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Predator Prey Relationship in Different Maize Based Planting Pattern

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A B S T R A C T

The present investigation on Predator prey relationship in different maize based planting pattern was carried out at Instructional farm and Department of Entomology, Rajasthan College of Agriculture, MPUAT, Udaipur. Maize variety Pratap maize-5 was sown with different intercrops *viz*., green gram, black gram, cowpea and soyabean in kharif, 2017. It was observed that the coefficient of correlation values (r) were positively significant for aphids and the aphidiphagous coccinellids in all the intercrop treatments: sole maize (0.94), maize + green gram (0.95), maize + black gram (0.74), maize + cowpea (0.77) and maize + soybean (0.90) conforming a density-dependent relationship and coefficient of correlation values (r) were significant and positive for aphids and their aphidiphagous syrphid fly maggots in all the intercrop treatments: sole maize (0.66), maize + green gram (0.79), maize + black gram (0.46), maize + cowpea (0.76) and maize + soybean (0.72), depicting a density-dependent relationship.

Introduction

Maize (*Zea mays* L.) belongs to family Poaceae is a cereal grain, also known as queen of cereals due to its diverse usages. In India, it is cultivated in most of the states throughout all the seasons. Depending on the regions and socioeconomic conditions of the population, the maize grain is used for various purposes including food, feed, fodder, green cobs, sweet corn, baby corn, popcorn, starch and several industrial products (Kumar *et al.,* 2014).. Its grain contains protein (10 %), oil (4 %), carbohydrates (70 %), fat (5 to 7 %), fiber (3 to 5 %) and minerals (2 %). In India, the potential maize growing states are Andhra Pradesh, Arunachal Pradesh, Assam, Bihar, Gujarat, Himachal Pradesh, Jammu & Kashmir, Karnataka, Madhya Pradesh, Maharashtra, Manipur, Meghalaya, Mizoram, Nagaland, Orissa, Punjab, Rajasthan, Sikkim, Tamil Nadu, Tripura, Uttar Pradesh and West Bengal. Maize is cultivated on an area of 8.69 mha with a production of 21.80 million tonnes and productivity of 2509 kg/ ha (Anonymous, 2016). Rajasthan is one of the major maize growing states in India covering an area of 0.88 mha with a production of 1.14 million tonnes and productivity of 1318 kg/ ha (Govt. of Rajasthan. 2016). Maize can be grown in both *rabi* and *kharif* seasons in Rajasthan, but it is a major *kharif* season crop in the maize growing districts. As many as 141 insect pests cause varying degrees of damage to maize

crop right from sowing till harvest (Reddy and Trivedi, 2008).

Materials and Methods

The experiment to correlate predator prey relationship between aphids and their associated natural enemies was conducted in plot size of 3.0 m x 5.0 m replicated four times with row to row and plant to plant spacing of 60 cm and 20 cm, respectively.

The insect pest complex infesting the maize crop was recorded from 21 days after germination till harvest of crop at weekly interval.

The population of aphids and their associated enemies in maize ecosystem were recorded and data obtained were using suitable statistical tools.

Sampling techniques

Five randomly selected plants were tagged and observations were recorded from 15 cm tassel and three leaves (top, middle and lower) of each selected plant by visual count during morning hours (7.30 - 9.00 AM) depending upon their occurrence in field during crop season at weekly intervals.

The associated natural enemies were recorded by the visual count technique from the same 5 randomly selected plants per replication during early hours of the day. The number of aphids and their associated natural enemies were correlated to find out predator prey relationship using the method suggested by Karl Pearson.

$$r_{xy} = \frac{\sum XY - \frac{\sum X \sum Y}{n}}{\sqrt{\left[\sum X^2 - \frac{(\sum X)^2}{n}\right]\left[\sum Y^2 - \frac{(\sum Y)^2}{n}\right]}}$$

Where,

r_{xy} = Simple correlation coefficient.
X = aphid population per plant
Y = their associated natural enemies per plant.
n = Number of observations.

The correlation coefficient (r) values will be subjected to the test of significance using t-test:

$$t = \frac{r}{\sqrt{1 - r^2}} \times \sqrt{n\text{-}2} \sim t_{n-2} \text{ d.f.}$$

The calculated t-value obtained will be compared with tabulated t-value at 1% and 5% level of significance.

Results and Discussion

Maize aphids and aphidiphagous coccinellids

From the Table 1 it can be observed that the coefficient of correlation values (r) were positively significant for aphids and the aphidiphagous coccinellids in all the intercrop treatments: sole maize (0.94), maize + greengram (0.95), maize + blackgram (0.74), maize + cowpea (0.77) and maize + soybean (0.90) conforming a density-dependent relationship.

Maize aphids and aphidiphagous syrphid fly larvae

A perusal of the Table 2 indicates that the coefficient of correlation values (r) were significant and positive for aphids and their aphidiphagous syrphid fly maggots in all the intercrop treatments: sole maize (0.66), maize + greengram (0.79), maize + blackgram (0.46), maize + cowpea (0.76) and maize + soybean (0.72), depicting a density-dependent relationship.

Table.1 Predator-prey relationship between coccinellids and maize aphids under sole and intercropped conditions during *Kharif*, 2017

Dates of Observation	Mean No. of aphids and coccinellids per plant on maize									
	M		M + Gg		M + Bg		M + C		M + S	
	Aphids	Coccinellids	Aphids	Coccinellids	Aphids	Coccinellids	Aphids	Coccinellids	Aphids	Coccinellids
07 – Aug	5.40	0.80	1.20	1.00	0.80	1.80	0.00	4.00	1.60	0.60
14 – Aug	19.00	2.00	8.20	4.00	8.00	3.80	5.00	4.00	6.00	1.80
21 – Aug	32.00	2.80	20.00	6.00	20.00	6.80	2.40	5.20	25.00	2.60
28 – Aug	38.00	5.20	24.20	6.40	25.00	8.00	6.00	8.80	29.80	5.80
04– Sept	10.00	0.40	1.20	1.20	0.40	2.40	5.60	6.80	0.60	0.20
11 – Sept	40.00	5.80	25.00	8.40	26.00	10.00	20.60	10.80	38.60	6.00
18 – Sept	10.00	1.20	6.00	3.00	1.40	8.00	8.60	9.80	15.00	0.80
25– Sept	35.60	4.60	13.40	4.60	15.00	6.00	5..40	3.00	20.00	4.40
02 – Oct	30.00	3.00	15.00	3.80	10.40	6.20	4.60	2.00	18.40	2.80
09– Oct	22.00	2.40	10.00	2.80	8.00	2.20	1.20	1.00	13.60	2.20
16-Oct	5.00	1.00	3.20	1.60	2.20	0.40	0.80	0.60	3.40	0.80
Mean	**22.45**	**2.65**	**11.58**	**3.89**	**10.65**	**5.05**	**4.98**	**5.09**	**15.64**	**2.55**
Coefficient of correlation (r)	**0.944***		**0.958***		**0.741***		**0.770***		**0.902***	

* Significant at 5% level of significance

Legend: M = Maize sole, M + Gg = Maize + Geengram (1:1), M + Bg = Maize + Blackgram (1:1), M + C = Maize + Cowpea (1:1), M + S = Maize + Soybean (1:1)

Table.2 Predator-prey relationship between syrphid flies maggots and maize aphids in sole and intercropped conditions during *Kharif*, 2017

Dates of Observation	Mean No. of aphids and syrphid flies maggots per plant on maize									
	M		M + Gg		M + Bg		M + C		M + S	
	Aphids	Maggots	Aphids	Maggots	Aphids	Maggots	Aphids	Maggots	Aphids	Maggots
07 – Aug	5.40	0.00	1.20	0.20	0.80	0.60	0.00	1.00	1.60	0.00
14 – Aug	19.00	0.20	8.20	0.60	8.00	3.40	5.00	3.80	6.00	0.40
21 – Aug	32.00	0.80	20.00	0.80	20.00	3.00	2.40	0.60	25.00	1.00
28 – Aug	38.00	1.60	24.20	2.40	25.00	2.20	6.00	3.60	29.80	0.80
04– Sept	10.00	1.00	1.20	0.40	0.40	2.60	5.60	3.00	0.60	1.00
11 – Sept	40.00	2.80	25.00	2.80	26.00	4.20	20.60	4.60	38.60	1.80
18 – Sept	10.00	0.40	6.00	1.00	1.40	2.20	8.60	2.60	15.00	0.60
25– Sept	35.60	1.20	13.40	2.60	15.00	1.00	5..40	1.40	20.00	1.00
02 – Oct	30.00	0.80	15.00	2.00	10.40	0.40	4.60	0.80	18.40	0.80
09– Oct	22.00	0.80	10.00	1.60	8.00	0.20	1.20	0.40	13.60	0.40
16-Oct	5.00	1.00	3.20	0.20	2.20	0.40	0.80	0.20	3.40	0.60
Mean	**22.45**	**0.96**	**11.58**	**1.33**	**10.65**	**1.84**	**4.98**	**2.00**	**15.64**	0.76
Coefficient of correlation (r)	0.666*		0.792*		0.469*		0.768*		0.723*	

* Significant at 5% level of significance

Legend: M = Maize sole, M + Gg = Maize + Geengram (1:1), M + Bg = Maize + Blackgram (1:1), M + C= Maize + Cowpea (1:1), M + S = Maize + Sorybean (1:1)

Treatments details

S. No.	Treatment
T_1	Maize sole
T_2	Maize +Greengram (1:1)
T_3	Maize +Blackgram (1:1)
T_4	Maize +Cowpea(1:1)
T_5	Maize +Soybean(1:1)

Similar to the predator-prey relationship for coccinellids and aphid prey, the coefficient of correlation values (r) were significant and positive for aphids and their aphidiphagous syrphid fly maggots in all the intercropped treatments and sole maize registering a density-dependent relationship.

Earlier workers reported that the coccinellid grubs and adult beetles consumed relatively more aphids at lower aphid densities (25, 50 and 75), significantly being the maximum at a prey density of 75. At higher aphid densities (100, 125 and 150) the consumption rates declined. The feeding behaviour of coccinellids showed a sharp decline in percentage feeding with an increase in prey density for both adults and grubs (Swaminathan *et al.*, 2015). Patel and Das (2010) studied that the build-up of coccinellid population was attributed to optimum temperature and host availability. Chavan *et al.*, (2006) studied the incidence of insect pests and their natural enemies at 15, 45 and 80 days after seed germination. The observations recorded at 45 days after germination indicated the incidence of aphids and predatory lady bird beetle. The predatory lady bird beetles were noticed on aphid infested plants and the adult counts ranged from 1 to 4 adults per plant.

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