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Stem Application Technology with Modified Tools for Management of Sucking Pests in Cotton (*Gossypium herbaceum* L.)

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ABSTRACT

Cotton is the most important commercial crop of Telangana State with an area of 1.41 M ha., covering more than 95 per cent under Bt. Sucking pest infestation is the major biotic constraint responsible for considerable yield loss and high consumption of insecticide in cotton. As an alternative to chemical spray, stem application technology was assessed for the sucking pest management of cotton in the farmer's field of Karimnagar District for the five years starting from 2014-15. Imidacloprid (18.5 SL) solution @ 1:20 dilution was applied for three times at 20, 40 and 60 DAS. It was effectively controlled the sucking pests of cotton by reducing number of sprays and saved 74.95 per cent of insecticide (249.49 g.ai/ha). Cost saving of Rs. 3,340/ha., coupled with 8.11 per cent increase in yield resulted in additional net returns of Rs. 7,810/ha., over control. Obtained high B:C ratio of 1.86 compared to control (1.59). Over all cumulative monitory benefit of Rs. 6,49,300/- was realised in an area of 20.0 ha., over five years.

Key Words: Karimnagar, Imidacloprid, Stem application bottle, Cost saving, B: C ratio.

INTRODUCTION

In India, Telangana is one of the leading cotton growing states stood at third position in area and production after Maharashtra and Gujarat. In Telangana, cotton is the most important commercial crop covering of an area of 1.41 M ha., contributing to 13.01 per cent of total cotton area in the country and with a production of 3.44 M bales which is 10.6 per cent to the total production of country. Even though the area and production is high, the yield levels are very low (416 kg/ha) compared to Maharashtra (475 kg/ha), Gujarat (612.0 kg/ha) and other cotton growing states (NFSM, 2018). One of the major reasons for low yields is that, the cotton is grown predominantly under rainfed (87.5%). Uncertain yields and high cost of cultivation is causing losses frequently to cotton farmers in the state. Every possibility of reduction in cost and improvement in yield will be very helpful to avoid or reduce the losses and add to the profits.

Karimnagar is the leading cotton growing district in Telangana with an area of 0.23 M.ha., occupying with more than 95 per cent of area under Bt cotton. Apart from the low and uncertain rain fall, sucking pest infestation is the major constraint towards which farmers were investing more. Farmers used to spray for 6-8 times with different insecticides and their mixes such as Acephate, Monocrotophos, Imidacloprid, Thiamethoxam, Acetamiprid and others. Sprayings starts early right from 20-25 d of crop that results in removal of beneficial insects drastically which lead to more and more sucking pest incidence further and hence increased number of sprays.

Stem application is an alternate method of sucking pest control in cotton. Stem application of Imidacloprid @ 1:20 dilution with water for three times at 20, 40 and 60 DAS is effective against cotton aphid, *Aphis* gossypii Glover (Ramarao *et al*, 1998) and other sucking pests of cotton (Barkhade and Nimbalkar, 2000). It was also found effective against sucking pests of Okra (Satyaprasad, 2000). Stem application of Monoocrotophos @ 1:4 or Imidacloprid @ 1:20 dilution with water is

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recommended by the state agricultural university, Professor Jayashankar Telangana State Agriculture University (PJTSAU). It is recommended to practice for three times at 20, 40 and 60 days after sowing. Chemical is smeared along any one side of stem for about 6 to 10 cm long on green soft stem leaving basal thickened hard portion of stem. Neem sticks or painting brush or tooth brushes were used for the insecticide application purpose. Even though the stem application technology was proved for its efficacy against sucking pests of cotton, it has not got much popularity due to the application process involved is a labour intensive. To take this technology to the farmer level it needs to introduce with necessary modifications to reduce drudgery there by easy to adopt and more economic.

With this back ground, the stem application method of sucking pest management in cotton, *Gossypium herbaceum* L. was assessed in the farmer's field with improved application tools.

MATERIALS AND METHODS

A contiguous area of 10.0 ha was selected for assessment by keeping equal area as control for the comparison. Pre-implementation training on technology assessment was conducted to the selected farmers before sowing of crop. After 15 days of sowing, a sucking pest infested field was selected and organised a method demonstration of stem application. The tools used for stem application such as neem stick, paint brush and tooth brush were replaced with plastic bottles with cotton swab at tip of bottle (stem application bottles). Usage of stem application bottle made easy and reduces labour as there is no need of dipping in insecticide solution every time of application as it required in case of tooth brush or neem stick. The bottle filled once with insecticide solution (200ml) covers an area of 0.1 ha by continuous application. After three days of method demonstration, field was shown to the farmers to observe the efficacy of technology to control different sucking pests. Then stem application bottles and Imidacloprid were supplied to the farmers. Care was taken to avoid spraying particularly at early growth stage of crop up to 90 DAS. However, need based sprays were given after 90 DAS based on economic threshold level (ETL).

Stem application was practiced regularly for three times at 20, 40 and 60 days after sowing. As part of further improvement, sticks with rolling applicator were used in place of stem application bottle to reduce drudgery further. This technology was assessed for five years starting from 2014-15 to 2018-19. Initially, during 2014-15, selected 10.0 ha and increased the area in successive years up to 20.0 ha. In case of control, chemical spray of neo-nicotinoids and other systemic insecticides were used as per the farmer's choice. Data on cost of sucking pest management, total cost of cultivation, pesticide consumption, number of sprays, yield and gross returns were collected from each farmer of assessment and control. Based on data collected, saving of insecticide, net returns, B:C ratio and total monitory benefit were worked out.

RESULTS AND DISCUSSION

Sucking pests *viz.,* thrips, aphids, leaf hoppers, whiteflies and mealy bugs were effectively managed up to 90 DAS in both assessment and control for all the five years of study. In the assessment, leaf hoppers was increased after 90 DAS and crossed ETL at 140 DAS in the year 2014-15, 2015-16 and 2018-19 while whiteflies in the year 2016-17 and 2017-18. Similar trend was recorded in control with crossing ETLs about 20-25 d earlier than assessment for both leaf hoppers and whiteflies in the corresponding years mentioned as in case of assessment.

Number of sprays and insecticide consumption

During the first year of assessment (2014-15), insecticidal sprays were reduced to 2.13±0.53 as against 6.56±0.63 sprays in control. As the assessed technology was shown positive results, the area was increased to 15.0 ha. in 2015-16 and to 20.0 ha., in the year 2016-17 onwards. In the successive

Table 1. Details of insecticide consumption and number of sprays given in cotton field.

Year	No. of Farmers	Area (ha)	Number of sprays		Consumption of insecticide (g.ai/ha)		Reduction in insecticide over control (%)
			Assessment	Control	Assessment	Control	
2018-19	47	20.0	0.48±0.09	8.22±0.75	45.8±2.39	357.8±21.3	87.20
2017-18	47	20.0	0.72±0.13	8.14±0.64	56.3±3.12	354.3±31.6	84.12
2016-17	47	20.0	1.13±0.35	7.73±0.72	74.1±4.22	336.5±25.1	77.98
2015-16	25	15.0	1.81±0.42	7.14±0.62	103.7±5.63	310.8±22.4	66.63
2014-15	14	10.0	2.13±0.53	6.56±0.63	117.6±4.72	285.6±19.6	58.80
Mean	-	-	1.25±0.38	7.56±0.69	79.5±9.6	329.0±26.4	74.95±11.64

Values shown with ± are mean±SEm.

years, the number of sprays had been reduced to 2.13±0.53, 1.81±0.42, 1.13±0.35, 0.72±0.13 and 0.48±0.09 in the year 2014-15, 2015-16, 2016-17, 2017-18 and 2018-19, respectively. In contrast to the assessment, number of sprays was increased from 6.56±0.63 (2014-15) to 8.22±0.75 (2018-19) in control.

The overall mean number of sprays for the five years of assessment was 1.25±0.38 which was six times lower than control (7.56±0.69 sprays). Insecticide consumption was reduced from 117.64 g.ai/ha (2014-15) to 45.81 gai/ha (2018-19). In case of control it has increased from 285.5 (2014-15) to 357.82 gai/ha (2018-19). The five years mean for consumption of insecticide was shown four times reduction by recording 79.51±9.62 g.ai/ha as against control of 329.0±26.36 g.ai/ha. The per cent reduction of insecticide usage over control during the year 2014-15, 2015-16, 2016-17, 2017-18 and 2018-19 was 58.8, 66.63, 77.98, 84.12 and 87.2, respectively.

Overall mean reduction of insecticide was 249.49 g.ai/ha accounting for 74.95 percent reduction over control. Reduction in number of sprays and insecticide usage were achieved due to effective control of different sucking pests by stem application particularly during early crop growth stage up to 90 DAS. The present results were in agreement with earlier findings of research field experiments of Mahale *et al* (2017) who reported the stem application efficacy against cotton sucking pests *viz*., aphids, leaf hoppers, thrips and white flies up to 75 to 90 DAS. Similar findings were also reported by Prasad and Malathi (2016) and Yang *et al* (2005) for reduction of insecticidal spray when stem application was used as a component of IPM in cotton. Detailed account of number of sprays and insecticidal consumption were given (Table 1).

Yield and economics

Considerable yield increase of 18.33 per cent over control was recorded in the year 2014-15, while a marginal increase was obtained in the following years. Overall mean yield of 1552 kg/ha was obtained in assessment as against 1442 kg/ha of control with increase of 8.11 per cent over five years of assessment. Similar findings were reported by Satyaprasad (2000) with stem application of Imidacloprid on Okra. Mean cost of cultivation over five years was Rs. 37,420/ha as against Rs. 40,760/ha., of control with a saving of Rs. 3,340/ ha contributing to 8.19 percent of cost saving. With dual advantage of cost reduction and yield increase was added to the net higher returns in treatment over control. The additional benefit over control was achieved as Rs. 9520/ha., 7300, 7300, 5950 and 8980 per hectare in the year 2014-15, 2015-16, 2016-17, 2017-18 and 2018-19, respectively. The mean additional benefit over control for five years was Rs. 7810/ha.

Table 2. Details of cost-economics of the cotton field.

Year	Area (ha)	Yield (kg/ha)		% Increase in yield	Economics of demonstration (Rs./ha)				Economics of check (Rs./ha)				Additional benefit (Rs/ha)	Total monitory benefit (Rs)	Cumulative monitory benefit (Rs)
		Assessment	Control	Gross Cost	Gross Return	Net Return	B:C ratio	Gross Cost	Gross Return	Net Return	B:C ratio				
2018-19	20.0	1610	1550	3.87	45200	77280	32080	1.71	51300	74400	23100	1.45	8,980	179600	649300
2017-18	20.0	1560	1510	3.31	43400	70200	26800	1.62	47100	67950	20850	1.44	5,950	119000	469700
2016-17	20.0	1820	1700	7.06	38500	86400	47900	2.24	41000	81600	40600	1.99	7,300	146000	350700
2015-16	15.0	1350	1250	8.00	31600	60750	29150	1.92	34400	56250	21850	1.63	7,300	109500	204700
2014-15	10.0	1420	1200	18.33	28400	51120	22720	1.80	30000	43200	13200	1.44	9,520	95200	95200
Mean	-	1552±82	1442±94	8.11	37420±3261	69150±6166	31730±4323	1.86	40760±3922	64680±6797	23920±4514	1.59	7,810±643	-	-

Values shown with ± are mean±SEm.

Benefit cost ratio

The benefit cost ratio obtained was higher in treatment with 1.80, 1.92, 2.24, 1.62 and 1.17 over control of 1.44, 1.63, 1.99, 1.44 and 1.45 for the year 2014-15, 2015-16, 2016-17, 2017-18 and 2018-19, respectively. The mean benefit cost ratio was 1.86 as against 1.59 of control over the five years. With the obtained additional benefit of using stem application technology realised a total monitory benefit of Rs. 95,200/-, 1,46,000/-, 1,19,000/- and 17,960/- for the year 2014-15, 2015-16, 2016-17, 2017-18 and 2018-19, respectively. The overall cumulative benefit of Rs. 6,49,300/- was obtained in an area of 20.0 ha over five years (Table 2).

However there is a shortage of reports on technology assessment of stem application taking in a large scale at farmer's field. The results of present investigations were in agreement with earlier research field studies as reported by Kumar *et al* (2012) for the effective control of sucking pests of cotton with neo-nicotinoids. The efficacy of stem application also reported on other crops such as beetelvine for the control of sesbania stem borer, *Azygophleps scalaris* (Gangadar *et al*, 2002), in okra for sucking pest complex (Kiranmai *et al*, 2002), coffee for scale, *Coccus viridis* and on forest trees for borers.

CONCLUSION

The stem application of Imidacloprid with improved application tools was proved to be effective and economic when practiced in a larger area in the farmer's field. There is a scope to further improve the efficacy of stem application by investigating the technology with new chemicals and also to make more economic by inventing new application tools. As this technology was reported for its efficacy in controlling sucking pests on other crops, it can be extended to such other crops with necessary modifications.

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