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Ecology and Control of Brinjal insect pests from Kolhapur region, India

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ABSTRACT

Brinjal *Solanum melongela* L. is an important vegetable crop of subtropics and tropic with fuel, nutritional and ayurvedic medicinal value. In India it is cultivated in almost all states. Therefore, ecology and control of insect pests have been studied from Kolhapur region of India. A total of 12 species of insect pests, namely *Leucidonus orbonalis* Guen, *Euzophera perticella* Rag., *Epilachna vigintioctopunctata* (Fab.), *Urentius sentis* Diast., *Amrasca bigutulla biguttula* Dist., *Bemisia tabaci* Genn., *Aleurodicus dispursus* (Rus.), *Lipaphis erysimi* Kalt., *Aspidoitus destructor* Sign., *Aonidiella auranti* (Maskell), *Thrips palmi* Karny and Ants have been recorded damaging Brinjal crop. Out of which *L. orbonalis, A. bigutulla bigutulla, A. dispersus, A. destructor, L. erysimi* and Ants were found throughout the year. Natural enemies, host plants, life cycle and control measures are suggested in the paper. 0.1% carbaryl or Azadirachtin or 0.05% malathion were found effective. *Trichogramma chilonis* 1 to 1.5 lakh/ha was found effective for lepidopteran pests as ecofriendly control.

Key words : Brinjal, insect-pests, ecology, natural enemies, control.

INTRODUCTION

Brinjal *Solanum melongena* L. is an important crop of sub-tropics and tropics. Its varieties display a wide range of fruit shapes and colours, ranging from oval or egg shaped to long club-shaped. It is used as fuel in rural areas. The fruits contain low in calories and fats, mostly water, some protein, fibre and carbohydrates. It is with ayurvedic medicinal property, useful to diabetic patients and also excellent remedy for liver complaints (Shukla and Naik, 1993).

In India, Brinjal is cultivated since last 4000 years and food production accounted as 8.7 million MTs with an area of 0.53 million hectares (DGCIS, 2008). The prominent species of Brinjal refer to *S. melongena, S. aethiopicum* and *C. macrocarpon* are interfertile with their respective wild ancestors (Daunay, *et al*. 1991). In India, it is widely cultivated in 8 states, practically on all soils from light sand to heavy clay and in almost all eight vegetable growing zones including Maharashtra- Madhya Pradesh ((Zone - VII). Although several varieties of brinjal are cultivated, the expected yield of the crop is not achieved so far because of the crop damage caused by the insect pests. Insect pests are most limiting factor for accelaring crop yield. The Brinjal is attacked by varieties of insect pests such as fruit and stem borers, defoliators, cell sap suckers, stem girdlers, etc. Review of literature indicates Fletcher (1722), Katiyar *et al*. (1976), Lall (1964), Subba Rao *et al*. (1968, 1969), Deshmukh *et al*. (1977), Patel *et al*. (1988), Mall *et al*., (1992), Gapud & Canapi (1994), Dhamdhere *et al*., (1995), Roy *et al*., (1995), Sudhakar *et al*. (1993), Shrinivasan (2009), Shivalingaswamy & Satpathy (2007), Sidhu & Datta

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(2007), Sathe & Chougule (2014), Sathe & Gangate (2015), Sathe (1998,2003, 2014, 2015), Sathe & Oulkar (2010), Sathe *et al.* (2015) etc. worked on insect pest management on egg plant and some other crops. Ecological pest control strategy has great importance in ecofriendly control. The present work will add great relevance in Integrated pest management of Brinjal insect pests.

Materials and Methods

The present study was carried out from Kolhapur region of Maharashtra during the years 2014-15. Kolhapur district of India is situated between 15^{o} to 17^{o} North Latitude and 73^{o} to 74^{o} East longitude with an average rain fall 1100 mm mostly covered by monsoon. Diversity, survey and abundance of insect pests of *S. melongena* was studied by spot observations and by collecting insect pests which were associated with the above crop by one man one hour search methods from different study spots from Kolhapur region. The collected insects were identified by consulting appropriate literature. The observations were continued through out the year at weekly interval. Natural enemies have been recorded by spot observations and also by collecting various immature stages of pests from field and later rearing these stages on their natural food plant for screening parasitoids. The microbes from field collected pest stages have been isolated (Sathe & Oulkar, 2010) and identified for making the records. Observations were also taken on the abundance of pests with respect of rainfall, temperature and humidity. A twig of 1 ft length was selected for noting the insects for seasonal abundance. The pests have also been surveyed on other crops and identified consulting appropriate literature.

Results

Results are recorded in tables 1 & 2 and figures 1 to 8. Results indicated that *Leucinodus orbonalis* Guen., *Amrasca bigutulla bigutulla* Dist., *Aleurodicus dispersus* (Rus.), *Lipaphis erysimi* Kalt., *Aspidoitus destructor* Sign. and Ants were found through out the year on Brinjal in Kolhapur region, while *Euzophera perticella* Rag. occurred during October to March, *Epilachno vigintioctopunctata* (Fab.) found from August to March and *Urentius sentis* Diast was from April to October and *Bemisia tabaci* Karney was associated with Brinjal from July to May. A total of 12 species of insects found attacking various parts of the crop. Out of 12 species 2 were borers, 2 were defoliators and 7 were cell sap suckers while, 1 was stem girdler (Fig.-2). As regards to natural enemies, *L. orbonalis* have been attacked by 9 species, out of which 7 species were from parasitoid category and 3 were from predators. Similarly, on *E. perticella* 3 species of parasitoids have been recorded (Table-1). One predator and one parasitoid was associated with *E. vigintioctopunctata.* Similarly, for sucking type of pests, a large number of natural enemies have been reported from Kolhapur region (Table-1). Host plants, life cycle and control measures are also given in table-1. The seasonal abundance of important insect pests is given in Table-2. As a part of ecofriendly control of brinjal pests, natural enemies have been allowed to work against pest species reported in the study area. Pesticidal use have been avoided when natural enemies were in active stage on the crop. Spray of 0.15% carbaryl or Azadirachtin or 0.05% malathion was found effective against the insect pests. Release of *Trichogramma chilonis* with 1.00 to 1.5 lakh/ha was found effective against Lepidopteraous pests, *L. orbonalis* and *E. perticella.* The use of NPV 250 LE as microbial control was also found suitable for Lepidopterans.

Discussion

Fletcher (1922) reported that the larvae of *Spilosoma obliqua* (Walker) were found damaging several types of crops including cereals, pulses, oil seeds, fibers, ornament and vegetables. Katiyar *et al*.(1976) studied the effect of feeding of brinjal, radish, mustard, cauliflower and tomato on larval development of *S. obliqua* under laboratory conditions. There was a complete inhibition of larval development on tomato leaves and brinjal was consistently significantly inferior to cauliflower, radish and mustard. Deshmukh *et al*. (1977) tested 16 host plants for *S. obliqua.* The pest was not able to complete its life cycle on *Cardia myxa, Solanum melongina, Ocimum gratissium, Fiscus bengalensis, Acalypha corarata* and *Cannabis sativa.*

According to Mall *et al*. (1992) *S. melongena* was infected by a number of insect pests including jassid *A. biguttula biguttula* ; aphid *Aphis gossypii* Glover; epilachna beetle *E. vigintioctopunctata* and shoot and fruit borer *L. orbonalis* during different stages of its growth in most of the tropical countries including India. The losses caused by these pests vary from season to season depending upon environmental factors (Patel *et al*., 1988). Seasonal incidence of jassid, aphid, epilachna beetle and shoot and fruit borer were more prevalent during vegetative phase of the crop upto the 3rd week of September when the average temperature and humidity were more than 28^{o}C and 80% respectively. These conditions were more conducive for epilachna beetle and shoot and fruit borer. At the initiation of fruiting stage in October, the intensity of jassid and aphid was increased along with the shifting of borer infestation from shoots to

Table - 1 : Ecology and control of Brinjal insect pests

Sr. No.	Species	Damage	Host plant	Occurrence	Life cycle	Natural Enemies	Chemical control	Preventive
1.	*Leucinodes orbonalis* Guen. Pyraustidae : Lepidoptera	Fruit borer	Brinjal, greenpea, Solanaceous plants	Through out the year	25-30 days, fecundity 250 eggs.	i) *Trathala flavoorbitalis* *ii) Prestomerus testaceus* *iii) Bracon* sp. iv) *Shirakia shoenobi* v) *Diadegma apastata* vi) *Eriborus argenteopilosus* vii) *Trichogramma chilonis* Predators : i) *Coccinella septumpuctata* ii) *Cheilomenes sexmaculatus* *Brumoides suturalis*	Spray : 0.1% carbaryl or Azadirachtin	Collection and destruction infected plants with Pest
2.	*Euzophera perticella* Rag. (Phycitidae : Lepidoptera)	Stem borer	Potato, tomato, chillies, Brinjal	Oct. - March	35-40 days, Fecundity - 300 eggs	- *Xanthopimpla* sp. - *Apanteles* sp. - *Goryphus* sp.	Spray : 0.15% carbaryl, 0.03% Azadirachtin/ Apply need cake in soil	Collection and destruction infected plants
3.	*Epilachna viginctiopunctata* (Fab.) (Coccinellidae : Coleoptera)	defolitor	Potato, tomato, solanaceous plants Brinjal	Aug - March	18-20 days, Fecundity - 300 eggs	- Lace wings feed on eggs - *Pediobius foveolatus* (parastoid)	Spray : 0.2% Carboryl 0.05% malathion 0.02% diazinon 0.03% Azadirachtin	Hand picking of pest stages
4.	*Urentius sentis Diast. (Tingidae : Hemiptera)*	Cell sap sucker	Specific Brinjal	April - Oct.	15-20 days, Fecundity - 40 eggs	- Lace wings feed on eggs - Pediobius foveolatus (parastoid)	Spray : 0.05% Rogor or 0.02% diazinon	Collection and destruction of infected twigs with pest stages
5.	*Amrasca bigutulla bigutulla (Cicadellidae : Hemiptera)*	Cell sap sucker	Brinjal, cotton, Okra, Potato, Tomato	Throughout year	15-20 days, Fecundity - 20 eggs	- Lace wings, Lady bird beetles, dragonflies	Spray : 0.15% Carbaryl, 0.03% Azadirachtin	Collection and destruction of infected twigs with pest stages
6.	*Bemisia tabaci Karney Hemiptera : Aleyrodidae*	Cell sap sucker	Cabbage, cauliflower, melon, mustard, Okra, Brinjal	July - May	15-22 days, Fecundity - 120 eggs	- Crysoperla sp. - Brumus sp. - Ladybird beetles - Mantids	Spray : 1% malathion Phosphamndon, 0.025% methyldemeton/ Imidacloprid/ Neem formulation soil	Collection and destruction of infected plant parts
7.	*Aleurodicus dispersus (Rus.) (Aleurodidae : Hemiptera)*	Cell sap sucker	Polyphagus, potato, tomato, chilli, guava, sugarcane, several other plants	Throughout year	16-18 days, Fecundity - 150 eggs	- Lady bird beetles, Menochilus sp. Coccinella sp., Brumus sp. - Mantids	Spray : 1% malathion Phosphamidon, 0.025% methyldemeton/ Imidacloprid. Neem formulation soil	Use of yellow sticky traps. Make the border of maize, jowar, to Brinjal

…Table - 1 : Ecology and control of Brinjal insect pests

Sr. No.	Species	Damage	Host plant	Occurrence	Life cycle	Natural Enemies	Chemical control	Preventive
8.	Lipaphis erysimi Kalt. (Aphidae : Hemiptera)	Cell sap sucker	Cruciferous and vegetable crops. Mustard, Brinjal, raddish, knol khol	Throughout year December-March, migrate to hills in summer	Parthenogenic, 45 generations/ year	- Syrphus serarius Ichiodan scutellaris, - Coccinella septum punctata, - Parasitoids : - Diaerctiella rapae, Lipolexis gracilis	Spray : 0.03% Azadirachtin/ 0.15% Carbaryl/ 0.02% Phosphamidon/ 0.03% Rogor	Use of yellow sticky traps Make the border of maize, jowar
9.	Ants (Formicidae-Hymenoptera)	Girdling stem	Brinjal, chilli	Throughout year	Social insects, cast system, division of labour,	-	Spray : Carbaryl 0.15%/ Malathon 0.05%/ Rogor 0.03%	Destruction of their nests, irrigation
10.	Scale insect Aonidiella auranti Aspidoitus destructor Sign. Diaspididae :	Sucking cell sap	Brinjal, Papaya, Citus, Guava Gingar	Throughout the year	35 days, fecundity 20-25 eggs	- Red ants - Lace wings, - Lady bird beetles	Spray : Carbaryl 0.15%/ Malathon 0.05%/ Rogor 0.03%	Collection & destruction infected plant parts

Table - 2 : Seasonal abundance of insect pests on Brinjal *S. melongena*

Sr.No.	Pest Species	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	April	May
1.	*L.orbonalis*	1	2	2	3	2	1	1	1	2	3	2	3
2.	*E.perticella*	--	--	--	1	2	3	4	3	3	4	--	--
3.	*E. vigintioctopunctata*	--	--	11	24	27	25	21	20	17	10	--	--
4.	*U.sentis*	27	25	20	31	32	--	--	--	--	--	19	33
5.	*A.bigutulla higutulla*	4	4	7	7	6	5	5	7	10	11	12	11
6.	*B.tabaci*	--	3	7	7	7	8	5	6	8	9	10	7
7.	*A.disperus*	6	4	5	6	6	7	7	9	12	13	13	13
8.	*L.erysimi*	13	17	15	27	31	39	42	52	59	49	27	28
9.	*A.destructor*	12	18	22	27	23	28	33	36	35	36	38	30
10.	*Ant.*	7	11	13	12	19	27	38	42	40	43	38	29
	Total spp.	**7**	**8**	**9**	**10**	**10**	**9**	**9**	**9**	**9**	**9**	**8**	**8**

fruits at average temperature and humidity ranging between 20-25^{o}C and 50-72% respectively were responsible for multiplication of jassid and aphid while, rainfall played negative role for these pests. Fruit infestation was maximum at the initial stage of fruiting which declined slowly with the advent of winter during December (Mall *et al*. 1992).

Sachan and Gangwar (1990) studied the seasonal incidence of insect pests of cabbage, cauliflower and knol khol from Shilong region, India. Their report indicated that the above crops were attacked by cabbage butterfly *Pieris brassicae* (Linn.), cabbage aphid *Brevicoryne brassicae* (Linn.), mustard aphid *L. erysimi*, cutworm *Agrotis ipsilon* Root. and *A. flammatra* S.M., cabbage looper *Plusia orichalcea, Trichoplusia* sp. and diamond back moth *Plutella xylostella* (Linn.), *P. brassicae* was found throughout the year with maximum activity during February to October. Cabbage aphid was next to babbage butterfly in damaging the crop and active from November to April while cutworm showed more activity during July to November. In the present study, jassids, fruit borer and scale insects were found through the year on brinjal while jassids, aphids, epilachna beetle, shoot and fruit borers were prevalent during the vegetative phase of the brinjal crop.

According to Mishra (1993) based on the pest control ability, fruit yield and cost : benefit ratio cypermethrin / fenvalerate 0.05 kg.a.i./ha were the best suitable insecticides for control of brinjal fruit and shoot borers.

Figure-1. Brinjal field.

Figure-2. *L. orbonalis* (moth).

Figure-3. *L. orbonalis* (Larva).

Biotic factors play an important role in ecofriendly pest control (Sathe & Oulkar, 2011). According to Tewari and Sardana (1990) an unusual heavy parasitization of *L. orbonalis* was noted due to a braconid parasitoid, *Bracon* sp. During September - October 1985 the survey studies was conducted on the natural enemies mortality factors of *L. orbonalis* around Bangalore. The parasite pupated easily in the rearing petridishes under laboratory conditions. The minimum 9.21% parasitism was noted with the first picking and was increased in subsequent pickings. Maximum 28.10% was noted in Sixth picking in September then it showed a declined trend.

Figure-4. *L. orbonalis* damage

Fig**ure-5. *A.destructor***

According to Dogra *et al*. (2001) the peak population of *L.erysimi* and *B. brassicae* was recorded during second week of March with maximum and minimum temperature of 22.5^{o}C and 10.3^{o}C and no rainfall was recorded during the same period. The maximum population of *Myzus persicae* (Sulzer) was observed during the last week of January with maximum temperature of 4^{o}C, relative humidity 58% and no rainfall.

Bilasini and Singh (2012) noted the larvae as well as adults of *C. septumpunetata* in colonies from first week of December (0.05 predaotr/ sample) in the first year and its peak population was noted during middle of February which coincided with the peak of aphid population. In the second cropping season

(2004-05), the prey population appeared during last week of November with 1.45 aphids/sample.

Figure-6. Fruits damaged

Figure-7. *A.dispersus*

Singh and Arya (2001) studied insecticidal activity of petroleum ether extract of mustard seeds against mustard aphid, *L. erysimi*. The extract they tested was found very effective which caused 100% mortality in the pest. Application of phorate or carbofuran along with seed followed by need based application of Carbaryl 0.2% or malathion 0.1% or quinolphos 0.05% were effective in controlling aphids, jassids, epilachna beetles and fruit borers and increased the returns to the farmers (Raghunath *et al*., 1989). According to Verma (1992) one spray of dicofol followed by one spray with any of endosulfan, monocrotophos and phosphamidon can control jassids, white flies, fruit borers and mites.

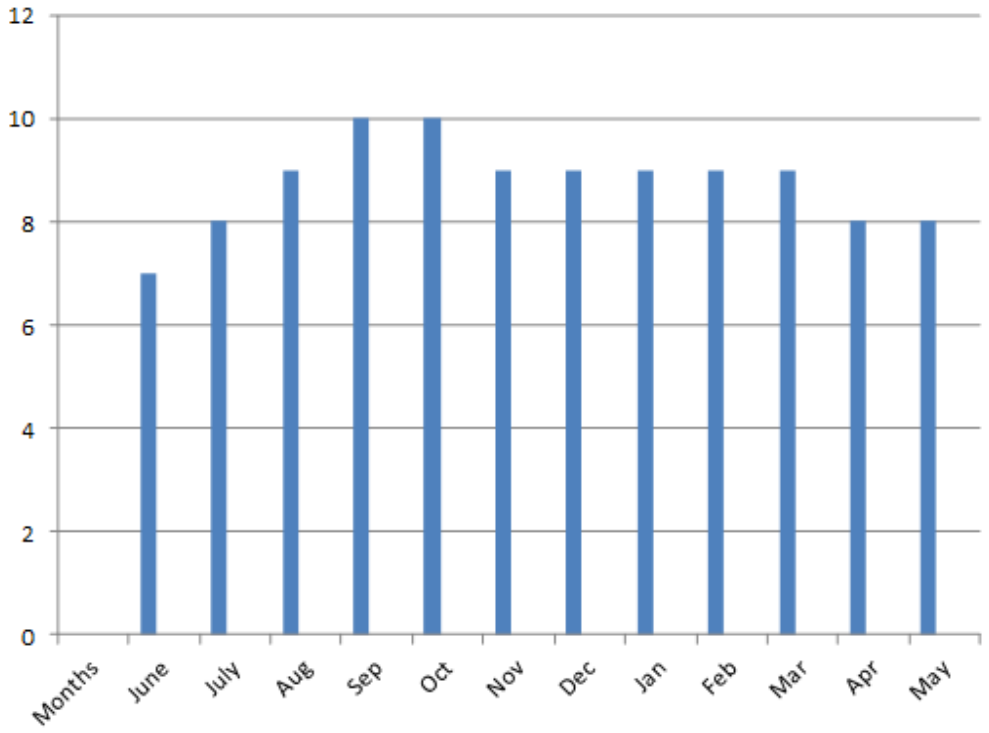
Figure-8. Ant nesting and damage.

According to Shreedevi and Chitra (1993) carbaryl was superior to all the other treatments which recorded 81.47% efficacy. The efficacy of plant extracts was found to be in the following order. RD9 Repellin > Neemicide > Vapenik > Wellgro.

Sathe and Gangate (2015) reported the occurrence of *A. dispersus* on Brinjal from Kolhapur region, throughout the year. However, its population was found increased in hot months and declined in monsoon months. The same trend was confirmed in the present study. According to Wright and Diez (2005) there were distinct seasonal variations in *A. destructor* numbers on bananas in Hawaii and varietal differences in population densities and proportions of plants infested. The population was found increased during the months from October to February on Cavendish and apple.

According to Sinha *et al*. (1989) *L. erysimi* was found to appear and establish on *Brassica* spp. in the third week of December. It built its population in January-February reaching the peak on 8th and 18th

Figure-9 Seasonal abundance of different species on brinjal from Kolhapur region.



February in 1980 and 1981, respectively. They further noted that none of ecological parameters alone was responsible for the multiplication and growth of the aphid and consequently its incidence on the crop. While in the present *L. erysimi* was associated with brinjal throughout the year and very prominently recorded from December to March but, declined in monsoon season due to rains. Similarly, *L. orbonalis, A. bigutulla bigutulla,* ants and scale insects were found throughout the year on brinjal. The scale insects, ants and fruit borers caused severe infestation in Kolhapur region. The pests of brinjal can be controlled by adopting above suggested control measures. However, biological control is ecofriendly and safer to humans on edible crops hence, more emphasis should be given on biological and natural control (Sathe 2014).

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Conflict of Interests

Authors declare that there is no conflict of interests regarding the publication of this paper.

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