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EFFECT OF DIFFERENT TREATMENT COMBINATION ON EGG LAYING OF SHOOT FLY, *Atherigona soccata* (RONDANI) IN MAIZE CROP (*Zea mays* L.)

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ABSTRACT:

The field experiment was conducted in two consecutive year (Spring 2015 and 2016) at NawabGanj Farm of C. S. Azad University of Agriculture and Technology, Kanpur 208002 (U.P.). It is evident from the result the number of egg/plant was found lowest in 0.0 KgN/ha with lowest mean. The highest egg laying was found in 90 KgN/ha followed by 80 KgN/ha. The lowest number of egg/plant found in Imidacloprid 17.8SL. In different sixteen treatment combination (Nitrogen and Insecticide) the minimum egg laying observed in Imidacloprid 17.8SL+ 0.0 KgN/ha followed by Imidacloprid 17.8SL+ 70 KgN/ha , Imidacloprid 17.8SL+ 80 KgN/ha, Imidacloprid 17.8SL+ 90 KgN/ha.

KEYWORDS: *Egg laying, Shoot Fly, Atherigona soccata, Rondani, Maize, Zea mays.*

INTRODUCTION:

Maize or corn (*Zea mays*) belongs to the family Poaceae. It is the third most important cereal crop in India after rice and wheat. It has dual importance as food and fodder in addition to industrial uses as raw material for manufacture of many industrial products. The products include corn starch, maltodextrins, corn oil, corn syrup and products of fermentation and distillation industries. It is also being recently used as bio fuel. The maize contributes 36% (712MT) of the global grain production. The global productivity of maize is 4.92 tons/ha and productivity in USA is 10 tons/ha.

In India area, production and productivity of maize was 0.87 million hectares, 2.22 million tonnes and 2556Kg/hectare, respectively. In Uttar Pradesh it is grown in an area of 0.74 million hectare, with production 1.24 million tonnes and productivity 1671 kg/ha (Anonymous, 2013-14). Rabi maize is grown in an area of 1.2 million ha with the grain production of 5.08million tonnes with an average productivity of 4.00 qt/ha. The predominant Rabi maize growing states are Andhra Pradesh (45.5%), Bihar (20.1%), Tamil Nadu (9.3%), Karnataka(8.5%), Maharastra (7.7%) and West Bengal (5.3%) (Anonymous, 2011-12). The per hectare yield of maize has not increased despite the introduction of high yielding varieties. The major obstacle in achieving this goal is the attack/infestation of insects-pest. The most important pest insects in maize crop are maize and jowar stem borer (*Chilo partellus* Swinhoe), shoot fly,*Atherigona soccata* (Rondani), armyworm,*Mythimna separate* (Wlk.) and many species of aphid, the infestation of which ultimately results in total failure of crop (Singh & Sharma, 1984; Lisowicz, 2000).

MATERIAL AND METHODS

The present investigation was carried out at NawabGanj Farm of C. S. Azad University of Agriculture and Technology, Kanpur 208002 (U.P.) during both the *Spring* season of 2015 and 2016. The treatments consisted of combinations of different levels of Nitrogen (N) and insecticide (P) (treated or untreated). Four levels of N (0, 70, 80 and 90 KgN/ha) were combined with three number of insecticides with one level (each pesticide applied only one specific dose and concentration), giving a total of sixteen NP combinations. Total NP combination had a control plot (IFP versus ITP, where IFP is insecticide-free plot and ITP is insecticide-treated plot, NFP Vs NTP, where NFP is nitrogen free plot and NTP is nitrogen treated plot). The 16 treatment combinations were arranged in a completely randomized block design with three replications. All Plots were 6×4 m^2 each. The three blocks were established at a distance of 1.5m from each other to reduce interactions between treatments. The distance between plots within a block was 1.0 m. The data recorded during the course of investigation was subjected to statistical analysis by using analysis of variance technique (ANOVA) for Factorial Randomized Block Design (Chandel 2012).There are two factor nitrogen (N) and pesticide (P), suppose the number of level of N is m and P is n. And the number of replication is denoted by r.

Details of Factors

	Factor Level (Treatments)	Symbols
Factor A (Nitrogen Dose)		
	Control (0.00KgN/Ha)	N_1
	70.00KgN/Ha	N_2
	80.00KgN/Ha	N_3
	90.00KgN/Ha	N_4
Factor B (Insecticide)		
	Control	P_1
	Imidacloprid 17.8%SL	P_2
	Diflubenzuron 25%WP	P_3
	Quinalphos 25%EC	P_4

Treatments combination

(Factor A)		(Factor B)			
		P_1	P_2	P_3	P_4
	N_1	$P_1N_1(T_1)$	P_2 $N_1(T_2)$	P_3 $N_1(T_3)$	P_4 $N_1(T_4)$
	N_2	P_1 $N_2(T_5)$	P_2 $N_2(T_6)$	P_3 $N_2(T_7)$	P_4 $N_2(T_8)$
	N_3	P_1 $N_3(T_9)$	P_2 $N_3(T_{10})$	P_3 $N_3(T_{11})$	P_4 $N_3(T_{12})$
	N_4	P_1 $N_4(T_{13})$	P_2 $N_4(T_{14})$	P_3 $N_4(T_{15})$	P_4 $N_4(T_{16})$

Details of treatments Combination

S. No.	Symbols	Treatments combination
1	T_1	Control
2	T_2	Imidacloprid 17.8SL+ 0.0 Kg N/ha
3	T_3	Diflubenzuron 25WP+ 0.0 Kg N/ha
4	T_4	Quinalphos 25EC+ 0.0Kg N/ha
5	T_5	No insecticide+ 70 Kg N/ha
6	T_6	Imidacloprid 17.8SL+ 70 Kg N/ha
7	T_7	Diflubenzuron 25WP+ 70 Kg N/ha
8	T_8	Quinalphos 25EC+ 70 Kg N/ha
9	T_9	No insecticide+ 80 Kg N/ha
10	T_{10}	Imidacloprid 17.8SL+ 80 Kg N/ha
11	T_{11}	Diflubenzuron 25WP+ 80 Kg N/ha
12	T_{12}	Quinalphos 25EC+ 80 Kg N/ha
13	T_{13}	No insecticide+ 90 Kg N/ha
14	T_{14}	Imidacloprid 17.8SL + 90 Kg N/ha
15	T_{15}	Diflubenzuron 25WP+ 90 Kg N/ha
16	T_{16}	Quinalphos 25EC+ 90 Kg N/ha

Sr. No.	Name of Insectide	Dose (a.i.,gm/ha)
1.	Imidacloprid 17.8%SL	25
2.	Diflubenzuron 25%WP	75
3.	Quinalphos 25%EC	375

Design	Factorial RBD
Treatment combinations	16
Replication	3
Row to row distance	60 cm
Plant to plant distance	20 cm
Variety	"Azad Uttam"

Spray schedule

The treatment was imposed with knapsack sprayer using a spray fluid of 500 liter per ha. Two applications of sprays were taken at 15 and 26 DAS (Day after sowing), to compare the efficacy of treatments combinations both insecticide as well as untreated (control) was maintained.

Number of eggs per plant:

In each plot, ten plants were randomly selected to observe the number of eggs/plant. So, numbers of eggs were counted from each plant and total number of eggs on ten plants taken and averaged to represent, the eggs were present on each plant at both 11 and 21 Days after emergence.

RESULTS AND DISCUSSION:

Effect of treatments on egg laying at 11 days after emergence on *Atherigona soccata* (Rondani) in Pooled analysed of 2015 and 2016 presented in the Table- 1

It is evident from the result the number of egg/plant was found lowest in 0.0 KgN/ha with mean 1.16 followed by 1.23 in 70 KgN/ha. The highest egg laying with mean 1.52 was found in 90 KgN/ha followed by 1.43egg/plant in 80 KgN/ha.

CONCLUSION:

The results of this investigation revealed that significant differences exist among ten plus trees on the basis of phonological characters within populations. Further genetic improvement of PTs for fruit and seed characters stands a high chance. 100 fruit weight and oil percent had significant high heritability, however genetic advance also high in 100 fruit weight followed by oil percent this may indicate additive gene action. Inflorescence length had high positive significant correlation with 100 fruit weight followed by number of fruits per inflorescence with fruiting

percent in this case both inflorescence length and numbers of fruit are important traits for future selection would help to limited objective of high seed production.

Table 1- Effect of treatments on egg laying at 11 days after emergence on *Atherigona soccata* (Rondani) in 2015& 2016

Factor A (Nitrogen Doses)	Factor B (Insecticides)				Mean of Nitrogen Doses (Factor A)
	Control	Imidacloprid 17.8 SL @ 25 g.a.i./ha	Diflubenzuron 25 WP @ 75 g.a.i./ha	Quinalphos 25 EC @ 375 g.a.i/ha.	
Control(0.0KgN/Ha)	1.636(1.68)	1.101(0.21)	1.578(1.49)	1.504(1.26)	1.455(1.16)
70 Kg N/Ha	1.661(1.76)	1.130(0.28)	1.598(1.55)	1.524(1.32)	1.478(1.23)
80 Kg N/Ha	1.668(1.78)	1.401(0.96)	1.605(1.58)	1.546(1.39)	1.555(1.43)
90 Kg N/Ha	1.684(1.84)	1.463(1.14)	1.631(1.66)	1.563(1.44)	1.585(1.52)
Mean for Insecticide (Factor B)	1.662(1.77)	1.274(0.65)	1.603(1.57)	1.534(1.35)	
Factors	C.D.	SE(m)			
Factor A	0.0185	0.0064			
Factor B	0.0185	0.0064			
Interaction (A×B)	0.037	0.0128			

Note-Figures in parentheses are mean value of egg/plant of *A. soccata.* The value without parentheses shows Square Root transformed Value.

It is clear from the data that the number of egg/plant lowest in Imidacloprid 17.8SL with mean 0.65 followed by 1.35 was found in Quinalphos 25EC.The maximum egg laying was found in IFP with mean 1.77 followed by ITP with Diflubenzuron 25WP, 1.57 egg/plant.

It was determined from the table-1 in N/I combination the lowest egg laying observed in Imidacloprid 17.8SL+ 0.0 KgN/ha with mean 0.21 followed by Imidacloprid 17.8SL+ 70 KgN/ha , Imidacloprid 17.8SL+ 80 KgN/ha, Imidacloprid 17.8SL+ 90 KgN/ha with the mean of 0.28, 0.96 and 1.14 egg/plant, respectively. It is also clear by the data that highest egg laying was found 1.84 followed by 1.78, 1.76 and 1.68 in No Insecticide+ 90 KgN/ha, No Insecticide+ 80 KgN/ha, No Insecticide+ 70 KgN/ha, No Insecticide+ 0.0 KgN/ha, respectively.

Effect of treatments on egg laying at 21 days after emergence on *Atherigona soccata* (Rondani) in Pooled analysis (Table-2)

It is obvious from the data portrayed in Table-2 that highest egg laying was found in highest dose 90 KgN/ha with mean 2.39 followed by 2.26, 2.10 and 1.88 egg/plant in 80 KgN/ha, 70 KgN/ha and 0.0 KgN/ha, respectively.The investigations were carried out on the efficacy of different insecticides Imidacloprid 17.8SL were found most effective with minimum egg laying, 1.28

followed by 2.24 and 2.43 egg/plant in Quinalphos 25EC and Diflubenzuron 25WP, respectively. It is also observed the higher egg laying was found with mean 2.68 egg/plant in control plot (IFP).

Table 2: Effect of treatments on egg laying at 21 days after emergence on *Atherigona soccata* (Rondani) in 2015& 2016

Factor A (Nitrogen Doses)	Factor B (Insecticides)				Mean of Nitrogen Doses (Factor A)
	Control	Imidacloprid 17.8 SL @ 25 g.a.i./ha	Diflubenzuron 25 WP @ 75 g.a.i./ha	Quinalphos 25 EC @ 375 g.a.i/ha.	
Control(0.0KgN/Ha)	1.896(2.59)	1.214(0.47)	1.835(2.37)	1.757(2.09)	1.675(1.88)
70 Kg N/Ha	1.910(2.65)	1.456(1.12)	1.844(2.40)	1.801(2.24)	1.753(2.10)
80 Kg N/Ha	1.923(2.70)	1.607(1.58)	1.862(2.47)	1.815(2.29)	1.801(2.26)
90 Kg N/Ha	1.940(2.76)	1.719(1.96)	1.880(2.53)	1.823(2.32)	1.840(2.39)
Mean for Insecticide (Factor B)	1.917(2.68)	1.499(1.28)	1.855(2.43)	1.799(2.24)	
Factors	C.D.	SE(m)			
Factor A	0.0217	0.0075			
Factor B	0.0217	0.0075			
Interaction (A×B)	0.043	0.0150			

Note-Figures in parentheses are mean value of egg/plant of *A. soccata.* The value without parentheses shows Square Root transformed Value.

Among the treatments, pooled data showed the efficacy of different N/I combinations the lowest egg laying with mean 0.47, 1.12, 1.58 and 1.96 egg/plant was found in Imidacloprid 17.8SL+ 0.0 KgN/ha, Imidacloprid 17.8SL+ 70 KgN/ha, Imidacloprid 17.8SL+ 80 KgN/ha and Imidacloprid 17.8SL+ 90 KgN/ha, respectively. It is also observed that maximum egg laying was observed in untreated by insecticide with mean 2.76 followed by 2.70, 2.65 and 2.59 egg/plant in 90 KgN/ha, 80 KgN/ha, 70 KgN/ha and 0.0 KgN/ha, respectively.

The above finding supported by **Shivayya *et al.* (2009)** who reported that the incidence of shoot fly on maize at different levels of fertilizer revealed that the highest incidence of shoot fly was noticed in N0P0K0 (49.29%) and the lowest in N2P2K2 (21.28%) while **Wang *et. al.* (2006)** observed that the higher nitrogen treatments resulted higher insects development and significantly shorter development time and higher immature survival rate and laid significantly more eggs. Plants with higher nitrogen concentration also resulted in significantly greater adult mass. **Kumar *et al.* (2017)** reported that the Imidacloprid 70WS-NSKE was found best to reduce the number of eggs laid by *A. soccata i.e.* 0.00 eggs/plant (11 DAE) and 0.45 eggs/plant (22 DAE). **Siddique *et al.* (2011)** reported the efficacy of different treatments against maize shoot fly, *Atherigona soccata.* Result revealed that Imidacloprid spray was most effective in reducing *A.*

soccata dead hearts. Moreover, **Shahzad *et al.* (2010)** reported the Confidor (Imidaclorid) 200 SC most efficient against shootfly, *Atherigona soccata infestation* in maize.

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Table 1. Morphological characters of different plus trees of Neem

Plus Tree	Height (m)	GBH (cm)	Crown Diameter (m)	Crown Height (m)
FCRI AZ 1	18.5	125.5	18.0	12.0
FCRI AZ 2	12.5	72.0	14.0	9.5
FCRI AZ 3	9.0	53.0	8.5	7.0
FCRI AZ 4	16.5	126.0	20.5	13.5
FCRI AZ 5	15.0	124.5	21.0	11.5
FCRI AZ 6	13.5	112.0	15.0	10.0
FCRI AZ 7	19.0	140.0	22.0	17.5
FCRI AZ 8	14.5	111.5	15.5	11.5
FCRI AZ 9	16.5	108.0	18.0	11.5
FCRI AZ 10	13.5	98.5	12.5	9.0

Table 2. Mean performance of PTs (plus trees) variation for reproductive trait in Neem

Plus Tree	No of flowers / inflorescence	Inflorescence length	No of fruits / inflorescence	Fruiting percent	100 fruit weight	100 Seed weight	Oil percent
FCRI AZ 1	29.80	12.42	5.80	19.63	108.64	21.46	39.25
FCRI AZ 2	32.40	15.23	8.20	23.33	96.74	21.35	43.55
FCRI AZ 3	41.20*	13.26	13.00*	38.13	143.80*	26.73*	47.53*
FCRI AZ 4	34.60*	15.36	7.80	19.57	122.08	18.03	41.32
FCRI AZ 5	28.60	13.04	6.80	24.91	87.80	17.84	41.64
FCRI AZ 6	27.80	18.42*	7.20	26.94	131.02	24.53	39.49
FCRI AZ 7	22.20	14.48	6.00	27.90	115.80	20.09	43.73
FCRI AZ 8	29.20	12.99	8.20	28.41	90.74	22.96	40.81
FCRI AZ 9	35.40*	20.72*	9.40*	30.90	128.78	22.78	40.14
FCRI AZ 10	27.60	13.91	8.80	32.27	146.38*	17.53	41.35
Mean	**30.88**	**14.98**	**8.12**	**27.20**	**117.18**	**21.33**	**41.88**
SED	**3.78**	**1.68**	**1.83**	**NS**	**4.50**	**2.04**	**1.10**
CD	**7.65**	**3.40**	**3.70**	**NS**	**9.09**	**4.12**	**2.22**

Table 3. Estimation of genetic variability, heritability and genetic advance in neem

Characters	Range	GCV	PCV	Heritability	Genetic advance
No of flowers / inflorescence	12 - 65	15.22	22.75	45.2	13.8
Inflorescence length	7 - 28	15.93	23.65	46.4	11.0
No of fruits / inflorescence	2 - 12	19.91	40.71	24.7	10.1
Fruiting percent	8 - 41	11.06	41.68	7.1	5.50
100 fruit weight	82 - 148	17.72	18.68	90.3	21.5
100 Seed weight	15.5 - 29.2	13.44	17.09	62.4	15.2
Oil percent	35.2 - 51.02	5.66	6.94	66.7	19.8

Table 4. Genotypic and phenotypic correlation coefficient among different traits of

Characters		No of flowers / inflorescence	Inflorescence length	No of fruits / inflorescence	Fruiting percent	100 fruit weight	100 Seed weight	Oil percent
No of flowers / inflorescence	G	1.000	0.084	0.564*	-0.272	-0.055	0.501*	0.589*
	P	1.000	0.244	0.256	-0.229	-0.078	0.339*	0.333
Inflorescence length	G		1.000	0.229	0.235	0.769**	0.142	-0.034
	P		1.000	0.110	-0.020	0.478*	0.077	0.074
No of fruits / inflorescence	G			1.000	0.729**	0.386*	-0.342*	-0.058
	P			1.000	0.353*	0.158	-0.138*	-0.044
Fruiting percent	G				1.000	0.701**	-1.034	-0.668
	P				1.000	0.174	-0.265	-0.159
100 fruit weight	G					1.000	-0.226	-0.195
	P					1.000	-0.132	-0.156
100 Seed weight	G						1.000	0.319
	P						1.000	0.265
Oil percent	G							1.000
	P							1.000

* 0.05% Significant level
** 0.01% Significant level