



E-ISSN: 2320-7078

P-ISSN: 2349-6800

JEZS 2018; 6(5): 201-205

© 2018 JEZS

Received: 03-07-2018

Accepted: 04-08-2018

Suchithra Kumari MH

Assistant Professor,
Department of Entomology,
College of Horticulture,
Mudigere, Chikkamagaluru,
Karnataka, India

Srinivas MP

Department of Entomology,
College of Horticulture,
Mudigere, Chikkamagaluru,
Karnataka, India

Pests attacking medicinal and aromatic plants in India: A review

Suchithra Kumari MH and Srinivas MP

Abstract

Several medicinal and aromatic crops that are used to cure specific ailments since time immemorial are being cultivated in the fields now-a-days to meet the increasing demand for pharmaceutical industries. Like any other plants, medicinal and aromatic plants too are attacked by different species of insect-pests including mites and limits the successful cultivation of the crops. Sometimes the devastating nature of few pests leaves the crop plant completely destroyed. Practically, so far not much attention has been paid on the incidence of the pests attacking the medicinal and aromatic plants in India. The research on pests of medicinal and aromatic plants helps in understanding their role and developing the management strategies. This review summarizes the diversity of pests occurring on medicinal and aromatic plants, and also provides a brief overview of their incidence and injury caused on different medicinal and aromatic plants.

Keywords: Medicinal, aromatic, pests, incidence, diversity, injury

1. Introduction

The ancient Indians had vast knowledge and expertise of medicinal and aromatic plants that have been used to cure specific ailments. The oldest literature on medicinal properties of plants dates back to Rigveda, which was supposed to be written between 4500 BC and 1600 BC. Hence from centuries, the autochthonous system of medicine, namely, Ayurveda, Sidda and Unani have exploited and used medicinal plants extensively to cater the needs of nearly 70 percent of the Indian population residing in villages^[22].

India is in the leading position with respect to production in plant drugs and intermediaries obtained from opium poppy, isabgol, senna, rauwolfia, cinchona, periwinkle, Gloriosa, papaya and ipecac^[22]. Now-a-days in order to meet out the increasing demand of the pharmaceutical industries, many medicinal and aromatic plants are grown on a large scale in the fields. Larger area of ashwagandha is covered by Madhya Pradesh and Rajasthan. While, Gujarat covers larger area in coleus, isabgol and to a smaller extent covers periwinkle. Similarly, Karnataka covers large area in cultivation of coleus and periwinkle. Tamil Nadu leads the area covered under periwinkle while Madhya Pradesh, Uttar Pradesh and Rajasthan lead the area covered under opium poppy. Sarpagandha is grown to a larger extent in Madhya Pradesh, Uttar Pradesh, west Bengal and Orissa^[25].

These medicinal and aromatic plants when cultivated in large areas and in new areas, they are much prone to attack by different insect pests including mites that cause considerable damage and limit the successful cultivation of the medicinal and aromatic crops. Sometimes the epidemic nature of the pests results in complete failure of the crop^[47]. Practically, much attention has not been paid so far to the pests attacking the medicinal and aromatic plants in India. Thus, an attempt has been made to gather the literature pertaining to the incidence of pests on medicinal and aromatic plants in India (1990 onwards) and has been reviewed here under.

2. Diversity of insects occurring on medicinal and aromatic plants

Various workers have attempted to survey on the pest incidence and document the diversity of pest species occurring on medicinal and aromatic crops.

Insect pests attacking eight medicinal plants of forestry origin were reported^[10]. Semilooper, *Plusia signata* Fab. was a new record on *Polianthus tuberosa* Linn.^[39]. Neem was attacked by *Parasa hilaris* Westwood^[44]. Among the 13 pests that attacked neem in southern Tamil Nadu, the tea mosquito bug, the mealy bug, the scale insect and the leaf webber were very important

Correspondence

Suchithra Kumari MH

Assistant Professor,
Department of Entomology,
College of Horticulture,
Mudigere, Chikkamagaluru,
Karnataka, India

[11]. *Atmetonychus peregrinus* Olivier was found as a pest of *Terminalia arjuna* Bedd. and *T. tomentosa* W.& A. in Ranchi [21]. Among the fourteen insect-pests recorded in Bangalore, *Polytela gloriosae* Linn. was a major pest causing severe loss to *Gloriosa superba* Linn. Further, a pyrgomorphid *Neorthacris acnticeps*, the curculionids *Blosyrus inaequalis* and *M. undecimpunctata*, the noctuid *Anadenidia peponis*, the lygacids, *Graptostethus servus* and *L. hospes*, and the scutellarid, *Chrysocoris stollii* were found feeding on *Adhatoda vasica* in Bangalore [7].

Extensive wilting and drying of the *Indigofera tinctoria* crop was observed [36] and found that it was due to the infestation by the psyllid, *Arytaina punctipennis*. This was a new record of the pest from southern India. *Nysius ericae*, the larvae of *Plusia orichalcea*, nymphs and/or adults of *Frankliniella* sp. and *Dolycoris indicus* Stal. were reported on *Artemisia annua* Linn. plants [19]. Further, *Mylokerus lartivirens* Marshall was reported as a new pest of neem in Rajasthan. Outbreak of *Spodoptera litura* on brahmi (*Bacopa monnieri*) an important medicinal plant in a greenhouse at Lucknow was reported [46]. Similarly, *H. armigera* and *P. orichalcea* were the most important insect pests of Kalazira (*Bunium persicum* (Bois.)) in the Kinnaur district of Himachal Pradesh [40].

A brown Scale, *Parasaitetia nigra* caused significant damage on Kalmegh during 2001 to 2002 in Bangalore [27]. The record of these pests on Kalmegh is thought to be the first record of arthropod pests from India. The nursery sandalwood seedlings were mainly attacked by six species of defoliators and two species of sap sucking insects [29]. The aspects of survey, incidence and population levels, nature and extent of damage due to insect pests on different medicinal plants was reviewed and concluded that pest status should be determined before adopting control strategies [47].

Eleven and Eight species of phytophagous pest species were recorded on coleus and Ashwagandha, respectively [14]. Three species of scarab beetles, *Amorites dorsalis* Fabricius, *Apogonia ferruginea* Fabricius and *Adoretus pallens* Blanchard damaged rose plants in Assam [2]. A survey conducted revealed occurrence of 13 species of pest including a one species of snail on medicinal plants [13]. Twenty-one insect species on *E. officinalis* were reported in Allahabad, Uttar Pradesh among which *Betousa stylophora*, *Cerciaphis emblica*, *S. emblica*, *Indarbela tetraonis* and *Virachola Isocrates* were the major pests [45]. Further, gall caterpillar (*Betousa stylophor*), leaf roller (*Gracillaria acidula*), bark eating caterpillar (*Indarbela tetraonis*), *Cerciaphis emblica*, *Nipaeoccus vastator*, *Oxyrhachis tarandus*, *Mylokerus discolor* and *Odontotermes* spp. were reported as major insect-pests attacking aonla in India [1]. Eleven species of phytophagous insects were reported on ashwagandha from Bangalore [26]. Fifty-four insect and mite pests were recorded on rose at GKVK, Bengaluru of which 22 insect pests were recorded for the first time on rose. Thrips, aphids, whiteflies, mites and chafer beetles damaged roses throughout the year [8].

Hadda beetle was a new record on *W. somnifera* in Punjab province of Northern India and is thought to be the new host for *O. tarandus* [41]. As coccids (scales and mealy bugs) were recorded from 60 plant species of flower and medicinal crops, they were reported as attaining serious pest status on a wide range of host plants [48]. Similarly, 26 species phytophagous arthropods were reported on ashwagadha [3]. In Himachal Pradesh, from different parts 15 insect species were observed to be associated with medicinal plants and all of them caused

moderate damage [42]. Tulsi, *Ocimum sanctum* were seriously attacked by sucking insect pests like lace wing *Cochlochila bullita* (Stal.), white flies (*Aleurodicus dispersus* Russell, *Dialeurodes* sp.) and aphids (*Macrosiphum* sp. *C. bullitta* and *A. dispersus*) throughout the year while aphids appeared occasionally in December-January at Maharashtra [38].

Twelve species of aphids were found to cause considerable damage to medicinal and aromatic plants in Chikkamagaluru district, Karnataka [30]. Mealybug, *Phenacoccus solenopsis* Tin. was recorded as a major insect pest on ashwagandha [35]. Thirteen species of insect and mite pests were found damaging the jasmine crop at Shivamogga and banana flower thrips, *Thrips florum* was the first report from India infesting jasmine [12]. A survey conducted by [28] showed that 23 phytophagous pest species occurred on important medicinal plants in Shivamogga. Similarly, eight species of thrips were identified to occur on medicinal plants viz., chandrashoor, patchouli and flax in Nauni (HP) of which seven species were phytophagous [37].

3. Diversity of mite species on medicinal and aromatic plants

Work on mites infesting medicinal plants by [5, 16] reported 54 and 51 species in west Bengal, respectively. Twenty-four species of mites were recorded from Darjeeling Himalayas [33, 34]. A faunistic survey on mite pests infesting medicinal plants from Rajasthan revealed presence of four phytophagous mites from 16 medicinal plants [31].

A survey at different medicinal gardens in west Bengal discovered 99 species of mites belonging to 40 genera, 17 families and three orders. Among these 33 species were phytophagous and among them, 25 species of mites were new reports [32]. However, 267 mite species of 93 genera were reported on medicinal and aromatic plants in India and 208 species constituted the phytophages [6].

4. Incidence and population level of insects

Frankliniella schultzei (Trybone) (80% on flowers), *Scirtothrips dorsalis* (80% on leaves), *Haplothrips ganglabaueri* (Schmutz) (15% in flowers) and *Thrips palmi* (5% in flowers and 20% in leaves) were reported to be infesting roses [24]. *Rauwolfia serpentina* was observed to be infested by a new insect pest, *Psilogramma menephron* with 40 percent incidence and another new record was *Holotrichia serrata* on *W. somnifera* with approximately 20 percent incidence from Satpura plateau of Madhya Pradesh [20].

High incidence of *H. armigera* and hadda beetle, *E. vigintioctopunctata* on *W. somnifera* Linn. was reported from 12th to 14th standard week and 10th to 12th standard week, respectively [15]. Hadda beetle was confirmed to be a predominant species during September - December [19] and on ashwagandha in chartour region of Gujarat [4]. This insect was active from last week of September to mid of December with a peak population (7.8 grubs/plant and 1.73 grubs/plant) in 2nd week of October during 2008-09 and 2009-10. Hadda beetle and mealybug, *Phenococcus solanopsis* were predominant during September to December and September - February, respectively [3]. Maximum population of lace bug, *Cochlochila bullita* (Stal.) on tulsi was noticed during 52 standard weeks of 2014 with 43.2 insects per plant leading to 33.33 percent loss in herbage yield in unprotected plots [43]. Jasmine bud borer, *Elasmopalpus jasminophagus* was predominant pest with a maximum incidence of 38.85 percent affected buds during first fortnight of January [12].

5. Incidence and population level of mites

Tetranychus urticae was predominant from September 2008 to January 2009 [25]. Among the 33 species of phytophagous mites recovered in west Bengal on medicinal plants, predominant genera were *Brevipalpus* (10 species) followed by *Tetranychus* (8 species) and *Tetranychus urticae* and 12 species were seriously infesting medicinal plants with considerable damage [32]. Spider mite (*Tetranychus urticae*) was also found to be a major pest with concentrated population on the lower surface of the leaves during 3rd week of October to November and the infested plot looked as if burnt and stunted growth was evident [3]. The population of aphid, leaf bug and mite was significantly least in dodi crop planted at wider spacing (60x120 cm) than other treatments [23].

6. Injury

The injury caused by different pests on different medicinal and aromatic plants have been examined and described by various workers. Painted grasshopper (*Poeciloceris pictus* Fab.) was most active during July and August on ak (*C. procera*) and the percent leaf defoliation per five branches was 57.66 and 47.57 during 1990-91 and 1991-92, respectively. The leaves of sarpagandha were eaten by *P. menephron* in the early morning and evening. At a later stage, it wandered some distances and then pupated underneath the fallen leaves and debris or in the soil. Similarly, the grubs of *H. serrata* fed on the roots and rootlets of *W. Somnifera* and the adult beetles were seen emerging from the soil soon after the monsoon showers in June in Satpura plateau of Madhya Pradesh [20]. It was reported that weevil (*Sympiezomias cretaceus*) fed on the leaves from the edges towards the midrib, grasshopper (*Teratodes monticollis* and *Letana inflata*) cut off the young seedlings almost at ground level and bagworm (*Cryptothelea cramerii*, *Acanthopsyche moorei* and *Pteroma plagiophleps*) fed on the leaves [29]. The two common coccids, *Pulvinaria maxima* and *Pulvinaria psidii* fed on sap of leaves and tender shoot of sandalwood seedlings.

Helicoverpa armigera (Hubner) was reported as a pest of rose where the larva damaged the roses from calyx and reduced the ornamental value of the flowers [17]. The grubs of the three species of scarab beetles that damaged rose plants in Assam attacked the root system of the plant. The adult beetles were positively phototactic which came out at night and fed on the leaves of rose plant by making some holes and the severe infestation lead to complete plant defoliation [2]. The rose aphid, *Macrosiphum rosae* was reported to be the most important pest of rose that caused significant economic damage annually [18]. The larvae of *I. tetraonis* were found feeding on *E. officinalis* and boring the main trunk, stems and branches. *B. stylophora* infested nursery plants and old bearing trees [45].

Further, *Scirtothrips dorsalis* was reported to be the dominant species and a major pest in field and polyhouse damaging tender plant parts, reducing flower quality and yield on rose [8]. Cowbug, *Oxyrachis tarandus* found on aerial apical parts of ashwagandha (*W. somnifera*) plants in the Punjab fed on apical portions of the stem, made them rough and woody in appearance, brown in colour gradually leading to drying and finally shedding [41]. Both grubs and adults of hadda beetle fed on the parenchymatous tissues on both the surface of the leaves and in severe condition the leaves were completely skeletonised, ultimately leading to defoliation in plants [3].

The sucking insect pests attacking tulsi suck the cell sap, secrete honey dew like substance, create sooty moulds, affect photosynthesis and yield of the crop [38].

Larvae of *D. nerii* caused defoliation of ashwagandha leaves and three species of coleopterans were reported to be feeding on the leaves of ashwagandha of which, *H. vigintioctopunctata* was predominant at early stage of the crop [22]. Further, reported that both adults and grubs of epilachna beetle caused damage to the leaves and tender parts by scraping the epidermal layer in a very characteristic manner leaving a netted pattern. At later stage of the crop growth during heavy infestation, the incidence of *Epilachna* beetle resulted in complete skeletonised of leaves and finally ended up with dried and withered plants. They also reported that nymphs and adults of green plant bug, *N. viridula* sucked the sap from leaves and buds of ashwagandha. *Helicoverpa* sp. was found feeding on leaves and also boring into buds, flowers and fruits with its head inside the infested parts.

No serious insect pests are found to attack the vetiver crop. However, termites and white ants attack the roots of vetiver in dry areas. Further, bud borer (*Helicoverpa armigera*), Aphids (*Aphis craccivora*), grasshopper (*Atractomorpha remulata*), red spider mites (*Tetranychus urticae*) and weevils (*Myllocerus* spp) were found to be major insect pest attacking tuberose [9]. The important defoliator on mint, *Diacrisia obliqua* eat the under-surface of the mint leaves, cutworms, (*Agrotis flammatr*) damage at the collar region during spring season and mint leaf roller (*Syngamia abrupalalis*) fold the leaf in the form of a roll and feed inside the leaf tissue [9].

Among the 13 species of insects and mite pests reported on jasmine, bud borers, *Elasmopalpus jasminophagus* and *Hendecasis duplifascialis*, leaf web worm, *Nausinoe geometrialis* were found feeding on leaves while red spider mite, *Tetranychus* sp. and thrips were found to suck the sap from jasmine leaves [12].

7. Conclusion

Various control strategies are adopted for the improvement of the productivity and quality of medicinal plants. But, before adoption of any pest control strategies, assessment of population as well as estimation of the damage caused are necessary, in order to determine their pest status. Their studies have, therefore, to be given due importance because with the rapid expansion of drug industry, large-scale cultivation of these plants can be taken up.

8. References

1. Bharpoda TM, Koshiya DJ, Korat DM. Seasonal occurrence of insect-pests on aonla (*Emblica officinalis* Geartn) and their natural enemies. Karnataka Journal of Agricultural Sciences. 2009; 22(2):314-318.
2. Bhuyan U, Bhattacharyya AA, Baruah LH. Incidence of scarab beetles on rose in Assam. Insect Environment. 2008; 14(1):15-16.
3. Chaudhary V. Arthropods associated with ashwagandha (*Withania somnifera*) in semi arid region of Gujarat. Karnataka Journal of Agricultural Research. 2013; 26(3):433-435.
4. Chaudhary V, Saravanan L. Biology and Seasonal incidence of *Henosepilachna vigintioctopunctata* on ashwagandha in charotur region of Gujarat. Pest Manage. Hort. Ecosyst. 2011; 17(2):132-139.
5. Ghosh S, Gupta SK. A report on mites occurring on medicinal plants in west Bengal. Records of Zoological

- Survey, India. 2003; 10:287-298.
6. Gupta SK, Karmakar K. Diversity of mites (Acari) on medicinal and aromatic plants in India. *Zoosymposia*. 2011; 6:56-61.
 7. Hanumanthaswamy BC, Rajgopal D. Insect pests of *Gloriosa superba* Linn. an Indian medicinal plant. *Indian Journal of Forestry*. 1995; 18(2):101-103.
 8. Hegde JN. Insect pest complex of rose with special reference to bio-ecology and management of thrips, *Scirtothrips dorsalis* Hood (Thysanoptera: Thripidae). P.hD Thesis, University of Agricultural Sciences. Bengaluru, 2010.
 9. [http://www. http:// agritech.tnau.ac.in/](http://www.agritech.tnau.ac.in/) TNAU, Agritech portal, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu, India, 2016.
 10. Joshi KC, Meshram PB, Sambath S, Ushakiran, Shalinihumane and Kharkwal GN. Insects pests of some medicinal plants in Madhya Pradesh. *Indian Journal of Forestry*. 1992; 15:17-26.
 11. Karthikeyan K, Rangarajan AV, Velusamy R. Major pests of neem and their management in southern Tamil Nadu. (abstr.) Proc. World Neem Conference, Bangalore, India, 1993.
 12. Kiran CM, Hegde JN, Chakravarthy A, Thippesha KD. and Kalleshwarswamy CM. Seasonal incidence of major Insect and mite pests of jasmine. *International Journal of Current Microbiology and Applied Sciences*. 2017; 6(10):5060-5070.
 13. Kulkarni SS, Naik KV, Jal gaonkar VN, Rege AV. Survey of pest infestations on the important medicinal plants of Konkan region of Maharashtra. *Pestology*. 2008; 32:31-33.
 14. Kumar HR. Survey of pests of medicinal plants with special reference to biology and management of epilachna beetle, *Henosepilachna vigintioctopunctata* on ashwagandha, M.Sc. (Agri.) thesis, University of Agricultural Sciences. Dharwad, 2007.
 15. Kumar A, Singh CP, Pandey R. Influence of environmental factor on population build up of *Helicoverpa armigera* and *Epilachna vigintioctopunctata* on Ashwagandha. *Journal of Entomological Research*. 2009; 33(2):123-129.
 16. Lahiri S, Podder S, Saha GK, Gupta SK. Diversity of phytophagous and predatory mites occurring on medicinal plants in Kolkata metropolis. *Proceedings of Zoological Society, Kolkata*. 2004; 57(1):47-52.
 17. Matsui T, Ueda M, Saito M, Yosida A. Damage to rose flower buds by cotton bollworm, *Helicoverpa armigera* in Ibaraki prefectural flower park. *Annual Report of the Kanto Tosan Plant Protection Sciences*. 2006; 53:145-147.
 18. Mehrparvar M, Mobli M, Hatami B. Seasonal population fluctuations of the rose aphid, *Macrosiphum rosae* (L.) (Hemiptera: Aphididae) on different cultivars of roses and Nastaran. *Journal of Science Technology Agricultural Research and Natural Resources*. 2008; 12(45B):711-719.
 19. Mehta SS, Singh D, Singh J, Tripathi J, Kumar S. Arthropods associated with *Artemisia annua* in north India plains. *Journal of Medicinal and Aromatic Plant Science*. 1996; 18:26-33.
 20. Meshram PB. New reports of defoliator, *Psilogramma menephron* on *Rauwolfia serpentine* and white grub, *Holotrichia serrata* on *Withania somnifera*. *Indian Forester*. 2005, 13(7):969-970.
 21. Mishra PK, Singh RN, Jayswal J, Thangavelu K. First report on *Atmetonychus peregrinus* Olivier (Coleoptera: Curculionidae) as a pest of *Terminalia arjuna* Bedd. and *Terminalia tomentosa* W.& A. *Indian Forester*. 1995; 121(12):1167-1168.
 22. Nirmal A, Jayaram CS, Ganguli JL, Tirkey A. Scenario of insect pests on Ashwagandha (*Withania somnifera*) in the plains of Chhattisgarh. *Insect Environment*. 2015; 20(4):142-143.
 23. Patel BK, Korat DM, Dabhi MR. Influence of spacing on sucking pests infesting dodi, *Leptadenia reticulata* (Retz.) Wight and Aruott. *Karnataka Journal of Agricultural Sciences*. 2014; 27(1):76-78.
 24. Rajkumar M, Reddy KL, Gour TB. Thrips and mites infesting roses. *Insect Environment*. 2004; 10(1):27-28.
 25. Ramanna D. Investigations on pest complex of medicinal plants and their management with special reference to ashwagandha (*Withania somnifera* (Linn.)). M.Sc. (Agri.) Thesis, University of Agricultural Sciences. Dharwad, 2009.
 26. Ramanna D, Kumar P, Basavana Goud K. Pest complex of medicinal plants. *Karnataka Journal of Agricultural Sciences*. 2010; 23(1):197-199.
 27. Rani BJ, Sridhar V. Record of arthropod pest of Kalmeg. *Andrographis paniculata* a medicinal plant. *Insect Environment*. 2005; 11(2):89-91.
 28. Rehaman SK, Pradeep S, Dhanapal R, Chandrashekara GV. Survey studies on insect-pests associated with important medicinal plants in Shivamogga. *Karnataka Journal of Entomology and Zoology Studies*. 2018; 6(1):848-857.
 29. Remadevi OK, Nagaveni HC, Muthukrishnan R. Pests and diseases of sandalwood plants in nurseries and their management. *Working Papers of the Finnish Forest Research Institute*, 2005, 69-76.
 30. Rohini BS. Species complex of aphids on horticultural crops in selected taluks of Chikkamagaluru district. M.Sc. (Hort.) Thesis (Unpubl.), University of Agricultural and Horticultural Sciences. Shivamogga, 2017, 99p.
 31. Rolania K, Sharma A. Faunistic observations on mite pests in medicinal agroecosystems. *Insect Environment*. 2008; 14(2):67-68.
 32. Roy I, Aditya G, Gupta SK, Saha GK. An annotated report of mites infesting medicinal plants of west Bengal, India. *Journal of Bombay Natural History Society*. 2011; 108(2):142-150.
 33. Roy I, Gupta SK, Saha GK. New reports of predatory mites (Acari: Prostigmata, Mesostigmata) from medicinal plants of Darjeeling district, West Bengal, India, with description of a new species. *Entomon*. 2008a; 33(2):119-128.
 34. Roy I, Gupta SK, Saha GK. Notes on the occurrence of mites infesting medicinal plants of Darjeeling Himalayas. *Insect Environment*. 2008b; 14(3):130-132.
 35. Sahu C, Ganguli JL, Joshi S. Seasonal incidence of the mealybug, *Phenacoccus solenopsis* Tinsley (Hemiptera: Pseudococcidae) on ashwagandha in Raipur (Chhattisgarh). *International Journal of Plant Protection*. 2017; 10(2):270-274.
 36. Sakaria BP, Ushakumari R, Thomas J. Psyllid, *Arytaina punctipennis* Crawford Infestation on cultivated *Indigofera tinctoria* L. in Kerala – A new record. *Insect*

- Environment. 1996; 2(1):28.
37. Sanjta S, Chauhan U. Incidence and diversity of thrips and its associated natural enemies in medicinal plants. *Journal of Medicinal Plant Studies*. 2018; 6(1):1-2.
 38. Sathe TV, Sathe NT, Ghodake D, Sathe A. Sucking insect pests and medicinal value of tulsi *Ocimum sanctum* L. (Lamiaceae). *Indian Journal of Applied Research*. 2014; 4(3):31-33.
 39. Savithri P. A new record of semilooper, *Plusia signata* on *Polianthus tuberosa*. *Andhra Agriculture Journal*. 1992; 39:238.
 40. Sharma SD. Insect-pests of kalzira in the hills of Himachal Pradesh. *Insect Environment*. 1998; 4(2):43.
 41. Sharma A, Patil. First report of *Withania somnifera* as a new host of cowbug (*Oxyrachis tarandus*) in plains of Punjab. *World Applied Science Journal*. 2011; 14(9):1344-1346.
 42. Sharma PC, Kumar A, Mehta PK, Singh R. Survey studies on insect-pests associated with important medicinal plants in Himachal Pradesh. *Indian Journal of Scientific Research and Technology*. 2014; 2(4):2-7.
 43. Smitha Kumari, Nagendra Kumar, Anil Kumar. Seasonal incidence and damage intensity of lace bug, *Cochlochila bullita* (Stal) (Hemiptera: Tingidae) on tulsi, *Ocimum basilicum* L. *International Journal of Science, Environment and Technology*. 2016; 5(6):4312-4319.
 44. Suresh S. Neem a new host record of *Parosa hilaris* (Cochilidiidae: Lepidoptera). *Neem Newsletter*, 1992; 9(3):42.
 45. Tiwari AK, Mishra, Pratibha, Tiwari SC. The insect pest complex of aonla (*Emblica officinalis* Gaert) in present day cropping pattern of Eastern Uttar Pradesh. *Indian Journal of Entomology*. 2008; 70(1):86-88.
 46. Tripathi J, Singh D, Mathur S. Outbreak of *Spodoptera litura* on brahmi-an important medicinal plant. *Insect Environment*. 1997; 2(4):134.
 47. Verma JS. Insect pest problem in medicinal plants- A review. *Agricultural Reviews*. 2006; 27(3):130-136.
 48. Vijay S, Suresh S. Coccid pests of flower and medicinal crops in Tamil Nadu. *Karnataka Journal of Agricultural Sciences*. 2013; 26(1):46-53.