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Influence of abiotic factors on activity of insect pests and their predators in sesame

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ABSTRACT

Study on population dynamics of sesame pests and their natural enemies was carried out at Agronomy farm, B. A. College of Agriculture, Anand Agricultural University, Anand (Gujarat) during summer and *kharif* 2015. Population of whitefly was higher in both summer and *kharif* seasons, whereas incidence of leaf webber was noticed only during *kharif* season. Population of other pests' viz., leafhopper, mirid bug and hawk moth as well as predatory fauna such as chrysopids, coccinellids and spiders were less during the study period. Peak activity of whitefly was observed during 17th standard week (4th week of April) and on 36th standard week (1st week of September) during summer and *kharif*, respectively. The activity of leaf webber reached to peak level during 38th standard week (3rd week of September) during *kharif* season. The maximum and minimum temperature, maximum vapour pressure, morning and evening wind direction as well as evaporation had highly significantly positive association, whereas minimum vapour pressure had significantly positive association with whitefly population on sesame in summer season. During *kharif* season, minimum vapour pressure and evening wind direction had significantly positive correlation.

Key words : Sesame, pest activity, predators, weather parameters, correlation

Sesame (*Sesamum indicum* Linnaeus), also known as the "queen of oil seeds", is an important oil seed crop grown in India. It contains approximately 52 to 57% oil and 25% protein (Smith *et al.*, 2000; Khan *et al.*, 2009; Umar *et al.*, 2010). India is the second largest producer of sesame seed with a production of 7,55,346 Metric Tons and Myanmar topped the ranking with 7,85,038 Metric Tons in 2019. However, in harvested area, India ranks first with 1,732,975 Hectares. In India, sesame production has increased from 746 Metric Tons in 2018 to 7,55,346 Metric Tons in 2019 (Anon., 2019_a). Export of this important oilseed crop has declined from 336.85 tonnes in 2017-18 to 312.00 tonnes in 2018-19 and import has increased from 26.27 tonnes (2017-18) to 87.54 tonnes (2018-19) (Anon., 2019_b). India produces a wide variety of sesame seeds varying in colour from white to red to black. The major Indian states producing sesame are Gujarat, West Bengal, Tamil Nadu, Andhra Pradesh, Madhya Pradesh and Maharashtra.

There is a great need to boost up the productivity of sesame but insect pests are one of the major constraints in enhancing it. This crop is reported to be damaged by 29 insect pests (Rai, 1976), however, due to the changed cropping pattern, the insect pest complex has increased to about 65 including one mite species (Ahuja and Bakhetia, 1995). Insect pests of sesame having national significance includes, leaf webber or roller and capsule borer, *Antigastra catalaunalis* Duponchel; gall fly, *Asphondylia sesame* Felt and leafhopper, *Orosius albicinctus* Distant. Insect pests *viz.*, sphinx moth or hawk moth, *Acherontia styx* Westwood; Bihar hairy caterpillar, *Spilosoma obliqua* Walker; red hairy caterpillar, *Amsacta albistriga* Walker; pod bug, *Elasmolomus sordidus* Fabricius; pentatomid bug, *Nezara viridula* (Linnaeus) and cotton aphid, *Aphis gossypii* Glover are of regional significance in India (Anon., 2014). These pests damage the crop at different stages of growth affecting both quality and quantity resulting in heavy loss (25 - 90%) in seed yield (Ahuja and Kalyan, 2002). Global changes, which include climate change among the wide range of anthropogenic and natural environmental variation could profoundly affect the population dynamics and status of insect pests of crops (Khaliq *et al.*, 2014). Therefore, it is imperative to study the population fluctuation of the crop pests in relation to weather parameters that largely direct the activity of

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a given species of insect pest. Keeping in view the economic importance of the crop and magnitude of the damage caused by various insect pests, the study on population build-up of major insect pests and their natural enemies in sesame was undertaken.

MATERIALS AND METHODS

A field trial was carried out at Agronomy farm, B. A. College of Agriculture, Anand Agricultural University, Anand, Gujarat during summer and *kharif,* 2015 on sesame variety G. TIL-3. The crop was raised by adopting the standard agronomical practices. Experiment was laid in an area of 20 × 10 m and with a spacing 45 × 10 cm. The whole experimental plot was divided into four sectors and five plants from each sector were selected for recording the observations. The plots were kept free from insecticidal spray throughout the crop period.

Incidence of different insect pests was recorded at weekly interval from germination to harvesting of the crop. For recording observations on number of nymphs and adults of sap feeders *viz.*, white fly, *Bemisia tabaci*; leafhopper, *Orosius albicinctus* and mirid bug, *Nesidiocoris tenuis*, three leaves (upper, middle and lower) from each five randomly selected plants were examined. Population of defoliators' *viz.*, leaf webber, *Antigastra catalaunalis* and hawk moth, *Acherontia styx* were recorded from five randomly selected plants per sector. Plants were critically observed at weekly interval from germination till harvesting of the crop. Natural enemies' *viz.*, coccinellids, chrysopids and spiders were also recorded from the randomly selected plants.

Data recorded on insect pests and meteorological parameters were statistically analysed. Correlation study was done in order to determine the population dynamics of insect pests and their natural enemies, the periodic mean incidence of the major insect pests and their natural enemies were worked out. Meteorological data during crop period was obtained from the Department of Meteorology, B. A. College of Agriculture, Anand Agricultural University, Anand. Simple correlation was computed between population of these insect pests, damage indices and abiotic factors *viz.*, evaporation, bright sunshine, rainfall, morning wind direction, evening wind direction, wind speed, maximum and minimum temperatures, maximum and minimum relative humidity and maximum and minimum vapour pressure.

RESULTS AND DISCUSSION

Population of whitefly was higher in both summer and *kharif* seasons, whereas incidence of leaf webber was noticed only during *kharif* season. Population of other pests like, leafhopper, mirid bug and hawk moth as well as predatory fauna such as, chrysopids, coccinellids and spiders were less during the study period.

Whitefly, B. tabaci

Activity of whitefly started from 9th standard week *i.e.* 1st week of March during summer and from 32nd standard week *i.e.* 2nd week of August during *kharif* and continued till harvest of the crop in both the seasons. Peak activity of the pest was during 17th standard week *i.e.* 4th week of April (2.52 whiteflies/ 3 leaves) and on 36th standard week (0.43 whitefly/3 leaves) *i.e.* 1st week of September during summer (Table 1) and *kharif* (Table 2), respectively.

The correlation coefficient analysis (Table 3) of whitefly population in summer season revealed that maximum and minimum temperature, maximum vapour pressure, morning and evening wind direction as well as evaporation had highly significantly positive association (r = 0.915**, 0.910**, 0.880**, 0.782**, 0.762** and 0.833**, respectively), whereas minimum vapour pressure had significantly positive relation (r = 0.602*) with whitefly population on sesame. In *kharif* season, minimum vapour pressure (r = 0.577*) and evening wind direction (r = 0.639*) had significantly positive association.

Earlier reports of higher populations of *B. tabaci* during 35th to 36th standard week reported by Ahirwar *et al.* (2009); Kumar *et al.* (2010) and Choudhary *et al.* (2015) strongly support the present findings.

Leafhopper, O. albicinctus

Population of *O. albicinctus* first appeared on sesame crop from 12th standard week *i.e.* 4th week of March and remained constant till 15th standard week *i.e.* 2nd week of April (Table 1). The pest reached to a peak level (0.25 leafhopper/ 3 leaves) on 18th standard week *i.e.* 1st week of May. Minimum incidence of leafhopper was observed during *kharif* (Table 2) and the activity was noticed only for few weeks. The pest first appeared (0.05 leafhopper/ 3 leaves) from 36th standard week (1st week of September) and reached the peak level (0.15 leafhopper/ 3 leaves) on 37th standard week (2nd week of September).

Ahirwar *et al.* (2009) and Choudhary *et al.* (2015)

Table 1 Population fluctuation of insect pests and natural enemies in sesame during summer, 2015

SMW	Month	Week	No. of sucking insect pests/ 3 leaves			No. of predators/ plant		
			Whitefly	Leafhopper	Mirid bug	Coccinellid	Chrysopid	Spider
9	March	1	0.20	-	-	-	-	-
10		2	0.58	-	-	-	-	-
11		3	0.82	-	-	-	-	-
12		4	2.00	0.10	0.40	-	-	-
13		5	2.12	0.10	0.30	-	-	-
14	April	1	2.28	0.10	0.20	-	-	-
15		2	2.30	0.10	0.10	-	-	-
16		3	2.46	0.05	-	0.05	0.10	-
17		4	2.52	0.20	-	0.05	0.05	0.05
18	May	1	2.50	0.25	-	0.05	0.10	0.05
19		2	2.44	0.15	-	0.05	0.05	0.05
20		3	2.38	0.10	-	-	-	0.05

noticed the higher incidence of *O. albicinctus* in between 32nd and 37th standard weeks.

Mirid bug, N. tenuis

The data (Table 1) on population of mirid bug indicated that, it appeared only for four weeks during crop period in summer with a population of 0.40, 0.30, 0.20 and 0.10 mirid bug/ 3 leaves during 12th, 13th, 14th and 15th standard weeks (4th and 5th week of March and 1st and 2nd week of April). Population of *N. tenuis* indicated that the activity was less in *kharif* season as well (Table 2). Pest appeared (0.10 mirid bug/ 3 leaves) during 37th standard week (2nd week of September) and disappeared in the 38th standard week (3rd week of September). However, the pest appeared again in the crop during 39th *i.e.* 4th week of September with a population 0.05 mirid bug per three leaves.

Leaf webber, A. catalaunalis

Population of leaf webber first appeared (2.10 larvae/ plant) on sesame crop from 32nd standard week *i.e.* 2nd week of August and continued till harvesting of the crop *viz.*, 43rd standard week (Table 2). The activity of *A. catalaunalis* gradually increased from 33rd standard week (3rd week of August) and reached to peak level (4.20 larvae/ plant) during 38th standard week (3rd week of September). Leaf damage caused by leaf webber was 20.13 per cent on sesame crop from 32nd standard week (2nd week of August) and continued till maturity of the crop (3rd week of October). Damage gradually increased and reached to peak (31.88 %) on 40th standard week (1st week of October). The flower damage was observed only for five weeks and it started from 38th standard week and continued till maturity of the crop (3rd week of October). Peak (30.08 %) flower infestation was noticed on 41st standard week (2nd week of October). The capsule damage was noticed only for five weeks which started from 38th standard week and continued till maturity of the crop (3rd week of October). The highest (28.87 %) capsule damage was recorded on 42nd standard week (3rd week of October).

Leaf webber showed non-significant positive correlation (Table 3) with minimum temperature, minimum relative humidity, maximum and minimum vapour pressure, morning and evening wind direction, wind speed, rainfall, bright sunshine and evaporation (r = 0.229, 0.351, 0.301, 0.385, 0.350, 0.340, 0.284, 0.415, 0.088 and 0.006, respectively). Negative but non-significant correlation was noticed between leaf webber population and maximum temperature (r = -0.269) and maximum relative humidity (r = -0.150).

Peak activity of *A. catalaunalis* was observed on sesame during 35th to 37th standard week (Ahirwar *et al.*, 2009 and Choudhary *et al.*, 2015). These reports are almost similar to the present findings.

Hawk Moth, A. styx

Incidence of hawk moth was not noticed during the summer season, however pest appeared in *kharif* season (Table 2). Incidence of hawk moth was very less and it appeared only for three weeks with a mean population ranging from 0.25 to 0.75 larvae/ plant during 38th to 40th standard weeks.

Activity of natural enemies in sesame

In summer season (Table 1), coccinellids and chrysopids were found during 16th to 19th standard

Table 2 Population fluctuation of insect pests and natural enemies in sesame during kharif, 2015

SMW	Month	Week	No. of sucking insect pests/ 3 leaves			No. of predators/ plant			No. of larvae/ plant		Damage (%) due to *A. catalaunalis*		
			Whitefly	Leafhopper	Mirid bug	Coccinellid	Chrysopid	Spider	Hawk moth	Leaf webber	Leaf	Flower	Capsule
32	Aug	2	0.18	-	-	-	-	-	-	2.10	20.13	-	-
33		3	0.26	-	-	-	-	-	-	2.38	21.98	-	-
34		4	0.32	-	-	-	-	-	-	2.56	23.30	-	-
35		5	0.40	-	-	-	0.05	0.10	-	3.06	25.58	-	-
36	Sep	1	0.43	0.05	-	-	0.05	0.05	-	3.70	29.06	-	-
37		2	0.42	0.15	0.10	-	0.03	-	-	4.08	31.13	-	-
38		3	0.40	-	-	0.05	-	-	0.75	4.20	31.38	22.82	20.76
39		4	0.35	0.10	0.05	0.10	0.03	0.10	0.50	4.00	31.53	26.23	23.57
40	Oct	1	0.30	0.10	-	0.05	0.10	0.10	0.25	3.38	31.88	27.53	27.46
41		2	0.26	0.05	-	0.05	0.05	0.10	-	3.02	30.36	30.08	28.68
42		3	0.20	-	-	0.05	0.03	0.10	-	2.18	27.87	28.23	28.87

Table 3 Correlation between abiotic factors and incidence of insect pests of sesame

Abiotic factors		Correlation coefficient (r)		
		Summer	Kharif	
		Whitefly	Whitefly	Leaf webber
Evaporation (mmday-1), EP		0.833**	0.153	0.006
Bright Sunshine (hrsday-1), BSS		0.550	-0.004	0.088
Rainfall (mm), RF		-0.486	0.292	0.415
Morning Wind Direction, WD1		0.782**	0.530	0.350
Evening Wind Direction, WD2		0.762**	0.639*	0.340
Wind Speed (Kmhr-1), WS		0.439	0.470	0.284
Temperature (0C)	Max	0.915**	-0.367	-0.269
	Min	0.910**	0.447	0.229
Relative Humidity (%)	Max	-0.376	-0.060	-0.150
	Min	-0.552	0.481	0.351
Vapour Pressure (mm)	Max	0.880**	0.513	0.301
	Min	0.602*	0.577*	0.385

* Significant at 5 % level
** Significant at 1 % level

week (3rd week of April to 2nd week of May). The spider population was noticed from 17th to 20th standard weeks (4th week of April to 3rd week of May). Population of chrysopid and spider remained constant (0.05 chrysopid/ plant and 0.05 spider/ plant) from 16th to 19th standard week (3rd week of April to 2nd week of May) and 17th to 20th standard weeks (4th week of April to 3rd week of May), respectively. Population of chrysopid fluctuated between 0.05 and 0.10 chrysopid per plant in alternative weeks.

During *kharif* season (Table 2), chrysopid and spider population was observed from 35th standard week (5th week of August), whereas, coccinellid from 38th standard week (3rd week of September) till harvesting of the crop (42nd standard week). Population of coccinellid remained constant (0.05 coccinellid/ plant) except during the peak (0.10 coccinellid/ plant) period. Chrysopid population fluctuated between 0.03 and 0.10 per plant with a peak of 0.10 chrysopid per plant. The mean spider population varied from 0.05 to 0.10 per plant.

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