J. Cotton Res. Dev. **31** (2) 317-321 (July, 2017) **ISSN No. 0972-8619**

Effect of different bollworm management practices on sucking insect pests population of cotton

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ABSTRACT: Different bollworm management practices *viz.*, sowing dates, spacing, *neem* spray, *Trichogramma chilonis* Ishii release, intercropping with sesame and need based insecticides application (NBIA) were evaluated alone and in combinations to assess their effect on population of sucking insect pests, namely, leafhopper (*Amrasca bigutulla bigutulla* Ishida), whitefly (*Bemisia tabaci* Gennadius) and aphid (*Aphis gossypii* Glover) of cotton. Pooled mean of the data indicated that the population of leafhopper and whitefly was lower in timely sown crop as compared to the early and late sown crop, but did not differ significantly under different spacings. On the other hand, aphid population was lower in early sown crop and also in wider spaced crop under late sown conditions. Weekly releases of *T. chilonis*, spraying of *neem*, and intercropping with sesame resulted in significantly lower population of leafhopper (0.66, 0.67 and 0.68 nymph/leaf, respectively) as compared to chemical insecticides spray (0.86 nymph/leaf). The population in these treatments was found to be statistically *on a par* with other treatments including control. Treatment involving chemical insecticides spray was equally effective as that having a combination of all other practices including chemicals. It was important to note that *neem* sprayed plots as well as control (unsprayed) plots recorded significantly lower population of whitefly (0.85 and 0.97 adult/leaf, respectively) as compared to those having spray of chemical insecticides (1.91 adults/leaf). These plots were even better than those plots where various management practices were used collectively. Thus, chemical insecticides spray resulted in significantly higher population of whitefly compared to other treatments. Though, the use of chemical insecticide proved better in checking the aphid population, but it resulted in higher population build up of leafhopper and whitefly in particular.

Key words:, Cotton, *neem*, pest management, sucking pests

A number of integrated pest management practices have been evaluated and recommended by different workers for the management of bollworms in cotton. These include need based application of chemical insecticides; spraying of *neem* based insecticides; release of *Trichogramma chilonis* Ishii; intercropping; date of sowing and a combination of these and other practices. However, their role in suppressing the populations of sucking insects has not been studied comprehensively. Because of broad spectrum nature of various chemical insecticides, their adverse effect on natural enemies is most likely to occur which may, sometimes, result in pest resurgence or secondary pest outbreaks. It has been observed that some of the pests such as whitefly (*Bemisia tabaci* Genn.) appear in greater numbers after the spraying of chemical insecticides. Therefore, it was thought desirable to evaluate the effect of different bollworm management practices against the sucking pests of cotton such as whitefly, leafhopper (*Amrasca biguttula biguttula* Ishida) and aphid (*Aphis gossypii* Glover).

The cotton variety H1117 was sown on three different dates *i.e.* 12th April (early), 29th April (timely) and 27th May (late) keeping a spacing of 67.5 and 30 cm between the rows and plants, respectively. Different management practices *viz.*, date of sowing, spacings, intercropping cotton with sesame, *Trichogramma chilonis* release, *neem* spray, spray of chemical insecticides and combinations of various practices (Table 1.), were evaluated in plots of 48 m^2 (7.8 x 6.1 m) size in randomized block design keeping three replications for each treatment. The insecticides used in different sprays were deltamethrin (Decis) 2.8 EC @ 0.5 l, triazophos (Trikon) 40 EC @ 1.5 l, profenofos (Profex) 50 EC @ 2.0 l, carbaryl (Sevin) 50 WP @ 2.0 kg and *neem* (Azadirachtin) 0.15 EC @ 0.5 l/ha. Nymphal population of leafhopper and adult population of whitefly were recorded on under surface of three fully expanded leaves in the upper canopy from each of 10 randomly selected plants in a plot.

First three observations were recorded at weekly interval starting from first week of August and the remaining observations at fortnightly interval. One time observation on nymphal population of whitefly was also recorded using dissecting microscope. Three fortnightly observations on aphid population were recorded on 4 cm^2 area of each of three leaves of randomly selected plant starting from middle of September. Pooled mean was calculated based on seven observations on leafhopper as well as whitefly population and three observations on aphid

Table 1. Management practices evaluated under different sowing and spacing regimes

Treatment	Description
Early sown crop	**(12th April)**
T_1	Need based insecticides application (NBIA)
T_2	Control
Timely sown crop	**(29th April)**
T_3	*Trichogramma chilonis* release @ 1.5 lac at weekly interval starting from middle of August to early October
T_4	*Neem* spray at weekly interval starting from middle of August to early October
T_5	*T. chilonis* release and *neem* spray on alternate week
T_6	Need based insecticides application (NBIA)
T_7	Intercropping with sesame
T_8	Intercropping + NBIA
T_9	Intercropping + *T. chilonis* release and *neem* spray on alternate week
T_{10}	Intercropping + first two weekly spray of *neem* + NBIA + *T. chilonis* release after 10 days of spray
T_{11}	Control
Late sown crop	**(27th May)**
T_{12}	NBIA
T_{13}	Intercropping + first two weekly spray of neem + NBIA + *T. chilonis* release after 10 days of spray
T_{14}	Control
Late sown with wider spacing (1 m x 30 cm)	**(27th May)**
T_{15}	NBIA
T_{16}	Control

population.

Leafhopper: The population of leafhopper remained low throughout the season and it did not reach economic threshold (*i.e.* 2 nymphs/leaf), probably due to high temperature (Av. 39.2^0 C) and less relative humidity (Av. 69%). Selvaraj *et al.,* (2011) also reported that maximum population build up was at temperature from 21^0 to 31^0 C and relative humidity from 82 to 55 per cent.

Pooled mean of leafhopper population revealed that the overall population of leafhopper was higher in late sown crop, followed by early sown and normal sown crop (Table 2.) Under timely sown conditions, the population of leafhopper was significantly higher (0.86 nymph/leaf) in (T_6) as compared to T_3 where weekly release of *Trichogramma* were made (0.66 nymph/leaf), T_4 having *neem* spray (0.67 nymph/leaf) and T_7 having intercropping with sesame (0.68 nymph/leaf). However, leafhopper population in T_6 was statistically *on a par* with other treatments including control. Other workers have also reported that application of bicontrol agent proved effective (Ahmad *et al.,* 2011) and *neem* leaf extract and NSKE were the most effective in reducing jassid (*Amrasca bigutulla bigutulla*) population (Borker *et al.,* 2012). Cotton intercropped with sesame also recorded lower population of sucking pests compared to that sole crop (Kadam *et al.,* (2014).

Whitefly : Whitefly population during the season also remained very low and it did not reach economic threshold (*i.e.* 6-8 adults/leaf) throughout the season probably due to unfavourable environmental conditions *i.e.* high temperature (Av. 39.2^0) and low relative humidity (Av. 69%). As reported by Selvaraj and Ramesh (2012), maximum population build up of whitefly was observed at temperature range from 26^0 to 35^0 C and relative humidity from 67 to 84 per cent. Sitaramaraju *et al.,* (2010) also reported that whitefly incidence was negatively correlated with maximum temperature and positively correlated with relative humidity. Whitefly population was higher in early sown and late sown crop as compared to the timely sown crop. The population did not differ significantly between different spacings. Similarly, Patel *et al.,* (2015) also reported the cotton sown at wider spacing recorded lower activity of aphid, leafhopper and whitefly.

Under timely sown conditions, treatment with weekly spray of *neem* resulted in significantly lower population (0.85 adults/leaf), as compared to other treatments, except and the control where it was found *on a par*. Other workers have also reported that the application of *neem* products proved effective in reducing the population of sucking pests (Vinodhini and Malaikozhundan, 2011 and Borker *et al.,* 2012). The whitefly population was the highest (1.91 adults/leaf) in (T_6) as compared to control. (T_{10}) The population of whitefly was significantly higher (1.47 adults/leaf) as compared to control (0.97 adults/leaf) but it was found *on a par* with treatment T_7, T_8 and T_9.

Under late sown conditions, the population of whitefly adults was significantly higher (1.73 adults/leaf) in chemical insecticides treated plots as compared to control (1.49 adults/leaf) and the plots where all the management practices were included (1.46 adults/leaf). Higher whitefly population in insecticides treated plots could probably be due to killing of natural enemies of whitefly. Other workers have also reported that eco friendly module promote the activity of natural enemies (Pandher and Singh, 2012).

Almost similar trend was observed in

Table 2. Effect of different bollworm management practices on population of sucking pests of cotton

Treatment	Pooled mean of sucking insect pests population/leaf			
	Leafhopper (Nymph)	Whitefly (Adult)	Whitefly*(Nymph)	Aphid
Early sown crop				
T_1 (Need Based Insecticidal Application) (NBIA)	0.91^{bc**}	1.55^{de**}	60.89^{k**}	5.65^{a**}
T_2 (Control)	0.82^{a}	1.70^{de}	3.44^{a}	10.84^{d}
Timely sown crop				
T_3 (*T. chilonis*)	0.66^{a}	1.09^{b}	25.00^{fg}	14.79^{fg}
T_4 (*Neem*)	0.67^{a}	0.85^{a}	10.00^{d}	16.23^{h}
T_5 (*Neem*+ *T. chilonis*)	0.76^{ab}	1.01^{ab}	9.11^{c}	14.23^{f}
T_6 (NBIA)	0.86^{b}	1.91^{e}	32.89^{i}	12.09^{e}
T_7 (Intercropping with Sesame)	0.68^{a}	1.14^{bc}	5.11^{b}	14.42^{fg}
T_8 (Intercropping +NBIA)	0.81^{ab}	1.37^{cd}	23.89^{f}	9.67^{c}
T_9 (Intercropping+*Neem*+*T. chilonis*)	0.69^{ab}	1.13^{bc}	24.67^{fg}	11.95^{e}
T_{10} (Intercropping+*Neem*+NBIA+*T. chilonis*)	0.71^{ab}	1.47^{cd}	30.89^{h}	8.30^{b}
T_{11} (Control)	0.71^{ab}	0.97^{ab}	12.11^{e}	15.25^{g}
Late sown crop				
T_{12} (NBIA)	1.08^{c}	1.73^{e}	57.00^{j}	15.01^{g}
T_{13} (Intercropping+*Neem*+NBIA+*T. chilonis*)	1.11^{c}	1.46^{cd}	25.66^{g}	8.93b^{c}
T_{14} (Control)	1.11^{c}	1.49^{d}	11.33^{de}	18.53^{i}
Late sown with wider spacing				
T_{15} (NBIA)	1.01^{bc}	1.27^{c}	68.22^{l}	6.07^{a}
T_{16} (Control)	0.97^{bc}	1.43^{cd}	8.00^{c}	14.81^{fg}
C.D. (p=0.05)	0.17	0.21	1.36	0.74

* Nymphal population per 10 leaves

** DMRT (Duncan's multiple range test): Figures with the same letter(s) do not differ significantly

case of nymphal population of whitefly as in the case of adult population. Lower nymphal population was recorded in early sown crop as compared to timely and late sown crop. Under late sown conditions, the population of whitefly nymphs was significantly lower in crop sown with wider spacing as compared to that sown with normal spacing. The pooled mean of whitefly nymphs indicated that the plots intercropped with sesame recorded significantly lower population (5.11 nymphs/10 leaves) as compared to other treatments including control. The (T_5) recorded significantly lower population as compared to T_3, T_4, T_9 and T_{10}. The population was found significantly higher (32.89 nymphs/10 leaves) in (T_6) as compared to control (12.11 nymphs/10 leaves) and other treatments. Under late sown conditions, significantly higher populations (57 nymphs/10 leaves) was recorded in (T_{12}) as compared to T_{13} where all the management practices were included (25.6 nymphs/10 leaves) and the control T_{14} (11.33 nymphs/10 leaves).

Aphid : The population of aphid was higher in late sown crop, followed by timely sown and early sown crops. Under late sown conditions, crop sown with normal spacing recorded higher population of aphid as compared to that with wider spacing. However, other workers reported that cotton sown at wider spacing recorded lower activity of aphid (Patel *et al.,* 2015).

The pooled mean of the data indicated that under timely sown conditions, the population of aphid did not differ significantly in (T_3), (T_5) and (T_7). But the plots in which

intercropping was followed by *neem* spray and release of *Trichogramma* on alternate week, recorded significantly lower population of aphid than in plots where these practices were used alone. This showed an additive effect of various non-insecticidal management practices on aphid population. T_{10} recorded significantly lower population (8.30 aphids/4 cm^2 leaf area) as compared to (T_6) (12.09 aphids/4 cm^2 leaf area) and (T_8) (9.67 aphids/4 cm^2 leaf area). Luo *et al.,* (2014) also reported that reduced insecticides sprays abundance of natural enemies increased which prevent the outbreak of aphid. Under late sown conditions, the treatment in which all the management practices were included recorded significantly lower population of aphid as compared to control.

The overall comparison of the impact of various management practices revealed that the non chemical practices, particularly *neem* spray proved better against sucking pests of cotton like leafhopper and whitefly. The combination of these practices showed the additive effect in controlling the aphid also. The chemical insecticidal application alone resulted in higher population build up of leafhopper and whitefly but in combination with other practices kept the sucking pests population under check.

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Received for publication : March 21, 2015
Accepted for publication : December 19, 2016