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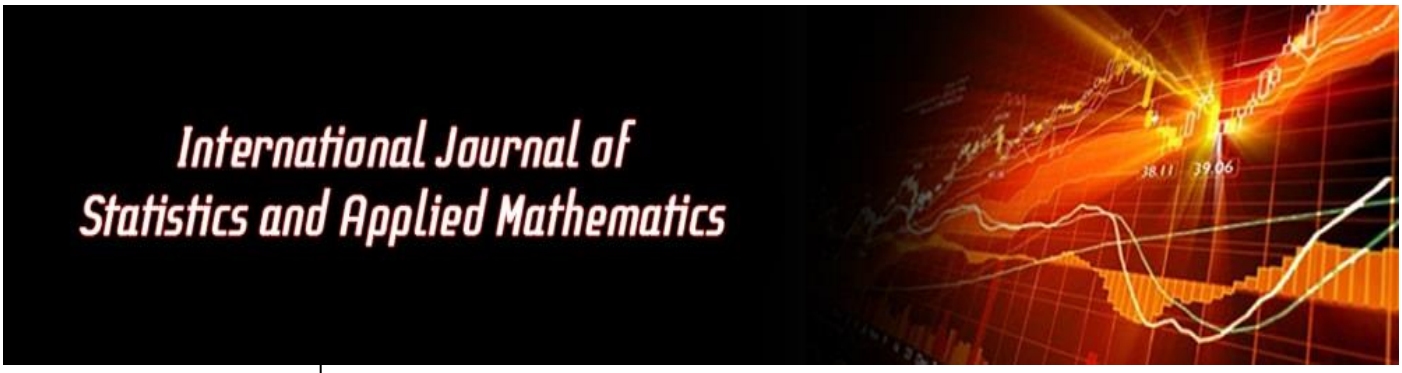

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VD Chavan
M.Sc. Agriculture, Department of Entomology, RCSM College of Agriculture Kolhapur, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

AS Bagde
Assistant Professor, Department of Entomology, RCSM College of Agriculture, Kolhapur, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

UB Hole
Professor, Department of Entomology, College of Agriculture, Nandurbar, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

SB Kharbade
Head of Division, Department of Entomology, RCSM College of Agriculture, Kolhapur, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

SM Galande
Associate Professor, Department of Entomology, RCSM College of Agriculture, Kolhapur, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

NA Deore
M.Sc. Agriculture, Department of Entomology, RCSM College of Agriculture Kolhapur, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Corresponding Author:
VD Chavan
M.Sc. Agriculture, Department of Entomology, RCSM College of Agriculture Kolhapur, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Seasonal incidence of different species of white grub infesting groundnut

VD Chavan, AS Bagde, UB Hole, SB Kharbade, SM Galande and NA Deore

Abstract
The experiment was undertaken to investigate the incidence of different species of white grub infesting groundnut. The appearance of various species of white grub beetles initiated in the 24th week of 2023. Initially, two beetles were collected from a field-based light trap during this week. The beetle collection continued to rise consistently, reaching its peak during the first half of August, specifically in the 31st week, where a total of 112 beetles were recorded. Starting from the 33rd week, there was a decline in beetle collection from the light trap. By the 36th week, only 6 beetles were observed. Subsequent observations in the 37th week indicated fluctuating beetle numbers, with an increase to 9. These observations spanned from June to the first week of October, revealing that the highest beetle collections occurred in the months of July and August compared to other months.

Keywords: Groundnut, White grub, seasonal incidence, significant, diversity

1. Introduction
The groundnut, also referred to as the "poor man's nut," is a widely grown crop that ranks in the top fifteen global food crops. It is a native of South America and goes by several names, including peanut, earthnut, monkey nut, and goobers (Biswas *et al*., 2019) [2]. An important member of the Leguminosae family, groundnut (*Arachis hypogaea* L.) is grown mostly in Asia and Africa during the kharif season and plays a vital role as an oilseed and cash crop. Among the many pests that damage groundnuts, soil-inhibiting pests particularly white grubs represent a serious threat. White grubs are the early stages of scarab beetles; they are fleshy, wide, and have a whitish or grayish-white hue. They resemble a curved 'C' and are found in the soil, feeding on roots. These damaging grubs are less common in areas without vegetation or in wet, compacted, stony soils. They thrive in light soils, especially surrounding plants with fibrous roots and high organic matter content. The percentage of groundnut damage might range from 20 to 80 percent in areas where infestations are common. Interestingly, plant mortality rates can reach 80–100% just by having one grub per square meter of soil (Baloda *et al.*, 2021) [1]. White grubs are frequently referred to as May/June beetles or cockchafers because they typically appear during these months. The adult beetles consume foliage from a variety of plants such as neem, ber, acacia, drumstick, prosopis, and others. The larvae, commonly referred to as white grubs or root grubs, nourish themselves by consuming the subterranean roots and stems of living plants. In the Indian subcontinent, there are over 2000 species of white grubs, and more than 40 of them are known to inflict considerable harm to various crop plants (Kumar *et al*., 2017) [6]. Because a large amount of the life cycle of white grubs occurs underground, detection of the pests can be difficult even after they have caused major damage to healthy crops, making them a significant hazard to field crops. These pests eat on a variety of trees and cultivated crops, demonstrating their polyphagous nature. Attacks by white grubs can occur in cultivated crops such plantation crops, vegetables, pulses, cereals, and groundnuts (David *et al*., 1987) [4]. White grubs can significantly damage crops, with some reports indicating yield reductions of as much as 70 percent (Yadava and Sharma, 1995) [8], emphasizing the need for effective management strategies to mitigate their impact on agricultural productivity.

2. Material methods

2.1 Experimental site

The experiment was carried during Kharif season, 2022-23 on the farmer's field, A/P Tardal, Tal - Hatkanangale, Dist - Kolhapur.

2.2 Location, Climate and Weather Condition

The location is positioned at an altitude of 390 meters above mean sea level, with latitude 16.51° and longitude 73.84°. climate is semi-arid with an average annual rainfall of approximately 492 mm. The region is characterized by low temperatures during the winter season. Weather parameters significantly influence the development of insect pests in this agro-climatic zone.

2.3 Methods of Recording Observations Mass trapping

To collect the adults (beetles) of white grubs, light trap at groundnut farm was installed during crop period. For the collection of beetles 100 watts bulb was used as source of energy. The unit was operated at weekly interval from dusk to dawn and collections of trapped beetles were done. The number of adult beetles were statistically analysed and correlated with metrological data *viz*., temperature, relative humidity and rainfall. (Choudhary *et al*.,2018) [3]

3. Results

3.1 Seasonal incidence of different species of white grub infesting groundnut

Adult white grubs emerged from the soil following the initial monsoon rainstorm, typically occurring in the second week of June, and their activity extended through the third week of August. During this period, the beetles primarily fed on the tender, succulent leaves of host trees. The beetles emerged from the soil between 7:00 pm and 10:00 pm. After emerging, adult beetles would often gather on trees for various activities, including feeding and mating.

Table 1: Seasonal incidence of different species of white grub infesting groundnut

Meteorological Week	Temperature (^{0}C)		Relative Humidity (%)		Rainfall (mm)	White grub Beetles/trap
	Maximum	Minimum	RH_1	RH_2		
22	39.4	24.1	86.5	64.9	0	0
23	37.3	23.3	87.5	59	9	0
24	34.4	23.9	90.0	71.2	2.3	2
25	34.7	23.6	92.8	71.1	6.5	4
26	36.4	22.5	98	95	31.5	13
27	36.4	22.5	98	96.9	32.5	24
28	29.6	22.7	98	96.6	18.5	31
29	35.5	22.3	98	98	108.5	65
30	25.9	22.3	98	98	102.3	102
31	28.1	22.4	98	98	10.8	112
32	29.4	21.8	98	95	9.5	99
33	30.8	21.5	98	93.9	3.5	47
34	31.3	21.5	98	91.8	6.3	14
35	32.7	21.8	98	90.2	14.5	7
36	29.6	21.7	98	93.5	13.8	6
37	30.7	21.4	98	93.1	5	9
38	30.8	21.9	98	97.4	13.5	7
39	31.4	22.0	98	93.6	26.8	4
40	30.1	21.9	98	93.4	22.8	2

The emergence of various species of white grub beetles commenced during the 24th week of the year 2023. In the 24th week, we collected 2 beetles from a light trap situated in the field. The collection of beetles increased continuously until the 31st week, with the peak beetle outbreak occurring in the first fortnight of August. The highest number of beetles, 112 in total, was observed during the 31st week. Starting from the 33rd week, the collection of beetles from the light trap began to decrease.

In the 36th week, we only observed 6 beetles on host trees. Subsequently, during the 37th week, the number of beetles collected fluctuated and rose to 9. Our observations were made from June to the first week of October, and we noted that the highest number of beetles were collected from traps in the months of July and August, compared to other months.

These findings align with Seram *et al*., 2015 which reported that emergence of adult beetles commenced in the final week of July, featuring an initial density of 0.2 beetles per plot. Subsequently, this population rose to 0.4 in the initial week of August, culminating in a peak of 1.1 beetles per plot in the second week of August.

Table 2: Correlation coefficient of white grub beetles with the abiotic factors

Sr. No.	Meteorological parameters	Correlation of coefficient values (r)
1.	Maximum temperature	-0.532*
2.	Minimum temperature	-0.216^{NS}
3.	Relative Humidity (morning) (RH_1)	0.374^{NS}
4.	Relative Humidity (evening) (RH_2)	0.472*
5.	Rainfall	0.461*

*Significant at 5%

NS-Non significant

The relationship between the incidence of white grub beetles and various abiotic factors, such as temperature, rainfall, and relative humidity, is presented in Table-2. During this period, we observed a negative correlation between white grub beetles

and maximum temperature (r = -0.532) as well as minimum temperature (r = -0.216). In contrast, we found a positive correlation with RH_1 (r = 0.374) and RH_2 (r = 0.472). Additionally, there was a positive correlation with rainfall (r = 0.461). The correlation coefficient values (r values) indicate that the beetle population tends to increase with higher levels of morning relative humidity, evening relative humidity, and rainfall, while it decreases with higher maximum and minimum temperatures.

The current findings align with Choudhary *et al.* (2018) [3] their research revealed that the influence of abiotic factors on damage caused by white grubs exhibited a noteworthy inverse relationship with maximum temperature in 2014. In contrast, there was an insignificant negative correlation with minimum temperature during the same period. Furthermore, a significant positive correlation was observed with average relative humidity, along with a non-significant positive correlation with total rainfall for the corresponding year. In 2015, Choudhary *et al.* [3] noted an insignificant negative correlation with maximum temperature, total rainfall, and sunshine hours. Conversely, a non-significant positive correlation was identified with average relative humidity and minimum temperature for that specific year.

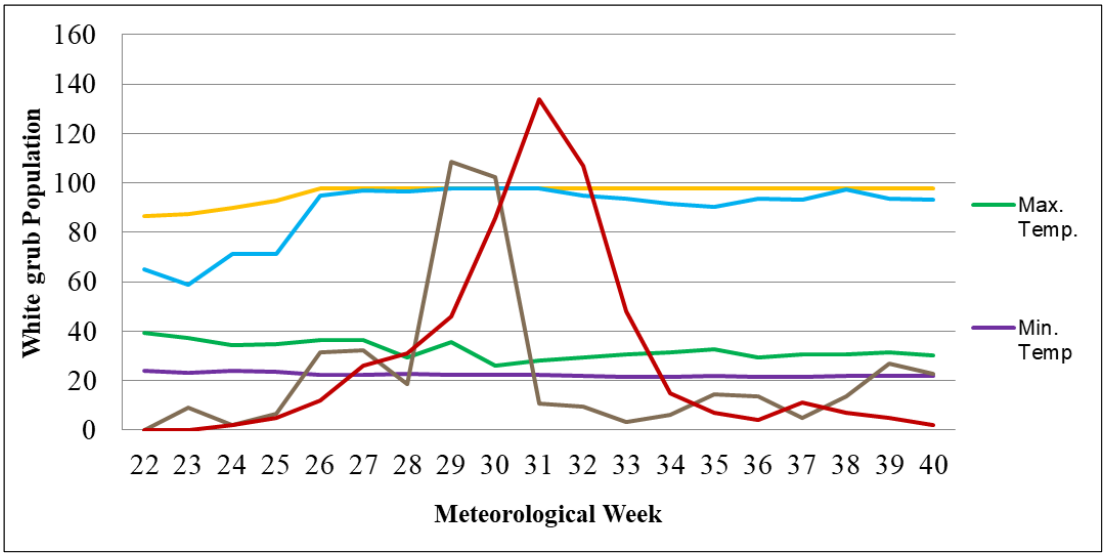

Fig 1: Seasonal incidence of white grub beetles with weather parameters

3.2 Taxonomic information about White grub Species collected

During the research period, a total of 12 beetle species were observed, spanning across four subfamilies: Scarabaeinae, Melolonthinae, Rutelinae, and Dynastinae. These beetles were lured to light traps strategically positioned in agricultural fields A/P Tardal, Hatkanangale tehsil of Kolhapur district. The light traps were strategically placed at various points within the agricultural fields. The identification of the collected beetles was carried out at the All India Network Project on Soil Arthropod Pest, Department of Entomology, University of Agricultural Sciences, GKVK, Bangalore-65. The study revealed that beetle emergence commenced after the initial pre-monsoon showers in June.

Table 3: Taxonomic information about White grub Species collected

Sr.no.	Species identified	Family	Subfamily
1	*Holotrichia serrata* (Fabricius)	Scarabaeidae	Melolonthinae
2	*Holotrichia consanguinea* (Blanchard)	Scarabaeidae	Melolonthinae
3	*Leucopholis lepidophora* (Blanchard)	Scarabaeidae	Scarabaeinae
4	*Anomolochela bicolor* (Brenske)	Scarabaeidae	Melolonthinae
5	*Sophrops karschi* (Brenske)	Scarabaeidae	Melolonthinae
6	*Anomala dorsalis* (Fabricius)	Scarabaeidae	Rutelinae
7	*Anomala bengalensis* (Blanchard)	Scarabaeidae	Rutelinae
8	*Anomala communis* (Burmeister)	Scarabaeidae	Rutelinae
9	*Anomala rugosa* (Arrow)	Scarabaeidae	Rutelinae
10	*Phyllognathus dionysius* (Fabricius)	Scarabaeidae	Dynastinae
11	*Pentodon sp.*	Scarabaeidae	Dynastinae
12	*Maladera iridiscens*	Scarabaeidae	Melolonthinae

The highest emergence was documented in the second half of August. The species *Holotrichia serrata* (Fabricius) and *Holotrichia consanguinea* (Blanchard) were notably abundant in the light traps set up at groundnut field. Throughout the research duration, a total of 548 white grub beetles were drawn to the light traps placed at field.

Table 4: Diversity of white grubs by Simpson's method

Sr. No	White grub Species	Number of specimens (n)	n(n-1)	Simpson's Index (D)
1	*Holotrichia serrata* (Fabricius)	214	45582	0.77
2	*Holotrichia consanguinea* (Blanchard)	126	15750	
3	*Leucopholis lepidophora* (Blanchard)	5	20	
4	*Anomolochela bicolor* (Brenske)	14	182	
5	*Sophrops karschi* (Brenske)	17	272	
6	*Anomala dorsalis* (Fabricius)	9	72	
7	*Anomala bengalensis* (Blanchard)	51	2550	
8	*Anomala communis* (Burmeister)	11	110	
9	*Anomala rugosa* (Arrow)	5	20	
10	*Phyllognathus dionysius*(Fabricius)	76	5700	
11	*Pentodon sp.*	7	42	
12	*Mellodera iridiscense*	13	156	

The examination of white grub diversity was conducted on the population collected from A/P Tardal, Hatkanangale tehsils in Kolhapur district. To assess diversity and the reciprocal index, Simpson's index was employed (Gite *et al*., 2014). The Simpson's index was determined to be 0.77, with a specific Simpson's diversity index of 0.23 for Tardal, Hatkanangale, as detailed in Table 4.3. The Simpson's index of diversity, ranging from 0 to 1, reflects sample diversity, with higher values indicating greater diversity. In this context, the index denotes the likelihood that two randomly selected individuals from the sample belong to different species. To mitigate the counterintuitive nature of Simpson's Index, an alternative approach involves considering the reciprocal of the index, referred to as Simpson's Reciprocal Index (1/D). Starting at 1, representing a community with only one species, higher values signify increased diversity, with the maximum value corresponding to the number of species in the sample. Notably, the Simpson's diversity index for Tardal village was recorded at 0.23 in this study.

Table 5: Simpson's diversity indices of white grub in examine area

Index of Diversity	Region of sampling Tardal Village, Tal-Hatkangale
Simpson's Index (D)	0.77
Simpsons diversity index (1-D)	0.23
Simpsons reciprocal index (1/D)	1.30

The three aforementioned values all signify the same diversity measure. It is crucial to determine the specific index utilized in any comparative diversity studies. It's important to note that a Simpson's Index value of 0.77 is distinct from a Simpson's Index of Diversity value of 0.23.

The findings presented herein align with the observations made by Gite *et al*., 2014 [5]. The study documented the abundance percentages of various white grub species. Notably, *H. serrata* emerged as the predominant species, constituting 26.55 percent of the total. In Western Maharashtra, the Simpson's index was calculated as 0.15, the Simpson's diversity index as 0.85, and the Simpson's reciprocal index (1/D) as 6.66.

5. Conclusion

White grub incidence was observed from the 24th Meteorological Week (MW), with the highest recorded activity occurring during the 31st MW. In the period from June to October 2023, a total of 12 species of white grub beetles were collected in light traps from a groundnut field. Among these species, *Holotrichia serrata* (Fabricius) and *Holotrichia consanguinea* (Blanchard) were the predominant ones recorded in the light traps.

6. Acknowledgement

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7. References

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