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Influence of weather parameter on flowering and fruiting spike of medicinal plant *Piper longum* L. in Assam, India

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ABSTRACT : The present investigation was carried out in the Experimental farm, Department of Horticulture, Assam Agriculture University (AAU), Jorhat to investigate the relationship between meteorological parameters and spike development of *Piper longum* L. in Assam, during 2013 and 2014. The present finding revealed that highest numbers of flowering spike (92.59) in *P. longum* could be obtained in the month of September which finally gave rise to maximum fruiting spike (80.73) per plant in the month of December. The result indicated that meteorological parameters have also a great influence on the number of flowering and fruiting spike per plant. As the numbers of flowering spike per plant showed significant negative correlation with maximum temperature (r= -0.554 and -0.566), rainfall (r= -0.638 and -0.623) for the years 2013 and 2014, respectively. However, the findings indicated that numbers of fruiting spike per plant showed significant negative correlation with maximum temperature (r= -0.747 and -0.677), minimum temperature (r= -0.704 and -0.708) and rainfall (r= -0.738 and -0.593) in 2013 and 2014, respectively. This present findings would be helpful for climate based crop cultivation to increase the production and productivity as the crop has a high demand in pharmaceutical market.

KEY **W**ORDS : Medicinal plant, *Piper longum*, Spike caharacters, Meteorological parameters, Correlation

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Piper longum L. is a medicinal shrub with large woody root and numerous creeping, jointed stem, thickened at the node. It belongs to the family Piperaceae. *P. longum* produce two types of branches vegetative branches (Orthotropic) that creep and spread and fruiting branches(Plagiotropic) that are erect. Indian long pipper is also known as Pipli, Pipar, Pipal (Hindi), Hippali, Thippali balli (Kannada), Tippali, Pippali (Malayalam), Pimpli (Marathi), Pippli, Tippili (Tamil), Pippallu, Pippali (Telegu), Pippali, Kana, Ushana (Sanskrit) (Sumy *et al*., 2000). The plant is a dioecious slender aromatic climber with perennial woody roots, or perennial creeper under shrub. The plant grows all over India, in evergreen forests of Western Ghats from Kankan to Tranvorcore and is also found in Assam, Khasi and Mikir hills, lower hills of West Bengal. In different agro-climatic regions of the country a number of geographical races exist. The main sources of supply being Assam and West Bengal and small quantities are being collected from Kerala (Manoj *et al.,* 2004). It is a shade loving plant but, for better fruiting, 50 per cent shade is best (Sumy *et al*., 2000).

Fruits and roots of *P. longum* contain a number of constituents including alkaloids, isobutyl amides, essential oils, lignans and esters. Out of these piperine ($C_{17}H_{19}NO_3$) is the primary constituent and reported to be imparting medicinal value for these spices. The essential oil of the fruit of *P. longum* is a complex mixture of three major components which are (excluding piperine) caryophyllene, pentadecane (both about 17.8%) and bisaboline (11%).

It has been observed that weather factors like temperature, relative humidity, BSSH and rainfall have great impact on production of many economically important crops according to the area of cultivated region. Knowledge on the characteristics of *P. longum* varieties, environmental conditions, climate and soil conditions where the *P. longum* plants grow is a pivotal consideration in the cultivation of this in Assam.

Hence, observing its demand in therapeutics as well as in trade and variability in production due to different climatic condition, the present study was undertaken to assess the impact of weather parameters on number of flowering and fruiting spike which ultimately affect the final yield of *P. longum* in Assam, India.

RESEARCH PROCEDURE

The present investigation was carredout in Assam Agricultural University (AAU), Jorhat in 2013 and 2014.

Experimental site :

The experimental site was situated at 26°47'N latitude and 94°12'E longitude having an elevation of 86.8 m above mean sea level. The prevailing climatic condition of Jorhat is humid subtropical with hot summer, cold winter and high relative humidity. The meteorological observations during the period of experimentation were as recorded at the meteorological observatory of the university. The soil of the experimental site belonged to the order inceptisoil and derived from the alluvial deposits of the river Brahmaputra.

Selection of *Piper longum* variety :

Piper longum variety "Viswam" collected from Kerala Agricultural University, Kerala was considered for the study. Being dioecious in nature a common *P. longum* male plant was also included as an experimental material. The crop *P. longum* needs heavy manuring *i.e.* twenty (20) tons of farm yard manure (FYM) along with recommended dose of N:P:K per year for optimum growth and yield of the crop. The half of the total dose of N_2 and entire dose of P_2O_5 and K_2O was given as basal doses and the remaining half of N_2 was given as top dressing in the first year.

Design and layout of the experiment :

The experiment was laid in Randomized Block Design with eight replications in a net area of 64 sqm. There were sixteen plots having individual plot size of 2m x 2m. Planting of crop was done at a spacing of 60cm x 60cm (Plant to plant and row to row). Before planting the individual pits were filled with 100 g compost by mixing with soil. The rooted cuttings were planted in pits at the rate of two numbers per pit. Gap filling was done as per the need till one month after planting. The crop usually rose as rainfed but irrigation during dry season (Nov.-Mar.) was given for continuous spike formation.

Data collection :

Data on number of flowering and fruiting spike were observed on ten randomly selected plant from each plot at weekly interval and monthly mean was calculated at both flowering and fruiting spike for both the years.

Statistical analysis :

A statistical design, RBD was followed for data collated on number of flowering and fruiting spike of *Piper longum* plant under field. A simple correlation analysis was made between the mean number of flowering and fruiting spike and weather factors like temperature (maximum and minimum), relative humidity (morning and evening), total rainfall and bright sunshine hours (BSSH). All the collected data were subjected to statistical analysis by using SPSS-16 computer based software.

For correlation studies, monthly average values of the environmental factors were taken into consideration to know their influence on the number of flowering and fruiting spike.

RESEARCH ANALYSIS AND REASONING

Data on number of flowering and fruiting spike were observed at weekly interval and monthly mean was calculated on both flowering and fruiting spike for the years 2013 and 2014 (Table 1).

Flowering spike per plant :

The perusal of the experimental data presented in Table 1 and Fig. 1 and 2 showed variation in number of flowering spike per plant. The number of flowering spike per plant ranged in between 43.0 - 91.55 and 43.22 – 92.59 in 2013 and 2014, respectively. The highest number of flowering spike per plant (91.55 and 92.59) was recorded in the month of October of 2013 and 2014 respectively, whereas lower number of flowering spike (43.0) was recorded in the month of September of 2013 and 43.22 in the month of November in 2014. There was a fluctuation in number of flowering spike per plant throughout the year. The variation in numbers of flowering spike per plant may be due to effect of weather parameters during spike initiation period (Rajamani, 2001) that confirmed the present findings.

Correlation study of flowering spike per plant with meteorological parameters :

Simple correlation studies were carried out between the flowering spike per plant with meteorological parameters *viz*., maximum temperature, minimum temperature, morning relative humidity, evening relative humidity, bright sunshine hours (BSSH) and rainfall (RF) in both 2013 and 2014 (Table 1).

The co-efficients of correlation studies are presented in Table 1. The data indicated that numbers of flowering spike per plant showed significant negative correlation with maximum temperature (r= -0.554), rainfall (r= -0.638) and non-significant negative correlation with minimum temperature (r= -0.511), however, morning relative humidity (r=0.214) and BSSH (r=0.382) showed a non-significant positive correlation with numbers of flowering spike per plant. On the other hand evening relative humidity (r= -0.180) showed non-significant negative correlation with flowering spike per plant.

Similar result was also obtained in 2014 where maximum temperature (r= -0.566), minimum temperature (r= -0.629) and rainfall (r= -0.623) showed a significant negative correlation with numbers of flowering spike per

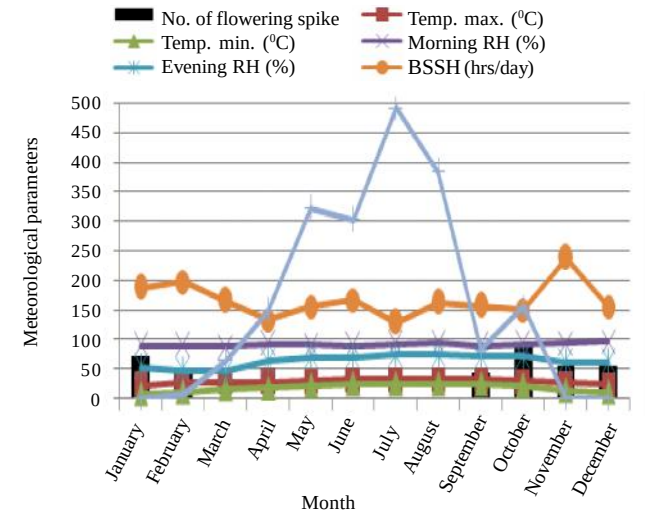

Fig. 1 : Number of flowering spike in response to meteorological parameters in 2013

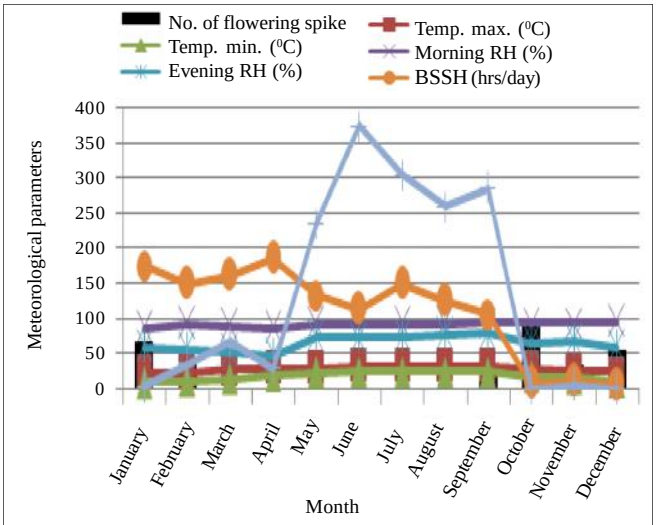

Fig. 2 : Number of flowering spike in response to meteorological parameters in 2014

Table 1 : Correlation of meteorological parameters with numbers of flowering and fruiting spike in *P. longum*

Spike number	Maximum Mean	Meteorological parameters					
		Temp. max. (°C)	Temp. min. (°C)	Morning RH (%)	Evening RH (%)	BSSH (hrs/day)	Av. RF (mm)
2013							
No. of flowering spike/plant	91.55	- 0.554*	- 0.511	0.214	- 0.180	0.382	- 0.638*
No. of fruiting spike/plant	79.73	- 0.747*	- 0.704*	0.336	- 0.314	0.408	- 0.738*
2014							
No. of flowering spike/plant	92.59	- 0.566*	- 0.629*	0.271	- 0.170	0.539	- 0.623*
No. of fruiting spike/plant	80.39	- 0.677*	- 0.708*	0.331	- 0.189	0.516	- 0.593*

* indicates significance of value at P=0.05

plant (Table 1). However, morning relative humidity (r= 0.271) and BSSH (r= 0.539) showed a non-significant positive correlation with numbers of flowering spike per plant. A non-significant negative correlation was observed with evening relative humidity (r= -0.170) with spike number per plant in 2014. The result confirmed that at moderate BSSH (not too low and not too high), maximum numbers of flowering spike in *P. longum* can be obtained. The present findings is in conformity with Das *et al.*(1976) who reported that a moderate BSSH (not too low and not too high) is required for formation of spike in black piper, *P. nigrum*.

Fruiting spike per plant :

The number of fruiting spike per plant ranged in between 40.01 to 79.73 and 32.89 to 80.73 in 2013 and 2014, respectively and presented in Table 1. The highest number of fruiting spike per plant (79.73 and 80.73) was recorded in the month of December for both the year 2013 and 2014, respectively. However, lowest number of fruiting spike per plant (40.01) was observed in the month of September in 2013 and 32.89 number of fruiting spikes per plant was found in November, 2014. The variation in fruiting spike was also reported by Rajamani (2001) that number of fruiting spike per plant ranged from 54.90 to 95.40 numbers which confirmed the present finding.

The increased in number of spike may be due to the growing environment that affect pollination whereby increase the total production of *P. longum*. Ibrahim *et al*. (1987) reported that spike number in black pepper as important traits for increase yield.

Correlation study of fruiting spike per plant with meteorological parameters :

The co-efficients of correlation studies are presented in Table 1 and Fig. 3 and 4. The data indicated that numbers of fruiting spike per plant showed significant negative correlation with maximum temperature (r= -0.747), minimum temperature (r= -0.704) and rainfall (r= -0.738), however, morning relative humidity (r=0.336) and BSSH (r=0.408) showed a non-significant positive correlation with numbers of fruiting spike per plant. On the other hand evening relative humidity (r= -0.314) non-significant negative correlation with the number of fruiting spike per plant.

In the year 2014, maximum temperature (r= -0.677), minimum temperature (r= -0.708) and rainfall (r= -0.593)

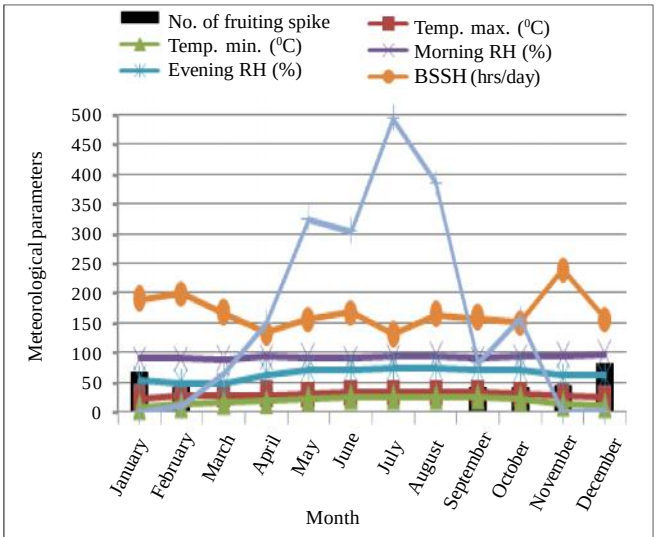

Fig. 3 : Number of fruiting spike in response to meteorological parameters in 2013

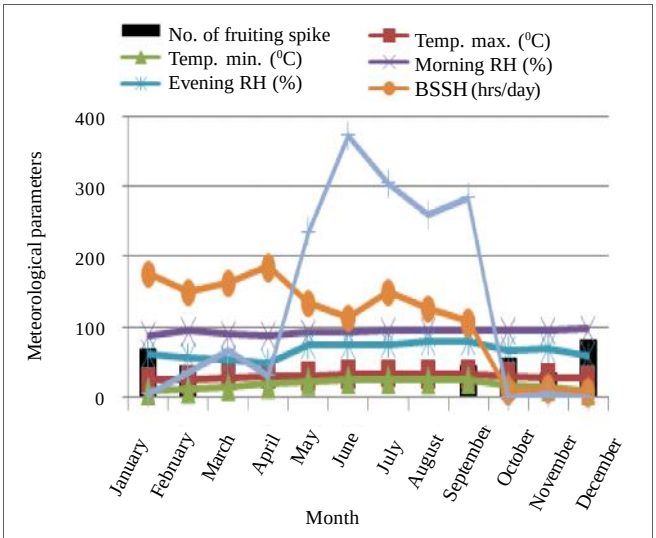

Fig. 4 : Number of fruiting spike in response to meteorological parameters in 2014

showed a significant negative correlation with numbers of fruiting spike per plant (Table 1) whereas, morning relative humidity (r=0.331) and BSSH (r=0.516) showed a non-significant positive correlation with numbers of fruiting spike per plant. However, a non-significant negative correlation in fruiting spike per plant was observed with evening relative humidity (r= -0.189). Krishnamurthy *et al.* (2011) also reported that higher temperature has a decreasing trend in productivity in black piper which confirms the present findings. The result confirmed that to obtain more numbers of fruiting spike

in *P. longum* requires a moderate BSSH (not too low and not too high). Similar observation was also reported by Das *et al.* (1976) in black piper, *P. nigrum*.

Conclusion :

From the present finding it can be concluded that maximum numbers of flowering spike in *P. longum* could be obtained in the month of September in Assam which finally gave rise to fruiting spike in the month of December. It can also be concluded that meteorological factors had also a great influence on the number of flowering and fruiting spike per plant. which actually are the yield attributing character of *P. longum*. Based on the present findings of correlation with meteorological factors one can go for cultivation of this crop to increase their production and productivity as the crop has a high demand in pharmaceutical market. This information is important for the policy of further development of *P. longum* plantation area in the country. However, production of *P. longum* will be facing an uncertainty in the context of climate change driven by global warming in the future. Development of a certain varieties that are adapted to such environment may provide a solution for the future of *P. longum* plantation.

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