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Population dynamics of painted bug and sawfly in mustard based on meteorological parameters in semi-arid eastern plain of Rajasthan

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Abstract

The impact of meteorological parameters on the population of painted bug, *Bagrada hilaris* (Burmeister) and sawfly, *Athalia lugens proxima* (Klug) was studied at the research farm of Rajasthan Agricultural Research Institute, Durgapura, Jaipur, during *rabi* 2020–21 and 2021–22. The correlation coefficients with the pooled data, showed a substantial positive significant correlation of painted bug and sawfly population with maximum and minimum temperature (r=0.725* and 0.749*) and (r=0.487* and 0.535*) respectively. Painted bug and sawfly had negative correlation with average relative humidity (r = -0.599* and -0.366) and total rainfall (-0.275 and -0.205) respectively. On the basis of principle component (PC) 1 and 2 the most significant variables for painted bug and sawfly larvae are abiotic factors as maximum and minimum temperature.

Keywords*: Athalia lugens proxima, Bagrada hilaris, meteorological parameters, principle component analysis, regression*

Introduction

Brassica juncea (L.) Czern & Coss, also known as Indian mustard, is a member of the mustard family of plants, or *Brassicaceae* (Cruciferae). Along with four other closely related cultivated species, *Brassica rapa, B. napus, B. carinata,* and *Eruca sativa*, it is referred to as rapeseed-mustard in the trade. In India rapeseed-mustard accounted for an area 6.78 million hectare, production 9.12 million tonnes and yield 1345 kg ha^{-1} with four major producing states are being Rajasthan, Haryana, Uttar Pradesh and Madhya Pradesh (Anonymous, 2020). Rajasthan is leading state with the share of 46.28 per cent of overall production of mustard (Anonymous, 2021). The attack of numerous insect pests poses a serious threat to the production of mustard. *Bagrada hilaris* (Burm) (Hemiptera: Pentatomidae) and *Athalia lugens proxima* (Klug) (Hymenoptera: Tenthredinidae) were economic important pests in the production of mustard. Painted bug, *B. hilaris* is active throughout the crop growing season, from seedling to harvest. Crop losses are caused by this bug is due to both adults and nymphal stages. The bugs consume tender, young leaves. Nymphs and adults both consume the sap from leaves and seed, which reduced oil content of seed. It was estimated, to loss of 26.84 to 70.0 per cent in crop grain yield and a reduction of 2.75 per cent in oil content in mustard (Kalasariya and Parmar, 2016). Sawfly, *A. proxima* is also active through seedling stage and estimated to average 25 per cent decrease in yield due to this pest, but under certain conditions where the pest population is flourishing, this decrease in yield can reach 100 per cent (Patel *et al.*, 2018). Hence, and experiment was planned to study the effect of abiotic factors on insect pests of mustard.

Materials and Methods

The impact of meteorological parameters on the population of painted bug, *Bagrada hilaris* (Burmeister) and sawfly, *Athalia lugens proxima* (Klug) was studied at the research farm of Rajasthan Agricultural Research Institute, Durgapura, Jaipur, during *Rabi*, 2020–21 and 2021–22. Mustard variety Varuna (T-59) was sown on 24th and 27th October during two consecutive seasons *i.e.*, *Rabi* 2020-21 and 2021-22, respectively in simple layout of five plots with the dimension of 4.0 x 3.0 m^2 and R x P (30 x 10 cm) and left for natural infestation of insect pests. Population of painted bug and sawfly were recorded from selected and tagged five plants from each plots and meteorological data collected weekly from agromet observatory are correlated. Principal component analysis and stepwise liner regression were analysed by using 'R' software (R-Studio) for explained the type and degree of relationships between various variables and it help for reduced the dimensions of the data.

Results and Discussion

Expansion of pest population

Painted bug and sawfly

Pooled data of two crop seasons during *Rabi* 2020-21

Table 1: Population dynamics of painted bug and sawfly on mustard with meteorological parameters of Pooled *Rabi* 2020-21 and 2021-22

	SMWPooled *Rabi* 2020-21 and 2021-22					
	Temperature °C		Relative humidity (%)	Total rainfall (mm)	Painted bug (nymph and adult)	Sawfly (grubs/ five plants)
	Max.	Min.				
45	30.55	13.25	40.75	0.00	1.18	2.04
46	27.80	12.75	46.75	5.50	3.00	1.60
47	27.10	13.15	42.00	0.40	4.30	3.24
48	26.95	12.15	54.25	1.60	4.40	2.50
49	27.05	11.15	54.50	0.20	2.60	1.50
50	24.15	11.35	56.00	0.00	1.00	0.30
51	22.75	6.75	45.00	0.00	0.00	0.00
52	22.00	8.35	53.25	1.60	0.00	0.00
1	20.75	11.00	69.25	7.50	0.00	0.00
2	19.15	7.95	68.25	8.30	0.00	0.00
3	21.60	7.60	64.75	0.00	0.00	0.00
4	20.70	6.85	61.75	4.60	0.00	0.00
5	24.25	8.40	54.75	0.00	0.00	0.00
6	25.00	9.50	54.25	0.00	0.40	0.00
7	27.25	11.95	48.00	0.00	2.20	0.00
8	29.45	13.15	38.50	0.00	5.50	0.00
9	29.90	13.95	42.25	0.00	10.20	0.00

and 2021-22 reveled that the painted bug can be seen in two stages of the crop *i.e.* at the seedling and stage just before crop maturity. First generation of painted bug began to appear from 45 to 50th SMW with 1.18 bug average per five plants and second from 6 to 9th SMW with 0.40 bug average per five plants.

Pal *et al.* (2020) and Sharma (2016) were found that painted bug appeared in two stages of crop season. Pal *et al.* (2020) found the first generation of painted bugs from 45th to 52nd SMW and the second generation from 6th to 12th SMW were similar to the current findings, as were Sharma (2016)'s findings from the 44th to 48th and 9th to 13th SMW. Similarly, sawfly also first appeared at seedling stage, with 2.04 grub average per plant from 45th SMW and reached its extreme population during 47th SMW with 3.24 grub average per plant. The sawfly population began to decline after the extreme population grade and its population completely vanished till 50th SMW. Kumar (2021) reported sawfly at seedling stage of crop. Singh *et al.* (2018) and Sharma (2016) reported peak of sawfly population at 48th SMW, present study results were in agreement with their findings (Table 1).

Principal component analysis (PCA)

In the PC1 and PC2 correspondingly, the dimensions of the data were 62.02 and 17.41 percent (Fig. 1) The PCA variables fall on the same and opposite side of the axis and distances between variables indicate degrees of

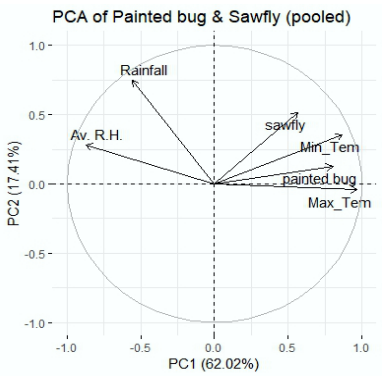

Fig. 1: Variables of principle components analysis.

significance, longer distance of variables indicate less degrees of significance. The figure indicated the maximum and minimum temperatures are strongly correlated with painted bug and sawfly which were fall on the same side of axis and less distance of variables. Based on PC variables length and distance concluded that the meteorological parameters as maximum and minimum temperatures are the important factor of fluctuation in population of painted bug and sawfly larvae.

Abiotic factors' effects on population growth painted bug

On the basis of pooled data, painted bug had a significant positive correlation with maximum and minimum

Table 2: Correlation coefficient of painted bug and sawfly, in relation to meteorological parameters during Pooled *Rabi*, 2020-21 and 2021-22

S. No.	Weather parameters	Pooled *Rabi* 2020-21 and 2021-22	
		Painted bug	Sawfly
1.	Temperature (°C)		
	a. Maximum temperature	0.725*	0.487*
	b. Minimum temperature	0.749*	0.535*
2	Average relative humidity (%)	-0.599*	-0.366
3	Total rainfall (mm)	-0.275	-0.105

*Significant at 5 per cent level, NS = Non significant

temperature (r = 0.725 and 0.749). Sharma (2016) and Yadav (2020) were studies correlation between temperature and painted bug, and found positive significant correlation which agreement present findings. Kalasariya and Parmar (2016) and Singh *et al.* (2018) also found positive correlation with maximum temperature and painted bug which corroborated the present findings. Painted bug had negative correlation with average relative humidity (r = -0.599) and rainfall (r = -0.275) which were supported by the findings of Sharma (2016) and Yadav (2020) (Table 2).

Sawfly larvae

Sawfly had positive correlation with maximum and minimum temperature (r = 0.487 and 0.535), Sharma (2016) found positive correlation with maximum temperature which agreement present findings. Kumar (2021), Yadav (2020) and Sharma (2016) were found negative correlation between sawfly and minimum temperature which do not support the current findings. Sawfly had negative correlation with average relative humidity (r = -0.366) and rainfall (r = -0.105). Similar findings were also reported by Kumar (2021) indicated negative correlation of sawfly between average relative humidity and rainfall (Table 2).

Regression analysis

The pooled data from two *Rabi* seasons 2020-21 and 2021-22, the regression models for the mean painted bug and sawfly larvae population indicated variations in minimum temperature of 53 and 24 per cent, respectively (Table 3). Based on the stepwise regression equation, it was clear

Table 3: Stepwise linear regression coefficients and equation of painted bug and sawfly, in relation to meteorological parameters during Pooled *Rabi,* 2020-21 and 2021-22

Particulars	Regression equations	R^2
Painted bug	$Y= -6.882^{**} + 0.846T_{min}^{***}$	0.53
Sawfly	$Y= -1.803 + 0.233^{*}T_{min}$	0.24

Significant levels at, * = 0.01 %, ** = 0.001 %. and *** = 0%, T_{min} = Minimum temperature

that the population of painted bug was influenced by meteorological characteristics. The computed model for the prediction of the population fluctuation is in corroboration with models earlier developed by Singh (1996) as it was noticed that combined action of all the abiotic factors contributed to 92.81 and 93.82 per cent variations in the population dynamics of *B. hilaris*. Singh *et al.* (2018) contributed to 72 per cent variations in the population dynamics of *A. proxima*.

Conclusion

During the cropping season, the painted bug population peaked twice: once when it was at seedling and second when it reached maturity. Sawfly larvae also appeared in the mustard field at the seedling stage and suck sap of the plants. Painted bug and sawfly larvae had positive significant correlation with maximum and minimum temperature, and negative correlation with average relative humidity and rainfall during the experimentation period of *Rabi* 2020-21 and 2021-22. The results of principal component analysis and regression analysis showed that the population of *A. proxima* and *B. hilaris* varied significantly in terms of temperature (maximum and minimum) that were important for the development of the bug and larval populations.

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References

Anonymous. 2020. Agricultural Statistics at a Glance 2020. (www.agricoop.gov.in).

Anonymous. 2021. Rajasthan Agricultural Statistics at a Glance 2020-21. (www.agriculture.rajasthan.gov.in).

Kalasariya RL and Parmar KD. 2016. Effect of abiotic factors on population fluctuations of mustard painted bug (*Bagrada hilaris* Burmeister) using path co-efficient analysis. *J Exp Zool India* **19**: 1485-1490.

Kumar A. 2021. Study on incidence of insect-pests of rapeseed in Bundelkhand region. (Master's thesis, Banda University of Agriculture and Technology, Banda).

Pal DS, Singh DK, Kumar A and Singh S. 2020. Seasonal incidence of insect pests on rapeseed-mustard. *Int J. Curr Microbiol Appl Sci* **9**: 2525-2531.

Patel S, Yadav SK and Singh CP. 2018. Foraging behaviour of mustard sawfly, *Athalia lugens proxima* Klug. on rapeseed-mustard. *J Exp Zool India* **21**: 379-381.

Patel GP, Jhala RC and Shekh AM. 2000. Population dynamics of sawfly, *Athalia lugens proxima (*Klug.) in relation to weather parameters in radish crop. *J Agrometeorol* **2**: 93-95.

Sharma N. 2016. Studies on integrated management of mustard aphid, *Lipaphis erysimi* (Kaltenbach). (Doctoral thesis, Rajmata Vijayaraje Scindia Krishi Vishwavidyalaya, Gwalior).

Singh H. 1996. Studies of seasonal abundance, extent of losses and biology of painted bug, *Bagrada hilaris* (Brumeister) on different hosts. (Doctoral thesis, Chaudhary Charan Singh Hisar Agriculture University, Hisar).

Singh S, Kumar S, Singh J, Dohare APS, Kumar P and Lal MN. 2018. Population dynamics of painted bug (*Bagrada hilaris*), in different varieties of brassica oil seed crops. *Int J Curr Microbiol Appl Sci* **7**: 3682-3685.

Singh VV, Agarwal N, Sathish BN, Kumar S, Kumar S. and Pal K. 2018. Studies on insect diversity in mustard (*Brassica campestris* L.) ecosystem. *J Entomol Zool* **6**: 698-702.

Soni S, Kumar S, Sood AK and Rana RS. 2021. Modeling of aphid complex and its associated natural enemies in rapeseed-mustard in relation to climatic factors. *J Agrometeorol* **23**: 207–212. doi: https://doi.org/10.54386/jam.v23i2.70.

Yadav AK. 2020. Studies on seasonal abundance of insect-pests of rapeseed mustard and field efficacy of botanicals against mustard aphid *Lipaphis erysimi* (Kalt.). (Master thesis, Acharya Narendra Dev University of Agriculture & Technology, Ayodhya).

Yadav RV, Kumar V and Saxena R. 2023. Population dynamics of aphid and their natural enemies in mustard based on meteorological parameters using principal component analysis. *J Agrometeorol* **25**: 458-461. doi: https://doi.org/10.54386/jam.v25i3.2209.