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Variability for growth, flowering and fruit set in seedling progenies of nutmeg (*Myristica fragrans* Houtt.)

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Abstract

The variability in growth, flowering and fruit set of 39 seedling progenies of nutmeg (*Myristica fragrans*) was studied at Ratnagiri (Maharashtra). Growth was cyclic with two peaks, one in January–February and the second in May. Shoot elongation was rapid during 150–270 days after shoot emergence during first peak. Considerable variation among the genotypes with respect to growth parameters was noticed. Duration of anthesis was short in female flowers and long in male flowers. Significant variations were noticed among genotypes for duration of anthesis and fruit set. Environmental coefficient of variation was very low for fruit set and duration of anthesis. Higher magnitudes of phenotypic coefficient of variation and genotypic coefficient of variation indicated good amount of variation among the genotypes for these characters. High estimates of heritability and genetic advance for fruit set suggested that it is under the control of additive gene action.

Key words: anthesis, fruit set, genetic advance, growth, heritability, *Myristica fragrans*, nutmeg, variability.

Introduction

Nutmeg (*Myristica fragrans* Houtt.) is grown in India in certain pockets of Kerala, Karnataka and Tamil Nadu and also in non traditional areas such as Konkan region of Maharashtra. Being an obligatory cross pollinated crop, wide natural variability is observed in nutmeg with respect to vegetative and reproductive characters (NRCS 1989). The present investigation was therefore undertaken to study the growth and flowering pattern of nutmeg for assessing the extent of variability under Maharashtra conditions with an aim to select superior genotypes in crop improvement programmes.

Materials and methods

The study was conducted on 20 year old nutmeg trees (raised from seedlings) planted as intercrop in a coconut plantation at 7.5 m x 7.5 m spacing at the Regional Coconut Research Station, Ratnagiri (Maharashtra) (17°00' N, 73°20' E, 3 m MSL) during 1999 and 2000. The climate in this region is warm and humid and soil is sandy. Thirty three bearing nutmeg genotypes namely, N1, N4, N5, N7, N10, N11, N22, N23, N24, N26, N27, N29, N30, N32, N33, N34, N36, N37, N38, N41, N42, N43, N46, N49, N51, N55, N56, N57, N61, N63, N66, N70, N72 and N74 and five

male genotypes namely, N15, N35, N60, N53 and N69 constituted the experimental material. The experiment was conducted in a randomized block design with two replications. Fifty flowers from each genotype were randomly selected per replication. The flower buds were tagged when they just appeared on the leaf axil. Observations on appearance of flower on shoot, number of flowers leaf axil^{-1}, time required for anthesis, and fruit set were recorded. The growth pattern was studied in 33 genotypes. Ten shoots were tagged randomly from all around the canopy at the stage of their emergence after January and observations on length of shoots and number of shoots were recorded at monthly intervals. However, among the selected types, N10, N34, N57, N61, N35 and N69 did not produce new shoots and hence were not considered for shoot growth studies. Biometrical analysis of pooled data was performed by the technique suggested by Singh & Chaudhari (1985).

Results and discussion

The genotypes N1, N5, N23, N24, N26, N51, N56, N63 and N70 exhibited bud sprout during the first fortnight of January whereas in genotypes N22, N27, N29, N55 and N15, bud sprouts were noticed during the first fortnight of February (Table 1). The genotype N36 exhibited bud sprout during a later period (second fortnight of February). However, majority of the genotypes exhibited first vegetative flush during the first and second fortnights of January.

In general, elongation of the first shoot was completed within 30 to 90 days from its appearance and the leaves became dark and thick. The shoots remained in a quiescent state for 60 to 90 days. At about 150 to 180 days from tagging, the mature shoots exhibited production of new shoot primordia at apex and simultaneously a floral bud appeared in the axil of the basal mature leaves. The period of maturity phase of first shoot quiescent state (lag phase), appearance of new vegetative shoot and floral primordia varied among the genotypes. A majority of the genotypes exhibited a span of 60 days for cessation of elongation of first shoot followed by 90 days for lag period and 150 days for occurrence of flowering on basal leaves. Under Kerala conditions, Nazeem & Nair (1981) observed two peaks in nutmeg flushes during May and September. A cyclic growth pattern in nutmeg has been also noticed under Kerala conditions (Priyamal 1997).

Flowering was recorded on the developing shoot from the second fortnight of May. In the genotypes N5, N30, N42, N43, N51, N72 and N74, flowering was observed only once. The developing shoots of genotypes N38, N55, N56 and N15 produced flowers five times. The earlier formed flowers exhibited fruit set after about 20 days of flowering. Fruit set was observed from June to October.

Considerable variation was observed in the length of terminal shoots in the genotypes (Table 2). The mean shoot length was 11.78 cm and the number of leaves produced was 7.4, indicating slow growth of nutmeg. Such slow growth of nutmeg was also recorded in Kerala by Priyamal (1997).

Duration for flowering from the day of appearance of floral bud ranged between 34.3 and 52.0 days (Table 3). Average period from appearance of floral bud to anthesis was 40.8 days. Duration of flowering was maximum in N27 (52 days) and minimum in N37 (34.3 days). In female genotypes, the flowers were borne in leaf axil either solitarily or in small groups, whereas in male genotypes, the flowers were borne in clusters of 3 to 7. Interestingly on female trees, the duration from bud to flowering stage was shorter (40.1 days) whereas, it was longer in male flowers (46.1 days). Under Kerala conditions, Nazeem (1979) reported that anthesis in male and female genotypes took place in 84.2 and 154.1 days, respectively. This indicates that the period required for anthesis might vary according to genotypes and location.

The average fruit set was 15% and was maximum in N72 (41%) and minimum in N27 (2%) (Table 4). Varying degrees of fruit set has also been reported by Flach (1966) in nutmeg.

Table 1. Variation in period of emergence of new shoot, flower initiation and fruit set in nutmeg genotypes

Genotype	Period of emergence of new shoot	Period of flower initiation	Period of fruit set
N1	January (I), June (I)	May (II), August (I), July (I), September (I)	July (II), September (II)
N4	January (II), June (I)	May (II), June (I), July (I), October (I)	September (I)
N7	January (II), May (II), November (I)	May (II), June (I), July (I), September (I)	September (II), October (II)
N5	January (I), May (II), December (I)	June (I), July (II)	June (II)
N11	January (II), June (II)	May (II), June (I), July (I), September (I)	September (II), October (II)
N22	February (I), June (I)	June (I), October (I), November (I)	October (II)
N23	January (I), May (II)	May (II), September (I)	September (II)
N24	January (I), May (II)	May (II), June (I), September (I)	September (II), October (II)
N26	January (I), May (II)	May (II), June (I)	June (II)
N27	February (I), May (II)	May (II), June (I)	June (II)
N29	February (I), June (I), December (I)	May (II), June (I), September (I), November (I)	September (II)
N30	January (II), May (II)	June (I), July (II)	June (II)
N32	January (II), May (II)	May (II), June (I), September (II)	September (II)
N33	January (II), June (I)	May (II), August (I), September (I)	September (II)
N36	February (II), June (II)	May (II), June (I), September (I), October (I)	October (II)
N37	January (II), June (I), November (I)	August (I), July (II), September (I), December (I)	October (II)
N38	January (II), June (I)	May (II), June (I), July (II), September (I), October (I)	October (II)
N41	January (II), June (I)	May (II), June (I), October (I), November (I)	October (II)
N42	January (II), June (I)	June (I)	June (II)
N43	January (II), June (I), November (I)	June (I)	June (II)
N46	January (II), May (II)	May (II), June (I), September (I)	September (II)
N49	January (II), May (II), December (I)	May (II), June (I), September (I) October (I)	September (II)
N51	January (I), June (II)	June (I), July (II)	June (II)
N55	February (I), May (II)	May (II), June (I), September (II), October (I), November (I)	October (II)
N56	January (I), June (I)	May (II), June (I), September (I), October (I), November (I)	October (II)
N63	January (I), May (II)	May (II), June (I), October (I), December (I)	October (II)
N66	January (II), May (II), December (I)	May (II), June (I)	June (II)
N70	January (I), June (I), December (I)	August (II), December (I)	August (II)
N72	January (II), May (II), December (I)	June (I), July (II)	June (II)
N74	January (II), June (I)	June (I), July (II)	June (II)
N15	February (I), May (II)	May (II), June (I), July (II), September (I), October (I), November (I)	-
N53	January (II), May (II)	May (II), June (I), September (I), October (I)	-
N60	January (II), June (II)	June (I), September (I)	-

I=First fortnight; II=Second fortnight

Table 2. Variation in the length of terminal shoots and number of leaves in nutmeg genotypes

Particulars	Days after bud appearance											
	30	60	90	120	150	180	210	240	270	300	330	360
Shoot length (cm)												
Range	2.04–6.10	2.80–6.93	2.80–7.04	2.80–7.04	2.80–7.38	3.91–10.13	4.81–11.44	4.84–13.47	4.84–19.75	5.38–19.75	5.38–19.75	5.38–19.75
Mean	3.5	4.4	4.5	4.5	4.6	6.3	8.2	9.6	10.9	11.2	10.7	11.8
SD	1.0	1.0	1.1	1.1	1.3	1.4	1.6	2.5	4.3	4.0	3.9	4.1
CV %	29.3	22.7	24.1	24.4	27.7	21.5	19.7	25.8	39.9	35.8	36.0	34.8
Number of leaves												
Range	1.4–3.1	1.5–3.7	1.8–4.3	1.8–4.3	1.8–5.2	1.9–6.2	3.0–7.3	3.3–10.6	3.3–10.6	3.5–10.6	3.5–10.6	3.5–12.0
Mean	2.2	2.6	2.6	2.6	2.8	3.9	4.9	5.9	6.7	6.8	6.9	7.4
SD	0.5	0.1	0.7	0.7	0.8	0.9	1.6	1.5	2.0	1.9	1.9	2.1
CV %	22.5	41.1	26.0	25.3	29.8	23.8	21.7	25.8	29.2	27.9	28.1	28.0

Table 3. Variation in number of flowers leaf axil^{-1} and duration of anthesis in nutmeg genotypes

Genotype	No. of flowers leaf axil^{-1}	Duration of anthesis (days)		
		1999	2000	Mean
N1	1	42.0	43.0	42.5
N4	1-3	36.0	43.0	39.5
N5	1	42.0	43.0	42.5
N7	1-3	38.0	36.5	37.3
N10	1	36.0	37.0	36.5
N11	1	35.0	37.0	36.0
N22	1-3	35.0	43.0	39.0
N23	1-3	49.0	55.0	51.0
N24	1	29.0	43.0	36.0
N26	1-3	36.0	37.0	36.5
N27	1-3	49.0	55.0	52.0
N29	1	36.5	36.5	36.5
N30	1	33.5	43.0	38.3
N32	1-3	37.0	41.5	39.3
N33	1-3	36.5	37.0	36.8
N34	1	32.0	37.0	34.5
N36	1	37.5	37.0	37.3
N37	1	31.5	37.0	34.3
N38	1	40.0	43.0	41.5
N41	1	35.0	43.0	39.0
N42	1	46.5	48.0	47.3
N43	1	37.0	43.0	40.0
N46	1	35.5	43.0	39.3
N49	1	37.5	38.0	37.8
N51	1	43.5	46.0	44.8
N55	1-3	36.0	35.0	35.5
N56	1-3	36.0	39.5	37.8
N57	1	38.5	43.0	40.8
N61	1-3	43.5	48.0	45.8
N63	1-3	47.5	55.0	51.3
N66	1	35.5	36.5	36.0
N70	1	33.5	37.0	35.3
N72	1	41.0	46.0	43.5
N74	1	42.0	41.0	41.5
N15	1-5	47.5	46.0	46.8
N35	1-4	47.5	46.0	46.8
N53	1-3	43.5	43.0	43.3
N60	1-3	45.5	44.0	44.8
N69	1-5	49.0	48.5	48.8
Mean		39.3	42.4	40.8
SEm ±		1.8	2.6	1.8
CD (P=0.05)		5.2	7.6	5.0

Table 4. Variation in fruit set in nutmeg genotypes

Genotype	Fruit set (%)		
	1999	2000	Mean
N1	20 (26.6)	13 (21.1)	16.5 (24.0)
N4	12 (20.3)	6 (14.2)	9.0 (17.5)
N5	6 (14.2)	4 (11.5)	5.0 (12.9)
N7	8 (16.5)	4 (11.5)	6.0 (14.2)
N10	32 (34.5)	8 (16.4)	20.0 (26.6)
N11	4 (11.5)	8 (16.4)	6.0 (14.2)
N22	8 (16.5)	9 (17.5)	8.5 (17.0)
N23	16 (23.6)	15 (22.8)	15.5 (23.2)
N24	8 (16.5)	8 (16.4)	8.0 (16.4)
N26	4 (11.5)	12 (20.3)	8.0 (16.4)
N27	1 (5.7)	3 (10.0)	2.0 (8.1)
N29	40 (39.2)	17 (24.4)	28.5 (32.3)
N30	28 (32.0)	8 (16.4)	18.0 (25.1)
N32	4 (11.5)	1 (5.7)	2.5 (9.1)
N33	36 (36.9)	12 (20.3)	24.0 (29.3)
N34	21 (27.3)	17 (24.4)	19.0 (25.8)
N36	8 (16.5)	34 (35.7)	21.0 (27.3)
N37	9 (17.5)	33 (35.1)	21.0 (27.3)
N38	14 (22.0)	17 (24.4)	15.5 (23.2)
N41	4 (11.5)	4 (11.5)	4.0 (11.5)
N42	16 (23.6)	17 (24.4)	16.5 (24.0)
N43	28 (32.0)	9 (17.5)	18.5 (25.5)
N46	24 (29.3)	4 (11.5)	14.0 (22.0)
N49	52 (46.2)	4 (11.5)	28.0 (32.0)
N51	36 (36.9)	17 (24.4)	21.5 (27.6)
N55	4 (11.5)	4 (11.5)	4.0 (11.5)
N56	4 (11.5)	8 (16.4)	6.0 (14.2)
N57	20 (26.6)	19 (25.8)	19.5 (26.2)
N61	1 (5.7)	6 (14.2)	3.5 (10.8)
N63	20 (26.6)	4 (11.5)	12.0 (20.3)
N66	16 (23.6)	15 (22.8)	15.5 (23.2)
N70	36 (36.9)	20 (26.6)	28.0 (32.0)
N72	44 (41.6)	38 (38.1)	41.0 (39.8)
N74	32 (34.5)	16 (23.6)	24.0 (29.3)
Mean	18.1	12.2	15.0
SEm ±	2.2	1.5	1.3
CD (P=0.05)	6.4	4.4	3.8

Figures in parenthesis indicate arcsine transformed values

The variability among the genotypes for period required for anthesis and fruit set was statistically significant (Table 5). The magnitude of phenotypic coefficient of variation and genotypic coefficient of variation for these characters were higher than those for duration of flowering. The environmental component of variation was very low which indicated that these characters are genetically governed and environment has very little effect on them. The heritability in broad sense was very high for fruit set (94.44) in comparison with the period required for anthesis (77.93). Further, genetic advance on per cent mean basis for fruit set was also appreciably high (103.3%). This suggests that fruit set in nutmeg is also governed by additive gene action and there is good scope for selecting genotypes with higher fruit set on per se performance basis. In this context, the genotypes N72, N29, N70, N49 and N74 have shown promise.

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Table 5. Genetic parameters for anthesis and fruit set in nutmeg genotypes

Particulars	Days required for anthesis	Fruit set (%)
Mean sum of squares for treatments	49.29*	123.36*
Mean sum of squares for error	6.12	3.52
Genotypic variance	21.59	59.92
Phenotypic variance	27.71	63.44
Environmental variance	6.12	3.52
Phenotypic coefficient of variation	11.24	36.50
Genotypic coefficient of variation	9.92	35.47
Environmental coefficient of variation	1.32	1.02
Heritability	77.93	94.44
Genetic advance	8.45	15.49
Genetic advance on % mean basis	20.71	103.30

* Significant at 1% level

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