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Effect of Weather Parameters on Pest Dynamics of Maize in Summer at District Bahawalnagar (Pakistan)

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ABSTRACT

This study was designed to evaluate the association between maize pest dynamics and in relation to abiotic factors (temperature, relative humidity and rainfall) in tehsil Minchinabad district Bahawalnagar. The study was conducted from months of April to July in the crop of maize. The current study indicates that the attack of the insect pest increased on maize. These insect pests and diseases on maize are Stem borer (*Chilo partellus*), Armyworm (*Spodoptera frugiperda*), Common earwig (*Forficula auricularia*), Garden snail (*Helix aspersa*), Red cotton stainer (*Dysdercus cingulatus*), *Aspergillus flavus* and Rotten corn disease stock have been recognized to their broad environmental distribution in Bahawalnagar as a result of weather parameters. At higher temperature there was a marked increase in the population of pests while at relative humidity 46% and temperature 40°C maximum population of the pest was recorded, it means that higher the temperature and relative humidity there was a marked fluctuation in pest dynamics and hence in spite of the absence of rainfall, the pest outbreak was recorded. Statistically different results significantly different ($p < 0.05$) using ANOVA one-way and linear regression.

INTRODUCTION

Maize or corn (*Zea mays*) is a member of the grasses (*Poaceae*) family. Maize farming is worldwide and is the most essential cereal crop all over the world. It is not only used as essential food for humans, but also for mammal feed and unprocessed matter for the production of numerous industrial goods. This contains corn starch, maltodextrin, corn oil, corn syrup and materials for fermentation and purification in industries. Since in numerous countries, it is the essential fasten food and the main component in the food of the community. Internationally, it has been expected that about 21% of the full amount of grains is used as food (Shaw 1988; Dowswell *et al.*, 1996). In Pakistan later than further cereal crops for example wheat and rice, corn occupies the 3rd position and out of this 98% is cultivated in the area of NWFP and Punjab, where crop rotating motion meets relatively well. This is cultivated at 935,500 hectares area with a yearly yield of 1737 tones because

maize is used as an important cereal crop (Anonymous, 2004). The crop of maize is cultivated twice a year (spring and autumn) in a region of 411.4 thousand hectares in Punjab. In the spring season maize is cultivated approximately with diseased resistance variety of maize grains on a land of 70.2 thousand hectares, whereas in autumn diseased resistance variety of seeds crop cultivated on 341.2 thousand hectares is 102.4 thousand hectares. The maize is cultivated on 30% of the total area (Anonymous, 2004). Reportedly 140 different insect species attack maize, at various stages of injured proportion. There are only 12 groups of insect pests that attack maize cause injuries from sowing to harvesting. These are too damaging on stocks (Siddiqui and Marwaha, 1993). This crop is damaged by many pests, these are the following (grain weevil, grain borer, Indian meal moth, rootworms, seed corn maggots, white grub, termites, aphids, thrips, stem borer, and armyworm) in corn stock. The attack of pests can at any step before or after cutting or storage. The ratio of damage is related to the farmers, farming, measures, means of storage and ecological situation (Arabjafari and Jalai, 2007). Every year great loss is done by a large diversity of insect pest attacks on maize crops. *Chilo partellus* (Lepidoptera: Pyralidae) is the only risky pest that becomes the reason for great harm to corn (Kavita *et al.*, 2016; Yonow *et al.*, 2017). It is thought that there are associations among the change in ecological features and numbers of the pests which can facilitate predict the pest damages to the maize crop, although too helps prevent the crop timely during pest control method (Aasman, 2001). In Pakistan there are many reasons to decrease the production of maize crop. The major cause of the decrease in yield is the damage done by different pests of maize. The ruin due to pests relates with their number in the field in which physical factors of their surroundings affect (Isard, 2004). Production of maize per hectare has decreased because in the presence of maximum yielding cultivars and because of various biotic parts of the environment such as fungi (Iqbal and Mukhtar, 2014) bacteria (Aslam *et al.*, 2017), nematodes (Hussain *et al.*, 2016; Kayani *et al.*, 2017) viruses (Ashfaq *et al.*, 2017) and pests (Ahmed *et al.*, 2003). Abiotic factors like temperature, relative humidity and rainfall take part a very important function in the growth of insect pest variation and sources of changeability in the population. The current study is designed to examine the result of temperature, relative humidity (RH) and rainfall on the number of several pests of maize crop without spray. Observance in the scenario concerning pest attack on maize crop the present investigation planned to examine the result of temperature, relative humidity and rainfall on several insect pests of maize crop.

MATERIALS AND METHODS

Study Area and Assessment of Pest Complex:

The assessment was started from December 2018 to February 2019 and., SG-2002, S-6634, varieties of maize predominantly cultivated in the district Bhawalnagar (Fig.1). Pest species complex and their relative richness were assessed by plant sampling. For the study of weather parameters on pests of maize Tehsil Minchinabad of District Bhawalnagar was selected.

Two fields from Tehsil were selected (Fig.2) for the collection of maize pests. Selected field tagged as Field A, Field B. The entire field free of pesticides or any chemical not sprayed on maize fields to ensure the credibility of work. Pests collected from selected fields. So that to find out the effect of temperature relative humidity and rainfall on the population dynamics of some insect pests of maize. The conducted test was arranged in an unplanned complete block design (UCBD) on two varieties of maize viz., SG-2002, S-6634, containing two different fields. The distance between plants was 9 inch and the distance

between the rows was 2 feet. Therefore, the research work was extending more than a field of about 1/4 subfields of an acre and selected fields divided into 8 subfields.

The fields were without a spray for the existence of the pests from April to July, 2019. But the data was collected by choosing plants/parts up to 10-07-2019 when they had almost disappeared from the field. The data of a huge number of pests collected by choosing 5 plants from every part of the field Investigation and calculate the number of pests by choose 5 plants/parts.

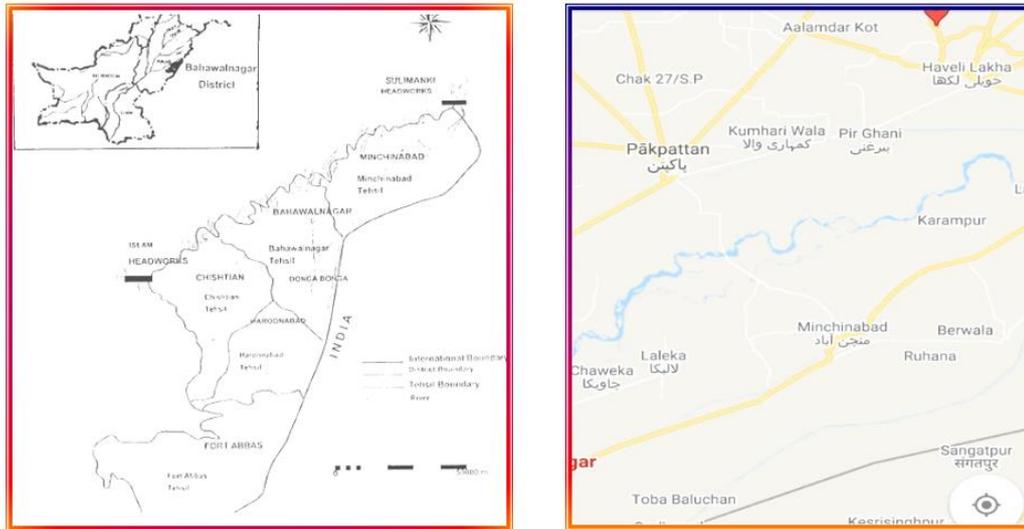


Fig.1 The study area



Fig.2. Field selected to study the weather parameters.

Investigation of Metrological Parameters:

The data on various weather parameters like temperature, relative humidity and rainfall obtained from the meteorological office of Bahawalnagar (Table 1). Data regarding pests and associated damage were statistically analyzed so that to determine the effect of temperature, relative humidity and rainfall on the dynamics of some pests of maize under unsprayed conditions.

Table 1: Month-wise population of pests in relation to temperature, relative humidity and rainfall under unsprayed conditions.

Months	Temperature(⁰ C)	Relative humidity (%)	Rainfall(mm)	No of pests' population
April	36	46	0	12
May	40	41	0	16
June	43	35	0	08
July	38	31	0.2	06

RESULTS

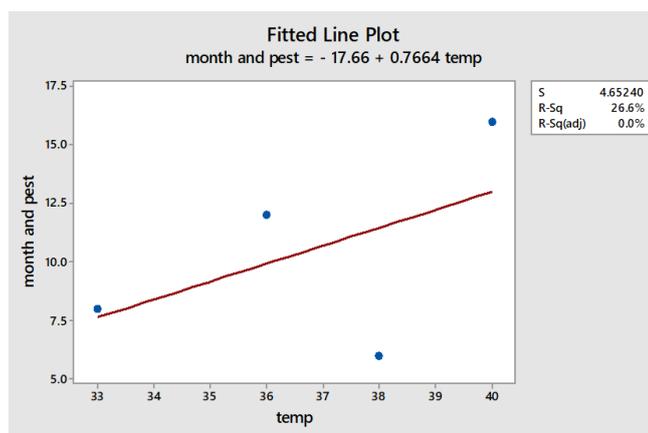
The present study was planned to observe the effect of temperature, relative humidity and rainfall on the population dynamics of some insect pests of maize. The current study indicates that the insect pest attack and increased on maize. At a higher temperature, there was a marked increase in the population of pests while at a relative humidity of 46% and temperature of 40⁰C maximum population of the pest was recorded, it means that higher the temperature and relative humidity there was a marked fluctuation in pest dynamics and hence in spite of the absence of rainfall, the pest outbreak was recorded.

Temperature (⁰C) and Pest Outbreak:

When data regarding months, temperature and pest outbreak were compared then at a temperature of 40⁰C, the number of pest outbreaks witnessed in may under field bioassays. This data shows the role of temperature under high with elevating pest outbreak, therefore the temperature is a key abiotic factor contributing to the higher pest outbreak. The regression equation was positives, $17.66 + 0.7664$ temperature and root square is 0% (Table 2 Fig. 3).

Table 2: Temperature versus pest outbreak.

Source	DF	SS	MS	F	P
Regression	1	15.7	15.7	0.73	0.484
Error	2	43.2	21.6		

**Fig. 3:** Months, temperature and number of pests

Relative humidity (%) and Pest Outbreak:

When data regarding months, humidity and pest outbreak were compared then at a temperature of 41% the number of pest outbreaks witnessed in may under field bioassays.

This data shows the role of humidity under high with elevating pest outbreak, therefore humidity a key abiotic factor contributing to the higher pest outbreak. The regression equation was positive as $9.15 + 0.0323 \text{ humidity\%}$ and root square is 0%. (Table 3 Fig. 4).

Table 3: Month and pest versus humidity

Source	DF	SS	MS	F	P
Regression	1	0.064	0.0645	0.00	0.967
Error	2	58.935	29.467		
Total	3	59.000			

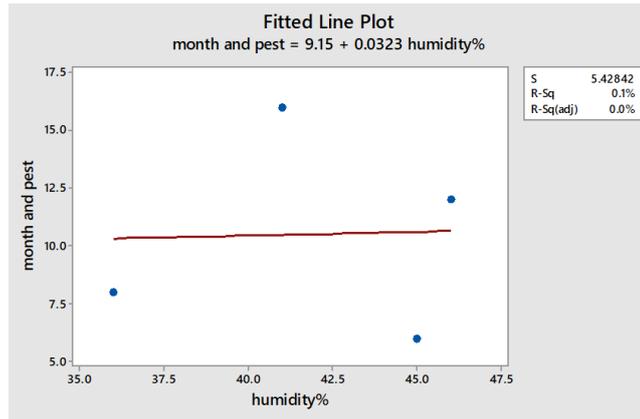


Fig. 4: Relationship months, pest outbreak and humidity%

Rainfall (mm) and Pest Outbreak:

When data regarding months, rainfall and pest outbreak was compared with, the number of pest outbreaks witnessed in the month of May, under field bioassays. This data shows the role of rainfall under high with elevating pest outbreak, therefore rainfall is a key abiotic factor contributing to the higher pest outbreak. The regression equation was positive as $12.00+30.00 \text{ rainfall}$ and root square is 18%. (Table 4 Fig 5).

Table 4: Months and pest versus rainfall.

Source	DF	SS	MS	F	P
Regression	1	27	27	1.69	0.324
Error	2	32	16		
Total	3	59			

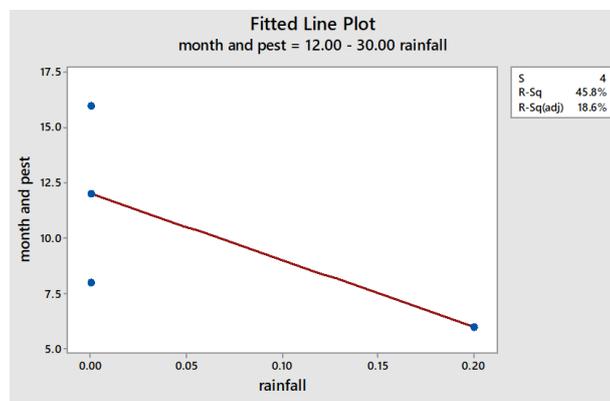


Fig. 5: Linear regression of months, rainfall and pest outbreak

Following pests and disease observed in maize crop at Tehsil Minchin Abad District Bahawal nagar (Fig.6).



Fig.6: Pests and disease observed in maize crop.

(a) Stem borer (*Chilo partellus*) (b) Armyworm (*Spodoptera frugiperda*) (c) Common earwig (*Forficula auricularia*) (d) Garden snail) (e) Red cotton stainer Dysder(*Helix aspersacus cingulatus*) (f) *Aspergillus flavus* (g) Rotten corn disease stock.

DISCUSSION

The results and findings are consistent with the Zulfiqar *et al.* (2010) study of the cause of weather parameters such as relative humidity and temperature on the population dynamics of various pests of maize. The effect of these weather parameters was observed that the number of leafhoppers was present maximum on relative humidity at 68 per cent and temperature of 36.5⁰C. The fewer numbers were present at the humidity at 75 per cent and temperature of 31.5⁰C. The population of jassid was recorded maximum at the relative humidity (RH) at 68 per cent and temperature of 36⁰C and lowly Population was observed at relative humidity at 70 per cent and at temperature 35⁰C. The huge number of *Chilo partellus* was found highest at the relative humidity at 68 percent and temperature of 32.5⁰C and lowest number of *Chilo partellus* found at the relative humidity at 50 percent and temperature of 32.5⁰C. On the whole, the results of the study work were proved that the relative humidity and temperature have an important influence on the number of maize insect pests. In the current study, our results are consistent with previous findings in temperature and relative humidity. These findings were confirmed with the work of Ahmad (1988) on the effect of weather parameters on the outbreak of pests of maize crop. This effect on jassid the conclusions of research indicated that the number of jassid raises with a rise in temperature and vice versa. Therefore, temperature and moisture were very important in jassid community. The smaller number of jassid be recorded at 35⁰C and RH 70 percent with a mean value of 0.60 and the maximum number of jassid present (mean (value = 1.7) at 36⁰C and moisture 68.0 percent. These discoveries were also associated with Suggetha (2001) he observed that the most favorable situations of temperature and comparative moisture for the population increase of jassid at the temperature 30⁰C and comparative moisture 60.7 percent. The *Chilo partellus* is the most important pest of maize. The *Chilo partellus* undergo existence stages in 22 to 33 days and undergo numerous life cycles in the 12 months. Complete mature larvae get winter sleep in the corn in October to November, hibernation completed at last of February and at the end March develop into a pupa. These findings were associated also by Farag *et al.* (1992) the number of *Chilo partellus* in this study work raised with reduces relative humidity and temperature. The least number of *Chilo partellus* 16 per cent was viewed at the temperature of 36.5⁰C and comparative moisture percent. The maximum number of *Chilo partellus* 45 percent was observed at a temperature of 32.50⁰C and comparative moisture 50 percent. These findings were associated also with Panwar (1979) found that *Chilo partellus* number on diverse types and nonliving parameters and investigated that number of the *Chilo partellus* rise to less in temperature and relative humidity. The number of aphids raises with less in temperature and moisture, mostly less number of pests were observed (mean value 2.27) at a temperature of 33⁰C and moisture content of 61 percent and the maximum community were observed (mean value 2.4) at temperature 32.5⁰C and moisture 50 percent (Barbiani 2003). The study work was also associated with Phamdthera *et al.* (1995). The total number of Aphid was present by less in temperature and moisture (Hemerik 2004) the result of just one nonliving factor such as relative humidity or temperature cannot affect the population of one insect pest that is why abiotic parameters have a deep combined effect and the total results of present study work represented that the moisture and temperature a lot influenced on the pests community of maize (Sharma 1997).

Climate factors take part in a fundamental role in the development of an insect pest, distribution growth population dynamics (Chang *et al.* 2008; Masood 2016). Temperature, comparative moisture and rain of the environmental crop has influenced on the population of insect pest. Results of this study showed an association of rainfall, relative humidity and temperature, determined rainfall showed negatively and non-significantly correlation,

relative humidity showed significantly and negatively correlation, temperature shows significantly and positively correlated with respect to the population of the larva.

Disclosure

The authors declare that they have no conflicts of interest.

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