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Studies on Correlation of Pheromone Trap Catch of *Spodoptera frugiperda* (JE Smith) with Weather Parameters on Maize Crop

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ABSTRACT

FAW lures procured from AG Bio Systems Pvt. Ltd., Hyderabad (India) and placed in sleeve pheromone traps were installed six inch above the crop canopy. To evaluate the efficacy of pheromone traps with different weather parameters, the study was conducted on farmer's maize field with five treatments viz., 5, 10 and 15 traps per acre along with recommended package (RPP) for FAW management (spraying of emamectin benzoate 5 SG @ 0.3 g/l and chloranitraniliprole 18.5 SC @ 0.2 ml/l at 30 and 50 days of sowing) with one untreated control and the treatments were replicated four times. Studies on correlation and regression analysis between 5 traps per acre and weather parameters revealed negative non-significant relationship with maximum temperature (r = -0.154) and rainfall (r = - 0.188). Among weather parameters, viz., maximum temperature (r = - 0.134) and rainfall (r = - 0.097) registered negative relationship with10 traps per acre. Whereas, same trend was noticed with 15 traps per acre which exhibited negative non-significant association with maximum temperature (r = -0.129) and rainfall (r = -0.033). However, remaining weather parameters showed positive non-significant correlation with different trap density level treatments.

Keywords Zea mays, Weather parameter, Fall armyworm, Pheromone traps, Lures, Rainfall, Temperature, Emamectin benzoate, Chlorantraniliprole.

INTRODUCTION

Corn (*Zea mays* L.) is one of the most commonly used crops in the world, second only to wheat and rice, due to its many uses, including human food, animal feed, biofuel and construction (Abebe and Feyisa 2017). Therefore, maize is known to have the potential to reduce food insecurity and improve livelihoods. Currently, it is used as a biofuel, renewable energy which helps to mitigate climate change effect, thereby increasing crop productions.

Maize (*Zea mays* L.) is most important and world's leading cereal crop, widely cultivated grain it was adapted in Central America. It is one of the newest crops with wide adaptability. Corn belongs to the Maydeae grass family. "Zea" is derived from

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the ancient Greek name for grass.

All over the world, maize is known as the king of grains due to its superior genetic quality (Jeyraman 2017). Corn is the only food that can be grown in different seasons and in different ecological conditions, and it is used in human consumption, as food for cattle and poultry, starch, glucose, corn syrup, corn oil, in various industries.

The fall armyworm is a major defoliator pest on maize, sorghum, sugarcane and other grasses and also reported from various allied host plants (about 80 species) including crops belonging to dicotyledons. The *Spodoptera frugiperda* is native to the America (Luginbill 1928) and has recently been reported in Africa (Goergen *et al.* 2016) and India. It spread quickly from West Africa across the continent, causing extensive damage to crops (Abrahams *et al.* 2017) and has subsequently spread across Asia (Kalleshwaraswamy *et al.* 2018).

MATERIALS AND METHODS

FAW lures procured from AG Bio Systems Pvt Ltd, Hyderabad (India) and placed in sleeve pheromone traps were installed six inch above the crop canopy. To evaluate the efficacy of pheromone traps, the study was conducted on farmer's maize field with five treatments viz., 5, 10 and 15 traps per acre along with recommended package (RPP) for FAW management (spraying of chloranitraniliprole 18.5 SC @ 0.2 ml/l at 30 and 50 days of sowing) with one untreated control and the treatments were replicated four times (Table 1). Different number of traps were installed at least 10 meters apart in the middle of one acre block and the pheromone lures were replaced at 15 days interval.

Table 1. Sex pheromone traps treatments details.

Sl. No.	Treatments
1	5 traps / acre
2	10 traps / acre
3	15 raps / acre
4	Recommended package of practice (RPP)
5	Untreated control

Observations on total number of moths caught in each trap were made weekly from 39th to 51st MSW. Simultaneously, counts of egg masses, pest infestation, per cent defoliation and per cent cob damage were taken randomly on 20 plants in each treatment at 15 days interval after germination. Further, the observations on number of larvae and natural enemies (predators, parasitized larvae and larval cadavers affected by diseases) on 10 randomly selected plants were recorded at every 15 days interval. The grain yield from individual treatment was recorded separately and was expressed on hectare basis.

RESULTS AND DISCUSSION

The sex pheromone traps of the fall armyworm, *S. frugiperda* with the lures placed in sleeve traps obtained from AG Bio Systems Private Limited, Hyderabad were assessed for their efficacy as mass trapping technology for moths in maize ecosystem during 2019 and 2020 by installing the traps @ 5, 10 and 15 traps per acre. Simultaneously, the field incidence of the pest in consequence of reduced moth load was also assessed and the results are presented hereunder. The data on moth catches were recorded from 30th to 51st Meteorological Standard Week (MSW) and the results revealed that the maximum moth catches were noticed during 44th MSW in 2019 (260 moths/13 traps) and 43rd MSW during 2020 (244 moths/13 traps).

Similarly in case of 25 traps/acre treatment, the highest moth catches were observed during 45th and 43rd MSW in 2019 and 2020 (342 and 385 moths/25 traps, respectively). However, the maximum moth catches of 504 and 562 moths per acre was recorded in 38 traps per hectare treatment during 2019 and 2020 at 45th and 43rd MSW, respectively (Table 2). The data on mean moth catches indicated that the number of moths caught increased gradually from 39th MSW and reached peak during 43rd MSW, irrespective of number of traps used (239.50, 341.5 and 512 moths per 13, 25 and 38 traps/ hectare treatments, respectively). Then onwards, the moth catches declined gradually in all the treatments with minimum moth catches registered during 51st MSW (5.50, 9.50 and 15.00 moths in 13, 25 and 38 traps/hectare treatments, respectively.

Table 2. Trapping of fall armyworm moths using sex pheromone traps.

MSW	Total number of moths caught								
	13 traps per hectare			25 traps per hectare			38 traps per hectare		
	2019	2020	Mean	2019	2020	Mean	2019	2020	Mean
39th	59.00	66.00	62.50	125.00	139.00	132.00	221.00	239.00	230.00
40th	121.00	128.00	124.50	222.00	264.00	243.00	363.00	418.00	390.50
41st	175.00	194.00	184.50	260.00	309.00	284.50	411.90	502.00	456.95
42nd	196.00	203.00	199.50	287.00	351.00	319.00	439.00	535.00	487.00
43rd	235.00	244.00	239.50	298.00	385.00	341.50	462.00	562.00	512.00
44th	260.00	191.00	225.50	302.00	278.00	290.00	479.00	436.00	457.50
45th	243.00	156.00	199.50	342.00	217.00	279.50	504.00	310.00	407.00
46th	181.00	103.00	142.00	283.00	147.00	215.00	432.00	207.00	319.50
47th	146.00	68.00	107.00	247.00	91.00	169.00	341.00	138.00	239.50
48th	113.00	41.00	77.00	175.00	54.00	114.50	219.00	95.00	157.00
49th	77.00	29.00	53.00	123.00	37.00	80.00	141.00	64.00	102.50
50th	40.00	19.00	29.50	78.00	28.00	53.00	90.00	43.00	66.50
51st	0.00	11.00	5.50	0.00	19.00	9.50	0.00	30.00	15.00
Average	142.23	111.77	126.88	201.31	178.38	300.92	318.31	275.31	296.81

Studies on correlation and regression analysis between 5 traps per acre and weather parameters revealed negative non-significant relationship with maximum temperature (r = -0.154) and rainfall (r = - 0.188). Among weather parameters, viz., maximum temperature (r = - 0.134) and rainfall (r = - 0.097) registered negative relationship with 10 traps per acre. Whereas, same trend was noticed with 15 traps per acre which exhibited negative non-significant association with maximum temperature (r = -0.129) and rainfall (r = -0.033). However, remaining weather parameters exhibited positive non-significant correlation with different trap density level treatments (Table 3).

Grain yield and BC ratio

The pooled data clearly indicated that T_3 treatment with 56.00 q/ha grain yield was proved as good as T_4 treatment (66.25 q/ha) but failed to differ statistically from T_2 (46.25 q/ha). With minimum yield of 30.00 q/ha, the control treatment was found to be at par with T_1 treatment. The highest benefit cost ratio was registered in T_4 treatment (3.36) and was found superior over other treatments. Next treatments to follow were 15 traps / acre (2.39), 10 traps / acre (1.91) and 5 traps / acre (1.35). The lowest benefit cost ratio of 0.90 was recorded with control treatment (Table 4).

Table 4. Effect of moth trapping on field incidence of fall armyworm in maize and its impact on grain yield (Pooled Data).

Sl. No.	Treatments	Grain yield (q/ ha)	Benefit cost ratio
1	5 traps / acre	37.75 cd	1.35
2	10 traps / acre	46.25 bc	1.91
3	15 traps / acre	56.00 ab	2.39
4	Recommended package	66.25 a	3.36
5	Untreated control	30.00 d	0.90
	SEm ±	4.53	-
	CD (p=0.05)	13.58	-
	CV (%)	15.92	-

Table 3. Correlation between FAW moth trap catches and meteorological parameters.

Treatments	Temperature (^{0}C)				Relative humidity (%)					
	Maximum		Minimum		Maximum		Minimum		Rainfall (mm)	
	R value	R^2 value	R value	R^2 value	R value	R^2 value	R value	R^2 value	R value	R^2 value
Five traps / acre	-0.154	2.40	0.186	3.40	0.096	0.90	0.121	1.50	-0.188	3.50
Ten traps / acre	-0.134	1.80	0.276	7.60	0.127	1.60	0.185	3.40	-0.097	1.00
Fifteen traps/acre	-0.129	1.70	0.325	10.50	0.138	1.90	0.232	5.40	-0.038	0.10

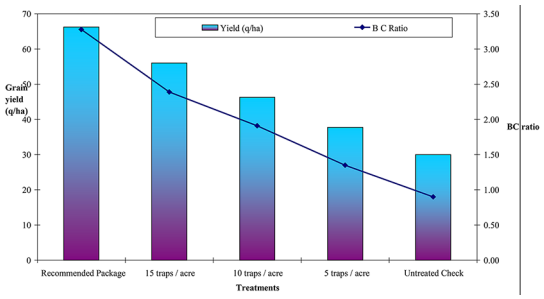

Fig. 1. Effect of moth trapping on grain yield and benefit cost ratio.

The impact of mass trapping of moths on the incidence of FAW revealed that use of 10 traps or 15 traps per acre proved as good as recommended package (spraying of emamectin benzoate 5 SG @ 0.3 g/l followed by chlorantraniliprole 18.5 SC @ 0.2 ml /l) with respect to per cent FAW infestation and rate of defoliation. All the trap installed treatments (5, 10 and 15 traps/acre) proved to be at par with recommended package in respect of cob damage by FAW while, they were as good as untreated control with respect to natural enemy activity. With regard to, installation of 15 traps per acre treatment resulted in grain yield at par with the recommended package indicating the efficiency of mass trapping of FAW moths as an effective tool in the eco friendly management of the pest in maize (Fig. 1).

Shah *et al.* (2015) reported the highest moth catches in pigeon pea crop installed with of 50 traps /ha. Sanjay *et al.* (2018) observed larval and pupal reduction which indicated that DBM population decreased with increase in trap density and they concluded that treatment with 40 traps per acre was the most effective and convenient trap density to use in an integrated management program of DBM. A recent study reported that the installation of 20 traps per acre used to attract the maximum catches of *H. armigera* moths (Madhu *et al.* 2019). Monobrullah *et al.* (2007) reported that four peaks represent the four overlapping generations of *S. litura* in Jammu, first one on 19th MSW, second on 26th MSW, third on 34th MSW and fourth on 41st MSW.

Correlation studies between trap catches and weather parameters indicated non significant negative relationship with most of the parameters. However, previous results on various other pests revealed varied type of relationship which may be due different insect species. Sagar *et al.* (2017) and Rathore *et al.* (2017) reported that the male moth population of gram pod borer had highest significant positive association with maximum and minimum temperature. The moth catches were positively correlated with maximum and minimum temperatures and negatively correlated with relative humidity (Sonkar *et al.* 2012). Kumar and Durairaj (2012) reported that the adult activity of *M. vitrata* showed positive significant correlation with maximum and minimum temperature, negative and highly significant with morning and evening relative humidity.

CONCLUSION

Mass trapping of FAW moths using sex pheromone traps revealed that although the moth catches began during 39th MSW, peak trapping was noticed on 43rd MSW in all trap density. Maximum moth trapping was observed in the block wherein 15 traps per acre were installed followed by 10 traps and 5 traps per acre treatments. Mass trapping of FAW moths using sex pheromone lures @ 10 -15 traps per acre was found quite effective in maize ecosystem. A negative correlation was revealed among total life cycle of the pest v/s average temperature and relative humidity. Grain yield obtained from treatment 15 traps per acre and was on par with the recommended package.

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