Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2019; 7(5): 1088-1091

Received: 07-07-2019
Accepted: 12-08-2019

RL Kalasariya
Assistant Research Scientist, AINP on Pesticide Residues, ICAR, Unit-9, Anand Agricultural University Anand, Gujarat, India

BB Katariya
PG Institute of ABM, Junagadh Agricultural University, Junagadh, Gujarat, India

KD Parmar
Assistant Residue Analyst, AINP on Pesticide Residues, ICAR, Unit-9, Anand Agricultural University, Anand, Gujarat, India

Corresponding Author:
RL Kalasariya
Assistant Research Scientist, AINP on Pesticide Residues, ICAR, Unit-9, Anand Agricultural University Anand, Gujarat, India

Impact of weather parameters on population fluctuations of mustard leaf webber, *Crocidolomia binotalis* (Zeller) in reference to path co-efficient analysis

RL Kalasariya, BB Katariya and KD Parmar

Abstract
Investigation was conducted at the College Farm, College of Agriculture, Junagadh Agricultural University, Junagadh, Gujarat to study the effect of weather parameters on population fluctuation of leaf webber and role of abiotic factors influencing their population for consecutive two years during *rabi* season of 2012-13 and 2013-14. The results revealed that the direct effect of morning and evening relative humidity on larval population of leaf webber was negative and very high (r = -7.3552 and r = -3.2490, respectively) while it was positive and very high (r = 12.6507) by mean relative humidity. The direct effect of maximum temperature and bright sunshine hours were positive and very high (r = 2.4703 and r = 2.0583, respectively) while minimum temperature exhibited negatively high direct effect (r = -1.003) on larval population of leaf webber. Residual value indicated that all abiotic factors had a total combined effect of 41.77 present on population build-up of mustard leaf webber. It indicated that 58.23 per cent was through other unknown factors existing in the ecosystem during both seasons.

Keywords: Weather parameters, path co-efficient analysis, correlation, leaf webber

Introduction

Mustard, *Brassica juncea* (Linnaeus) Czern and Coss (family: cruciferae) is an important oilseed crop and a major source of edible oil. It is second most important oilseed crop of the world as well as India after groundnut and in India it occupies an area of 6652 million hectare with total production of 7109 million tonnes and productivity of 1069 kg/ha during 2016-2017. It is also important *rabi* oilseed crop in Gujarat and cultivated in 200 million hectares of area with total production of 303 million tonnes with productivity of 1515 kg/ha [7].

Mustard is widely cultivated in tropical and sub-tropical areas of the world. Globally, it is mainly cultivated in India, Canada, China, Pakistan, Poland, Bangladesh, Sweden and France. About 35% area of the total cultivated area of world is in India with 16% of shares in production. India is the 5th major mustard producing country and 4th major mustard consuming country in the world. Apart from that, various other initiatives have been taken to increase oilseed production in India, including mustard in order to meet domestic as well as global demand. Rajasthan contributes about 49% to the county's total mustard production, followed by Uttar Pradesh (11%), Haryana (11%), Madhya Pradesh (11%), Gujarat (6%), West Bengal (5%) and other districts (7%) [1].

According to, 38 insect pests are known to be associated with different stages of mustard growth in India. Among these, the leaf webber, *Crocidolomia binotalis* Zeller is a serious pest causing yield loss of 13.2 to 81.8 per cent [2 & 4]. Damage is caused mainly by the caterpillars. The caterpillars form silken web around the leaves. They feed upon the leaves making them completely skeletonised. They also feed on flower buds and bore into pods. Whereas, 13.2 to 81.8 per cent loss in yield was reported due to leaf webber [12]. However, with increase in cropping intensity and the changing patterns under different agro-climatic conditions, the pest complex of the crops has also been changed to a great deal. Seasonal abundance of insect pest provides not only information of initiation of the pest but also provides peak activity of particular pest. Biotic and abiotic parameters play a vital role in population build-up of insect pests. Correlation study helps in to provide either positive or negative association of pest population with biotic or abiotic factors. Combined as well as individual effect of abiotic parameters on population fluctuation of the pest can be measured through path coefficient

Analysis. It gives direct influence of particular parameter on pest population build-up as well as its indirect effect through other parameters [5].

In the present study the efforts have been made to study the direct and indirect effect of various abiotic parameters on population build-up of mustard leaf webber.

Materials and Methods

Field experiment was conducted to study on population dynamics of mustard leaf webber in field, the mustard variety "Gujarat Mustard-3" which recommended for this region was used for the experiment. The experiment was conducted at College farm, Junagadh Agricultural University, Junagadh, Gujarat (21.5018 °N, 70.4495 °E) during *rabi* 2012-13 and 2013-14. The crop was raised after following the standard agronomic practices in large plot and it was divided in to ten equal sectors (2.0 m x 2.0 m) considering one sector as one repetition. The plots were kept free from insecticidal spray throughout the crop period. Generally, the larval population of leaf webber was recorded at weekly interval from randomly selected five plants from each quadrate. Observations were recorded at weekly interval starting from the first week of sowing till the maturity of crop.

Correlation study

During the present investigation, the effect (direct as well as indirect) of nine different abiotic parameters *i.e.* maximum temperature (X_1), minimum temperature (X_2), mean temperature (X_3), relative humidity at morning (X_4), at evening (X_5), average relative humidity (X_6), sunshine hours (X_7), wind velocity (X_8) and evaporation (X_9) on the population build-up of mustard leaf webber was studied with the help of path co-efficient analysis.

Path co-efficient analysis

The association of larval population of leaf webber and different abiotic factors was ascertained by computing correlation co-efficient which gave strength and direction of association and provided the mutual association between the two characters (weekly average larval population and any one of the abiotic factors). The correlation, however, did not reflect actual contribution of individual abiotic factor on larval population and, therefore, it becomes difficult to determine the influence of a particular abiotic factor on the expressivity of dependent variable (weekly average larval population per plant), where confounding effects was encountered.

The path co-efficient analysis on the other hand, describes direct and indirect effects of each of the variable and gives the path in which an independent variable is affecting the dependent variable in a given set of independent variables.

A path co-efficient was obtained by solving simultaneous equation which represents the basic relationship between correlation and path co-efficient of the formula given below.

$$R_{iy} = P_{1y}.\ r_{i1} + P_{2y}.\ r_{i2} + \dots\dots\dots + P_{i}\text{-}1_{y}.\ r_{i,\ i-1} + \dots\dots\dots + P_{iy} + P_{i}{+}1_{y}.\ r_{i,\ i+1} + \dots\dots\dots + P_{ky}.\ r_{ik}.$$

for i = 1, 2,.......... k.

Where

P_{1y}, P_{2y}.......... P_{ky} are the co-efficient in the linear relation and are known as path co-efficient: r_{i1}, r_{i2},.......... r_{ik} are simple correlation co-efficient among independent variables (abiotic factors) and r_{iy} is the simple correlation co-efficient between i^{th} independent variable X_1 and dependent variable Y (average larval population per plant). P_{iy} is the direct effect of X_i on Y and P_{1y}. r_{i1}......... P_{i-1}, y ri, i-2' Pi + 1, y ri, i + 1.......... P_{ky} r_{ik} are indirect on X_i on Y through X_1, X_2, X_3... $X_{i-1'}$ $X_{i+1'}$.......... X_k'. Therefore, the simple correlation co-efficient (Total effect) between X_i and Y is the sum of direct and indirect effects of X_i on Y.

The residual variation which is the variation due to uncontrolled causes in dependent characters (larval population) was estimated by the following relationship.

$$\text{Residual effect } (P_{RY}) = \sqrt{1 - (P_{1y}.r1y + P_{2y}.r_{2y} + \dots\dots\dots + P_{ky}.r_{ky})}$$

The weekly weather parameters were obtained from meteorological observatory of Central Experimental Research Station, Junagadh Agricultural University, Junagadh. In order to study the effect of weather parameters on the population of mustard leaf webber, correlation between weather parameters and larval incidence worked out with the statistical analysis was done according to the methods of [10] for analysis of correlation co-efficient and for path co-efficient analysis [8 & 6].

Results and Discussion

The data present in (Table 1 & depicted fig. 1) indicated that maximum temperature exhibited non-significant correlation (r = 0.2783) but it exerted positively very high direct effect (2.4703) and minimum temperature having non-significant negative association (r = -0.0250) with larval population also had a negatively high direct effect (-1.003) on larval population, indicating an unfavourable individual influence in the population build-up of leaf webber. The mean temperature was found to have non-significant positive correlation (r = 0.1174) but it exerted negatively high direct effect (-1.0272) indicating unfavourable individual influence on the larval population build-up of leaf webber. The indirect effect of this parameter *i.e.* maximum, morning and evening relative humidity, bright sunshine hours and evaporation was found positive low to very high on larval population through almost all abiotic factor except minimum temperature, mean temperature, mean relative humidity and wind speed. The morning relative humidity exhibited non-significant negative correlation (r = -0.1009) but it exerted very high direct effect (-7.3552) and evening relative humidity having non-significant positive association (r = 0.0346) with larval population also had a very high direct effect (-3.2490) on leaf webber population indicating unfavourable individual influence on the population build-up of leaf webber. The mean relative humidity was found to be non-significant negative correlation (r = -0.0423) but it exerted positively very high direct effect (12.6507) indicating most favourable individual influence on the population build-up of leaf weeber. The individual effect of this parameter *i.e.* morning, evening and mean relative humidity was found negative low to very high on leaf webber, almost all the abiotic factors except minimum temperature, mean temperature, mean relative humidity and wind speed. The bright sunshine hours and evaporation was found to have positively very high and low direct effects (2.0583 & 0.2523), indicating most favourable individual influence on the population build-up of leaf webber. This parameter *i.e.* bright sunshine hours and evaporation exhibited positively low to very high indirect effects on larval population through abiotic factors except minimum temperature, mean temperature, mean relative humidity and wind speed. The direct effect of wind speed was found to be negatively low (-0.2478), indicating a unfavourable individual influence on the population build-up of leaf webber. This parameter exhibited positively low to moderate indirect effects on larval population through almost all other abiotic factors except mean temperature and mean relative humidity but morning relative humidity was found to have positively very high indirect effect (1.6816), indicating most favourable influence on the larval population build-up of leaf webber.

Among all the weather factors, the minimum temperature, morning relative humidity, evening relative humidity and wind speed were found to be negative and low to very high direct effect on larval population of leaf webber, indicating that increase in minimum temperature, mean temperature, morning as well as evening relative humidity and wind speed would decrease the larval population of leaf webber but positively very high direct effect of maximum temperature, mean relative humidity and bright sunshine hours on larval population were found favourable for fast multiplication and dispersal of mustard leaf webber. The larval population of leaf webber is affected greatly by different weather factors that fluctuate at various crop growth stages. This clearly indicates that these two factors play a crucial role in the population build-up and survival of the leaf webber successfully. The clumping nature of the population of *C. binotalis* was entirely due to physical factors such as temperature and humidity, which shows that there were positive and negative correlations, respectively [14]. The larval population of leaf webber was showed negatively correlated with sunshine hours on cabbage [3] and positively correlated with maximum temperature [11]. The weather parameters (maximum temperature & bright sunshine hours showed a positive non-significant correlation with larval population [9 & 13].

Residual value present (Table 1) indicated that all these abiotic factors had a total combined effect of 41.77 per cent on population build-up of mustard leaf webber. It indicated that 58.23 per cent effect was through other unknown factors existing in the ecosystem. Weather plays an important role in agricultural production. It has a profound influence on crop growth, development and yields and incidence of pests.

Table 1: Pooled data on direct and indirect effect of key abiotic factors on population build-up of mustard leaf webber, *C. binotalis* during both seasons (*Rabi* 2012-13 & 2013-14)

Abiotic factors	Temperature (ºC)			Relative humidity (%)			Bright sunshine hours	Wind speed (km/hr)	Evaporation (mm)	Correlation with Leaf webber population
	Maximum	Minimum	Mean	Morning	Evening	Mean				
Maximum temperature	**2.4703**	-0.6903	-0.9218	2.7319	1.8644	-6.1202	0.8966	-0.0901	0.1375	0.2783
Minimum temperature	1.7047	**-1.003**	-0.9642	0.9589	0.6837	-2.2015	0.7469	0.0175	0.0294	-0.0250
Mean temperature	2.2168	-0.9389	**-1.0272**	1.8867	1.3055	-4.2593	0.8827	-0.0323	0.0834	0.1174
Morning relative humidity	-0.9175	0.1304	0.2635	**-7.3552**	-2.6658	12.1900	-1.7350	0.0567	-0.0680	-0.1009
Evening relative humidity	-1.4176	0.2105	0.4127	-6.0350	**-3.2490**	11.9359	-1.7963	0.0720	-0.0987	0.0346
Mean relative humidity	-1.1951	0.1741	0.3458	-7.0873	-3.0654	**12.6507**	-1.8461	0.0665	-0.0856	-0.0423
Bright sunshine hours	1.0760	-0.3630	-0.4405	6.1997	2.8354	11.3467	**2.0583**	-0.0396	0.0181	-0.0023
Wind speed (km/hr)	0.8985	0.0706	-0.1339	1.6816	0.9438	-3.3960	0.3286	**-0.2478**	0.0976	0.2430
Evaporation (mm)	1.3463	-0.1164	-0.3397	1.9814	1.2709	-4.2908	0.1477	-0.0959	**0.2523**	0.1559

* Significant at 5 per cent level (r = 0.497) n=14

** Significant at 1 per cent level (r = 0.623) Residual = 0.5823 $R^2 = 0.6609$

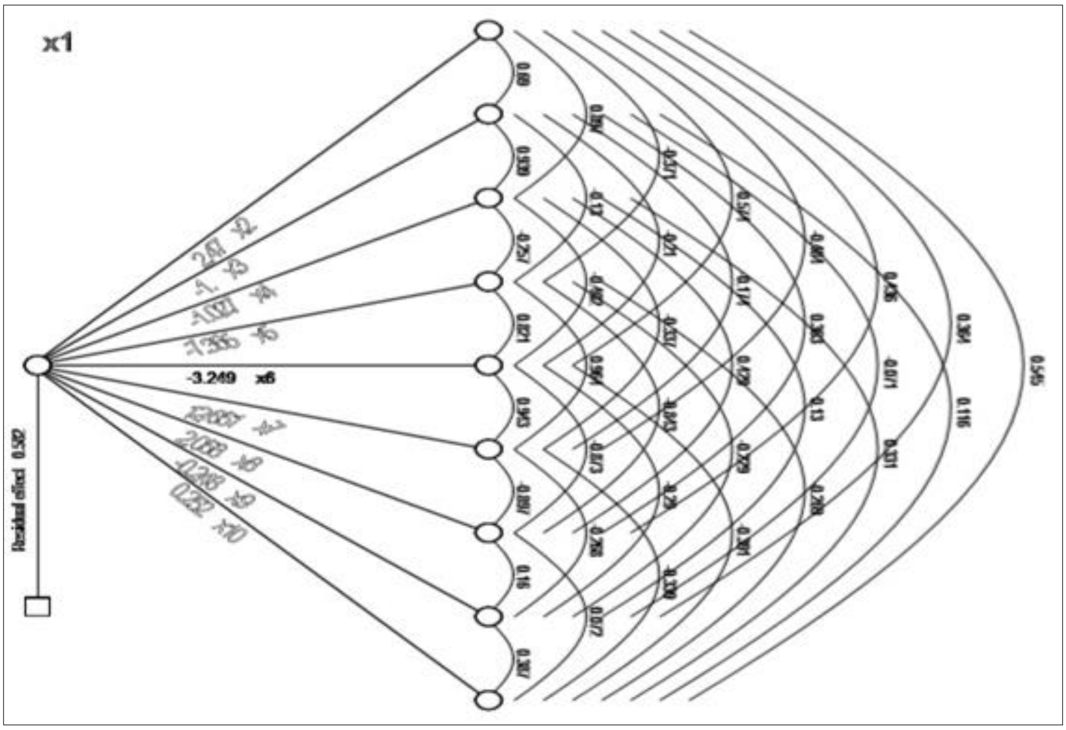

Fig 1: Direct and indirect effect of key abiotic factors on population build-up of mustard leaf webber, *C. binotalis* during both seasons (*Rabi* 2012-13 & 2013-14)

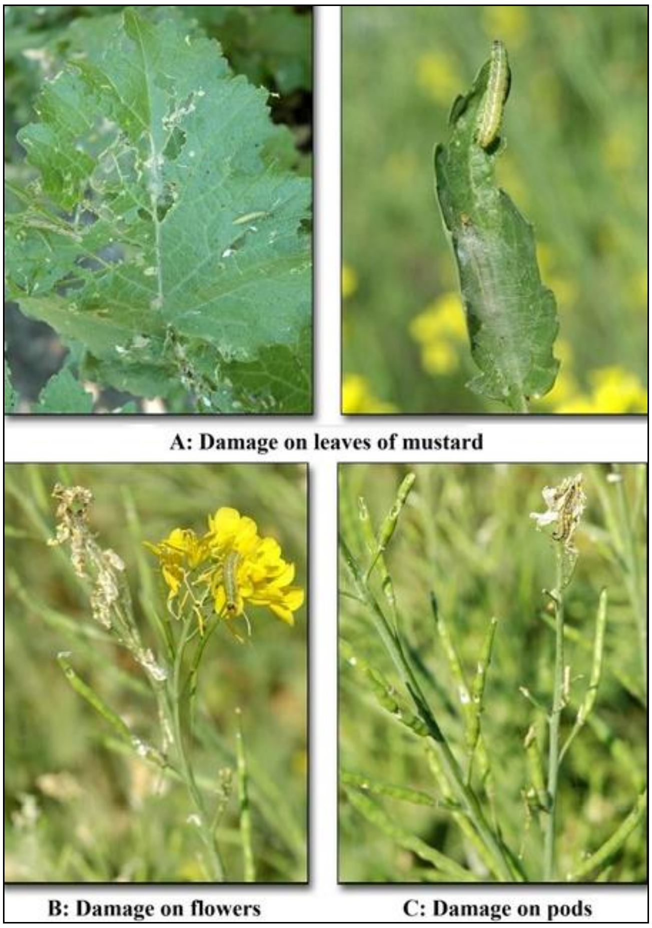

Fig 2: Damage of *C. binotalis* at different stages of mustard crop

Acknowledgement

The authors are thankful to the Dr. K. L. Raghvani, Retd. Professor & Head, Department of Entomology, Junagadh Agricultural University, Junagadh (Gujarat) for providing necessary facilities, valuable suggestions and encouragement during the course of investigation

References

1. Ashwini Darekar, Amarender Reddy A. Oil seeds price forecasting: case of mustard in India. Agricultural Situation in India, 2018, 31-37.
2. Bakhetia DRC, Sekhon BS. Insect pests and their management rapeseed and mustard. Journal of Oilseeds Research. 1989; 6:269-273.
3. Chaudhuri N, Ghosh S, Ghosh J, Senapati SK. Incidence of insect pests of cabbage in relation to prevailing climatic conditions of Terai region. Indian Journal of Entomology. 2001; 63(4):421-428.
4. Kalasariya RL. Management of aphid, *Lipaphis erysimi* in mustard with different spray schedules. Indian Journal of Plant Protection. 2016; 44(1):16-23.
5. Kalasariya RL, Parmar KD. Effect of weather factors on population fluctuations of mustard aphid (*Lipaphis erysimi* Kaltenbach) using path co-efficient analysis. Journal of Agrometeorology. 2018; 20(1):46-49.
6. Kalasariya RL, Parmar KD. Population dynamics of the mustard sawfly, *Athalia lugens proxima* (Klug). Indian Journal of Entomology. 2019; 81(1):159-162.
7. Kalasariya RL, Parmar KD. Management of painted bug, *Bagarada hilaris* (Burmeister) in mustard with different spray schedules. Journal of Entomology and Zoology Studies. 2019; 7(3):1157-1163.
8. Nagesar Rao G. Statistics for agriculture sciences. Oxford and IBH publication. Co. New Delhi, 1983, pp. 376.
9. Pawar VR, Bapodra JG, Joshi MD, Ghadge SM. Population dynamics of leaf webber, *Crocidolomia binotalis* (Zeller) on Mustard, International Journal of Plant Protection. 2010; 3(1):130-131.
10. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. ICAR, New Delhi, 1985, 381.
11. Rao JR, Babu BR, Krishnayya PV. Correlation of weather parameters with the insect Pests incidence on cauliflower. Crop Research, Hissar. 2003; 25(2):341-346.
12. Reddy AS, Ali MH. Chemical control of mustard leaf webber, *Crocidolomia binotalis* (Zeller). Journal of Oilseeds Research. 1977; 7:19-21.
13. Rahul SS. Varietal screening and population dynamics of major insect pest of mustard. M.Sc. Thesis, VNMKV, Parbhani, 2014.
14. Suman CL, Wahi SD, Prasad VG. Distribution behavior of cabbage leaf webber. Indian Journal of Agriculture Research. 1980; 50(10):785-787.