



E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; SP5: 111-115

Sandeep Kumar
Department of Entomology,
Sardar Vallabhbhai Patel
University of Agriculture and
Technology, Meerut, Uttar
Pradesh, India

Vishvendra
Department of Entomology,
Sardar Vallabhbhai Patel
University of Agriculture and
Technology, Meerut, Uttar
Pradesh, India

(Special Issue- 5)

**Advances in Agriculture and Natural Sciences for Sustainable
Agriculture
(October 12 &13, 2018)**

Identification of Scarabaeid beetles (Coleoptera) in vicinity of sugarcane crop in the western plain zone of Uttar Pradesh, India

Sandeep Kumar and Vishvendra

Abstract

The fantastic survey was conducted in vicinity of sugarcane growing area in four district Meerut, Muzaffarnagar, Baghpat and Saharanpur of western plain zone of Uttar Pradesh, India revealed 26 species belong to 5 subfamilies Rutelinae, Melolonthinae, Scarabaeinae, Dynastinae and Cetoniinae. In the subfamily Rutelinae, the maximum number of beetles was collected *Anomala begalensis* followed by *Anomala dimidiata* and least collected *Anomala varicolor* and *Anomala ruficapilla*. In the subfamily Melolonthinae, the maximum number of beetles was collected *Holotrichia nagpurensis* followed by *Holotrichia* spp. and least collected *Lepidiota* spp. In the subfamily Scarabaeinae, the maximum number of beetles was collected *Onthophagus ramosellus* followed by *Onthophagus gazella* and least collected *Catharsius pithecus*. In the subfamily Dynastinae, the maximum number of beetles was collected *Protaetia albaguttata* and least collected *Phylloganthus dionysius*. In the subfamily Cetoniinae, the maximum number of beetles was collected *Oxycetonia versicolor* and least collected *Oxycetonia albopunctata*. All these species recorded for the first time from sugarcane growing area of the western plain zone of Uttar Pradesh, India.

Keywords: Sugarcane Identification, White grub beetles

1. Introduction

The all species of scarab beetles are founded in sugarcane growing area. Adults of these beetles are manifest due to their relatively large size, bright colors, often elaborate ornamentation, and interesting life histories. Life histories of scarab beetles are unbelievably diverse and include adults that feed on dung, carrion, fungi, vegetation, pollen, fruits, compost, or roots. These beetle are a common name applied to beetles in the subfamilies Scarabaeinae and Aphodiinae, while most species in the subfamilies Melolonthinae, Dynastinae, Rutelinae, and Cetoniinae feed on plant products and are occasionally agricultural pests of various commercial crops. Dung beetles as a whole performs a series of ecological functions such as nutrient cycling, soil aeration (Mittal 1993) [19] seed dispersal (Estrada & Estrada 1991, Larsen 2004) [10, 16] and regulation of enteric parasites and dung breeding dipteran pests (Borenmissza 1970; Fincher 1981) [4, 11].

The family Scarabaeidae includes about 91% of all scarabaeoids (except Lucanidae and Passalidae) and includes about 27,800 species worldwide. Within the family Scarabaeidae, the two subfamilies Aphodiinae and Scarabaeinae include approximately 6,850 species worldwide, and the subfamilies Orphninae, Melolonthinae, Dynastinae, Rutelinae, Cetoniinae, Trichiinae and Valginae include approximately 20,950 species (Ratcliffe & Jameson 2001) [23]. White grub has emerged as a serious insect pest in Western Uttar Pradesh as the remains found hidden in the soil, their damage is hard to predict in advance and once damage is caused, remediation become difficult. The White grub life cycle consists of four stages viz., egg, larval instars (grubs), pupa, adult stages. The grubs with subterranean habitat feed extensively on the roots and the adult defoliates plants/trees for feeding and mating. Several insecticides are recommended for the control of white grubs, but in fact the insecticides do not provide satisfactory control unless use in very high dose, which in turn becomes hazardous and uneconomic besides being unsustainable. A satisfactory solution to these conflicting demands

Correspondence

Vishvendra
Department of Entomology,
Sardar Vallabhbhai Patel
University of Agriculture and
Technology, Meerut, India

can be met through developing safer control methods considering the microbial agents like entomopathogenic fungus (EPF) and entomopathogenic nematodes (EPN) against white grub so as to develop a viable, environmentally safe method of management. Further, trapping of adult white grub beetles with light source can also be considered economical over pheromones in the context of the multi species situation for the management of adults. There is an ample scope of increasing sugarcane production in the districts like Meerut, Muzaffarnagar, Saharanpur, Baghpat, Ghaziabad and nearby area, as the sugarcane is a main crop of these regions.

The present study was aimed to investigate the identification of Scarabaeid Beetles (Coleoptera) in vicinity of sugarcane crop and the identified of 26 spp of white grub beetles in the vicinity of sugarcane growing area. Which is the major species of *H. nagpurensis*.

2. Materials and Methods

A faunistic survey was conducted between March to October 2012 and 2013 and these beetles were collected from four different localities, viz., Khanoda (Meerut), Behada Sadhat (Muzaffarnagar), Daha (Baghpat) and Jhabiran (Saharanpur) districts were selected for the present studies. The white grub beetles were collected from light trap, methoxy benzene trap, light trap with methoxy benzene lure and hand picking method. During the survey, more than 100 field visits were made, periodically in four rounds per month. The survey was also conducted in the field where the trials on the white grub management were made. Information was also collected from the farmers during the survey after interacting with them in identifying the sick field. The collected of these beetles were maintained in Bio-control laboratory at Sardar Vallabhbhai Patel University of Agriculture and Technology Meerut, Uttar Pradesh.

The collected beetles were identified locally with the help of key available and confirmation was also made with the help of Dr. V. V. Ramamurty, Professor, Department of Entomology, Indian institute of Agricultural Research (IARI), New Delhi. (Registration under RRS No. 710 – 750/13).

3. Results and Discussion

The collected beetles were maintained at Bio-control laboratory. These were identified and belonged to the family Scarabaeidae. The identified 26 different species of this family consists of 9 species to sub family Rutelinae, 7 species to sub family Melolonthinae, 4 species to sub family Scarabaeinae, and 3 species, each to sub family Dynastinae and Cetoniinae, respectively. (Plate 1 to 26).

3.1. Sub family Rutelinae

***Anomala bengalensis* (Blanchard):** (Rutelinae: Scarabaeidae: Coleoptera)

Adults of these beetles were moderately elongated pale lustrous yellow head, hind tibiae and all the tarsi were dark in colour. The head was rather finely punctuated; rugose, clypeus broadly and transversely rectangular, its front margin strongly reflexed. Pronotum was strongly rounded; front tibia was tridentated and larger claw of the front and middle teeth cleft, 19-22 mm in length and 10-11 mm in breadth (Plate – 1). The present results are in agreement with the finding of (Reddy *et al.* 1978) [22] who observed that individuals of this species fed on apical buds and tender leaves of mulberry at MRS, Hebbal, Bangalore.

***Anomala rugosa* (Arrow):** (Rutelinae: Scarabaeidae: Coleoptera)

The body colour of the adult beetles *A. rugosa* was light black with two triangle spots on the each side of the head. It was phototactic in nature and adult fed on the newly emerged leaves of the forest trees. The lengths of the adult beetles were about 2.0 cm and width 1.3 cm. (Plate- 2). In India, this species was also recorded from Himachal Pradesh and Uttrakhand, (Chandra *et al.* 2012) [6].

***Anomala sp.* (Indet):** (Rutelinae: Scarabaeidae: Coleoptera)

The adult beetles were phototactic in nature and the colour of the body was blackish brown with the two black strips from the anterior to posterior region of the wing. The length of the adult beetles was 1.6 cm and the width 1.2 cm (Plate - 3). This species was also recorded from Himachal Pradesh and Uttrakhand, (Sadoyama *et al.* 2001 and Chandra 2012) [24, 6].

***Anomala varicolor* (Gyllenhal):** (Anomalina: Scarabaeidae: Coleoptera)

The extremities of the tibia and the tarsi were dark. The elytron was deeply and finely punctuate striate with the subsutural interval broad and closely punctured. It was phototactic in nature and the adult beetle was 1.6 cm and width 1.1 cm. The adult beetle colour was light brown with having two black spot on each side of the head (Plate-4). In India, this species was also recorded from Himachal Pradesh and Uttrakhand, (Chandra *et al.* 2012) [6].

***Anomala ruficapilla* (Burmeister):** (Anomalina: Scarabaeidae: Coleoptera)

The adult beetles were phototactic in nature with dark black colour of the body. Wing had black line on each side from anterior to posterior region and adult beetle was about 1.4 cm length and width 1.0cm. Adult beetles were having two spot on the each side of the head region (Plate-5). In India, this species was also recorded from Himachal Pradesh and Uttrakhand. (Chandra, *et al.* 2012 Chandra and Gupta 2013) [6, 8].

***Anomala dimidiata* (Hope):** (Anomalina: Scarabaeidae: Coleoptera)

The grape green beetle was with broad and oval body with Clypeus densely and frons less densely punctuate. Pronotum was moderately closely punctuate and coarsely confluent at sides. Scutellum finely punctuate and elytra finely and closely punctuate, with slight traces of longitudinal lines. Pygidium was moderately finely and transversely rugose (Plate-6). In India, this species was also recorded from Himachal Pradesh and Uttrakhand, (Garg 1987, Singh and Mishra 2003 and Chandra *et al.* 2012) [12, 27, 6].

***Adoretus versutus* (Harold):** (Rutelinae: Scarabaeidae: Coleoptera)

The beetle was reddish chestnut with the forehead and pronotum, except the sides of the latter and sometimes with a median line, dark and evenly but not very densely clothed with gray decumbent setae. It is moderately broad and convex, the clypeus was coarsely rugose, and front tibia was armed with three strong acute teeth. In male, the eyes were large and clypeus small and transverse. Pronotum was less convex than in the female and rather less shining. In female, the body was broader and more convex and generally larger than male, with 9-12 mm length and 5-6 mm in breadth (Plate – 7). The present observations were in agreement with

(Veeresh 1974) [28] who observed *A. versutus* commonly defoliating cultivated roses in Bangalore.

***Adoretus duvauceli* (Blanchard):** (Rutelinae: Scarabaeidae: Coleoptera)

The adult beetles were phototactic in nature and the body colour of the adult beetles was light black colour. The body length of the adults beetles was 1.5 cm and the width 0.9 cm (Plate – 8). In India, this species was also recorded from Himachal Pradesh and Uttarakhand, (Chandra *et al.* 2012) [6].

***Mimela fulgidivittata* (Blanchard):** (Rutelinae: Scarabaeidae: Coleoptera)

The beetle was deep metallic green above and beneath, with the antennae ferruginous and with fiery-red markings on elytra, pronotum finely and rather evenly punctured. Elytra finely but distinctly punctured all over except at the apices, pygidium very finely and scantily punctured, mesosternum bluntly prominent in the middle but not produced, front tibia bi-dentate (Plate – 9). In India, this species was also recorded at Hawalbagh in Almora district of Uttarakhand (Shah and Garg 1988) [26].

3.2. Sub family: Melolonthinae

***Holotrichia nagpurensis*:** (Melolonthinae: Scarabaeidae: Coleoptera)

The adult beetles were light brown, pronotum with or without setae, male genitalia with three chitinised processes that arise from lateral sides. Male genital of *H. nagpurensis* was SpiculumGastrale ‘Y’ shaped, with broad stem, two arms widely separated. The adult beetles fed on the newly emerge leaves of the neem plants (Plate –10). In India, this species was also recorded from Maharastra and Uttar Pradesh, (Chandel *et al.* 1997 and Dadmal *et al.* 2013) [5, 9].

***Holotrichia nr. freyi*:** (Melolonthinae: Scarabaeidae: Coleoptera)

The adult beetles were phototactic in nature and the body colour was dark black in colour. The length of the adult beetles 2.0 cm and width about 1.4 cm. The adult beetles fed on the ornamental plants. (Plate – 11)

***Holotrichia sp. (Indet.)*:** (Melolonthinae: Scarabaeidae: Coleoptera)

The adult beetles fed on the newly emerged neem leaves. The colour of the adult beetles was light brown in colour and was phototactic in nature. The body length of the adult beetle was 2.0 cm and width about 1.1 cm (Plate – 12). In India, this species was also recorded from kheda district of Uttar Pradesh, (Dadmal *et al.*, 2013) [9].

***Maladera insanabilis*:** (Melolonthinae: Scarabaeidae: Coleoptera)

The adults beetle was small size as compared to other white grub beetles. The size of beetle ranged from 6.5 to 8.5 mm in length and 2.5 to 4.0 mm in width. The body colour of this beetle was brownish red in colour. These adult beetles were phototactic and phytophagus in nature (Plate – 13). In India, this species was also recorded in Himachal Pradesh and Uttarakhand (Veresh 1977, Khan and Ghai 1974 Chandra *et al.* 2012) [28, 14, 6].

***Schizonycha ruficollis* (F.):** (Melolonthinae: Scarabaeidae: Coleoptera)

Adults had shining ruflocastaneous clypeus, emarginated;

upper surface of the head roughly rugose, third antennal segment beaded; club in male was longer and larger than 2nd to 7th segment; punctuation on the elytra closer and irregular; forelegs long, tarsus more than twice as long as tibia, close forked at the tip, the elongated body with 12-13 mm in length. The adult beetle colour was light yellowish (Plate - 14). In India, this species was also recorded from Bihar, Chhattisgarh, Madhya Pradesh, Odisha, Uttarakhand, and West Bengal, (Oyafuso *et al.* 2002 and Chandra and Ahirwar 2007) [20, 7].

***Melolontha cuprescens* (Blanchard):** (Melolonthinae: Scarabaeidae: Coleoptera)

The adult beetles were phototactic in nature and the colour of the body was dull brown colour. Adult beetle length was 2.3 cm and width 1.3 cm. (Plate- 15). In India, this species was also recorded from Himachal Pradesh and Uttarakhand (Chandra *et al.* 2012) [6].

Lepdiota sp

The adult beetles were phototactic in nature and the colour of the body was brownish black (Plate-16). In India, this species was also recorded from Himachal Pradesh and Uttarakhand, (Padmanaban and Daniel 2003 and Chandra *et al.* 2012) [21, 6].

3.3. Sub family: Scarabaeinae

***Onthophagus ramosellus* (Bates):** (Scarabaeinae: Scarabaeidae: Coleoptera)

The Adult beetles were phototactic in nature and the body colour light black. The head was having two hard spines on the each side. It was very small in length about 1.0 cm and width 0.9 cm. (Plate -17). In India, this species was also recorded from Kurukshetra, Haryana (Kakkar and Gupta 2009) [13].

***Onthophagus gazelle*:** (Scarabaeinae: Scarabaeidae: Coleoptera)

The adult beetles were phototactic in nature and the body colour deep chocolate-brown or black. The head was moderately broad. The vertex a pair of strong conical horns directed obliquely backward The Adult beetle length was 8-9.5 mm and width 4-5 cm (Plate -18). In India, this beetle was also recorded from Andhra Pradesh, Chhattisgarh, Delhi, Gujarat, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, and Tamil Nadu (Arrow 1931 Balthasar 1963 Löbl *et al.* 2006b Chandra & Ahirwar 2007) [2, 3, 18, 7].

***Catharsius molossus*:** (Scarabaeinae: Scarabaeidae: Coleoptera)

C. molossus had a length of about 25–35 millimetres, (0.98–1.4 in) females and about 45 millimetres (1.8 in) in males. This species is completely black; the body is short and convex, quite hairy on the ventral side and usually with a short conical horn in the centre of the head of the males. Pronotum was densely granulated and elytra was finely striated (Plate- 19). This species was also recorded from Andaman and Nicobar Island, Arunachal Pradesh, Assam, Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Karnataka, Kerala, Madhya Pradesh, Meghalaya, Odisha, Sikkim, Uttarakhand, and West Bengal (Arrow 1931 Balthasar 1963 Löbl *et al.* 2006a Chandra & Ahirwar 2007) [2, 3, 17, 7].

***Catharsius pithecius*:** (Scarabaeinae: Scarabaeidae: Coleoptera)

The body colour was black and shining with pronotum partly or entirely opaqing of the antennae, mouth - organs hairy clothing and legs lower surface reddish. The body was shortly oval, very convex in shape. Head nearly semi - circular in shape, the body length of beetle was 15-12 mm and writh 10-13.5mm. Head bears a nearly straight slender horn arising just in the front of eyes and inclined very slightly backwords (Plate- 20). This species was also recorded from Andhra Pradesh, Bihar, Chhattisgarh, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Punjab, Rajasthan, Tamil Nadu, China, Pakistan, Sri Lanka (Arrow 1931 Balthasar 1963 Löbl *et al.* 2006a) [2, 3, 17].

3.4. Sub family: Dynastinae

***Oryctes rhinoceros* (F.):** (Dynastinae: Scarabaeidae: Coleoptera)

The body of adult beetle was covered by a thick exoskeleton. The beetle was known for their unique shape and large size. This beetle reached more than 150 mm in length. It was phototactic in nature and the body colour of the beetle was dark black (Plate- 21). In India, this species was also recorded from Palakkad, Kerala (Yaminivarma 2013) [29].

***Phylloganthus dionysius* (F.):** (Dynastinae: Scarabaeidae: Coleoptera)

The beetles were chestnut red incolour and shining. Body length varies from 16-23 mm and breadth ranges from 9.5 - 13.0 mm. In male beetles, cephalic horn was broad strongly inclined backwards, triangular extremely with acute apex (Plate- 22). This species was also recorded from Andhra Pradesh, Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Karnataka, Madhya Pradesh, Maharashtra, Odisha, Sikkim, Tamil Nadu, Uttarakhand, and China (Taiwan); Nepal; Sri Lanka (Arrow 1910; Krell 2006; Chandra & Ahirwar 2007) [1, 15, 7].

***Protaetia alboguttata* (Vigors):** (Dynastinae: Scarabaeidae: Coleoptera)

The adult beetles were phototactic in nature. The head colour of *P. alboguttata* was black and the wings were whitish with black line. The length of the adult beetle was 2.7 cm and width about 1.4 cm (Plate 23). In India, this species was also recorded from Himachal Pradesh and Utrakhand, (Chandra *et al.* 2012) [6].

3.5. Sub family: Cetoniinae

***Oxycetonia versicolor* (F.):** (Cetoniinae: Scarabaeidae: Coleoptera)

Adult was compact and oval, 7- 15mm in length and 5-7 mm in breadth. Body was compact and oval usually somewhat flattened, brilliantly coloured and mostly red with black marking, the top surface of the body was smooth with a metallic shining and striking colour patterns. Its upper surface was smooth; prothorax and elytra were brick red in colour. A pair of black spots was present on the prothorax and lateral margins revealed white border. The elytra bare various patterns of white spots (Plate- 24). This species was also recorded from Assam, Madhya Pradesh, West Bengal, Uttarakhand and Myanmar Uttar Pradesh, Himachal Pradesh, Rajasthan (Chandra *et al.* 2012 and Shah and Garg 1985) [6, 25].

***Oxycetonia albopunctata* (F.):** (Cetoniinae: Scarabaeidae: Coleoptera)

The adult beetles were phototactic in nature and the body

colour was green with two dark red colourstrip on the each side of the wing from the anterior to posterior region. The adult beetles were triangular dark red strip with the green point on each side of the head. The lengths of the adult beetles were 1.4 cm and width 1.0 cm (Plate- 25). This species was also recorded from Assam, Karnataka, Madhya Pradesh, Tamil Nadu and West Bengal. (Chandra *et al.* 2012) [6].

***Chiloloba acuta* (Wiedemann)** (Cetoniinae: Scarabaeidae: Coleoptera)

The beautiful green gloss is produced by the micro-structure of the layers of chitin on the elytra. There is absolutely no green or red pigment involved. The entire colouration was purely the result of optical phenomena (if you powdered a wing from a dead beetle you would be left with nothing but grey dust.) (Plate- 26). In India, this species was also recorded from Himachal Pradesh and Utrakhand, (Chandra *et al.* 2012) [6].

4. References

1. Arrow GJ. *The Fauna of British India including Ceylon and Burma*. Col. Lamell.I (Cetoniinae & Dynastinae). Taylor & Francis, London, V-XIV, 1910, 1-322.
2. Arrow GJ. *The Fauna of British India including Ceylon and Burma*. Col. Lamell.III, (Coprinae). Taylor & Francis, London, XII: 1-428, 61 fig., 19pls., map, 1931.
3. Balthasar V. *Monographiederscarabaeidaeand Aphodiidaederpalaearktischen and Orientalischen Region*. (Coleoptera: Lamellicornia). *Verlagder Tschechoslowakischen Akademie der Wissenschafte*. 1963; 11:1-627(226 figs., 16 pls).
4. Borenmissza GF. Insectary studies on the control of dung breeding flies by the activity of dung beetle, *Onthophagusgazella* F. (Coleoptera: Scarabaeinae). *Journal of the Australian Entomological Society*. 1970; 9:31-41.
5. Chandel RS, Gupta PR, Thakurm JR. Host preference and seasonal abundance of defoliating beetles infesting fruit trees in mid hills of Himachal Pradesh. *J Soil Biol. and Ecol*. 1997; 17(1):140-146.
6. Chandra K, Gupta D, Uniyal VP, Bharadwaj M, Sanyal KA. Studies on Scarabaeid beetles (Coleoptera) of govind wildlife sanctuary, Garhwal, Uttarakhand, India. *An International Journal*. 2012; 4(1):48-54.
7. Chandra K, Ahirwar SC. Insecta: Coleoptera: Scarabaeidae, Zoological Survey of India, Fauna of Madhya Pradesh (including Chhattisgarh), State Fauna Series. 2007; 15(1):273-300.
8. Chandra K, Gupta D. Scarab beetles (Coleoptera: Scarabaeidae) of Barnawapara wildlife sanctuary, Chhattisgarh, India. *Journal of Threatened Taxa*. 2013; 5(12):4660-4671.
9. Dadmal S, M Khadakkar, SS, Ghuge PA. Occurance of five *Holotrichia* species (Coleoptera: Scarabaeidae: Melolonthinae) in Maharastra and their makegenitalia characterization. *The Bioscan*. 2013; 8(1):349-352.
10. Estrada A, Estrada RC. Howler monkeys, dung beetles (Scarabaeidae) and seed dispersal: Ecological interactions in the tropical rainforest of Los tuxlas, Mexico. *Journal of Tropical Ecology*. 1991; 7:459-474.
11. Fincher GT. The potential value of dung beetles in pasture ecosystem. *Journal of the Georgia Entomological Society*. 1981; 16(2):316-333.
12. Garg DK. White grub present status of research and

- management in Kumaun hills. U.P. paper presented in *annual workshop on white grub*, held at G. B. Pant University of Agri. and Tech. Hill Campus. Ranichauri district Tehri May, 1987, 20-22.
13. Kakkar N, Gupta SK. Temporal variation in dug beetle (coleoptera: Scarabaeidae) assemblages in Kurukshetra, Haryana, India. *Journal of threatened taxa*. 2009; 1(9):481-483.
 14. Khan KM, Ghai S. White grub and their control in India. *Pesticide*. 1974; 8(22):19-25.
 15. Krell FT. Scarabaeidae: Dynastinae, pp. 277–283. In: Löbl, I. & A. Semetana(ed.). *Catalogue of Palaearctic Coleoptera - volume 3*. Apollo Books, Stenstrup, 2006, 690.
 16. Larsen T. Dung beetle extinctions and ecological function, 2004. <http://www.princeton.edu/kremen/trond.htm>.
 17. Lobl I, Krell FT, Kral D. Scarabaeidae: Scarabaeinae: Coprini, 151-153. In: Lobl, I. and A. Semetana (ed.). *Catalogue of Palaearctic Coleoptera - volume 3*. Apollo Books, Stenstrup, 2006a, 690.
 18. Lobl I, Krell FT, Ziani S, Kral D. Scarabaeidae: Scarabaeinae: Onthophagini, pp. 159-176. In I. Lobl & A. Semetana (ed.), *Catalogue of Palaearctic Coleoptera - volume 3*. Apollo Books, Stenstrup, 2006b, 690.
 19. Mittal IC. Natural manuring and soil conditioning by dung beetles. *Tropical Ecology*. 1993; 34(2):150-159.
 20. Oyafuso A, Arakaki N, Sadoyama Y, Kishita M, Kawamura F, Ishimine M *et al.* Life history of the white grub *Dosylepidasp.* (Coleoptera: Scarabaeidae), a new and severe pest on sugarcane on the Miyako Island, Okinawa. *Appl. Ent. Zoo.* 2002; 37(4):595-601.
 21. Padmanaban, B, Daniel M. Biology and bionomics of palm white grub *Leucopholis burmeisteri*. *Indian J Ent.* 2003; 65(4):444-452.
 22. Raddy RV, Gowda LV, Jayaramaiah M. incidence of chafers (Coleoptera: Scarabaeidae) on malbarry *Morus alba* L. in Bangalore. *White grub News Letters*. 1978; 2(1):6-7.
 23. Ratcliffe BC, Jameson ML. Scarabaeoidea: Scarabaeoid beetles (Lamellicornia). (URL:[http://www.museum.unl.edu/research/entomology/Guide/Scarabaeoidea/Scarabaeoidea-pages/Scarabaeoidea Overview/ScarabaeoideaO.html](http://www.museum.unl.edu/research/entomology/Guide/Scarabaeoidea/Scarabaeoidea-pages/Scarabaeoidea%20Overview/ScarabaeoideaO.html)). In: Ratcliffe, B.C. & M.L. Jameson (eds.). *Generic Guide to New World Scarab Beetles* (URL: [http://www-museum.unl.edu/research/entomology/Guide/index4.htm](http://www.museum.unl.edu/research/entomology/Guide/index4.htm)). Accessed on: 01.06.2012, 2001.
 24. Sadoyama Y, Oroku, Nakamori H. Injury of sugarcane roots by the white grub, *Dasylepidasp.* (Coleoptera: Scarabaeidae), in the Miyako Island. *Japanese J Appl. Ent. and Zool.* 2001; 45(2):89-91.
 25. Shah NK, Garg DK. White grub and their beetles (Coleoptera: Scarabaeidae) in Uttar Pradesh hills. *Indian Journal Ent.* 1985; 47(2):240-244.
 26. Shah NK, Garg DK. Seasonal abundance of white grub beetles on a light trap. *Indian Journal Ecol.* 1988; 15(1):105-108.
 27. Singh MP, Mishra PN. White grubs in hilly and mountain agro ecosystem of Uttaranchal. *Indian Farm.* 2003; 1(1):20-23.
 28. Veeresh GK. Light trap for the control of *Adoretus bicolor* Brenske (Rutelidae: Coleoptera), a pest of grapevine. *Mysore J agri. Sci.* 1974; 8395- 399.
 29. Yaminiwarma CK. Efficacy of eco-friendly management against Rhinoceros beetle grubs in coconut J