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Role of birds in the natural regulation of pod borer, *Helicoverpa armigera* (Hubner) in pigeon pea

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Abstract
Major insectivorous birds *viz.*, Black Drongo (*Dicrurus macrocercus*), Jungle babbler (*Turdoides striatus*), Common Myna (*Acridotheres tristis*), Rosy starling (*Sturnus roseus*) and Red vented bulbul (*Pycnonotus cafer*) have been recorded in pigeon pea. All birds were found potent predators of pigeon pea pod borer, *Helicoverpa armigera* (Hubner) by suppression of 61.16% larval population.

Keywords: Pigeon pea, *Helicoverpa armigera*, nylon anti bird net

Introduction
Pigeon pea *Cajanus cajan* (L.) Millspaugh, also known as red gram, tur or arhar, is the second most important grain legume of India after chickpea. Mandal *et al*. (2009) [2] observed that pigeon pea infested with as many as 21 insect pests and 2 species of mites at different stages of crop growth in an overlapping manner. Pigeon pea is attacked by insect/pests right from sowing to harvesting and also during the storage. Among the pod borer complex, gram pod borer (*H. armigera*) cause heavy damage to pods resulting in extensive loss in the grain yield. In Chickpea, birds like Myna, Sparrow, Baya, Babbler, Black drongo, Cattle egret etc feed on *H. armigera* larvae and cause significant reduction in pod damage which result in tremendous increase in the yield (Parasharya *et al.*, 2002) [3]. House crow fed voraciously on castor semilooper larvae and a single bird could consume 30-40 larvae (Satyanaryana *et al.*, 2002) [6]. Jungle babbler (*Turdoides striatus*) reported to prefer for feeding of larvae of diamond back moth and aphids in cabbage (Bharucha *et al.*, 2002) [1]. However, the useful role of birds against *H. armigera* in pigeon pea crop has not been studied. The birds will be evaluated against *H. armigera* larvae in pigeon pea. Thus, the present experiment was planning to evaluate the effect of insectivorous birds for suppression of pod borer in pigeon pea.

Materials and Methods
One plot (18.5 × 40 m) was served as treatment plot where birds could freely prey upon *Helicoverpa* larvae. Second plot (18.5 × 40 m) (ten fixed quadrate (3.6 × 3.0 m) was covered with nylon anti bird net of mesh size (2.5 X 2.5 cm) to prevent the access of birds to their prey (Plate-1). This served as bird-free area (netted area). Net was installed just after flowering in each quadrate to the height of 8 feet with the help of Iron sticks. Absolute population of *H. armigera* larvae (Number of small, medium and large size larva) from 10 randomly sampled plants from quadrate in open and netted plots was counted in the morning at weekly interval (Plate-2). Percent reduction of larval population by using following formula:

$$= \frac{\text{Larval population in control plot} - \text{larval population in treated plot}}{\text{larval population in control plot}} \times 100$$

Most abundant five insectivorous bird's species visiting to open plot were selected for recording observation on their foraging activity. Five birds of each species was observed for number of feeding attempt made in one minute and attempt was categorized in success and failure to predate on prey. Observation on bird visitation to experimental plot was recorded for period of one hour at 10 minutes interval in morning hours at weekly interval. Yield were recorded from each plot and converted into kg/ha.

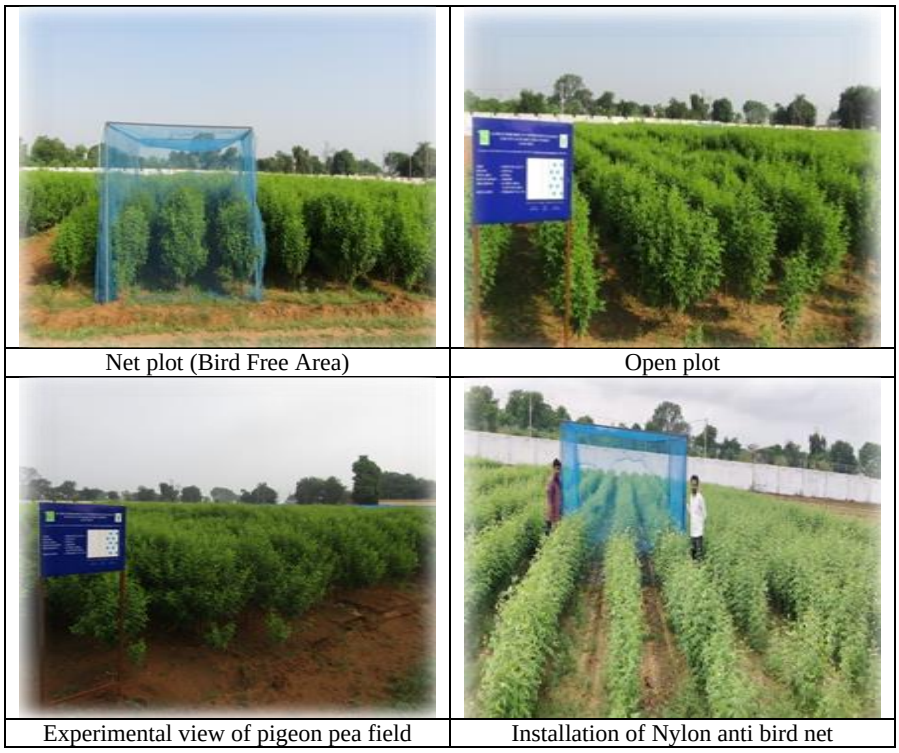

Plate 1: Experimental view of Pigeon pea field at agronomy farm, AAU, Anand

Plate 2: View of pigeon pea pod borer in experimental plot

Result and Discussion

In case of larval population of pod borer, the lowest (0.84 larvae/plant) medium (0.90 larvae/plant) and large (0.75 larvae/plant) sized larvae was recorded from the open plot at weekly interval, while the highest (1.95 larvae/plant), medium (2.25 larvae/plant) and large (2.49 larvae/plant) sized larvae was recorded from the netted plot (Table 1 to 3). The number of larvae was found significant in netted and open plots. Total 61.16% reduction of larval population per plot was recorded in open plot as compared to netted plot.

Table 1: Number of larvae recorded in experimental site

Observation Week	Number of larva per plant at weekly interval																	
	2020-21						2021-22						Pooled					
	T1			T2			T1			T2			T1			T2		
	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L
Week-1	0.78	0.69	0.55	1.23	1.51	1.62	0.78	0.84	0.65	1.33	1.55	1.71	0.78	0.77	0.60	1.28	1.53	1.67
Week-2	0.70	0.78	0.55	1.41	1.69	1.86	0.74	0.66	0.52	1.61	1.77	1.94	0.72	0.72	0.54	1.51	1.73	1.90
Week-3	0.58	0.72	0.69	1.86	1.96	2.2	1.03	1.22	0.95	2.02	2.05	2.32	0.81	0.97	0.82	1.94	2.01	2.26
Week-4	0.69	0.75	0.67	2.04	2.52	3.04	1.01	1.32	0.93	2.12	2.65	3.14	0.85	1.04	0.80	2.08	2.59	3.09
Week-5	0.69	0.6	0.45	2.91	3.35	3.49	1.38	1.44	1.57	3.00	3.38	3.54	1.04	1.02	1.01	2.96	3.37	3.52
Average	0.69	0.71	0.58	1.89	2.21	2.44	0.99	1.10	0.92	2.02	2.28	2.53	0.84	0.90	0.75	1.95	2.25	2.49

T1= open area (Treated plot), T2= Netted area (Control plot), S= Small sized larva, M= Medium sized larva, L=Large sized larva

Table 2: Population of *Heliothis* larvae in Pigeon pea field $n_1=n_2=50$

Sr. No.	Treatments	Number of larva per plant at weekly interval								
		2021			2022			Pooled		
		Small	Medium	Large	Small	Medium	Large	Small	Medium	Large
1.	Open Plot	0.69	0.71	0.58	0.99	1.10	0.92	0.84	0.90	0.75
2.	Netted Plot	1.89	2.21	2.44	2.02	2.28	2.53	1.95	2.25	2.49
Cal t		8.79**	2.38**	14.23**	9.04**	8.90**	12.14**	13.28**	15.45**	18.73**

** Significant at 1% level

Table 3: Suppression of *Heliothis* larvae in pigeon pea field

Observation Week	Number of larva per plant at weekly interval								
	2020-21			2021-22			Pooled		
	open	Netted	Reduction (%)	open	netted	Reduction (%)	Open	netted	Reduction (%)
Week-1	2.02	4.36	53.67	2.27	4.59	50.54	2.15	4.48	52.01
Week-2	2.03	4.96	59.07	1.92	5.32	63.91	1.98	5.14	61.48
Week-3	1.99	6.02	66.94	3.2	6.39	49.92	2.6	6.21	58.13
Week-4	2.11	7.6	72.24	3.26	7.91	58.79	2.69	7.76	65.34
Week-5	1.74	9.75	82.15	4.39	9.92	55.75	3.07	9.85	68.83
Average	1.98	6.54	66.82	3.01	6.83	55.78	2.50	6.69	61.16

The number of healthy and damaged pod was found significant in netted and open plots, while total pods were found non-significantly differed in both the plots. The number of healthy pods (57.80 pods/plant) was recorded higher in open plot than (45.77 pods/plant) in netted plot. While number of damaged pods (2.90 pods/plant) was recorded lower in open plot as compared to (12.21 pods/ plant) netted plot (Table 4 & 5).

Table 4: Total number of pods recorded in experimental site

Observation week	Number of pod per plant at weekly interval																	
	Total pod				Healthy pod				Damaged pod				Pooled					
	2020-21		2021-22		2020-21		2021-22		2020-21		2021-22		Total pod		Healthy pod		Damaged pod	
	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2	T1	T2
Week-1	42.31	41.54	43	42.93	40.24	38.85	40.93	40.41	2.07	2.69	2.07	2.52	42.66	42.24	40.59	39.63	2.07	2.61
Week-2	52.01	50.18	52.65	50.37	49.57	46.92	50.21	47.17	2.44	3.26	2.44	3.2	52.33	50.28	49.89	47.05	2.44	3.23
Week-3	61.59	58.1	61.67	58.29	58.57	45.72	58.57	46.04	3.02	12.38	3.1	12.25	61.63	58.20	58.57	45.88	3.06	12.32
Week-4	68.65	66.42	68.86	66.41	65.73	50.11	65.94	50.3	2.92	16.31	2.92	16.11	68.76	66.42	65.84	50.21	2.92	16.21
Week-5	77.88	72.69	78.36	72.79	74.45	46	73.78	46.16	3.43	26.69	4.58	26.63	78.13	72.74	74.12	46.08	4.01	26.66
Average	60.49	57.79	60.91	58.16	57.71	45.52	57.89	46.02	2.78	12.27	3.02	12.14	60.70	57.98	57.80	45.77	2.90	12.21

T1= open area, T2= netted area

Table 5: Number of healthy and damaged pod per plant at weekly interval in pigeon pea field $n_1=n_2=50$

Sr. No.	Treatments	pods/plant								
		2020-21			2021-22			Pooled		
		Damaged	Healthy	Total	Damaged	Healthy	Total	Damaged	Healthy	Total
1.	Open plot	2.78	57.71	60.49	3.02	57.89	60.91	2.90	57.80	60.70
2.	Netted Plot	12.27	45.52	57.79	12.14	46.02	58.16	12.21	45.77	57.98
Cal t		7.37**	6.37**	1.11^{NS}	7.07^{**}	6.40^{**}	1.13^{NS}	10.28**	9.07**	1.59^{NS}

** Significant at 1% level

Observation of birds was recorded from ten fixed quadrate from open plot at weekly interval (Table 6). Average 7.74 numbers of birds per hour per 10 minute interval were observed in open plot during the study period.

Table 6: Average number of birds visitation at weekly interval in pigeon pea

Average number of birds in each quadrate/hour/10 minute interval in open plot			
Observation week	2020-21	2021-22	pooled
Week-1	9.2	8.5	8.85
Week-2	9.2	9.2	9.2
Week-3	7.3	7.6	7.45
Week-4	7.3	7.3	7.3
Week-5	6.7	7.1	6.9
Week-6	7.5	7.7	7.6
Week-7	7.9	8.1	8.0
Week-8	7.3	7.6	7.45
Week-9	7.0	6.8	6.9
Week-10	7.8	7.7	7.75
Week-11	8	7.4	7.7
Average	7.75	7.73	7.74

The Highest (13.64) average number of attempt for feeding of larva were observed by common myna while the lowest average (10.89) number of attempt was observed by Black drongo. The Highest average of successful attempt (1.06) was observed by Rosy starling where as the lowest average of successful attempt (0.83) was noted by Jungle babbler (Table 7). From the unsuccessful attempt, we can conclude that the highest average unsuccessful (2.77) from attempt was made by Red vented bulbul while the lowest average unsuccessful attempt (1.70) was done by Black drongo. The Highest average number of attempt (10.05) by common myna was not visible from naked eye. Various Bird communities including selected five common bird's species recorded during study period (Table 8). Total 331 Kg yield was increase per hectare as compared to netted plot and obtained 19,860 Rs. additional incomes due to suppression of larva by insectivorous birds (Table 9).

Table 7: Feeding activity of insectivorous birds inpigeon pea field

Month	Year	Average number of feeding activity of insectivorous birds at weekly interval in open area																			
		Attempt					Successful					Unsuccessful					Not Visible				
		Black drongo	Jungle babbler	Common myna	Rosy starling	Red vented Bulbul	Black drongo	Jungle babbler	Common myna	Rosy starling	Red vented Bulbul	Black drongo	Jungle babbler	Common myna	Rosy starling	Red vented Bulbul	Black drongo	Jungle babbler	Common myna	Rosy starling	Red vented Bulbul
October	2021	12.00	8.00	11.00	8.00	11.00	1.00	0.00	0.00	0.00	0.00	1.00	3.00	2.00	2.00	4.00	10.00	5.00	9.00	6.00	7.00
	2022	9.00	12.00	15.00	10.00	15.00	1.00	0.00	1.00	1.00	1.00	1.00	6.00	4.00	3.00	6.00	7.00	6.00	10.00	6.00	8.00
	Pooled	10.50	10.00	13.00	9.00	13.00	1.00	0.00	0.50	0.50	0.50	1.00	4.50	3.00	2.50	5.00	8.50	5.50	9.50	6.00	7.50
November	2021	10.00	13.67	13.00	13.33	12.67	0.67	0.67	0.33	1.33	0.67	1.67	1.33	1.67	0.67	0.67	7.67	11.67	10.67	11.00	10.67
	2022	9.33	15.33	15.00	15.00	14.33	1.00	1.33	1.67	2.00	1.33	1.00	3.67	3.00	2.67	3.00	7.33	10.67	10.33	10.33	10.00
	Pooled	9.67	14.50	14.00	14.17	13.50	0.84	1.00	1.00	1.67	1.00	1.34	2.50	2.34	1.67	1.84	7.50	11.17	10.50	10.67	10.34
December	2021	9.80	10.20	11.60	10.80	10.40	0.60	0.20	0.40	0.20	0.60	1.80	1.60	1.60	2.20	1.60	7.40	8.40	9.60	8.40	8.20
	2022	11.00	12.80	14.00	11.80	12.00	1.80	1.40	1.40	1.40	1.40	3.60	3.00	2.80	4.00	2.40	7.20	8.40	9.80	6.40	8.20
	Pooled	10.40	11.50	12.80	11.30	11.20	1.20	0.80	0.90	0.80	1.00	2.70	2.30	2.20	3.10	2.00	7.30	8.40	9.70	7.40	8.20
January	2021	13.00	11.50	14.00	11.50	12.50	1.00	1.00	1.00	1.00	1.00	1.50	0.50	2.00	1.50	1.50	10.50	9.50	11.00	9.00	10.00
	2022	13.00	13.50	15.50	13.00	14.50	1.00	2.00	1.50	1.50	2.00	2.00	1.50	4.00	3.00	3.00	9.50	10.00	10.00	8.50	9.50
	Pooled	13.00	12.50	14.75	12.25	13.50	1.00	1.50	1.25	1.25	1.50	1.75	1.00	3.00	2.25	2.25	10.00	9.75	10.50	8.75	9.75
Average	2021	11.20	10.84	12.40	10.91	11.64	0.82	0.47	0.43	0.63	0.57	1.49	1.61	1.82	1.59	1.94	8.89	8.64	10.07	8.60	8.97
	2022	9.00	13.41	14.88	12.45	13.96	1.20	1.18	1.39	1.48	1.43	1.90	3.54	3.45	3.17	3.60	7.76	8.77	10.03	7.81	8.93
	Pooled	10.89	12.13	13.64	11.68	12.80	1.01	0.83	0.91	1.06	1.00	1.70	2.58	2.64	2.38	2.77	8.33	8.71	10.05	8.21	8.95

Table 8: List of birds visiting in pigeon pea experimental plot at Agronomy farm, AAU, Anand

Sr. No	Name of bird	Scientific name
1	Purple Sunbird	*Nectarinia asiatica* (Latham)
2	Red vented bulbul	*Pycnonotus cafer* (Linnaeus)
3	House Sparrow	*Passer domesticus*(Linnaeus)
4	Black Drongo	*Dicrurus macrocercus* (Vieillot)
5	Common Myna	*Acridotheres tristis* (Linnaeus)
6	House crow	*Corvus splendens* (Vieillot)
7	Cattle Egret	*Bubulcus ibis* (Linnaeus)
8	Rose- Ringed Parakeet	*Psittacula krameri* (Scopoli)
9	Bee eater	*Merops orientalis* (Rafinesque)
10	Rosy starling	*Sturnus roseus* (Linnaeus)
11	Jungle babbler	*Turdoides striatus* (Dumont)
12	Red-naped Ibis	*Pseudibis papillosa* (Temminck)
13	Yellow wattled lapwing	*Vanellus indicus* (Boddaert)

Table 9: Details of Pigeon pea seed yield in experimental plot

Seed Yield	2020-21		2021-22		Pooled		Additional Yield (ha)
	kg/ha	Increase yield (ha)	kg/ha	Increase yield (ha)	kg/ha	Increase yield (ha)	
T1	1270	324	1365	338	1318	331	**19,860 Rs.**
T2	946	-	1027	-	986		-

T1= open area, T2= Netted area
*60.00 Rs per 1 Kg of Pigeon pea

Conclusion

The lowest (0.84 larvae/plant) medium (0.90 larvae/plant) and large (0.75 larvae/plant) sized larvae was recorded from the open plot at weekly interval, while the highest (1.95 larvae/plant), medium (2.25 larvae/plant) and large (2.49 larvae/plant) sized larvae was recorded from the netted plot. Total 61.16% reduction of larval population per plot was recorded in open plot as compared to netted plot. The number of healthy pods (57.80 pods/plant) was recorded higher in open plot than (45.77 pods/plant) in netted plot. While number of damaged pods (2.90 pods/plant) was recorded lower in open plot as compared to (12.21 pods/ plant) netted plot. Average 7.74 numbers of birds per hour per 10 minute interval were observed in open plot during the study period.

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