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Impact of weather parameters on seasonal incidence of black pepper root Mealybug, *Formicococcus polysperma* Williams under hill zone of Karnataka

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Abstract

The present investigation was undertaken to find the impact of weather factors on seasonal incidence of sucking pest of black pepper under field conditions during 2017-18 & 2018-19. The incidence of root Mealybug population 5.36 and 6.93 colonies per 15 cm root length was observed during 2017-18 & 2018-19, respectively, with an average population of 6.14. the incidence was noticed throughout the year and reached peak by 40th standard week (18.80 & 8.10 mealy bug colonies/15cm root length) (*i.e.* October & November) confirming the infestation during post rainy season coinciding drier months with relative humidity (84%) in soil favouring the pest population and lowest population in March (2.40). The per cent infestation of pepper vines ranged from 21 to 48 per cent with an average per cent damage of 31.79%. There was a strong positive correlation was observed between rainfall, relative humidity, maximum temperature and root mealy bug population.

Keywords: *Piper nigrum*, weather, incidence, sucking pest, alkaloids

Introduction

Black pepper (*Piper nigrum* L.) is a vine belongs to family Piperaceae, cultivated for its fruit which is usually dried and used as a spice. It is popularly known as King of spices which is native to South India and is extensively cultivated there and elsewhere in tropical and sub-tropical regions. Dried ground pepper has been used since antiquity both for its flavour and as a traditional medicine. Black pepper is the world's most traded spice and is one of the most common spices added to cuisines around the world. Its spiciness is due to the chemical piperine, not to be confused with the capsaicin characteristic of chilli peppers. It is ubiquitous in the modern world as a seasoning and is often paired with salt (Srinivasan, 2007) ^[10]. The alkaloids and flavonoids in pepper are used in Ayurvedic medicines for sedating, detoxification, hypotensive and anticancer activities (Yoon *et al.*, 2015) ^[11]. As of 2013, Vietnam was the world's largest producer and exporter of black peppercorns, producing 1,63,000 tones or 34 per cent of the world total of 4,73,000 tones. Other major producers include Indonesia (19%), India (11%) and Brazil (9%). Global pepper production may vary annually according to crop management, pests, disease and weather.

Insect pests are the major threat to the pepper production accounting for huge seasonal loss. Thirty four insect pests has been reported to infest black pepper in India. Among the insect pests major ones are pollu beetle (*Longitarsus nigripennis* Auctt), marginal gall thrips (*Liothrips karnyi* Bagnall) and top shoot borer (*Scirpophaga novella* Fabricius). The leaf feeders and sap feeders like scales and mealy bugs were grouped as minor pests (Devasahayam *et al.*, 1998) ^[2]. Mealy bugs are major insect pests of black pepper plantations in India. Twelve species of mealy bugs infesting black pepper have been identified by researchers at the Indian Institute of Spices Research (IISR), Marikunnu, Kozhikode. Among them the root mealy bugs are the most severe. (Devasahayam *et al.*, 2010) ^[3]

Root mealy bugs are small species found below the soil surface, and feed on root and root hairs in numerous plants. They are also called soil mealy bugs and subterranean mealy bugs. Infestations frequently are not detected as the pests occur in the soil, and populations are quite slow to develop, with three to six months occurring before infestations are easily visible. Careful examination of infested roots will reveal white, cotton-like masses. These

white masses contain both mature females and egg masses. Infected plants become wilted and stunted with yellowing of leaves or chlorosis (Beltra *et al.*, 2013; Khan *et al.*, 1998) ^[1, 5]. Vines infested by the bugs are often attacked by fungal pathogens and nematodes which cause mortality of vines. The present study was undertaken to assess the severity of black pepper root mealybugs and favouring abiotic factors in Hill zone of Karnataka.

Materials and methods

Seasonal incidence of black pepper root mealybug was carried in well-established black pepper field located at Halekote village, Mudigere taluk of Chikkamagaluru district for two years 2017-18 and 2018-19. Mudigere is located in Western Ghats of Karnataka at an elevation of 970 m above MSL. The research station is located at 13° 07' 48.00" N Latitude and 75° 37' 48.00" E Longitude. According to India Meteorological Department the four seasons are winter, summer, monsoon and post monsoon. April-May is the warmest month in the year with highest mean maximum temperature (30.3 °C) and December is the coldest month in the year with lowest mean minimum temperature (16. °C). The average annual rainfall ranges from 3000 mm to 3500 mm. The soils are acidic with medium organic carbon and low phosphorous and potassium content.

In the study site the crop was kept free from insecticidal application and all other recommended cultural practices were followed during the period of study. The observations of root mealy bug infested vines were recorded at monthly interval for two year. Twenty vines infested with mealy bugs were selected from the field and tagged randomly. The observations were made on the tagged vines at monthly interval. Number of mealy bug populations on 15 cm root length of vines with symptoms of damage was recorded. The average number of mealy bugs per vine on 15cm root length were counted and expressed as number of mealy bugs per 15cm root length.

The data on the influence of abiotic factors (meteorological parameters) on seasonal incidence, the meteorological data on maximum and minimum temperature, relative humidity, sunshine hours and rainfall data were recorded during the experiment period from the agrometeorological observatory installed at Zonal Agricultural and Horticultural Research Station, Mudigere. The simple correlation coefficient was studied between root mealy bug population and weather parameters.

Results

Seasonal incidence of pepper root mealy bugs during 2017-18 & 2018-19 in mudigere

Results during 2017-2018 on black pepper root mealybug revealed that the infestations occurred throughout the year with an average mean number of mealy bugs of 5.36 per 15cm root length. However, the peak infestation varied from season to season. The mealybugs exhibited peak infestation on root zone during October month with mean of 18.2 number of mealy bug/15cm root and lowest population in March (1.20). The per cent infestation ranged from 20 to maximum of 50 per cent by showing the symptom of yellowing of vines, with an average per cent infestation of 31.25 (Table 1).

Similarly root mealy bug population on black pepper vines during 2018-19 showed the population existence throughout the year with peak incidence during post monsoon i.e. October and November month with 19.40 and 13.20

colonies per 15 cm root length and lowest was observed during summer in march (2.40 colonies). The population infestation ranged from 20 to maximum of 46 per cent with an average per cent infestation of 32.33.

A positive correlation existed between root mealybug population with relative humidity and rainfall. It has been observed that during post monsoon *i.e.* September and October months had severe mealybug population with high damage (48%). During monsoon and summer season the mealybug population was low with an average damage of 31.79 per cent of vines. The mealy bug population and damage indicates that there are two peaks of population in a year during June and October months.

Discussion

The pooled data of 2017-18 & 2018-19 observed that the population of mealy bugs on roots of black pepper was higher during post monsoon season with 18.80 & 8.10 colonies per 15 cm root length showing heavy amount of rainfall associated with monsoon season didn't have any effect on mealybug population in pepper plantation. The relative humidity of 84.85% with a maximum temperature of 28 °C favoured the mealy bug population build-up in soil on roots of black pepper. There was a distinct variation in per cent damage in two peaks of a year during June and October month is considered as a temporal scale for development of forewarning model. During maximum month damage (October) registered higher per cent damage (48%) whereas, lower peak with 21 per cent damage observed during January. The per cent infestation of pepper vines ranged from 21 to 48 per cent with an average per cent damage of 31.79% (Table 2). The peak per cent damage was observed during October & November months and low during January, February and March months of the year. Similarly, Singh and Kumar (2012) ^[9] & Jat *et al.*, (2014) ^[4] reported *Planococcus solenopsis* (Tinsley) infestation was higher in the month of October on cotton and okra. Ngeve (2003) ^[7] also mentioned that the cassava root mealybugs' impact was higher during the dry season.

Correlation with weather parameters

The correlation studies indicated that, the climatic parameters had significant positive correlation with temperature Maximum and minimum (0.40 and 0.08, respectively) and positive correlation with relative humidity and rainfall (0.11 and 0.53, respectively) (Table 3, fig.1). A significant positive correlation existed between root mealybug population with relative humidity and rainfall. It has been observed that during post monsoon *i.e.* September and October months had severe mealybug population with high damage (48%). During monsoon and summer season the mealybug population was low with an average damage of 31.79 per cent of vines. The mealy bug population and damage indicates that there are two peaks of population in a year during June and October months which corresponds to spike initiation and fruit setting stage of black pepper. Similarly, Mani (1986) ^[6] observed a positive and significant correlation of the grape mealy bug population with maximum temperature and negative correlation with the relative humidity. The relative humidity of 85% with a maximum temperature of 29 °C favoured the mealy bug population build-up in soil on roots of black pepper. The

regression analysis had 48 per cent good fit with root mealy bug population and weather parameters. The results were close to findings of Shreedharan *et al.*, 1989^[8] who reported the association of weather factors temperature and relative

humidity with the population dynamics of green bug and mealy bug in orange in Shevroy hills of Tamil Nadu during dry periods which had high population and damage.

Table 1: Seasonal incidence and per cent infestation of root mealy bug on black pepper during 2017-18 & 2018-19

Months	2017-18		2018-19		Pooled	
	No. of mealy bug/15cm root	Per cent infestation (%)	No. of mealy bug/15cm root	Per cent infestation (%)	No. of mealy bug/15cm root	Per cent infestation (%)
April	3.00	30.00	4.60	28.00	3.80	29.00
May	4.80	30.00	5.20	36.00	5.00	33.00
June	6.50	35.00	5.80	35.00	6.15	35.00
July	7.30	30.00	6.80	30.00	7.05	30.00
August	4.20	30.00	3.80	30.00	4.00	30.00
September	5.10	40.00	5.60	35.00	5.35	37.50
October	18.20	50.00	19.40	46.00	18.80	48.00
November	3.00	35.00	13.20	52.00	8.10	43.50
December	2.83	20.00	6.80	28.00	4.82	24.00
January	3.62	20.00	4.36	22.00	3.99	21.00
February	4.62	25.00	3.94	20.00	4.28	22.50
March	1.20	30.00	3.60	26.00	2.40	28.00
Average	5.36	31.25	6.93	32.33	6.14	31.79

Table 2: Pooled data on Seasonal incidence of root mealy bug on black pepper and weather parameters during 2017-18 & 2018-19

Months	No. of mealy bug /15cm root	Per cent infestation (%)	Rainfall (mm)	Relative Humidity (%)	Temp. Max	Temp. mini
April	3.80	29.00	77.20	72.43	31.60	21.82
May	5.00	33.00	223.65	84.69	29.48	19.93
June	6.15	35.00	501.75	83.75	24.76	20.71
July	7.05	30.00	506.35	85.27	24.09	19.92
August	4.00	30.00	445.70	84.95	24.33	19.39
September	5.35	37.50	160.00	84.75	25.15	19.37
October	18.80	48.00	89.95	84.85	28.05	19.30
November	8.10	43.50	17.70	84.50	29.58	22.05
December	4.82	24.00	11.35	80.87	28.25	19.19
January	3.99	21.00	0.00	80.47	30.05	19.22
February	4.28	22.50	4.65	82.09	31.13	19.53
March	2.40	28.00	14.70	84.13	33.29	20.05
Average	6.14	31.79	171.08	82.72	28.31	20.04

Table 3: Correlation coefficient and regression analysis of pepper root mealy bugs with weather parameters

Sl. No.	Parameters	Correlation coefficient
1.	Rainfall (mm)	0.53*
2.	Relative Humidity (%)	0.11*
3.	Maximum temperature (°C)	0.40*
4.	Minimum temperature (°C)	0.08*
6.	R ²	0.48

*Significance at 5% level.

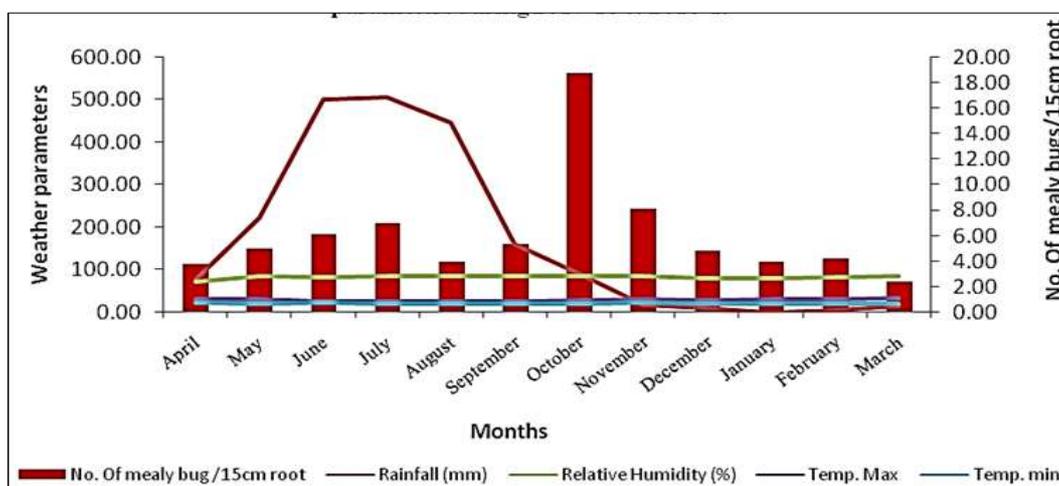


Fig 1: Pooled data on seasonal incidence of black pepper root mealy bugs and weather parameters during 2017-18 & 2018-19

Conclusion

In the present study, there is an increasing trend of annual damage of root mealy bug in black pepper in Karnataka with the possibility of increasing damage of mealy bug in the future due to climate change. The present experiment provides an insight into the population dynamics of the insect pest of black pepper. It can be concluded that seasonal population fluctuations of root mealy bug on black pepper crops are greatly influenced by abiotic factors and peak population levels were observed during the months of October to November. Seasonal incidence of root mealy bug population was observed throughout the year, but the peak incidence was higher during the month of October (18.80 mealy bug colonies/15cm root length) confirming the infestation during the post-rainy season with drier months. Relative humidity in soil favours the pest population. There was a strong positive correlation observed between rainfall, relative humidity, maximum temperature and minimum temperature. Further, the study has to be replicated in hilly zones to find out whether temperature and relative humidity are dominant parameters controlling mealy bug population and damage in black pepper.

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