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T-PERCHES DETERMINING AVIAN FEEDING GUILDS IN MAIZE

Khushdeep Kaur[1], Tejdeep Kaur Kler[2]* and Surinder Kaur Sandhu[3]

[1,2]Department of Zoology; All India Network Project on Vertebrate Pest Management (Agricultural Ornithology), [3]Department of Plant Breeding and Genetics
Punjab Agricultural University, Ludhiana, Punjab 141004, India
*Email: tejdeepkler@pau.edu (corresponding author): ORCID: ID 0000-0003-3076-0732

ABSTRACT

Avian diversity is considered an environmental indicator for measuring ecosystem quality. The availability of food and its diverse types influence bird distribution and their community structure in agricultural landscapes. The current study investigated the role of T-perches as bird attractants in maize at the Punjab Agricultural University, Ludhiana. A total of 39 species were observed belonging to 12 orders and 24 families. Insectivorous birds were observed as the most dominant feeding guild constituting 47.12%. Black drongo, jungle babbler, common myna, house crow, green bee-eater, and red-vented bulbul were noted utilizing t-perches for foraging purposes. The key factor driving the increase in insectivorous bird species seemed to be the additional perching sites available by installing T-perches.

Key words: Insectivorous birds, maize, passeriformes, agricultural landscapes, T-perches, environmental indicator, pest control, black drongo, ecofriendly, avian diversity, vegetative stage, foraging sites

India has 1210 bird species, with 993 of them being terrestrial (Kler and Kumar, 2015), and out of these, 328 are found in Punjab (Jerath and Chadha, 2006). Avian diversity and feeding guilds are important environmental indicators (Newton, 2003). Analyzing bird guilds in agroecosystems provide a stronger insight into the community structure of bird species, as well as their habitat usage and services, and results in better maintenance of those species in agricultural landscapes (Shew et al., 2019). The distribution of birds and community structure is influenced by food resources and patterns of food utilization in a particular habitat. (Sohil and Sharma, 2020). Classifying birds into feeding guilds is one of the best ways to understand the structure of their communities. Foraging and breeding sites for resident and migratory species are provided by agricultural landscapes (Blount et al., 2021). In Punjab, maize is an important cereal crop and its yield/ ha is 35.82 quintals (Anonymous, 2021). Numerous bird species are pests' natural adversaries and act as biocontrol agents. Therefore, they must be kept within optimum ranges in the agroecosystem (Kaur and Sidhu, 2021). T-perches can be installed to attract birds to fields and aid in pest control. Artificial perches help to increase local bird diversity and improve structural complexity (Horgan et al., 2016). They mimic the barren trees that are commonly found in landscapes (Vogel et al., 2018, Kumar and Cheema, 2020). The main objective of this study was to evaluate the effect of T-shaped perches on bird diversity and various feeding guild patterns in maize.

MATERIALS AND METHODS

The present study was conducted at the Punjab Agricultural University Ludhiana, Punjab, India from July 2021 to November 2021 in maize. The variety PMH1 was raised according to cultural practices provided in 'Package and practices of kharif crops', Directorate of Extension, Punjab Agricultural University, Ludhiana (Anonymous, 2021). Experiment comprised of two types of plots; one was installed with T-perches and the other without as a control plot. T-perches were installed at non-grain stages (initial vegetative stage, knee-height stage, and mature vegetative stage). The height of T- perches was chosen 60 cm higher than the crop height. A total of 15 T-perches were installed in 2500m^2 with 10 m distance between each, and these were made by nailing shorter (horizontal) stick over the larger (vertical) stick (Kler, 2005). The point count method was followed to record bird species thrice a week/ identification of species and their feeding guilds have been given as per keys given by Ali (1960). The community structure of bird species was calculated as: i. Species richness: Total number of species observed in experimental plots; ii. Species diversity calculated as Shannon- Weiner Index; iii. Relative abundance calculated by formula: Ni/ N × 100. Where, Ni is number of birds of the ith species. N is the total bird population observed; and iv. Species evenness: Species evenness was calculated by the formula: J = H/H'max. Where H denotes observed species diversity and H'max

denotes log of bird species richness (Krebs et al., 1985). Data was subjected to ANOVA followed by paired t-test to compare the feeding guilds and bird species using SPSS-25 software.

RESULTS AND DISCUSSION

The present study was conducted to observe the difference in bird feeding guilds and overall bird diversity with and without integration of T-perches in maize. A total of 39 bird species (12 orders and 24 families) and 36 bird species (12 orders and 24 families) were in T-perches installed plot and control plot, respectively. The most dominant order was Passeriformes (38%) (Table 1). Overall insectivorous bird species number was higher (18) in T-perches installed plot than in the control plot (15). These findings are similar to those of Kler (2005) in Bt cotton. Bird species richness of other feeding guilds (carnivorous, omnivorous, granivorous and nectarivorous) was similar in both T-perches installed plot and control plot. A total of 18 bird species were observed utilizing T-perches in combined data of studied crop stages, out of which 14 were insectivorous followed by 2 omnivorous and 1 granivorous bird species. Insectivorous birds were more species rich in the T-perches installed plot (18, 13, and 13) than control plot (9, 10, and 10). Three insectivorous bird species (Indian Robin, White-browed Wagtail, and Yellow Wagtail) were exclusive at the initial vegetative stage of the T-perches installed plot only. Species richness was slightly higher (7) at the knee-height stage of the control plot than T-perches installed plot (6) (Table 2). Avian feeding guilds exhibited significant differences in both T-perches installed and control plots. While stagewise analysis revealed no significant differences.

Overall, the most dominant avian feeding guilds were insectivorous (47.12%) and omnivorous (40.84%). The abundance of insectivorous bird species was 52.62%, 44.57%, and 44.18% at the initial vegetative, knee-height, and mature vegetative stage in fields installed with T-perches, respectively. Whereas the insectivorous bird species abundance in the control plot was 26.76%, 20.56 5, and 39.75% at initial vegetative, knee-height, and mature vegetative stages respectively (Table 3). It is evident from the above finding that T-perches contributed as additional sites for insectivorous birds thereby helping them in prey-hunting.

At the initial vegetative stage, the most dominant bird species were house crow (18.08 %) followed by black drongo (14.60%) and other abundant species utilizing T-perches. House Crow (17.58 %) followed by both Common Tailorbird and Common Myna (13.19%) were found most abundant species at the mature vegetative stage utilizing T-perches (Table 1). ANOVA revealed that bird species were significantly different at all the stages of T-perches installed plot. Stage-wise analysis revealed non-significant difference among all the stages. Bird species utilizing T-perches at the mature vegetative stage of the crop were significantly different from both initial vegetative and knee-height stage. However, bird species utilizing T-perches at the initial vegetative stage exhibited non-significant differences from the knee-height stage of T-perches installed plot. The initial vegetative stage was found to be having maximum species diversity (3.52) followed by both the knee-height stage (3.43) and mature vegetative stage (3.43) in the T-perches installed plot which was greater than the species diversity at the initial vegetative (3.09), knee-height (3.29) and mature vegetative stage (3.25) of control plot. Species richness was found higher at the initial vegetative stage (34), knee-height stage (31), and mature vegetative stage (31) of the T-perches plot (34) as compared to the same stages (22, 27, and 26, respectively) of control plot (Table 4).

The abundance of black drongo at the initial vegetative stage, knee-height stage, and mature vegetative stage of the plot installed with T-perches was higher (13.06%, 9.31%, and 9.88%, respectively) compared to control plots. Asokan and Ali (2010) observed that white-throated kingfishers and black drongos watched their prey from the apexes or vintax points of trees. Black drongos were observed in groups as well as singly perching in the T-perches plots showing similar observations to Kaur and Kler (2018). According to Sidhu and Kler's (2018) findings, black drongo preferred agricultural farms more than orchards. At the initial vegetative stage of the T-perches plot, the most abundant species was house crow (14.1%). These observations contrdict with those of Chand (2005) in cabbage and by Kaur and Kumar (2021) in barseem crop which mentioned common myna as the most abundant species. The most abundant species at the knee-height stage of the T-perches plot were common myna (10.79%) followed by house crow (10.24%) and then black drongo (9.31%). These observations were correspondent to the results of Chand (2005). House crow (16.88%) was observed as the most abundant species followed by common myna (15.25%) and then black drongo (9.88%) at the mature vegetative stage of the T-perches plot (Table 4). On the other hand, the most abundant bird species at the initial vegetative stage of control plot were found to be house crow (13.95%)

Table 1. Overall avian diversity and composition observed in maize (PAU Ludhiana, Punjab)

Order	Family	common name	Scientific name	Status in Punjab	Residential status	IUCN status	Feeding guild	Observed at stages
Accipitriformes	Accipitridae	Black kite	*Milvus migrans*	VC	R	LC	C	IV, KH, MV
		Black-winged kite	*Elanus caeruleus*	C	R	LC	C	IV, KH, MV
Bucerotiformes	Upupidae	Common hoopoe	*Upupa epops*	C	RM	LC	I	IV, KH, MV
Charadriiformes	Recurvirostridae	Black winged stilt	*Himantopus himantopus*	VC	R	LC	I	IV, KH, MV
	Charadriidae	Red-wattled lapwing	*Vanellus indicus*	VC	R	LC	I	IV, KH, MV
Columbiformes	Columbidae	Eurasian collard dove	*Streptopelia decaocto*	VC	R	LC	G	V
		Little brown dove	*Stigmatopelia senegalensis*	VC	R	LC	G	IV, KH, MV
		Rock pigeon	*Columba livia*	VC	R	LC	G	IV, KH, MV
Coraciiformes	Alcedinidae	White-throated kingfisher	*Halcyon smyrnensis*	VC	R	LC	I	IV, KH, MV
	Meropidae	Green bee-eater	*Merops orientalis*	VC	R	LC	I	IV, KH, MV
	Coraciidae	Indian roller	*Coracias benghalensis*	C	R	LC	I	IV, KH, MV
Cuculiformes	Cuculidae	Asian koel	*Eudynamys scolopaceus*	C	R	LC	O	IV, KH, MV
		Greater coucal	*Centropus sinensis*	C	RM	LC	C	IV, KH, MV
Galliformes	Phasianidae	Grey francolin	*Francolinus pondicerinus*	C	R	LC	O	IV, KH
		Indian peafowl	*Pavo cristatus*	C	R	LC	O	IV, KH, MV
Passeriformes	Cisticolidae	Common tailorbird	*Orthotomus sutorius*	VC	R	LC	I	IV, KH, MV
	Dicruridae	Black drongo	*Dicrurus macrocercus*	VC	R	LC	I	KH, MV
	Motacillidae	Paddy field pipit	*Anthus rufulus*	VC	R	LC	I	IV, KH, MV
		White wagtail	*Motacilla alba*	C	RM	LC	I	IV, KH, MV
		White-browed wagtail	*Motacilla maderaspatensis*	C	R	LC	I	IV, KH, MV
		Yellow wagtail	*Motacilla flava*	C	RM	LC	I	IV, KH
	Muscicapidae	Brown rock chat	*Oenanthe fusca*	C	RM	LC	I	IV
		Indian robin	*Saxicoloides fulicata*	VC	R	LC	I	IV, KH, MV
		Pied bushchat	*Saxicola caprata*	C	R	LC	I	IV, KH, MV
	Nectariniidae	Purple sunbird	*Cinnyris asiaticus*	VC	R	LC	N	IV, KH, MV
	Timaliinae	Jungle babbler	*Turdoides striatus*	VC	R	LC	I	IV, KH, MV
	Passeridae	House sparrow	*Passer domesticus*	C	R	LC	O	IV, KH, MV
	Sturnidae	Common myna	*Acridotheres tristis*	VC	R	LC	O	IV, KH, MV
		Asian pied starling	*Sturnus contra*	VC	R	LC	O	IV, KH, MV
		Bank myna	*Acridotheres ginginianus*	VC	R	LC	O	IV, KH, MV
Passerine	Corvidae	House crow	*Corvus splendens*	VC	R	LC	O	IV, KH, MV
	Pycnonotidae	Red vented bulbul	*Pycnonotus cafer*	VC	R	LC	I	IV, KH, MV
Pelecaniformes	Threskiornithidae	Glossy ibis	*Plegadis falcinellus*	LC	RM	LC	C	IV, KH, MV
		Red naped ibis	*Pseudibis papillosa*	C	R	LC	C	IV, KH, MV
	Ardeidae	Cattle egret	*Bubulcus ibis*	VC	RM	LC	C	IV, KH, MV
		Indian pond heron	*Ardeola grayii*	VC	R	LC	C	IV, KH
		Little egret	*Egret tagarzetta*	C	R	LC	C	IV
Psittaciformes	Psittacidae	Rose-ringed parakeet	*Psittacula krameri*	VC	R	LC	G	IV, KH, MV
Strigiformes	Strigidae	Spotted owlet	*Athene brama*	VC	R	LC	I	IV

M - Resident migrant; IUCN Status: LC – Least Concerned; Feeding guild: O – Omnivorous, I – Insectivorous, G – Granivorous, I/G - Insectivorous/Grainivorous, I/C - Insectivorous/Carnivorous, I/F - Insectivorous/Frugivorous, F/G - Frugivorous/Granivorous (Kler and Kumar 2015); Observed at stages: IV – Initial vegetative, KH-Knee-height, MV- Mature Vegetative

Table 2. Stage-wise relative abundance of bird species utilizing T-perches in maize crop

	Bird species (common name)	Initial vegetative	Knee-height	Mature vegetative	Feeding guild
1	Bank myna	4.17	1.14	3.30	O
2	Black drongo	14.60	20.45	9.89	I
3	Brown rock chat	-	1.70	2.20	I
4	Common hoopoe	1.39	-	6.59	I
5	Common myna	8.35	23.30	13.19	O
6	Common tailorbird	6.26	-	13.19	I
7	Eurasian collared dove	-	1.70	-	G
8	Green bee-eater	9.74	9.66	3.30	I
9	House crow	18.08	20.45	17.58	O
10	Indian robin	0.316	-	-	I
11	Indian roller	1.39	0.57	1.10	I
12	Jungle babbler	13.21	11.93	7.69	I
13	Paddy field pipit	4.87	0.00	5.49	I
14	Pied bushchat	-	0.57	2.20	I
15	Red-vented bulbul	11.82	3.98	9.89	I
16	White-browed wagtail	0.41475	-	-	I
17	White-throated kingfisher	4.87	4.55	4.40	I
18	Yellow wagtail	0.523375	-	-	I
	Species richness	15	12	14	
	Species diversity	2.7	2.48	2.64	
	Species evenness	0.86	0.79	0.91	

Species Richness along with feeding guilds observed

Treatment plot	T-perches plot			Control plot		
Crop stages	Initial vegetative	Knee-height	Mature vegetative	Initial egetative	Knee-height	Mature vegetative
Feeding guilds	Species richness					
Carnivorous	7	6	6	5	7	5
Granivorous	3	4	4	4	3	3
Insectivorous	18	13	13	9	10	10
Nectarivorous	1	1	1	1	1	1
Omnivorous	6	7	7	6	6	7
Total No. of species	35	31	31	25	27	26

followed by common myna (13.08%) and bank myna (7.25%). At the knee-height stage, the most abundant bird species was house crow (15.11%) followed by common myna (13.61%) and purple sunbird (7.46%). The most abundant bird species at the mature vegetative stage of the control plot was common hoopoe (13.34%) followed by purple sunbird (9.2%) and grey francolin (9.08%) (Table 4). Bird species were significantly different in both T-perches installed and control plots. Initial vegetative stages of the before-mentioned plots

Table 3. Feeding guilds with avian diversity at different crop stages of maize

Treatment plot	T-perches plot			Control plot		
Crop stages	Initial vegetative	Knee-height	Mature vegetative	Initial vegetative	Knee-height	Mature vegetative
Feeding guilds	Relative abundance (%)					
Carnivorous	16.08	10.42	8.21	10.33	17.7	12.05
Granivorous	1.37	13.75	5.38	16.04	14.16	4.35
Insectivorous	52.62	44.57	44.18	26.76	20.56	39.75
Nectarivorous	0.12	1.41	0.38	0.73	7.46	9.2
Omnivorous	29.95	29.84	41.85	46.19	41.71	34.64

Table 4. Stage wise avian diversity and composition in maize

	Plot		T-perches plot			Control plot		
	Crop stages		Initial vegetative	Knee-height	Mature vegetative	Initial vegetative	Knee-height	Mature vegetative
	Bird species (common name)	Bird species (scientific name)	Relative abundance (%)					
1	Asian koel	*Eudynamys scolopaceus*	0.1	1.7	0.48	0.73	1.47	1.44
2	Asian pied starling	*Sturnus contra*	3.71	2.09	6.31	6.86	5.54	4.23
3	Bank myna	*Acridotheres ginginianus*	3.57	-	0.58	7.25	4.98	8.82
4	Black drongo	*Dicrurusmacrocercus*	13.06	9.31	9.88	4.99	3.27	1.84
5	Black kite	*Milvus migrans*	5.23	3.45	0.38	1.53	1.83	-
6	Black winged stilt	*Himantopus himantopus*	-	1.72	-	-	1.08	-
7	Black winged-kite	*Elanus caeruleus*	1.07	1.62	2.91	1.83	-	2.12
8	Brown rock chat	*Oenanthe fusca*	3.12	2.9	1.05	-	-	2.05
9	Cattle egret	*Bubulcus ibis*	4.21	2.01	0.58	3.7	7.1	4.2
10	Common hoopoe	*Upupa epops*	0.98	1.81	4.87	3.14	-	13.34
11	Common myna	*Acridotheres tristis*	8.36	10.79	15.25	13.08	13.61	2.36
12	Common tailorbird	*Orthotomus sutorius*	2.76	2.92	1.46	1.47	-	4.53
13	Eurasian collared dove	*Streptopelia decaocto*	0.63	3.91	1.63	6.06	6.82	2.94
14	Glossy ibis	*Plegadis falcinellus*	2.33	-	-	-	1.34	-
15	Greater coucal	*Centropus sinensis*	-	0.92	2.63	1.54	1.49	2.52
16	Green bee-eater	*Merops orientalis*	7.23	4.28	2.8	3.06	1.63	-
17	Grey francolin	*Francolinus pondicerianus*	-	1.73	0.3	-	1	9.08
18	House crow	*Corvus splendens*	14.1	10.24	16.88	14.95	15.11	7.94
19	House sparrow	*Passer domesticus*	-	2.42	2.05	3.32	-	-
20	Indian peafowl	*Pavo cristatus*	0.11	0.87	-	-	-	0.77
21	Indian pond heron	*Ardeola grayii*	0.42	-	-	-	1.52	-
22	Indian robin	*Saxicoloides fulicata*	0.32	-	-	-	-	-
23	Indian roller	*Coracias benghalensis*	3.63	1.22	0.96	-	0.5	7.5
24	Jungle babbler	*Argya striata*	5.66	5.19	3.87	2.64	5.32	2.54
25	Little brown dove	*Spilopelia senegalensis*	0.27	3.34	1.44	0.53	-	0.49
26	Little egret	*Egretta garzetta*	0.97	0.86	0.86	-	2.47	1.59
27	Paddy field pipit	*Anthus rufulus*	1.56	1.93	2.52	5.21	2.43	1.59
28	Pied bushchat	*Saxicola caprata*	2.64	1.58	2.23	0.78	-	1.62
29	Purple sunbird	*Cinnyris asiaticus*	0.12	1.41	0.38	0.73	7.46	9.2
30	Red naped ibis	*Pseudibis papillosa*	1.85	1.56	0.85	1.73	1.95	1.62
31	Red-vented bulbul	*Pycnonotus cafer*	2.32	4.75	0.48	-	1.57	0.61
32	Red-wattled lapwing	*Vanellus indicus*	6.17	5.05	8.87	5.1	1.56	4.13
33	Rock pigeon	*Columba livia*	0.47	5.46	1.73	7.25	2.47	-
34	Rose-ringed parakeet	*Psittacula krameri*	-	1.04	0.58	2.2	4.87	0.92
35	Spotted owlet	*Athene brama*	1.11	0.6	0.19	0.37	-	-
36	White wagtail	*Motacilla alba*	0.8	-	-	-	2.81	-
37	White-browed wagtail	*Motacilla maderaspatensis*	0.42	-	-	-	-	-
38	White-throated kingfisher	*Halcyon smyrnensis*	0.31	1.31	5	-	0.39	-
39	Yellow wagtail	*Motacilla flava*	0.53	-	-	-	-	-
	Species richness		34	31	31	22	27	26
	Species diversity		3.52	3.43	3.43	3.09	3.29	3.25
	Species evenness		0.85	0.9	0.82	0.88	0.89	0.9

showed significantly different results through paired t-test. But knee-height stage and mature vegetative stage exhibited non-significant difference in both type of plots. Most of the bird species (23) were observed as very common (VC) followed by common (C) (15) and less common (LC) (1) according to their status in Punjab. Residential status of bird species has shown that most species were resident and least were resident migratory. IUCN status was found least concern of all the observed bird species (Kler and Kumar, 2015) (Table 1).

Overall observations revealed that a greater number of bird species were found foraging in plots with T-perches and most of them were insectivorous indicating that the perches attracted foraging birds and these proved efficient in increasing avian diversity. Plots with T-perches were preferred by most of the

insectivorous birds. Similar findings were found in soybean fields of Australia, where T-perches were installed to increase the useful area for birds and it resulted in the decline of pests (Lindell et al., 2018). For thousands of years, birds have been used in agriculture. They, along with other native predatory animals, are rarely able to eradicate a pest issue, but they could be a component of an IPM strategy. According to Nyffeler et al. (2018), 400–500 mt of insects are consumed annually by insectivorous birds, with 28 mt (or 7% of the total) being from agricultural regions. Ecological pest-control strategies, such as using insectivorous birds, are now being used by farmers who are professionals with IPM ideas (Seni and Halder, 2022). The present study suggests that the utilization of T-shaped perches is one of the ecofriendly or inexpensive technology for farmers.

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AUTHOR CONTRIBUTION STATEMENT

First Author Khushdeep Kaur has carried out field work as MSc student, second Dr Tejdeep Kaur Kler has conceptualized and supervised the study as major advisor and third author Dr Surinder Kaur Sandhu has facilitated in the execution of research problem.

CONFLICT OF INTEREST

No conflict of interest.

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