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INSECT POLLINATORS OF PUMPKIN (*CUCURBITA PEPO* L.) AND THEIR FORAGING BEHAVIOUR

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ABSTRACT

Investigations were carried out on "Insect Pollinators of Pumpkin (*Cucurbita pepo* L.) and their Foraging Behaviour" during *kharif* 2019 at Rajasthan college of Agriculture, Udaipur. The insect pollinators of pumpkin consist of total 7 species. Among honey bees, *Apis dorsata* proved to be the dominant one (67.40%) followed by *A. florea* (14.28%). *A. dorsata* activity was observed from 0600-1300 hrs with peak activity at 0900-1000 hrs. *A. florea* activity was observed from 0600-1400 hrs with peak activity at 0800-0900 hrs. The treatments comprised of:*Azadirachta* seed kernel extracts-5%, *Azadirachta* leaf extracts-10%, *Azadirachta* oil-1%, Dusparni-10%, Teekha sat-3% replicated 4 times.Side-effects of botanicals on major insect pollinators of pumpkin recorded that there was a decrease in insect pollinator intensity ranging from 7.95 to 20.45%. Effect of botanicals on the major insect pest of pumpkin observed that *Azadirachtin* seed kernel extract (5%) was more effective against red pumpkin beetle followed by *Azadirachtin* leaf extract (10%).

Keywords: Insect pollinators, pumpkin, botanicals, crop pest.

INTRODUCTION

Pumpkin, *Cucurbita pepo* L. belongs to the family Cucurbitaceae and is grown extensively during *kharif* and summer season throughout India.It was brought in to India around 9th century from South America (Pearce and Pearce, 2010). Pumpkins are limited in temperate regions because of their sensitivity to frost (Tsuchiya and Gupta, 1991). Pumpkin is not only used as a vegetable for cooking (Okoli, 1984), but also has good medicinal properties.In India the area under pumpkin cultivation is 78,000 ha with a total production is 17.14lakh metric tonnes (Annon. 2018). India is the second largest country producing pumpkin in the world after China.

The appearance of pollinators in cross pollination of important agro-horticultural crops are well appreciated. Among the 95 per cent cross pollinated flowers, 85 per cent depend on insect pollination (Carruth,1950). The important pollinators are honey bees, bumble bees (*Bombus*), solitary bees (*Xylocopa*, *Andrena*, *Halictus*) stingless bees (*Trigona*, *Melipona*) and many kinds of flies (*Syrphus*, *Bombilius*), black ants, thrips, beetles and moths. The insects belonging to the super-family Apoidea (Hymenoptera) are the most important pollinators of cucurbits.

Detailed work on foraging behaviour of pollinators of pumpkin is lacking. Though the flowers are visited by several species of bees, recognition of most ideal pollinator, its activity coinciding with time of stigma receptivity and pollen viability, need investigation. In general, botanicals act quickly, degrade rapidly and have, with a few exceptions, low mammalian toxicity. They are environmental friendly and safe to the insect pollinators as compared to the synthetic insecticides. Therefore, the present investigation on, Insect Pollinators of Pumpkin (*Cucurbita pepo* L.) and their Foraging Behaviour was carried out.

MATERIALS AND METHODS

The present investigation was conducted at the Instructional Horticulture Farm and the Department of Entomology, Rajasthan college of Agriculture, MPUAT, Udaipur during *kharif* 2019. Udaipur is located at 24º35' N latitude and 73º42' E longitude

at an elevation of 582.17 MSL (Mean Sea Level) in the state of Rajasthan. The region comes under agro-climatic zone IVa (Sub-Humid Southern Plain and Aravalli Hills of Rajasthan). Pumpkin variety (MAHY 1) was raised in a field with a plot size of 4 × 2 m with a spacing of 90 × 90 cm. Timely weeding and hoeing operations were implemented as per the package of practices (manual weeding was performed at 20 and 30 days after sowing). Recommended doses of N: P: K (70:25:25 kg/ha) were applied to the crop.The crop was rainfed, but during periods of dry spell irrigation was given.

The foraging behaviour of major insect pollinators of pumpkin was observed at two hours interval from 0600 to 1600 hr on number of bees visiting each square meter area for five minutes at 5 days intervals from five per cent flowering. There were five such spots for each observation. Observations were continued from 5 per cent flowering till the spraying of botanicals.

The treatments comprised of:*Azadirachta* seed kernel extract-5%, *Azadirachta* leaf extract-10%, *Azadirachta* oil-1%, Dusparni-10%, Teekha sat-3%. Each treatment was replicated 4 times. The number of major pollinators during their peak foraging period was counted one day before treatment and 1, 3 and 5 days after the treatments. The decrease or increase in the insect pollinators population was evaluated 1, 3 and 5 days after the application of botanicals. Later, the reduction in insect population was estimated one day after the spray of the botanicals by using the methodology given by Henderson and Tilton (1955); whereas 3 and 5 days after the spray of botanicals the average per centage increase or decrease in insect pollinator abundance was computed over control.

RESULTS AND DISCUSSION

Apis dorsata activity was observed from 0600-1300 hrs with peak activity at 0900-1000 hrs. Bee activity was suddenly decreased after 1300 hr could be due to the closing of pumpkin flowers after 1100 hr of the day. The foraging behaviour of *A. dorsata* was seen throughout the flowering period. The present results are in accordance with the results of Thakur and Rana (2008) who reported that the foraging activity of insect pollinators was peaked between 0900 and 1000 hr of the day. Kumar (2010) observed that the foraging activity of *A. dorsata* was peaked between 0800-1000 hrs of the day (Table 1).

A. florea activity was observed from 0600-1400 hrs with peak activity at 0800-0900 hrs. Bee activity was suddenly decreased after 1400 hr could be due to the closing of pumpkin flowers after 1100 hr of the day. The foraging behaviour of *A. florea* was seen throughout the flowering period. The present results more or less accordance with the results of Subhakar *et al*. (2011) who reported that foraging activity of *A. florea* was maximum at 0900-1000 hrs of the day. Kumar *et al*. (2012) reported that the foraging activity of Hymenopteran insects was found to be high from 0800 h to 1000 hrs of the day (Table 2).

When a comparison was made between treatments and control with regard to insect pollinator population, one day after the spray of botanicals on pumpkin crop against red pumpkin beetle (*Raphidopalpa foveicollis*), the side-effect of the botanicals showed a decrease in insect pollinator intensity ranging from 7.95 to 20.45% (Table 3). Effect of botanicals on the major insect pest of pumpkin observed that neem seed kernel extract (5%) was more effective against red pumpkin beetle followed by neem leaf extract (10%). The minimum number of red pumpkin beetle/m^2 was found in the plot treated with neem seed kernel extract (5%) (1.31) and neem leaf extract (10%) (1.57). In botanical treated plots, the maximum number of beetles/m^2 were recorded in the plots treated with Dusparni (10%) (1.91), Teekha sat (3%) (1.86)and neem oil (1%) (1.78). The present results are in accordance with the results of Singh *et al*. (2010) reported that the maximum reduction of insect pollinators (25.06%) was recorded from plots treated with neem seed oil (1%) and 3 days after the pollinator percentage increased in plots treated with NSKE (5%) and neem leaf extract (10%). Khan *et al*. (2015) reported that ethanolic-extracts of *Azadirachta indica* 5% causes 76.7% repellency against *Aulocophora foveicollis* Lucas adults.

Based on the outcome of the present investigations, it could be concluded that the pumpkin attracts large number of insects as

Table 1: Foraging behaviour of *Apis dorsata* on pumpkin

Hours of the day	Number of bees/m^2/5 min				Total	Mean
	1DAF	5DAF	10DAF	15DAF		
0600-0700	1.6	3.4	3.8	3.2	12	3
0700-0800	5.2	6	6.6	7.8	25.6	6.4
0800-0900	5.4	9.6	5.6	9.2	29.8	7.45
0900-1000	11	10.2	13.4	12.4	47	11.75
1000-1100	9.2	8.2	9.6	8.4	35.4	8.85
1100-1200	6.4	9	6.8	8.2	30.4	7.6
1200-1300	4.6	3.8	2.8	3.4	14.6	3.65
1300-1400	0	0	0	0	0	0
1400-1500	0	0	0	0	0	0
1500-1600	0	0	0	0	0	0
Total	43.4	50.2	48.6	52.6		
Mean	4.34	5.02	4.86	5.26		

DAF-Days after five per cent flowering

Table 2. Foraging behaviour of *Apis florea* on pumpkin

Hours of the day	Number of bees/m^2/5 min				Total	Mean
	1DAF	5DAF	10DAF	15DAF		
0600-0700	0	0	0	0	0	0
0700-0800	0.8	0.6	1.4	1.6	4.4	1.1
0800-0900	1.6	1.8	2	2.4	7.8	1.95
0900-1000	1.2	0.8	1.4	1	4.4	1.1
1000-1100	0.8	0.6	1.4	0.6	3.4s	0.85
1100-1200	0.6	0.2	0.6	0.6	2	0.5
1200-1300	0.6	0.2	0.4	0.4	1.6	0.4
1300-1400	0.4	0	0.2	0	0.6	0.15
1400-1500	0	0	0	0	0	0
1500-1600	0	0	0	0	0	0
Total	6	4.2	7.4	6.6		
Mean	0.6	0.42	0.74	0.66		

DAF-Days after five per cent flowering

Table 3: Effect of botanicals on the mean insect pollinator intensity over control

Treatments	Pollinator intensity (%)		
	I day	III day	V day
***Azadirachtin* seed kernel extract (5%)**	(-)7.95 *(21.12)	(+)9.09	(+)13.41
***Azadirachtin* leaf extract (10%)**	(-)14.77 (20.58)	(+)2.43	(+)6.09
***Azadirachtin* oil (1%)**	(-)20.45 (29.41)	(-)8.75	(-)17.07
Dashparni (10%)	(-)17.04 (20.94)	(-)6.25	(-)10.97
Teekha sat (3%)	(-)9.09 (18.57)	(-)2.5	(+)2.43
S. Em. ±	1.43		
C. D.	4.35		

*** Figures in parenthesis are arc sine values, + indicates per cent increase in pollinator intensity and - indicates per cent decrease in pollinator intensity**

pollinators in which the honey bees were the major group. Among honey bees, *A. dorsata* play a major role. Among botanicals treated, application of neem seed kernel extract 5% for the management of red pumpkin beetle is an appropriate control measure with less health risk and also safe for social insects.

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