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Phenological Characteristics of Chironji (*Buchanania lanzan)* Fruits at chotanagpur plateau region

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ABSTRACT

Chironji, Char or Achar (*Buchanania lanzan* Spreng; family Anacardiaceae) is an important non – wood tree species found in deciduous forests throughout the greater part of India. In central India, it is a common associate of teak, sal and mixed forests. It is a small to moderate sized tree, generally attaining a height up to 18 m and girth 1.5 m. The bark is dark gray or black, regularly divided into small rectangular plates, somewhat resembling a crocodile hide and reddish inside. Chironji is a multipurpose tree and very important plant for rural and tribal economy. It is used for environmental conservation and in Agro-forestry/Agro-horticulture system. It is used as a fuel, fodder (especially for buffaloes), alternative host for *Kusmi* lac insect, and also used in cosmetic items and soaps. Its wood is very cheap compared to other timbers. The wood is used in making boxes and cheap furniture. It is also suitable for match industry. Its bark contains about 13.4% of tannin. Its gum is soluble in water that exudes from the wounds in the stem and it is used in textile business (Tewari, 1995). Seeds/ kernel are nutritional, palatable and used as a substitute of almonds in confectionery. Flowers appear from January to March and their colour is greenish-white. Fruits ripen in the months of May–June (Troup, 1986). The fruit collection starts from mid April and ends by mid June, but its harvesting is generally finished in 15-20 days only. The harvesting period may vary with the purpose of fruit collection in different agro-climatic zones. Early harvesting result into low fruit/seed setting and poor seed germination. In forests, its natural regeneration is very scanty due to unscientific and pre-mature harvesting of its seeds and site degradation on account of growing biotic pressure.

Key Words : Chironji, Fruits, Forests, Tannin

INTRODUCTION

Chironji is an income generating produce of forest dependent communities. On an average, 40–50 kg fresh fruits are produced per tree, which yields 8–10 kg on drying, resulting in 1–1.5 kg of finished produce per tree (Tewari, 1995). Average annual seed collection is 300 to 1200 quintals in Madhya Pradesh (Prasad, 1989). In the recent past, due to excessive felling of trees and overgrazing, considerable reduction in the population of chironji in the forest and non-forest areas has been recorded (Singh *et al*., 2002). It is included in the Red Data Book published by International Union for Conservation of Nature and Natural Resources (IUCN) as it is a vulnerable medicinal plant.

Chironji crop play an important role in rural and tribal community of state of Jharkhand. It is not cultivated commercially. However, it contributes 10 % of total forest product in collection-based livelihood of forest dwellers of this region (Govt. of Jharkhand, 2013). The tribal people often collect the fruits of this tree to earn their livelihood, through its sale, the tree is consequently overexploited. A wide diversity of chironji exists in Chotanagpur plateau region. However, a high rate of genetic erosion noticed in forest area due to deforestation. The seeds

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Table 1. GPS Reading of Plants Selected.

Plant	GPS reading	
	N	E
BL 01	23 ^{0}28’11.2”	84^{0}15’53.0”
BL 02	23 ^{0}28’09.0”	84^{0}16’28.5”
BL 03	23 ^{0}28’09.1”	84^{0}16.28.9”
BL 04	23 ^{0}28’07.5”	84^{0}15’31.2”
BL 05	23 ^{0}28’07.0”	84^{0}15’35.8”
BL 06	23 ^{0}28’03.6”	84^{0}15’56.2”
BL 07	23 ^{0}28’10.2”	84^{0}15’16.5”
BL 08	23 ^{0}25’43.4”	84^{0}17’28.4”
BL 09	23 ^{0}25’48.8”	84^{0}17’44.7”
BL 10	23 ^{0}26’06.3”	84^{0}19’23.8”

are the major source of regeneration of chironji in India. The major problem in the reforestation is low seed germination. The basic problem in germination is the presence of a hard seed coat which hinders germination.

Afforestation and regeneration of chironji, proper harvesting, post-harvest operations and processing and strengthing marketing can increase living slandered of tribal people of Jharkhand. However, this crop is yet not studied thoroughly in entire Chotanagpur plateau region. The present research work was undertaken to address the above problems and with following objectives of to study the phonology of chironji and to study the chironji as fruit species.

MATERIALS AND METHODS

Experiment was conducted during year 2019-20 and 2020-21 at the Netarhat area which is a part of Chotanagpur plateau region of Jharkhand. Netarhat is situated at 23° 0’ 0” N latitude to 85° 0’ 0” E Longitude with an average altitude of 700 m above mean sea level. Studied area composed of red soils varies from sand to clay; soil was acidic in reaction with low level of organic carbon, available nitrogen, available P_2O_5 and medium in available K_2O. The composite soil samples were collected from the study area and analyzed to determine the chemical properties.

Experimental Material

The experimental material was chironji crop available in the Netarhat plateau of Chotanagpur plateau region. Ten fully grown healthy chironji plants aged between 15 to 20 years were selected from five kilometer radius of Netarhat plateau in Randomized Block Design with five replications using branches on the same tree as a replication. Netarhat Residential School and Forest Bungalow was center part of working area. GPS data of plants was taken (Table 1). Information on people’s perceptions on chironji crop was collected through field visit and personal interaction of the local people. Data on different fruit characteristics were collected by several personal visits to the plants.

Observations taken: Various quantitative and quality traits were taken from ten selected chironji plants of Netarhat plateau. Five branches of each plant (each from east, west, north, south and top position) were selected that act as replication. Observations taken panicle initiation (Date), flower opening (10%, 50% and 100%), panicle length (cm), total flowers per panicle, number of perfect flower and pseudo perfect flower& percentage of pseudo perfect flowers was calculated. Fruits per panicle at the time of harvesting, colour of fruit were observed during April, fruit weight was recorded. Fruit length and fruit width was recorded

Table 2. Panicle initiation (Date/Week) and flower opening (Date).

Plants	Panicle Initiation		10% Flower opening		50% Flower opening		100% Flower opening	
	2020	2021	2020	2021	2020	2021	2020	2021
BL 01	2nd week Dec 2019	3rd week Dec 2020	3rd week of Jan 2020	4th week of Jan 2021	4th week of Jan 2020	1st week of Feb 2021	1st week of Feb 2020	2nd week of Feb 2021
BL 02	2nd week Dec 2019	3rd week Dec 2020	2nd week of Jan 2020	4th week of Jan 2021	4th week of Jan 2020	1st week of Feb 2021	1st week of Feb 2020	2nd week of Feb 2021
BL 03	3rd week Dec 2019	4th week Dec 2020	3rd week of Jan 2020	4th week of Jan 2021	4th week of Jan 2020	1st week of Feb 2021	1st week of Feb 2020	2nd week of Feb 2021
BL 04	3rd week Dec 2019	4th week Dec 2020	2nd week of Jan 2020	5th week of Jan 2021	4th week of Jan 2020	1st week of Feb 2021	1st week of Feb 2020	3rd week of Feb 2021
BL 05	2nd week Dec 2019	4th week Dec 2020	3rd week of Jan 2020	4th week of Jan 2021	4th week of Jan 2020	1st week of Feb 2021	1st week of Feb 2020	2nd week of Feb 2021
BL 06	3rd week Dec 2019	5th week Dec 2020	3rd week of Jan 2020	5th week of Jan 2021	4th week of Jan 2020	2nd week of Feb 2021	1st week of Feb 2020	3rd week of Feb 2021
BL 07	3rd week Dec 2019	5th week Dec 2020	3rd week of Jan 2020	5th week of Jan 2021	4th week of Jan 2020	2nd week of Feb 2021	1st week of Feb 2020	3rd week of Feb 2021
BL 08	2nd week Dec 2019	5th week Dec 2020	3rd week of Jan 2020	5th week of Jan 2021	4th week of Jan 2020	2nd week of Feb 2021	1st week of Feb 2020	3rd week of Feb 2021
BL 09	3rd week Dec 2019	4th week Dec 2020	3rd week of Jan 2020	4th week of Jan 2021	4th week of Jan 2020	2nd week of Feb 2021	1st week of Feb 2020	3rd week of Feb 2021
BL 10	3rd week Dec 2019	5th week Dec 2020	3rd week of Jan 2020	5th week of Jan 2021	4th week of Jan 2020	2nd week of Feb 2021	1st week of Feb 2020	3rd week of Feb 2021

Table 3. Number of total flowers, perfect flower and pseudo perfect flower/panicle.

Plants	Total Flower (no)			Perfect Flower (no)			Pseudo Perfect flower (no)			% of Perfect Flower			% of Pseudo Perfect flower		
	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled	2020	2021	Pooled
BL 01	1432.60	1426.00	1429.30	140.60	142.80	141.70	1292.00	1283.20	1287.60	9.89	10.00	9.94	90.11	90.00	90.06
BL 02	1725.00	1756.80	1740.90	173.80	156.60	165.20	1551.20	1600.20	1575.70	10.36	8.90	9.63	89.64	91.10	90.37
BL 03	1403.80	1544.00	1473.90	136.20	138.00	137.10	1267.60	1406.00	1336.80	9.83	8.92	9.37	90.17	91.08	90.63
BL 04	1483.40	1358.80	1421.10	153.00	121.60	137.30	1330.40	1237.20	1283.80	10.59	8.94	9.76	89.41	91.06	90.24
BL 05	1367.00	1341.00	1354.00	144.20	136.20	140.20	1222.80	1204.80	1213.80	10.57	10.18	10.38	89.43	89.82	89.62
BL 06	1367.20	1633.80	1500.50	144.00	162.00	153.00	1223.20	1471.80	1347.50	10.58	10.09	10.33	89.42	89.91	89.67
BL 07	1430.60	1412.60	1421.60	160.00	145.60	152.80	1270.60	1267.00	1268.80	11.24	10.29	10.76	88.76	89.71	89.24
BL 08	1646.40	1708.80	1677.60	169.20	154.00	161.60	1477.20	1554.80	1516.00	10.33	9.15	9.74	89.67	90.85	90.26
BL 09	2052.40	1695.40	1873.90	197.80	156.20	177.00	1854.60	1539.20	1696.90	9.78	9.41	9.60	90.22	90.59	90.40
BL 10	1587.20	1596.00	1591.60	160.40	145.20	152.80	1426.80	1450.80	1438.80	10.28	9.18	9.73	89.72	90.82	90.27
Mean	1549.56	1547.32	1548.44	157.92	145.82	151.87	1391.64	1401.50	1396.57	10.345	9.506	9.9	89.655	90.494	90.07
$CD_{0.05\%}$	277.667	263.395	192.538	24.215	N.S.	20.28	266.50	251.61	182.90	N.S.	N.S.	N.S.	N.S.	N.S.	N.S.
SE (d)	136.355	129.246	96.587	11.89	11.40	10.17	130.87	123.56	91.75	0.82	1.02	0.6	0.82	1.02	0.629
SE (m)	96.447	91.462	68.298	8.41	8.06	7.19	92.54	87.37	64.88	0.58	0.72	0.4	0.58	0.72	0.445
CV (%)	13.913	13.217	13.948	11.91	12.09	14.98	14.87	13.94	14.69	12.51	16.92	14.2	1.44	1.78	1.561

Table4. Panicle length (cm), fruits per panicle (no), fruit length (cm), fruit width (cm), fruit weight (g) (Average data of year 2019-20 and 2020-21)

Plant	Panicle length	Fruits per panicle	Fruit Length (cm)	Fruit Width (cm)	Fruit Weight (gm)
BL 01	21.14	20.80	1.07	0.99	1.12
BL 02	25.10	22.80	1.10	1.01	1.19
BL 03	23.48	21.00	1.11	1.11	1.17
BL 04	26.04	24.80	1.12	1.01	1.20
BL 05	22.38	24.50	0.99	0.88	1.10
BL 06	23.93	23.60	1.08	1.07	1.11
BL 07	25.72	23.70	0.97	0.86	1.09
BL 08	23.76	25.90	1.06	0.99	1.09
BL 09	24.89	25.80	1.05	1.04	1.12
BL 10	27.67	27.00	1.08	1.02	1.07
Mean	24.41	23.99	1.063	1.00	1.13
$CD_{0.05\%}$	3.75	NS	0.05	0.06	N.S.
SE (d)	1.88	2.10	0.03	0.03	0.07
SE (m)	1.33	1.49	0.02	0.02	0.05
CV (%)	17.26	19.58	5.57	6.88	13.07

by using vernier scale; Stone weight was calculated after removing pulp of fruits and expressed in gram. Pulp weight was expressed in gram and in percent.

RESULTS AND DISCUSSION

Earlier Panicle initiation and flower opening is a good index which may contribute towards greater production of crop plants. The data regarding date of panicle initiation have been presented in Table 2. Panicle initiation started in 3rdweek of December and continued till 5thweek of December. In whole process of panicle initiation, however completed within fifteen days in the selected plants. Chauhan *et al* (2012) reported that flowers appear from January to March in chironji. Flower opening in chironji crop was observed at three stages i.e. 10%, 50% and 100% flowering. It was revealed from the data that 10 % flower opening in chironji plants completed between 4th to 5th weeks of January. 50% of flower opening completed by 1st and 2nd of February (Table 2). Similarly, 100 % flower opening completed by 2nd to 3rd week of February. Thus, it took 15 to 20 days from 10 % flower opening to 100 % flowering in a panicle in chironji. Sundarapandian *et al* (2005) reported that flowering behavior that could be partly attributed to abiotic factors. Sharma (2012) reported that the chironji flowers from January to March.

A significant variation in total, perfect and psedo-perfect flowers was observed among the chironji genotypes. Data revealed that on an average number of total, perfect and psedo-perfect flowers in chironji was 1548.44, 151.87 and 1396.57 respectively. In

data, range of total number of flower, perfect flower and psedo-perfect flower was 1354.00 to 1873.90, 137.10 to 177.00 and 1213.80 to 1696.90. On the other hand, Chauhan *et al* (2012) reported that a single panicle bears about 3000 to 5000 flowers. Maximum number of total flower was found in genotype BL09 (1873.90) that were found at par with BL02 (1740.90). Maximum number of perfect flower was found in genotype BL09 (177.00) which were found significantly at par with BL02 (165.20) and BL 08 (161.60). Maximum number of pseudo-perfect flower was found in BL09 (1696.90) which was noted significantly at par with BL02 (1575.70) and BL08 (1554.80). Data on percentage of perfect flower and pseudo-perfect flower showed non-significant variation among different genotypes of chironji. Singh *et al* (2006) reported variation in perfect flowers of chironji due to wide genetic diversity owing to its heterozygous nature.

A significant difference in panicle length among the genotypes has been recorded. Data (Table 4) revealed that the maximum panicle length was recorded in BL10 (27.67 cm), which was statistically at par with BL02 (25.10 cm), BL04 (26.04cm), BL06 (23.93 cm), BL07 (25.72 cm) and BL09 (24.89 cm). Singh *et al* (2010) reported wide variation in panicle length of chironji that ranged between 35.11 to 15.34 cm. Fruits per panicle indicated non-significant differences among the genotypes. Singh *et al* (2006) reported highest 37.50 fruits per panicle in chironji. Chauhan *et al* (2012) reported that the fruit set was around 3 per cent. Maximum fruit length is recorded in BL 04 (1.12 cm), followed by BL01, BL02, BL 03,BL 06 and BL 10. Average fruit length was recorded 1.06 cm. Significance difference was found among maximum fruit width was recorded in BL 03 (1.11 cm) which was significantly at par with genotype BL06. Singh *et al* (2006) recorded maximum fruit width of 1.13 cm in chironji. Data on fruit weight revealed that genotypes did not differ significantly among themselves with respect on fruit weight. On an average fruit weight was recorded 1.13 gm. Singh *et al* (2012) reported that the fruit had 1.20 g average weight.

Data on fruiting quality and its attributes of chironji has been given in Table 5. Pooled data revealed that pulp weight varied between 0.67 (BL 03) to 0.54 g (BL 08). Average pulp content was noted 54.62 percent. However, pulp content (%) was noted non-significant. Maximum stone weight was found in plant genotype BL07 (0.69 g) which was found at pat with BL01 (0.65 g), BL 02 (0.60 g), BL 04 (0.63 g), BL 05 (0.64 g), BL06 (0.63 g) and BL 08 (0.66 g). Stone weight was noted statistically non-significant. Average stone weight was recorded 0.61 g. Singh *et al* (2006) reported that stone weight in chironji range from minimum 0.37 to maximum 0.69 g. Data presented in Table 5 indicated significant difference in kernel weight in genotypes of chironji fruits. Highest kernel weight is found in genotype BL10 (0.13 g) which was noted at par with BL01, BL06 and BL07. Singh *et al* (2012) reported that the fruit had 0.12 g kernel weight. Fruit yield per tree ranged from 10.85 (BL 06) to 15.50 kg (BL10). Singh *et al* (2012) reported highest fruit yield of 28.0 kg/plant in chironji. Tewari *et al* (2001) however further reported that 3-4 kg kernels per plant per year are normally harvested.

CONCLUSION

To protect the chironji plants from accelerated genetic erosion in Chotonagpur plateau region the strategies may be taken as commercial multiplication of suitable genotype(s) using proper seed treatment and spread it to forest areas, homestead lands and/or farmer's field involving locals and tribes. Fruits are kernels were found highly nutritious. It indicates the future scope for further value addition. Efficiency of kernel extraction machines should be increased for quality improvement. Marketing system of chironji should be organized and Government should play a decisive role towards its improvement

Table 5. Pulp weight, pulp content of fruit, stone weight (g), kernel weight (g) yield (kg) (Average data of 2019-20 and 2020-21)

Plants	Pulp Weight (g)	Pulp contain (%)	Stone Weight (gm)	Kernel Weight (gm)	Fruit Yield (kg)
BL 01	0.65	58.87	0.62	0.12	12.20
BL 02	0.61	52.52	0.60	0.11	11.70
BL 03	0.67	58.01	0.56	0.11	14.40
BL 04	0.61	51.27	0.62	0.10	12.10
BL 05	0.64	59.46	0.59	0.10	13.30
BL 06	0.62	56.99	0.59	0.12	10.90
BL 07	0.57	53.46	0.64	0.12	14.20
BL 08	0.54	49.87	0.67	0.11	12.60
BL 09	0.56	50.13	0.60	0.11	11.90
BL 10	0.59	55.66	0.61	0.13	15.10
Mean	0.61	54.62	0.61	0.11	12.80
$CD_{0.05\%}$	0.059	NS	NS	0.01	-
SE (d)	0.03	4.25	0.04	0.01	1.40
SE (m)	0.02	3.01	0.03	0.01	-
CV (%)	10.97	17.40	15.62	11.25	

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Panicle initiation stages of chironji (A to F)

Flower of chironji (different stages)

Phenological Characteristics of Chironji

Different stages of Chironji fruits