



Varietal evaluation for yield and yield parameters of ber under semi-arid region of West Bengal

R.K. Tarai and S.N. Ghosh¹

Krishi Vigyan Kendra (Nayagarh)
Orissa University of Agriculture and Technology, Panipoila, Balugaon
E-mail: ranjan_04@rediffmail.com

ABSTRACT

An experiment was conducted in a private orchard 5 km away from Regional Research Station, Bidhan Krishi Viswavidyalaya, West Bengal, during 2004-2005 to study fruit drop, retention, maturity and fruit yield of ten cultivars of ber. Among ten cultivars studied, cv. Kaithali took a minimum of 6 days to attain flower bud development while, in cv. Jogia, it was 13 days. Period from fruit-set to fruit maturity in different cultivars varied from 130 to 160 days. The time of harvest in different cultivars of ber was from third week of December to third week of March. Maximum fruit-drop occurred at 15 and 30 days after fruit-set and, subsequently, decreased up to maturity. The total fruit-drop percentage varied from 66.5 (cv. Gola) to 92.5 (cv. Illaichi). Similarly, final fruit-retention in different cultivars varied from 7.5 in cv. Illaichi to 33.5% in cv. Gola. Cultivar Jogia produced highest fruit yield (111.4 kg plant⁻¹), followed by cv. Gola (90.0 kg plant⁻¹) and cv. Seb (81.5 kg plant⁻¹). Lowest average yield was recorded in cv. Mundia (35.3 kg plant⁻¹).

Key words: Ber, *Zizyphus mauritiana*, fruit-drop, fruit retention, maturity, yield

INTRODUCTION

Ber (*Zizyphus mauritiana* Lamk.) belongs to the family Rhamnaceae, and is an ideal fruit tree for arid and semi-arid regions. The ber is valued for its nutritional qualities, prolific and regular bearing habit and adaptability to adverse soil and climatic conditions (Jawanda and Bal, 1978). Good productivity and its ability to stand transport and storage makes ber more popular for commercial cultivation than other fruit crops (Pareek, 1983). In the western part of West Bengal, ber is grown commercially, as, the soil and climate are well-suited. The plant is dormant in summer and escapes the dry spell. In ber, many flowers fail to set fruit and, even among the fruits set, there is some amount of shedding. Several studies on floral biology, fruit-drop, fruit retention, period required for fruit maturity and yield in various ber cultivars were made in India by different workers (Sharma *et al.*, 1990; Neeraja *et al.*, 1995; Nath and Bhargava, 2002; Ghosh and Mathew, 2002). To exploit ber for commercial cultivation in West Bengal, very little information is available on fruit-set, period for maturity, retention and yield in this region. Hence, an attempt was made on these aspects in the present investigation to facilitate breeding for crop improvement in future. Appropriate

cultural practices that may influence performance of the crop can then be formulated.

MATERIAL AND METHODS

The experiment was conducted during 2004-2005 in a drought-prone semi-arid zone (with average annual rainfall of 1100 to 1500 mm, of which 80% occurs during July- September; Bauri and Ghosh, 1998). Soil at the experimental site located 5 km away from Regional Research Station, Jhargran, Bidhan Chandra Krishi Viswavidyalaya, is red laterite with pH 5.4, available N 300 kg ha⁻¹, available P 30.60 kg ha⁻¹, available K 101.0 kg ha⁻¹ and organic carbon 0.57%. Buds of ten ber cultivars, viz., Banarasi Karka, Chuhara, Dandan, Gola, Illaichi, Jogia, Kaithali, Mundia, Seb and Umran, collected from R.R.S., B.C.K.V.V and top-worked during June, 2001 on 5 year-old rootstock of local ber plants (after heading-back during March, 2001) were maintained at row-to-row and plant-to-plant spacing of 6 m x 6 m. Randomized Block Design was adopted, taking three replications and two plants in each replication. The plants were pruned at 25% level during May. Plants were fertilized with 40kg FYM, 150 g N, 50g P₂O₅ and 100g K₂O plant⁻¹ during June and, again with the same

¹Department of Fruits and Orchard Management, B.C.K.V.V., Mohanpur, Nadia, West Bengal

dose during September plant⁻¹ year⁻¹, in the form of urea (46% N), rock phosphate (24% P₂O₅) and muriate of potash (60% K₂O), respectively. The manure and fertilizers were applied in a circular trench 30 cm wide at a radial distance of 90 and 120 cm from the trunk. All plants were irrigated thrice at monthly intervals during October, November and December at fruit growth and development stage. To record time required from emergence of flower bud to its opening, 50 flower buds were tagged soon upon their emergence. Fruit-drop and fruit retention were recorded at 15-day intervals by tagging 200 just-set fruits, up to maturity, and expressed in terms of percentage. Data on fruit weight and fruit size were taken from ten randomly-selected matured fruits in each replication and expressed as g and cm, respectively. The total number of fruits tree⁻¹ was counted and the yield tree⁻¹ was calculated by multiplying number of fruits with mean fruit weight and expressed in Kg. Data were statistically analyzed following standard procedures as described by Panse and Sukhatme (1978). Angular transformation of data on percentage was done as per Snedecor (1959). The significance of difference of different sources of variation was tested by error mean square by Fisher-Snedecor's 't' test, at probability level of 0.05.

RESULTS AND DISCUSSION

Different cultivars of ber differed significantly in fruit-set to maturity period, fruit-drop, retention and fruit yield. The period from emergence of flower buds to their opening varied from 6 to 13 days in different cultivars (Table 1). 'Kaithali' took 6 days to flower-bud development, while, it was 13 days in 'Jogia'. However, Teatota and Chauhan (1963) and Josan *et al* (1980) observed longer duration of 20-22 days for flower-bud development in different cultivars in North India. Short duration of flower-bud development in

the present study may be due to higher temperatures prevalent in this agro-climatic zone.

Cultivars Chhuhara, Gola and Jogia required 130 days for maturity after fruit-set, while, in Umran, Seb and Illaichi, it was 160 days. In other cultivars, viz., Banarasi Karka, Dandan, Kaithali and Mundia, it was 145 days (Table 1). Longer period taken for fruit development in cv. Seb compared to 'Gola' under Rajendranagar condition has also been reported by Neeraja *et al* (1995). The period of harvesting of Gola and Chhuhara ranged from third week of December to first week of February, while, in cvs. Banarasi Karka, Dandan, Jogia, Kaithali, it was from the second week of January to third week of February (Table 1). In other cultivars like Illaichi, Seb and Umran, the period of harvesting ranged from the second week of February to third week of March. This result is in line with findings of Ghosh and Mathew, 2002. Irrespective of cultivar, the peak period of maturity fell between last week of November and first week of January (in the Southern region) and between January and March (in the Northern region) of India (Nath and Bhargava, 2002). Thus, variation in the period of maturity of different cultivars in different regions of the country might be due to cultivation of these cultivars under different agro-climatic conditions.

Percent fruit-drop was recorded at 15-day intervals from fruit-set up to maturity (Table 2). Maximum fruit-drop occurred at 15 and 30 days after fruit-set and, subsequently, decreased up to maturity. At 15 days from fruit set, fruit-drop percentage varied from 18.0% (cvs. Kaithali and Seb) to 62.5% in 'Jogia'. Similarly, at 30 days from fruit-set, fruit-drop varied from 23.5% in 'Chhuhara' to 55% in 'Seb'. Heavy fruit drop during early stages of fruit development may be attributed to unsuccessful fertilization or ovule

Table 1. Time required for flower bud development and fruit maturity in ten cultivars of ber grown under irrigated conditions at Jhargram

Variety	Period required for flower-bud development (days)	Period required from fruit set to maturity (days)	Date of first harvest harvest(weeks)	Date of last harvest	Duration of
Banarasi Karka	10	145	2 nd week, January	3 rd week, February	5
Chhuhara	12	130	3 rd week, December	1 st week, February	6
Dandan	10	145	2 nd week, January	3 rd week, February	5
Gola	9	130	3 rd week, December	1 st week, February	6
Illaichi	8.5	160	2 nd week, February	3 rd week, March	5
Jogia	13	130	2 nd week, January	2 nd week, February	5
Kaithali	6	145	2 nd week, January	3 rd week, February	5
Mundia	7	145	2 nd week, January	3 rd week, February	5
Seb	10	160	2 nd week, February	3 rd week, March	5
Umran	8	160	2 nd week, February	3 rd week, March	5
C.D. (<i>P</i> =0.05)	0.42	9.24	--	--	--

Varietal evaluation in ber for yield

Table 2. Fruit-drop and fruit retention in ten cultivars of ber grown under irrigated conditions at Jhargram*

Variety	Fruit drop percentage (days after fruit-set)								Total fruit drop (%)	Final fruit retention (%)
	15 DAFS**	30 DAFS	45 DAFS	60 DAFS	75 DAFS	90 DAFS	105 DAFS	120 DAFS		
Banarasi Karka	21.0 (27.35)	29.0 (32.58)	2.0 (8.13)	2.0 (8.13)	8.5 (16.95)	2.0 (8.13)	2.0 (8.13)	2.0 (8.13)	68.5 (55.86)	31.5 (34.14)
Chhuhara	40.0 (39.23)	23.5 (29.00)	0 (0.00)	3.0 (9.97)	0 (0.00)	0.5 (4.05)	3.0 (9.97)	6.5 (14.77)	76.5 (61.00)	23.5 (29.00)
Dandan	35.0 (36.27)	30.0 (33.21)	3.0 (9.97)	0 (0.00)	2.0 (8.13)	2.0 (8.13)	6.0 (14.18)	0 (0.00)	78.0 (62.03)	22.0 (27.97)
Gola	29.0 (32.58)	26.5 (30.98)	2.0 (8.13)	1.5 (7.03)	1.0 (5.74)	4.5 (12.25)	2.0 (8.13)	0 (0.00)	66.5 (54.63)	33.5 (35.37)
Illaichi	50.0 (45.00)	35.0 (36.27)	7.5 (15.89)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	92.5 (74.11)	7.5 (15.89)
Jogia	62.5 (52.24)	24.5 (26.97)	3.0 (9.97)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	90.0 (71.57)	10.0 (18.43)
Kaithali	18.0 (25.10)	46.5 (42.99)	1.5 (7.03)	3.0 (9.97)	2.0 (8.13)	2.5 (9.10)	2.0 (8.13)	13.5 (21.56)	89.0 (70.63)	11.0 (19.37)
Mundia	35.0 (36.27)	26.0 (30.66)	1.0 (5.74)	0 (0.00)	0 (0.00)	1.0 (5.74)	2.0 (8.13)	4.0 (11.54)	69.0 (56.17)	31.0 (33.83)
Seb	18.0 (25.10)	55.0 (47.87)	1.0 (5.74)	5.0 (12.92)	1.0 (5.74)	1.0 (5.74)	1.0 (5.74)	0 (0.00)	82.0 (64.99)	18.0 (25.10)
Umran	18.5 (25.47)	50.0 (45.00)	1.5 (7.03)	2.5 (9.10)	1.5 (7.03)	1.0 (5.74)	2.5 (9.10)	0 (0.00)	77.5 (61.68)	22.5 (28.32)
C.D ($P=0.05$)	2.90	1.70	0.19	0.51	0.15	0.13	0.46	0.65	1.60	1.52

*Figures in parentheses are angular transformed values

** DAFS = Days After Fruit Set

degeneration. However, 120 days after fruit-set, this ranged between 0 to 13.5% in different cultivars. Total fruit-drop varied from a minimum of 66.5% in ‘Gola’ to a maximum of 92.5% in ‘Illaichi’. However, under Ludhiana conditions in Punjab, cumulative fruit-drop ranged between 68.3% in ‘ZG-2’ to 85% in ‘Kaithali’ (Singh *et al*, 1991), while, it ranged between 82.14% in ‘Gola’ to 87.94% in ‘Seb’ under Rajendranagar, Hyderabad, conditions (Neeraja *et al*, 1995). Similarly, final fruit-retention in different cultivars varied from 7.5% in ‘Illaichi’ to 33.5% in ‘Gola’. This result is in close proximity with findings of Sharma *et al* 1990 who obtained final fruit-retention values in the range of 4% in ‘Illaichi’ to 20% in ‘Tikadi’.

Fruit weight, which is considered to be one of the important criteria for attracting premium price, varied significantly among the ten cultivars of ber (Table 3). Heaviest fruit was obtained in ‘Jogia’ (28.5 g), closely followed by ‘Gola’ (28 g) and ‘Seb’ (26.8 g). ‘Illaichi’ (8.3 g) recorded the lowest fruit weight. It is interesting that all the cultivars studied produced heavier fruits compared to same varieties studied by Vashistha, 2001. This may be due to the growth of these varieties under different agro-climatic conditions and to providing irrigation during fruit growth and development. As for fruit length and diameter, cultivars Banarasi Karka, Dandan and Jogia produced bigger size

Table 3. Fruit weight, fruit size, number of fruits and yield per plant in ber cultivars grown under irrigated conditions at Jhargram

Variety	Average fruit weight (g)	Average fruit length (cm)	Average Fruit diameter (cm)	Average number of fruits per plant	Average yield per plant (kg)
Banarasi Karka	25.7	5.8	3.9	3069	78.7
Chhuhara	21.8	4.8	3.8	2308	50.1
Dandan	24.9	5.8	3.9	1634	40.5
Gola	28.0	4.8	4.5	3207	90.0
Illaichi	8.3	3.0	3.0	5034	46.3
Jogia	28.5	5.4	3.9	3987	111.4
Kaithali	23.7	5.2	4.0	2553	59.4
Mundia	21.9	4.9	3.9	1605	35.3
Seb	26.8	4.3	4.2	3046	81.5
Umran	24.6	4.8	3.9	1791	44.6
C.D. ($P=0.05$)	0.29	0.29	0.34	91.6	4.56

fruits, while, ‘Illaichi’ produced fruits with minimum weight and size (Table 3).

Various cultivars of ber showed significant variation in fruit production (Table 3). The data showed that ‘Jogia’ produced highest yield (111.4 kg plant⁻¹) followed by ‘Gola’ (90.0 kg plant⁻¹). Lowest average yield was recorded in ‘Mundia’ (35.3 kg plant⁻¹). Highest yield in ‘Jogia’ in the present study was due to production of maximum fruit number and heavier fruits. Pareek and Vashistha (1983), however, reported 60 and 80 kg plant⁻¹ from 5- year old

'Jogia' trees under irrigated conditions in Rajasthan. Contrary to this, Gupta (1977) reported the highest yield (210 kg plant⁻¹) in 20-year old 'Umran', followed by 'Sanaur' No.2, ZG-2 and Dandan, which were on par with each other (200 kg plant⁻¹) at Hoshangabad, Madhya Pradesh. Such variation in yield could be attributed to age of the trees too. Bisla *et al* (1980) at Hissar, Haryana, found 'Umran' and 'Katha Bombay' to be the highest yielders among late cultivars. Lowest yield in 'Mundia' was due to production of lesser number of fruits plant⁻¹ and due to fruit-drop at subsequent stages of fruit development.

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