



INSECT HERBIVORES AND THEIR NATURAL ENEMIES IN LINSEED AND THEIR POPULATION DYNAMICS

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ABSTRACT

A field experiment was conducted to explore the activity of insect herbivores in linseed, their natural enemies, and population dynamics, on variety BRLS-102 at Sabour (Bhagalpur), Bihar during *rabi*, 2016-17. A total of nine insect herbivores were observed of which the two thrips viz., *Thrips palmi* and *Frankliniella schultzei* are new records. Four natural enemies (predators)- *Coccinella septempunctata* and *Menochilus sexmaculata* belonging to Coccinellidae, spider (*Oxyopes* sp.), and *Paederus* sp (Staphylinidae) were observed. The linseed pests were active from mid-January to mid-March from vegetative to bud formation stage. Maximum population of *Agrotis ipsilon* and thrips were observed during 52 and 9 SMW, respectively; and that of aphids, *Helicoverpa armigera*, *Oxyopes* sp., coccinellids and bud fly was on 8 SMW. Correlation coefficients of the population/ infestation of these with the weather factors are given herein to explain their population dynamics.

Key words: Linseed, pests, predators, *Helicoverpa armigera*, *Agrotis ipsilon*, thrips, ladybird beetles, staphylinid, *Oxyopes*, correlation, weather factors

Among the *rabi* oilseed crops, linseed is an important crop after rapeseed and mustard in area as well as production (Kumar et al., 2008). Linseed crop suffers due to ravages of diseases and insect pests at various phases of its growth which reduce the crop yield and quality. Amongst insect pests, linseed bud fly, (*Dasyneura lini* Barnes), semilooper (*Plusia orichalcea* F.), thrips (*Caliothrips indicus* Bagnall) and linseed caterpillar (*Spodoptera exigua* Hubn.) are important (Mukerji et al., 1999). The bud fly *D. lini* (Diptera: Cecidomyiidae) and linseed thrips, *C. indicus* (Thysanoptera: Thripidae) are recognised as the key pests (Rawat and Kaushik, 1983; Deshmukh et al., 1992). Linseed/ lucerne caterpillar *Laphygma exigua* (Lepidoptera: Noctuidae) being polyphagous in nature, is another important pest. The information on insect pests and their natural enemies in Bihar is explored in the present study.

MATERIALS AND METHODS

Study was conducted during *rabi*, 2016-17 at the Experimental Farm, Bihar Agricultural University, Sabour located in Zone IIIA of Bihar having subtropical climate (25°15'40" N, 82°2'42" E, 46 msal) Data on the occurrence of insect-pest and natural enemy

complex were recorded on linseed variety, BRLS- 102. Untreated plots of the experiment on field efficacy of insecticides and seed production plots were used for observations. The insect pests and natural enemies were collected were got identified. Weekly observations on insect pests and natural enemies were recorded on randomly selected five plants for thrips, aphids, spiders and lady bird beetle. Observations for cutworm and gram pod borer were recorded using five random quadrates. The infestation of bud fly was recorded on five randomly selected plants and fresh bud fly infestation and cumulative bud fly infestation were worked out. Weekly weather data viz., temperature (maximum and minimum), relative humidity (morning and evening), sunshine and rainfall were obtained from Meteorological Observatory, Department of Agronomy, Bihar Agricultural University, Sabour. The data on population dynamics were subjected to correlation coefficient analysis.

RESULTS AND DISCUSSION

Pests and their natural enemies

A total of nine insect pests and four natural enemies were observed (Table 1, 2). Among insect pests, two

Table 1. Insect-pests observed on linseed (*rabi*, 2016-17)

Common Name	Scientific Name	Family	Order	Damaging stage	Crop stage attacked
Cutworm	<i>Agrotis ipsilon</i> (Hufnagel)	Noctuidae	Lepidoptera	Larva	Post germination to bud formation
Melon thrips	<i>Thrips palmi</i> Karny	Thripidae	Thysanoptera	Nymph, adult	Vegetative to bud formation
Common blossom thrips	<i>Frankliniella schultzei</i> (Trybom)	Thripidae	Thysanoptera	Nymph, adult	Vegetative to bud formation
Aphids	Unidentified	Aphididae	Hemiptera	Nymph, adult	Vegetative to bud formation
Bihar hairy caterpillar	<i>Spilosoma obliqua</i> Walker	Noctuidae	Lepidoptera	Larva	Vegetative to bud formation
White-spotted leaf beetle	<i>Monolepta signata</i> Olivier	Chrysomelidae	Coleoptera	Adult	Vegetative to bud formation
Gram pod borer	<i>Helicoverpa armigera</i> (Hübner)	Noctuidae	Lepidoptera	Larva	Vegetative to dough stage
Linseed bud fly	<i>Dasyneura lini</i> Barnes	Cecidomyiidae	Diptera	Maggot	Bud initiation to dough stage

Table 2. Natural enemies observed on linseed (*rabi*, 2016-17)

Common name	Scientific name	Family	Order
Lady bird beetle	<i>Coccinella septempunctata</i> L.	Coccinellidae	Coleoptera
	<i>Menochilus sexmaculatus</i> (F.)	Coccinellidae	Coleoptera
Rove beetle	<i>Paederus</i> sp.	Staphylinidae	Coleoptera
Spider	<i>Oxyopes</i> sp.	Oxyopidae	Araneae

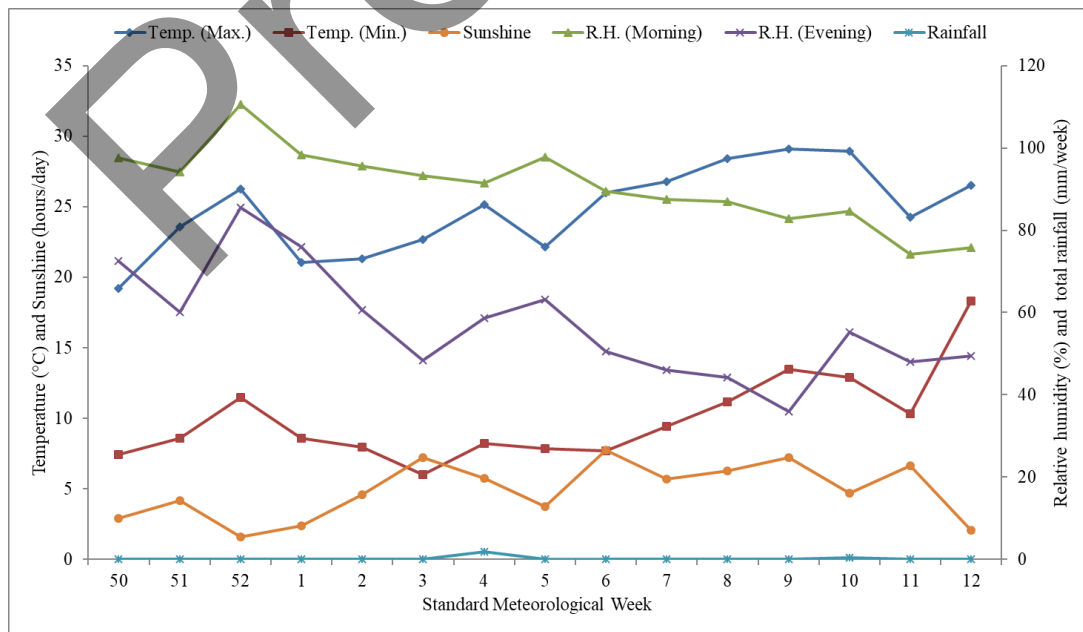


Fig. 1. Weekly meteorological data (linseed cropping period - *rabi*, 2016-17, Sabour (Bihar))

species of thrips namely *Thrips palmi* Karny and *Frankliniella schultzei* (Trybom) were identified as new records. Linseed bud fly, *D. lini* was observed as a major pest. Three noctuid viz., *Agrotis ipsilon* (Hufnagel), *Helicoverpa armigera* (Hübner) and *Spilosoma obliqua* Walker were observed. White-spotted leaf beetle *Monolepta signata* Olivier was also observed. Among natural enemies, two species of lady bird beetle namely, *Coccinella septempunctata* L. and *Menochilus sexmaculatus* (F.), spider belonging to genus *Oxyopes* and rove beetle of genus *Paederus* were observed.

Patel and Thakur (2005) also reported *H. armigera*, *M. persicae* and *D. lini* on linseed at Raipur (Chhattisgarh). Earlier, three thrips species viz., *Caliothrips indicus*, *Thrips tabaci* and *T. angusticeps* had been known on linseed from India and Pakistan (Patel and Thakur, 2005; Borah et al., 2005; Abro et al., 2016). Borah et al. (2005) observed *D. lini*, *A. ipsilon*, *H. armigera* and *S. obliqua* as important from Assam. The literature of *M. signata* feeding on linseed is not available. Reports of *C. septempunctata* and *M. sexmaculatus* are in conformity with those reported by Malik (1997). Patel and Thakur (2005) also reported rove beetle, *Paederus* sp. and an unidentified spider on linseed.

Crop stage vis-à-vis damaging stage

The damaging stage of the insect pests and crop stage attacked by them are given in Table 1. *T. palmi*, *F. schultzei*, aphids, *S. obliqua* and *M. signata* were found to attack the crop during vegetative to bud formation

stage. Others viz., *A. ipsilon* and *H. armigera* were observed during post germination to bud formation and vegetative to dough stages, respectively. The infestation of bud fly was noticed during bud initiation to dough stage. Patel (1996) reported that *C. indicus*, *M. persicae*, *H. armigera* and *D. lini* were found to feed during vegetative to podding, vegetative, vegetative to podding and bud formation stages, respectively, which substantiate the present findings on thrips, aphids, pod borer and bud fly, respectively. *A. ipsilon* usually damages the crops in their post germination stage and similar observations were made by Deshmukh et al. (1992). The larvae of *S. obliqua* and adults of *M. signata* were found to feed on the crop during vegetative to bud formation stage. Borah et al. (2005) also reported *S. obliqua* on linseed in Assam. Two species of flea beetle namely, *Aphthona euphorbiae* and *Longitarsus parvulus* were reported on linseed in British Isles by Rhynehart (1922) and Ferguson et al. (1997).

Population dynamics

The population of *A. ipsilon* varied from 0.20 to 1.00 larvae/ m² and maximum population was recorded during 52 SMW and the next peak observed during fourth SMW (Table 3). In case of thrips, three population peaks were observed during first, fifth and ninth SMWs wherein the population varied from 3.20 to 26.60 thrips/ plant. The population of aphids was maximum (2.40 aphids/plant) during eighth SMW. Eighth SMW also recorded maximum population of *H. armigera* (1.0 larvae/m²), *Oxyopes* sp. (1.0 spider/

Table 3. Population dynamics of insect pests and their natural enemies on linseed (rabi, 2016-17)

SMW	<i>A. ipsilon</i> (No. /m ²)	Thrips (No./plant*)	Aphids (No./plant*)	<i>H. armigera</i> (No. /m ²)	<i>Oxyopes</i> sp. (No./plant*)	Coccinellids (No./plant*)	Fresh bud fly infestation* (%)	Cumulative bud fly infestation* (%)
50	0.00	0.00	0.60	0.00	0.00	0.00	0.00	0.00
51	0.60	3.20	1.60	0.00	0.20	0.40	0.00	0.00
52	1.00	3.80	1.00	0.00	0.40	0.20	0.00	0.00
1	0.80	7.40	0.80	0.00	0.20	0.60	1.33	1.33
2	0.40	4.40	1.20	0.20	0.40	0.40	2.35	3.53
3	0.20	13.00	0.40	0.40	0.40	0.60	2.17	5.43
4	0.60	18.60	0.40	0.20	0.80	0.40	1.02	6.12
5	0.40	23.60	0.60	0.40	0.20	0.20	2.97	8.91
6	0.40	21.40	1.60	0.60	0.60	0.40	0.98	9.80
7	0.00	22.60	1.40	0.40	0.40	0.80	3.92	13.73
8	0.00	25.00	2.40	1.00	1.00	1.00	6.12	20.41
9	0.00	26.60	1.80	0.60	0.60	0.60	3.06	23.47
10	0.00	17.40	1.00	0.40	0.20	0.00	1.04	25.00
11	0.00	4.40	0.00	0.00	0.20	0.20	0.00	-
12	0.00	0.00	0.00	0.00	0.00	0.20	0.00	-

*Mean of five plants

plant) and coccinellids (1.0 lady bird beetle/ plant). The fresh bud fly infestation varied from 0.98 to 6.12% which was also maximum during eighth SMW. The maximum population of aphids, *H. armigera*, *Oxyopes* sp. and coccinellids, and fresh bud fly infestation were observed during 8 SMW, whereas in case of *A. ipsilon* and thrips, it was during 52 and 9 SMW, respectively.

Gupta (2012) also observed maximum fresh bud fly infestation and population of lady bird beetle during 8 SMW at Raipur (Chhattisgarh); maximum populations of thrips and spiders were during 10 and 9 SMWs, respectively. Sahu (1999) observed maximum population of aphids and spiders during 6 and 8 SMWs at Raipur (Chhattisgarh); and Humayun (2008) observed maximum population of *H. armigera* during 6 SMW.

The correlation coefficients with weather factors given in Table 4 reveal that the population of *A. ipsilon* showed highly significant positive correlation with minimum temperature ($r = 0.93$) and evening relative humidity ($r = 0.91$). Morning relative humidity ($r = 0.73$) and sunshine hours ($r = -0.81$) had significant positive and negative correlation with *A. ipsilon*, respectively. Maximum temperature ($r = 0.56$) had significant positive impact while evening relative humidity ($r = -0.60$) had significant negative impact on population of thrips. In case of aphids, the maximum temperature showed significant positive correlation ($r = 0.59$). Minimum temperature ($r = 0.83$) and morning relative humidity ($r = -0.82$) showed highly significant positive and negative correlations with the population of *H. armigera*, respectively.

Further, significant correlations with maximum

temperature ($r = 0.73$) and evening relative humidity ($r = -0.66$) were also found for *H. armigera*. The fresh bud fly infestation did not show any significant correlation. Both maximum ($r = 0.93$) and minimum temperatures ($r = 0.89$) had highly significant positive correlations and morning relative humidity ($r = -0.89$) showed negative correlation with cumulative bud fly infestation. Evening relative humidity ($r = -0.68$) had significant negative impact cumulative bud fly infestation. Among natural enemies, the population of spiders and coccinellids did not show any significant correlation with weather parameters. Sunshine hours had significant negative correlation ($r = -0.81$) with the population of *A. ipsilon*.

Dharia (2011) also observed that maximum temperature is positively correlated with the population of thrips infesting linseed, whereas morning relative humidity is negatively correlated and evening relative humidity is positively correlated at Raipur. In contrast, present study showed negative correlation between evening relative humidity and thrips' population. The correlations of spiders with weather factors obtained herein are substantiated by Dharia (2011), except for rainfall. Gupta (2012) found that the fresh bud fly infestation did not show any significant correlation with any weather factor, whereas cumulative bud fly infestation had positive correlation with maximum and minimum temperature and negative correlation with morning and evening relative humidity, which substantiate the present findings. Kumar et al. (2008) observed that the population of *H. armigera* is negatively correlated with temperature, relative humidity and rainfall which are contradictory to present findings.

Table 4. Correlation coefficients- insect-pests/ natural enemies vs. weather factors

Insect –pests/ natural enemies	Temperature (°C)		Rainfall (mm)	Relative humidity (%)		Sunshine (hours/ day)
	Maximum	Minimum		Morning	Evening	
<i>A. ipsilon</i>	0.31	0.93**	0.08	0.73*	0.91**	-0.81*
Thrips	0.563	0.21	0.13	-0.33	-0.60*	0.51
Aphids	0.593	0.51	-0.38	-0.45	-0.51	0.36
<i>H. armigera</i>	0.73*	0.83**	-0.05	-0.82**	-0.66*	0.26
Fresh bud fly infestation	0.31	0.27	-0.40	-0.25	-0.48	0.15
Cumulative bud fly infestation	0.93**	0.89**	-0.09	-0.89**	-0.68*	0.35
<i>Oxyopes</i> sp.	0.48	0.11	0.35	-0.11	-0.38	0.45
Coccinellids	0.09	-0.21	-0.17	0.02	-0.36	0.39

*Significant ($p=0.05$); **Highly significant ($p=0.01$)

ACKNOWLEDGEMENTS

Authors thank Dr Rachna R R, Scientist (Insect Systematics), ICAR-National Bureau of Agricultural Insect Resources, Bangalore for the identification of thrips.

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(Manuscript Received: April, 2019; Revised: August, 2019;
Accepted: August, 2019; Online Published: August, 2019)