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Intercropping impact on population of cotton sucking insect pests

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ABSTRACT

The cotton intercropping experiment was conducted for the management of sucking pests, viz. leafhopper, *Amrasca biguttula biguttula* Ishida (Hemiptera: Cicadellidae); whitefly, *Bemisia tabaci* Gennadius (Hemiptera: Aleyrodidae) and thrips, *Thrips tabaci* Linderman (Thysanoptera: Thripidae) in *desi* cotton, *Gossypium arborium.* The results of the study revealed that less mean population of leafhopper nymphs, whitefly and thrips adults was recorded from the treatments T_7 (2.47, 2.61 and 2.10/leaf, respectively) and T_8 (2.49, 2.52 and 2.25/leaf, respectively) where pearl millet (*Pennisetum glaucum* L.) and sorghum (*Sorghum bicolor* L.) crops grown as border crops around cotton, respectively. Cotton as sole crop (T_9) recorded the highest mean population of leafhopper nymphs, whitefly and thrips adults i.e. 3.54, 3.97, 3.59/leaf, respectively. However, the maximum net returns was recorded in cotton intercropped with sesame 1:1 (T_1: 104140 ₹/ha) whereas minimum net returns was recorded in sole cotton (T_9: 80021 ₹/ha).

Keywords: Cultural control, Cotton, Economics, IPM, Sucking pests

Cotton, *Gossypium* spp. is one of the commercially important fiber crops in the world grown as an annual crop in both tropical and temperate regions (Ozyigit *et al.* 2007). It also known as queen of fibers, contributing up to 75% of total raw material needs of textile industry. India ranks first in area (11.55 million hectares) and second in production (37.10 million bales) next to China (Anonymous 2018). However, there are several constraints for low yields of cotton but the losses due to insect pests are the foremost. There are several insect pests associated with cotton crop but the sucking pests, viz. leafhopper (*Amrasca biguttula biguttula* Ishida), whitefly (*Bemisia tabaci* Gennadius) and thrips (*Thrips tabaci* Linderman) are the most important and theysuck the phloem sap from the crop resulting in the reduction of plant vigour and consequently yield in almost all cotton growing areas of India (Bennett *et al.* 2004). To control these pests, farmers still rely on chemical pesticides for their management. But a number of environmental, health and other hazards are associated with their uses. In order to prevent the farmers from falling into pesticide treadmill, the usages of intercropping and border cropping as an Integrated Pest Management (IPM) strategy was envisaged. Intercropping system is primarily used to change the biodiversity of pests and beneficial on the main crop. The intercropping leads to a change in crop canopies and bring about a resultant change in climate at the micro level (Prasad and Kumar 2002). In addition, it is also elucidated that in intercropping system the increasing diversity in the crop field attract predators and parasitoids and they directly kill the insect pests of the main crop and help in the reduction of uses of insecticides which is harmful to ecological framework. Therefore, it was considered worthwhile to evaluate eco-friendly practices to explore the possibility of providing comparable pest management in agriculturally important crops.

MATERIALS AND METHODS

The study was carried out at experimental farm of CCS Haryana Agricultural University, Hisar, India, during 2016–17 and 2017–18. Cotton variety, HD-432 was sown on 14th and 11th May during 2016–17 and 2017–18, respectively. For the experiment, intercrops, viz. Sesame (*Sesamum indicum* L.; Variety: HT-1), Pigeonpea (*Cajanus cajan* L.; Variety: Paras), and border crops, viz. Sorghum (*Sorghum bicolor* L.; Variety: HC-171) and Pearl millet (*Pennisetum glaucum* L.; Variety: HHB-67i) were taken. All intercrops and border crops were sown on1st fortnight of July in both years of study. The plot size (22.65 m^2) of six rows of cotton with a spacing of 67.5 cm between the rows and 30 cm between the plants. There were nine treatments and replicated three times in randomized block design.

Observationsof leafhopper nymphs, whitefly and thrips adults were recorded from three leaves, each one from top, middle and bottom canopies on six randomly selected plants per plot. The population of sucking pests were recorded

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Table 1 Intercropping impact on population of leafhopper nymphs, adults of whitefly and thrips in cotton (Pooled mean of both the years during 2016 and 2017)

Treatment	Mean of leafhopper nymphs/leaf	Mean of whitefly adults/leaf	Mean of thrips adults/leaf
Cotton+Sesame 1:1 (T_1)	2.96 (1.93)**b	3.26 (2.01)**c	2.92 (1.89)**b
Cotton+Sesame 2:1 (T_2)	2.97 (1.93)b	3.61 (2.08)c	3.24 (1.97)c
Cotton+Sesame 3:1 (T_3)	3.10 (1.96)c	3.66 (2.10)d	3.22 (1.96)c
Cotton+Pigeonpea 1:1 (T_4)	2.85 (1.89)b	2.93 (1.93)b	2.76 (1.84)b
Cotton+Pigeonpea 2:1 (T_5)	2.87 (1.90)*b	3.29 (2.02)c	2.93 (1.89)b
Cotton+Pigeonpea 3:1 (T_6)	3.02 (1.94)b	3.44 (2.04)c	3.02 (1.90)b
Cotton+ Pearl millet (border crop) (T_7)	2.47 (1.81)a	2.61 (1.85)a	2.10 (1.69)a
Cotton+ Sorghum (border crop) (T_8)	2.49 (1.81)a	2.52 (1.83)a	2.25 (1.73)a
Sole Cotton (T_9)	3.54 (2.06)d	3.97 (2.16)e	3.59 (2.03)d
SE± (m)	(0.02)	(0.03)	(0.03)
CD at 5%	(0.05)	(0.07)	(0.09)

* Figures in parentheses are square root transformed values.

** Means in column with the same letter are not significantly different at 0.05 levels (DMRT test)

on the lower side of leaves by gently turning the leaf in the morning hours and with the help of magnifying glass wherever required (Kalkal *et al.* 2015). Observations were recorded at 10 days intervals starting from 10 days after sowing of crop. Plant height (cm), number of bolls and boll weight (g) of six tagged cotton plants in the three middle rows of each plot were recorded.The yield of intercrops was recorded from all rows in each plot after crop harvest. All the opened bolls of each plot were plucked and seed cotton was removed and weighed at each picking.The data was transformed and analysed using ANNOVA and DMRT (Duncan's multiple range test) with SPSS 19 software.

RESULTS AND DISCUSSION

Average leafhopper, whitefly and thrips population in cotton crop varied significantly among various treatments. The lowest mean population of leafhopper nymphs were recorded from treatment having pearl millet as border crop (T_7: 2.47/leaf) and it was at par with treatment having sorghum as border crop (T_8: 2.49/plant) (Table 1). The intercropped treatments from T_1 to T_8 recorded lower population than T_9 (sole cotton). From the present study it was found that pearl millet and sorghum as border crops reduced the incidence of leafhopper nymphs in cotton. The taller border crops might have helped to check the dispersal of flying insect pests of shorter crops. The present findings support the reports of Kranthi and Russell (2009) that lady beetles and lacewings as important predators attracted in cotton intercropped with pulse crops which helped in reduction of sucking pests in cotton agro-system.

The results of intercropping on whitefly adults population showed that the lowest mean whitefly's adults population in cotton was recorded from treatment having

Table 2 Intercropping impact on yield and economics of cotton (Pooled mean of 2016 and 2017)

Treatment	Plant height/ plant	Number of bolls/plant	Weight of bolls/plant (g)	Yield of seed cotton (Kg/ ha)	Yield of intercrops (Kg/ha)	Net returns (₹/ha)
Cotton+Sesame 1:1 (T_1)	179 (13.41)*	74.50 (8.66)	193.2 (13.93)	1660 (40.75)	312	104140
Cotton+Sesame 2:1 (T_2)	186 (13.67)	80.50 (9.00)	205.2 (14.35)	1544 (39.30)	242	94110
Cotton+Sesame 3:1 (T_3)	206 (14.38)	81.50 (9.07)	217.2 (14.75)	1466 (38.29)	177	89590
Cotton+Pigeonpea 1:1 (T_4)	175 (13.29)	74.00 (8.64)	195.7 (14.00)	1242 (35.25)	765	96500
Cotton+Pigeonpea 2:1 (T_5)	207 (14.44)	60.83 (7.84)	234.7 (15.28)	1393 (36.07)	612	97115
Cotton+Pigeonpea 3:1 (T_6)	198 (14.10)	77.33 (8.84)	231.5 (15.18)	1223 (34.00)	420	87700
Cotton+ Pearl millet (border crop) (T_7)	207 (14.42)	77.67 (8.86)	213.5 (14.60)	1476 (38.10)	900	84795
Cotton+ Sorghum (border crop) (T_8)	206 (14.38)	81.17 (9.06)	236.2 (15.35)	1542 (39.28)	721	87875
Sole Cotton (T_9)	210 (14.50)	82.67 (9.13)	244.0 (15.64)	1754 (45.20)		80021
SE± (m)	(0.02)	(0.61)	(0.45)	(0.02)		
CD at 5%	(0.06)	(0.21)	(NS**)	(0.06)		

* Figures in parentheses are square root transformed values.

** NS: Non Significant

sorghum as border crop (T_8: 2.52/leaf) and pearl millet as border crop (T_7: 2.61/leaf) than sole crop (T_9: 3.97/leaf) (Table 1). Thus sorghum and pearl millet played a pivotal role in reduction of whitefly's population by checking the movement of whitefly to the main crop. This might be due to sorghum acted as a barrier crop for dispersion of whitefly when cotton crop is bordered by sorghum (Kavitha *et al.* 2003). The second best treatment and third best treatment was the treatment having pigeonpea as intercrop in ratio 1:1 (T_4: 2.93/leaf) and having sesame as intercrop in ratio of 1:1 (T_1: 3.26/leaf), respectively. The present finding are in agreement with the findings of the Balakrishnan *et al.* (2010) who reported that intercropped cotton with pigeonpea suppressed the incidence of sucking pests over sole crop.

The results of intercropping on thrips adult population showed that the lowest mean population of thrips adults was recorded from treatment having pearl millet as border crop (T_7: 2.10 /leaf) (Table 1). Thus pearl millet and sorghum border cropping in cotton proved best, and pigeonpea and sesame intercropping proved better for controlling the population of thrips. Cotton intercropping with sorghum reduced the incidence of thrips also noticed by Rafee (2010). The present finding is in the conformity with the finding of Godhani (2006) and Kadam *et al.* (2014) also concluded that lower incidence of thrips was found in cotton intercropped with sesame over sole cotton. The results of intercropping on the yield parameters and economics of cotton showed that maximum yield of seed cotton was recorded in T_9 (1754 kg/ha) and minimum yield of seed cotton was recorded in T_6 (1223 kg/ha) (Table 2). Whereas maximum net returns were recorded in T_1 (₹ 104140/ha) and minimum net returns was recorded in T_9 (₹ 80021/ha). The present results are in corroboration with Vekariya *et al.* (2015) who reported higher monetary net returns (₹ 20744/ ha) in intercropping of cotton with sesame over sole cotton (₹ 15389/ha). This is because of additional yield obtained from the intercrop along with main crop.

It is concluded from the aforesaid study that sorghum and pearl millet border cropping proved best for controlling the sucking insect pests in cotton. Crop diversification helped in reducing the insect pest population. As intercrops and border crops are nonchemical method, safe to environment, no resurgence problem and no residue in food, and helped to reducing the population of insect-pest, cost of cultivation, and further, addition income in the field.Thus, the adoption will be beneficial for the upliftment of farmers, their socio-economic conditions and consequently the government exchequer.

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