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Seasonal incidence of major insect pests of pigeonpea (*Cajanus cajan* L.) under field conditions

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Abstract
The present investigation entitled "Seasonal Incidence of Major Insect Pests of Pigeonpea (*Cajanus cajan* L.) under Field Conditions" was conducted during the *Kharif* season of 2024-25 at the Research Farm, RAK College of Agriculture, Sehore (M.P.). The pigeonpea variety TJT-501 was sown on 20th July 2024 with a spacing of 60 × 20 cm. Observations on the seasonal incidence of major insect pests, including defoliators (leaf webber, plume moth), sucking pests (jassids, green stink bug, pod bug) and pod-infesting pests (pod borer, pod fly), were recorded once in a standard week from 10 randomly selected plants per plot using the visual search method. Pod fly infestation was assessed by splitting 50 pods per plot, while jassid counts were taken from six leaves representing the top, middle and lower canopy. The results revealed that jassid (*Empoasca kerri*) appeared from the 35th SMW to 1st SMW with a low population and showed a positive but non-significant correlation with maximum temperature. Leaf webber (*Grapholita critica*) persisted from the 33rd to 47th SMW, peaking in the 44th SMW (3.1/plant), and was significantly positively correlated with maximum temperature. Plume moth (*Exelastis atomosa*) appeared from the 42nd to 52nd SMW, peaking in the 49th SMW (4.9/plant), with non-significant negative correlations with all-weather parameters. Pod bug (*Clavigralla gibbosa*) was observed from the 43rd to 52nd SMW, peaking in the 50th SMW (4.8/plant) and showed significant negative correlations with both temperatures. Pod borer (*Helicoverpa armigera*) occurred from the 41st SMW to 1st SMW, with a peak of 6.6/plant in the 50th SMW, and was significantly negatively correlated with minimum temperature. Pod fly damage was recorded from the 49th SMW (30%) to 4th SMW (74%), showing significant negative correlations with maximum temperature and relative humidity.

Keywords: Pigeonpea, seasonal incidence, correlation analysis, major insect pests

Introduction

India is the leading producer of pulses globally, cultivating a wide variety throughout the year, with pigeonpea (tur/arhar) [*Cajanus cajan* (L.) Millsp.] being one of the most significant. As a vital source of plant-based protein in the predominantly vegetarian Indian diet, pigeonpea contains 20-30% protein and is consumed both as green peas and dry seeds, making it a staple in many regions (Singh *et al.*, 2023). Nutritionally, pigeonpea seeds have 7.04-12.09% moisture, 17.62-25.45% crude protein, 1.41-2.93% crude fat, 49.68-60.48% carbohydrates, and 3.05-5.00% ash. Among essential amino acids, tryptophan (0.56-1.03 g) and methionine (0.70-1.16 g) per 16 g nitrogen are the limiting ones, highlighting its rich but slightly imbalanced protein quality (Kachare *et al.*, 2018) [6].

It is a major crop cultivated primarily in rainfed and drought-prone regions, with India, Myanmar, Malawi, Tanzania and Haiti being the leading producers. Worldwide, it occupies around 5.38 million hectares, yielding 4.58 million tons with an average productivity of 851 kg/ha (Anonymous, 2023) [1]. India dominates global production, accounting for more than 90% of the total output (Chakravarty *et al.*, 2016) [4]. Within India, pigeonpea is grown on 4.13 million hectares, producing 3.42 million tons annually at an average yield of 827 kg/ha. In Madhya Pradesh alone, the crop covers about 0.16 million hectares with a production of 0.14 million tons and a productivity of 885 kg/ha (UPAg, 2023) [16].

In India, pigeonpea crops are vulnerable to over 250 insect pest species at various stages of growth, affecting plants from early vegetative stages to pod formation (Gopali *et al.*, 2010) [5]. These pests can cause substantial yield losses, ranging from 27% to complete crop failure, underscoring the need for effective pest management strategies (Srilaxmi and Paul, 2010) [14]. Major pests include the pod borer complex, comprising *Helicoverpa armigera* Hubner, plume moth *Exelastis atomosa* Walsingham, pod fly *Melanagromyza obtusa* Malloch, and pod bug *Clavigralla gibbosa* Spinola, which can reduce yields by 30-100% (Satpute and Barkhade, 2012) [12]. In the Jabalpur region, *H. armigera*, *C. gibbosa*, *M. obtusa*, and *E. atomosa* are the primary pod-infesting insects, with *M. obtusa* identified as the most damaging, causing 55-85% pod damage and 29-63% grain loss (Bijewar *et al*., 2019) [13].

Material and Methods

The study was conducted at the Research Farm of R.A.K. College of Agriculture, Sehore (M.P.) during the *Kharif* season of 2024-25 to investigate the seasonal incidence of major insect pests of pigeonpea (*Cajanus cajan* L.) variety TJT-501. The crop was sown on 20th July 2024 in plots of 5 × 5 m with a spacing of 60 × 20 cm and harvested on 30th January 2025. Observations on defoliators and pod-infesting pests, including leaf webber, green stink bug, pod bug, pod borer larvae and plume moth, were recorded visually from 10 randomly selected plants per plot once in a Standard Meteorological Week (SMW) from germination to maturity. Pod fly (*Melanagromyza obtusa*) infestation was assessed by examining 50 pods per plot, while jassid populations were recorded weekly from six leaves per plant across the canopy. All pest data were correlated with meteorological parameters, including maximum and minimum temperature, morning and evening relative humidity and rainfall, obtained from the Department of Agrometeorology, RAK College of Agriculture. Statistical analyses, including correlation, regression, and significance testing, were performed following Snedecor and Cochran (1967), with regression models ({Y} = a + bx) and coefficient of determination (R^2) used to quantify relationships between abiotic factors and pest populations.

Results and Discussion

During the pigeonpea cropping season, the population dynamics of major insect pests *i.e.*, jassid, leaf webber, plume moth, pod bug, pod borer and pod fly were monitored periodically, and their activity was subsequently analyzed in relation to various abiotic factors.

Jassid, *Empoasca kerri* (Pruthi) (Hemiptera: Cicadellidae)

The first occurrence of jassid was recorded during the 35th Standard Meteorological Week (SMW) at a population of 0.8 jassids per 6 leaves, and it persisted until harvest in the 1st SMW, with a population of 0.9 jassids per 6 leaves. The population peaked during the 49th SMW at 3.9 jassids per 6 leaves, when the maximum and minimum temperatures were 29.4 °C and 9.3 °C, respectively, with 78% relative humidity and no rainfall. Correlation analysis indicated a positive relationship between jassid population and maximum temperature (r = 0.22), while negative correlations were observed with minimum temperature, relative humidity, and rainfall (r = -0.40, -0.37 and -0.43, respectively); however, all correlations were statistically non-significant (Table 1 & 2). These results are also congruent with Kumar *et al*. (2010) [8] and Udayababu *et al*. (2021) [15].

Leaf Webber, *Grapholita critica* (Lepidoptera: Tortricidae)

The leaf webber was first recorded during the 33rd SMW at 0.3 larvae per plant and continued to be present until crop maturity in the 47th SMW, with a population of 0.8 larvae per plant. The peak population occurred during the 44th SMW, reaching 3.1 larvae per plant, when maximum and minimum temperatures were 33.9 °C and 16.4 °C, respectively, relative humidity was 83%, and no rainfall was recorded. Correlation analysis showed a significant positive relationship between leaf webber population and maximum temperature (r = 0.91), with the regression equation $\hat{Y}$ = 18.42 + 6.64x (R^2 = 0.82), indicating that each 1 °C increase in maximum temperature corresponded to an increase of 6.64 larvae per plant (Fig. 1). The population exhibited negative correlations with minimum temperature, relative humidity, and rainfall (r = -0.20, -0.11, and -0.27, respectively), although these were statistically non-significant (Table 1 & 2). These results are also congruent with Kumar *et al*. (2010) [8] and Bapatla *et al*. (2021) [2].

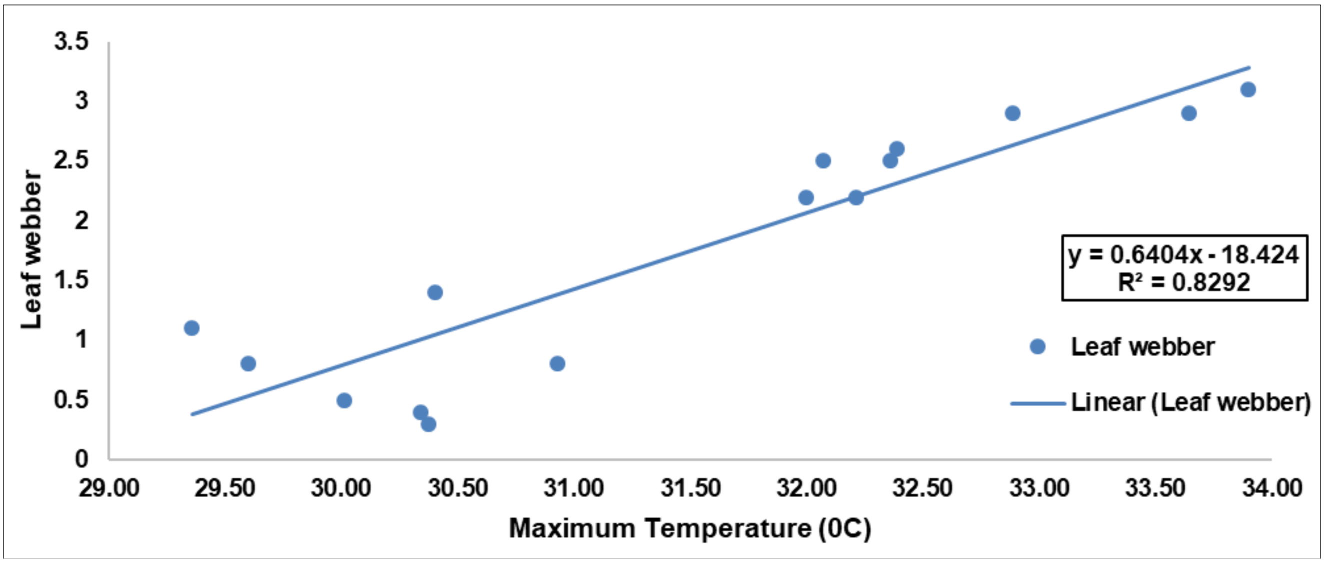

Fig 1: Regression of maximum temperature on Leaf webber incidence on pigeonpea

Plume Moth, *Exelastis atomosa* (Walsingham) (Lepidoptera: Pterophoridae)

The plume moth was first observed during the 42nd SMW at a population of 1.3 moths per plant and persisted until harvest in the 52nd SMW, with 0.7 moths per plant. The population peaked during the 49th SMW at 4.9 moths per plant, when maximum and minimum temperatures were 28.9 °C and 11.4 °C, respectively, relative humidity was 81%, and no rainfall was recorded. Correlation analysis indicated negative relationships between plume moth population and maximum and minimum temperature, relative humidity, and rainfall (r = -0.02, -0.43, -0.54 and -0.45, respectively), although these correlations were statistically non-significant (Table 1 & 2). The current results partly align with the findings reported by Udayababu *et al*. (2021) [15] and Bapatla *et al*. (2021) [2].

Pod Bug, *Clavigralla gibbosa* (Hemiptera: Pentatomidae)

The pod bug was first recorded during the 43rd SMW at 0.5 bugs per plant and persisted until harvest in the 52nd SMW, reaching 1.8 bugs per plant. The population peaked during the 50th SMW at 4.8 bugs per plant, when maximum and minimum temperatures were 25.6 °C and 3.6 °C, respectively, relative humidity was 80%, and no rainfall occurred. Correlation analysis revealed a significant negative relationship between pod bug population and both maximum and minimum temperatures (r = -0.63 and -0.85, respectively), with regression equations $\hat{Y} = 11.61 - 0.30x$ ($R^2 = 0.40$) and $\hat{Y} = 6.24 - 0.31x$ ($R^2 = 0.73$), indicating that each 1 °C increase in maximum and minimum temperatures corresponded to decreases of 0.30 and 0.31 bugs per plant, respectively (Fig. 2). Negative, but statistically non-significant, correlations were also observed with relative humidity and rainfall (r = -0.46 and -0.18, respectively) (Table 1 & 2). The present findings partially agree with those of Keval *et al*. (2018) [7].

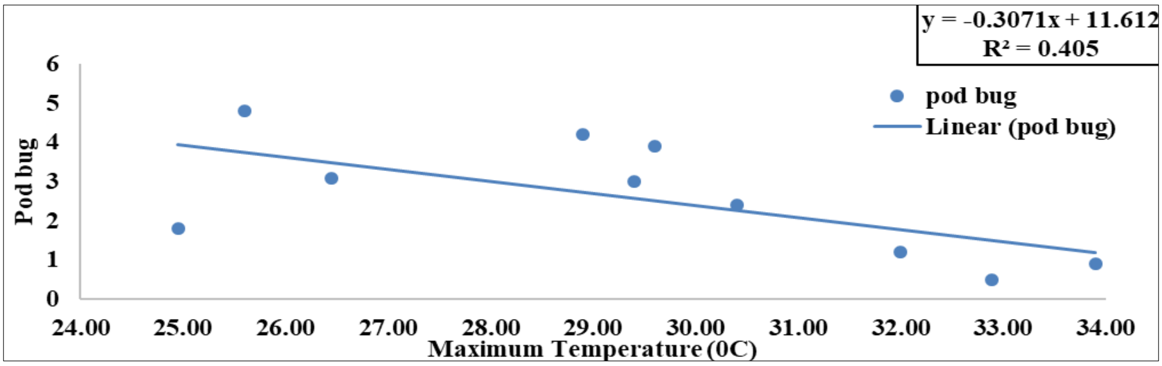

Fig 2: Regression of maximum temperature on pod bug incidence on pigeonpea

Pod Borer, *Helicoverpa armigera* Hub. (Lepidoptera: Noctuidae)

The pod borer was first observed during the 41st SMW at 0.8 larvae per plant and persisted until harvest in the 1st SMW, with 1.1 larvae per plant. The population peaked during the 50th SMW at 6.6 larvae per plant, when maximum and minimum temperatures were 25.6 °C and 3.6 °C, respectively, relative humidity was 80%, and no rainfall was recorded. Correlation analysis showed a significant negative relationship between pod borer population and minimum temperature (r = -0.66), with the regression equation $\hat{Y} = 6.52 - 0.25x$ ($R^2 = 0.43$), indicating that each 1 °C increase in minimum temperature corresponded to a decrease of 0.25 larvae per plant (Fig. 3). Negative, but statistically non-significant, correlations were also observed with maximum temperature, relative humidity, and rainfall (r = -0.34, -0.40, and -0.39, respectively) (Table 1 & 2). The current findings partially align with those reported by Rathore (2011) [11].

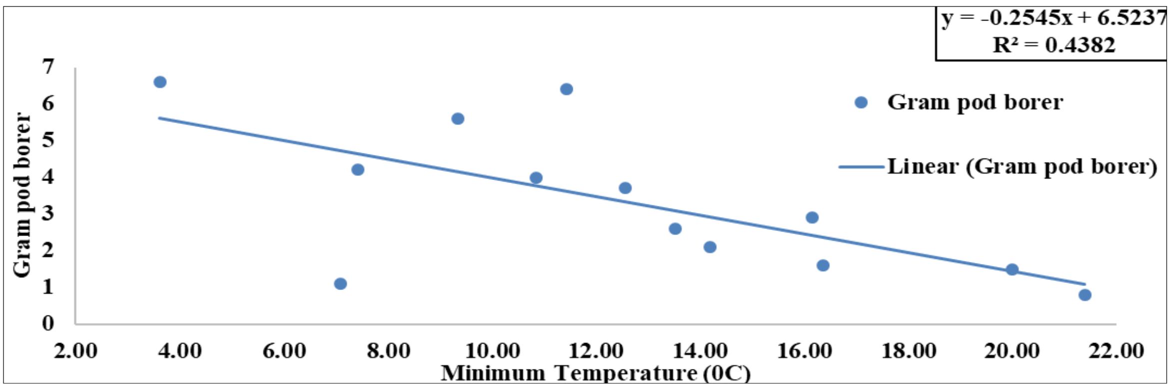

Fig 3: Regression of minimum temperature on Pod borer incidence on pigeonpea

Pod Fly, *Melanagromyza obtusa* (Diptera: Agromyzidae)

Pod fly damage was first observed during the 49th SMW at 30% per plant and persisted until harvest in the 4th SMW, reaching 74% per plant. The peak infestation occurred during the 4th SMW, coinciding with maximum and minimum temperatures of 26.2 °C and 8.2 °C, relative humidity of 71%, and no rainfall. Correlation analysis revealed significant negative relationships between pod fly damage and both maximum temperature (r = -0.67) and relative humidity (r = -0.57), with regression equations $\hat{Y}$ =

293.7 - 3.1x (R^2 = 0.76) and $\hat{Y}$ = 212.4 - 6.1x (R^2 = 0.45), indicating decreases of 3.1% per plant and 6.1% per plant with each unit increase in relative humidity and maximum temperature, respectively (Figs. 4 & 5). Negative, but statistically non-significant, correlations were also observed with minimum temperature and rainfall (r = -0.08 and -0.02, respectively) (Table 1 & 2). These results are also congruent with Rathore (2011) [11] and Pandey *et al*. (2016) [10].

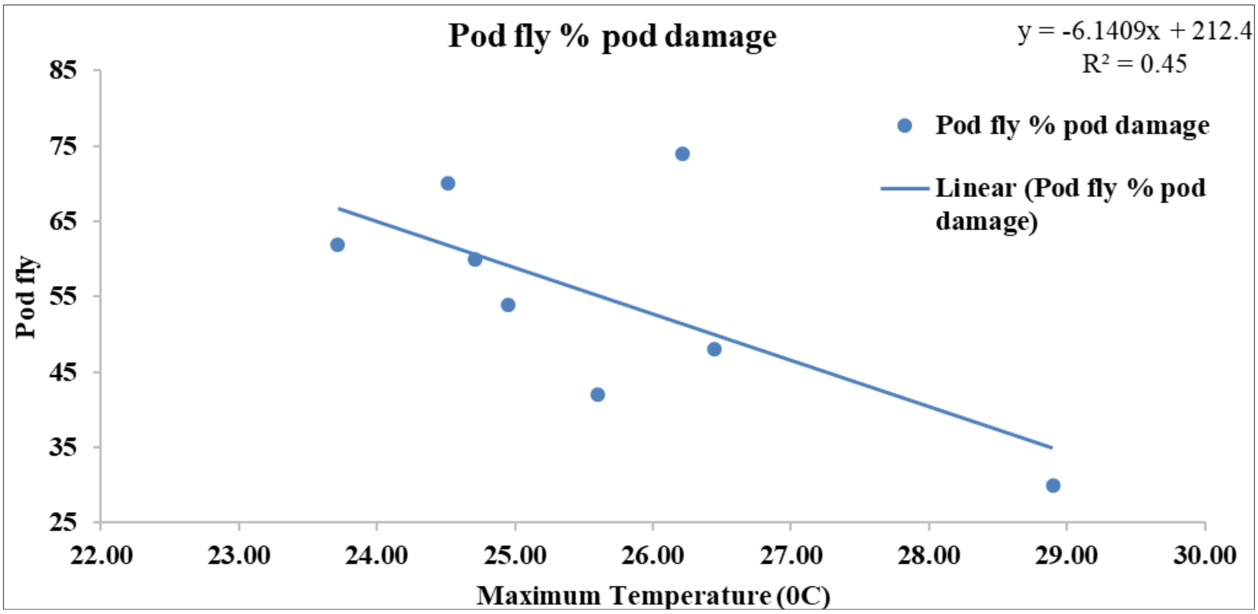

Fig 4: Regression of Maximum Temperature on Pod fly incidence on pigeonpea

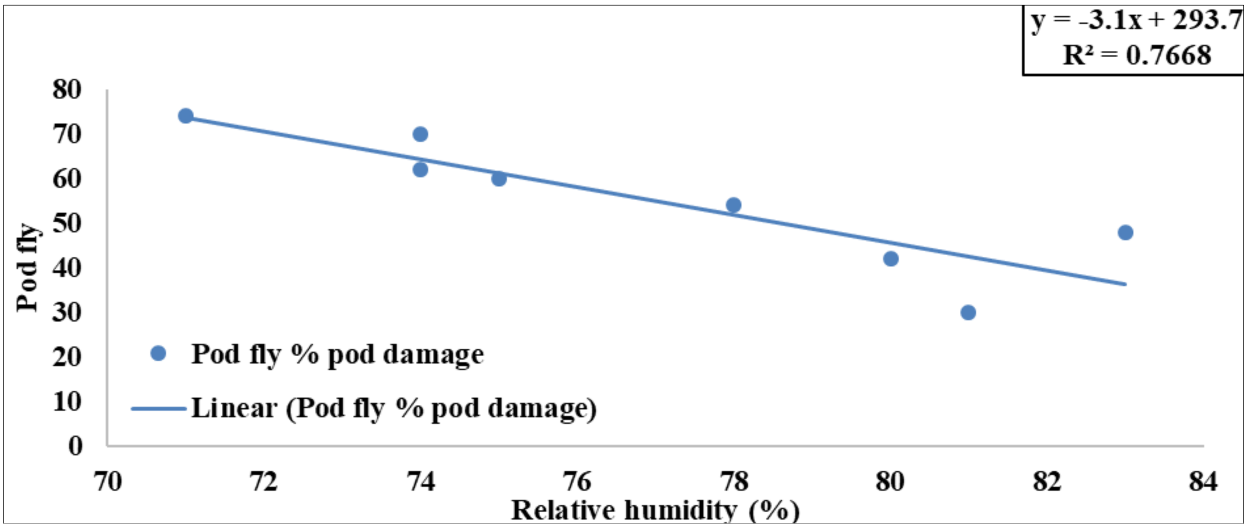

Fig 5: Regression of Relative Humidity on Pod fly incidence on pigeonpea

Conclusion

The study clearly revealed that the seasonal incidence of major insect pests of pigeonpea varied in their appearance, peak activity, and persistence, being strongly influenced by weather parameters. Among the pests, leaf webber, pod bug, pod borer, and pod fly caused considerable damage during the reproductive stages, whereas jassid and plume moth maintained relatively lower populations. Correlation analysis indicated that maximum and minimum temperatures, relative humidity, and rainfall had varying degrees of influence on pest dynamics, with significant negative associations observed in pod bug, pod borer, and pod fly, while leaf webber showed a significant positive relationship with maximum temperature. These results highlight the importance of regular monitoring and timely management interventions, particularly during peak infestation periods, to minimize crop losses. Developing weather-based pest forecasting models and adopting integrated pest management (IPM) practices can help farmers effectively manage pigeonpea pests in a sustainable manner.

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Table 1: Incidence of major insect pests on pigeonpea at Sehore district during *kharif* season 2024-25

SMW	Mean					
	Per plant				Pod borer (Larvae/mrl)	Pod fly (% pod damage)
	Jassid	Leaf webber	Plume moth	Pod bug		
30	0	0	0	0	0	0
31	0	0	0	0	0	0
32	0	0	0	0	0	0
33	0	0.3	0	0	0	0
34	0	0.4	0	0	0	0
35	0.8	0.5	0	0	0	0
36	1.3	0.8	0	0	0	0
37	1.1	1.1	0	0	0	0
38	2.4	2.6	0	0	0	0
39	2.3	2.5	0	0	0	0
40	3.2	2.9	0	0	0	0
41	2.8	2.2	0	0	0.8	0
42	2.9	2.5	1.3	0	1.5	0
43	3	2.9	1	0.5	1.6	0
44	3.4	3.1	2.4	0.9	2.9	0
45	3	2.2	2.6	1.2	2.1	0
46	3.2	1.4	3.2	2.4	3.7	0
47	3.5	0.8	3.8	3.9	4	0
48	3.9	0	4.6	3	5.6	0
49	4	0	4.9	4.2	6.4	30
50	2.9	0	3.1	4.8	6.6	42
51	3.5	0	1.5	3.1	4.2	48
52	2.1	0	0.7	1.8	2.6	54
1	0.9	0	0	0	1.1	60
2	0	0	0	0	0	62
3	0	0	0	0	0	70
4	0	0	0	0	0	74

SMW: Standard Meteorological Week

Table 2: Correlation of abiotic factors on major insect pests of pigeonpea

SN	Metrological parameter		Jassid	Leaf webber	Plume moth	Pod bug	Pod borer	Pod fly
1	Maximum Temperature (^{0}C)	r	0.22	0.91**	-0.02	-0.63*	-0.34	-0.67*
		byx	-	0.64	-	-0.30	-	-0.44
2	Minimum Temperature (^{0}C)	r	-0.40	-0.20	-0.43	-0.85**	-0.66*	-0.08
		byx	-	-	-	-0.31	-0.25	-
3	Relative humidity (%)	r	-0.37	-0.11	-0.54	-0.46	-0.40	-0.87**
		byx	-	-	-	-	-	-3.10
4	Rainfall (mm)	r	-0.43	-0.27	-0.45	-0.18	-0.39	-0.02
		byx	-	-	-	-	-	-

* = significant at 5%; ** = significant at 1%

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