Available online at www.elixirpublishers.com (Elixir International Journal)

Agriculture

Elixir Agriculture 87 (2015) 35840-35842

ISSN: 2229-712X

Impact of intercropping on sucking pests and their natural enemies in Bt cotton

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ARTICLE INFO

Article history:

Received: 14 August 2015;

Received in revised form:

15 October 2015;

Accepted: 21 October 2015;

Keywords

Intercrop,

Sucking pests,

Natural enemies,

Bt cotton.

ABSTRACT

A field experiment was conducted during *Kharif*, 2013-14 at Main Agricultural Research Station to study the impact of intercropping on sucking pests and their natural enemies in Bt cotton. The results showed that the sucking pests were significantly lower on cotton under intercropping system than sole crop. Among the different intercrops, cotton intercropped with cowpea (1:2) was the best intercropping system which recorded less incidence of leafhopper (2.75/3 leaves), thrips (4.66/leaves) and whitefly (1.03/3 leaves) with more number of natural enemies followed by the cotton intercropped with coriander (1:2) and greengram (1:2). However, cotton + beans was significantly superior in recording the highest total yield (20.46 q/ha) followed by cotton + okra (16.86 q/ha) and cotton + cowpea (16.42 q/ha).

Introduction

Cotton (*Gossypium* spp.) popularly known as "the white gold", is an important commercial fibre crop grown under diverse agro-climatic conditions around the world. Gujarat stands first in production followed by Maharashtra and Andra Pradesh. India now produces 375.00 lakh bales of cotton from 115.53 lakh ha area with productivity of 552.00 kg/ha. In Karnataka, the area under cotton cultivation is 4.85 lakh ha with production of 15 lakh bales with an average productivity of 526.00 kg/ha during 2013 (Anon., 2013). Cotton was attacked by the so many pests, among sucking pest play an important role in reducing the yield. Use of insecticides to manage these pests is not a permanent solution. In recent years intercropping is one of the important tool for the management of sucking pests.

Intercropping can also interfere with the population development, spread and survival of insect pests, because companion crops block their dispersal across the field and it may be more difficult for them to locate and remain in microhabitats which affect their rapid development (Altieri, 1987). Intercropping of cotton with other crops also affects the population of pests by encouraging natural enemies. Crops like cowpea, okra, corn, marigold, greengram and castor can be used to increase the efficiency of natural enemies in cotton (Singh *et al.*, 1993). Cotton based intercropping system was one of the IPM tools to reduce the sucking pests in Bt cotton. In view of this, the present study was under taken to know the influence of intercrops in Bt cotton in reduction of sucking pests.

Materials and method

A field experiment was conducted during *Kharif*, 2013-14 to study the impact of intercropping on sucking pests and their natural enemies in Bt cotton. The experiment was laid out in Randomized Block Design (RBD) 7 treatments having different intercrops and replicated thrice with at Main Agricultural Research Station, Dharwad. The crop was sown on 27th of June during 2013 using RCH -2 Bt genotypes. The treatments comprised of six intercrops *viz.*, cotton + okra, cotton + coriander, cotton + beans, cotton + cowpea, cotton + greengram and cotton + soyabean along with sole cotton crop (Table 1). The crop was raised following the recommended agronomic practices except plant protection.

For assessing the comparative performance of different intercrops for their reaction to observations on thrips, leafhoppers, aphids, whiteflies and mirid bugs and natural enemies viz., coccinellids, *Chrysoperla* and spiders were recorded at 15 days intervals from 30 to 90 days after sowing on randomly selected 5 plants on cotton per treatment avoiding border row plants. Sucking pests were recorded on 3 leaves/plant by selecting top, middle and bottom leaves while the natural enemies were recorded per plant. The average values of sucking pests natural enemies were worked out from the data collected at 30, 45, 60, 75 and 90 day after sowing.

Before picking of seed cotton, number of good opened bolls (GOBs) and bad opened bolls (BOBs) were recorded from 5 randomly selected plants. The averages of GOBs and BOBs were worked out per plant. The intercrop yield was recorded and converted into cotton equivalent yield (CYE) and the formula for calculation for convertion of intercrop yield is given below.

$$\text{CEY (kg/ha)} = \text{Cotton yield (kg/ha)} + \frac{\text{Yield of intercrop (kg/ha)} \times \text{Price of intercrop (Rs/kg)}}{\text{Price of cotton (Rs/Kg)}}$$

The data collected on the population of sucking pests and natural enemies were subjected to ANOVA test after $\sqrt{x+0.5}$ transformations. The seed cotton harvested from each plot was presented and converted on hectare basis including intercrop yield and yield data were subjected to statistical analysis.

Results and discussion

Sucking pests

Leafhopper population was significantly lower on cotton under intercropping system than on sole crop. Cotton intercropped with cowpea recorded the lowest leafhopper population (2.75/3 leaves) followed by greengram (2.89 /3 leaves) and okra (2.85 /3 leaves). Aphid population in cotton + coriander (3.96 aphids /3 leaves) was significantly low followed by cotton + greengram (5.05 aphids /3 leaves) which was on par with cotton + cowpea (5.19 /3 leaves). Cotton intercropped with cowpea (8.57/3 leaves) was superior in recording less thrips population which was followed by coriander (9.36 thrips /3 leaves), beans (12.10 thrips /3 leaves) and okra (12.53 thrips /3 leaves).

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Table 1. Impact of intercropping on sucking pests and their natural enemies (Pooled data during 2013-14*)

	Number of sucking pests/ 3 leaves*				Number of natural enemies/ plant		
Treatments	**Leafhopper**	**Aphids**	**Thrips**	**Whiteflies**	**Coccinellids**	**Chrysoperla**	**Spiders**
T_1- Sole cotton	4.46 (2.23)^{b}	9.27 (3.13)^{d}	17.26 (4.21)^{d}	3.96 (2.11)^{d}	0.35 (0.91)	0.22 (0.47)^{c}	0.28 (0.62)
T_2- Cotton + cowpea(1:2)	2.75 (1.80)^{a}	5.19 (2.39)^{b}	8.57 (3.01)^{a}	1.78 (1.51)^{a}	0.40 (0.95)	0.38 (0.62)^{a}	0.12 (0.79)
T_3- Cotton + greengram(1:2)	2.89 (1.84)^{a}	5.05 (2.35)^{b}	11.16 (3.42)^{bc}	2.36 (1.69)^{ab}	0.27 (0.88)	0.15 (0.39)^{d}	0.15 (0.81)
T_4- Cotton + soybean(1:2)	3.94 (2.11)^{b}	6.49 (2.64)^{c}	12.52 (3.61)^{c}	2.89 (1.84)^{bc}	0.15 (0.80)	0.25 (0.50)^{c}	0.14 (0.80)
T_5- Cotton + okra(1:1)	2.85 (1.83)^{a}	6.99 (2.74)^{c}	12.53 (3.61)^{c}	2.81 (1.82)^{bc}	0.40 (0.95)	0.35 (0.59)^{b}	0.27 (0.88)
T_6- Cotton + coriander(1:2)	4.12 (2.15)^{b}	3.96 (2.11)^{a}	9.63 (3.18)^{ab}	2.43 (1.71)^{b}	0.11 (0.78)	0.17 (0.41)^{c}	0.12 (0.79)
T_7- Cotton + beans(1:2)	3.83 (2.08)^{b}	6.16 (2.58)^{c}	12.1 (3.55)^{c}	3.25 (1.94)^{cd}	0.19 (0.83)	0.07 (0.26)^{e}	0.14 (0.80)
S. Em±	0.05	0.05	0.08	0.06	0.06	0.03	0.06
CD (0.05)	0.15	0.15	0.24	0.19	NS	0.11	NS
CV	5.80	5.31	7.16	8.02	8.02	9.16	12.14

* Average values of the observation recorded at 30, 45, 60, 75 and 90 days after sowing

NS – Non - significant.

Figures in the parenthesis are $\sqrt{x+0.5}$ transformed values.

Means followed by same letter do not differ significantly by DMRT (P = 0.05)

Table 2. Impact of intercrops on yield, yield attributes in Bt cotton against sucking pests

Treatments	GOB/ plant	BOB/ plant	Cotton yield (q /ha)	Intercrop yield (q /ha)	Equivalent yield (q /ha)	Cotton equivalent Yield (q /ha)
T_1- Sole cotton	21.67	18.70	12.91	-	-	12.91^{e}
T_2- Cotton + cowpea(1:2)	33.00	18.33	15.14	1.96	1.28	16.42^{b}
T_3- Cotton + greengram(1:2)	26.40	17.24	14.92	1.10	1.06	15.98^{c}
T_4- Cotton + soybean(1:2)	24.23	20.30	13.92	1.29	1.18	15.10^{d}
T_5- Cotton + okra(1:1)	22.97	19.30	13.77	6.41	3.09	16.86^{b}
T_6- Cotton + coriander(1:2)	24.33	19.60	14.74	0.86	0.93	15.67^{c}
T_7- Cotton + beans(1:2)	22.13	21.00	14.51	12.35	5.95	20.46^{a}
S. Em±	0.69	0.34	0.17	-	-	0.28
CD	1.51	0.73	0.37	-	-	0.62
CV	17.04	9.42	5.49	-	-	8.59

GOB – Good opened bolls BOB – Bad opened bolls

Means followed by same letter do not differ significantly by DMRT (P = 0.05)

Cotton intercropped with cowpea recorded the significantly less population of whitefly (1.78/3 leaves) which was followed by coriander (2.43 /3 leaves), greengram (2.36 /3 leaves), okra (2.81 /3 leaves), soybean (2.89/3 leaves) and beans (3.25 /3 leaves).

The present findings are in agreement with Mallapur *et al.* (2004) who observed that desi (diploid) cotton intercropped with sesamum, greengram and okra had significantly lower number of leafhoppers. Rafee (2010) recorded that cotton with cowpea, sorghum and okra reduced the population of leafhopper in *G. arboreum* and *G. herbaceum* and who observed that cotton + okra and cotton + cowpea intercropping systems were equally effective in interfering with breeding and colonization of thrips on the cotton. Okra and cowpea had favourable influence to lower thrips activity.Mote *et al.* (2001), Godhani *et al.* (2008) and Sree Rekha and Dhuruva (2009) reinforce the favorable effect created by coriander intercropping on aphid suppression on cotton. Mallapur *et al.*, (2004) and Rafee (2010) reported that intercropping of okra and coriander with desi (diploid) cotton restricting aphid build up on AK–235 and Jayadhar cultivars in Karnataka.

Patel *et al.* (2012) who observed that population of whitefly (*Bemisia tabaci* Gen) was suppressed significantly in cotton plots interspersed with maize @ 10 per cent and cowpea sown in between two rows of cotton. Enhancement of arthropod natural enemies of cotton pests *viz;* chrysopids, coccinellids, geocoris bug and spiders due to habitat manipulation might suppressed the whitefly.

Natural enemies

There was no significant difference among different intercropping systems in recording coccinellids. However the chrysoperla population was more on cotton intercropped with cowpea followed by okra and soybean. The present findings are lined with Hedge (1997) recorded significantly high population of *C. carnea* on cotton intercropped with lucerne, cowpea and groundnut. According to Rajput and Daware (2002), enhanced activity of *C. carnea* was observed on cotton intercropped with cowpea and sorghum than setaria. Cotton intercropped with lucerne, cowpea, sorghum, groundnut, and chilli and with coriander, okra, jowar and maize recorded significantly higher number of *C. carnea* eggs (Hegde *et al.*, 2004). Cotton intercropped with different component crops did not influence the spiders activity.

Yield parameter and seed cotton yield

Significantly highest number of good opened bolls was recorded in cotton intercropped with cowpea (33.00 /plant) followed intercropped with greengram (26.40 /plant) than in the other intercropping systems (Table 2).

Minimum bad boll opening was noticed in cotton intercropped with greengram (17.24 /plant) which was followed by cowpea intercropping system (18.33 /plant) and sole cotton (18.70 /plant). Cotton intercropped with cowpea was

significantly superior by recording 15.14 q/ha seed cotton which was on par with cotton + greengram (14.92 q/ha). These intercropping systems recorded significantly higher seed cotton than others.

Equivalent yield computed for various intercropping system and it revealed that beans contributed maximum of 5.95 q/ha which recorded the highest cotton equivalent yield (20.46 q/ha) followed by cotton + okra (16.86 q/ha) which was on par with cotton + cowpea (16.42 q/ha).

Similar documentation of higher seed cotton yield and cotton equivalent yield in cotton intercropping with cowpea have been made by Mallapur *et al.* (2004). Whereas Patel *et al.* (2012) reported higher seed cotton yield obtained from cotton interspersed with maize and cowpea sown in between two rows of cotton. Even though these findings are in agreement with the present study, cotton based intercropping with beans recorded significantly highest cotton equivalent yield might be due to highest remuneration as a vegetable.

In conclusion, cumulative effect of intercropping systems was reflected in suppression of sucking pests, increased good boll opening, reduction in bad boll opening and ultimately increasing the cotton equivalent yield and enhancement of biotic potential of natural enemies for effective suppression of pests in cotton.

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