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Pest status on fennel (*Foeniculum vulgare* Mill) under organic production system in semi-arid region of Rajasthan, India

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Abstract

In view of the field experiments conducted at ICAR-National Research Centre on Seed Spices, Ajmer on insect-pests scenario of fennel (*Foeniculum vulgare* Mill.) in *Rabi* season crop under organic production system in semi-arid conditions stated that fennel crop received an infestation of thirteen pest species from different order and family. Thrips (*Thrips tabaci*, *T. flavus* and *Scirtothrips dorsalis*), aphids (*Aphis gossypii* and *Hyadaphis coriandri*), jassids (*Empoasca kerri*), chalcid wasp (*Systole albipennis*), seed bug (*Nysius* sp.), tobacco caterpillar (*Spodoptera litura*) and grasshopper (*Acrida* spp.) were recorded as fennel pest of major importance. The insects like whitefly (*Bemisia tabaci*), lygus bug (*Lygus* sp.), stink bug (*Nezara viridula*), red cotton bug (*Dysdercus koenighii*), cutworm (*Agrotis* spp.) and leaf eating caterpillar (*Heliothis armigera*) were recorded as minor pests of fennel in semi-arid region under organic production system. The infestation of thrips, jassids, whitefly, cutworm and grasshopper was started at early growth stage where aphid infestation was observed throughout cropping period at different level of damage with maximum population 70.7 aphids/plant or umbel followed by thrips (4.82/plant) and chalcid wasp (4.07/umbel), whereas remaining pests populations were observed in scanty population.

Keywords: Abundance, diversity, *Foeniculum vulgare*, occurrence, organic production system and pests

1. Introduction

Fennel (*Foeniculum vulgare* Mill.; chromosome number 2n=22) is an herbaceous biennial or perennial plant belongs to family Apiaceae. It is originated from Southern Europe and Mediterranean region. It is commonly known as 'Variali' in Gujarati, whereas 'Saunf' in Hindi and considered as an important seed spices crop^[1]. It is mainly grows in *Rabi* season. In India, it cultivates commercially for various uses. Being an important seed spice, it is growing mainly in the states of Gujarat, Rajasthan, Uttar Pradesh, Karnataka, Bihar, Maharashtra, Punjab^[2], Tamil Nadu, Haryana and Madhya Pradesh. In 2017-18, it was cultivated in an area of 66020 hectare, produced 103940 tonnes seed with an average productivity of 1574 kg/hectare^[3]. A total volume of exported fennel seed (34550 tonnes) was valued for Rs. 25906 lakh during 2017-18, reflecting its prospective among major seed spices. Fennel is primarily used as mouth freshener just after intake of meals. It is also used for seasoning, flavouring and imparting aroma in variety of food items and beverages. It contains a rich source of nutrients i.e. carbohydrate, protein and minerals like calcium, iron, zinc and phosphorus. Besides importance in food industry, it also has several medicinal properties, used for healing of various ailments like mouth ulcer, swollen stomach, abdominal pain, diarrhoea, kidney ailments, liver pain and arthritis. It is also uses in pharmaceutical preparations as well as in cosmetic industry. A numerous insect-pests and diseases cause losses in its production and quality depending upon package and practices followed in the field.

Among the pests infest fennel crops, sucking insects i.e. jassids, *Empoasca kerri* (Das), thrips (*Thrips tabaci*, and *Thrips flavus* Schrank)^[1], whitefly, *Bemisia tabaci* Genn., aphids (*Hyadaphis coriandri* Das and *Aphis gossypii* Glover) and some bugs cause damage by sucking the cell sap of plants. Chalcid wasp, *Systole albipennis* Walker^[4], cutworm, *Agrotis* sp., lepidopteran caterpillars and grasshopper, *Acrida* sp., are another type of pests' damage on fennel during winter season crop under semi-arid conditions of Rajasthan. The pests appear on fennel crop just after germination and extended till crop maturation cause different level of damage. Keeping above in view, field experiments were carried out at organic block of research farm, ICAR-National Research Centre on Seed Spices, Ajmer for three consecutive years to find out the diversity of arthropod fauna associated with fennel under organic production system.

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2. Materials and Methods

Field trials were conducted at organic block of research farm, ICAR- National Research Centre on Seed Spices, Ajmer (A semi-arid region of Rajasthan) during 2015-16 to 2017-18 to study the diversity of arthropod fauna associated with fennel crop grown in *Rabi* season. The experimental site lies at 26° 27' 0" N latitude and 74° 38' 0" E longitude along with an altitude of 460 meter msl. The experimental location is surrounded by Aravalli hills, receives average annual rainfall 300-550 mm, temperature ranges between 25-30° Celsius during sowing time, 2-5° Celsius in January and 42-45° Celsius in May-June and 60-80% relative humidity during the entire study period.

Fennel variety AF-1 was grown in well prepared and laid out field and recommended package of practices were applied for optimum growth of the plants. There were only organic based plant protection measures applied for the management of insect-pests on the crops during entire cropping period. A regular field monitoring for insect pests infestation were carried out to know the qualitative and quantitative pest status on crop. The observations on insect pests of fennel were recorded at fortnightly intervals right from germination of the crop to maturation of crop. The population of sucking pests i.e. aphid (scale: 01 =10 aphids), jassid, thrips and whitefly were recorded on 5 randomly selected and tagged plants in a plot. In initial growth period, whole plant was taken as a single unit. During full plant growth stage, three 10cm long twigs of a branch from lower, middle and top portion of plant were taken to record the observation of aphid, thrips and jassids. In flowering stage, observations were recorded on three umbels of every tagged plant. Nymphs as well as adult stage of sucking pests were taken in to account while counting its population. Population of whitefly and bugs were recorded from five tagged plants per plot. Observations on lepidopteran caterpillars i.e. tobacco caterpillar, gram pod borer and cut worm were recorded on five plants per plot. The insect pests were counted during early hours of the day when they remain less active. Yearly recorded data on insect population at definite time interval were analysed separately and pooled. The results interpretation was made based on peak population to work out the pest status on fennel under organic production system.

3. Results and Discussion

The data on pests complex of fennel under organic production system were recorded and presented in Table 1, revealed that, thirteen insect species from different order and family were recorded on the crop in semi-arid region of Rajasthan during fennel's cropping season. Among pest complex of fennel, sucking pests i.e. three species of thrips (*Thrips tabaci* Lind., *Thrips flavus* Schrank and *Scirtothrips dorsalis* Hood), two species of aphid (*Aphis gossypii* Glover and *Hyadaphis coriandri* Das) and one species each of jassids, *Empoasca kerri* (Das), whitefly, *Bemisia tabaci* Genn., seed bug, *Nysius* sp., lygus bug, *Lygus* sp., stink bug, *Nezara viridula* Linn., and red cotton bug, *Dysdercus koenigii* Fab. were recorded. Cut worm, *Agrotis* spp., tobacco caterpillar, *Spodoptera litura* (Fab.) and leaf eating caterpillar, *Helicoverpa armigera* (Hub.) of lepidoptera were noticed on fennel during different years of observations. Chalcid wasp, *Systole albipennis* (Walker) Eurytomidae: Hymenoptera and grasshopper, *Acrida* spp. Acrididae: Hemiptera were also recorded on fennel crop. The results are in agreement with that of [5] who reported that fennel crop is attacked by insect-pests like aphid, cutworm

and armyworm. Other pests infested fennel crop include thrips, *Thrips tabaci* Lind., whitefly, *Bemisia tabaci* (Genn.), lucern caterpillar, *Spodoptera exigua* (Hub.) as reported by Kanwat [6] and seed midges, *Systole albipennis* Walker and *Systole coriandri* Gussakovsky [7, 8] partially get support to the present findings. Agrawal *et al.* [9] reported *Systole Albipennis* as major pest of fennel caused more than 50 percent loss in quantity and qualitative of fennel crop. Hake *et al.* [10] in a similar study reported aphid, *Hyadaphis coriandari* (Das) as serious pest of fennel.

Thrips infestation recorded on fennel crop at 10-15 days after germination in meagre in population. Jassids and whitefly infestation observed on crop at 25 days after germination with few in number, whereas, aphid population initiated on fennel crop at two to three leaf stage, almost 35 to 40 days after germination and was being active on crop throughout the cropping period in fluctuated population trend. Kanjiya *et al.* [1] reported the aphid (*Hyadaphis coriandri*) occurrence on fennel during fourth week of December at Junagarh region of Gujarat get support to the present findings. Cutworm infestation on fennel was observed in early growth stage at 20-25 days after germination during third week of November and continued up to third week of December. Cut worm's larvae damaged the crop by cutting the roots inside soil or soil surface as resulted plants felt down and whole plants dried. Infestation of tobacco caterpillar, *Spodoptera litura* and leaf eating caterpillar, *Heliothis armigera* initiated on fennel in last December to first week of January with very less in number and continued till second week of March. Grasshoppers' infestation was also observed on fennel from December to February cause damage to crop by eating leaves and new born shoots. The related observations were found in coriander by Meena [11], he reported that few lepidopteran caterpillars inflict damage to coriander an Apiaceae crop are accordance with the present study.

Seed wasp (*Systole albipennis*) and seed bug (*Nysius* sp.) were noticed on fennel crop at flowering stage to initiation of seed formation and continued till seed dried up. Infestation of *Systole albipennis* was found higher on the plants due to non-chemical pest management practices were followed throughout the cropping season and the pest was categorized as major status on fennel. The pupae of seed wasp became alive inside matured fennel seed till storage, hence it could also consider as storage pest of fennel. Lygus bug (*Lygus* sp.), stink bug (*Nezara viridula*) and red cotton bug (*Dysdercus koenigii*) appeared on fennel crop during third to fourth week of January and infestation continued till crop harvesting in the month of April. The similar observations were recorded by Meena *et al.* [12], who reported the infestation of red cotton bug (*Dysdercus koenighii*) and stink bug (*Nezara viridula*) on coriander during inception of flowering and was being active till seed maturation are in agreement of present study.

The occurrence and abundance of insect-pests of fennel crop for major importance were also recorded and presented in figure 1, revealed that sucking pests *viz.*, aphid, thrips and jassid were appeared on fennel crop in early growth stage in scanty population during November and December. Population of these pests was gradually increased and reached to its peak (70.7 aphids/plant or per umbel) during first week of March for aphids, last week of December to first week of January for thrips (4.82 thrips/plant) and third week of January for jassids (2.59 jassids/plant). Infestation of chalcid wasp was also started in third week of February with flowering to seed formation stage and lasted till harvesting of

crop. The three years average peak population of chalcid wasp (4.07 wasps /umbel) was recorded between last week of March and first week of April. The seed bug infestation was recorded on fennel during flowering stage to maturity of crop with an average peak population was 2.40 bugs/plant. Its population was fluctuated more or less in number, depending

upon the biotic and abiotic factors. Similarly, the other pests of major importance i.e. tobacco caterpillar (1.87 larvae/plant) and grasshopper (1.53 grasshoppers/plant) were also observed on fennel crops in less number but cause significant loss to fennel in the absence of suitable control measures during the period of study.

Table 1: Pests' diversity on fennel (*Foeniculum vulgare* Mill.) under organic production system in semi-arid region of Rajasthan

Sl. No.	Name of pests	Scientific name	Family & Order	Pest status
1.	Thrips	<i>Thrips tabaci</i> Lind.	Thripidae: Thysanoptera	Major
		<i>Thrips flavus</i> (Schrank)		
		<i>Scirtothrips dorsalis</i> (Hood).		
2.	Aphids	<i>Aphis gossypii</i> Glover	Aphididae: Hemiptera	Major
		<i>Hyadaphis coriandri</i> (Das)		
3.	Jassids	<i>Empoasca kerri</i> (Das)	Cicadelidae: Hemiptera	Major
4.	Whitefly	<i>Bemisia tabaci</i> Genn.	Aleurodidae: Hemiptera	Minor
5.	Seed bug	<i>Nysius</i> sp.	Lygaeidae: Hemiptera	Major
6.	Mirid bug	<i>Lygus</i> spp.	Miridae: Hemiptera	Minor
7.	Stink bug	<i>Nezara viridula</i> (Linn.)	Pentatomidae: Hemiptera	Minor
8.	Red cotton bug	<i>Dysdercus koenigii</i> Fab.	Pyrrhocoridae: Hemiptera	Minor
9.	Chalcid wasp	<i>Systole albipennis</i> (Walker)	Eurytomidae: Hymenoptera	Major
10.	Cut worm	<i>Agrotis</i> spp.	Noctuidae: Lepidoptera	Minor
11.	Tobacco caterpillar	<i>Spodoptera litura</i> (Fab.)	Noctuidae: Lepidoptera	Major
12.	Leaf eating caterpillar	<i>Heliothis armigera</i> Hub.	Noctuidae: Lepidoptera	Minor
13.	Grasshopper	<i>Acrida</i> spp.	Acrididae: Hemiptera	Minor

Insect-pests of fennel were enlisted based on visual observations

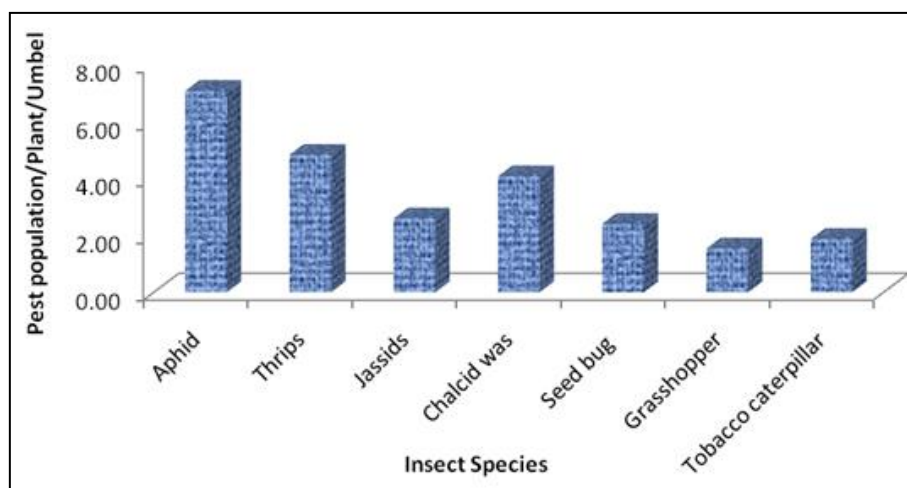


Fig 1: Pest's abundance on fennel under organic production system in semi-arid region during *Rabi* season

4. Conclusion

Fennel (*Foeniculum vulgare* Mill.) can successfully grow under organic production system in semi-arid conditions. The crop received the infestation of 13 pests species from different order and family. Pests' infestation started from few days after germination to crop maturity at different level of damage in yield and quality. Aphids, jassids, seed bugs, chalcid wasp and tobacco caterpillar were recorded as major pests of fennel in semi-arid region of Rajasthan cause heavy damage. The fennel crop is highly cross pollination is nature, needs pollinators for pollination services during flowering and aphids, seed bug and chalcid wasp cause heavy yield loss. In view of pest management strategies through bio-pesticides and organic control measures provided the effective management of these pests and protect pollinators' life in fennel crop.

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