Research Paper :

Habitat management of borers in corn

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SUMMARY

An attempt has been made to study the effect of finger millet and marigold as trap crop in maize. Finger millet can be used as a trap crop to manage *S.inferens* and marigold could be used as trap crop for *H.armigera* in corn. It is necessary to spray the trap crops with insecticides to prevent the spread of the insect pests to the main crop thereby reducing the insecticide load on the environment. Trap crops also encourage the abundance and activity of natural enemies. These pull strategies will help the farmers by not only reducing the insect damage but also by providing additional income.

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Corn is one of the important cereal crops for food, nutritional security and farm economy. In the end of manuscript and source of basic raw material for various industries *viz*., starch, food sweetners, bio-fuel, cosmetics etc.

Corn is infested by about 139 insect pests and only a dozen of these are quite serious and require control measures (Siddiqui and Marwaha, 1993). Of the different insects, stalk/ stem borers are the principal pests in all the top 25 corn growing countries of the world. Losses due to *Sesamia inferens* during winter varied from 25.7 to 78.9% (Chatterji *et al.* 1969). Godbole (1983) reported that Endosulfan 0.1% spray at 10 days after germination followed by Endosulfan 4 G in whorl @ 5kg/ha was effective in reducing the borer infestation.

Though cob damage due to *Helicoverpa armigera* has been reported but decrease in grain yield is only a minor one (Darvas *et al.*, 2011). Keszthelyi *et al.* (2011) reported 14.03 per cent weight loss in grains and 13.74 per cent weight loss in cobs of sweet corn. Loss of corn due to *H.armigera* has been estimated to be 262 kg/ha and if larvae damage early silks, pollination will be reduced resulting in even greater yield reductions. In most years, it is a case of forsaking the top of cob to larval damage (Anonymous,2010).

In recent years, habitat management techniques, which aim at increasing plant biodiversity through intercropping and mixed cropping, have gained increased attention in stemborer management. Plants emitting semiochemicals and those which are attractive for egg laying by stemborer moths were selected and employed as trap crops (pull) to draw pests away from the main crop (Khan *et al.*, 2010). Several reports on utilisation of Napier grass in push-pull strategy against stem borer in corn are available and effectiveness of marigold as trap crop has been studied in tomato, pigeonpea and cotton.

So far no report is available regarding the use of fingermillet and marigold in corn therefore in the light of this background, an attempt has been made to study the influence of fingermillet and marigold as trap crops in corn.

MATERIALS AND METHODS

Field experiments were conducted for two seasons during winter 2009 and 2010 at Maize Research Centre, Rajendranagar, Hyderabad utilizing HQPM-1 (Single cross quality protein corn hybrid developed from HAU, Karnal in 2006).Plot size was 6m x 6m. Corn was sown on ridges at a spacing of 75 cn x 20 cm. Two rows of trap crop were planted

around the plot. The experiments were laid out in Randomized Block Design with 4 treatments and 5 replications. Data were subjected to two-way ANOVA after arc-sin transformation for per cent values.

Stem borer:

Treatments are as follows:

T_1: Corn with finger millet(*Eleusine coracana*) as trap crop. (VR-847 developed at ANGRAU)

T_2: Corn with napier millet as trap crop (APBN-1 developed at ANGRAU in 1997 is a cross between napier grass(*Pennisetm purpureum)* and pearl millet (*P. americanum)* to reduce oxalate content and also the side effects of spines in napier grass)

T_3:Sole corn sprayed with Endosulfan 35 EC @ 2 ml/l at 12 days after germination (ANGRAU recommendation for stem borer control)

T_4: Sole corn(control)

Stem cuttings of napier millet were planted at 60 cm x 60 cm one month before sowing of corn. Transplanting of 20 day old seedlings of finger millet was done at a spacing of 15 cm x 10 cm at the time of sowing corn. Data on per cent infestation, dead hearts and leaf injury were recorded.

Cob borer:

The treatments consisted follows:

T_1: Corn with marigold(*Tagetes patula*) as trap crop (African marigold), 15-20 days old seedlings were transplanted at a spacing of 45 cm at the time of sowing corn so that flowering of marigold coincided with silking of corn)

T_2: Corn sprayed with chlorantriniliprole 20SC @ 150 ml/ha at 60 days after sowing.

T_3: Corn with soil application of carbofuran 3G @20 kg/ha at 60 days after sowing.

T_4: Sole corn (control)

Data on per cent cob borer infestation was recorded.

RESULTS AND DISCUSSION

The results obtained from the present investigation are summarized below :

Stem borer (*Sesamia inferens*):

The stem borer population was higher in 2010 compared to 2009.

Leaf injury:

Plants with Leaf injury rating of 2 - 8 (shot holes, midrib tunneling) were categorized as leaf injured plants. Significant differences were found among all the treatments (Table 1). Corn sprayed with Endosulfan had 3.07% plants with leaf injury followed by finger millet (3.33%) and Napier millet (3.96%) as trap crops. Control plot (7.74%) had highest plants with leaf injury. In 2010 also, similar trend was noticed with 5.3% plants with leaf injury in insecticide treated plot compared to 5.9% in finger millet and 7.3% in Napier millet. Two years pooled data showed that corn treated with Endosulfan recorded lowest *i.e.* 4.19% plants with leaf injury followed by corn with finger millet (4.62%) and Napier millet (5.63%) as trap crops. Control plot had significantly highest (9.83%) plants with leaf injury.

Dead hearts:

During 2009, dead heart formation was least in corn with finger millet as trap (0.42%) which was significantly not different from corn with Napier as trap (0.44). Endosulfan treated plot had 0.86% dead hearts which clearly shows the effectiveness of trap crops. During 2010 also trap crops proved effective than chemical treatment

Table 1: Effect of trapcropping on stemborer, *S .inferens* infestation in corn

Treatments	% Corn Plants with leaf injry			Dead heart% in corn			Total Infestation% in corn			Dead heart% in trap		
	2009	2010	Pooled	2009	2010	Pooled	2009	2010	Pooled	2009	2010	Pooled
T_1-Corn+Napier	3.96	7.3	5.63	0.44	4.92	2.68	4.36	12.24	8.3	13.0	26.8	19.9
millet	(11.48)	(15.67)	(13.57)	(3.8)	(12.81)	(8.29)	(12.05)	(20.48)	(16.26)			
T_2-Corn+	3.33	5.9	4.62	0.42	4.52	2.47	3.78	10.4	7.09	20.5	37.93	29.22
Fingermillet	(10.51)	(14.06)	(12.29)	(3.68)	(12.27)	(7.97)	(11.21)	(18.81)	(15.01)			
T_3-Corn sprayed with	3.07	5.3	4.19	0.86	6.1	3.48	3.92	11.4	7.66	--	--	--
Endoslfan	(10.09)	(13.31)	(11.7)	(5.31)	(14.3)	(9.8)	(11.42)	(19.73)	(15.57)			
T_4-Control	7.74	11.92	9.83	1.42	8.56	4.99	9.18	20.48	14.83	--	--	--
	(16.15)	(20.2)	(18.17)	(6.83)	(17.01)	(11.92)	(17.64)	(26.91)	(22.27)			
CD	0.16	0.34	0.18	0.37	0.25	0.21	0.26	0.48	0.26			

Figures in parentheses are angular transformed values

Table 2 : Comparison of trap cropping with insecticides against cob borer, *H.armigera*

Treatments		% cob borer infestation in corn			% flower infestation in marigold		
		2009	2010	Pooled	2009	2010	Mean
T_1	Corn+Marigold	0.41(3.63)	1.74 (7.57)	1.08(5.60)	1.67	1.4	1.53
T_2	Corn sprayed with Chlorantriniliprole	0.29(2.76)	0.68 (4.67)	0.49(3.71)			
T_3	Corn soil application of Carbofran	1.17(6.20)	4.94 (12.82)	3.06(9.51)			
T_4	Control	1.31(6.57)	5.78 (13.91)	3.55(10.24)			
	CD	0.95	1.02	0.66			

Figures in parentheses are angular transformed values

in reducing dead heart formation. Slight difference was noticed among the trap crops as 4.52% dead hearts in finger millet and 4.92% in Napier millet. 6.1% dead hearts were observed in Endosulfan treated plot while 8.56% were recorded in control. It is clear from the mean data that corn with finger millet as trap crop recorded 2.47% dead hearts followed by corn with napier millet (2.68%).

Total infestation:

Per cent total infestation in 2009 was least in finger millet trapped corn(3.78) and Endosulfan sprayed corn (3.92) which were at par with each other. In 2010 also, similar trend was noticed with 10.4% and 11.4%, respectively. Significantly highest infestation was observed in control during both the years (9.18% and 20.48%). Average of two years data showed that total infested corn plants per cent was lowest in corn with finger millet (7.09) as the pull crop and highest in the control (14.83) plot. Napier grass, despite its attractiveness, supported minimal survival of the pests in immature stages (Khan *et al.*, 2010). Khan *et al.*, 2008 reported that farmers in Africa rated the push-pull technology as significantly superior in reducing stem borers and increasing soil fertility and grain yields. Hari and Jindal (2009) reported that Napier is a poor larval host of *C. partellus* and there was no appreciable larval shift from Napier millet to adjoining corn.

From the two seasons data it is evident that leaf injury in both the trap crops was negligible while dead heart formation in finger millet was 29.22% compared to 19.9% in Napier millet, clearly suggesting the effectiveness of trap crops.

Cob borer (*Helicoverpa armigera*):

The cob borer population was higher in 2010 compared to 2009(Table 2). During 2009, though corn sprayed with Chlorantriniliprole had lowest cob borer infestation (0.29%) which was not significantly different from corn trap cropped with marigold (0.41%) and corn crop in which soil application of Carbofuran was done (1.17%). Control plot had highest *H.armigera* infested cobs(1.31%) which was at par with Carbofuran applied crop. In 2010 also, similar trend was observed with 0.68% cobs infested in corn sprayed with Chlorantriniliprole followed by corn with marigold as trap crop (1.74%). It is evident from the mean data that corn sprayed with Chlorantriniliprole was better with 0.49 % cob infestation followed by corn with marigold as trap crop (1.08%). Highest cob borer incidence was observed in control plot (3.55%). Control measures are generally not practiced because of high cost and difficulty in spraying associated with repeated insecticide application required during silking (Anonymous,2010). Irrespective of initial egg density on silks, population of final instar larvae per infested cob rarely exceeded unity because of the protection afforded by tight husks around cob and intraspecific competition(cannibalism) among the younger instar larvae (Twine,1975). African marigold afforded maximum reduction of both eggs and larvae of *H.armigera* in the intercropped tomato with a consequent reduction in number of bored fruits (Srinivasan *et al.*, 1994). Farmers adopt marigold as a trap crop for the gram pod borer and it reduces pest load on pigeonpea.

In marigold trap, per cent flowers infested with *H.armigera* was found to be 1.67% in 2009 while 1.4% in 2010 and on an average it was 1.53 per cent.

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