Research Article

Influence of Trap Crops on Management of Insect Pests by Exploitation of Heteropteran Predatory Bugs in Cotton

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Abstract | The influence of mix cropping on the population of sucking insect pests and their heteropteran predatory bugs was determined in cotton crop. Millet, maize and sunflower were grown as trap crops in cotton (cv CRIS-342) croping the experimental area of Entomology section, Agriculture Research Institute, Tandojam during 2011 and 2012. There was significant effect of trap crops on population reduction of jassid, thrips and white flyin cotton intercropped with millet, maize and sunflower. The minimum population of jassid (0.89), whitefly (0.36) and thrips (6.20) was recorded on cotton intercropped with maize. The maximum population of predator, *Orius sp* was recorded on cotton intercropped with maize as (2.29) and (2.36), *Zanchius sp* (0.86) and (0.93) and *Geocoris ochropterus* (Fieber 1844) (0.57) and (0.66) predators per plant during 2011 and 2012, respectively. The studies indicated that on average maize intercropped with cotton as trap crop resulted in the lowest density of jassid, thrips and whitefly and the higher population of predators, *G. ochropterus*, *Orius spp.* and *Zanchius sp*. per plant.

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Introduction

Cotton, *Gossypium hirsutum* (L.) is one of the important cash crops of Pakistan and the source of raw materials to the textile industry. It enables the textile industry to survive and expand its base. During 2017-18, cotton production stood at 11.935 million bales and recorded growth of 11.8 percent over the production of 10.671 million bales during same period last year. The cotton crop shares 1.0 percent in GDP and contributes 5.5 % to agriculture value addition (Pakistan 2017-18). Cotton is leading the world in natural fiber production. The global textile industry mainly is based on cotton fiber and this crop is also a major source of edible oil production (Abid, Ashfaq, Hassan and Fatima, 2011). Cotton is infested by a wide range of sucking and chewing pests. Among sucking insect pests i.e. *Bemisia tabaci* (Genn.), *Aphis gossypii* (Glover), *Thrips tabaci* (Lind.) and *Amrasca bigutullabigu tulla* (Ishida) are very important. The loss caused by the insect pests is reported to be 40 to 50% by (Ali and Aheer, 2007), while (Aslam, Razaq, Shah, and Ahmad, 2004) found 20-40% losses annually. In case of serious damage, drooping and wilting of leaves also occur (Abro, Syed, Tunio, and Khuhro, 2004).

Natural enemies especially predatory insects play a significant role in the reduction of many soft bod-

ied sucking pests and larvae of bollworms. Among those, heteropteran predators hold key importance (Naranjo, 2001) and have been used successfully for the management of insect pests on cotton (Stinner, 1977). Among major heteropteran predators include Big-eyed bugs *(Geocoris sp)*, Assassin bug (*Zelusrenardii Kolenati),* Minute pirate bug (*Orius tristicolor),* big eyed bug *(Geocoris bullatus* (Say) and *G. uliginosus* (Say). *Geocoris* spp. has been reported to be widely used to prevent many pest outbreaks in many agricultural and other natural habitats (Crocker and Whitcomb, 1980).

Oriusins sp (Say) was the dominant predator on cotton crops and proved to be the most important mortality factor of *Helicoverpazea* (Boddie) eggs in Texas (Sansone and Smith Jr, 2001). Also, *Orius spp*. was the most abundant predators consisting 69.5% of the predator numbers on non-chemically treated cotton (Greenberg, Liu, and Adamczyk, 2009). Big eyed bug, *Geocoris sp* is another most abundant and important predator of many insect species in cotton crop and feeds on all life stages of whiteflies, thrips, aphids, jassid and eggs of the bollworms. Both the immature and adults feed by sucking juices from their prey through a "needle-like" beak. Adult and immature can consume dozens of eggs, larvae and adults of *Heliothiszea* per day (Tillman and Mullinix Jr, 2003).

The growers mostly rely upon on chemical measures to manage the population of insect pests of cotton. However, continuous and injudicious use of chemicals resulted in environmental pollution, development of resistance in insect pests, brought many non-target and minor pests to the status of serious pests of cotton (Ali, 1992), decline in the population of many beneficial fauna including predators and pollinators and create many human health hazardous problems (Gupta, Katiyar, Sharma and Sharma, 1999); (Singh and Kumar, 2003).

Among the alternate control measures, trap crops in cotton field play an important role in the management of insect pests as they can attract or repel pests according to their characteristics (Ahmad and Aboud, 2001). In cotton, trap crops are mostly planted either within rows or around the borders of main cotton field. Moreover, cultivation of trap crops can enhance the population of natural enemies along with conservation of soil and its environment (Vaiyapuri, Amanullah, Pazhanivelan, and Somasundaram, 2007). (Loya-Ramirez, Garcia-Hernandez, Ellington and Thompson, 2003) showed that the interplanted: canola (*Brassica napus* L.), alfalfa (*Medicago sativa* L.), hairy vetch (*Vicia villosa* Roth) and sainfoin (*Onobrychis viciifolia* Scop) supported high populations of heteropteran predators accompanied by a significant migration toward the intercropped cotton. In particular, *Geocoris spp.* attained highest densities on hairy vetch that increased towards the end of the crop season. On the same plant, *Nabis spp*. was initially favored, but densities were higher in alfalfa and sanfoin. On alfalfa, *Orius spp*. had the highest density during the whole season. In comparison, treated cotton attained the lowest number of predators. Plantings of *Sorghum bicolor* beside cotton crops effectively favored the abundance of heteropteran predators and timely emigration to the cotton crops (Fye, 1971). This approach was further explored by (Prasifka, Krauter, Heinz, Sansone and Minzenmayer, 1999). Marigold, cowpeas, sun hemp and sesamum are some of the trap crops used in cotton (Boucher and Durgy, 2003); (Vaiyapuri et al., 2007).

Considering the importance of cotton crop to Pakistan's economy and role of pests and other related factors towards cotton yield, study was conducted with the objective to explore the role of trap crops (maize, millet and sunflower) within cotton rows (cv. CRIS 342) in term of population density of heteropteranpredatory bugs and insect pests. The result obtained from this study could be helpful to manage the population of noxious insect pests of cotton with eco-friendly control measures to increase cotton productivity.

Materials and Methods

The influence of trap crops on the population of sucking insedct pests and their predatory bugs was evaluated. Three trap crops i.e., millet, maize and sunflower were planted in rows in main cotton crop. Cotton variety CRIS-342 was planted in a randomized complete block design with six replications. The sub plot size was 8m × 10m, and total experimental area was 2040^2 m. The experiment was conducted atthe Entomology section, Agriculture Research Institute, Tandojam. The cotton crop was sown on April10, 2011 and April 14, 2012 on same area. The trap crops were grown in 2 rows per treatment in the center of main cotton crop in each treatment excluding control (without trap crop). All standard cultural practices i.e.; fertilizers,

interculturing and irrigation were adopted from germination till harvest. There were four treatments as.

- T1 = Cotton + Millet
- T2 = Cotton + Maize
- T3 = Cotton + Sunflower
- T4 = Cotton alone

The observations on population of cotton sucking pests and their predatory bugs were taken from five randomly selectedplants per treatment. Three leaves, one each from top, middle and bottom were randomly selected. The populationof predators was recorded from 15 plants selected at random per treatment and both adult and nymphal population of predators was recorded from mid June through mid-September. Samples were frozen and later sorted in the laboratory. The observations were taken on fortnightly basis from sowing till harvesting of cotton crop.

Data so collected were analyzed statistically using Mstat software and the means were compared by DMR Test at P = 0.05.

Results and Discussion

The results shown in Table 1 revealed that during 2011 and 2012, maize intercropping with cotton resulted in significantly the lowest infestation of jassid, *Amrasca bigutulla bigutulla* (0.96 and 0.89/leaf), thrips (7.44 and 6.20/leaf) and whitefly, *Bemisia tabaci* (0.42 and 0.36/leaf), and higher population of *Geocoris sp* (0.57 and 0.66/leaf), *Orius* (2.29 and 2.36/leaf), *Zanchius sp* (0.86 and 0.93/plant), respectively (Table 2).The pest poplation on cotton intercropped withmillet and sunflower as trap crop ranked second and third, respectively for all the above insect pests.The predator populations were also higherin cotton intercropped withmillet and sunflower; while cotton sown as sole crop suffered with highest infestation of jassid,*Amrasca bigutulla bigutulla* (2.61 and 2.24/leaf), thrips (11.95 and 10.01/leaf), whitefly *Bemisia tabaci* (0.89 and 0.72/leaf) during 2011 and 2012, respectively (Table 1). Maize was preferred host ofjassid, *Amrasca bigutulla bigutulla,* whitefly, *Bemisia tabaci* and thrip sand reduced the pest stress on main cotton crop; whereas, sunflower and millet sheltered natural enemies which kept the pests of cotton below than cotton alone. The trap crops with cotton reduced the pressure of pests on cotton when compared with cotton alone. The present findings are in conformity with those of Ahmad and Abboud (2001) who reported that using trap crops and varietal resistance on the basis of gossypol and nectariless in plants were long lasting and by these methods trap crops play significant role in management of sucking insect pests in cottonand they could attract or play role as repellentfor the insect pests on the basis of specific plant characteristics. Similarly (Vaiyapuri et al., 2007) reported that the success of trap crop was mainly depending on ability of attractingmore insects than the main cotton crop and might improve natural enemy's population by conserving soil and environment. The present findings can also be compared with those of (Loya-Ramirez et al., 2003) who cultivated canola, alfalfa, hairy vetch and sanfoinas alternate rows in cotton fields and reported that heteropteran predator's population was significantly increased by migration to intercrops in cotton. The results of present studies agree with those of Abro et al. (2004) who reported that mono crop (Cotton) received maximum fluctuation in comparison to mixed cropping of cotton and okra.

Table 1: *Influence of trap crops in cotton on the population of sucking insect pests during 2011 and 2012.*

Treatments	Jassid		Whitefly		Thrips	
	2011	2012	2011	2012	2011	2012
Millet + Cotton	1.33 c	1.16 c	0.52 c	0.41 c	8.53 c	7.22 c
Maize + Cotton	0.96 d	0.89 d	0.42 c	0.36 c	7.44 c	6.20 c
Sunflower + Cotton	1.67 b	1.47 b	0.67 b	0.52 b	10.15 b	8.49 b
Cotton alone	2.61 a	2.24 a	0.89 a	0.72 a	11.95 a	10.01 a

Means sharing similar letters in coloums are not significantly different at P: 0.05.

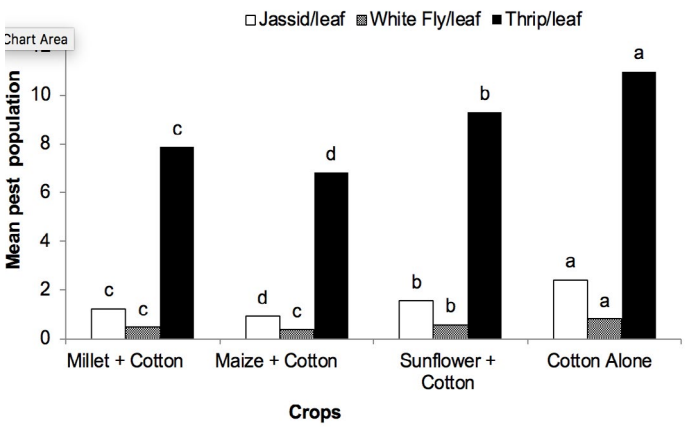

Figure 1: *Average population of sucking insect pests per leaf for both years in various trap cropping schemes.*

In the present study maize crop was found to be more useful as compared to millet and sunflower and these findings are in agreement with (Vaiyapuri et al., 2007) who reported that intercropped maize remained highly beneficial followed by cow peas, sesame and sun hemp. The present findings are in line with those of (Kopta, Pokluda and Psota, 2012) who found that *A. graveolens, C. officinalis, C. cyanus*, *F. vulgare* and *F. esculentum* were most effective to attract beneficial insects and population on these plantation comprised of hoverflies and ladybeetles followed by predatory bugs and ichneumon wasps. The present study further showed that overall conclusions of trap crops with cotton as main crop reduced the pressure of pests on cotton crop and increased the population of natural enemies.

Table 2: *Influence of trap crops in cotton on the population of herteropteran predatory bugs during 2011 and 2012.*

Crop	*Oriuss p*		*Zanchius sp*		*Geocoris sp*	
	2011	2012	2011	2012	2011	2012
Millet + Cotton	1.87 b	1.97 b	0.62 b	0.70 b	0.40 b	0.48 b
Maize + Cotton	2.29 a	2.36 a	0.86 a	0.93 a	0.57 a	0.66 a
Sunflower + Cotton	1.47 c	1.54 c	0.50 b	0.59 b	0.36 bc	0.45 c
Cotton alone	0.74 d	0.85 d	0.31 c	0.40 c	0.25 c	0.33 d

Means sharing similar letters in coloums are not significantly different at P: 0.05.

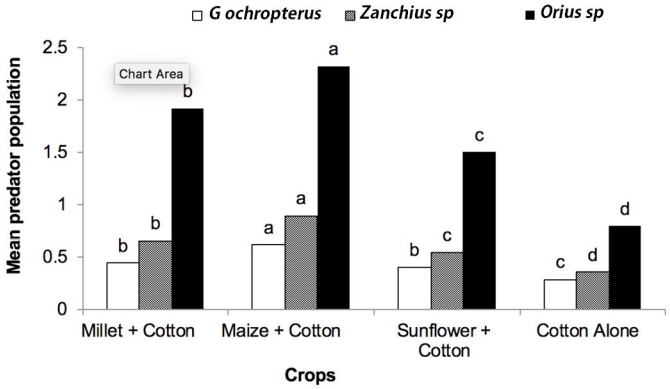

Figure 2: *Average population of heteropteran predatory bugs per plant for both years in various trap cropping schemes.*

Conclusions

The present study concluded that *Orius* population on cotton CRIS-342 was highest when intercropped with maize, followed by millet and sunflower intercrop *Geocoris* population was highest when maize was intercropped in cotton, followed by use of millet and sunflower as trap crops and the average *Geocoris* population on cotton increased considerably with intercropping practice of maize, millet and sunflower. Trap crops remained beneficial for predatory bug's population compared to cotton grown as sole crop and the population of predators was the highest under cotton-maize, followed by cotton-millet and cotton-sunflower combinations.

Author's Contribution

Saima Siddiqui: Conducted experiment, collected data and wrote paper.
Ghulam Hussain Abro: Conceived the idea and analyzed the data.
Tajwer Sultana Syed: Provided technical input and improved manuscript.
Abdul Sattar Buriro: Overall discussed and checked the manuscript.

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