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Impact of strip crops on the population of arthropod predators and insect-pests in cotton*

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ABSTRACT: **Three strip crops, namely, maize, sorghum and cowpea were evaluated for their role in the enhancement of arthropod predators and reduction in pest populations in cotton and were compared with a control (cotton alone). Populations of arthropod predators such as spiders, coccinellids, green lacewing and rove beetles as well as insect-pests such as leafhopper, whitefly and aphid were recorded on cotton. Boll infestation due to spotted bollworm and pink bollworm was determined in opened cotton bolls at harvest. Among different strip crops, maize supported the highest number of predators (16.06 per 10 plants) as compared to control (10.73). Cotton stripcropped with sorghum (16.74) and maize (14.68) recorded the higher number of predators per 10 plants over control (10.23). Leafhopper population was significantly low in all the treatments as compared to control. Pink bollworm incidence was significantly low in cotton stripcropped with maize (17.4%) as compared to control (27.23%). However, different treatments had no significant effect on aphid, whitefly and spotted bollworm incidence.**

KEY WORDS: Arthropod predators, cotton, insect-pests, strip crops

Cotton is an important cash crop of Haryana. Major insect pests including *Earias insulana* (Boisduval), *E. vittella* (Fabricius), *Pectinophora gossypiella* (Saunders), *Helicoverpa armigera* (Hübner), *Amrasca biguttula* (Ishida) and *Bemisia tabaci* (Gennadius), have been reported to cause an annual loss of 50 to 60 per cent to the total production in India (AICCIP, 1989). Due to intensive application of insecticides for controlling these pests, natural enemy fauna have suffered heavily in many of the cotton growing areas (Singh, 1999). Growing strip crops along with cotton provide refuge to the natural enemies in times of pest scarcity as well as insecticidal pressure (Parajulee and Slosser, 1999). In the present study, effect of strip crops grown along with cotton, on the build-up of populations of arthropod predators and insect-pests in cotton was studied under agroclimatic conditions of Hisar, Haryana.

MATERIALS AND METHODS

The present study was conducted during 2001 at the Research Area of Department of Entomology, CCS Haryana Agricultural University, Hisar. The experiment consisted of growing four rows of strip crops, namely, maize (var. HHM-2), sorghum (var. HC-117) and cowpea (var. CS-88) on both sides of a 50 sq. m. cotton (HS-6) plot replicated four times in a Randomized Block Design. The sowing of cotton was done on May 11 while that of strip crops on June 26. A control consisting of four rows of

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cotton grown on both sides of a cotton plot was maintained as above. Each plot in the experiment was separated by two buffer rows of non-experimental cotton. Recommended cultural practices were followed in raising the main crop as well as strip crops.

Weekly counts of leafhopper and aphid nymphs, and whitefly adults were made on three leaves per plant, one each from upper, middle and lower canopy of 10 randomly selected plants in each plot, from July to October. Incidence of bollworms was recorded at harvest by examining all opened cotton bolls from 10 randomly selected plants per plot. Arthropod predators were counted on cotton as well as strip crops at weekly interval. On cotton, predators were sampled by beat-bucket method developed by Knutson and Wilson (1999) whereas on strip crops these were visually observed on top 20-25 cm of the plant. Predator species collected in different strip crops and cotton were categorized into different groups and the values in percentages were changed into angular transformation while that in numbers into $\sqrt{n+1}$ transformation in case of population numbers. The data were subjected to analysis of variance (ANOVA).

RESULTS AND DISCUSSION

Four groups of arthropod predators a) spiders: *Oxyopes shweta* Tikader, *Oxyopes pandae* Tikader, *Phidippus punjabensis* Tikader, *Cheiracanthium sadanai* Tikader, *Neoscona theis* Walckenaer, *Neoscona mukerjei* Tikader and *Thomisus* sp.; b) coccinellids: *Coccinella septempunctata* Linnaeus, *Cheilomenes sexmaculata* (Fabricius) and *Scymnus nubilis* (Mulsant); c) green lacewing, *Chrysoperla carnea* (Stephens) and d) rove beetle, *Paederus fuscipes* Curtis were recorded from the strip crops as well as cotton. Comparison of predator population on different strip crops indicated that maize (16.06) supported the greater number of predators per 10 plants as compared to control (10.73). The predator numbers did not vary significantly between sorghum (12.64), cowpea (12.37) and the control (Table 1). Among different predators, spider population was significantly higher in maize (5.45) than any other strip crop while coccinellids were in significantly higher numbers in cowpea (5.38) as well as in maize (5.3) as compared to other treatments. Likewise, maize (4.08) and sorghum

Table 1. Population of different arthropod predators in strip crops alone and stripcropped cotton

Strip crop	Average number of arthropod predators/ 10 plants									
	Strip crop					Cotton				
	Spiders	Cocci-nellids	Green lacewings	Rove beetles	Total predators	Spiders	Coccine-llids	Green lace-wings	Rove beetles	Total predators
Maize	5.45 (2.53)	5.30 (2.50)	4.08 (2.25)	1.23 (1.49)	16.06 (4.13)	5.18 (2.48)	6.01 (2.64)	2.49 (1.86)	1.01 (1.41)	14.68 (3.96)
Sorghum	4.31 (2.30)	3.76 (2.18)	3.45 (2.10)	1.12 (1.45)	12.64 (3.67)	4.87 (2.42)	8.07 (3.01)	2.77 (1.99)	1.03 (1.42)	16.74 (4.19)
Cowpea	4.20 (2.28)	5.38 (2.52)	1.76 (1.66)	1.03 (1.42)	12.37 (3.63)	2.41 (1.84)	6.93 (2.81)	2.42 (1.84)	1.01 (1.41)	12.77 (3.69)
Control	4.18 (2.27)	3.20 (2.04)	2.25 (1.80)	1.10 (1.44)	10.73 (3.63)	3.18 (2.04)	4.23 (2.28)	1.77 (1.66)	1.02 (1.42)	10.23 (3.34)
CD (P=0.05)	(0.13)	(0.14)	(0.29)	(0.01)	(0.48)	(0.30)	(0.18)	(0.14)	NS	(0.55)

Figures in parentheses are $\sqrt{n+1}$-transformed values.

(3.45) supported significantly greater number of green lacewing than other treatments. Rove beetle population was higher in maize (1.23) as compared to all other treatments. Greater survival of natural enemies in the above crops has been highlighted by several workers. Plewka and Pankanin-Franczyk (1989) reported that maize plants harboured large number of the natural enemies like coccinellids, chrysopids, syrphids and braconid parasitoids. Furthermore, maize plants have been reported to provide pollen as food and shelter to arthropod predators (Dong, 1984). Similarly, sorghum crop has been observed to act as a bio-reservoir for the development of spider colony (Duffield, 1995) while cowpea helped in the colonization of coccinellids in cotton-cowpea polyculture (Natarajan and Seshadri, 1988).

The predator population was significantly higher in cotton plots stripcropped with sorghum (16.74) and maize (14.68) as compared to the control (10.23). The predator numbers did not vary significantly between cotton plots stripcropped with cowpea (12.77) and the control. Among different predators, population of spiders was significantly higher in cotton stripcropped with maize (5.18/10 plants) and sorghum (4.87/10 plants) than other treatments. Stripcropping cotton with sorghum (8.07/10 plants), maize (6.01/10 plants) and cowpea (6.93/10 plants) significantly increased the population of coccinellids on cotton as compared to control (4.23/10 plants). The green lacewing population on cotton stripcropped with different crops (2.42 to 2.77/10 plants) was significantly higher as compared to control (1.77/10 plants). Rove beetle population on cotton did not vary significantly among different treatments. These findings are in agreement with the findings of other workers who have reported that intercropping/ stripcropping maize; sorghum and cowpea in cotton increased the population of arthropod predators in the main crop (Natarajan & Seshadri, 1988; Rajput and Daware, 2002).

The data on effect of different strip crops on pest population is given in Table 2. It was observed that the enhanced population of predators on cotton stripcropped with different crops had a marked effect on the population of leafhoppers. As compared to a significantly higher population of leafhoppers (22.55 nymphs/ 3 leaves) in the control, population was 10.52, 10.74 and 10.81 nymphs/3 leaves on cotton stripcropped with maize, sorghum and cowpea, respectively (Table 2). Different strip crops had no significant effect on the aphid and whitefly population on the main cotton crop in

Table 2. Population of sucking insect-pests and bollworms infestation in stripcropped cotton

Strip crop	Mean population* / three leaves			Per cent** bolls infested	
	Leafhopper	Aphid	Whitefly	Spotted bollworm	Pink bollworm
Maize	10.52 (3.30)	10.33 (3.36)	10.64 (3.41)	5.06 (12.92)	17.40 (22.65)
Sorghum	10.74 (3.34)	10.91 (3.40)	10.76 (3.42)	5.93 (13.06)	23.02 (28.66)
Cowpea	10.81 (3.33)	10.00 (3.41)	11.41 (3.50)	6.89 (15.12)	22.60 (27.93)
Control	22.55 (4.75)	12.12 (3.62)	12.86 (3.70)	7.13 (15.45)	27.23 (31.27)
CD (P=0.05)	(0.82)	NS	NS	NS	(5.01)

Figures in parentheses are *$\sqrt{n+1}$ and **angular transformed values.

comparison to the control. The infestation of cotton bolls by pink bollworm was significantly low (17.4%) in cotton stripcropped with maize as compared to other treatments. It did not vary significantly between cotton plots stripcropped with sorghum (23.02%), cowpea (22.60%) and the control (27.23%). No effect of any treatment was observed on the incidence of spotted bollworm, which ranged from 5.06 to 7.13 per cent.

As evident from the above studies, low population of different insect-pests in cotton stripcropped with maize, sorghum and cowpea was probably due to higher number of arthropod predators, which might have resulted in the higher mortality of different insect-pests. Singh and Singh (1978) suggested that stripcrops/intercrops affected the microclimate of the crop making it unfavourable for the build-up of insect-pests. Further, taller intercrops/stripcrops have been observed to check the dispersal of flying insect-pests of shorter crops, thus preventing migration towards the main crop (Leon *et al.*, 1997). Other studies have also exhibited that planting stripcrops/intercrops in cotton suppressed the populations of insect-pests (Natarajan & Seshadri, 1988; Parajulee & Slosser, 1999).

Thus, it may be concluded that growing of strip crops such as maize, sorghum and cowpea in cotton may help in enhancing the population of arthropod predators and in reducing the insect-pest population in cotton. It may also help in minimising the insecticide use in this crop. Strip crops may act as a refuge for the adult arthropod predators, which can migrate, to the cotton crop once insecticide residues are reduced. Thus, growing strip crops may be useful in managing cotton insect-pests both in pesticide sprayed as well as in organic cotton production systems.

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