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## Species diversity of root grubs associated with groundnut cropping systems in Rayalaseema region of Andhra Pradesh

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### Abstract

Root grub species diversity and distribution in groundnut ecosystem of Rayalaseema region 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 Rayalaseema region of Andhra Pradesh during *Kharif*, 2014 and 2015. A total of 1557.5 adult Scarabaeidae beetles collected from the light traps consisting of 17 species under 9 genera of three subfamilies Melolonthinae constituting 67.22% followed by Dynastinae (17.72%) and Rutelinae (15.06%). Higher species diversity, richness and evenness in Melolonthinae followed by Rutelinae and Dynastinae. *Holotrichia reynaudi* (34.19%) was the predominant species followed by *Phyllognathus dionysius* (17.53%), *Holotrichia serrata* (16.34%), *Brahmina mysorensis* (9.05%), *Anomala dorsalis* (8.83%) 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, Species diversity

### 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) <sup>[1]</sup>. 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) <sup>[2]</sup>. 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) <sup>[3]</sup>. It causes damage to other agricultural crops like sugarcane, pearl millet, sorghum, maize, pea, potato etc. (Vasanth *et al.*, 2014) <sup>[4]</sup>. 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) <sup>[5]</sup>, it causes damage upto 39.40 per cent (Umeh *et al.*, 1999) <sup>[6]</sup>, 12-60% (Pokhrel, 2004) <sup>[7]</sup>.

A Total of 22 species from 9 genera of Scarabaeids are associated with groundnut in India (Wightman and Ranga Rao, 1994) <sup>[8]</sup>. *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) <sup>[9]</sup>. 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) <sup>[2]</sup>. 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) <sup>[10, 11, 12]</sup>. 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) <sup>[13]</sup>.

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.

### Materials and methods

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) [14, 15, 16, 17].

The indices namely Shannon's Wiener, Simpson's (Magurram, 1988) [18], 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) [19, 20] 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 1557.5 adults from the survey of four districts representing three subfamilies viz., Melolonthinae, Rutelinae, Dynastinae, among which, Melolonthinae constitutes 67.22% followed by Dynastinae (17.72%). Rutelinae (15.06%). A total of 465 adults collected in YSR Kadapa, Ananthapuramu (417), Chittoor (372) and Kurnool (303.5)

Sixteen species under eight genera of three subfamilies, where Melolonthinae had five genera with nine species, Rutelinae two genera with six species, Dynastinae two species under genera were recorded. Among the genera, *Holotrichia* was predominant (52.68%) followed by *Phyllognathus* (17.53%), *Anomola* (12.01%) and *Brahmina* (9.05%).

*Holotrichia reynaudi* (34.19%) was the predominant species followed by *Phyllognathus dionysius* (17.53%), *Holotrichia serrata* (16.34%), *Brahmina mysorensis* (9.05%), *Anomola dorsalis* (8.83%) and these were found to be most common species in groundnut of Rayalaseema region of Andhra Pradesh (Table 1).

Melolonthinae subfamily was dominated by *Holotrichia reynaudi* with 50.86% followed by *H. serrata* (24.31%) and *Brahmina mysorensis* (13.47%) and in Rutelinae *Anomola dorsalis* (58.64%) was the predominant followed by *Anomola bengalensis* (18.34%) and *Adoretus fusiceps* (9.38%) (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) [5], Anitha (1997) [21], 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) [22] 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 = 2.101) followed by YSR Kadapa (H = 1.927), Kurnool (H = 1.735) and Ananthapuramu (H = 1.545). The Simpson's diversity in terms of richness was high in Chittoor (D = 0.169; 1/D = 5.917) followed by Kurnool (D = 0.243; 1/D = 4.115),

YSR Kadapa (D = 0.244; 1/D = 4.098) and Ananthapuramu (D = 0.262; 1/D = 3.816). The Pielou's evenness index representing evenness was high in Kurnool (J = 0.889) followed by Chittoor (0.847), YSR Kadapa (0.753) and Ananthapuramu (0.702). The probability of two individuals randomly collected belonging to the same species was high in Ananthapuramu (26.2%) and YSR Kadapa (24.4%). The probability of two individuals randomly collected in a habitat belonging to more than one species is high in Chittoor district (83%) (Table 2).

The similarity index among the surveyed districts varied from 0.33 to 0.64; Ananthapuramu district showed nearly 64% similarity with that of Chittoor district. The highest dissimilarity index of 67% was recorded in Kurnool with YSR district (Table 3).

**Table 1:** Species abundance of Scarabaeidae insects associated with groundnut crop in Rayalaseema region of Andhra Pradesh of *Kharif*, 2014 and 2015.

S. No.	Sub family/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>1. Melonthinae</b>								
1	<i>Holotrichia reynaudi</i>	207	78	121	126.5	532.5	34.19	50.86
2	<i>Holotrichia serrata</i>	82.50	40	65	67	254.5	16.34	24.31
3	<i>Holotrichia consanguinea</i>	10	4.5	-	-	14.5	0.93	1.39
4	<i>Holotrichia rufoflava</i>	5.50	5.5	8	-	19	1.22	1.81
5	<i>Brahmina mysorensis</i>	31.50	109.5	-	-	141	9.05	13.47
6	<i>Schizonycha ruficollis</i>	25.50	4	14.5	3.5	47.5	3.05	4.53
7	<i>Schizonycha impressa</i>		21.5	3	-	24.5	1.57	2.34
8	<i>Maladera insanabilis</i>	7	-	3.5	-	10.5	0.67	1.00
9	<i>Apogonia ferruginea</i>	3	-	-	-	3	0.19	0.29
Sub total		372	263	215	197	1047	67.22	100.0
<b>2. Rutelinae</b>								
1	<i>Anomola dorsalis</i>	43	20.5	30.5	43.5	137.5	8.83	58.64
2	<i>Anomola bengalensis</i>	-	43.0	-	-	43	2.76	18.34
3	<i>Anomola ruficapilla</i>	6.5	-	-	-	6.5	0.42	2.77
4	<i>Adoretus flavus</i>	7	10	-	-	17	1.09	7.25
5	<i>Adoretus duvauceli</i>	-	-	8.5	-	8.5	0.55	3.62
6	<i>Adoretus fusiceps</i>	-	-	-	22	22	1.41	9.38
Sub total		56.5	73.5	39	65.5	234.5	15.06	100.0
<b>3. Dynastinae</b>								
1	<i>Phyllognathus dionysius</i>	36.5	32.5	163	41	273	17.53	98.91
2	<i>Allisonottum piceum</i>	-	3	-	-	3	0.19	1.09
Sub total		36.5	35.5	163	41	276	17.72	100.0
TOTAL		465	372	417	303.5	1574.5	100	-

**Table 2:** Diversity indices of Scarabaeidae insects collected in groundnut ecosystem in Rayalaseema region of Andhra Pradesh for pooled data of *Kharif*, 2014 and 2015.

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	1.927	0.753	0.244	0.756	4.098
Chittoor	2.101	0.847	0.169	0.831	5.917
Ananthapuramu	1.545	0.702	0.262	0.738	3.816
Kurnool	1.735	0.889	0.243	0.757	4.115

**Table 3:** Similarity index of Scarabaeidae insects in groundnut ecosystem among the different districts of Rayalaseema region of Andhra Pradesh during *Kharif*, 2014 and 2015.

Location	Jaccard's Similarity Co-efficient			
	YSR Kadapa	Chittoor	Ananthapuramu	Kurnool
YSR Kadapa	1.0	0.56	0.46	0.33
Chittoor		1.0	0.64	0.35
Ananthapuramu			1.0	0.45
Kurnool				1.0

## Conclusion

The faunal composition collected from light traps from four districts of Rayalaseema region of Andhra Pradesh during Kharif, 2014 and 2015 comprised of 17 species under 9 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 Chittoor district and species evenness was high in Kurnool. The pestiferous species viz., *H. reynaudi*, *Phyllognathus dionysius*, *H. serrata*, *Brahmina mysorensis* and *Anomola dorsalis* were abundant in major groundnut growing areas of Rayalaseema region in Andhra Pradesh.

In conclusion, a lot of diversity among different districts in Rayalseema region 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 Rayalaseema region in Andhra Pradesh.

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