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## Root grub species associated with groundnut ecosystem in Southern and Scarce rainfall Zones of Andhra Pradesh

**K Sunil Kumar and G Karuna Sagar**

### Abstract

Root grub species richness, evenness, diversity and distribution in groundnut ecosystem of Southern and Scarce Rainfall Zones of Andhra Pradesh was studied as the information on its species diversity and abundance provides valuable inputs in devising suitable management strategies. Light traps installed in major groundnut growing tracts of four districts of Southern and Scarce Rainfall Zones Andhra Pradesh during *Kharif*, 2014. A total of 1471 adult Scarabaeidae beetles collected from the light traps consisting of 15 species under 7 genera of three subfamilies Melolonthinae constituting 64.58% followed by Dynastinae (17.95%) and Rutelinae (17.47%). Higher species diversity, richness and evenness in Melolonthinae followed by Rutelinae and Dynastinae. *Holotrichia reynaudi* (32.90%) was the predominant species followed by *Phyllognathus dionysius* (17.95%), *Holotrichia serrata* (14.68%), *Brahmina mysorensis* (9.18%), *Anomola dorsalis* (9.18%) associated with groundnut in Rayalaseema region. The alpha diversity and species richness were high in Chittoor district followed by YSR, Kurnool and Ananthapuramu. The species evenness was high in Kurnool followed by Chittoor, YSR Kadapa and Ananthapuramu.

**Keywords:** alpha diversity, groundnut, root grub, scarabaeidae

### Introduction

Groundnut (*Arachis hypogaea* L.) is a principal oilseed crop of India. In Andhra Pradesh it is cultivated in an area of 8.72 lakh ha, out of which 95 percent of area belongs to Rayalaseema region ([www.apdes.ap.gov.in](http://www.apdes.ap.gov.in), 2014-15) [6]. Groundnut crop is known to be infested by more than 360 species of insect pests in different parts of the world (Anitha *et al.*, 2006) [2]. Root grub or white grub is the one of the most important soil pests affecting groundnut. The white grubs belonging to Scarabaeidae are the diverse and devastating pests of several crops and assumed national importance due to high per cent loss incurred (Sreedevi and Tyagi, 2015) [18]. It causes damage to other agricultural crops like sugarcane, pearl millet, sorghum, maize, pea, potato etc. (Vasanth *et al.*, 2014) [20]. In endemic areas the damage to groundnut ranges from 20-100 per cent. The presence of one grub/m<sup>2</sup> may cause 80-100 per cent mortality (Yadava & Sharma, 1995) [22], it causes damage upto 39.40 per cent (Umeh *et al.*, 1999) [19], 12-60% (Pokhrel, 2004) [16].

A Total of 22 species from 9 genera of Scarabaeids are associated with groundnut in India (Wightman and Ranga Rao, 1994) [21]. *Holotrichia* genus is the most important pest species in groundnut in India. *H. consanguinea* Blanch is the predominant species in Northern India, *H. serrata* is the serious pest in Northern & Southern India (Musthak Ali, 2001) [14]. Extensive research has been done on the distribution and control strategies of these two species. *H. reynaudi* and *H. serrata* were the major species associated with groundnut in Southern India (Anitha *et al.*, 2006) [2]. Early reports of white grubs damaging groundnut in Andhra Pradesh are *H. consanguinea*, *Phyllophaga consanguinea* or *H. serrata* (Hussain, 1974, Rao *et al.*, 1976 and Pal, 1977) [8, 17, 15]. Earlier Researchers had confirmed that *H. consanguinea* as major root grub species in Andhra Pradesh and recent studies revealed that *H. reynaudi* was predominant, there is quite uncertainty with species identity and distribution, it should be clarified as the species diversity and abundance plays vital role in devising suitable management strategies. In addition, an insight into the geographical distribution of species diversity helps in tracking the spread of invasive species and effects of global climate change on the maintenance of biodiversity (Gaston and Black burn, 2000) [7]. Hence, in order to identify the predominant, major and minor root grub species this study has been conducted in four districts *viz.*, YSR, Chittoor, Ananthapuramu and Kurnool of Rayalaseema region in Andhra Pradesh.

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## Materials and Methods

Roving surveys were conducted in major groundnut growing areas of YSR, Chittoor, Anantapuramu and Kurnool districts of Andhra Pradesh for collection of white grub adults during May to August, 2014 and 2015. Light trap was specially designed for adult collection which consists of iron frame of 100 cm length, tripod stand with two circular reems, PVC funnel was arranged beneath the mercury vapour lamp of 160 watts. Adult beetles attracted to light fall into the funnel and collected into a plastic container with ethyl acetate as killing agent. A total of 24 light traps were installed in groundnut cultivated fields in 24 locations from four districts at six villages per district. Scarabaeid beetles were sorted out from the trapped insects, labeled and brought into the laboratory, cleaned, relaxed, dried and pinned. The specimens collected were identified at Division of Entomology, Indian Agricultural Research Institute, New Delhi with standard taxonomic keys (Brenske, 1899; Arrow, 1910, 1917; Khan, 1975) [5, 3, 4, 12].

The indices namely Shannon's Wiener, Simpson's (Magurram, 1988) [13], Pielou's evenness indices were used to determine the species richness and evenness. The Shannon's Wiener index was used for the calculation of alpha diversity as it is found most important for the major species rather than the rare species. The similarity index between any two districts was calculated by Jaccard's Similarity Coefficient (Jaccard, 1901, 1912) [9, 10] and was used to analyze the similarities among the districts.

**Simpsons Index (D):** Measures diversity and also dominance of individual species. It also measures the probability that two individuals randomly selected from a sample will belong to same species. The value ranges from 0 to 1, lower the value greater is the diversity

$$D = \sum_{i=1}^S \frac{n_i(n_i - 1)}{N(N - 1)}$$

where,

'n' is the total number of organisms of a particular species

'N' is total number of organisms of all species

**Simpsons Index of diversity (1-D):** Measures the probability that two individuals randomly selected from a sample will belong to different species.

**Simpsons reciprocal index (1/D):** It provides the number of equally common categories that will produce the observed Simpsons index. More the value more the diversity

**Shannons Weiner index:** This is used to compare the diversity but does not give the measure of dominance.

$$H' = -\sum_{i=1}^R p_i \ln p_i$$

where,

$p_i$  is the proportion of the  $i^{\text{th}}$  species in the community

'S' is the total number of species

ln is the log with base 'e' [27]

**Pielou's evenness index (J):** It represents the evenness of a community

$$J' = \frac{H'}{H'_{\max}}$$

where,

$H'$  = number derived from Shannon Weiner index

$$H'_{\max} = \ln S$$

S = Total no. of species

**Jaccard's coefficient:** Used to assess similarity of quadrats

$$S_j = \frac{a}{(a + b + c)}$$

where,

$S_j$  = Jaccard similarity coefficient,

A = number of species common to (shared by) quadrats,

B = number of species unique to the first quadrat, and

C = number of species unique to the second quadrat

## Results and Discussions

The faunal composition comprised of 1471 adults from the survey of four districts representing three subfamilies viz., Melolonthinae, Rutelinae, Dynastinae, among which, Melolonthinae constitutes 64.58% followed by Dynastinae (17.95%). Rutelinae (17.47%). A total of 421 adults collected in YSR Kadapa, Ananthapuramu (403), Chittoor (390) and Kurnool (257)

Fifteen species under seven genera of three subfamilies, where Melolonthinae had four genera with eight species, Rutelinae two genera with six species, Dynastinae one species under one genera were recorded. Among the genera, *Holotrichia* was predominant (49.22%) followed by *Phyllognathus* (17.95%), *Anomola* (13.33%) and *Brahmina* (9.18%).

*Holotrichia reynaudi* (32.90%) was the predominant species followed by *Phyllognathus dionysius* (17.95%), *Holotrichia serrata* (14.68%), *Brahmina mysorensis* (9.18%), *Anomola dorsalis* (9.18%) and these were found to be most common species in groundnut of two zones of of Andhra Pradesh (Table 1).

Melolonthinae subfamily was dominated by *Holotrichia reynaudi* with 50.95% followed by *H. serrata* (22.74%) and *Brahmina mysorensis* (14.21%) and in Rutelinae *Anomola dorsalis* (52.53%) was the predominant followed by *Anomola bengalensis* (21.79%) and *Adoretus flavus* (8.56%) (Table 1). Studies of the diversity and relative abundance revealed higher species diversity in terms of species richness and evenness, species abundance was also relatively high in Melolonthinae followed by Rutelinae.

The present findings are in agreement with the findings of Yadava and Sharma (1995) [22], Anitha (1997) [1], Anitha *et al.*, (2006) [2] who reported that *H. reynaudi*, *H. serrata* were predominant in groundnut of Andhra Pradesh and other genera encountered were *Anomola dorsalis*, *Anomola bengalensis*, *Schizonycha ruficollis*, *Adoretus duvauceli*, *Brahmina mysorensis*, *Apogonia ferruginea*, *H. rufiflava*, *Maladera* sps. all these other genera were also reported in the present investigation. *Phyllognathus dionysius* was reported

as a predominant species in groundnut fields of Ananthapuramu district in the present investigation and it was first report from Andhra Pradesh. Kapadia *et al.*, (2006) [11] reported first time *Phyllognathus* sp. as predominant white grub species causing damage to groundnut in Saurashtra region in Gujarat. Minor species viz., *Schizonycha impressa*, *Anomola ruficapilla*, *Adoretus flavus*, *Adoretus fusiceps*, *Allisonottum piceum*, *Hybosorus* sp and *Trox* sp. were first time reported in the groundnut ecosystem of Andhra Pradesh. The Scarabaeid beetle species diversity and abundance varied highly with location and with the latitude gradient. Many factors like cropping patterns, topography, soil type, weather conditions, seasons, altitude etc. may be attributed for species diversity.

The alpha diversity among the neighbouring districts as indicated by Shannon’s Wiener index was highest in Chittoor (H = 2.018) followed by YSR Kadapa (H = 1.851), Kurnool (H = 1.671) and Ananthapuramu (H = 1.595). The Simpson’s

diversity in terms of richness was high in Ananthapuramu (D = 0.262; 1/D = 3.816) followed by YSR Kadapa (D = 0.261; 1/D = 3.831) Kurnool (D = 0.226; 1/D = 4.424), and Chittoor (D = 0.168; 1/D = 5.950). The Pielou’s evenness index representing evenness was high in Chittoor (0.877) followed by Kurnool (J = 0.846) YSR Kadapa (0.771) and Ananthapuramu (0.725). The probability of two individuals randomly collected belonging to the same species was high in Ananthapuramu (26.2%) and YSR Kadapa (26.1%). The probability of two individuals randomly collected in a habitat belonging to more than one species is high in Chittoor district (83.2%) (Table 2).

The similarity index among the surveyed districts varied from 0.38 to 0.58; Ananthapuramu district showed nearly 58% similarity with that of Chittoor district. The highest dissimilarity index of 62% was recorded in Kurnool with YSR district and Chittoor district (Table 3).

**Table 1:** Species abundance of Scarabaeidae insects associated with groundnut in Southern and Scarce rainfall Zones of Andhra Pradesh in *kharif*, 2014.

S. No.	Subfamily/Species	Number of adult beetles trapped in the light trap					Abundance to the total (%)	Abundance to the sub family (%)
		YSR Kadapa	Chittoor	Ananthapuramu	Kurnool	Total		
<b>I. Melolonthinae</b>								
1	<i>Holotrichia reynaudi</i>	190	91	98	105	484	32.90	50.95
2	<i>Holotrichia serrata</i>	67	37	65	47	216	14.68	22.74
3	<i>Holotrichia consanguinea</i>	6	-	-	-	6	0.41	0.63
4	<i>Holotrichia rufoflava</i>	5	4	9	-	18	1.22	1.89
5	<i>Brahmina mysorensis</i>	30	105	-	-	135	9.18	14.21
6	<i>Schizonycha ruficollis</i>	24	8	10	7	49	3.33	5.16
7	<i>Schizonycha impressa</i>	-	23	6	-	29	1.97	3.05
8	<i>Maladerains anabilis</i>	6	-	7	-	13	0.88	1.37
Sub total		328	268	195	159	950	64.58	100.0
<b>II. Rutelinae</b>								
1	<i>Anomola dorsalis</i>	44	23	32	36	135	9.18	52.53
2	<i>Anomola bengalensis</i>	-	56	-	-	56	3.81	21.79
3	<i>Anomola ruficapilla</i>	5	-	-	-	5	0.34	1.95
4	<i>Adoretu sflavus</i>	6	16	-	-	22	1.50	8.56
5	<i>Adoretus duvauceli</i>	-	-	10	-	10	0.68	3.89
6	<i>Adoretus fusiceps</i>	-	-	-	29	29	1.97	11.28
Sub total		55	95	42	65	257	17.47	100.0
<b>III. Dynastinae</b>								
1	<i>Phyllognathusdionysius</i>	38	27	166	33	264	17.95	100.0
Sub total		38	27	166	33	264	17.95	100.0
Total		421	390	403	257	1471	100.0	-

**Table 2:** Diversity indices of Scarabaeidae insects collected in groundnut ecosystem in Southern and Scarce rainfall Zones of Andhra Pradesh during *kharif*, 2014.

Location	Shannon’s Wiener index (H)	Pielou’s evenness index (J)	Simpson index (D)	Simpson’s index of diversity (1-D)	Simpson’s Reciprocal index (1/D)
YSR Kadapa	1.851	0.771	0.261	0.739	3.831
Chittoor	2.018	0.877	0.168	0.832	5.950
Ananthapuramu	1.595	0.725	0.262	0.738	3.816
Kurnool	1.671	0.846	0.226	0.774	4.424

**Table 3:** Similarity index of Scarabaeidae insects in groundnut ecosystem among the different districts of Southern and Scarce rainfall Zones of Andhra Pradesh during *kharif*, 2014.

Location	Jaccard’s Similarity Co-efficient			
	YSR Kadapa	Chittoor	Ananthapuramu	Kurnool
YSR Kadapa	1.0	0.57	0.53	0.38
Chittoor		1.0	0.58	0.38
Ananthapuramu			1.0	0.45
Kurnool				1.0

## Conclusion

The faunal composition collected from light traps from two districts of Southern and two districts of Scarce rainfall Zone of Andhra Pradesh during Kharif, 2014 comprised of 15 species under 7 genera of *Pleurosticti scarababaeids*, species diversity and abundance were high with sub family Melolonthinae followed by Rutelinae and Dynastinae. The alpha diversity among the neighbouring districts, species richness was high in Ananthapuramu district and species evenness was high in Chittoor. The pestiferous species viz., *H. reynaudi*, *Phyllognathus dionysius*, *H. serrata*, *Brahmina mysorensis* and *Anomola dorsalis* were abundant in major groundnut growing areas of two zones in Andhra Pradesh. In conclusion, a lot of diversity among different districts in two zones was observed, *H. reynaudi* and *H. serrata* were the predominant root grub species in YSR and Kurnool Districts, *Phyllognathus dionysius* was predominant and first time reported in Ananthapuramu district and *Brahmina mysorensis* was predominant in Chittoor district in major groundnut growing areas of Southern and Scarce rainfall Zones in Andhra Pradesh.

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