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SHORT COMMUNICATION

Relationship of some insect pests of roselle with weather parameters in Makurdi, Nigeria

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ABSTRACT

The population dynamics of three insect species namely: *Monolepta thomsoni, Nisotra sjostedti*, and *Dysdercus volkeri* along with their correlation with weather factors were studied during the 2016 cropping seasoning Makurdi, Benue State, Nigeria. Insect count was done within a 1m by 1m area for 21 weeks. *M. thomsoni* and *N. sjostedti* populations peaked at 9 WAP, while *D. volkeri* peaked at 21 at pod maturity. *M. thomsoni* and *N. sjostedti* strongly linked with early crop relative humidity. *M. thomsoni* associated favourably with rainfall and relative humidity in the late harvest, but not maximum temperature. *D. volkeri* was positively correlated with sun radiation, maximum temperature, and relative humidity in early-sown crops. Positive and significant association between *D. volkeri* and maximum temperature in late crop. *N. sjostedti* did not link with late-sown crop weather. This study's result can be used to forecast insect pest damage, which can aid with pest management in roselle.

Keywords: correlation, roselle, temperature, rainfall, relative humidity, insect-pests

INTRODUCTION

The Roselle plant (*Hibiscus sabdariffa* Linn.) is a Malvaceae family blooming plant that is widely planted for its aesthetics over the world. It's grown in tropical and subtropical climates for a variety of purposes (Babatunde and Mofoke, 2006). Roselle cultivation is predominantly rural, multi-cultural, and purposefully for food and revenue-generating in Nigeria. (Simon et al 2021). Despite the crop's economic potential, little research has been done on the biotic and environmental conditions that limits Roselle development. (Simon et al 2021). One of the most important elements affecting Roselle's growing success is insect pest infestation, it is used by a variety of insect species as a habitat, oviposition, or eating location (Simon et al 2021). According to Simon et al (2018) If no synthetic control measures are used to combat insect pest infestations throughout the vegetative and reproductive growth stages of Roselle, the crop's fresh calyx production might be reduced by more than 80 percent.

The most significant factors of insect species' geographical and temporal dispersion are regarded to be seasonal conditions (Andrewartha and Birchm 1984). Temperature, humidity levels, and precipitation have all been shown to have a substantial impact on insect population fluctuations. (Sharma et al., 2018). Insect pests' survival, growth, and reproductive capability are all influenced by environmental parameters, their populations have been observed to rise in favorable settings. (Rahmathulla, et al., 2012). Meteorological factors have a substantial impact on the establishment and development of the pest population, resulting in varying levels of infestation. (Afroz, et al 2019). These variables impact insect population dynamics, favorable circumstances contribute to quicker developing rates, meteorological elements may influence the death ratios caused by insect natural enemies both directly and indirectly (Stireman et al., 2000). Food availability, natural enemies numbers, and herbivorous populations were all shown to be affected by weather factors, suggesting that they might be key drivers of insect-pest population changes. (Guedes et al., 2000). Knowledge of the seasonal abundance and population growth trend is critical for early pest management and crop loss prevention, as well as for the construction of a forecasting model that can anticipate the likely prevalence of insect pests on the crop. (Manjunatha et al., 2001; Meena et al., 2013; Rahmathulla et al., 2012; Kumar, et al 2019). The study's findings may disclose acceptable ecological requirements, notably meteorological parameters like temperature, relative humidity, and rainfall, which all play a role in insect pest multiplication and dissemination, and these aspects will help to move pest control research forward.

MATERIALS AND METHODS

Experimental location and layout

The experiment was conducted at the College of Agronomy Experimental Field, University of Agriculture, Makurdi, 2016. To determine the effect on some weather parameters on insect abundance. Each plot measure 5 x 5 m wide, adjacent plot 1 m alley while adjacent replications separated by 2 m alley.

Data collection & Data analysis

Insect collection: Population insect pests viz: *Dysdercus volkeri, Nisotra sjostedti* and *Monolepta thomsoni* were recorded weekly throughout the growing period during morning hours (7.00-8.00am) in 1mx1m^2 area. Similarly, data on monthly maximum, minimum and average temperature and relative humidity, number of rainy days, total precipitation and solar radiation per month were obtained from Airforce Base Metrological Station, Makurdi, Benue State. Correlation analysis was done to suing SPSS to determine the relationships between insect abundance and metrological parameters.

RESULTS

Population dynamics

The number of *M. thomsoni and N. sjostedti* per M^2 infesting Roselle fluctuated with duration, first increase was observed at 3WAP, followed by a decline in species number at 4WAP. However, at 7-9WAP, an increase occurred, but at 10WAP, a slight drop in number was noticed for both species. Highest peak of mean number of insect species occurred at 11WAP, thereafter, a decline followed between the period of 12-13WAP. Insect men number after this period insect increased again at 14 and 17WAP, then decline towards harvest. For *D. volkeri*, however, the population fluctuated throughout the growing period, but the population peak at 20 weeks which coincide with calyx maturity, at 21WAP, however a sharp population drop was observed. Fig. 1

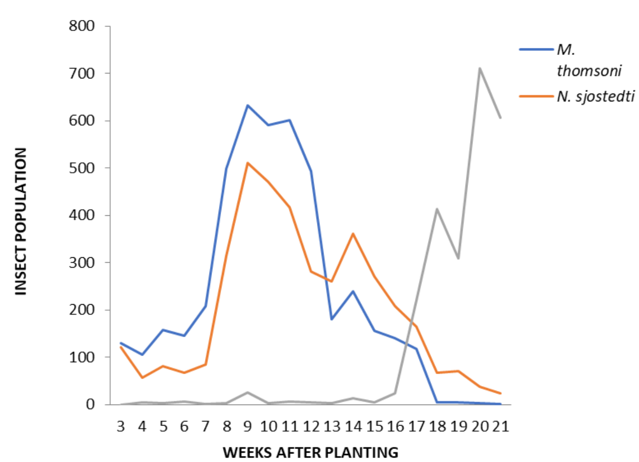

Figure 1. Fluctuations in numbers of insect species infesting Roselle at Makurdi (June-December, 2016)

Table 1. Correlation of some weather parameters with populations of highly abundant insect pests in early and late sown Roselle at Makurdi, 2016

Abiotic Factors		Early Sown			Late Sown		
		M. thomsoni	*N. sjostedti*	*D. volkeri*	*M. thomsoni*	*N. Sjostedti*	*D. Volkeri*
Rainfall[a]	Pearson Correlation	0.04	0.05	-0.14	0.78**	0.05	-0.27
	Sig. (2-tailed)	0.88	0.85	0.58	0.00	0.87	0.34
	N	19	19	19	15	15	15
Solar Radiation[a]	Pearson Correlation	-0.35	-0.25	0.72**	-0.29	-0.06	0.20
	Sig. (2-tailed)	0.15	0.30	0.00	0.29	0.84	0.47
	N	19	19	19	15	15	15
Maximum Temperature[a]	Pearson Correlation	-0.12	-0.05	0.73**	-0.66**	-0.43	0.58*
	Sig. (2-tailed)	0.63	0.85	0.00	0.01	0.11	0.02
	N	19	19	19	15	15	15
Minimum Temperature[a]	Pearson Correlation	-0.03	-0.15	-0.23	-0.05	-0.23	0.07
	Sig. (2-tailed)	0.90	0.55	0.34	0.85	0.42	0.80
	N	19	19	19	15	15	15
Mean Temperature[a]	Pearson Correlation	-0.11	-0.14	0.40	-0.51	-0.46	0.47
	Sig. (2-tailed)	0.65	0.58	0.09	0.05	0.09	0.08
	N	19	19	19	15	15	15
Relative Humidity[b]	Pearson Correlation	0.56*	0.51*	-0.92**	0.68**	0.49	-0.38
	Sig. (2-tailed)	0.01	0.03	0.00	0.01	0.06	0.17
	N	19	19	19	15	15	15

Table 2. Regression model for weather parameters with populations of highly abundant insect pests in early and late sown Roselle

Abiotic Factors	Early Sown			Late Sown		
	M. thomsoni	*N.sjostedti*	*D. volkeri*	*M. thomsoni*	*N.sjostedti*	*D. volkeri*
Rainfall	Y= 2.71x+227.3	Y=2.474x+199.3	Y=-3.80x+201.2	Y=2.79x+141.9	Y=0.14x+71.7	Y=-10.47x+141.9
	R^2=0.00	R^2=0.00	R^2=0.07	R^2=0.61	R^2=0.00	R^2=0.02
Solar Radiation	Y=-30.74x+387.2	Y=-15.90x+283.8	Y=32.36x-67.86	Y=-11.55x+171.9	Y=-1.50x+60.09	Y=65.59x-207.1
	R^2=0.12	R^2=0.06	R^2=0.04	R^2=0.08	R^2=0.00	R^2=0.51
Maximum Temperature	Y= -13.88x+669	Y=-3.93x+327.4	Y=104.8x-3345	Y=-29.62x+1081	Y=-12.50x+487.9	Y=88.91x-2675
	R^2=0.01	R^2=0.00	R^2=0.34	R^2=0.44	R^2=0.18	R^2=0.53
Minimum Temperature	Y=-4.04x+352.6	Y=-13.67x+520.7	Y=14.16x-177.9	Y=-2.6x+153.6	Y=-7.12x+487.9	Y=-31.07x+845.1
	R^2=0.01	R^2=0.02	R^2=0.00	R^2=0.00	R^2=0.05	R^2=0.05
Mean Temperature	Y=-20.48x+791.9	Y=-17.98x+695.3	Y=104.8x-3345	Y=-29.62x+1081	Y=-12.50x+487.9	Y=75.83x+1949
	R^2=0.01	R^2=0.02	R^2=0.34	R^2=0.44	R^2=0.18	R^2=0.16
Relative Humidity	Y=28.81x-2154	Y=18.7x-1349	Y=-12.32x+1200	Y=6.07x-383.8	Y=2.83x-151.4	Y=-48.63+4151
	R^2= 0.31	R^2=0.26	R^2=0.14	R^2=0.47	R^2=0.24	R^2=0.84

Correlation of density of dominant insect species infesting Roselle with crop growth period meteorological data

M. thomsoni: There was a positive but non-significant correlation with rainfall in the early sown crop (r=0.04). However, in the late sown crop correlation (r=0.78) with rainfall was significant. Correlation of *M.thomsoni* with solar radiation, minimum and mean temperature were negative and nonsignificant for both early and late sown crops. Maximum temperature correlated negatively with the density of *M. thomsoni* in both early (not significant, r=-0.12) and late (significant, r=-0.66). Relative humidity correlation was positive and significant for both early and late sown crops. *N. sjostedti*: Rainfall correlation with *N. sjostedti* abundance recorded a positive but-non significant correlation (r=0.05) in both the early (0.05) the late crop Correlation with solar radiation was negative for both the early crop (r=-0.25) and the crop (r=-0.06) both were not significant. Maximum (r=-0.12 and -0.43), minimum (r=-0.15 and -0.23), and mean temperatures (r=-0.14 and -0.46) resulted in a negative and non-significant correlation in both early and late sown crops respectively. However, correlation with relative humidity was positive and significant in the early crop (r=0.51) and but non-significant (r= 0.49) in the late sown crop (**Table 1**)

D. *volkeri* There was a negative but non-significant correlation with rainfall at both early (r=-0.14) and late (r=-0.27) crops. The correlation of solar radiation with cotton stainer was positive and significant for early (r=0.717) and non-significant for late (r=0.20). Maximum temperature resulted in a positive but significant correlation in both early (r=0.73) and late (r=0.58) sown crops. For minimum temperature, however, the correlation was negative and non-significant in the early crop (r=-0.23) it was however positive and also non-significant in the late crop (r=0.07). Mean temperature resulted in a positive and non-significant correlation in both the early (r=0.40) and late (r=0.47). With relative humidity, the correlation was negative in both planting dates but significant in the early crop (r=-0.92) and non-significant in the late crop (r=-0.38). Linear regression analysis revealed that measured weather parameters had a relationship with *M. thomsoni*, *N.sjostedti* and *D. volkeri* pest abundance confirming results were obtained from the correlation analysis. Regression analysis also showed that relative humidity (r2=0.31) in the early crop while rainfall (r2=0.61), maximum /mean temperature (r2=0.44), and relative humidity (r2=0.47) affected the population of *M.thomsoni* in the late sown crop. Similarly, solar radiation (r2=0.51), maximum temperature (r2=0.53), and relative humidity (r2=0.84) influenced the t population of *D. volkeri* in the late crop whereas maximum and mean temperature influenced the population of *D. volkeri* in the late crop. *N. sjostedti* seemed to only be affected by relative humidity in both cropping seasons (**Table 2**)

DISCUSSION

Throughout the experimental period, it was observed that insect infestation commenced immediately after seedling emergence, number of insect species peaked at 11 and 13th WAP for the early and late crop. However, at harvest, the insect species number relatively decrease for both planting dates. The number of insect species and abundance of each increased with the crop's growth and increased with opportunity for finding mates, food resource and shelter which culminates in severe foliage damage especially at the late vegetative stage

M. thomsoni and Nisotra sjostedti abundance from the results increased with increase relative humidity and rainfall. A favorable positive relationship between Aphids (A. gossypii), whiteflies (B. tabaci), and mites (Polypha gotarsonemus latus Banks) and rainfall and relative humidity was reported by (Meena, et al., 2013). In another research carried out by Saini et al.,. 2017), populations of whitefly and leaf roller (*Diaphania pulverulentalis* Hampson) rose as rainfall and relative humidity increased, according to the study. According to (Rahmathulla et al., 2012) the population of whitefly and leaf roller (*Diaphania pulverulentalis* Hampson) rose as rainfall and relative humidity increased. From the results, *D. volkeri* decreased with increased in rainfall and relative humidity in also agrees with the findings of Meena *et al.,* (2013), and Patel (1992) who reported a negative correlation of Thrips (*Scirthothrips dorsalis* Hood) with relative humidity and rainfall parameters.

M. thomsoni and *N. sjostedti* decreased while *D. volkeri* increased with temperature and solar radiation increase. Saini *et al.,* (2017), reported that thrips decreased and jassids (*A. biguttula biguttula* Ishida) increased with temperature increase. Rahmathulla et al. (2012) reported that leaf roller correlated positively with temperature. Mani (2013) also reported that *D. volkeri* on some accessions of sunflower correlated positively with temperature. From the study, it can be deduced that relative humidity appeared to be one of the major factors determining the abundance of *M. thomsoni*, *N. sjostedti* and *D. volkeri*. Solar radiation and temperature also determined the population of the cotton stainer in the early crop. For late sown crop however, rainfall, maximum temperature played a major role in *M. thomsoni* abundance while maximum temperature determined *D. volkeri* abundance. *N. sjostedti* abundance was not affected by abiotic factors in the late sown crop. Rainfall can indirectly affect pest abundance by making food available for different insect species. (Christenson and Foole, 1960), the significant correlation of this insect pests with weather parameters help to develop models which can be used for either forecasting and planning of adequate control majors.

CONCLUSION

The present study concluded that the populations of *M. thomsoni, N. sjostedti*, and *D. volkeri* peaked at 9 WAP and 21 a*t pod maturity, respectively. Early crop relative humidity is closely correlated with M. thomsoni and N. sjostedti.* In the late harvest, *M. thomsoni* was positively correlated with relative humidity and rainfall, but not with maximum temperature. In early-sown crops, *D. volkeri* had a positive correlation with solar radiation, maximum temperature, and relative humidity. The maximum temperature in the late crop and *D. volkeri* have a positive and substantial correlation. Weather for late-sown crops and *N. sjostedti* were not linked. The findings of this study can be utilised to predict the harm caused by insect pests, which will help with pest management.

COMPETING INTERESTS

The authors declare that they have no competing interests

DATA AVAILABILITY STATEMENT

The raw data used to support the findings of this study are available from the corresponding author upon request.

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