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Impact of weather parameters on scarab beetles diversity in grassland ecosystem of Rajasthan

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Abstract
The experiment was conducted to check the effect of weather parameters on scarab beetles diversity collected from the light trap in grassland ecosystem at CSWRI, Avikanagar, Tonk, Rajasthan during July 2024 to July 2025. A total of 36 species were recorded, belonging to 18 genera under 10 subfamilies *viz.*, Melolonthinae, Rutelinae, Dynastinae, Scarabaeinae, Orphninae, Aphodiinae, Hybosorinae, Bolboceratinae and Omorginae. The highest beetle diversity was recorded in month of June and July. Correlation analysis indicated that rainfall showed positive significant correlation with all recorded subfamilies except Orphninae. The aim of the investigation may be helpful in sustainable pest management strategies.

Keywords: Scarab beetle, diversity, correlation, significant, pest management

Introduction
The order Coleoptera is the largest order within class Insecta, which includes beetles and weevils (Stork *et al.*, 2015) [10]. Within the order Coleoptera Scarabaeoidea is one of the largest superfamily that include largest family Scarabaeidae (Smith *et al.*, 2006) [9]. The family Scarabaeidae is the second largest family with more than 30,000 species recorded worldwide and about 2,500 species are reported from India (Murthy K.S., 2020) [8]. The family includes two main groups, one group include Coprinae, Scarabaeinae, Aphodiinae, Geotrupinae and Troginae which are either saprophagous or fungus feeders and form a separate group 'Laprosticti'. The second group include the subfamilies Melolonthinae, Rutelinae, Dynastinae and Cetoniinae, which are strictly phytophagous forming 'Pleurosticti' (Tarasov and Genier, 2015) [11]. Scarabaeoids beetles are nocturnal and feed on leaves, shoot, shrubs and grasses, exhibit polyphagous feeding behaviour. Both life stages *i.e.*, adult and grubs cause significant economic losses within diverse cropping ecosystem in the worldwide (Chandra *et al.*, 2012) [3]. Most of the scarab beetles population increase in rainy season, particularly in light sandy soils of Northern India. In severe conditions white grub cause 40 to 80 per cent losses in various crops (Chelvi *et al.*, 2011) [4]. For sustainable management of pests, there is need to know the population density of scarab beetles. The correlation between the scarab beetle population and weather parameters was evaluated to identify the environmental conditions suitable for scarab beetle abundance.

Materials and Methods
The present investigation was conducted at Central sheep and Wool Research Station, Avikanagar, Tonk, Rajasthan. The light trap was installed at a height of approximately 7 ft, fitted with a 150 W UV light lamp. The trap was operated from 7:00 pm to 11:00 pm over a period of one year, from July 2024 to July 2025, at fortnightly intervals. Adult scarab beetles attracted to the light were collected using a white cloth placed across the trap. A white cloth of about 2 m length was tied slightly behind the light source to either fixed sticks. Following emergence, adult beetles attracted to the light settled on the white cloth as well as on nearby host trees and crops for feeding and mating. Therefore, additional collections were made from host plants through manual scouting with the aid of a torch. The collected scarab beetles were correlated with weather parameters such as temperature, humidity and rainfall. The correlation coefficient (r) and the level of significance between environmental factors and species distribution were computed using Karl Pearson's formula as described by (Chandel, 1974) [2].

Results and Discussion
According to table 1 the maximum population of Melolonthinae and Rutelinae beetles were observed in 25-26th SMW, whereas Scarabaeinae, Orphninae and Hybosorinae beetles were recorded maximum in 27-28th SMW. Aphodiinae, Bolboceratinae and Omorginae beetles were found abundant in 31-32th SMW, while Dynastinae beetle was found maximum in 29-30th SMW.

Table 1: Influence of weather parameters on scarab beetles diversity in grassland ecosystem

SMW	Temp. (°C)		RH (%)		Rainfall	Population of scarab beetles (No.)								
	Max.	Min.	Morn.	Even.		Melolonthinae	Rutelinae	Dynastinae	Scarabaeinae	Orphninae	Aphodiinae	Hybosorinae	Bolboceratinae	Omorginae
31-32	31.96	26.25	92.86	88.93	51.66	17	58	7	9	0	9	2	4	1
33-34	32.54	27.11	85.79	83.14	37.84	8	51	9	6	0	5	1	2	0
35-36	32.00	26.29	93.43	84.64	29.43	2	24	5	4	0	2	3	0	0
37-38	32.29	24.79	89.14	79.14	18.50	0	8	3	6	0	4	0	0	0
39-40	35.32	25.61	84.64	81.36	0.00	2	0	0	1	0	0	0	0	0

41-42	34.93	22.11	83.36	78.64	3.00	1	0	0	0	0	0	0	0	0
43-44	35.21	20.15	82.00	75.36	0.00	0	0	0	0	0	0	0	0	0
45-46	34.18	18.14	84.36	72.50	0.00	0	0	0	0	0	0	0	0	0
47-48	28.25	12.14	86.79	84.07	0.00	0	0	0	0	0	0	0	0	0
49-50	25.50	7.78	88.64	73.07	0.00	0	0	0	0	0	0	0	0	0
51-52	22.33	9.83	84.20	72.60	0.00	0	0	0	0	0	0	0	0	0
01-02	23.57	9.07	80.43	72.79	2.70	0	0	0	0	0	0	0	0	0
03-04	25.57	11.50	91.21	73.21	7.20	0	0	0	0	0	0	0	0	0
05-06	28.93	13.29	89.14	68.14	0.50	0	0	0	0	0	0	0	0	0
07-08	31.86	16.43	89.21	75.71	0.35	0	0	0	0	0	0	0	0	0
09-10	34.39	16.29	88.79	71.86	0.00	5	0	0	0	0	0	0	0	0
11-12	36.93	18.54	74.57	72.07	1.45	11	0	0	0	0	0	0	0	0
13-14	38.93	21.61	66.07	69.43	0.00	22	0	0	0	0	0	0	0	0
15-16	42.43	26.32	70.71	72.79	0.00	26	0	0	0	0	0	0	0	0
17-18	42.29	26.18	74.14	69.36	1.80	44	0	0	0	0	0	0	0	0
19-20	39.89	27.36	74.71	71.50	0.75	34	6	0	0	0	0	2	0	0
21-22	40.75	29.07	88.43	82.29	0.20	40	21	0	2	0	0	3	0	0
23-24	40.96	28.71	67.93	54.71	7.43	53	47	0	9	0	0	7	0	0
25-26	33.43	27.00	87.36	79.29	36.22	61	93	3	11	0	0	9	0	0
27-28	32.57	27.07	91.71	83.14	17.29	45	58	9	16	3	2	11	2	0
29-30	33.25	27.18	89.71	81.00	37.30	20	90	11	7	2	5	2	1	0

SMW = Standard Meteorological Week

From the table 2 the Melolonthinae beetles showed significant positive correlation with maximum temperature and minimum temperature (r = 0.599 and r = 0.657, respectively), whereas morning relative humidity and evening relative humidity showed negative non significant correlation (r = -0.349 and r = -0.177, respectively). The rainfall had positive non significant correlation (r = 0.224) with Melolonthinae beetles. Rutelinae beetles showed significant positive correlation with minimum temperature and rainfall (r = 0.558 and r = 0.833, respectively), whereas maximum temperature, morning relative humidity and evening relative humidity exhibited non significant positive correlation (r = 0.071, r = 0.264 and r = 0.332, respectively) with Rutelinae beetles. Dynastinae beetles showed significant positive correlation with minimum temperature, morning relative humidity, evening relative humidity, rainfall were observed as r = 0.461, r = 0.438, r = 0.576, r = 0.852, repectively, whereas the maximum temperature had negative non significant correlation (r = -0.086) with Dynastinae beetles. Scarabaeinae beetles exhibited significant positive correlation with minimum temperature and rainfall (r = 0.558 r = 0.722, respectively), while maximum temperature, morning and evening relative humidity (r = 0.058, r= 0.275 and r= 0.307, respectively) exhibited non significant correlation with Scarabaeinae beetles.

Table 2: Correlation between scarab beetles diversity and weather parameters in grassland ecosystem

Weather parameters	Correlation coefficient (r)								
	Melolonthinae	**Rutelinae**	**Dynastinae**	**Scarabaeinae**	**Orphninae**	**Aphodiinae**	**Hybosorinae**	**Bolboceratinae**	**Omorginae**
Maximum temperature (ºC)	0.599*	0.071	-0.086	0.058	-0.033	-0.092	0.166	-0.077	-0.056
Minimum temperature (ºC)	0.657*	0.558*	0.461*	0.558*	0.256	0.378	0.502*	0.320	0.155
Morning RH (%)	-0.349	0.264	0.438*	0.275	0.262	0.402*	0.110	0.338	0.236
Evening RH (%)	-0.177	0.332	0.576*	0.307	0.265	0.570*	0.088	0.528*	0.379
Rainfall	0.224	0.833*	0.852*	0.722*	0.290	0.856*	0.422*	0.737*	0.553*

Orphninae beetles showed negative non significant correlation (r = -0.033) with maximum temperature, whereas positive non significant correlation with rest of the weather parameters. Hybosorinae beetles had positive significant correlation with minimum temperature (r = 0.502) and rainfall (r = 0.422), whereas rest of the weather parameters exhibited non significant correlation with Hybosorinae beetles. Aphodiinae beetles showed significant positive correlation with morning relative humidity, evening relative humidity and rainfall (r = 0.402, r = 0.570 and r = 0.856, respectively). Maximum temperature showed negative non significant correlation (r = -0.092), while minimum temperature had positive non significant correlation (r = 0.378) with Aphodiinae beetles. Bolboceratinae beetles showed positive significant correlation with evening relative humidity and rainfall (r = 0.528 and r = 0.737, respectively), whereas rest of the weather parameters showed non significant correlation with Boboceratinae beetles. Omorginae beetles had a significant positive correlation with rainfall (r = 0.553), whereas maximum temperature showed negative non significant correlation (r = -0.056). The rest of the weather parameters had non significant correlation with Omorginae beetles (Table 2).

The present findings are partially similar with results of Kumar *et al.* (2018) [5] investigated the highest diversity of soil arthropods was observed in 24th SMW. Soil arthropods showed positive correlation with maximum temperature minimum temperature and sunshine (r = 0.86, r = 0.91 and r = 0.64, respectively), whereas negatively significant correlation (r = -0.81) with morning relative humidity. Evening relative humidity and rainfall showed negative non-significant correlation (r = -0.34 and r = -0.04, respectively) with soil arthropods. Similarly, Mohapatra and Mishra (2018) [7] examined the maximum abundance of scarabaeoid beetles was observed in 25th SMW collected from the light traps. The results represented that the scarab beetles exhibited a significant positive correlation with maximum and minimum temperature (r = 0.68 and r = 0.43, respectively), while negative correlation with morning relative humidity and evening relative humidity (r = -0.07 and r = -0.04, repectively). The present findings are partially agreement with the results of Bajad *et al.* (2019) [1] reported that the maximum abundance of scarab beetles were recorded in 30th SMW. The population of scarab beetles indicated non-significant negative correlation (r = -0.197) with maximum temperature, whereas a significant positive correlation was recorded with minimum temperature, morning relative humidity, evening relative humidity and rainfall (r = 0.462, r = 0.542, r = 0.461 and r = 0.651, respectively). The results are partially corroborate with findings of Kumar *et al.* (2025) [6] examined the influence of weather parameters on scarab diversity collected from light traps in Terai region of Uttarakhand. The highest beetle diversity was recorded in the month of June and exhibited positive correlation with the temperature, while negative correlation with relative humidity and rainfall.

Conclusion

Highest abundance of scarab beetle was observed during June and July in grassland ecosystem. Maximum population was recorded in Rutelinae subfamily followed by Melolonthinae, Scarabaeinae, Dynastinae, Hybosorinae, Aphodiinae, Bolboceratinae, Orphninae and Omorginae.

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