

Short Communication

Influence of weather parameters on sex expression and flowering pattern of nutmeg (*Myristica fragrans* Houtt.)

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Nutmeg (*Myristica fragrans* Houtt., family-Myristicaceae) is a source of twin spice- nutmeg (dried seed) and mace (dried aril covering the seed). Nutmeg, with a dioecious habit has been differentiated into five types viz., pure female, pure male, bisexual female, bisexual male, and hermaphrodites. Every species of plant has different flowering response to the environment (Thomas 1993; Ravindra *et al.*, 2006). The climatic variables play an important role in sex expression of nutmeg. Flach and Crucikshank (1969) observed year round production of flowers and fruits on nutmeg trees in Grenada with abundant production in the months of April, May, November and December. In this paper an attempt was made to analyze the influence of weather parameters on the flowering pattern of nutmeg in Kerala and Karnataka states of India.

The study was conducted during 2015 at two locations viz., ICAR -Indian Institute of Spices Research (IISR), Kozhikode, Kerala (humid tropical climate with 11°15'N Latitude, 75°43' E Longitude and altitude 30 MSL) and ICAR-IISR Regional Station, Appangala, Karnataka (Sub humid tropical climate with 12° 26'N Latitude, 75°45' E Longitude and altitude 920 MSL). The study population consists of 52 and 20 nutmeg trees selected randomly from Kozhikode and Appangala germplasm, respectively including male, female and monoecious types.

The monthly flowering pattern and sex expression of individual trees were studied from January to December 2015. As reported by Arthi *et al.* (2015) the sexes of flowers were differentiated and recorded at monthly interval by collecting a maximum of 100 flowers (depending on the availability) from each tree and dissected out for the identification of sex. Weather parameters such as rainfall (mm), rainy days, temperature maximum (°C), temperature minimum (°C) and relative humidity (%) were recorded every month from well maintained agro meteorological observatory situated at both the locations. The multiple

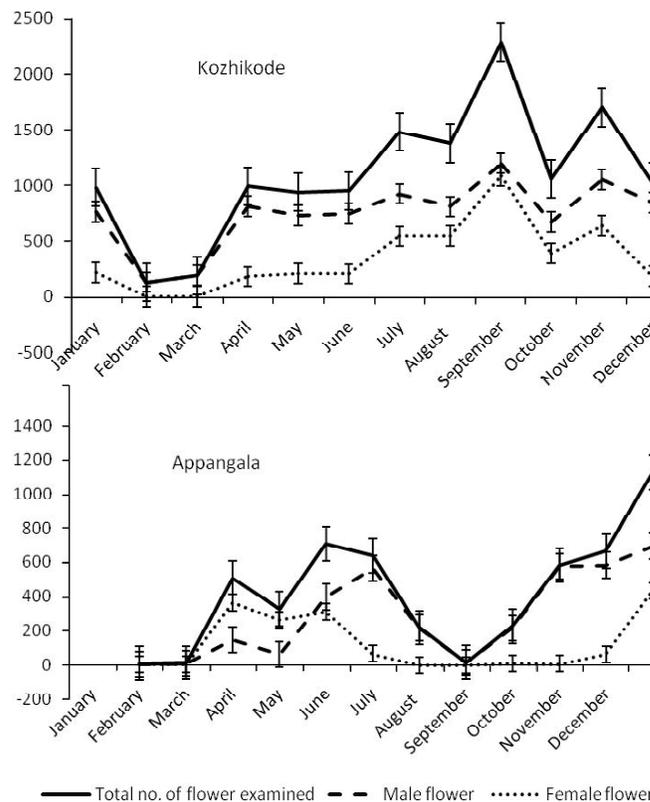


Fig. 1: Flowering pattern at Kozhikode and Appangala (Vertical bar indicates Standard Error)

regression coefficient was used to quantify the relationship between the flowering pattern and the meteorological parameters which were analysed using SAS 9.3 software.

Based on the phenological observations, the study revealed prominent difference in sex expression of nutmeg flowers across the month in a year at two locations. Generally at two locations, the male flowers were seen throughout the year with variation in the period of their lean production. At Kozhikode, the peak female flower production was observed in the month of September whereas, at Appangala, it was in the month of December and March (Fig. 1).

The bisexual flowers were observed in July and August

Table 1: Estimate of multiples regressions co-efficient of flowering pattern on weather parameter in nutmeg

Regression relationship	Kozhikode			Appangala		
	Male	Female	Bisexual	Male	Female	Bisexual
Intercept	-4598.21	-4029.16	77.36	2011.34	-117.52	38.87
Tmax	94.03	44.83	0.21**	-93.91**	17.51	-1.63
Tmin	-160.20	-118.21	1.77	142.98**	72.77*	1.622
RH	73.13	69.08	-0.29	-17.97	-20.21*	-0.20
RF	-2.05	-1.56	-0.01*	0.48*	0.12	0.01
RD	40.79	26.53	0.21	-29.05*	3.38	-0.56
R ²	0.56	0.57	0.85*	0.90**	0.82*	0.43

* Significant @ P = 0.05; ** Significant @ P = 0.01

at Kozhikode and in June and November at Appangala. Thus there is a comparative difference in the flowering pattern of nutmeg at the two locations. The possible reason for the variations in flowering pattern of male and female trees of nutmeg may be due to the presence of large amount of reserved food which in turn is used for fruit production whereas for male trees which is non productive but receiving similar cultural practices like female has the tendency for increased flowering.

The regression model developed using multiple regression analysis emphasized that under Appangala conditions, maximum and minimum temperatures had significant effect on male flower production whereas minimum temperature and relative humidity played a significant role on female flower production. Maximum temperature along with rainfall had significant effect on bisexual flower production at Kozhikode. Sangadji *et al.* (2015) outlined that the high rainfall, humidity and rainy days results in lowering the fruit set, while the increase in air temperature and solar radiation increases the fruit set of nutmeg.

Multiple regression model is highly significant ($R^2=0.90$) for male form of sex expression and significant ($R^2=0.82$) for female form of sex expression only for Appangala location. Bisexual form of sex expression was found to be significant ($R^2=0.85$) at Kozhikode location (Table 1). This implies that the mechanisms of sex determination in plants are highly diverse and includes physiological, genetic and environmental aspects (Ainsworth *et al.* 1998).

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