface of leaves and secrets honeydew. As a result, sooty mould grows on secretions of honeydew which reduces the photosynthetic area of leaves. It also transmits the viral diseases to cotton crop (Khan and Ahmad 2005) by transmitting leaf curl virus disease (CLCuV) which is great threat to cotton-based economy (Amjad et al 2009). The use of chemical pesticides for the control of insect pests is quick and rapid one, hence, it is an effective component of integrated pest management (IPM) of crops. Keeping the above points in view, the present study was conducted to evaluate the frontline demonstrations on management of cotton whitefly in Rohtak district of Haryana.

MATERIAL and METHODS

Frontline demonstrations were conducted by the ICAR – Krishi Vigyan Kendra, CCS HAU, Rohtak, Haryana during kharif season of 2021 and 2022 in the farmers' fields in different villages of Rohtak district of Haryana to evaluate the IPM practices against whitefly of *Bt* cotton. Under this study, 10 farmers were selected purposively for demonstrations. Baseline information regarding crop production practices adopted by farmers from selected villages was collected before starting FLDs. The technology gap was identified wrt plant protection measures which ultimately reduced production potential of crop.

Conferences, group meetings and skill trainings were conducted for the selected farmers on different aspects of protection technology of cotton crop. The IPM technology was adopted from CCS HAU while farmers' practice comprised sprays of non-recommended insecticides. Critical inputs such as nimbecidine 300 ppm @ 2.5 l/ha followed by second spray of flonicamid 50 WG @ 200 g/ha were applied in the demonstration fields (DFs). The farmers used monocrotophos 36 SL and imidachloprid 17.8 SL in the control fields. The farmers' practice (FP) was considered as control/local check. The control fields were maintained by the farmers according to their own cultivation practices. The second spray was applied at 15 days interval. The observations on population of whitefly were made on three plants selected randomly under each demonstration. The first spray was initiated when whitefly population crossed the economic threshold level. The population of whitefly was recorded per three leaves viz one each from top, middle and bottom canopies after 3rd day of second spray. The yield data of demonstrated fields as well as control plots were recorded immediately after harvesting to assess the impact of FLDs intervention on the yield of cotton crop and benefit-cost ratio was also worked out. Data were analysed for different parameters using the formula as given below:

$$\text{Per cent increase in yield} = \frac{\text{Yield gain in DFs (q/ha)} - \text{Yield gain in FP (q/ha)}}{\text{Yield gain in FP (q/ha)}} \times 100$$

where DFs = Demonstrated fields, FP = Farmers' practice

The following formula was used for the calculation of benefit-cost ratio:

$$\text{B-C ratio} = \frac{\text{Gross return}}{\text{Cost of cultivation}} \times 100$$

The knowledge level of 50 selected beneficiaries regarding improved cotton production technologies was also assessed. For selection of farmers, a list of farmers, where FLDs were conducted during the preceding two years, was prepared and for uniform representation, 10 farmers from each selected village were taken, making sample size of 50 respondents. The data were collected through personal interview with the help of pre-tested schedule.

RESULTS and DISCUSSION

Data given in Table 1 show that population of whiteflies before application of insecticides ranged from 36-50 and 34-52/3 leaves in farmers' fields and 34-52 and 32-50/3 leaves in demonstration fields during kharif 2021 and 2022 respectively. During kharif 2021, IPM practice revealed that population of whiteflies ranged from 9-12/3 leaves after application of nimbecidine 300 ppm and flonicamid 50 WG as compared to farmers' practice where it ranged from 18-24/3 leaves after application of monocrotophos 36 SL and imidachloprid 17.8 per cent SL. Farmers' practice showed higher infestation of whiteflies. HIgher yield of 12.0 q/ha was recorded in demonstrated fields as compared to farmers' practice of 10.0 q/ha during kharif 2021. During 2022, maximum yield of 14.0 q/ha was recorded in demonstration fields as compared to 12.0 q/ha in farmers' practice.

The data pertaining to cost of cultivation, gross return, net return and B-C ratio of cotton crop in demonstration fields and farmers' practice are presented in Table 2. Average cost of cultivation was Rs 64,050 and 62,850/ha under demonstration fields and farmers' practice respectively. Higher net return of Rs 37,800 was recorded in demonstration fields as compared to Rs 22,950 in farmers' practice. The mean B-C ratio was also high (1:1.57) in the demonstration fields as compared to farmer's practice (1:1.36). Average data for two years viz 2021 and 2022 indicate that IPM practice (recommended technology) was better than the farmers' practice under cotton agro-ecosystem. Thus IPM strategy kept the population of whiteflies below their threshold level. Present findings are in agreement with the findings of Rajasekhar et al (2018) who reported that flonicamid 50 per cent WG was proved highly effective insecticide against whiteflies with maximum reduction of 92.33 per cent. Khajuria et al (2020) reported that IPM practice (recommended technology) for the management of sucking pests in *Bt* cotton was found to be more effective over farmers' practice. They further described that the B-C ratio was also higher in the IPM practice 1:2.45 as compared to farmers' practice (1:1.94). Birah et al (2019) and Khajuria et al (2016) have reported that the seed yield of cotton from IPM plots was higher which resulted in a higher B-C ratio in comparison to farmers' practice.

Table 1. Whitefly population and cotton yield in demonstration and farmers' fields during 2021 and 2022

Component	Farmers' practice		Demonstrations	
	2021	2022	2021	2022
Population of whiteflies/3 leaves (before spray)	36-50	35-52	34-52	32-50
Population of whiteflies/3 leaves (after spray)	18-24	21-27	9-12	9-15
Average yield (q/ha)	10.0	12.0	12.0	14.0
Increase in yield (%)	-	-	20.0	16.6

Table 2. Economics of performance of cotton crop under demonstrations and farmers' practice

Year	Demonstration plots				Farmers' practice			
	Gross cost (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	BCR	Gross cost (Rs/ha)	Gross return (Rs/ha)	Net return (Rs/ha)	BCR
2021	63,450	90,000	26,550	1.41	62,250	75,000	12,750	1.20
2022	64,650	1,12,700	48,050	1.74	63,450	96,600	33,150	1.52
Mean	64,050	1,01,350	37,800	1.57	62,850	85,800	22,950	1.36

Table 3 reveals that farmers possessed maximum knowledge regarding high yielding varieties of cotton crop (100%) followed by time of sowing (80%). Similarly, they possessed less knowledge regarding the use of hormones (10%) followed by sowing of refugea seed (20%) aspects of cotton cultivation. The data further indicate that per cent adoption level of farmers regarding aspects like field preparation, fertilizer application, irrigation management, weed management and plant protection measures were found to be 70, 60, 50, 40 and 40 respectively. Similar observations were made by Meena and Singh (2016) who reported that respondents possessed maximum knowledge regarding time of sowing and high yielding varieties of cotton crop.

The study revealed that farmers were not much aware of the recommended package of practices of cotton. Farmers in general, used non-recommended insecticides for the control of insect pests of cotton due to lack of awareness. A comparison of frontline demonstrations based on IPM practices and farmers' practice showed that IPM practice (recommended technology) for the management of whitefly in *Bt* cotton was found to be more effective over farmers' practice.

CONCLUSION

It is concluded that IPM practices were more effective as compared to farmers' practice who used non-recommended pesticides for the control of whitefly in cotton. It was also observed that integrated pest management strategies were needed for higher yield and better benefit-cost ratio. Therefore, the integrated pest management practices should be adopted by the cotton growing farmers. More extension activities are required to motivate the farmers for adoption of recommended pesticides and sowing of refugea seed.

Table 3. Knowledge level of respondents about improved cotton production technology

Technology	Recommended practice	Per cent adoption	Farmers' practice	Per cent gap
High yielding varieties	*Bt* varieties	100	Nil	0
Field preparation	3-4 ploughings	70	2-3 ploughings	30
Sowing time	15 April to 7 June	80	15 April to 20 June	20
Sowing of refugea seed	Yes	20	No	80
Fertilizer application (NPK/acre)	70:24:24	60	80:12:0	40
Irrigation management	3-4 irrigations	50	2-3 irrigations	50
Weed management	Weedicides + hand weeding	40	Hand weeding	60
Plant protection measures	Recommended pesticides	40	Non- recommended pesticides	60
Use of hormones	2 sprays of NAA	10	Nil	90

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