



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2019; 7(2): 818-825

© 2019 JEZS

Received: 25-01-2019

Accepted: 28-02-2019

**Ritesh Kumar**

Department of Entomology,  
G. B. Pant University of  
Agriculture and Technology,  
Pantnagar, Uttarakhand, India

**Ishtiyah Ahad**

Division of Entomology,  
Sher-e-Kashmir University of  
Agricultural Sciences and  
Technology of Kashmir,  
Wadura, Sopore, Kashmir, India

**Ravindra Kumar**

Department of Entomology,  
G. B. Pant University of  
Agriculture and Technology,  
Pantnagar, Uttarakhand, India

**Rakesh Kumar**

Department of Entomology,  
G. B. Pant University of  
Agriculture and Technology,  
Pantnagar, Uttarakhand, India

**Kawsar Rasool**

Division of Entomology,  
Sher-e-Kashmir University of  
Agricultural Sciences and  
Technology of Kashmir,  
Wadura, Sopore, Kashmir, India

**Correspondence****Ritesh Kumar**

Department of Entomology,  
G. B. Pant University of  
Agriculture and Technology,  
Pantnagar, Uttarakhand, India

## Occurrence of insect-pests and natural enemies infesting oats (*Avena sativa* L.) in North Kashmir

**Ritesh Kumar, Ishtiyah Ahad, Ravindra Kumar, Rakesh Kumar and Kawsar Rasool**

### Abstract

The present experiment was carried out in the field at the Faculty of Agriculture, Wadura, North Kashmir during 2015-16. Fifteen (15) insect pest and natural enemies of crop plants, belonging to 5 different orders were recorded in the oats (*Avena sativa* L.) agro ecosystem. Soil borne insects viz. white grubs (*Holotrichia longipennis*, *Brahmina* spp, *Melolontha furcicauda* and *Oryctes* spp), wireworm (*Agriotes* spp) and cutworm (*Agrotis* spp); sucking pests including wheat aphid (*Schizaphis graminum*), green stink bug (*Carpocoris* spp), aster leafhoppers (*Macrosteles quadrilineatus*), broad-headed bug (*Camptopus lateralis*) and oat thrips (*Stenothrips graminum*) and foliage pests including cereal leaf beetle (*Oulema melanopa* L.), surface grasshopper (*Chrotogonus trachypterus* Blanchard), armyworm (*Mythimna separata*) and gram pod borer (*H. armigera*) appeared as pests in the oats field. Among the insect pest complex *M. separata*, *O. melanopa*, *H. armigera* are appeared as major pests in North Kashmir district of Baramulla. However, syrphid fly (*Eristalis* spp), dragon fly (*Aeshna* spp), damsel fly (*Agriocnemis femina*), lady bird beetle (*Coccinella septempunctata* Linnaeus), lace wing (*Chrysoperla* spp), pale damsel bug (*Nabis capsiformis*), ground beetle (*Pterostichus melanarius*) and spider (unidentified) appeared as natural enemies associated to insect pest complex of oats.

**Keywords:** Pest-complex, natural enemies, oats, agro-ecosystem

### 1. Introduction

Oats, *Avena sativa* Linnaeus is the sixth major crop of the world after wheat; maize, rice, barley and sorghum [17]. It is extensively grown in the mountain tract of temperate region mostly on the flat lands. It is mainly cultivated as fodder for animals and also for grain because of its high nutritional and medicinal value. The use of grain is now more focused on mining its benefits as a health food. The importance of oats in the biochemical and cosmetic industry is also on the rise [23]. Out of cereals, the highest amounts of  $\beta$ -glycan are found in barley and oats grains [2]. It is cultivated in Punjab, Haryana, West Bengal, Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Rajasthan and Maharashtra [17]. The total area covered under oats cultivation in the country is about 5 lakh ha. The crop occupies maximum area in Uttar Pradesh (34 per cent), followed by Punjab (20 per cent), Bihar (16 per cent), Haryana (9 per cent) and Madhya Pradesh (6 per cent) [17]. Various arthropods and nematodes cause damage to oats (*Avena sativa* L. and *A. byzantino* K.) plants throughout their life and no stage of the crop is free from damage. Crops can be affected from the seedling stage until the grain is harvested [21]. Pests of oats are either polyphagous (damaging a wide range of plants) or oligophagous (feeding on only a few plant species) and it is very rare, any insect found to be monophagous to oats crop. Hundreds of arthropod species feed on oats cultivated in the USA and other countries. Low infestations of certain pests in cereals may stimulate growth and tillers, and actually increase yields [21]. The armyworm is one of the most destructive insects infesting oats. It destroys oats in some areas almost every year. Outbreaks are frequently local and sporadic, but occasionally high populations have infested large sections of the eastern USA and Canada [25]. In Jammu and Kashmir Lone *et al.* [12] reported armyworm *Mythimna separata* major pest in the state which caused heavy losses in the oats which is grown only for fodder purpose. White grubs are polyphagous pests and are cosmopolitan in distribution [15]. In the state of Jammu and Kashmir, white grub has gained a tremendous importance in recent past, due to its attack on many agricultural and horticultural crops, golf courses, lawns and park and they wear a bald and ugly look [19]. A number of species of white grub have been reported in Jammu and Kashmir State and they include

*Protecta neglecta* (Hope.), *Melolontha furcicauda*, *Hilyotrogus holosericus* (Redt.), *Articaphia battalina* (Bates), *Adoretus ladakhansis*, *Adoretus* sp., *Brahmina* sp., *Hetronychus subhoeosis* [19]. In Kashmir valley, *Agrotis ipsilon* is a destructive pest on maize, potato, vegetable crops, flowers and fruit seedlings. Thus, reducing the plant stand and biological yields [16]. In Kashmir valley, five species of cutworms that have been recorded are *Agrotis melafida*, *Agrotis exclamationsis*, *Peeridorma saucia* and *Noctus pronubo* [19]. The nocturnal larvae of this pest cut the haulms and stalk of young plants at the collar region and defoliate the plants in their early growth stage [18]. To provide forage in early season when no other green fodder is available, oats can be accommodated easily under double cropping system immediately after vanishing the white snow carpet over the field crops. However, one of the important constraints in its cultivation is the infestation of the crop to a large number of insect pests at different stages of crop growth. In Kashmir, cultivation of improved oats varieties like “Sabzar”, “Black nip”, “Kent” and injudicious use of fertilizer have made this crop more susceptible to some insect pests. Several authors reported many insects attacking oats from different region in Kashmir and abroad [7, 20]. Furthermore, status of insect pest of a particular crop is shifting under changing climate scenario. Therefore, periodical assessment on pest composite for a crop may help to know the relative economic importance of different pests on that crop. Keeping these views in mind, the present study was conducted to keep current information about Occurrence of insect-pests and natural enemies infesting oats (*Avena sativa* L.) in North Kashmir.

## 2. Materials and Methods

Oats variety “Sabzar” was raised during the Rabi season in 2015-16 under the recommended package of practices of SKUAST-Kashmir at Faculty of Agriculture, Wadura. Observations were recorded at weekly intervals to know the status and succession of the pests at the experimental site. After sowing of oats in the last week of November, white snow carpet remains over the crop during December-February. Oats variety “Sabzar” was planted at 22.5 cm spacing in 3 x 4 m plot size. The experimental plot was maintained without application of any insecticides. Crop was raised in natural conditions (*i.e.* without any application of insecticides) to allow population buildup of insect pests. The observation of various beetles and caterpillar of cutworm infesting oats was taken at weekly intervals throughout the growing season. Quantification of soil arthropods grubs hiding in the soil debris (soil arthropods *viz.* white grubs and wireworms) were quantified by taking three samples of larvae excavating in 8400 cm<sup>2</sup> area *i.e.* (20cm x 20cm) of 21cm deep in soil in the field. Mean number of larvae present per three samples was recorded [24]. Three samples of cutworm larvae was taken by excavating 6250 cm<sup>2</sup> area (25cm x 25cm) of 10 cm deep soil in the field. Mean number of larvae present per three samples was recorded [4]. Plants damaged by other lepidopteran pests were recorded on the basis of number of damaged plants or plant parts out of observed plants from each replication and converted into percent infestation. Bugs, hoppers, weevils, beetles, grasshoppers and natural enemies were recorded as number basis per plant whereas number of aphids was recorded per spikelet square area of leaf sheath. However, some insects infested the crop continuously after their first appearance in considerable numbers were designated as major pests and insect species which appeared occasionally or in small number were designated as minor pests, whereas insect species whose present was scare and

population was very low were considered as minor pests and tabulated accordingly. Similarly each species of insects were identified and counted separately from all the samples and finally average population of the respective pests per sample of the oats crop was calculated. The observations were recorded at weekly intervals from November to June and also frequent field visits were made to monitor the pest fauna of the crop around the area. The insect species were categorized into major and minor pests. The insect pests which infested the crop continuously after their first appearances in considerable numbers were designated as major pests and those which occurred intermittently and their population never became high were categorized as minor pests.

## 2.1 Statistical analysis

Data collected from the experimental site was subjected to standard statistical procedure using standard statistical procedures [6].

## 3. Results and Discussion

### 3.1 Pest Complex

Insect pests recorded infesting oats variety ‘Sabzar’ are presented (Table-1). Study revealed that as many as fifteen (15) insect pests were observed at different growth stage of the crop. Insect pests recorded belongs to five insect orders *i.e.*, three lepidopterans, four hemipterans, three coleopterans, and one orthopterans. During seedling stage oats was soil borne insects *viz.* white grubs (*Holotrichia longipennis*, *Brahmina* spp, *Melolontha furcicauda* and *Oryctes* spp), wireworm (*Agriotes* spp) and cutworm (*Agrotis* spp) and vegetative stage while sucking pests including wheat aphid (*Schizaphis graminum*), green stink bug (*Carpocoris* spp), aster leafhoppers (*Macrostelus quadrilineatus*), broad-headed bug (*Camptopus lateralis*) and oat thrips (*Stenothrips graminum*) and foliage pests including cereal leaf beetle (*Oulema melanopa* L.), surface grasshopper (*Chrotogonus trachypterus* Blanchard), armyworm (*Mythimna separata*) and gram pod borer (*H. armigera*) appeared as pests in the oats field. Among the insect pest complex *M. separata*, *O. melanopa*, *H. armigera* are appeared are major pests. The caterpillars of army worm, *Mythimna separata* appeared from 10<sup>th</sup> meteorological week and reached its peak in the 22<sup>nd</sup> meteorological week whereas, caterpillars of gram pod borer (*H. armigera*) appeared from 12<sup>th</sup> meteorological week and reached its peak in the 18<sup>th</sup> meteorological week. Similarly, damage of cereal leaf beetle (*O. melanopa* L) appeared from 8<sup>th</sup> meteorological week and reached its peak in the 23<sup>rd</sup> meteorological week while, damage of surface grasshoppers appeared from 10<sup>th</sup> meteorological week and reached its peak in the 22<sup>nd</sup> meteorological week attacked the crop and become highly destructive, damaging leaves and stem portions with the rise in temperature above 28°C. The consequent increase in number of this pest also proved a voracious major potential pest, damaging all the parts of the plant *viz.* leaves, seedlings and tender grains. However, population of sucking insect pest like *S. graminum*, *M. quadrilineatus* and *Carpocoris* spp were observed from the experimental site. Among these, aphid population appeared from 9<sup>th</sup> meteorological week and reached their peak in the 22<sup>nd</sup> meteorological week. Hoppers appeared from 10<sup>th</sup> meteorological week and reached their peak in the 24<sup>th</sup> meteorological week. However, bugs appeared from 9<sup>th</sup> meteorological week and reached their peak in the 21<sup>st</sup> meteorological week. All hemipteran insect pests after reaching the peak showed declining trend as crop progressed to the maturity.

**Table 1:** Insects pest complex and their succession on oats

J	Common name	Scientific name	Family and Order	Nature of damage	Host range	Period of prevalence	Period of peak incidence	Status
1	White grub	<i>Holotrichia longipennis</i> <i>Brahmina</i> spp <i>Melolontha fuscicauda</i> <i>Oryctes</i> spp	Scarabaeidae: Coleoptera	Grub feed on roots, destroying seedling	<i>A. sativa</i> <i>T. aestivum</i> <i>H. vulgare</i> <i>Z. mays</i>	May-September	1 <sup>st</sup> fortnight of June	Minor
2	Cut worm	<i>Agrotis</i> spp	Noctuidae: Lepidoptera	Young seedlings, foliage	<i>A. sativa</i> <i>T. aestivum</i> <i>H. vulgare</i> <i>Z. mays</i>	April-June	2 <sup>nd</sup> fort night of May	Minor
3	Wire worms	<i>Agriotes</i> spp	Elateridae: Coleoptera	Damaging roots inside soil.	<i>A. sativa</i> <i>T. aestivum</i> <i>H. vulgare</i> <i>Z. mays</i>	May-August	1 <sup>st</sup> fortnight of April	Minor
4	Wheat aphid	<i>Schizaphis graminum</i>	Aphididae: Hemiptera	Nymph and adult suck cell sap from tender parts	<i>A. sativa</i> <i>T. aestivum</i> <i>H. vulgare</i> <i>Z. mays</i>	May-July	1 <sup>st</sup> fort night of June	Minor
5	Green Stink bug	<i>Carpocoris</i> spp	Pentatomidae: Hemiptera	Nymph and adults infesting foliage, leaves, Ears and grain	<i>A. sativa</i> <i>T. aestivum</i> <i>H. vulgare</i> <i>Z. mays</i>	June-August	2 <sup>nd</sup> fort night of May	Minor
6	Aster Leafhoppers	<i>Macrostelus quadrilineatus</i>	Cicadellidae: Hemiptera	Nymph and adult infesting foliage, sucking sap	<i>A. sativa</i> <i>T. aestivum</i> <i>H. vulgare</i> <i>Z. mays</i>	April-July	2 <sup>nd</sup> fort night of June	Minor
7	Broad-headed bug	<i>Camptopus lateralis</i> (Germar)	Alydidae: Hemiptera	Nymph infesting foliage, sucking sap	<i>A. sativa</i> <i>T. aestivum</i> <i>H. vulgare</i> <i>Z. mays</i>	May-August	1 <sup>st</sup> fortnight of June	Minor
8	Cereal leaf beetle	<i>Oulema melanopa</i> L.	Chrysomelidae: Coleoptera	Grubs scrap chlorophyll from leaves	<i>A. sativa</i> <i>T. aestivum</i> <i>H. vulgare</i> <i>Z. mays</i>	April-July	1 <sup>st</sup> fortnight of June	Major
9	Surface grasshopper	<i>Chrotogonus trachypterus</i> Blanchard	Acrididae: Orthoptera	Formation of white ears (Chaffyness)	<i>A. sativa</i> <i>T. aestivum</i> <i>H. vulgare</i> <i>Z. mays</i>	April-August	1 <sup>st</sup> fortnight of June	Minor
10	Armyworm	<i>Mythimna separata</i>	Noctuidae: Lepidoptera	Caterpillars mainly act as defoliators	<i>A. sativa</i> <i>T. aestivum</i> <i>H. vulgare</i> <i>Z. mays</i>	April-July	1 <sup>st</sup> fortnight of June	Major
11	Gram pod borer	<i>Helicoverpa armigera</i>	Noctuidae: Lepidoptera	Caterpillars mainly act as defoliators	<i>Gossypium</i> Sp, <i>Glycine max</i> , <i>Cicer arietinum</i> <i>T. aestivum</i>	April-July	1 <sup>st</sup> fortnight of May	Major
12	Oat thrips	<i>Stenothrips-graminum</i>	Thripidae: Thysanoptera	Adults and nymphs infesting foliage	<i>A. sativa</i> <i>T. aestivum</i>	May-August	1 <sup>st</sup> fort night of June	Minor

**Table 2:** Natural enemies associated with insect pest complex of oats

Sr. No	Common name	Scientific name	Family and order
1.	Syrphid fly	<i>Eristalis</i> spp	Syrphidae: Diptera
2.	Dragon fly	<i>Aeshna</i> spp	Aeshnidae: Odonata
3.	Damsel fly	<i>Agriocnemis femina</i>	Calypterygidae: Odonata
4.	Lady bird beetle	<i>Coccinella septempunctata</i> Linnaeus	Coccinellidae: Coleoptera
5.	Lace wing	<i>Chrysoperla</i> spp	Chrysopidae: Neuroptera
6.	Pale damsel bug	<i>Nabis capsiformis</i>	Nabidae: Hemiptera
7.	Spider	Unidentified spp	
8.	Ground beetle	<i>Pterostichus melanarius</i>	Carabidae: Coleoptera

### 3.2 Natural enemies

Natural enemies found in oats during study period are presented in (Table 2). Among insects eight enemies, syrphid fly (*Eristalis* spp), dragon fly (*Aeshna* spp), damsel fly (*A. femina*), lady bird beetle (*C. septempunctata* Linnaeus), lace wing (*Chrysoperla* spp), pale damsel bug (*N. capsiformis*), ground beetle (*P. melanarius*) and spider (unidentified) appeared as natural enemies associated to insect pest complex of oats.

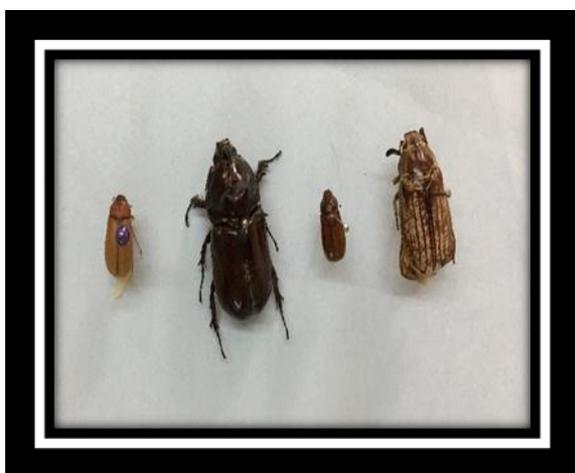
### 3.3 Pest status

Among various insect pest associated with the crop, only three insects are major pest during the year rabi 2015-16 and other insect pests associated with the crop were of minor importance (Table-1). During rabi 2015-16 the association of all the insects with the crop including *M separata*, *H armigera* and *O melanopa* were of major importance. It is clear that temperature has an important role on the development of insect pests especially on the development of *M separata*, *H armigera* and *O melanopa*. Its out break in the form of plaque like a voracious status supports the report of (Laurent 1955; Narayanan 1953 and Khan *et. al.* 1972.)<sup>[10, 16, 9]</sup>. Besides during the period of study *H. armigera* is the first report from Kashmir and a few weeds were also detected in oats field among which *Chenopodium* specie was found as an alternate habitat host of aphids which is a new finding under Kashmir conditions. Our results are in contradictory with (Herbert *et al.* 2007)<sup>[8]</sup>. Cereal leaf beetle feeds on numerous species of wild and cultivated grasses although preferences are shown for including oats, barley, and wheat, possibly because of increases in survival and development time (Wilson and Shade 1966)<sup>[26]</sup>. Our results are in close conformity with the Lone *et al.* (2009)<sup>[12]</sup> who reported army worm (*M. separata*), cutworm (*A. ipsilon*), wheat aphid (*S. graminum*), plant bug (*Lecanium viride*), grass hopper (*Heiroglypus banian*), oats thrip (*S. graminum*), wire worm (*Agriotes* spp), fruit fly (*Oscinella fruit*), cyst nematodes (*Heterodera* spp) and five natural enemies associated with the above mentioned pests *viz.*, ear wig, yellow wasp, tachina fly (*Wenthamia* sp), lace wing (*Chrysoperla* sp) and lady bird beetle (*C. septempunctata*). The variation of the experimental results from other co-workers might be attributed due to changes in weather parameters. It is clear that weather

parameters has an important role on the development of insect pests. Similarly, Ahad *et al.* (2012)<sup>[11]</sup> reported the abundance of soil borne insects white grubs, wire worms and cutworms higher reaches at Udhampur, Jammu and Kashmir. Bohm and Krause (2005)<sup>[3]</sup> reported the occurrence of click beetles in early to mid-May. Moreover, less population of larva might be due to the saturation of moisture in the soil during winter season as soils remain fully submerged is reported by Dalthorp *et al.* (2000)<sup>[5]</sup> who reported that localized populations of white grubs annually shrink and correlation with relative humidity, except grub showing non-significant results with evening relative humidity. Similarly, swell because of variations in rainfall and soil moisture. Although, Maneva *et al.* (2009)<sup>[14]</sup> found three species of aphids infesting oats. Lavinia *et al.* (2013)<sup>[11]</sup> and Tanaskovic *et al.* (2012)<sup>[22]</sup> reported behavior, prevalence and susceptibility of *O. melanopa* on wheat. Haldar *et al.* (2012) studied host range and development of surface grasshopper, *C. trachypterus* however, Maalik *et al.* (2013)<sup>[13]</sup> reported *H. armigera* a pest on wheat, fodder and vegetables.

### 4. Conclusions

It was concluded that Experiment entitled “Studies on Insect Pest Complex of Oats (*Avena sativa* L.) And its natural enemies” was carried out at under Complete Randomized Block Design (RCBD) at the farm of Faculty of Agriculture Wadura in the year 2015-16. It was evident from the experimental findings that fifteen (15) insect pests *viz.* *Holotrichia longipennis*, *Brahmina* spp, *Melolntha furcicauda*, *Oryctes* spp., *Agriotes* spp., *Agrotis* spp., *Schizaphis graminum.*, *Carpocoris* spp., *Macrostelus quadrilineatus.*, *Camptopus lateralis.*, *Stenothrips graminum.*, *Oulema melanopa.*, *Chrotogonus trachypterus.*, *Mythimna separata* and *H. armigera* infested the oats, out of which *O. melanopa*, *M. separata* and *H. armigera* attained major status. In addition to this, eight (8) natural enemies *viz.* *Eristalis* spp, *Aeshna* spp, *Agriocnemis femina*, *Coccinella septempunctata*, *Chrysoperla* spp, *Nabis capsiformis*, *Pterostichus melanarius* and spider (Unidentified) were found associated to the insect pest complex. Overall maximum population of the above mentioned insect pests attained peak at the 21<sup>st</sup> and 22<sup>nd</sup> meteorological week.



White grub adult



White grub larvae



Wire worm adult



Wire worm larvae



Cutworm adult



Cutworm larvae



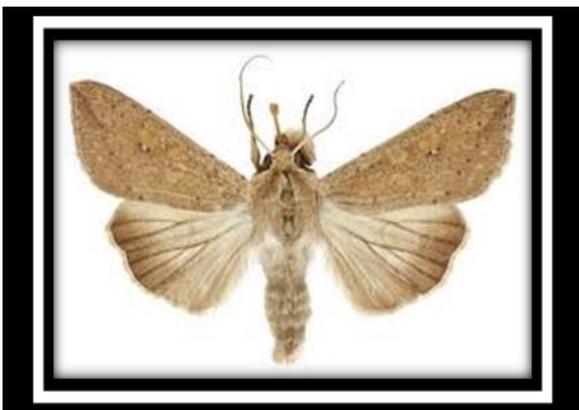
*Helicoverpa armigera* larva



*Helicoverpa armigera* adult



*Mythimna separata* larva



*Mythimna separata* adult



Larvae of cereal leaf beetle



Cereal leaf beetle adult



Surface grasshopper



Damage of cereal leaf beetle



Wheat aphid



Broad headed bug

**Plate 1: Pest Complex of Oats**



Ground beetle



Lady bird beetle



Dragon fly

Damsel fly

Syrphid fly

Spider

**Plate 2:** Natural Enemy of Pest Complex of Oats

## 5. Acknowledgement

Authors are thankful to Dean (Agriculture), Sher-e-Kashmir University of Agricultural Sciences and Technology of Kashmir, Wadura, Sopore, for providing the necessary facilities and support for carrying out the study successfully.

## 6. References

- Ahad I, Bhagat RM, Monobrullah MD. Incidence and distribution of coleopteran insect pests on rainfed maize (*Zea mays* L.) in upper Himalayas of Jammu and Kashmir. *Journal of Phytology*. 2011; 3(11):09-12.
- Ahmad M, Zaffar G. Evaluation of oats (*Avena sativa* L.) genotypes for beta-glucan, grain yield and physiological traits. *Applied Biological Research*. 2014; 16(1):1-3.
- Bohm H, Krause T. Einsatz von Pheromonfallen zum Monitoring von Schnellkafern (*Agriotes* spp.) in Vorfrüchten zu Kartoffeln. In Heß J., Rahmann G. (eds.): Ende der Nische - Beitr. 8. Wiss.- Tagung Ökol. Landbau, Kassel: Kassel university press, 2005, 141-142.
- Chandla VK. Pest complex of potato crop in Shimla hills and their management. *Ph.D. Thesis*. Y. S. P. University of Horticulture and Forestry, Solan (H.P.), 1986.
- Dalthorp D, Nyrop J, Viallani MG. Foundations of spatial ecology: the reification of patches through quantitative description of patterns and pattern repetition. *Entomology Experimental Applied*. 2000; 96:119-127.
- Gomez KA, Gomez AA. *Statistical Procedures for Agricultural Research*. An International Rice Research Institute. 2<sup>nd</sup> edition. Wiley-Inter Science Publication, New York. 1984, 680.
- Gosh CC. A note on the occurrence of *Orphis unipuncia*. Haworth in the Role of Armyworm. Report of Proceedings of fifth Entomologist at Meet Pusa, 1924, 90-91.
- Herbert DA, Van Duyn JW, Bryan MD, Karren JB. Cereal Leaf Beetle. In G. D. Buntin, K. S. Pike, M. J. Weiss, and J. A. Webster (eds.), *Handbook of small grain insects*. Entomological Society of America, Lanham, MD. 2007, 120.
- Khan RM, Sharma SK, Gupta BM. Appearance of army worms on wheat crop in out-break form and their control. *Madras Agriculture Journal*. 1972; 59:663-665.
- Laurant P. Army worm plaque in Philadelphia *Entomological News* 1915; 26:36.
- Lavinia MM, Doru P, Otilia C, Marius D, Pal F..Studies on the behavior of wheat varieties to pests attack *Oulema melanopa* *Research Journal of Agricultural Science*. 2013; 45(1):1.
- Lone GM, Baba ZA, Wani NA, Mir SA, Malik MA, Parveena B. Determination of pest complex of oats *Avena sativa* (L.) var. Kent and their status. *Indian Journal of Applied Entomology*. 2009; 23(2):140-144.
- Maalik S, Akhtar Rana S, Ahmad Khan H, Ashfaq M. Diversity and abundance of lepidopteran populations from selected crops of district. *Pakistan Journal of Agricultural Sciences*. 2013; 95(1):95-101.
- Maneva V, Savova T, Marcheva M. Propagation and species composition of aphids infesting oats. 44th

- Croatian and 4th International Symposium on Agriculture, 2008, 581-584.
15. Misra PN, Singh MP, Yadav CPS. Binomics of white grub *Anomala lineatopennis* in Western Himalaya. *Indian Journal of Entomology*. 1998; 60(1):74-78.
  16. Narayanan, E.S. Seasonal pests of crops. *Indian Farming* 1953; 3:8-13.
  17. Pandey KC, Roy AK. Forage Crops Varieties. IGFRI Jhansi (India) 2011, 16-17.
  18. Rajendra TP, Vera KD. Chemical control of cutworms *Agrotis* spp. (Noctuidae: Lepidoptera) on potato in the Nilgiris. *Indian Journal of Entomology*. 1989; 51(2):177-180.
  19. Reshi ND. Studies on insect pest of Kashmir. Part vegetables. Major pests with their life history and control measures. *Kashmir Sciences*. 1967; 4(1, 2):66-69.
  20. Singh R, Mrig KK, Choudhary JP. Incidence and survival of *Mythimna* species on cereal crops in Hisar. *Indian Journal of Agriculture Sciences*. 1987; 57:59-60.
  21. Southwood TRE, Norton GA. Economic aspects of pest management strategies and decisions. In: P.W. Geier *et al.*, (ed.) *Insects: Studies in population management*. Ecological Society of Australia, Canberra, Australia, 1973, 168-184.
  22. Tanaskovic S, Madic M, Durovic D, Knezevic D, Vukajlovic F. Susceptibility of cereal leaf beetle (*Oulema melanopa* L.) in winter wheat to various foliar insecticides in western Serbia region. *Romanian Agricultural Research*. 2012; 29:391-366.
  23. Tiwari U, Cummins E. Simulation of the factors affecting B-glucan levels during the cultivation of Oats. *Journal of Cereal Sciences*. 2009; 50:175-183.
  24. Toba HH, Turner JE. Seed piece examination: A method for sampling wireworms on potatoes. *Journal of Economic Entomology*. 1981; 74:718-720.
  25. Walkden HH. Cutworms, armyworms and related species attacking cereal and forage crops in the Central Great Plains. USDA Circular. 849. U.S. Government Printing Office, Washington, DC, 1950.
  26. Wilson MC, Shade RE. Survival and development of larvae of the cereal leaf beetle, *Oulema melanopa* (Coleoptera: Chrysomelidae), on various species of Gramineae. *Annals of the Entomological Society of America*. 1966; 59:170-173.