Indian Journal of Entomology 86(2): 456-461 (2024) DoI. No.: 10.55446/IJE.2023.785

AVIAN FEEDING GUILDS IN WINTER AND RAINY CROP SEASONS OF GUAVA

Shilpa[1]*, Tejdeep Kaur Kler[1] and Gagandeep Kaur[2]

[1]Department of Zoology; [2]Department of Fruit Science, Punjab Agricultural University, Ludhiana 141004, Punjab, India
*Email: shilparora31@gmail.com (corresponding author): ORCID ID 0000-0002-3232-3360

ABSTRACT

A comparative study was conducted on avian feeding guilds in winter and rainy crop seasons of guava at Punjab Agricultural University campus, Ludhiana, Punjab, during 2021-22. A total of 53 bird species belonging to 46 genera, 31 families and 13 orders were noted during the study period. The recorded bird species were classified into six feeding guilds. Except for insectivore, carnivore and omnivore birds, 13 species were recorded to play no beneficial role in the combined data of winter and rainy crop seasons. Relative abundance of insectivore bird species was found to be 40.34% at flowering stage, 25.44% at fruit set stage and 13.92% at fruit ripening stage in winter crop season; 35.43% at flowering stage, 26.35% at fruit set stage and 14.21% at fruit ripening stage in rainy crop season. Major feeding groups of omnivore and frugivore species were noted during the fruit ripening stage of both seasons. During rainy crop season, nine bird species were observed feeding on insects. A statistical analysis of avian feeding guilds using the T-test revealed a significant difference in flowering and fruit ripening stages of guava crop seasons in the winter and rainy seasons

Key words: Bird composition, Ludhiana, fruit developmental stages, flowering stage, fruit development stage, fruit ripening stage, insectivores, omnivores, carnivores, Passeriformes, relative abundance

Agriculture provides essential nutrients to global diet (Cribb, 2014). According to the report released by ministry of agriculture, India has shown the highest ever increase of 3% in the production of horticultural and agricultural crops in 2020-21 compared to previous years. Different fruit crops require favourable levels of light, moisture, temperature, and other environmental conditions for optimal growth and development (Gotame et al., 2018). Orchard systems with a wide variety of plants and a perennial multi-strata design provide abundant resources and habitat for birds and other species (Simon et al., 2011). Among various Indian fruit crops, guava holds fourth position in terms of productivity and in Punjab occupies nearly 8689 ha of the total area. Further, Uttar Pradesh is the leading producer of guava followed by Andhra Pradesh and Bihar (Anonymous, 2018). The fruit of guava is round to ovate or a pear-shaped berry, white or yellow at maturity with yellow or dark pink flesh having numerous seeds; various physical parameters of guava cultivation are the effect of pruning time, pruning intensity and bagging (Singh et al., 2021). The crop is grown in two seasons i.e., rainy and winter. The rainy season crop suffers greatly from bird and insect infestation and is often less preferred by the farmers (Sharma et al., 2020). The likelihood of feeding behaviour of bird species varies across different habitat types, implying that trophic groups respond differently when it comes to human land utilization (Ortega-Álvarez et al., 2021). Birds are often found in almost all agro-ecosystems and their foraging preference usually results in substantial beneficial together with harmful effects on yield of different crops (Sidhu and Kler, 2018). For instance, many insectivore species such as cattle egret, red-wattled lapwing, etc. often help in reducing the insect pest population whereas species such as rose-ringed Parakeet, house crow has shown their depredatory role (da Silva C et al., 2021). The supporting role of different feeding guilds, majorly insectivorus and carnivore speices are still poorly known, especially, in a comparative view of two crop seasons (Martinez-Nunez et al., 2021). So, the current study aims to assess the comparative view of avian feeding guilds and their potential role in winter and rainy crop seasons of guava.

MATERIALS AND METHODS

The present study was carried out at guava orchard of Fruit Research Farm of Punjab Agricultural University campus, Ludhiana, India (75 47` 642E, 30 54` 147N, 235 m asl) from 2021-2022. The point transect method was used to count all the birds at three different developmental stages of the guava crop (Verner,

1985). Bird species visiting guava fields for perching and feeding on fruits, leaves, insects, etc., were noted. Data was collected twice a week in the early and late hours i.e., from 6:00-7:00 am and 5:00-6:00 pm in the rainy and 7:00-8:00 am and 4:00-5:00 pm in the winter season; when the avian activity is maximum (Bonter et al., 2013). Three guava fields (F1, F2 and F3) were selected during the winter and rainy crop seasons to compare the bird composition at flowering, fruit set and fruit ripening stages. Bird species were observed using Bushnell binocular (7x50) and photographed using Nikon D90 having 12.3 megapixels. Bird identification and categorisation was done according to their feeding preferences and food availability (Ali, 2002). A complete checklist (Table 1) of recorded bird species was made referring to nomenclature given by Praveen et al. (2016). ANOVA (analysis of variance) and T-test were carried out on the calculated relative abundance of different bird species at three developmental stages of rainy crop season. Further, ANOVA and T-test were also used to compare the relative abundance of birds according to their six feeding guilds and 13 orders at three different developmental stages.

RESULTS AND DISCUSSION

A total of 53 species of birds were noted in both winter and rainy crop seasons of guava during the study period. Out of observed species, 26 were insectivores, 4 carnivores and 10 omnivores which seem to have biocontrol potential and 6 were observed to be frugivore species responsible for fruit damage. Species richness at three development stages came out to be 24, 21 and 25 in the winter crop season; 28, 28, 25 in the rainy crop season respectively. Most abundant species were found to be house crow at flowering stage, rose-ringed parakeet at fruit set as well as fruit ripening stage (Table 1). Comparative bird community characteristics at studied stages of fruit development showed significant statistical difference in winter and rainy crop seasons of guava, respectively.

Although insectivore feeding guild was dominant in abundance at flowering stage in both crop seasons, it was more abundant in winter crop season. During rainy season, insects like fruit fly, grasshopper, tea mosquito bug, blister beetle, black ants, yellow wasp and honey bees were observed in the guava orchard and their presence seemed to support insectivore and omnivore bird population. Insectivore bird species particularly green bee-eater was observed to be mainly feeding on fruit flies and honey bees. House crow, common myna, common hoopoe, red-wattled lapwing, cattle egret and greater coucal were found to be feeding on black ants on ground during rainy season. Black drongo was observed to capture and feed on grasshoppers, bees, wasps and beetles. Robins were spotted feeding on bugs and ants.

Relative abundance of omnivore feeding guild was highest at fruit set and fruit ripening stages in both crop seasons (Table 2). Abundance of carnivore group was higher at all three studied stages in rainy crop season compared to stages of winter crop season. Overall relative abundance of carnivore species might be positively associated with availability of large tree and shrub area which further regulates other trophic levels of food chain. Also, frugivore feeding guild was observed to be good in abundance in both winter and rainy crop season at all three studied stages. Similar trend was observed in granivore guild in both crop seasons. Further, least abundant group was found to be nectarivore at all three stages of fruit development. Significant difference in relative abundance of bird species belonging to six feeding guilds was observed in both winter and rainy crop seasons at three stages. T-test revealed significant difference between feeding guilds at flowering and fruit ripening stages.

Relative abundance of bird species belonging to the order Passeriformes in both winter and rainy crop seasons was the highest at all three stages. Out of bird species belonging to passeriformes, house crow and common myna were the most abundant followed by the Eurasian-collared dove (columbiformes) in the winter and cattle egret (pelecaniformes) in the rainy crop season (Table 2). ANOVA showed significant difference between the relative abundance of bird species belonging to 13 orders at three different developmental stages of guava fruit in winter crop season.

According to the present study, insectivore species were dominant at the flowering stage, while frugivores and omnivores dominated the fruit set and fruit ripening stages of both studied crop seasons. Sidhu and Kler (2018) also stated that more frugivorous and granivorous birds visited the guava crops at the fruit ripening stage and were responsible for the crop damage. The present study observed 53 bird species at three developemental stages of guava crop during the study period. Sidhu and Kler (2018) also observed 34 bird species in the guava orchard in Ludhiana. Kaur and Kler (2019) also discussed that various fruit tree species and habitat characteristics might attract carnivorous feeding guild to fruit orchards for roosting, perching and other

Table 1. Comparative bird community characteristics with respective order, family and feeding guilds at three fruit developmental stages of guava

						Winter crop season			Rainy crop season		
		Fruit developmental stages				Flowering stage (Oct-Nov)	Fruit Set stage (Nov-Dec)	Fruit Ripening (Dec-Jan)	Flowering stage (June-July)	Fruit set stage (July-Aug)	Fruit ripening stage (Aug-Sept)
S. No.	Bird species	Scientific name	Order	Family	Feeding habits	Relative abundance (%)					
1	Alexandrine parakeet	*Psittacula eupatria*	Psittaciformes	Psittacidae	F	0.00	0.73	3.92	2.09	3.79	6.02
2	Ashy drongo	*Dicrurus leucophaeus*	Passeriformes	Dicruridae	I	0.00	0.00	0.07	4.02	1.51	0.49
3	Asian koel	*Eudynamys scolopaceus*	Cuculiformes	Cuculidae	F	0.00	0.00	0.00	0.16	0.75	1.05
4	Asian pied starling	*Gracupica contra*	Passeriformes	Sturnidae	O	1.68	1.47	3.14	3.38	1.26	1.49
5	Bank myna	*Acridotheres ginginianus*	Passeriformes	Sturnidae	O	1.05	5.32	5.42	2.41	2.53	1.67
6	Black drongo	*Dicrurus macrocercus*	Passeriformes	Dicruridae	I	5.88	3.40	0.14	1.44	1.01	0.86
7	Black kite	*Milvus migrans*	Accipitriformes	Accipitridae	C	0.42	0.88	0.92	3.05	3.79	2.98
8	Black redstart	*Phoenicurus ochruros*	Passeriformes	Muscicapidae	I	0.00	0.44	0.57	0.00	0.00	0.00
9	Black-winged kite	*Elanus caeruleus*	Accipitriformes	Accipitridae	C	0.00	0.14	0.07	0.00	0.00	0.00
10	Brahmny myna	*Sturnia pagodarum*	Passeriformes	Sturnidae	O	0.00	0.00	0.00	0.00	0.00	0.49
11	Brown-headed barbet	*Psilopogon zeylanicus*	Piciformes	Megalaimidae	F	0.00	0.00	0.35	0.16	0.12	0.31
12	Brown rock chat	*Oenanthe scotocerca*	Passeriformes	Muscicapidae	I	0.00	0.00	0.00	0.00	0.12	0.00
13	Cattle egret	*Bubulcus ibis*	Pelecaniformes	Ardeidae	I	4.20	1.33	0.21	10.78	3.41	2.79
14	Common babbler	*Argya caudata*	Passeriformes	Leiothrichidae	I	0.00	0.00	0.00	4.83	2.78	0.55
15	Common hoopoe	*Upupa epops*	Bucerotiformes	Upupidae	I	5.04	0.44	0.07	1.61	0.88	0.62
16	Common myna	*Acridotheres tristis*	Passeriformes	Sturnidae	O	7.14	13.01	9.27	7.24	6.32	12.29
17	Common starling	*Sturnus vulgaris*	Passeriformes	Sturnidae	O	0.00	0.00	0.85	0.00	0.00	0.00
18	Common tailorbird	*Orthotomus sutorius*	Passeriformes	Cisticolidae	I	0.21	0.00	0.00	0.64	0.00	0.06
19	Eurasian collared dove	*Streptopelia decaocto*	Columbiformes	Columbidae	G	9.66	11.39	9.77	12.72	13.29	13.66
20	Eurasian stone-curlew	*Burhinus oedicnemus*	Charadiformes	Burhinidae	O	0.00	0.00	0.00	0.00	0.00	0.00
21	Greater coucal	*Centropus sinensis*	Cuculiformes	Cuculidae	I	0.84	0.29	0.07	0.80	0.12	0.12
22	Green bee-eater	*Merops orientalis*	Coraciformes	Meropidae	I	1.26	0.14	0.00	2.57	3.79	1.30
23	Grey frankolin	*Francolinu spondicerianus*	Galliformes	Phasianidae	I	6.72	6.36	3.92	0.96	2.27	0.62
24	House crow	*Corvus splendens*	Passeriformes	Phasianidae	O	20.58	9.91	17.13	14.97	16.45	16.70
25	House sparrow	*Passer domesticus*	Passeriformes	Passeridae	G	0.00	0.44	0.49	0.64	0.12	0.00
26	Indian black Ibis	*Pseudibis papillosa*	Pelecaniformes	Threskiornithidae	I	6.72	1.47	1.14	1.12	2.40	0.00
27	Indian grey Hornbill	*Ocyceros birostris*	Bucerotiformes	Bucerotidae	F	0.00	0.00	0.78	0.16	0.63	0.55
28	Indian peafowl	*Pavo cristatus*	Galliformes	Phasianidae	O	0.00	0.00	0.00	0.00	2.40	0.43
29	Indian pond Heron	*Ardeola grayii*	Pelecaniformes	Ardeidae	O	0.21	0.14	0.07	0.00	0.12	0.06
30	Indian roller	*Coracias benghalensis*	Coraciiformes	*Coracias benghalensis*	I	1.68	1.33	0.78	0.00	0.50	0.37
31	Large grey babbler	*Argya malcolmi*	Passeriformes	Leiothrichidae	I	0.00	1.77	1.28	0.00	0.00	0.00

(contd.)

(Table 1 contd.)

32	Laughing dove	*Streptopelia senegalensis*	Columbiformes	Columbidae	G	1.47	0.73	0.28	0.80	0.50	0.00
33	Little Egret	*Egretta garzetta*	Pelecaniformes	Ardeidae	I	0.21	0.00	0.14	0.16	0.00	0.00
34	Oriental magpie robin	*Copsychus saularis*	Passeriformes	Muscicapidae	I	0.00	0.00	0.00	0.32	0.00	0.00
35	Pied bush chat	*Saxicola caprata*	Passeriformes	Muscicapidae	I	0.00	0.00	0.00	0.32	0.00	0.00
36	Pied cuckoo	*Clamatorjacobinus*	Cuculiformes	Cuculidae	I	0.00	0.00	0.00	0.00	0.12	0.00
37	Plain prinia	*Priniainornata*	Passeriformes	Cisticolidae	I	5.04	3.99	2.06	0.00	0.00	0.00
38	Purple sunbird	*Cinnyris asiaticus*	Passeriformes	Nectariniidae	N	0.00	0.00	0.00	0.80	1.89	1.73
39	Red-wattled lapwing	*Vanellus indicus*	Charadiformes	Charadriidae	I	2.52	3.25	2.42	1.61	4.17	1.73
40	Rock pigeon	*Columba livia*	Columbiformes	Columbidae	G	2.10	11.83	6.35	0.64	1.26	2.79
41	Rose-ringed parakeet	*Psittacula krameri*	Psittaciformes	Psittaculidae	F	14.07	17.75	26.05	12.88	17.72	22.91
42	Rufous treepie	*Dendrocitta vagabunda*	Passeriformes	Corvidae	F	0.21	0.00	0.00	0.00	0.25	0.49
43	Scaly-breasted munia	*Lonchura punctulata*	Passeriformes	Estrildidae	I	0.00	0.00	0.00	0.16	0.00	0.00
44	Shikra	*Accipiter badius*	Accipitriformes	Accipitridae	C	0.00	0.00	0.00	0.16	0.00	0.00
45	Spotted dove	*Spilopelia chinensis*	Columbiformes	Columbidae	G	0.21	0.00	0.00	0.00	0.00	0.00
46	Spotted owl	*Strix occidentalis*	Strigiformes	Strigidae	C	0.00	0.00	0.64	1.61	0.63	0.18
47	White-breasted waterhen	*Amaurornis phoenicurus*	Gruiformes	Rallidae	I	0.00	0.00	0.00	0.00	0.12	0.00
48	White-throated Kingfisher	*Halcyon smyrnensis*	Coraciformes	Alcedinidae	O	0.84	0.73	0.49	0.64	0.63	0.24
49	White wagtail	*Motacilla flava*	Passeriformes	Motacillidae	I	0.00	0.59	0.57	0.00	0.00	0.00
50	White-browed wagtail	*Motacilla maderaspatensis*	Passeriformes	Motacillidae	I	0.00	0.44	0.42	0.00	0.00	0.00
51	Wire-tailed swallow	*Hirundo smithii*	Passeriformes	Hirundinidae	I	0.00	0.00	0.00	4.02	2.02	4.28
52	Yellow-legged green Pigeon	*Treron phoenicopterus*	Columbiformes	Columbidae	G	0.00	0.00	0.00	0.00	0.12	0.00
53	Yellow wagtail	*Motacilla flava*	Passeriformes	Motacillidae	I	0.00	0.14	0.00	0.00	0.00	0.00
Species richness						24	21	25	28	28	25
Species diversity						3.18	3.02	3.20	3.32	3.32	3.23
Species evenness						0.80	0.72	0.69	0.78	0.73	0.69

C: Carnivores; O: Omnivores; I: Insectivore; F: Frugivores; G: Granivores; N: Nectarivores

Table 2. Relative abundance (%) of bird feeding guilds and bird species in guava

	Winter crop season			Rainy crop season		
Fruit developmental stages	Flowering stage (Oct-Nov)	Fruit Set stage (Nov-Dec)	Fruit ripening (Dec-Jan)	Flowering stage (June-July)	Fruit set stage (July-Aug)	Fruit ripening (Aug-Sept)
Feeding guilds	Relative abundance (%)					
Carnivore	0.42	1.04	1.64	4.83	4.61	3.25
Frugivore	14.29	18.49	31.12	15.46	20.16	29.57
Granivore	13.45	24.41	16.92	14.81	15.94	16.89
Insectivore	40.34	25.44	13.92	35.43	26.35	14.21
Nectarivore	0.00	0.00	0.00	0.81	1.98	1.78
Omnivore	31.51	30.62	36.4	28.66	30.96	34.29
Orders	Relative abundance (%)					
Accipitriformes	0.83	1.03	0.18	0.72	0.00	1.40
Bucerotiformes	4.98	0.44	0.27	2.88	3.20	1.85
Charadiformes	3.32	4.12	4.80	7.91	7.10	2.35
Columbiformes	13.28	23.86	13.57	2.01	5.92	6.65
Coraciformes	3.73	2.21	2.62	1.58	2.96	5.40
Cuculiformes	0.83	0.29	0.09	0.86	1.66	1.35
Galliformes	6.64	6.33	3.53	2.30	2.72	0.85
Gruiformes	0.00	0.00	0.00	0.00	0.12	0.20
Passeriformes	41.29	40.35	50.23	55.4	42.72	44.93
Pelecaniformes	11.20	2.95	0.45	13.81	5.56	3.95
Piciformes	0.00	0.00	0.27	0.14	0.12	3.35
Psittaciformes	13.90	18.41	23.53	11.51	27.69	27.74
Strigiformes	0.00	0.00	0.45	0.86	0.24	0.00

purposes. A study of Amin et al. (2019) conducted in the agroforestry field of Bangabandhu Sheikh Mujibur Rahman Agricultural University, Gazipur, Bangladesh suggested that guava orchards showed a much higher abundance of scale insects and two species of fruit flies Da silva et al. (2021) mentioned that the occurrence of insectivore, granivore and omnivore species in guava orchards is similar to the pattern reported in other anthropogenic habitats of tropical region. Findings of a study conducted at Punjab Agricultural University, Ludhiana by Sharma et al. (2022) suggested that fruit flies *(Bactrocera* spp.) were observed as the main insect pest of guava that results in decreased fruit production.

The present study highlights avian feeding guilds in winter and rainy crop seasons during developmental stages of guava. Insectivore, carnivore and omnivore feeding guilds reveal significant biocontrol potential in guava orchard; therefore, there is a need to encourage their undisturbed survival and conservation possibilities. The impact of diverse avian groups can only be adequately addressed by evaluating the role of insectivore bird population and stressing their conservation strategies while managing depredatory avian groups. Further, it may be concluded that there is a need to focus on the dual role of insectivore and omnivore bird species, which are majorly responsible for stability of the overall ecosystem.

ACKNOWLEDGEMENTS

Authors acknowledge the Head, Department of Zoology, Punjab Agricultural University, Ludhiana for providing necessary facilities. Thanks are also extended to the Indian Council of Agricultural Research, New Delhi.

FINANCIAL SUPPORT

There was no financial support obtained from any sponsor or agency.

AUTHOR CONTRIBUTION STATEMENT

Conceptualization of research (SHILPA, TK, GK); Designing of the experiments (SHILPA, TK); Contribution of experimental materials and Execution of field/lab experiments and data collection (SHILPA, TK, GK); Analysis of data and interpretation (PS, TK); Preparation of the manuscript (SHILPA, TK, GK).

CONFLICT OF INTEREST

No conflict of interest.

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(Manuscript Received: September, 2022; Revised: March, 2023;
Accepted: May, 2023; Online Published: June, 2023)
Online First in www.entosocindia.org and indianentomology.org Ref. No. e23785