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## Studies on genetic diversity in Ber (*Ziziphus mauritiana* Lamk.) in Jabalpur district of Madhya Pradesh

**RK Rai, CS Pandey, SK Pandey, Mohni Parmar, Kumudani Sahu and Diksha S**

### Abstract

The present investigation was carried out to evaluate the twenty different genotypes of ber viz. Jawahar ber-1, Jawahar ber-2, and 3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19, up to Jawahar ber-20. Ber genotypes of Jabalpur district of MP for breeding and crop improvement purpose. On the basis of growth and development parameters viz. Fruit length, width, weight and volume, the genotypes are grouped as large, medium and small types. The ber genotypes grouped under large type fruits are Jawaharber-3,10,11,12,13,16, under medium types Jawahar ber- 4,7,8,14,17,18,19 and under small types-Jawahar ber 1,2,5,6,9,15,20. The ber fruits of different genotypes took about 120-180 days to reach harvestable maturity and thus grouped as early, mid and late variety. The genotypes Jawahar ber-1,2,3,5,8,16,20 reaching at harvestable maturity up to 140 days were categorized as early variety, between 145-160 days as Mid variety (Jawahar ber-4,6,9,10,11,14,17,18) whereas, between 160-180 days (Jawahar ber-7,12,13,15,19) as late variety. It is also noticed that fruit characteristics viz. fruit weight, fruit volume, fruit length, fruit width were found to be increased during the entire course of growth and development period. Among the various genotypes, Jawahar ber-12 was found the best genotype with regard to the highest average weight per fruit (24.63 g), followed by Jawahar ber-16(23.97 g) fruit weight. Similarly the maximum volume (18.0 ml) was observed in Jawahar ber-12 followed by Jawahar ber-16(17.0 ml).

**Keywords:** *Ziziphus mauritiana* Lamk, flower bud differentiation, blooming phase and harvesting

### Introduction

The Indian Ber (*Ziziphus mauritiana* Lamk.) is a small, fruit-bearing tree belonging to the Rhamnaceae family. It is native to South Asia, Indo china particularly in India and is widely cultivated in various parts of the world, including the Middle East, Africa, and Southeast Asia. It can be successfully grown in arid and semi-arid regions of India with pH range as high as 9.0. It is a hardy tree that can thrive in challenging environmental conditions. The tree is known by various common names, including king of arid fruits, poor man's fruit and summer deciduous fruit, Indian Jujube, Ber, Chinese Date and others. *Ziziphus mauritiana* is a small to medium-sized tree that can reach heights of 5 to 12 meters. It has a bushy appearance with thorny branches. The leaves are shiny green and oval-shape, with a serrated edge. They are typically 2-4 cm in length. The tree produces small, fragrant white or greenish-yellow flowers with five petals. The fruits of Indian Jujube are small, round and typically 2-4 cm in diameter. They start green and ripen to a reddish-brown or purplish-black colour. The flesh is sweet and can be eaten fresh or dried. The fruits are not only consumed locally but are also traded commercially. They are often dried to make snacks or used as ingredients in various dishes and desserts. *Ziziphus mauritiana* has cultural and culinary significance in many regions where it is grown. The fruits are used in a variety of culinary dishes, jams, and beverages. In some cultures, the tree holds traditional and medicinal value. Various parts of the tree, including the leaves, fruits and roots are used in traditional medicine for their potential health benefits. They are believed to have properties that can aid digestion, boost the immune system and provide relief from various ailments. The tree can also be used for its wood, which is used in construction and for making furniture.

Variation in flower bud differentiation, blooming phases and harvesting stages of different ber genotype has been reported by several researchers (Pareek and Vashishtha, 1983) [17]. Looking the potential of ber fruits, the search of the most promising elite genotypes well suited to Kymore plateau Satpura hill regions of Madhya Pradesh conditions is the need of time.

Considering these realities the present investigation was carried out during the season of 2018-19 to find out variability in blooming phases, fruit growth & development pattern and harvesting time of different genotypes of ber to identify appropriate genotypes for commercial cultivation.

### Materials and Methods

The present investigation was carried out at the Fruit Research Station Imaliya, College of Agriculture, JNKVV, Jabalpur, Madhya Pradesh during 2018-19. The maximum and minimum temperature during summer months varies between 42 °C and 27.5 °C respectively while during winter months it ranges between 23.5 °C and 10.0 °C. The average precipitation (June to October) in this area is about 1248 mm. The experimental material consisted of twenty genotypes, viz Jawahar Ber 1 to 20. This experiment was conducted in RBD with three replications. The observations on flowering, fruiting, fruit maturity and harvesting were recorded. Ten marketable fresh fruits of each of the twenty ber genotypes were used to record data on the morphological traits on different period of growth and development (80, 100, 120, and 140) viz. Fruit length, fruit width, fruit volume and fruit weight. The fruit length, fruit width were measured using Vernier Calipers, fruit volume by water displacement method and fruit weight with help of electronic balance. The pruning operation was done during second fortnight of May. All other cultural practices like manuring and fertilization, Irrigation, application of growth regulators, weeding, plant protection, etc. were carried out uniformly to all the plants. The data were analyzed statistically and test of significance were done by following the RBD methods as described by Panse and Sukhatme (1985) [28].

### Results and Discussion

#### Date of first flowering, Date of 50% flowering, Period for first flowering to 50% flowering and full bloom stage of different ber genotypes

A wide range of variation was observed among the genotypes in term of Fruit phenological characters. Date of first flowering, Date of 50% flowering, Period for 50% flowering and full bloom stage of different ber genotypes which is considered to be one of the most valuable parameters for attracting premium fruit price, varied significantly among the twenty genotypes of ber. From the investigation, period of onset of flowering ranged between 18<sup>th</sup> August to 18<sup>th</sup> November. The period of bloom was longest in case of Jawahar ber-5 (65 days) which ranged from 18<sup>th</sup> August to 23<sup>th</sup> October. The minimum period of bloom was recorded in Jawahar ber-12 (38 days). Earliest flowering was recorded in Jawahar ber-5 (18<sup>th</sup> August), mid flowering was recorded in Jawahar ber-14 (9<sup>th</sup> September) and late flowering was recorded in Jawahar ber-13 (8<sup>th</sup> October). The full bloom was noticed during 10<sup>th</sup> October to 3<sup>rd</sup> November 2018 in Jawahar ber-1,2,3,5,8,16,20, during 25<sup>th</sup> October to 15<sup>th</sup> November in Jawahar ber-4,6,9,10,11,14,17,18 and during 12<sup>th</sup> November to 18<sup>th</sup> November in Jawahar ber-7,12,13,15,19. The knowledge of botanical aspects of flowers and flowering period is important in the execution of successful characterization and also of successful hybridization programme. It was observed that flowering season in ber is long and duration of flowering varied in different genotypes. Our results are in consonance with Teotia and Chauhan (1983) [26], Chundawat *et al.* (1979) [6], Josan *et al.* (1980) [11], Godara (1980) [8], Gupta (2001) [9], Raja (2004) [19] and Saran (200) [23].



Fig 1: Show the plant flowering different of first to full stage

Table 1: Date of first flowering, Date of 50% flowering, Period for first flowering to 50% flowering and full bloom stage of different ber genotypes

S. No.	Treatments	Date of first flowering	Date of 50% flowering	Period for first flowering to 50% flowering	Full bloom stage (peak period)
1	Jawaharber 1	02.09.2018	20.09.2018	19 days	03.11.2018
2	Jawaharber 2	04.09.2018	20.09.2018	17 days	18.10.2018
3	Jawaharber 3	25.08.2018	22.09.2018	29 days	10.10.2018
4	Jawaharber 4	16.09.2018	04.10.2018	19 days	12.11.2018
5	Jawaharber 5	18.08.2018	14.09.2018	26 days	23.10.2018
6	Jawaharber 6	10.09.2018	04.10.2018	25 days	25.10.2018
7	Jawaharber 7	03.10.2018	16.10.2018	14 days	18.11.2018
8	Jawaharber 8	28.08.2018	24.09.2018	28 days	18.10.2018
9	Jawaharber 9	18.09.2018	04.10.2018	17 days	10.11.2018
10	Jawaharber 10	14.09.2018	11.10.2018	28 days	26.10.2018
11	Jawaharber 11	18.09.2018	04.10.2018	17 days	15.11.2018
12	Jawaharber 12	05.10.2018	22.10.2018	18 days	12.11.2018
13	Jawaharber 13	08.10.2018	22.10.2018	15 days	19.11.2018
14	Jawaharber 14	09.09.2018	30.09.2018	22 days	30.10.2018
15	Jawaharber 15	01.10.2018	17.10.2018	17 days	13.11.2018
16	Jawaharber 16	05.09.2018	25.09.2018	21 days	20.10.2018

17	Jawaharber 17	11.09.2018	30.09.2018	20 days	01.11.2018
18	Jawaharber 18	10.09.2018	28.09.2018	19 days	10.11.2018
19	Jawaharber 19	07.10.2018	22.10.2018	16 days	15.11.2018
20	Jawaharber 20	22.08.2018	13.09.2018	23 days	19.10.2018

### Fruit Length (cm) & Fruit width (cm)

The data revealed that length of fruit of different ber genotypes have been found to be increased with advancement of growth and development period. The maximum (2.84 cm) fruit length was recorded in Jawahar ber-12 followed by Jawahar ber-2 (2.07 cm) and the minimum (0.71 cm) in Jawahar ber-7 at 80 days. The maximum (3.14 cm) fruit length was recorded in Jawahar ber-12 followed by Jawahar ber-2 (2.37 cm) and the minimum (1.01 cm) in Jawahar ber-7 at 100 days. The maximum (3.54 cm) fruit length was observed in Jawahar ber-12 followed by Jawahar ber-2 (2.77 cm) and the minimum (1.41 cm) in Jawahar ber-7 at 120 days. The maximum (3.90 cm) fruit length was noted in Jawahar ber-12 followed by Jawahar ber-2 (3.13 cm) and minimum (1.77 cm) in Jawahar ber-7 at 140 days.

The maximum (2.99 cm) width was recorded in Jawahar ber-12 followed by Jawahar ber-2 (2.07 cm) and minimum (0.70 cm) in Jawahar ber-7 at 80 days. The maximum (3.29 cm) fruit width was found in Jawahar ber-12 followed by Jawahar ber-2 (2.37 cm) and the minimum (1.0 cm) in Jawahar ber-7 at 100 days. The maximum (3.64 cm) fruit width was observed in Jawahar ber-12 followed by Jawahar ber-2 (2.72 cm) and the minimum (1.35 cm) in Jawahar ber-7 at 120 days. The maximum (3.99 cm) fruit width was seen in Jawahar ber-12 followed by Jawahar ber-2 (3.07 cm) and the minimum (1.70 cm) in Jawahar ber-7 at 140 days. These findings are similar to the report of Pareek (2001) [18], Kumar *et al.* (1987) [12], Kundi *et al.* (1989) [13], Faroda (1996) [7], Akhundova and Agaev (1989) [1], Reddy *et al.* (1998) [21], Ram *et al.* (2008) [20], Jan Brindza *et al.* (2011) [10], Shukla *et al.* (2012) [24], Muhammad *et al.*, (2013) [15] and Mohsin Abbas *et al.* (2012) [14].

**Table 2:** Fruit length (cm) at different days of growth and development period (80,100,120,140 days) in various ber genotypes.

S. No.	Treatments	Fruit length (cm) at different days			
		80	100	120	140
1.	Jawahar ber 1	1.31	1.61	2.01	2.37
2.	Jawahar ber 2	2.07	2.37	2.77	3.13
3.	Jawahar ber 3	1.97	2.27	2.67	3.03
4.	Jawahar ber 4	1.64	1.94	2.34	2.7
5.	Jawahar ber 5	1.87	2.17	2.57	2.93
6.	Jawahar ber 6	1.74	2.04	2.44	2.8
7.	Jawahar ber 7	0.71	1.01	1.41	1.77
8.	Jawahar ber 8	1.61	1.91	2.31	2.67
9.	Jawahar ber 9	1.51	1.81	2.21	2.57
10.	Jawahar ber 10	0.84	1.14	1.54	1.9
11.	Jawahar ber 11	0.91	1.21	1.61	1.97
12.	Jawahar ber 12	2.84	3.14	3.54	3.9
13.	Jawahar ber 13	1.04	1.34	1.74	2.1
14.	Jawahar ber 14	1.24	1.54	1.94	2.3
15.	Jawahar ber 15	1.57	1.87	2.27	2.63
16.	Jawahar ber 16	1.74	2.04	2.44	2.8
17.	Jawahar ber 17	1.84	2.14	2.54	2.9
18.	Jawahar ber 18	1.57	1.87	2.27	2.63
19.	Jawahar ber 19	1.51	1.81	2.21	2.57
20.	Jawahar ber 20	1.87	2.17	2.57	2.93
	S.Em±	0.12	0.13	0.11	0.11
	CD at 5% level	0.32	0.32	0.33	0.32

**Table 3:** Fruit width (cm) at different days of growth and development period (80,100,120,140 days) in various ber genotypes

S. No.	Treatments	Fruit width (cm) at different days			
		80	100	120	140
1.	Jawaharber 1	1.48	1.78	2.13	2.48
2.	Jawaharber 2	2.07	2.37	2.72	3.07
3.	Jawaharber 3	2.13	2.43	2.78	3.13
4.	Jawaharber 4	1.63	1.93	2.28	2.63
5.	Jawaharber 5	2.14	2.44	2.79	3.14
6.	Jawaharber 6	1.14	1.44	1.79	2.14
7.	Jawaharber 7	0.70	1.00	1.35	1.70
8.	Jawaharber 8	1.65	1.95	2.30	2.65
9.	Jawaharber 9	1.43	1.73	2.08	2.43
10.	Jawaharber 10	0.65	0.95	1.30	1.65
11.	Jawaharber 11	0.84	1.14	1.49	1.84
12.	Jawaharber 12	2.99	3.29	3.64	3.99
13.	Jawaharber 13	1.48	1.78	2.13	2.48
14.	Jawaharber 14	1.33	1.63	1.98	2.33
15.	Jawaharber 15	1.69	1.99	2.34	2.69
16.	Jawaharber 16	1.65	1.95	2.30	2.65
17.	Jawaharber 17	1.95	2.25	2.60	2.95
18.	Jawaharber 18	1.48	1.78	2.13	2.48
19.	Jawaharber 19	1.35	1.65	2.00	2.35
20.	Jawaharber 20	1.67	1.97	2.32	2.67
	S.Em±	0.0074	0.0072	0.0074	0.0075
	CD at 5% level	0.021	0.020	0.021	0.022

**Fruit Weight (cm) & Fruit Volume (ml):** The data showed that weight of fruit of different ber genotype have been found to be increased with advancement of growth and development period. The maximum (12.32g) weight was recorded in Jawahar ber-12 followed by Jawahar ber-16 (11.98g) and minimum (3.73g) was in Jawahar ber-7 at 80 days. The maximum (14.82g) weight of fruit was found in Jawahar ber-12 followed by Jawahar ber-16 (14.48g) and the minimum (6.23g) was in Jawahar ber-7 at 100 days. The maximum (18.32g) weight of fruit was observed in Jawahar ber-12 followed by Jawahar ber-16 (17.98g) and the minimum (9.73g) was in Jawahar ber-7 at 120 days. The maximum (24.63g) weight of fruit was found in Jawahar ber-12 followed by Jawahar ber-16 (23.97g) and the minimum (10.05g) weight in Jawahar ber-7 at 140 days.

The volume of fruit was significantly influenced by different ber genotype and has been found to be increased with advancement of growth and development period. The maximum (9.0 ml) volume of fruit was recorded in Jawahar ber-12 followed by Jawahar ber-16 (8.5 ml), while the minimum (2.9 ml) was in Jawahar ber-7 at 80 days. The maximum (10.29 ml) volume of fruit was recorded in Jawahar ber-12 followed by Jawahar ber-16 (9.71ml) while the minimum (3.42 ml) was in Jawahar ber-7 at 100 days. The maximum (12.0 ml) was found in Jawahar ber-12 followed by Jawahar ber-16 (11.33 ml) while the minimum (3.99 ml) was in Jawahar ber-7 at 120 days. The maximum (18.0 ml) was in Jawahar ber-12 followed by Jawahar ber-16(17.0 ml) while the minimum (6.0 ml) was in Jawahar ber-7 at 140 days. Our findings are also in line reported by Pareek (2001) [18], Kumar *et al.* (1987) [12], and Kundi *et al.* (1989) [13], Faroda (1996) [7], Akhundova and Agaev (1989) [1], Reddy *et al.* (1998) [21], Ram *et al.* (2008) [20], Jan Brindza *et al.* (2011) [10], Shukla *et al.* (2012) [24].

**Table 4:** Fruit weight (g) at different days of growth and development period (80,100,120,140 days) in various ber genotypes.

S. No.	Treatments	Fruit weight (g) at different days			
		80	100	120	140
1.	Jawaharber 1	7.67	10.17	13.67	15.33
2.	Jawaharber 2	9.15	11.65	15.15	18.3
3.	Jawaharber 3	10.13	12.63	16.13	20.27
4.	Jawaharber 4	5.98	8.48	11.98	12.72
5.	Jawaharber 5	8.73	11.23	14.73	17.47
6.	Jawaharber 6	7.7	10.2	13.7	15.4
7.	Jawaharber 7	3.73	6.23	9.73	10.05
8.	Jawaharber 8	6.77	9.27	12.77	13.53
9.	Jawaharber 9	8.92	11.42	14.92	17.83
10.	Jawaharber 10	10.25	12.75	16.25	20.5
11.	Jawaharber 11	11.03	13.53	17.03	22.07
12.	Jawaharber 12	12.32	14.82	18.32	24.63
13.	Jawaharber 13	10.18	12.68	16.18	20.37
14.	Jawaharber 14	7.07	9.57	13.07	14.13
15.	Jawaharber 15	8.33	10.83	14.33	16.67
16.	Jawaharber 16	11.98	14.48	17.98	23.97
17.	Jawaharber 17	6.87	9.37	12.87	13.73
18.	Jawaharber 18	6.17	8.67	12.17	12.33
19.	Jawaharber 19	6.67	9.17	12.67	13.33
20.	Jawaharber 20	8.63	11.13	14.63	17.27
S.Em±		0.71	0.72	0.71	0.71
CD at 5% level		2.04	2.05	2.04	2.04

**Table 5:** Fruit volume (ml) at different days of growth and development period (80,100,120,140 days) in various ber genotypes.

S. No.	Treatments	Fruit volume (ml) at different days			
		80	100	120	140
1.	Jawaharber 1	4.5	5.14	6.0	8.97
2.	Jawaharber 2	6.3	7.24	8.44	12.7
3.	Jawaharber 3	6.5	7.43	8.67	12.80
4.	Jawaharber 4	3.0	3.43	4.0	6.20
5.	Jawaharber 5	5.0	5.71	6.67	10
6.	Jawaharber 6	4.5	5.14	6.0	9.20
7.	Jawaharber 7	2.9	3.42	3.99	5.98
8.	Jawaharber 8	3.5	4.0	4.67	7.28
9.	Jawaharber 9	5.5	6.29	7.33	10.82
10.	Jawaharber 10	8.0	9.14	10.67	16.28
11.	Jawaharber 11	8.5	9.71	11.33	16.72
12.	Jawaharber 12	9.0	10.29	12	18
13.	Jawaharber 13	7.5	8.57	10	15.33
14.	Jawaharber 14	4.2	4.76	5.56	8.0
15.	Jawaharber 15	4.5	5.14	6.0	9.30
16.	Jawaharber 16	8.5	9.71	11.33	16.70
17.	Jawaharber 17	4.0	4.57	5.33	7.90
18.	Jawaharber 18	3.0	3.43	4.0	6.10
19.	Jawaharber 19	3.5	4.0	4.67	7.20
20.	Jawaharber 20	3.0	3.43	4.0	5.80
S.Em±		0.72	2.07	0.96	1.44
CD at 5% level		2.07	2.36	2.76	4.14

### Harvesting and Maturity

The first harvest was started on Jawahar ber-1,2,3,8 during 2<sup>nd</sup> week of January and on Jawahar ber-5,16,20 during 3<sup>rd</sup> week of January, on Jawahar ber -4,6,9,10,11,14,17,18 during 4<sup>th</sup> week of January and on Jawahar ber-7,12,13,15,19 during 1<sup>st</sup> week of February. The last harvest was recorded during 1<sup>st</sup> week of February in Jawahar ber-1,2,3,8 and Jawahar ber-5,16,20 genotypes during 2<sup>nd</sup> week of February, Jawahar ber-4,6,9,10,11,14,17,18 in 3<sup>rd</sup> week of February and Jawahar ber-7,12,13,15,19. In 1<sup>st</sup> week of March 2019. The genotypes

Jawahar ber-1,2,3,5,8,16,20 comes under early maturity group, and the genotypes Jawahar ber-4,6,9,10,11,14,17,18 are mid maturing genotype and Jawahar ber-7,12,13,15,19 genotypes are late maturing genotype. These variations in flowering and fruit maturity relates to climatic variation like temperature, rainfall and genetic constitution. Saran *et al.* (2006) [23] classified Umran and Chuhara as late bearing genotype while Gola as early bearing genotype and Kaithli as mid-season genotype. Observations also collaborate with the findings of Chadha *et al.* (1972) [4].

**Table 6:** Period required for flowering to fruit set (Days), Harvesting and Maturity

S. No.	Treatments	Period required for flowering to fruit set(days)	Date of first harvest (week)	Date of last harvest (week)	Fruit maturity group
1	Jawahar ber 1	62	2 <sup>nd</sup> week of January	1st week of February	Early
2	Jawahar ber 2	44	2 <sup>nd</sup> week of January	1st week of February	Early
3	Jawahar ber 3	45	2 <sup>nd</sup> week of January	1st week of February	Early
4	Jawahar ber 4	56	4 <sup>th</sup> week of January	3rd week of February	Mid
5	Jawahar ber 5	65	3 <sup>rd</sup> week of January	2nd week of February	Early
6	Jawahar ber 6	45	4 <sup>th</sup> week of January	3rd week of February	Mid
7	Jawahar ber 7	46	1 <sup>st</sup> week of February	1st week of march	Late
8	Jawahar ber 8	58	2 <sup>nd</sup> week of January	1st week of February	Early
9	Jawahar ber 9	52	4 <sup>th</sup> week of January	3rd week of February	Mid
10	Jawahar ber 10	42	4 <sup>th</sup> week of January	3rd week of February	Mid
11	Jawahar ber 11	57	4 <sup>th</sup> week of January	3rd week of February	Mid
12	Jawahar ber 12	38	1 <sup>st</sup> week of February	1st week of march	Late
13	Jawahar ber 13	42	1 <sup>st</sup> week of February	1st week of march	Late
14	Jawahar ber 14	51	4 <sup>th</sup> week of January	3rd week of February	Mid
15	Jawahar ber 15	41	1 <sup>st</sup> week of February	1st week of march	Late
16	Jawahar ber 16	45	3 <sup>rd</sup> week of January	2nd week of February	Early
17	Jawahar ber 17	50	4 <sup>th</sup> week of January	3rd week of February	Mid
18	Jawahar ber 18	61	4 <sup>th</sup> week of January	3rd week of February	Mid
19	Jawahar ber 19	38	1 <sup>st</sup> week of February	1st week of march	Late
20	Jawahar ber 20	57	3 <sup>rd</sup> week of January	2nd week of February	Early

### Conclusion

On the basis of growth and development parameters *viz.* Fruit length, width, fruit weight and fruit volume, the genotypes are grouped large, medium and small types. The ber genotypes grouped under large type fruits are Jawaharber-3, 10, 11, 12, 13, 16, under medium types Jawahar ber 4, 7, 8, 14, 17, 18, 19 and under small types-Jawaharber 1, 2, 5, 6, 9, 15, 20. The ber fruits of different genotypes took about 120-180 days to reach harvestable maturity and thus grouped as early, mid and late variety. The genotypes Jawahar ber-1, 2, 3, 5, 8, 16, 20 reaches at harvestable maturity in 140 days (Early variety), Jawahar ber-4, 6, 9, 10, 11, 14, 17, 18 reaches at harvestable maturity between 145-160 days (Mid variety) whereas, Jawahar ber-7, 12, 13, 15, 19 reaches at harvestable maturity between 160-180 days(Late variety).It is also noticed that fruit characteristics *viz.* fruit weight, fruit volume, fruit length, fruit width were found to be increased during the entire course of growth and development period. Among the various genotypes, Jawahar ber-12 was found the best genotype with regard to the highest average weight per fruit (24.63 g), followed by Jawahar ber-16 (23.97 g) fruit weight. Similarly the maximum volume (18.0 ml) was observed in Jawahar ber-12 followed by Jawahar ber-16(17.0 ml).

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