

Arthropod fauna and diseases associated with the medicinal crop, Ashwagandha [*Withania somnifera* (L) Dunal] grown in Jaffna, Sri Lanka

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Abstract

One of the most versatile medicinal plants used in Ayurveda System of Medicine is *Withania somnifera* (L) Dunal (Ashwagandha). Due to its importance and demand in Jaffna farmers are interested to cultivate it in larger extent. Present study was aimed to assess the arthropod fauna and diseases associated with *W. somnifera* in a field of selected 150 plants in Jaffna, Sri Lanka during the cropping period of August 2011 to June 2012. Survey revealed that among the 20 identified insect pest species 12 and 9 species were defoliators and sucking insects, respectively. *Epilachna vigintioctopunctata* was observed as major among defoliators and recorded as 6 beetles/plant. In case of sucking pests, red cotton bug was predominant during January to March with a mean population of 6 bugs/plant while Green stink bug was high with a mean population of 7 bugs/plant during November to December. High shoot growth was due to the frequent irrigation after transplanting that invited the sucking pests. Association of beneficial insects was also observed considerably including predators and parasitoids. Besides, root-knot nematode and little leaf disease were recorded in the disease category. Root knot nematode may become serious threat to cultivation and affect chemical constituents of the root as it is the economic part of this herb. These results would be helpful to understand the pest management tactics in commercial scale cultivation in the future. Further investigations have to be done to fulfill the farmers need to monitor and manage the insect pests in large scale cultivation.

Introduction

Withania somnifera is a profusely used medicinal plant which belongs to the family Solanaceae [1]. It is considered to be cultivated as commercial medicinal crop in Sri Lanka. Extracts from different plant parts including root, shoot, leaves, and berry are credited with medicinal properties and have been used in several indigenous drug preparations for maintaining health as well as treatment of several disease conditions [2]. Recent studies reported that leaf extracts of *W. somnifera* have been explored for its strong anti cancer activity and selective killing of cancer cells [3]. The critical concerns are the diseases [4] and insect pests [5], [6], [7]

which affect both aerial and root parts. These diminish its aesthetic, medicinal value and marketable quality as well. To best of our knowledge, the present investigation is the first record of pests on *W. somnifera* in Sri Lanka. With the concern of the above facts and dearth of related information on Arthropod fauna of *W. somnifera*, the present investigations were undertaken to identify the various pests associated with this plant from cultivation to storage at natural temperature and humidity condition.

Materials and methods

Experimental Site

This study was carried out at a field, having 150 *W. somnifera* plants in Jaffna during the cropping period of August 2011 to June 2012. Jaffna falls under the Northern part of the country. The longitude of the location is 80° 01' and latitude is 09° 04'. During the period of this investigation, the average rainfall and temperature were 124.76mm and 28.3°C, respectively. Average humidity was 72.5% in day time and 83.2% in night time. Soil type was non-calcic brown earth [3]. Further identification and rearing of insects were carried out at the laboratory of Department of Agricultural Biology, Faculty of Agriculture, University of Jaffna, Sri Lanka.

Collection and rearing

Randomly selected 100 plants were examined at weekly interval for the presence of faunal association and diseases. The population of different pests was assessed by counting number of insects per plant depending upon the level of pest incidence. Moreover, persistence of the pests also recorded throughout the cropping period. Collected specimens were separated for identification. Caterpillars were reared under ambient laboratory condition. During their development, dates of pupation, emergence of adult and other traits of life stages were recorded.

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Morphological identification

Adults were identified by their morphological characters with the help of museum specimen and taxonomic keys [2]. Tiny insects were observed under the stereomicroscope. Careful observations in the field were fulfilled the biological information of the pests.

Disease identification

Before harvesting, 50 plants were uprooted randomly and were washed with running water for clear observation. Thereafter, the count of root knots/plant was taken and the pathogen inside the knot was identified by culturing and then with the help of microscope.

Results

During the survey, among the collected insect pests, 20 species were identified while three different types of beneficial insect species were also observed. Among 20 insect pest species 12 and 8 species were defoliators and sucking insects, respectively as shown in Table 1. Little leaf disease and root- knot nematode were recorded in the disease category. Three different types of beneficial insects were associated with this plant. They were predators, parasitoids and general social insects. Those are listed in Table 2.

Table 1: List of insect pests and diseases recorded in *Withania somnifera*

No.	Common Name	Species name	Family	Order	Damaging plant part
Defoliators					
1	Spotted beetle	<i>Henosepilachna vigintioctopunctata Fab.</i>	Coccinellidae	Coleoptera	Leaf
2	Ash Weevil	<i>Myllocerus undecimpustulatus</i>	Coccinellidae	Coleoptera	Leaf
3	Pumpkin beetle	<i>Raphidopalpa foveicollis</i>	Chrysomelidae	Coleoptera	Leaf
4	Chafer beetle	<i>Oxyctonia versicolor</i>	Scarabaeidae	Coleoptera	Leaf, fruit, stem, flower
5	Sphingid Caterpillar	<i>Deilephila nerii Linn.</i>	Sphingidae	Lepidoptera	Leaf, stem, fruit
6	Leaf miner	<i>Liriomyzae sp.</i>	Agromyzidae	Lepidoptera	Leaf
7	Army Worm	<i>Helicoverpa sp.</i>	Noctuidae	Lepidoptera	Fruit, leaf
8	Blue Butterfly	<i>Lampides boeticus</i>	Lycaenidae	Lepidoptera	Leaf
9	Blue Butterfly	<i>Dichromorpha viridis</i>	Acrididae	Orthoptera	Leaf, stem
10	Short horned grass hoppers	<i>Forficula auricularia</i>	Forficulidae	Dermoptera	Leaf
11	Ear wig	---	Blattidae	Dictyoptera	Leaf
12	Cockroach	---	---	Stylommatophora	Leaf
12	Snail	---	---	---	---
Sucking insects					
1	Cow bug	<i>Oxyrachis tarandus Fab</i>	Membracidae	Hemiptera	Leaf, stem, fruit, flower
2	Red cotton bug	<i>Dysdercus cingulatus</i>	pyrrhocoridae	Hemiptera	Fruit, stem, leaf
3	Green stink bug	<i>Nezara viridula</i>	Pentatomidae	Hemiptera	Leaf, stem, fruit, flower
4	Mealy bug	<i>Ferrisia virgata</i>	Pseudococcidae	Hemiptera	Fruit, leaf
5	Plant hopper	<i>Siphanta acuta</i>	Flatidae	Hemiptera	Leaf
6	Spittle bug	<i>Lepyronia quadrangularis</i>	Cercopidae	Hemiptera	Leaf
7	Pod bug	<i>Riptortus linearis</i>	Coreidae	Hemiptera	Fruit
8	Fly	<i>Scathophaga stercoraria</i>	Scatophagidae	Diptera	Flower bud, stem, leaf
9	Unknown	---	---	Hemiptera	Leaf, stem
Diseases					
1	Little leaf disease	<i>Phytoplasma sp</i>			Shoot
2	Root Knot nematode	<i>Meloidogyne incognita</i>			Root

Table 2: Recorded beneficial insects on *Withania somnifera*

No.	Common Name	Wntomological name	Family	Order
Predalors				
1	Preying mantis	-	Mantodea	Dictyoptera
2	Lady bird beetle	<i>Menochilus sexmaculatus</i>	Coccinellidae	Coleoptera
		<i>Hyperaspidius wolcotti</i>	Coccinellidae	Coleoptera
		<i>Coelophora inaequalis</i>	Coccinellidae	Coleoptera
		<i>Coccidophilus marginatus</i>	Latridiidae	Coleoptera
3	Spiders	<i>Micraspis discolor</i>	Coccinellidae	Coleoptera
		-	-	Arachinda
Others				
4	Parasitoid	-	-	Hymenoptera
5	Honey bee	<i>Apis cerema</i>	Apidae	Hymenoptera



(a)



(b)



(c)



(d)



(e)



(f)

Figure 1: a) Larve of *Helicoverpa* sp bores the *Withania somnifera* fruit b) *Henosepilachna vigintioctopunctata* and its damage pattern (Skeletinization) on leaf c) Mature *Deilephila nerii* d) *Dysdercus cingulatus* e) *Oxyrachis tarandus* f) *Knots in Withania somnifera* root by Root-knot nematode infection

Discussion

Insect pests' incidence was observed as high due to the climatic condition prevalent in Jaffna. Comparatively defoliators' occurrence on *W. somnifera* was higher than sucking insects. They damaged various aerial plant parts of *W. somnifera*. *Epilachna vigintioctopunctata* was observed as major among defoliators and registered as 6 beetles/plant. Its presence was observed throughout the study period and resulted typical damaging pattern of skeletonization as shown in figure 1(b). Its damage started from one month old stage of *W. somnifera*. Spingid caterpillar resulted heavy defoliation during November to January. It damaged almost all parts of *W. somnifera*. In case of sucking pests, frequent irrigation after two months of transplanting encouraged their presence. At that time population of these pests also increased because of abundance of food (according to the face-to-face interview with farmers). If the farmers adjust the irrigation according to that those pests incidence will be minimized. Cow bug, Red cotton bug and Green stink bug were the major pests among the sucking pests. Red cotton bug was predominant during January to March with a mean population of 6 bugs/plant. At the same time green stink bug was high with a mean population of 7 bugs/plant during November to December. Severity of mealy bug damage was high during hot season. These insect pests damage the aerial parts. It will reduce the root yield. Aerial parts were also used to prepare the drugs in other countries but not yet practice in Sri Lanka [8]. Moreover demand for this plant is high in Sri Lanka and cultivation is also changing to commercial scale [9]. This study will be useful when the aerial parts are collected for drug preparation.

Incidence of little leaf disease was observed six months after transplanting that means latter part of the plant growth as a perennial plant. All above ground part (shoot) were affected by this disease. Plant was stunted ultimately. Root knot nematode was identified in the root region of *W. somnifera*. It made numerous knots in the roots. Inside the knots life stages of the *Meloidogyne incognita* were identified by using microscope. Minimum and maximum numbers of knots/plant were recorded as 9 and 45, respectively. On an average 28.1 ± 12.10 knots were produced in a plant by *M. incognita*. This will affect the health during consumption of root as it considered be the most active for therapeutic purpose [10]. Prompt action need to overcome this disease before extend the cultivation.

Among beneficial species lady bird beetle was observed high in number and different other species were also noticed. Bees were helped for pollination. Ant movements were also high because of sugary nature of the plant.

Conclusion

Arthropod population in *W. somnifera* has an effect on plant growth and productivity as well as on active constituents of the plant. In case of root knot nematode, which will affect the quality of the roots thereby will affect the quality of drugs. This study will help to manage pests and a disease when *W. somnifera* is grown extensively for commercial purpose. Beneficial insect's assessment and scouting will help to plan the management practices of pests affecting *W. somnifera* without using inorganic pesticides. Furthermore, future studies are important with the concern of damage percentage of pests of *W. somnifera* and prey of natural enemies associated with this herb. Inter disciplinary studies of this nature will help to preserve and protect the medicinal plants not being sprayed with inorganic chemicals and especially to manage pests and diseases by other means of integrated pest management when cultivated in a larger extent as a medicinal crop.

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