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Avifaunal diversity in Egyptian clover (*Trifolium alexandrinum*) crop fields of Ludhiana, India

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Abstract
Egyptian clover or Berseem (*Trifolium alexandrinum*) is a winter season leguminous fodder crop. The study was carried out at agricultural field areas in district Ludhiana of Punjab state. Avifaunal diversity in berseem crop was studied and a total of 25 species of birds were observed. These bird species recorded belongs to 9 orders and 20 families. The most dominant order was Passeriformes (52%), followed by Pelecaniformes (12%). Based on the status of birds, 76% of the bird spices observed was resident and 24% were resident migrant. Insectivorous bird species were dominant in berseem crop throughout the study. Maximum species richness was recorded in the month of January, February and April. Common Myna was most dominant bird species. Egyptian clover acts an important habitat for bird species and the presence of the higher relative abundance of insectivorous birds in this crop do have positive role in controlling insect pest population and ultimately helpful in intensive agro-ecosystem.

Keywords: Egyptian clover berseem crop, avifauna, seasonal abundance, insectivorous birds, for aging guild

Introduction

Egyptian clover or Berseem (*Trifolium alexandrinum*) is a leguminous, annual, multi-cut, nitrogen-fixing, succulent, and palatable fodder crop [1]. As the quality of fodder crops is a very important input for the white revolution i.e. for more milk production [2]. Due to the continuous increase in population. This forage crop is superior in protein and mineral content as compared to other forage crops [3]. Berseem is heavily invaded by most destructive pest i.e. cotton bollworm (*Helicoverpa armigera*), larvae of this pest damages developing seed heads of berseem and flower buds; larvae of this pest feeds on the apical portion of inflorescence and destroy it partially or wholly [4]. Ecosystem services provided by insectivorous birds are also a significant component as natural regulators of harmful insects, and their mobility allows them to respond numerically to pest population increase [5].

India ranks among the top ten countries of the world due to the vast number of bird species [6]. The terrestrial landmass of India is 2.2% of the world but still, it harbours 12.5% of avian fauna; the reason for remarkable diversity is not just one but a combination of factors i.e., particular ecological, biogeographical history, heterogeneity in physical characters, and a high degree of eco-climatic variations that range from temperate to tropical [7]. It is the behaviour of the birds that they predate their prey, near perching site. Because it is easy for birds to attack and saves the energy of the birds. Birds do have various dietary habits but for integrated pest management insectivorous birds are of interest. Most of the bird species present in Punjab are insectivorous so they are dependent on insects as prey [8, 9]. Regulation of pests by promoting their natural enemies is the ideology that offers sustainable agricultural management as it promotes ecosystem services and biodiversity [10].

However, in the past 50 years, broad-spectrum conventional insecticides such as organophosphates, pyrethroids, organochlorines, and carbamates as a pest control tactic, had been adopted by the farmers. It is crystal clear by the scientific knowledge that chemical pesticide adversely affects the environment, a resurgence has reached crisis proportions and the problem of resistance in pests have emerged [11]. To protect crops, there is a need to reduce the use of pesticides and novel methods are needed to be adapted in Integrated Pest Management. All over the world, biological control is an important pest management approach. Structural complexity is promoted by perches and also aids in increased local biodiversity [12]. By supplementing artificial T-perches, predation of insects by birds can be increased, and ultimately damage to crops by pest drops from 20% to 5% [13].

In chickpea, birds like a babbler, myna, sparrow, cattle egret and black drongo feed on armigera larvae and cause a significant reduction in pod damage with resultant high yield [14]. To effectively utilize these ecosystem services of insectivorous birds in berseem crop, we undertake this study to make a baseline data about the avifaunal diversity in Egyptian clover or berseem crop.

Materials and Methods

Study was conducted in the selected fields of Egyptian clover or berseem (*Trifolium alexandrinum*) cultivar BL 10 fodder crop fields. This variety is of long duration, high nutritive value and yields about 410 quintals per acre green fodder. Berseem crop was raised all according to cultural practices provided in Package and Practices for *Rabi* crops, Directorate of Extension, Punjab Agricultural University, Ludhiana [15]. Berseem seeds are sown by broadcasting method in standing water. Purely berseem seeds were sown in the field no mixture was done with other kind of seeds. No application of pesticide was done at any stage of the crop.

The experiments were conducted at two locations during *Rabi* season

Location 1: Agricultural fields at Punjab Agricultural University (PAU), Ludhiana from November 2019 to April 2020. PAU is located l on 30°59'28.74"N latitude and 75°44'10.87"E longitude having elevation of 229 meters from sea level.

Location 2: Village-Dyalpura, District-Ludhiana during November 2019 to May 2020. This place is on 30°49'41"N latitude and 76°13'24"E longitude and at an elevation of 260m above mean sea level.

Fields were selected in triplicates at both the locations at an approximate distance of 500 m from each other at each location. Approximate area of each field was 4 *kanal* or half acre (2023 meter^2). Sowing was done by broadcasting method in standing water in fields. Prominent crops and plantations surrounding the selected fields at location 1 were wheat (*Triticum aestivum*), sunflower (*Helainthus annus*), guava (*Psidium guajava*), kinnow (*Citrus sinesnsis*) and poplar (*Populous deltoids*) and at location 2 were. Bajra *(Pennisetum glaucum)*, Cucumber *(Cucumis sativus)*, Potato *(Solanum tuberosum)*, Sagwan *(Tectona grandis)* and Wheat *(Triticum aestivum)*. Observations were taken in the morning and evening depending upon the season, as birds has maximum activity during that time. Species in the fields, on vegetations, on the ground and also utilizing perches like poles, electricity wires, trees and other natural perching around fields were recorded and identified based on visual observations which include their morphological characters such as color, size, wings, beak, shape and rest of body parts with the help of binocular (Nikon 10/50) and comparing with those described by Ali [16]. Slandered nomenclature of birds was followed [17]. Birds were also categorized based on the foraging habits [16]. The entire data of all months was pooled and community characteristics were calculated in order to quantify the structure of avifaunal diversity i.e. Relative abundance: - It was calculated by using formula: $Ni/N \times 100$

Where ni is the number of birds of the ith species and N is the total number of birds recorded.

Results and Discussion

A total of 25 bird species recorded belongs to 9 orders and 20 families. Order wise categorization of the bird species recorded revealed that these 25 bird species belongs to nine orders. (Table 1).

Table 1: Avifaunal diversity observed in selected fields of Egyptian clover

S. No.	Common name	Scientific name	Order	Family	Status	Food	IUCN status
1.	Asian Pied Starling	*Sturnus contra*	Passeriformes	Sturnidae	R	I, F	LC
2.	Black Drongo	*Dicrurus macrocercus*	Passeriformes	Dicruridae	R	I	LC
3.	Black Ibis	*Pseudibis papillosa*	Pelecaniformes	Threskiornitiidae	R	I, G	LC
4.	Blue Rock Pigeon	*Columbia livia*	Columbiformes	Columbidae	R	G	LC
5.	Cattle Egret	*Bubulcus ibis*	Pelecaniformes	Ardeidae	RM	I, SI	LC
6.	Common Hoopoe	*Upupa epops*	Bucerotiformes	Upupidae	RM	I	LC
7.	Common Myna	*Acridotheres tristis*	Passeriformes	Sturnidae	R	I, F	LC
8.	Common Stonechat	*Saxicola torquata*	Passeriformes	Turdinae	RM	I	LC
9.	Common Tailorbird	*Orthotomus sutorius*	Passeriformes	Cisticolidae	R	I, P	LC
10.	Eurasian Collared-Dove	*Streptopelia decaocto*	Columbiformes	Columbidae	R	G	LC
11.	Greater Coucal	*Centropus sinensis*	Cuculiformes	Cuculidae	RM	I, SI, SV	LC
12.	House Crow	*Corvus splendens*	Passeriformes	Corvidae	R	O	LC
13.	Indian Pond-Heron	*Ardeola grayii*	Pelecaniformes	Ardeidae	R	I, SI, SV	LC
14.	Indian Roller	*Coracias benghalensis*	Coraciformes	Coraciidae	R	I	LC
15.	Jungle Babbler	*Turdoides striatus*	Passeriformes	Timaliinae	R	I, F	LC
16.	Oriental Magpie-Robin	*Copsychus saularis*	Passeriformes	Turdinae	R	I	LC
17.	Plain Prinia	*Prinia inornata*	Passeriformes	Sylviinae	R	I	LC
18.	Purple Sunbird	*Nectarinia asiaticus*	Passeriformes	Nectariniidae	R	P	LC
19.	Red-vented Bulbul	*Pycnonotus cafer*	Passeriformes	Pycnonotidae	R	I/P/F	LC
20.	Red-wattled Lapwing	*Vanellus indicus*	Charadriiformes	Charadriidae	R	I, SI	LC
21.	Rose-ringed Parakeet	*Psittacula krameri*	Psittaciformes	Psittacidae	R	F, P, G	LC
22.	Streaked Fantail-Warbler	*Cisticola juncidis*	Passeriformes	Sylviinae	RM	I	LC
23.	White-breasted Kingfisher	*Halcyon smyrnensis*	Coraciiformes	Alcedinidae	R	I, SV	LC
24.	White-breasted Waterhen	*Amaurornis phoenicurcus*	Gruiformes	Rallidae	R	I, SI, G, P	LC
25.	Wire-tailed Swallow	*Hirundu smithi*	Passeriformes	Hirundinidae	RM	I	LC

Status: R- Resident (bird species which remains on native place throughout the year); RM- Resident Migrant (bird species which migrates temporarily from their native: Foraging guilds habit: I- Insectivorous; G- Granivorous; F- Fruigivourous; P- Phytophagus; SI- Small Invertebrates eating birds; SV- Small vertebrates eating birds; O- Omnivorous; IUCN status: LC- Least Concern [9].

The most dominant order was Passeriformes (52%), followed by Pelecaniformes (12%) (Fig. 1). Based on the status of birds, 76% of the bird spices observed was resident and 24 were resident migrant i.e. showing local migration [9, 16]. All the twenty five bird species falls under least concern (LC) category of IUCN status.

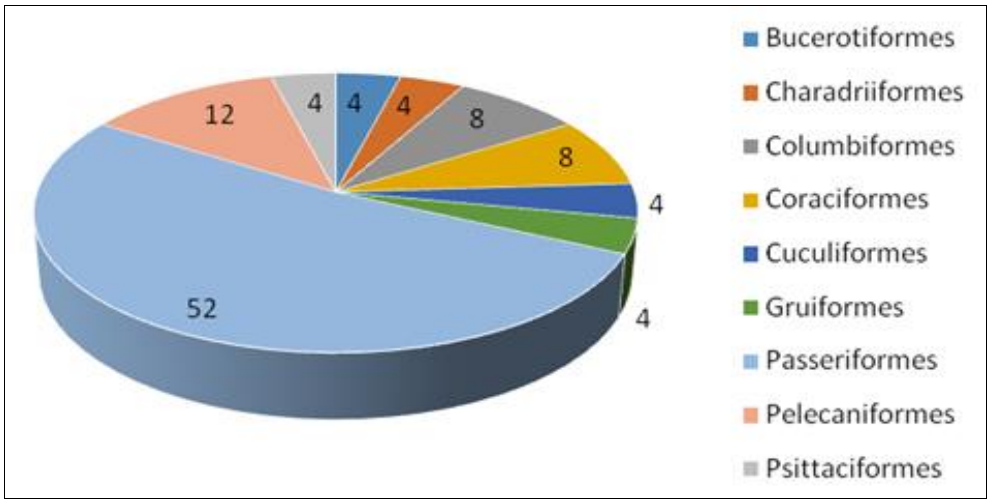

Fig 1: Order wise distribution (% age) of bird species observed

Foraging guilds of birds

Birds were also categorized based on the foraging guilds [16]. As the foraging guilds of the birds are overlapping and can vary depending upon the season, time, and availability of food resources, resulting in same bird falling in two or more foraging guilds. Out of the 25 bird species observed, 20, 3 and 1 bird species were insectivorous, feeding on small vertebrates and omnivorous respectively. Remaining foraging guilds i.e. granivorous, fruigivorous, phytophagus and feeding on small invertebrates were shown by five bird species each (Fig. 2).

Other workers also observed that: Little guord (*Coccinia indica)* was invaded by pumkin larvae (*Margaronia charantia*), but Common Myna (*Acridotheres tristis*) and Cattle Egret (*Bubulcus ibis*) predates this pumpkin larvae [18]. Perches installed in groundnut crop field encouraged Black Drongo into the field and also facilitated natural insect pest control [19]. Late instar large sized larvae were effectively removed by birds by using perches [20]. Insect pests are serious threats to yield of crop. *Helicoverpa armigera* was common insect pest of berseem crop. It was observed to be eaten by Black Drongo, Indian Roller and Common myna during the study. Similar finding were also reported by other workers who studied the Influence of population dynamics of predatory birds on *H. armigera population* in fields of pigeon pea, and found 5 insectivorous species i.e., House Sparrow, Indian Roller, Common Myna, Black Drongo and Green Bee-eater feeding on this pest [21-23].

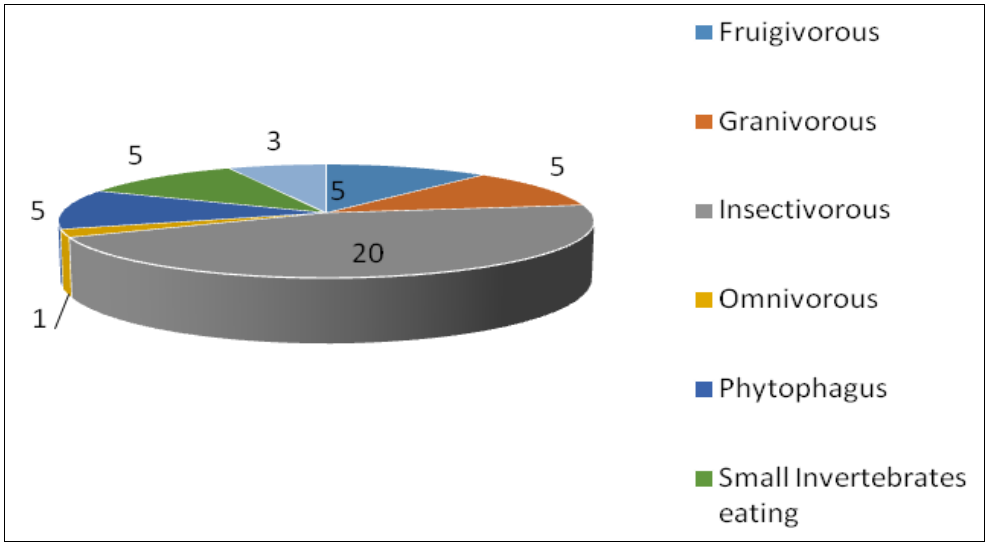

Fig 2: Foraging guild wise distribution of bird species

Month wise observations revealed that the maximum numbers of bird species were in the month of January 2021 and February 2021 at location 1 and January 2020 and April 2020 at location 2 (Table 2).

Location 1: Asian Pied Starling, Black Drongo and Common Myna were observed in all the months and Common Myna was dominant bird species at this location. Relative abundance of Common Myna was ranged from 11.33% to 24.23%. Least observed species was Plain Prinia observed only in the month of November 2019. Insectivorous birds as observed was also reported by others that Black Drongo feeds by aerial feeding and can utilize perches whereas Common Myna also preferred perches although it has ground foraging behavior [24]. Foraging behavior of Black Drongo was also

linked with habitat and available food resources [25].

Location 2: Cattle Egret and Common Myna were observed in all the months at this location. Common Myna was dominant bird species at this location also followed by Cattle egret. Relative abundance of Common Myna and Cattle Egret were ranged from 11.78%-28.63% and 5.65% to 21.13% respectively at location 2. %. Common Hoopoe, Greater Coucal and Red-vented Bulbul were least observed species at this location. Seven species of birds having insectivorous feeding habit were observed in berseem field, Black Drongo utilized perches as a substrate for predation activity maximum number of times [5].

Table 2: Month wise bird abundance (% age) in Egyptian clover crop

	Location 1					Location 2						
	November 2019	**December 2019**	**January 2020**	**February 2020**	**March 2020**	**November 2019**	**December 2019**	**January 2020**	**February 2020**	**March 2020**	**April 2020**	**May 2020**
Asian Pied Starling	5.66	3.41	4.54	3.03	5.88	7.14	11.11	3.85	5.88	-	10.21	8.24
Black Drongo	11.33	11.37	13.63	6.06	17.65	14.29	-	12.32	15.22	14.52	8.94	12.31
Black Ibis	3.77	1.72	2.92	-	-	-	-	-	5.88	-	-	4.12
Blue Rock Pigeon	-	-	13.63	3.03	-	--	11.11	5.14	-	4.63	3.91	16.32
Cattle Egret	11.33	19.43	-	-	11.77	21.13	5.65	18.54	11.78	17.34	15.45	8.24
Common Hoopoe	-	-	4.54	3.03	5.88	-	-	-	-	2.63	-	-
Common Myna	11.33	22.22	15.15	24.23	11.77	28.63	22.22	12.32	11.78	21.14	20.72	16.34
Common Stonechat	-	-	2.27	3.03	-	-	5.65	-	-	-	-	4.12
Common Tailorbird	5.66	-	-	6.06	-	-	-	-	-	7.89	1.81	-
Eurasian Collared-Dove	5.66	3.41	-	-	-	-	5.65	2.56	-	9.83	-	4.12
Greater Coucal	3.77	-	-	-	5.88	-	-	2.94	-	-	-	-
House Crow	-	13.87	9.09	3.03	-	7.14	11.11	-	5.88	5.26	3.63	-
Indian Pond-Heron	3.77	6.82	2.27	6.06	-	-	5.65	3.85	8.14	5.26	3.63	-
Indian Roller	-	-	-	6.06	5.88	-	-	3.85	-	-	-	-
Jungle Babbler	9.43	3.41	4.94	3.03	-	7.14	5.65	-	5.82	-	3.63	-
Oriental Magpie-Robin	-	-	-	6.06	11.77	-	5.65	-	-	-	-	-
Plain Prinia	3.77	-	-	-	-	-	-	6.25	-	-	5.59	-
Purple Sunbird	-	6.82	4.54	6.06	-	-	-	-	-	5.26	3.63	-
Red-vented Bulbul	3.77	-	-	12.12	-	-	-	-	-	-	-	4.12
Red-wattled Lapwing	11.33	6.82	4.54	6.06	11.77	-	5.65	8.97	5.81	5..26	10.05	8.17
Rose-ringed Parakeet	-	-	4.54	-	-	-	-	-	5.81	-	3.63	8.24
Streaked Fantail-Warbler	-	-	6.06	-	5.88	-	-	12.32	-	-	-	4.12
White-breasted Kingfisher	-	3.41	4.54	-	5.88	14.29	5.65	18.75	11.78	5.26	-	-
White-breasted Waterhen	11.33	-	2.27	3.03	-	-	-	3.84	5.81	-	5.59	-

Statistically significant difference was not observed between the species observed at two locations. Birds recorded were also observed to be using the natural and artificial structures for perching purposes near the experimental fields. They gleaned the fields from these perching places before foraging the crop. Other workers also observed such behaviour that birds in berseem crop was supported by perches and insectivorous birds are height generalist which relies on structure of vegetation, abundance and distribution of prey; also it affects their perch height selection [25, 26]. These structures serve as an opportunity for birds to analyse ground and crop for the purpose of searching food; as for insectivorous birds, main dietary component is insects so perches act as good attractant [20, 27]. Similar type of observation i.e. lowest level of *H. armigera* population was also recorded by others in berseem crop with border rows of marigold and perches installed in fields [5]. Common Myna and Black Drongo are very much helpful in controlling harmful insect pest of the crop [28].

The present study has provided baseline data of avian species in Egyptian clover along with their foraging guilds. Higher relative abundance of insectivorous birds in Egyptian clover do have positive role in controlling insect pest population and ultimately helpful in intensive agro-ecosystem. Insectivorous birds act as bio-control agents, are eco-friendly, natural and can be utilized in place of chemical based methods, thus, preventing the environmental contamination and loss of the biodiversity and ultimately beneficial for the farmers.

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