Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
www.entomoljournal.com
JEZS 2020; 8(4): 1078-1082

Received: 16-05-2020
Accepted: 18-06-2020

K Srinivasa Murthy
National Bureau of Agricultural Insect Resources P B No. 2491, H A Farm Post, Bellary Road Bangalore, Karnataka, India

Corresponding Author:
K Srinivasa Murthy
National Bureau of Agricultural Insect Resources P B No. 2491, H A Farm Post, Bellary Road Bangalore, Karnataka, India

Diversity and abundance of scarabaeid beetles in South India

K Srinivasa Murthy

Abstract
The diversity of scarabaeid beetles was studied in the different agreoceological regions of South India, in the states of Andhra Pradesh, Karnataka, Kerala and Tamilnadu. The species distribution was assessed and 18 species of scarabaeid beetles were recorded from the diversified cropping pattern comprising of arecanut, coconut, groundnut, millets, mulberry, pepper, sugarcane, tapioca and vegetables) was explored. The leaf feeders, Melolonthid beetles (38.23%) was more abundant in the states followed by the Rutelinids (20.53%), The cropping pattern, geographical location and the soil type determined the occurrence of the different species in the states.

Keywords: Abundance, beetle, cropping pattern, white grub

Introduction
The family scarabaeidae is the second largest family with more than 30,000 species recorded worldwide [12] and about 2500 species are reported from India [15] and a majority of these are phytophagous (sub families Melonthinae, Rutelinae, Dynastinae and Cetoninae**)** [8, 9] Adults of the sub-family Melolonthinae and Rutelinae are pre-eminently leaf feeders, whereas the adults of Cetoniinae feed on flowers and fruits, and are popularly referred to as flower beetles. Members of Dynastinae usually attack stems or roots of plants. The larvae of scarabaeid beetles commonly known as whitegrubs, are often soil dwelling and cause extensive to damage to the roots of cereals, legumes, small fruit plants, shrubs and trees in many parts of the world [3, 17, 22]

In India, the white grubs are pests of national importance [3, 17]. The scarab fauna of India is very rich and diverse and has not been explored to a greater extent. Scattered information on the diversity of the beetles of Chhattisgarh [5, 6, 8] Himachal Pradesh [20, 21] and North western ghats [24], is documented, while the information on white grub fauna in the southern states of India having diverse cropping pattern, soil type and varied habitats has not been explored to a greater extent

Integrated intensive farming systems and climate change had resulted in depleting biodiversity and habitat degradation, which had necessitated for an inventory of species richness of insect pests, their cataloguing and documentation. The occurrence and distribution of beetles in different geographic and ecosystems is imperative to understand their ecology. to formulate effective strategies for their management.

Materials and Methods
Study area
Surveys were carried out in the southern states of India, viz., Andhra Pradesh, Karnataka, Kerala and Tamilnadu in different locations. The geographical co-ordinates in the different locations considered for study ranged from 10.52-17.89 ^{0}N., 74.29 - 83.2 ^{0}E. The study area comprised of different cropping patterns and soil types (Table 1).

Collection of Scarabaeid beetles
The diversity of scarab beetles depends on the availability of food for larvae and adult, weather conditions and soil type. Collection of scarab beetles was made randomly by hand picking and light trapping. Grubs were collected from a soil depth of 0.25-0.5 nm in cultivated fields. The beetles were collected during May- June which is the major activity period to assess the diversity. The populations were collected from different states and geographical locations of the country from various trees and crop plants (arecanut, coconut, groundnut, mulberry, millets, pulses sugarcane and vegetables).

Collection of adult beetles was made using light traps. The light traps were installed at different locations and there was one trap per hectare at each location. The light traps were placed in the centre of the fields at a height of about 3 metre above the ground and operated between 7:00 PM to 5 AM to attract the scarabaeid beetles to attract the scarabaeid beetles which are positively heliotactic in nature.

The light trap was made of red coloured PVC plastic. The plastic funnel was 25 cm in height, and in diameter of 30 cm. The bottom diameter of the funnel was 5 cm. The rain shed cone for protecting the bulb was fixed at 17 cm above the funnel with the help of three white metal sheets. The diameter of the rain shed cone was 20 cm. The light trap had three baffles (30 cm x 10 cm), placed at a uniform distance of 10 cm around the circumference of funnel. The baffles were fixed to emit light uniformly in all directions without any interference, when the beetles are attracted to light they collide with baffles and fall into the trap. A nylon bag was attached to the bottom of this funnel. The light source consisted of hard glass bulb with copper wire choke. The capacity of bulb was 120 Watts with UV radiation in the visible spectrum range having bluish light

A nylon bag was attached to the bottom of this funnel for collection of beetles. The trapped beetles were collected and separated species-wise and the cumulative count of each species was determined at each location. These beetles were grouped on the basis of relative abundance and frequency for accessing the relative importance of different species. The collected beetles were preserved in a vial containing 70% alcohol and taken to the laboratory for morphological identification.

Identification of the beetles

The scarab adults collected during the surveys and the adults emerging from larvae collected from different locations were identified to the species level, at the Department of Entomology, University of Agricultural Sciences, Bangalore and the Division of Entomology, Indian Agricultural Research Institute, New Delhi, based on the keys and characters listed by [1, 21, 25.]

Adult beetles were identified based on the morphological characters such as body size, colouration, surface sculpture and male genitalia, while the grubs were differentiated based on the color, size of the cephalic capsule, number and form of dorsal sensorial maculae of the last antennomere, stridulatory structures in the maxilla and mandible, raster pattern, arrangement of bristles and hairs on the underside of the abdomen, shape of anal slit (crescent,Y shaped, strongly Y shaped), shape and size of the respiratory plates, proportions of each pair of legs and tarsungulus size [11, 16]

Results and Discussion

Study area

The study area comprised of four South Indian states, viz., Andhra Pradesh, Karnataka, Kerala and Tamilnadu. The states are characterized with varied cropping pattern, soil type and geography (Table 1). The plantation crops (arecanut, coconut, cocoa, coffee, pepper, tea and rubber) predominate in the state of Kerala, while Karnataka has more diversified pattern with maize, millets, pulses arecanut and vegetables. The type of soil in the states varied from red loamy, alluvial soils, sandy loams, red laterite and silty loam. The geographical co-ordinates ranged from 10.52-15.51 ^{0}N, 70.58-83.2 ^{0} E

Species composition and abundance

The population of scarabaeids were collected from different geographical locations in the country from the four states of South India - Andhra Pradesh, Karnataka, Kerala and Tamilnadu. The locations surveyed are indicated in Table 2.

The distribution of white grubs in the different states indicated occurrence of eighteen species in the locations surveyed. The collected beetles belonged to the subfamilies (Melolonthinae, Rutelinae, Cetoniinae, Dynastinae and Scarabeinae. The prevalence of the beetles indicated the occurrence of eighteen species in the various locations. Five species of Melolonthinae, three each of Rutelinidae and Cetoniidae and five of Scarabaeinae were recorded. Maximum species belonged to the sub-family Melolonthinae. Among the melolonthids, *Holotrichia consanguinea* registered 18.32% abundance followed by *H. serrata* (8.36%) and *Leucopholis lepidophora* (6.36%) in the various locations (Table 2). The Rutelenids, *Anomala ruficapilla* and *A.dimidata* recorded 12.23 and 6.08% abundance, respectively. The flower beetles *Protaetia* (Cetoniidae) accounted for 9.32% abundance. The occurrence of various species of the dung beetles (Scarabinae), was relatively low in all the areas of study and ranged from 2.18 - 5.62% in abundance (Fig. 1).

Such a diversity was earlier reported from various locations of the country. [3, 8], reported the diversity and relative abundance of pleurostrict scarabaeidae in the Achanakmar-Amkarkantak biosphere reserve in Chhattisgarh state. About 22 species belonging to 11 genera and 6 subfamilies were reported from the region, while in Madhya Pradesh, 47 species were reported [5, 6, 8]

The genus *Anomala* predominated over among all the scarabeids in both the states. In Maharshtra, the occurrence of different species of *Holotrichia* was widespread on sugarcane, sorghum, groundnut and soybean crops in South konkan and Vidharba regions [9], and in Pune [23, 24]. *Holotrichia serrata* was predominant among all the species recorded. In Himachal Pradesh, *Anomala* sp. followed by *Brahmina* sp. were dominant in Chamba, Kanra, Kullu and Shimla areas [12, 18]. Similar observations were made by [19] on the species prevalent in Western Uttar Pradesh

The percentage distribution of scarabaeied beetles in across the different states indicated that the leaf feeders, the Melolonthids outnumbered the other groups with 38.23% occurrence followed by the Rutelinids (20.53%) The subfamilies Cetoniidae and Scarabinae accounted for 17.66 and 17.64%, respectively while the dynastids registered 5.88%, occurrence, across the states (Table 3 and Fig 2).

The greater species richness of beetles in certain locations of study viz., *H. consanguinea*, *H. serrata* and *Protaetia* sp. is influenced by the cropping pattern, the climatological factors and the altitude. Species richness was reported to be negatively and significantly correlated with altitude. Low temperatures at higher altitudes inhibit the growth and development of beetles [8, 10, 14].

In the present studies, the prevalence of *Leucophora lepidophora* and *L. burmeisteri* in Karnataka and Kerala can be attributed to the type of vegetation at higher altitudes and the soil conditions prevailing. Earlier, congenial habitat, natural vegetation, food availability and appropriate soil type were reported to contribute to the diversity of scarabaeids and the species richness [4, 13] In addition, climatological factors rainfall, humidity, temperature and wind velocity play a decisive role on the emergence, movement, distribution and

bioecology of scarabaeids [2, 18]. The surveyed areas in the different states are located in tropical and forest ecosytem that facilitated the diversity

Knowledge on species diversity, abundance, richness and dominance through surveys would be helpful in planning strategies for conservation of natural enemies, habitat management, design and develop pest management strategies.

Table 1: Characteristics of the study area

State	Location	Geographical Co-ordinates	Cropping pattern	Soil type
Andhra Pradesh	Anakapalle	17 .38.^{0}N, 83.2 ^{0} E	Pigeon pea, Sugarcane, Groundnut, millets	Red laterite, Sandy loam
	Samarlakota	17 .5^{0}N, 82.2 ^{0} E	Millets, Sugarcane, Pulses, cotton	Alluvial, Sandy loam
	Tirupathi	13.65^{0}N, 79.42^0 E	Groundnut, millets, pulses	Red sandy loam
Kerala	Kannur	11.8 ^{0}N, 75.32^0 E	Arecanut, Coconut,Paddy, Pepper, Tapioca	Red laterite, Sandy loan
	Thrissur	10.52 ^{0}N, 76. 2 ^{0} E	Arecanut, Banana, Coconut Paddy, Pepper, Vegetables	Alluvial, Red laterite, Sandy loam
	Sultan Betheri Wayanad	11.67^{0}N, 76.28^0 E	Arecanut, Coconut, Coffee, Cardamom, Rubber, Pepper and Vegetables	Alluvial soil, Red laterite soil, Silty loam
Karnataka	Malanad region (Agumbe, Chikmagalur, Sringeri Sirsi, Shimoga Thirthahalli)	12.57 -13.52^{0}N., 75.72 -75.22 ^{0} E	Millets, maize, pulses. Arecanut, cocoa, sugarcane, coffee, cardamom and spices	Red laterite, Red Sandy, Silty clay
	Bangalore, Mysore	12.97 ^{0} N., 77.57 ^{0} E	Rice, Small millets, Maize, Groundnut, sorghum, Sugarcane, castor and vegetables	Red laterite and red loamy
	Chintamani	13.40 ^{0} N., 78.05^0 E	Rice, Small millets, Maize, Groundnut, sorghum, pulses, sunflower, fruit crops and vegetables	Red loamy, Red sandy
	Belgaum	15.51 ^{0} N., 74.29^0 E	Jowra, Maize, Paddy, Wheat, Bajra, Pulses, groundnut, sunflower, sugarcane, cotton, tobacco	Deep black soil, Red loamy. Laerite
Tamilnadu	Gudalur	11.59 ^{0} N., 76.50^0 E	Coffee, Tea, Paddy, Vegetables, Spices	Lateritic soil, Red sandy soil, Red loam, black soil, Alluvial and Colluvial soil.
	Coimbatore	11.16 ^{0} N., 76.58^0 E	Banana, Coconut, cotton, Oilseeds, Pulses, Millets, Vegetables, Sugarcane	Red calcareous Soil, Black Soil, Red non-calcareous, Alluvial and Colluvial.
	Ooty	11.41 ^{0} N., 70.58^0 E	Potato, Cabbage, Carrot, Cauliflower, peaches, pears, plums and strawberries Vegetables, Coconut	Lateritic soil, Red sandy soil, Red loam, black soil, Alluvial and Colluvial soil.
	Theni	15.51 ^{0} N., 77. 79^0 E	Banana, Chillies, Sugarcane, Paddy, Oilseeds, Vegetables, millets	Red spoil, Black soil, Brown soil
	Valparai	15.51 ^{0} N., 74.29^0 E	Coffee, Tea, Cardamom, Coconut, pulses, vegetables, millets	Red Sandy, Sandy Loam, Clay Loam

Table 2: Relative abundance of white grubs (Scarabaeidae) in various locations in Southern states

Sl. No	Subfamily	Species	Relative Abundance (%)	State (Location)
1	Melolonthinae	*Holotrichia consanguinea*	18.12	Tamilnadu (Coimbatore, Gudalur, Oooty, Valparai, Theni, Dindigul) Andhra Pradesh (Anakapalle, Samarlakota, Tirupathi. Horsely hills)
		H.serrata	8.34	Karnataka (Bangalore,Bagalkot, Chikkaballapur, Chintamani, Hubli, Mysore)
		Leucopholis lepidophora	6.16	Karnataka (Sringeri, Shivamoga, Thirthahalli,Sirsi, Kerala (Sultan Betheri, Thrissur, Kannur)
		Leucopholis.burmeisteri	4.01	Karnataka (Belgaum, Chikamagalur, Udupi, Mangalore) Kerala (Kannur)
		Leucopholis coneophora	2.10	Kerala (Thrissur, Wayanad)
2.	Rutelinae	*Anomala ruficapilla*	12.23	Karnataka (Bangalore, Bagalkot, Chikkaballapura, Chintamani, Mysore)
		Anomala dimidata	6.08	Tamilnadu (Theni, Dindigul, Valparai)
		Exomala pallidipennis	2.27	Karnataka (Bangalore, Chintamani, Mysore, Tumkur) Tamilnadu (Valparai)
3	Cetoniinae	*Protaetia sp.*	9.32	Andhra Pradesh (Tirupathi) Tamilnadu (Ooty, Gudalur)

		Protaetia cuprea ignicollis	5.06	Karnataka (Dasarhalli, Chikballapura)
		Heterorrhina sp.	3.28	Tamilnadu (Ooty)
4	Dynastinae	*Calicnemis obesa*	1.82	Tamilnadu (Theni, Dindigul)
		Oryctes rhinoceros	4.06	
5	Scarabaeinae	*Onthophagus nuchicornis*	5.62	Karnataka (Kolar, Chintamani, Chikkaballapura,
		Copris tripartitus	4.03	Bangalore (Nandi hills),
		Onthophagus coenobita	2.18	Mysore, Tumkur
		Onthophagus auritus	3.08	Agumbe, Mudhigere, Sirsi
		Basilepta sp	2.73	Mudhigere, Bagalkot

Table 3: Percentage of Scarabeids in South Indian states

Sl. No	Subfamily	Abundance (%)
1	Scarabaeinae	17.64
2	Melolonthinae	38.23
3	Cetoniinae	17.66
4	Rutelinae	20.58
5	Dynastinae	5.88

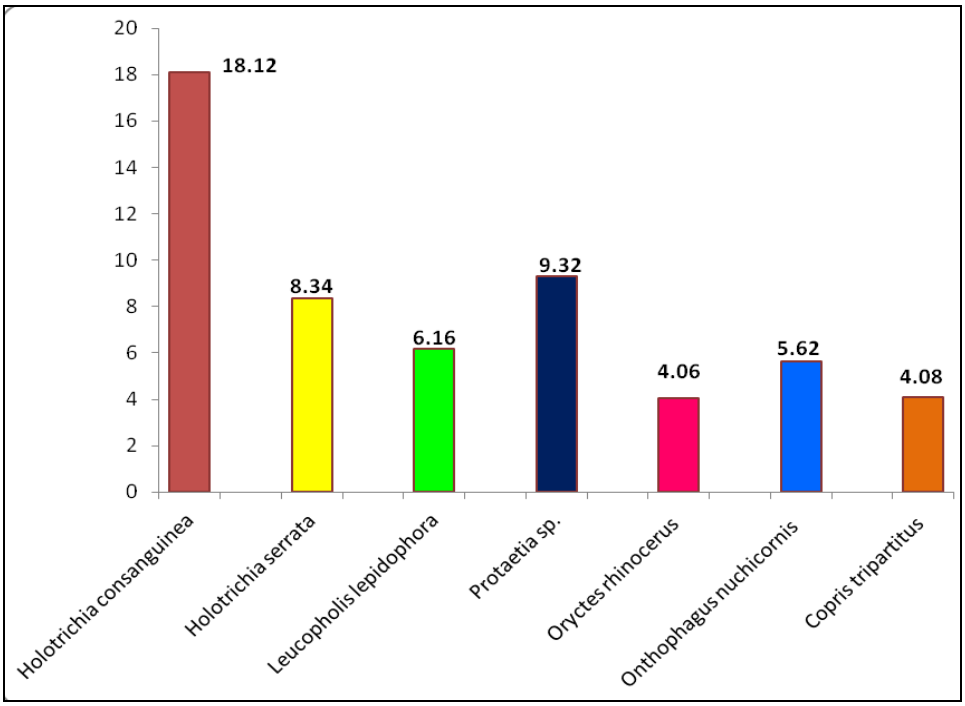

Fig 1: Percentage occurrence of more prevalent white grub species in the states of South India

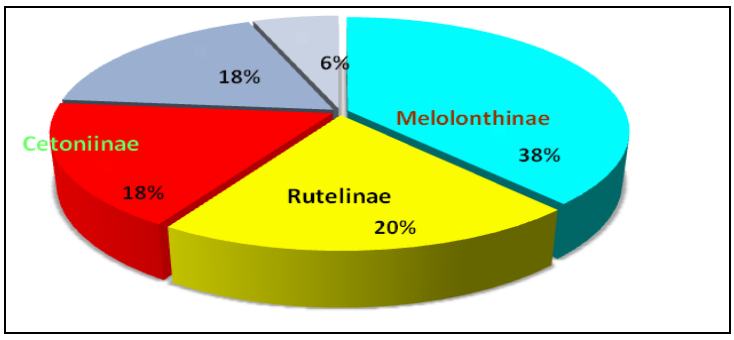

Fig 2: Percentage abundance of major white grub sub families across the states

Conclusion

The diversity and abundanc of scarabaeid beetles was assessed in the states of Andhra Pradesh, Kerala, Karnataka and Tamilnadu. Melolonthid beetles were more abundant in the crops studied. The occurrence of the beetles was influenced by the copping pattern, the soil type and the geographical co-ordinates.

Acknowledgements

The authors are thankful to the Director, ICAR-NBAIR, for providing the facilities. Identification of the scarabaeids by Dr. K.Sreedevi, ICAR-NBAIR, Dr ARV Kumar Department of Entomology, GKVK, Bangalore is duly acknowledged. We also thank Dr. Veena kumari, Dr. A.N.Shylesha and Dr. Jagdish Patil, of ICAR –NBAIR for the collections.

References

1. Ahrens D, Zorn C, Yubak GC, Keller S, Nagel P. Illustrated key of pleurostict scarabs of Nepal: A guide for the identification of white grubs and their adults of the mid hill and lowland regions of Middle-Western Nepal. Opuscula Biogeographica Basileensia 2007; 5:1-44.
2. Ali TM. Biosystematics of phytophagous Scarabacidae-an Indian overview. In: Sharma G, Mathur YS, Gupta RBL (eds) Indian phytophagous scarabs and their management: Present Status and Future Strategy. Agrobios, 2001, 5-37.
3. Bhawane GP, Mamlayya AB, Wagh SR, Chougule AK. Diversity of white grub beetles and their host range from northern western ghats, Kolhapur District (MS) India. The Bioscan. 2012; 7:589-596
4. Chandel RS, Mehta PK, Verma KS, Sharma PC. A survey study of white grubs of economic importance in Himachal Pradesh. In: Proceedings of National Conference on Plant Protection in Agriculture through Ecofriendly Techniques and Traditional Farming Practice. Durgapur Rajasthan, India 2010, 441-442.
5. Chandra K, Ahirwar SC. Insecta: Coleoptera: Scarabaeidae, Zoological Survey of India, Fauna of Madhya Pradesh (including Chhattisgarh), State Fauna Series. 2007; 15(Part-1):273-300.
6. Chandra K, Singh SP. Scarabaeid Beetles (Coleoptera) of Achanakmar Wildlife Sanctuary, Chhattisgarh. National Journal of Life Science, 2010; 7(1):71-74.
7. Chandra K, Salma Khan, Devanshu Gupta. New Records to thespecies diversity of family Scarabaeidae and Hybosoridae (Coleoptera: Scarabaeoidea) of Jabalpur, Madhya Pradesh (India). Academic Journal of Entomology. 2012; 5(1):28-36(ISSN: 1995-8994).
8. Chandra K, Gupta D. An inventory of scarab beetles (Coleoptera: Scarabaeidae) of Achanakmar-Amarkantak Biosphere Reserve, Chhattisgarh, India. International Journal of Science and Nature. 2012; 3:886-891
9. Dadmal SM, Khadakkar S. Revision of *Holotrichia* Hope (Scarabaeidae: Melolonthinae) in different agro – climatic zones of Maharashtra (India). Journal of Entomology and Zoology Studies. 2014; 2(3):50-58
10. Dhoj Yubak GC, Keller S, Nagel P, Kafle L. Abundance and diversity of scarabaeid beetles (Coleoptera: Scarabaeidae) in different farming areas of Nepal. Formosan Entomon. 2009; 29:103-112
11. Dittrich-Schröder G, Conlong De, Way MJ, Harrison J DUG, Mitchell A. Identification key to scarabaeid beetle larvae attacking sugarcane in South Africa using dna barcoding and integrative taxonomy. Proceedings of South African Sugarcane Technology Association. 2009; 82:500 -524.
12. Gupta S. Distribution and abundance of *Brahmina coriacea* (Hope) in Himachal Pradesh. MSc Thesis. CSK HPKV, Palampur, Himachal Pradesh, India, 2012.
13. Imura O, Morimoto N, Shi K, Sasaki H. Landscape diversity of pasture dung beetle communities in the central region of mainland Japan and implications for conservation management. Biodiversity and Conservation. 2014: 23:597-616
14. Khanal D, Dhoj YGC, Sporleder M, Thapa RB. Distribution of whitegrubs in here ecological domains of Nepal. The Journal of Agriculture and Environment. 2012; 13:40-46.
15. Krajcik M. Check list of the World Scarabeeoidea. Annexure X-Supplement. 2012; 5:278.
16. Mariana A, Cherman, Jerson VC, Guedes, Miguel A, Morón, *et al*. White grubs (Coleoptera, Melolonthidae) in the "Planalto Region", Rio Grande do Sul state, Brazil: Key for identification, species richness and distribution. Reviews of Brasilia Entomology. 2013; 57(3):271-278.
17. Mehta PK, Chandel RS, Mathur YS. Status of Whitegrubs in north Western Himalaya. Journal of Insect Science; 2010; 23:1-14
18. Pathania M, Chandel RS, Verma KS, Mehta PK. Diversity and population dynamics of phytophagous scarabaeid beetles (Coleoptera: Scarabaeidae) in different landscapes of Himachal Pradesh, India. Arthropods. 2015; 4(2):46-68.
19. Riazuddin, Rinni Sahrawant, Manish Kumar Sharma, Jagpal Singh, Mayank Kumar Rai. Surveying on prevailing species of whitegrubs (Coleoptera: Scrabaeidae) in different districts of Western Uttar Pardesh, India. Trends in Bio Sciences. 2018. 11(11):2137-2142
20. Sharma RM, Bulganin Mitra, Chakraborty P. Fauna of Protected areas - 12: Beetles of Kalatop-Khajjiar wildlife sanctuary, Himachal Pradesh. Zoos' Print Journal. 2004; 19(9):1626.
21. Sreedevi K, Sakshi Tyagi, Veena Sharma. Species diversity of white grubs (Coleoptera: Scarabaeidae) in the sub-Himalayan and northern plains of India. Current Science. 2017; 113(2):322-329
22. Thakare VG, Zade VS. Diversity of beetles (Insecta: Coleoptera) from the vicinity of Semadoh-Makhala road, Sipnarange, Melghat Tiger Reserve, (MS) India. Bioscience Discovery. 2012: 3:112-115.
23. Theurkar SV, Patil SB, Ghadage MK, Zaware YB, Madan SS. Distribution and abundance of White grubs (Coleoptera: Scarabaeidae) in Khed Taluka, part of Northern Western Ghats, MS, India. International Res. J. Biological Sci. 2012; 1(7):58-60.
24. Theurkar SV, Ghadage MK, Madan SS, Bhor GL, Patil, SB. Occurrence of white grubs in ground nut Growing area of Khed Taluka, part of Northern Western Ghats, MS, India. Res. J. Recent Sciences. 2013; 2(ISC-2012): 1
25. Veeresh GK. Studies on root grubs in Karnataka with special reference to bionomics and control of *Holotrichia serrata* F. (Coleoptera: Melolonthinae). UAS Monograph Series No. 2, Bangalore. India, 1977.