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RESEARCH ARTICLE

Prevalence of major sucking pests on black pepper, *Piper nigrum* L. in relation to weather parameters

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ABSTRACT

Studies were carried out on the prevalence of sucking pests in black pepper (*Piper nigrum* L.) during 2013-2015 in ten fixed plots, at five different localities in Idukki District, Kerala, located within a radius of 25 km from the meteorological observatory of the Cardamom Research Station, Pampadumpara. The incidence of *Liothrips karnyi* was noticed from January to June and declined thereafter up to November. From January to May, the highest *Lepidosaphes piperis* population was observed, which was positively connected to maximum temperature and sunshine hours and negatively related to morning relative humidity and rainfall. *Ferrisia virgata* was prominent from January to April, and it was significantly and favourably related to sunshine hours while being adversely related to morning relative humidity. Weather conditions were responsible for 49–71%, 51%, and 34%–47% of thrips, scales, and mealybug incidences, respectively. As a result, meteorological conditions had a substantial impact on the location and quantity of sucking pest populations on black pepper.

Keywords: black pepper; correlation; multiple regressions; prevalence; sucking pests; weather parameters

INTRODUCTION

Black pepper, Piper nigrum L. (Piperaceae), is an ancient Indian spice crop. It is a valuable crop that generates large foreign exchange (CSA, 2016). Pest and disease threats at all stages of the crop have severely limited its cultivation. In India, some 56 insect pest species attack black pepper, causing root, stem, leaf, spike, and berry damage (Devasahayam et al., 1988).

Among insect pests, leaf gall thrips, scale insects and striped mealybugs were found severely infesting black pepper in the Idukki and Wayanad districts of Kerala. Banerjee et al. (1981) reported leaf thrips as the main black pepper pest in south Wayanad, Kerala. Ummer (2016) found striped mealybug, *Ferrisia virgata*, in underground black pepper parts in Idukki and Wayanad. Thrips eat on leaves, causing marginal folded galls and stunting the plant's growth and spike development.

The scale insects cause localised chlorotic patches/spots on stems and mature leaves. Mealybug infestation causes yellowing, withering, and drying of vines and berries (Devasahayam, 2000). It is largely determined by abiotic causes. Pests' reactions to weather are useful for pest management. There is no published research on insect prevalence in black pepper based on weather conditions. So a study on sucking insect population dynamics and the influence of meteorological conditions on their occurrence was done.

MATERIALS AND METHODS

Experimental site

The study was carried out consecutively for three years during 2013, 2014 and 2015 in fixed plots. Five locations were selected, which are located within a radius of 25 km from the meteorological observatory of the Cardamom Research Station (CRS), Pampadumpara Idukki District, Kerala (Figure 1). The five locations *viz*., CRS Farm, Pampadumpara, Kattappana, Erattayar and Kamakshy are nearby ones.

Observations and data analysis

The weather data such as maximum and minimum temperature (ºC), morning and evening relative humidity (%), sunshine hours (hours) and rainfall (mm) for the study period were collected from the weather station of the CRS. Observations on pest incidence were recorded from *Karimunda* pepper vines at biweekly intervals throughout the year. Each selected plot has five-year-old black pepper vines. Appropriate care was taken to keep these experimental plots devoid of any pesticide spray during the experimental period. Nine leaves per vine (covering three each from the top, middle and bottom canopy) and five vines per plot were selected for observation of both nymphs and adults. This data was correlated with the concerned current week weather parameters. The peak activity of pests denoted in the study was based on the population levels but not ETL basis.

Figure 1. Map showing five selected locations for the study

RESULTS AND DISCUSSION

The prevalence as well as simple correlation and multiple regression coefficients estimated between the pest population and meteorological parameters with appropriate standard weeks for three subsequent years, 2013, 2014 and 2015, are furnished here in detail.

Leaf gall thrips (*Liothrips karnyi Bagnall*)

The incidence of leaf gall thrips population (0.2 to 1.0 number/9 leaves) for the year 2013 was evidenced from January to June and thereafter found to decline up to November. The occurrence (0.04 to 1.93 numbers/9 leaves) was ensured for the months January to April, June and September to December during 2014. The activity was seen throughout the year (0.27 to 1.0 number/9 leaves), but peak activity was observed from January to June 2015. The peak occurrence was registered six times (3rd, 9th, 13th, 21st, 41st and 49th standard weeks), six times (5th, 13th, 17th, 27th, 41st and 49th standard weeks) and eight times (9th, 13th, 21st, 25th, 29th, 37th, 43rd and 47th standard weeks) during the years 2013, 2014 and 2015 respectively (Figure 2). The present findings are in accordance with Devasahayam et al. (2010), who opined that leaf gall thrips infestation of black pepper was highest during monsoon periods (June to September). Similarly, Sathyan et al. (2017) observed maximum thrips population during January to February and November to December in cardamom, which shows partial agreement with our results.

Correlation analysis revealed that thrips had a significant negative association with morning relative humidity and rainfall whereas positive matching with sunshine hours (Table 1).

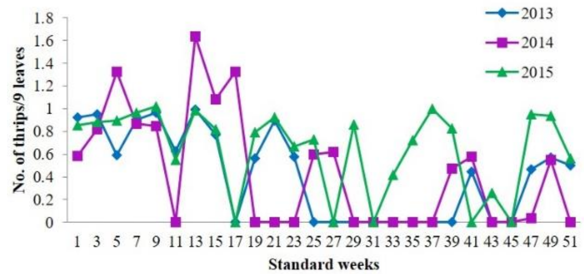

Figure 2. Population fluctuation of leaf gall thrips in black pepper

Multiple regression analysis showed that rainfall influenced the thrips population by 49 per cent (R^2 = 0.4857), and a unit decrease in rainfall increased the thrips population by 0.01 number in 2013 (Table 2). During 2014, morning relative humidity alone contributed about 51 per cent (R^2 = 0.5109) to the thrips population and a unit increase in morning relative humidity hindered the thrips population by 0.05 number. Rainfall and sunshine hours together influenced the thrips population in 2015 by 71 per cent (R^2 = 0.7060). A unit increase in rainfall and sunshine hours inhibited thrips population by 0.01 number and enhanced by 0.08 number respectively. The present results are in harmony with Sathyan et al. (2017), as rainfall alone contributed to 41 per cent for the occurrence of thrips and also rainfall and relative humidity are negatively correlated with thrips population in cardamom.

Table 1. Estimated correlation co-efficient between weather parameters and incidence of sucking pests in black pepper

Pest	Year	Max. Temp. (ºC)	Min. Temp. (ºC)	RH (Mor.) (%)	RH (Eve.) (%)	SH (hours)	Rainfall (mm)
Leaf gall thrips	2013	0.50**	-0.15NS	-0.47*	-0.23NS	0.76**	-0.70**
	2014	0.7NS	-0.10NS	-0.72**	-0.58**	0.70**	-0.62**
	2015	0.04NS	0.06NS	-0.26NS	-0.07NS	0.65**	-0.80**
Mussel scales	2013	0.47*	-0.22NS	-0.33NS	-0.07NS	0.76**	-0.51**
	2014	0.43*	-0.01NS	-0.63**	-0.62**	0.64**	-0.44*
	2015	0.25NS	0.14 NS	-0.72**	0.01NS	0.54**	-0.43*
Striped mealybugs	2013	0.23NS	-0.57**	-0.58**	-0.39NS	0.67**	-0.37NS
	2014	0.34NS	-0.15NS	-0.50**	-0.52**	0.55**	-0.33NS
	2015	0.34 NS	0.25 NS	-0.48*	0.06 NS	0.51**	-0.33NS

Note: SH: Sunshine Hours; RH (Mor.): Relative Humidity (Morning); RH (Eve.): Relative Humidity (Evening); Max. Temp: Maximum temperature; Min. Temp: Minimum temperature. * - Significant at 5% level; ** - Significant at 1% level; NS - Non-Significant.

Table 2. Influence of weather parameters on sucking pests of black pepper

Pest	Year	Variable	Mean	Regression Coefficient	Standard error	Probability	Intercept	R^2 value
Leaf gall thrips	2013	Rainfall	0.41	0.00	0.01	7.63E-05	0.62	0.4857
	2014	RH (Mor.)	0.44	-0.05	0.01	4.09E-05	4.59	0.5109
	2015	SS Hours	0.64	0.08	0.03	0.0265	0.52	0.7060
		Rainfall	0.64	-0.01	0.00	0.0001	0.52	0.7060
*Mussel scales	2015	RH (Mor.)	0.10	-0.09	0.02	3.9E-05	8.57	0.5121
*Striped mealybugs	2013	Min. T.	0.07	-0.03	0.01	0.0023	0.64	0.3261
	2014	Max. T.	0.02	0.01	0.00	0.0002	-0.03	0.4694
		Min. T.	0.02	-0.02	0.00	0.0007	-0.03	0.4694

*Since some of years were left out in the table due to non-significant contribution of weather parameters in the concerned years.

Mussel scales (*Lepidosaphes piperis* Green)

The occurrence of mussel scales was found during the months of January to May (0.02 to 0.5 number/9 leaves) during 2013, January to April (0.07 to 0.36 number/9 leaves) during 2014 and January to March (0.02 to 0.7 number/9 leaves) during 2015. The crest prevalence was recorded four times (3rd, 9th, 13th and 21st standard weeks), two times (5th and 15th standard weeks) and four times (9th, 13th, 37th and 43rd standard weeks) during the years 2013, 2014 and 2015 accordingly (Figure 3). Koya and Devasahayam (1995) observed that the population of *L. piperis* at Kalpetta was seen during summer (February-May). This result has close conformity with the present findings. The parallel outcome from Suresh and Kavitha (2007) as the peak activity of coffee scale, *Saissetia coffeae* was noticed during February to March, which also supports our report.

During the study period, there was a positive correlation between mussel scale and maximum temperature, and a negative correlation with morning relative humidity and rainfall (Table 1). The multiple regression scrutiny exposed that; morning relative humidity influenced the scale population by 51 per cent (R^2 = 0.5121) during 2015 (Table 2). None of the above weather factors significantly contributed towards the occurrence of scale insects during 2013 and 2014. The result obtained was in close agreement with Suresh and Kavitha (2007), where rainfall greatly diminished the occurrence of scale insects. Similarly, Devasahayam et al. (2010) proved that rainfall had deleterious effect on *L. piperis* and *A. destructor* in black pepper.

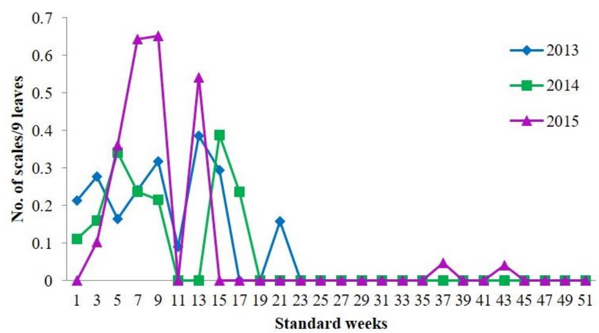

Figure 3. Population fluctuation of mussel scales in black pepper

Striped mealybug (*Ferrisia virgata* Cockerell)

The seasonal abundance of striped mealybugs was found during January to March during 2013 (0.32 to 0.48 number/9 leaves) and 2015 (0.02 to 0.54 number/9 leaves) and January to April during 2014 (0.02 to 0.2 number/9 leaves). The mealybug population hiked thrice (3rd, 7th and 13th standard weeks), two times (5th and 15th standard weeks) and three times (9th, 13th and 37th standard weeks) during 2013, 2014 and 2015 respectively (Figure 4).

The present finding is in alignment with Shanbhag and Sundararaj (2017). Ummer (2016) registered that root mealy bug infestation in black pepper was highest during cooler months (November to January) and lowest during rainy months (June and July). This information further authenticates the results of our study.

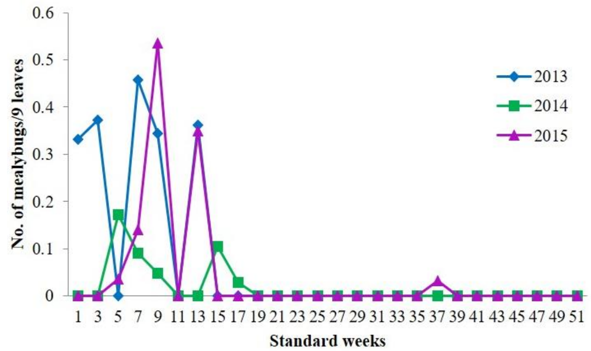

Figure 4. Population fluctuation of striped mealybugs in black pepper

The simple correlation coefficients between mealybug and weather parameters conveyed a positive association with sunshine hours whereas, a negative relationship was found with morning relative humidity (Table 1). Multiple regression analysis showed that minimum temperature influenced the mealybug population by 33 per cent (R^2 = 0.3261), and a unit decrease in minimum temperature increased the mealybug population by 0.03 number in the year 2013 (Table 2). During 2014, maximum temperature and minimum temperature influenced the mealybug population by 47 per cent (R^2 = 0.4694). During 2015, none of these weather factors significantly influenced the mealybug incidence. This finding is partially in line with Karar et al. (2013), who brought out about 24.7% maximum and minimum ambient temperatures and relative humidity towards the abundance of mealybugs in mango. Shanbhag and Sundararaj (2017) also detected that *F. virgata* had a negative correlation with relative humidity. This is in line with our results.

CONCLUSION

The study concluded that weather factors regulate pest population growth in black pepper. These data can be utilised to construct weather-based forecasting models for pest management tactics against black pepper insect pests, ensuring timely pest control.

DISCLOSURE STATEMENT

No any potential conflict of interest was reported by Authors.

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