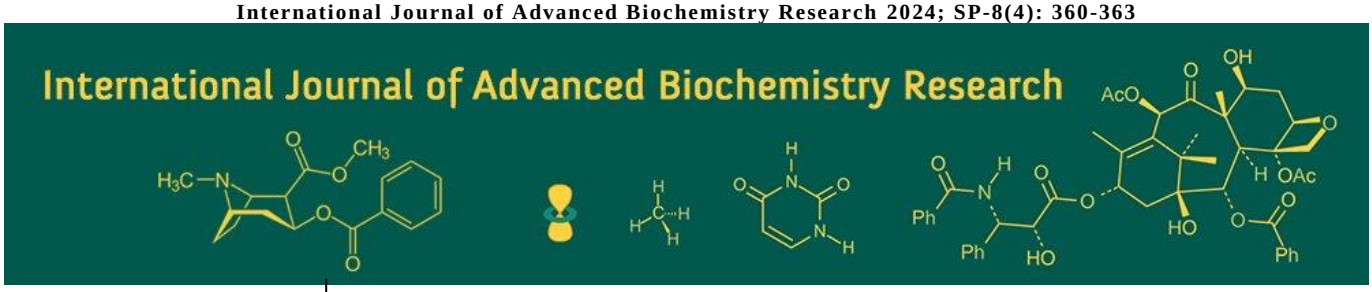

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PCRA based study of weather parameters on seasonal incidence of mango mealy bug, *Drosicha mangiferae* (Green)

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Abstract
The present investigation was carried out during the fruiting season 2021 and 2022 at the Horticulture Research Centre, GBPUA&T, Pantnagar. The incidence of *Drisicha mangiferae* on mango was slightly higher in 2022 (15.67±0.79 adults/three leaves) as compared to 2021 (13.84±0.65 adults/three leaves). Mango mealy bug populations showed significant positive correlation with maximum temperature and evaporation while being positively correlated with minimum temperature, sunshine and wind velocity. Major factors *viz.*, Maximum temperature, relative humidity, sunshine, and evaporation influencing the *D. mangiferae* population build-up were predicted using the PCRA technique with reasonable accuracy (R^2 =0.91).

Keywords: Abiotic factors, *D. mangiferae*, PCRA, population

Introduction
Horticultural crops are vital to human nutrition, disease prevention and contributing to the nation's development and prosperity (Tuteja, 2013) [11]. Among which mango (*Mangifera indica* Linnaeus) is associated with love, abundance, and good fortune in Indian mythology making them an integral part of festivals and rituals. India is the leader in mango production (20,946 thousand MT) during 2021-22, which accounts for more than 40 percent of global mango production (MoA&FW, 2022) [6]. It is grown in vast range of agro climatic condition and attacked by four to five key pest *viz.*, thrips, leaf gall midge, mango hoppers, mealy bug and fruit flies which are of major concern in Tarai region of Indian western Himalaya. Mango mealy bug (*Drosicha mangiferae*) (Hemiptera: Margarodidae), is a cryptic, destructive and polyphagous pest found throughout India and its neighbouring countries (Rao *et al.*, 2006; Arora and Gupta, 2021) [8, 2]. It adversely influences fruit yield both quantitatively and qualitatively due to its infestation by nymphs and female bugs on roots, tender leaves, twigs, inflorescence and fruits. Additionally, their excretion of honeydew leads to the subsequent development of sooty mould. (Bhagat, 2004 and Ibrahim *et al.*, 2021) [3, 5]. Severe infestation often leads to fruit drops or makes them unfit for marketing. The climate is an extrinsic integrative factor plays a crucial role in determining the abundance and distribution of insect pest population. It also observed that abiotic factors are believed to be responsible for pest population dynamics. The present investigation aims to find out influence of weather parameters on the population dynamics of *D. mangiferae*, which could helps in providing the baseline information for the prediction on seasonal population build-up and their management.

Materials and Methods
The present investigation on seasonal incidence of mango mealy bug was conducted during the fruiting season of 2021 and 2022 at the Horticulture Research Centre, G.B. Pant University of Agriculture and Technology (29.50°N, 79.30°E). The recommended orchard management practices were followed and insecticide application was avoided for ascertaining the population of mealy bug. Ten mango trees cv. Dasheri, aged 10-15 years, were randomly selected for this study. Five panicle or twig per branch from each direction (North, South, East and West) were selected for counting of mealy bug in the morning hours

(6-9 am) at weekly intervals. Meteorological data was collected from Department of Agrometeorology, College of Agriculture, G.B. Pant University of Agriculture and Technology (Fig: 1a & 1b). Statistical tools like Principal Component Regression Analysis (PCRA), SPSS (Version 26, SPSS, Inc. Chicago, II, USA) and R program was used to develop Regression equation for prediction of *D. mangiferae* incidence.

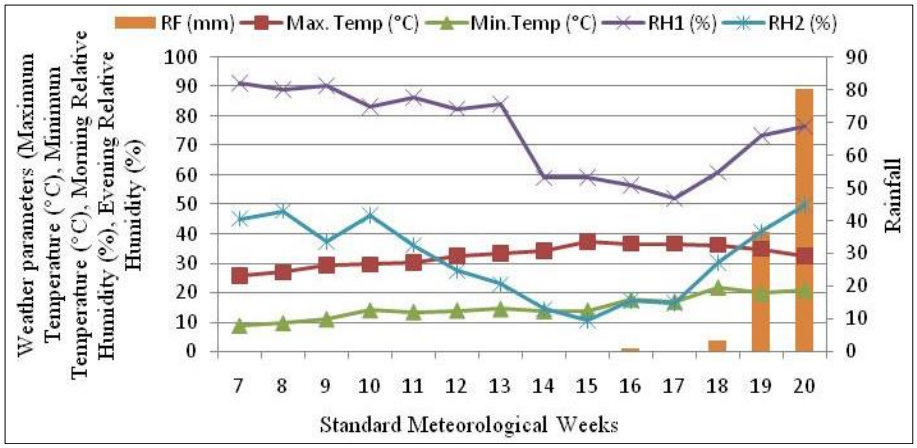


Fig 1a: Weekly weather parameters during 2021

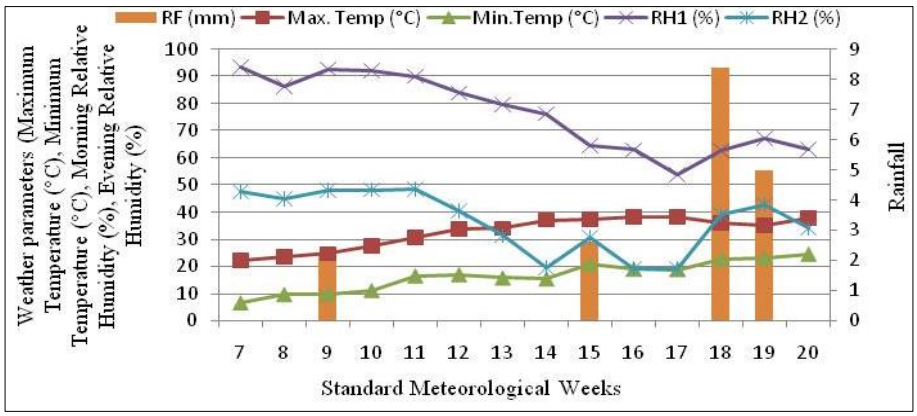


Fig 1b: Weekly weather parameters during 2022

Results and Discussion

Incidence of *D. mangiferae* on Mango and its correlation with abiotic factors

The nymphs of *D. mangiferae* started crawling on mango tree during second fortnight of February in 2021 (0.63±0.10-1.37±0.17nymph/panicle) and 2022 (0.76-1.64 nymph/panicle). The population of mealy bug increased to 6.12±0.48 and 8.12±0.46 individuals per panicle in the March 2021 and 2022 respectively. The Maximum population (13.84±0.65 and 15.67±0.79 nymph/panicle) was found in last week of April when average temperature and relative humidity was 26.95 °C, 36.95% in 2021 whereas 28.65°C and 40.95% in 2022 respectively (Fig:2). The minimum nymph population was recorded in the end of May (0.59±0.13 and 0.42±0.09 nymph/panicle) during both the years. Rizwan *et al*, (2021) [9] and reported similar trends in population build up of mealy bug The nymphs of *D. mangiferae* started to appear in February with gradually increase in March and attain its peak during April (14.55 nymphs/panicle). The results supported by the findings of Yadav *et al.* (2004) [12], who observed the highest population (17.50) of mango mealy bug in April, when the mean temperature and relative humidity were 27.43˚C and 46.15%, respectively.

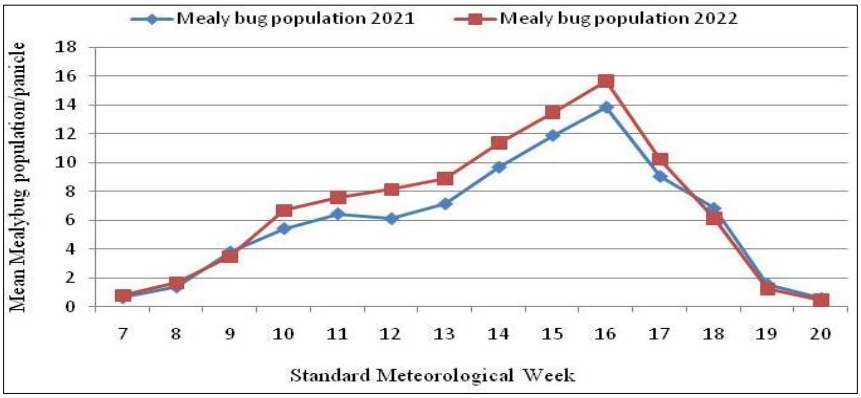
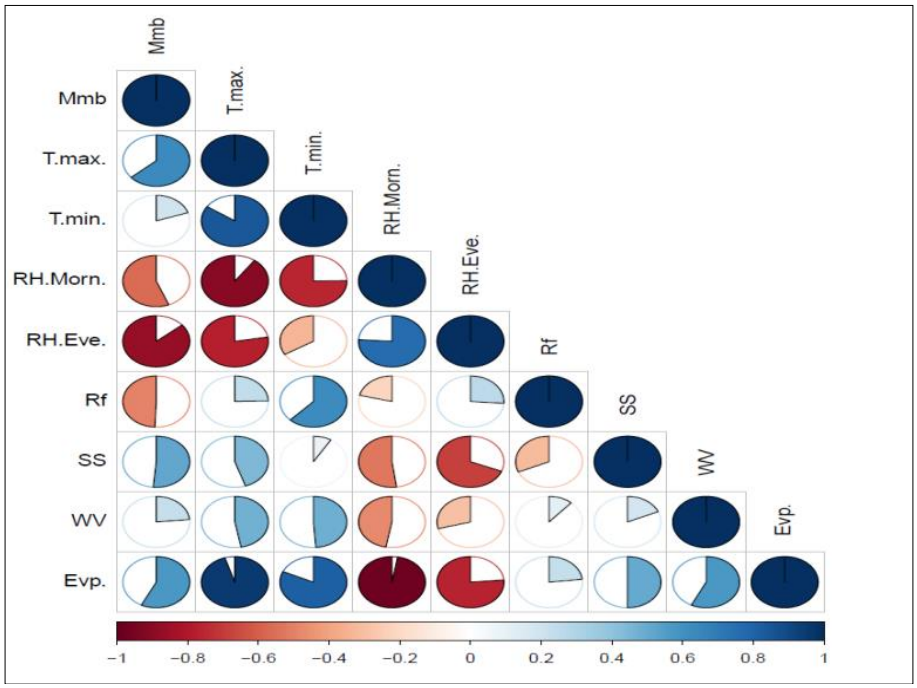


Fig 2: Seasonal incidence of *D. mangiferae* on mango in relation to climatic factors during 2021-2022

The pooled correlation studies in Mango (Fig:3) revealed that *D. mangiferae* exhibited a significant positive correlation with Tmax. (r = +0.63) and Evap. (r = +0.52)**.** Mealy bug nymphal population showed a significant negative correlation with morning and evening relative humidity (r =-0.562 and -0.859, respectively). There was no significant correlation between mealy bug population and minimum temperature, rainfall, sunshine hours and wind velocity. Present observation is also in agreement with Hala *et al.* (2011) [4] who observed that the mango mealy bug populations were affected mainly due to variation in temperature and to a lesser extent by humidity. A negative correlation (r = 0.177) found between incidence of mango mealy bug and relative humidity. Akhtar *et al.* (2022) [1] also reported positive correlation (r = 0.02) between population of mango mealy bug and average temperature. A negative correlation (r = 0.177) found between incidence of mango mealy bug and relative humidity.



Mmb: Mango mealy bug nymph population/panicle, Tmax: Maximum temperature (°C); Tmin: Minimum temperature (°C); RHmin: Minimum relative humidity (%); RHmax: Maximum relative humidity (%); RF: Rainfall (mm); SSH: Sunshine (Hrs.); WS: Wind velocity (Km-h) and Evap.: Evaporation (mm). Bold digits in the table indicate the "–" correlation data; data followed by '*' indicates their significant correlation at $p<0.05$ and data followed by '**' indicate their significant correlation at $p<0.01$; NS: not significant

Y= 0.269 (constant) +1.519 (Tmax.) - 0.516 (Tmin.) - 0.184 (Rhmax.) -0.044 (Rhmin) - 0.195 (RF) -1.108 (SS) + 0.473 (WV) -2.145 (Evp.)

(At $p<0.05$; $R^2 = 0.91$). Y = Mango mealy bug/ panicle

Fig 3: Correlation matrix (Pearson's) and regression equation for weather-based observations with mealy bug population in mango from 2021 & 2022

Principle component regression analysis of weather parameters

Principal component regression analysis (Table: 1) indicated that 81.29% variability had shown by the two PCs (Principal Components) *viz*. PC-1 (Tmax. RHmax., SSH, WV and Evap.) and PC-2 (Tmin. RHmin., RF). The variation expressed by PC-1 and PC-2 was found to be 58.00 and 23.29%, respectively (Table: 1). T(min.), RH (min.) and RF were not considered by PC-1 to develop principal component regression (PCR) due to the non-significant or slight correlation with the mealybug population. In Mango crop RHmin., RF and SSH showed non-significant correlation hence, in PC-1 and PC-2 having SSH and RHmin., RF respectively, were not used for PCR. Similar results were observed by Shera *et al.* (2013) [10] and Patel *et al.* (2021) [7]. As a result, a strategy could be used to manage pest population with quality fruit and more yield of mango.

Table 1: Principal components (PCs) with Percent Eigen values and variances

PCs	Variables	Percent Eigen value	Variance	Cumulative % of variance
1.	T (max.), RH(max.), SS, WV and Evap.	4.64	58.00	58.00
2.	T(min.), RH (min.) and RF	1.86	23.29	81.29

Conclusion

The utilization of PCA facilitate a clear understanding of the dominant factors influencing mealy bug populations, enabling proactive and efficient pest management strategies to obtain quality fruit production.

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