Pakistan J. Zool., vol. 45(1), pp. 213-217, 2013.

Studies on Population Dynamics of Insect Pest of Safflower, *Carthamus tinctorius* L.

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Abstract.- Various factors such as habitat loss, pollution, environmental changes and chemical manipulation can change the biodiversity level of different insects. Insects have a variety of functions ranges from destructive to beneficial aspects. The insect population community was monitored in the safflower (*Carthamus tinctorius* L.) field located in research farm of National Agriculture Research Centre, Islamabad. The data were recorded weekly by visual count method on randomly selected whole plant basis at seedling, vegetative stage, and maturity of five varieties of safflower including SAF-31, SAF-32, SAF-35, SAF-38 and THORI-78. Population dynamics of four insect genera including jassid (A*mrasca bigutella bigutella),* aphid (*Uroleucon carthami*), lygus bug *(Lygus Hesperus* K.*)* and pod borer (*Helicoverpa armigera* Hub.); and two beneficial insect genera named green lacewing (C*hrysoperla chornea)* and ladybird beetle (*Coccinella septempunctata* Linn.) were monitored. The data revealed that among the safflower varieties SAF-38, THORI-78, SAF-31 and SAF-38 carried maximum population of jassid, aphids, bug and pod borer, respectively. Highly significant differences in population build up was evident at monitoring dates. Population percentage of aphid (85%) was highest followed by bug (4.2%), jassid (2.79%), pod borer (2.56%), green lacewing (1.01%) and ladybird beetle (0.60%). The aphid populations on all five varieties showed significantly positive correlation with temperature but negative correlation with relative humidity. Our results provide important information that the insurgence of insect population is influenced by crop cultivar, phenology of plant, time, temperature and humidity. These findings are useful for designing the effective integrated pest management of safflower insect pest.

Key words: Safflower, jassid, aphids, pod borers, lygus bug, lady bird beetle, population dynamics

INTRODUCTION

Safflower (*Carthamus tinctorius* L.) is an important oilseed multipurpose *rabi* crop (Singh *et al.*, 1999) in semi arid areas of India, Iran, Egypt, Pakistan and Mediterranean countries. Its common name in Pakistan is 'kusum' which is derived form Sanskrit word 'kusumbha'. Safflower belongs to family Compositae and is used mainly as a source of dye and oil (Chavan, 1961).

Safflower is a drought tolerant oil seed crop and has high adaptability to low moisture conditions. Therefore, its production all over the world is mainly confined to areas with limited water. In Pakistan, it is mainly cultivated in Sindh and Baluchistan provinces. It is grown on rice harvested land in upper Sindh and as an irrigated crop in lower Sindh. Therefore, it is recommended for planting in rainfed areas and can also be cultivated on residual moisture after rice. Safflower can produce a good crop on such soil by ploughing it up to a considerable depth (Chaudary *et al*., 1998). The area under safflower is about 49 thousand hectares with an annual production of 64 metric tons (Anonymous, 2007).

Safflower is under threat from a variety of insects pests which is a main cause for its low yield (Singh *et al*., 1999: Weiss, 1983). These include capsule fly (*Acanthiophilus helianthi* Rossi), pod borer (*Helicoverpa armigera* Hub.), and safflower aphid (*Uroleucon carthami* L.) (Karv *et al*., 1978). Aphid infestation appears at 40-50 days after sowing and remains throughout the crop growth (November to April) that resulted in 37% average yield depletion (Singh *et al.*, 1994, 1999; Narangalkar and Shivpuje, 1990). The adults are black colored, but nymphs are reddish brown and soft bodied insects measuring 1.5 to 2 mm in length (Rai, 1976). The predatory evidences of *Coccinella septempunctata* L. on safflower aphid have also been reported (Singh *et al.*, 1994). The gram pod

* Correspondence author: aries_web@hotmail.com
0030-9923/2013/0001-0213 $ 8.00/0

borer, a highly polyphagus defoliating pest to cause severe damage to safflower. (Anonymous, 1995; Rai, 1976). Enormous yield losses of 62.6 to 100% have been encountered due to excessive foliage feeding by larvae (Sekhar and Rai, 1989). Keeping in view the drastic attack of insect pests on Safflower crop, the present study was designed to investigate the population dynamics of safflower insect pests and their natural enemies on five varieties of Safflower.

MATERIALS AND METHODS

The experiment was conducted at the experimental area of Oilseed Research Program in National Agriculture Research Center, Islamabad, Pakistan. The population dynamics and distribution of safflower insect pests and their natural enemies was recorded. Five varieties naming SAF-31, SAF-32, SAF-35, SAF-38 and THORI-78 were sown in 2^{nd} week of November with three replications in Randomized Complete Block Design. Crop was planted in lines; there were three replications for each entry and each containing fifteen lines. The row to row distance was 0.45 m and plot size was 10 x 6.75 m^2. At the time of sowing fertilizers diammonium phosphate (DAP, 46% P_2O_5 and 18% nitrogen) and urea (46% nitrogen) was applied on experimental plots at the rate of one bag per acre. All recommended agronomic practices were strictly followed throughout the growing season uniformly for all test plots.

Random sampling method was adopted to select 25 plants from each block in which 5 plants were selected from each entry. A total 75 plants were selected randomly on week basis. Each entry had 3 replications as there were 3 blocks with one replication for each entry randomly in it. The plants were visually examined at weekly intervals for the presence of Insect pests. Visual count method was used to record the population of insect pests, their parasitoids and predators from the time of immigration to the crop and continued at weekly intervals until the collapse of population. Meteorological data (temperature, relative humidity and rainfall) were taken from the Agro-meteorological Center at National Agriculture Research Center, Islamabad. The insect pests population was recorded on all above ground parts of plant. The parasitism ratio was calculated by the formula: [% parasitism = total number of mummies/ total number of aphids + mummies × 100]. The predation ratio was calculated by the formula [% predation = total number of predators / total number of aphids × 100].

The Insect pests specimens were collected from the adjacent field and preserved in 70% alcohol in glass vials. All mummified aphids during the survey were collected and kept in vials with a piece of moist cotton at room temperature until the parasitoids emerged. The piece of cotton was changed daily to avoid the attack of fungus. Emergent parasitoids were killed by freezing and arranged on mounting cards for further identification. The aphid predators were also collected and preserved for identification. Aphids and parasitoids were identified in laboratory by the available running keys (Blackman and Eastop, 2000; Hayat, 1983) with the help of binocular. The data were analyzed by using statistical package of social studies (SPSS 12). Descriptive statistics (Sum, Mean, S.D. and S.E.) and analysis of variance (ANOVA) models were used for logical conclusion on the basis of their results.

RESULTS AND DISCUSSION

Population of different insect pests including safflower aphid, jassid, bugs and pod borer was recorded on five different varieties of safflower including SAF-31, SAF-32, SAF-35, SAF-38 and THORI-78 (Table I). The data regarding two beneficial insect genera named green lacewing and ladybird beetle were also monitored. The population of these insects was observed at different stages of the crop weekly. Population fluctuation with different date of observation was also recorded along with its correlation with biotic (predators and parasites) and abiotic (temperature, rain fall and humidity) factors.

Population dynamics of insect pests on safflower

*Safflower Jassid (*Amrasca bigutella bigutella*)*

Population of safflower Jassid on safflower varieties revealed significant differences among dates of observation whereas non-significant

Table I.- Comparison of population of jassid (*Amrasca bigutella bigutella)*, aphid (*U. carthami)*, *Lygus* bug and pod borer (*Helicoverpa armigera)* on different varieties of safflower.

Variety	Means of jassid population (nymphs and adults/ plant)	Means of aphid population (nymphs and adults/ plant)	Means of bug population (bugs/plant)	Means of pod borer population (larvae/plant)
SAF-38	**0.53 a**	5.17 a	0.29 bc	**0.567 a**
SAF-32	0.52 b	4.07 bc	0.38 ab	0.358 b
THORI-78	0.44 ab	**5.48 a**	**0.16 c**	0.397 b
SAF-31	0.42 ab	**3.26 c**	**0.42 a**	**0.258 b**
SAF-35	**0.11 c**	4.89 ab	0.37 ab	0.275 b
LSD at 0.05 %	0.0319	2.003	0.223	0.0361

ns, non-significant (P>0.05); *, significant (P<0.05); **, highly significant (P<0.01). The means under each insect population column sharing the same letter are not significantly different at P<0.05.

Table II.- Analysis of variance (ANOVA) for population of safflower insect pests (*Amrasca bigutella bigutella, U. carthamim Lygus* bug and *Helicoverpa armigera*) on five different varieties of safflower.

Source of variation	Population of jassid		Population of aphid		Population of *Lygus* bug		Population of pod borer	
	d.f.	Mean squares	d.f.	Mean squares	d.f.	Mean squares	d.f.	Mean squares
Replication	2	0.265^{ns}	2	17.193^{ns}	2	0.203^{ns}	2	0.815^{ns}
Week	6	7.536^{**}	20	4541.366^{**}	14	11.494^{**}	7	4.570^{**}
Varieties	4	0.711^{ns}	4	254.887^{**}	4	2.32^{**}	4	1.823^{**}
Week×Varieties	108	0.560^{ns}	80	94.0313^{**}	56	0.275^{ns}	28	0.187^{ns}
Error	488	0.373	1468	39.119	1048	0.485	558	0.408
Coefficient of variance	2.71%		1.57%		2.90%		3.21%	

ns, non-significant (P>0.05); *, significant (P<0.05); **, highly significant (P<0.01).

differences were found among varieties and interaction between varieties and dates of observation (Table II). Comparison of means regarding jassid population on five varieties showed that maximum population of jassid was observed on SAF-38 (0.53 jassids) and lowest was observed on SAF-35 (0.11 jassids) per plant (Table I).

*Safflower aphid (*Uroleucon carthami*)*

Studies on the population of safflower aphid exhibited highly significant differences in population supported by varieties and dates of observation (Table II). Significantly higher population on five varieties showed that maximum population of aphids was observed on THORI-78 (5.48 aphids) and lowest was observed on SAF-31 (3.26 aphids) per plant (Table I).

*Safflower bug (*Lygus hesperus *K.)*

Population of safflower bugs didn't differ significantly among varieties of safflower and dates of observations whereas highly significant differences were found among varieties and different dates of observations (Table II). SAF-31 (0.42 bugs) harboured more bugs as against the lowest of (0.16 bugs) on THORI-78 per plant (Table I).

*Safflower pod borer (*Helicoverpa armigera *Hub.)*

Population of *H. armigera* on five different varieties of safflower differed significantly on different dates of observations (Table II). Maximum population of *H. armigera* was observed on SAF-38 (0.6 larvae) as against (0.3 larvae) on SAF-31 (Table I). The previous studies on gram pod borer reported that it is a highly polyphagus pest and cause severe damage to safflower (Dhembare, 2001; Rai, 1976).

Population of different safflower insect pests

A total of 8449 Insect fauna was counted on

Table III.- Correlation of abiotic and biotic factors with safflower aphid population on five varieties of safflower.

Varieties	Maximum temperature (C°)	Minimum temperature (C°)	Average temperature (C°)	Relative humidity (%)	Rainfall (mm)	Aphid mummies	Predator
SAF-31	0.701*	0.620*	0.702*	-0.547*	-0.174ns	0.535*	0.615*
SAF-32	0.656*	0.595*	0.649*	-0.522*	-0.202ns	0.597*	0.118ns
SAF-35	0.586*	0.545*	0.578*	-0.464*	-0.194ns	0.317ns	0.545*
SAF-38	0.557*	0.499*	0.541*	-0.423ns	-0.196ns	0.295ns	0.540*
THORI-78	0.570*	0.525*	0.565*	-0.446*	-0.195ns	0.171ns	0.225ns

ns, non-significant (P>0.05); *, significant (P<0.05); **, highly significant (P<0.01).

the selected plants. Out of which, aphids constituted 85%, Jassid 2.79%, Lygus bugs 4.2% and pod borer were 2.56% whereas mummified aphids were 3.5%, C*hrysoperla chornea* 1.01% and *Coccinella septempunctata* were 0.60%. The previous studies also strengthened the data where safflower aphid, *U. compositae* was indicated as a predominant species appearing on safflower (Bhardwaj *et al*., 1990; Rathore 1983; Rai, 1976). It is also observed that the population of jassid, aphid, bug and pod borer was highest during November, March, February and May, respectively.

Correlation of safflower aphid with abiotic and biotic factors

Abiotic and biotic factors were correlated with the population of aphid, *U. carthami* on Safflower varieties. The population of aphids had positive and significant correlation with maximum temperature, minimum temperature as well as average temperature on five varieties of safflower. Whereas aphid had negative significant correlation with relative humidity and negative non significant correlation with rain fall (Table III). These results are in agreement with the previous findings that the population of aphids was positively correlated with temperature and negatively correlated with relative humidity (Mane *et al*., 2002). The aphid population on safflower was negatively correlated with a number of weather parameters *viz.*, morning and evening humidity and rainfall (Akashe *et al.*, 1995, 2008; Painkra *et al*., 2003). In contrast, a negative significant correlation was also reported between aphid population and minimum temperature (Bade and Kadam, 1993).

Aphid mummies have significant positive correlation with aphid population on SAF-31 and SAF-32 varieties while it has positive non significant correlation on rest of all varieties. Predator has significant positive correlation with aphid population on SAF-31, SAF-35 and SAF-38 while SAF-32 and THORI-78 has positive non significant correlation with aphid population. Similar results have been reported about a positive highly significant correlation between safflower aphids population and mummification of aphids per predatory coccinellid beetle (Vijay, 2002).

CONCLUSIONS

The data revealed that maximum population of jassid, aphid, bug and pod borer was recorded on SAF-38, THORI-78, SAF-31 and SAF-38, respectively. It is also concluded that based on population density of different insect pest, safflower aphid, *U. carthami* was the predominant serious pest of safflower crop. Aphid population on all five varieties had positive significant correlation with the temperature and negative correlation with relative humidity and rainfall.

ACKNOWLEDGEMENTS

The authors fully acknowledge the contributions of National Agriculture Research Council, Islamabad for providing the experimental facilities.

REFERENCES

AGOSTI, D., MAJER, J. D., ALONSO, J. E. AND SCHULTZ T. R., 2000. *Ants: Standard methods for measuring and*

monitoring biodiversity. Smithsonian Institution Press. Washington, D.C.

AKASHE V. B., GHADGE, S. M., GUD, M.A., INDI, D.V. AND DESHPANDE, A.N., 2008. Role of abiotic components on the development of safflower aphids. *J. Maharashtra Agric. Univ.*, **33**: 125-126.

AKASHE, V. B., DEOKAR, C. D., PATIL, M. W. AND SHEWALE, M. R., 1995. Seasonal incidence of aphid, *Uroleucon compositae* in safflower. *Adr. Agric. J.*, **82**: 232-233.

ANONYMOUS, 1995. *Annual Progress Report of All India Co-ordinated Research Project on Oilseeds, Rabi Oilseed* Research Workers Group Meeting-Workshop (Safflower and Linseed) August, Punjabrao Krishi Vidhyapeet, Akola (M.S.), pp. 28-31.

ANONYMOUS, 2007. *Action plan of Rabi, 2006-2007 Crop.* Dirtectorate General, Agric. Extension, Hyderabad, Pakistan.

BADE, B.A. AND KADAM, J.R., 1993. Effect of sowing dates and abiotic factors on incidence of safflower aphid *Uroleucon compositae* (Theobald). *Pl. Protect. Bull. Faridabad.*, **45**: 9-12.

BHARDWAJ, S.C., KUMAR A., BHARGAVAND G. K., AND RANA, B. S., 1990. Assessment of losses caused by insect pests in safflower (*Carthamus tinctorius* L.) *Indian J. appl. Ent.*, **4**: 61-70.

BLACKMAN, R. L., AND EASTOP, V. F., 2000. *Aphids on the world' crops: An identification and information guide*. Wiley-Blackwell, London.

CHAUDHRY, A. H., OAD, B. R. AND MEMON, M. H., 1998. Research and production of safflower (*Carthamus tinctorius*) in southern Pakistan: 57-66. In *Proceedings Second International Safflower Conference*, Hyderabad, India, 9-13 Jan. 1989 (eds. V. Ranga Rao and M. Ramachandran). Ind. Soc. Oilseeds. Res. Directorate of Oilseeds Research, Hyderabad, India.

CHAVAN, V. M., 1961. *Niger and safflower*. Indian Central Oilseeds Committee publication, Hyderabad, India, pp. 57-150.

DHEMBARE, A. J., 2001. Population dynamics of pod borer, *Helicoverpa armigera* (Hubner) on safflower. *J. exp. Zool.*, **4**: 331-332.

HAYAT, M., 1983. The genera of Aphelinidae (Hymenoptera) of the world. *Syst. Ent.*, **8**: 63-102.

KARV, A. D., MURUGKAR, V. K. AND QUADRI, S. M., 1978. *Assessment of yield loss (reduction) due to aphid infestation. Report on resistance of safflower* (Carthamus tinctorius L.) *to insect and disease*. Nimbkar Agric. Res. Inst., Phaltan, pp. 58-60.

MANE, P. D., KULKARNI, S. N., MUNDE, A. T. AND MORE, D. G., 2002. Population dynamics of safflower aphids. *J. S Cr.*,, **12**: 325-328

NARANGALKAR, A. L. AND SHIVPUJE, P. R., 1990. Estimation of crop losses due to aphids' in safflower. *J. Maharashtra Agric. Univ.*, **15**: 239-240.

PAINKRA, G. P., YADU, Y. K., AND DUBEY, V. K., 2003. Population dynamics of safflower aphid (*Dactynotus carthami* HRL) and its predators. *J. appl. Zool. Res.*, **14**: 178-180.

RAI, B.K., 1976. *Pests of oilseed crops in India and their control*. I. C. Agri. Res. pub, New Delhi, pp. 321.

RATHORE, V. S., 1983. Bionomics and management of safflower aphid. *Indian Farm.*, **33**: 32-33.

SEKHAR, P. R. AND RAI, P. S., 1989. Studies on the biology and occurrence of natural enemies of safflower caterpillar, *Prospalta conducta* Walker (Lepidoptera: Noctuidae) in Karnataka (India). *J. Res.*, **17**: 19-22.

SINGH, H., AHLAWAT, D. S. AND ROHILLA, H. R., 1994. Perspective of insect-pests management in oilseed crops. In: *Trends in agricultural insect pests management* (eds. G.S. Dhaliwal and R. Arora). Commonwealth Publishers, New Delhi, pp. 265-306.

SINGH, V., PRASAD, Y. G. AND LAKSHMINARAYANA, M., 1999. Insect pests of safflower and their management. In: *IPM system in agriculture. Oilseeds* (eds. K. Rajeev, Upadhyay, K.G., Mukerji and R.L. Rajak). Aditya Books Pvt. Ltd., New Delhi, India, 5, 552.

VIJAY, S., 2002. Studies on population dynamics of safflower aphid, *Uroleucon carthami* H. R. L. and its natural enemies. *J. appl. Zool.*, **13**: 183-184.

WEISS, E. A., 1983. *Oilseed crops*. Chapter 6. *Safflower*. Longman Group Limited, Longman House, London, UK, pp. 216-281.

(Received 7 July 2012, revised 16 December 2012)