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Parthenocarpic Fruiting Behavior in Kakrol (*Momordica dioica* Roxb.)

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Parthenocarpic fruiting behavior and fruit characteristics in different kakrol genotypes were investigated. Only 'Rangpuri' genotype produced parthenocarpic fruits naturally among the genotypes tested. High number of flowers per plant, less vegetative growth, seedlessness or less seed number, successive bearing of fruits, and longer harvesting period of 'Rangpuri' were highly promising. All the genotypes set 100% fruits when they were pollinated artificially. In open (natural) pollination, 'Rangpuri' produced 96% fruits, whereas the fruit set was less than 45% in other genotypes.

INTRODUCTION

Kakrol (*Momordica dioica* Roxb.) is one of the important cucurbitaceous summer vegetables in Bangladesh with high demand. It is also known as teasel gourd or spine gourd. It appears in market when other vegetables are scarce. It is a highly priced vegetable and possesses a good source of vitamins (Bhuiya *et al.*, 1977). It originated in Indian sub continent (Rashid, 1993). In spite of its many advantages, it has a number of problems relating to its yield and fruit quality. Among the problems, as compared to other cucurbits, low yield, small sized fruit, low bearing, lack of flowering synchronization of male and female plants, regular cumbersome hand pollination and presence of hard seeds in the fruits are considered to be important. Among the problems related to fruit quality, presence of hard seeds in the fruits after 14–16 days of anthesis deteriorates the palatability of the vegetable. As kakrol is a dioecious, cross-pollinated perennial crop, female plants need artificial pollination for higher rate of fruit setting. If a seedless or less seeded variety could be developed, the above problems could be avoided and harvesting period could be extended.

At Bangabandhu Sheikh Mujibur Rahman Agricultural University (BSMRAU), there is a kakrol line (named as 'Rangpuri') which produces seedless fruits without pollination or less seeded fruits on pollination (Azad, 1995, Ali *et al.*, 1998). This variety has a tendency to bear fruits continuously in several nodes unlike other seeded genotypes.

Keeping the above facts in view, the present study was, therefore, undertaken to

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compare the fruit setting behavior, fruit set percentage, fruit size, fruit weight, etc. of the parthenocarpic (seedless) variety with those of non–parthenocarpic genotypes.

MATERIALS AND METHODS

The study was carried out during kharif (March–September) season in 1997 in the vinyl house of the Department of Genetics and Plant Breeding of BSMRAU, Gazipur, Bangladesh. Three non–parthenocarpic (TG920722, TG 920612 and TG 920616), one parthenocarpic ('Rangpuri') and one hybrid (TG920722×'Rangpuri') genotypes along with one male genotype of kakrol were used in this study. Tuberous roots of them were planted in earthen pots (containing a 1:1 mixture of soil and decomposed cowdung) on April 15, 1997. The tuberous roots began to sprout 18–25 days after potting. The sprouted tuberous roots were transplanted in pits (30×30×30 cm) in the experimental field on May 22, 1997 maintaining a spacing of 2.0×1.5 m. Other cultivation techniques (intercultural operations) were followed as recommended by Hussain and Rashid (1974) and Rashid (1993). The male plants were planted 150 meter away from the female plants. Hand pollination was performed in the early morning by gently touching a stigma with fresh pollen. Flowers of different genotypes were protected from undesired pollination (contamination) by bagging with paper bags a day before anthesis up to 3–4 days to see the parthenocarpic potentiality of the genotype.

RESULTS AND DISCUSSION

Bearing habit of different kakrol genotypes varied from accession to accession (Table 1). Days to first flowering in non–parthenocarpic genotypes were 75 to 90 and those in parthenocarpic genotype 'Rangpuri' were intermediate (82). It was observed that flowering was earlier in those plants which originated from big tuberous roots. Number of flowers per plant varied from 60–72 in different accessions. It was similar in 'Rangpuri' to that in other genotypes. Parthenocarpic traits may not affect the days to flowering and number of flowers per plant.

Commercially, kakrol fruits are harvested and sold in the market at edible stage. The edible stage means when the fruits remain green, spines on the fruit surface are still soft,

Table 1. Bearing habit of different kakrol genotypes under open (natural) pollination.

Genotype	Days to 1st flowering	No. of flowers per plant	Edible period (days)	Single fruit weight (g)	Yield per plant (kg)	Area covered (m^2)	Predicted yield (ton/ha)
TG 920722	75.4 a[z]	59.6 a	10–13	99.4 b	5.9 b	3.5 b	16.8 b
TG 920612	77.8 a	72.4 b	12–15	63.9 a	4.5 a	3.4 b	13.3 a
TG 92061	90.0 b	65.4 a	12–15	68.2 a	4.5 a	3.3 b	13.7 a
'Rangpuri'	82.0 ab	66.3 a	12–18	61.9 a	4.1 a	2.3 a	18.3 b

[z] Values having common letters in a column do not differ significantly at 5% level of probability (DMRT).

the fruit can be cut down perpendicularly easily by knife and when the seeds in the fruit are not hard enough. Fruits of non–parthenocarpic genotypes reached at edible size after 10–12 days of anthesis and remained edible up to 13–15 days. Fruits of 'Rangpuri' reached at edible size after 12 days of anthesis and the edible period became longer up to 18 days. The mean single fruit weight varied from 61.9 ('Rangpuri') to 99.4 g (TG 920722). The mean single fruit weight of 'Rangpuri' was similar to that of other two genotypes except TG 920722. Yield per plant in 'Rangpuri' (4.1 kg) was different only from that in TG 920722 (5.92 kg).

In this experiment it was estimated that each plant of non–parthenocarpic genotype covered an area of 3.3–3.5 m^2, whereas 'Rangpuri' did 2.3 m^2, i.e., vegetative growth of 'Rangpuri' was lower than that of other genotypes. The same space was maintained for all the genotypes during transplanting in this experiment. If the proper spacing would be maintained for 'Rangpuri', much higher yield would be expected.

Thirty–nine vines (78% of the examined vines) of 'Rangpuri' produced two or more fruits continuously but only fifteen vines (30%) of TG 920612 produced two or three

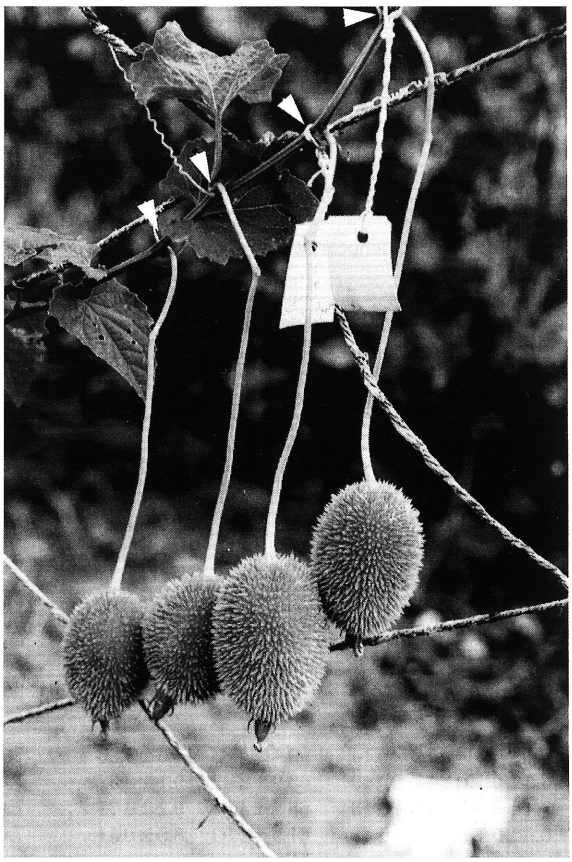

Fig. 1. Successive fruiting behavior of 'Rangpuri' kakrol. Arrows indicate fruit bearing nodes.

fruits successively by hand pollination (Fig. 1 and Table 2). There were no four or more successive fruits in TG 920612. Fruit size and weight decreased gradually from lower to upper node. In 'Rangpuri', 16, 12, 7 and 4 vines continuously bore two, three, four and more fruits, respectively having an average weight of a single fruit of 48.2 g.

One hundred percent fruit set was achieved by hand pollination in all the genotypes (Table 3). The result is in agreement with Hussain and Rashid (1974) and Ali *et al.* (1998). The highest fruit length, diameter, fruit weight and seed number per fruit were in TG 920722 followed by TG 920616 and TG 920612 and the lowest being in 'Rangpuri'.

Kakrol is an obligate cross-pollinated crop. Ants, bees, bumble bees, butterflies, etc. bring pollen and cause fruit setting (Rashid, 1993). 'Rangpuri' produced 96% fruits in open field conditions without hand pollination, whereas the fruit set in other genotypes was less than 45% (Table 4). The results indicate that 'Rangpuri' has some parthenocarpic potentiality. Fruit size, weight and number of seeds per fruit widely varied not only among the genotypes but also between the pollination methods; natural and hand pollination (Tables 4 and 5). The result is in agreement with the observation of Hossain *et al.* (1987). The performance of the hybrid (TG 920722×'Rangpuri') was in between of its parents, but much closer to TG 920722's characteristics.

Only 'Rangpuri' produced seedless fruits in unpollinated condition (Table 5). Fruit set percentage was 94%. The fruit size and weight were much lower than those of hand pollinated or natural pollinated fruits. As compared to other non-parthenocarpic genotypes, the fresh to dry weight ratio in 'Rangpuri' was also the highest (10.4) due to absence of seeds (Tables 3, 4 and 5).

Table 2. Successive fruit bearing of parthenocarpic and non-parthenocarpic kakrol genotypes by hand pollination.

Genotype	No. of vines observed	Two successive fruits		Three successive fruits		Four successive fruits		Five or more successive fruits	
		Number of vines	Single fruit weight (g)	Number of vines	Single fruit weight (g)	Number of vines	Single fruit weight (g)	Number of vines	Single fruit weight (g)
'Rangpuri'	50	16	48.2±4.34[z]	12	44.2±7.76	7	41.5±6.08	4	38.1±5.42
TG 920612	50	13	59.5±7.94	2	53.7±1.25	0	–	0	–

[z] Mean±SE.

Table 3. Percent fruit set and fruit characteristics in different kakrol genotypes produced by hand pollination.

Genotype	Fruit set (%)	Fruit size (cm)		Fruit weight (g)		Fresh/dry weight ratio	No. of seeds per fruit
		Length	Diameter	Fresh	Dry		
TG 920722	100	8.1±0.31[z]	5.2±0.14	99.4±4.83	14.0±2.50	7.1	40.2±2.90
TG 920612	100	6.6±0.19	4.5±0.19	63.9±2.42	9.1±0.37	7.0	34.6±0.82
TG 920616	100	7.4±0.30	4.5±0.13	68.2±4.09	9.2±0.77	7.4	34.8±1.55
'Rangpuri'	100	6.6±0.13	4.5±0.19	61.9±2.93	8.8±0.51	7.0	30.4±0.96

[z] Mean±SE.

Table 4. Percent fruit set and fruit characteristics in different kakrol genotypes produced by open (natural) pollination.

Genotype	Fruit set (%)	Fruit size (cm)		Fruit weight (g)		Fresh/dry weight ratio	No. of seeds per fruit
		Length	Diameter	Fresh	Dry		
TG 920722	32	6.9±0.78[z]	4.8±0.22	65.9±8.37	8.9±1.32	7.4	34.7±2.02
TG 920612	44	5.9±0.33	4.3±0.25	53.8±2.22	8.7±0.95	6.2	32.0±1.95
TG 920616	40	6.5±0.12	4.5±0.27	57.2±3.30	8.7±0.83	6.6	32.8±1.50
'Rangpuri'	96	5.2±0.19	3.8±0.90	34.4±2.35	4.3±0.47	8.0	5.5±2.43
Hybrid[y]	64	6.5±0.49	4.5±0.20	61.6±8.45	8.7±0.98	7.1	33.2±1.75

[z] Mean±SE.
[y] TG 920722×'Rangpuri'.

Table 5. Fruit setting potentiality of different kakrol genotypes in bagging condition.

Genotype	Fruit set		Fruit size (cm)		Fruit weight (g)		Fresh/dry weight ratio	No. of seeds per fruit
	No.	%	Length	Diameter	Fresh	Dry		
'Rangpuri'	47 (50)[z]	94	4.8±0.09[y]	3.0±0.04	25.9±0.91	2.5±0.13	10.4	0
TG 920722	0 (50)	0	–	–	–	–	–	–
Hybrid[x]	0 (50)	0	–	–	–	–	–	–

[z] ( )=Number of flowers investigated.
[y] Mean±SE.
[x] TG 920722×'Rangpuri'.

CONCLUSION

More number of flowers per plant, less vegetative growth, seedlessness, continuous bearing habit, longer harvesting period, attractive appearance of fruits are the promising characters of 'Rangpuri' genotype. These characteristics should be exploited in the improvement of parthenocarpic kakrol cultivars.

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