

Scientific Harvesting for Quality Seed Collection of *Buchanania lanzan* Spreng for its Conservation and Sustainable Management – Case Study of Chhindwara, Madhya Pradesh, India

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Abstract

Buchanania lanzan Spreng (common name - Char, Chironji) belonging to family Anacardiaceae. This plant was first described by Francis Hamilton in 1798. It is a non wood tree species found in deciduous forests throughout the greater part of India and generally attaining a height up to 18m and girth 1.5m. In Madhya Pradesh, it is a common associate of teak, sal and mixed forests. It is used for environmental conservation and in 'agroforestry system'. It is used as a fuel, fodder specially buffaloes alternative host Kusmi lac insect, and its oil for cosmetic items and soaps. Its oil is also used by tribal as edible oil. Seeds / kernel of *Buchanania lanzan* are nutritional, palatable and used as a substitute of almonds in confectionery. They yield a fatty oil known as Chironji oil and substitute for olive and almond oils in both confectionery and indigenous medicine used for glandular swellings of the neck (CSIR, 1986). Fruits are laxative and used to relieve thirst burning of body and fever. Kernels of fruits are used as ointment in skin diseases (Das and Agrawal, 1991).

Tree of *Buchanania lanzan* flowers from January to March and fruits ripen in the month of April-June (Troup, 1986). Fruits become red after ripening. The fruit collection take place from April to June. Early harvesting results into low fruit/ seed quality and poor germination potential. In most parts of M. P., fruits of *Buchanania lanzan* are harvested before ripening. With the result, it fetches low price in the market because of small seed size and low seed quality. In natural forests, its regeneration is vary scanty due to unscientific and pre-mature harvesting of its seeds and site degradation on account of growing biotic pressure. Keeping above in views, there is a need to find out the best harvesting period of Chironji fruit/seed with special reference to seed size, seed weight, biochemistry and germination potential of seed. The present communication deals with morphological, physiological and biochemical study of *Buchanania lanzan* seed harvested at 7 days interval during its various developing stages from April to May. The fruits were collected from forests of Kundam range in Jabalpur forest division for the present study. The best results in terms of seed size, seed weight, germination percent, oil content etc, were obtained in the fruits harvested in the 2nd week of May.

Keywords: Seed quality, harvesting period, Seed vigour

1. Introduction

Buchanania lanzan spreng (Common vernacular names, Char, Achar, and Chironji) belongs to family Anacardiaceae. It is an important no-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. This plant was first described by Francis Hamilton in 1798. 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. *Buchanania lanzan* is a multipurpose tree. The wood is used in making boxes and cheap furniture. It has been reported to be suitable for match industry. Its wood is very cheap compared to other timbers. It is important for rural and tribal economy. It is used for environmental conservation and in 'agro forestry system'. It is used as a fuel, fodder especially for buffaloes, alternative host for Kusmi lac insect, and oil for cosmetic items and soaps. Its oil is also used as edible oil by tribals. The seeds contain oil and protein. Seeds/ kernel of *Buchanania lanzan* are nutritional, palatable and used as a substitute of almonds in confectionery. They yield a fatty oil known as "Chironji oil" and substituted for olive and "Almond oils", both in confectionery and indigenous medicines used for glandular swellings of neck [1]. The kernels, which have a flavor somewhat between that of pistachio and almonds, are eaten raw or roasted and are commonly used in the preparation of milk-based sweet meals and puddings. Fruits are laxative and used to relieve thirst, burning of the body and fever. Kernels of fruits are used as ointment in skin diseases [2].

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 [6]. Average annual seed collection is 300 to 1200 quintals in Madhya Pradesh [5]. It 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 [6].

The tree is leafless or nearly so, for a very short time during the summer season. Flowers appear from January to March and their colour is greenish-white. Fruits ripen in the months of May–June [7]. The fruits become red after ripening. 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 germination potential. In most parts of Madhya Pradesh, fruits of *Buchanania lanzan* are harvested before ripening. As a result, it fetches much lower price in the market because of small seed size and low seed quality even. This tree is lopped frequently for the purpose of huge and rapid collection. 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. Keeping above in view there is a need to find out the best harvesting period of *Chironji* fruits/seeds with special reference to seed size, seed weight, bio-chemistry and germination potential of seed.

2. Site Description

The study area lies in Harrai range of East Chhindwara forest division between parallels of latitude 21° – 27' and 45" N to 21° – 27' – 15" N and the longitude 78° – 19' – 45" to 79° – 19' – 35" E. The area is mostly hilly. The most conspicuous features are the plateaus of Chhindwara with scattered single or irregular groups of flat-topped hills and the scattered southern edge of the main Chhindwara plateau. The main geological formations are deccan traps on the plateau and flat hill tops and geisses exposed by the denudation of the overlying deccan trap in the valley of Kanhan and Pench reserve. The soil in the trap zone is reddish, shallow or lateritic loam. The climate is health and of typical central Indian type with three distinct seasons viz; rainy, cold and hot. The maximum temperature varies from 42.6 to 40.3 °C and minimum temperature from 6.7 to 4.9 °C. The mean annual normal rainfall is 1135mm. Regions on the plateau receive higher rainfall than those below the ghat.

3. Materials and Methods

Forty five trees with three replicates of fifteen trees each were marked for detailed study. Fruit collection was done at 7 days interval during its maturing period, from the first week of April to the third week of May. After collection of fruits, analysis was done for morphological, physiological and biochemical.

In the first stage of study, observations were recorded at the initiation of flowering and fruiting. Morphological and physiological analysis of fruit was done by taking 500 gms of developing fruits picked from each of the 45 trees at 7 days interval from the initiation of fruit setting to maturity period. Morphological observations of fruits were recorded on various parameters viz; fruit size, colour, weight and moisture content during its developing stages. Physico-chemical analysis of fruits was carried out for oil, sugar and protein percent. For biochemical study, seeds were extracted from the fruits manually with light hammering.

In biochemical test, sugar, oil and protein contents were estimated by Anther one method, Soxhlet method and by the method of Linder and Harley [4], respectively. For physiological analysis, germination test of seeds was carried out in the field conditions.

Detailed procedure for analysis of various aspects is described as under.

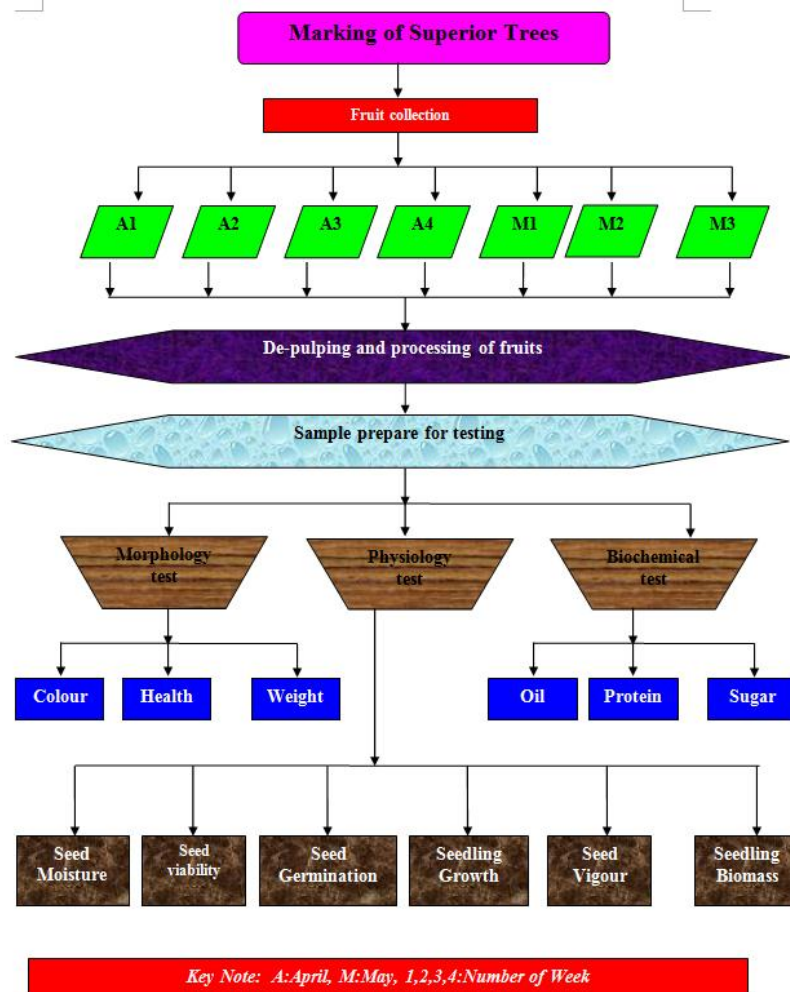


Figure 1. Methodology

3.1. Morphological Attributes

Following morphological observations of fruits were recorded on various parameters during its developing stages

- Fruit size
- Fruit colour
- Fruit weight
- Fruit moisture content

3.2. Physiological Attributes

3.2.1. Moisture Content

The analysis of moisture content was carried out by taking duplicate working samples, which were weighed with an accuracy of 1 mg. The moisture content (MC) was calculated to the first place of decimal [3].

- Weight of fruit · The fruits were weighed using electronic balance.
- Size of fruit · Size of fruits was measured by vernier calipers.
- Viability tests · (a) By cutting test
(b) By Tetrazolium test (TTZ)

3.2.2. Seed Viability

For testing seed viability, seeds were de-coated and the exposed seeds were immersed in 1% tetrazolium solution for 24 hours. During treatment, the immersed seeds were kept in darkness at 30°C. After the period of treatment, tetrazolium was decanted off and the preparations were washed with water prior to evaluation. For examination, the preparations were spread on a plate and kept wet throughout the determination.

3.2.3. Seed Germination Test

Extraction of seeds from the fruits was done by de-pulping of fruits. After extraction of seeds, germination test was carried out at different developing stages, right from the time of initiation of fruit setting to its maturity. For germination test, 150 seeds with three replicates of 50 each were taken for study. Germination test was done in field condition using sand as a medium.

New germinates were recorded daily starting from the day of germination till the 30th day after sowing to express germination percent of seeds.

3.2.4. Seedling Growth and Oven Dry Weight of Seedling

Total seedling length was measured at the end of experiment i.e. six months after sowing, Root and shoot measurements were also recorded for each seedling. Fifty seedlings were taken at random for measurements in each of the treatments. Seedlings were cut into root and shoot and dried at 110 °C for 17 hours and weighed. Dry weights for root, shoot and total seedling were expressed as mg / seedling by taking average for fifty seedlings.

3.2.5. Seed Vigor

Seed vigour was calculated by the following formula

$$\text{Seed vigor} = \% \text{ of germination} \times \text{seedling growth (cm)}$$

3.3. Biochemical Attributes

For biochemical study, seeds were extracted from the fruits manually with light hammering and tested for following parameters

- Oil Estimation: By Soxhalet method.
- Determination of total carbohydrates: By Anthrone method
- Protein estimation: By Linder method

Protein content was determined by estimating total amount of nitrogen present in the seed and then multiplying it by the conversion factor of 6.25.

4. Results and Discussions

4.1. Morphological Attributes

Harrai range selected in Chhindwara forest division belongs to M.P. seed zone 11. Tables 1A, 1B and 1C contain week wise morphological data of growth of developing fruits of Harrai origin during 2005–06 in terms of fruit size, weight, colour and health of fruits, number of fruits per kg, wt. of 100 seeds / kernel (obtained from 100 fruits).

Fruit size was found to be minimum (7 mm) in the 1st week of April, while it was maximum (12 mm) in the month of May 3rd week. The colour of fruits changed from green to black during different stages of maturity. In the 3rd week of May the percentage of black seeds was found to be maximum (84%) against 10% to 40% black seeds obtained from 3rd to 4th week of April, respectively. In the 1st and 2nd week of April, the black seeds were absent. The composition of seeds in terms of colour was 100% green in the 1st week of April and 90% green and 10% reddish green in April 2nd week, 70% green in April 3rd week and 35% green in April 4th week. While 6% green, 10% reddish green and 48% black seeds were found in May 3rd week (Table– 1).

The percentage of healthy seeds was found to be zero in first week as no seed formation had occurred by that time. The percentage of heavy and health seeds was found to be increase gradually during different phases of fruit maturity. It was found to be maximum (91% by morphological appearance and 76% by flotation test) in the 2nd week of May and minimum (70% by morphological appearance and 50% by flotation test) in the 2nd week of April (Tables– 1A and 1B). The weight of 100 fruits was found to have increased gradually from April 1st week (17.00 gm) to May 2nd to 3rd week (34.62 to 35 gm respectively), while the number of fruits/kg was found to have decreased gradually from April 1st week (5882) to May 2nd week (2888). Similarly, the weight of seed (kernel) per hundred fruits was the lowest (2.60gm) in the 2nd week of April and the highest (6.40gm) in the 2nd week of May. (Table–1C)

Table 1 (A). Morphological Attributes in Terms of Size, Colour, and Health of Fruits as vs Collection Periods of Fruits

| S. No. | Collection periods | Fruit size (mm) | | Colour of fruit (%) | | | Health of fruit (%) | | |
|--------|--------------------|-----------------|------|---------------------|-------|---------------|---------------------|----------|------------|
| | | Min | Max | Black | Green | Reddish green | Healthy | Wrinkled | Empty seed |
| I | April First week | 7.0 | 10.0 | 0 | 100 | 0 | 0 | 0 | 100 |
| II | April Second week | 8.0 | 12.0 | 0 | 90 | 10 | 70 | 10 | 20 |
| III | April Third week | 9.0 | 11.0 | 10 | 70 | 20 | 73 | 8 | 19 |
| IV | April Fourth week | 8.0 | 11.0 | 40 | 35 | 25 | 81 | 5 | 14 |
| V | May first week | 9.0 | 12.0 | 65 | 25 | 10 | 87 | 3 | 10 |
| VI | May Second week | 9.0 | 12.0 | 81 | 9 | 10 | 91 | 2 | 7 |
| VII | May Third week | 9.0 | 12.0 | 84 | 6 | 10 | 91 | 3 | 7 |

Table 1 (B). Morphological Attributes in Terms of Sunken and Floated Seeds vs Collection Periods of Fruits

| S. No. | Collection Periods | Health test by flotation method | |
|--------|--------------------|-----------------------------------|------------------------------------|
| | | Sunken seeds (with seed coat) (%) | Floated seeds (with seed coat) (%) |
| I | April First week | 0 | 100 |
| II | April Second week | 30 | 70 |
| III | April Third week | 38 | 62 |
| IV | April Fourth week | 50 | 50 |
| V | May first week | 70 | 30 |
| VI | May Second week | 76 | 24 |
| VII | May Third week | 73 | 27 |

Table 1 (C). Morphological Attributes in Terms of Fruit Weight, Number of Fruits per kg, seed/kernel Weight and Weight of Kernel Obtained from 1kg Fruits vs Collection Period of Fruits

| S. No. | Collection Periods | Weight of 100 fruits (gm) | No. of fruits per kg | Weight of seeds (kernels) obtained from 100 fruits (gm) | Weight of kernel obtained from 1kg fruits (gm) |
|--------|--------------------|---------------------------|----------------------|---|--|
| I | April First week | 17 | 5882 | 0 | 0 |
| II | April Second week | 19.5 | 5128 | 2.60 | 133.33 |
| III | April Third week | 24.0 | 4166 | 3.85 | 160.41 |
| IV | April Forth week | 27.12 | 3687 | 4.75 | 175.14 |
| V | May first week | 29.12 | 3434 | 5.00 | 171.70 |
| VI | May Second week | 34.72 | 2888 | 6.32 | 182.55 |
| VII | May Third week | 35 | 2857 | 6.40 | 182.85 |

4.2. Physiological Attributes

Table 2A and 2B contain week wise physiological data in relation to different maturity periods of fruits with respect to seed viability, seed germination, seedling growth, seed vigour and seedling biomass. The minimum values of seed germination (19.33%), seed vigour (222.2), seedling growth (11.5 cm) and seedling biomass (0.29gm per seedling) were recorded with fruits harvested in the second week of April, while maximum values of germination (37.33 to 38.5%), seed vigor (974 – 1007) and seedling growth (25.00 – 27cm) were recorded when fruits were harvested in the 2nd week of May. Seedling biomass (0.98 – 1.00 gm per Seedling) obtained in the 2nd to 3rd week of May.

Table 2 (A). Physiological Attributes in Terms of Moisture Percent of Fruits, Seed Viability and Seed Germination vs Collection Periods of Fruits

| S. No. | Collection Periods | % of Moisture | % of Seed viability | | | % of Seed germination |
|--------|--------------------|---------------|---------------------|------------------|------------|-----------------------|
| | | | Fully viable | Partially viable | Non viable | |
| I | April First week | 14 | 0 | 0 | 0 | 0 |
| II | April Second week | 15.7 | 20 | 35 | 45 | 19.33 |
| III | April Third week | 13.5 | 30 | 40 | 30 | 23.66 |
| IV | April Forth week | 11.7 | 38 | 30 | 32 | 31.33 |
| V | May first week | 9 | 45 | 28 | 27 | 34.56 |
| VI | May Second week | 8 | 50 | 30 | 20 | 37.33 |
| VII | May Third week | 7.13 | 52 | 32 | 16 | 38.5 |

Table 2 (B). Physiological Attributes in Terms of Seedling Growth, Seed Vigor and Seedling Biomass v/s Collection Periods of Fruits

| S. No. | Collection periods | Seedling growth (cm) | Seed vigor | Seedling biomass (gm) |
|--------|--------------------|----------------------|------------|-----------------------|
| I | April First week | 0 | 0 | 0 |
| II | April Second week | 11.5 | 222.2 | 0.29 |
| III | April Third week | 15.0 | 354.9 | 0.37 |
| IV | April Forth week | 18.48 | 578.9 | 0.44 |
| V | May first week | 24.50 | 886.7 | 0.87 |
| VI | May Second week | 27.0 | 1007.9 | 1.00 |
| VII | May Third week | 25.30 | 974.0 | 0.98 |

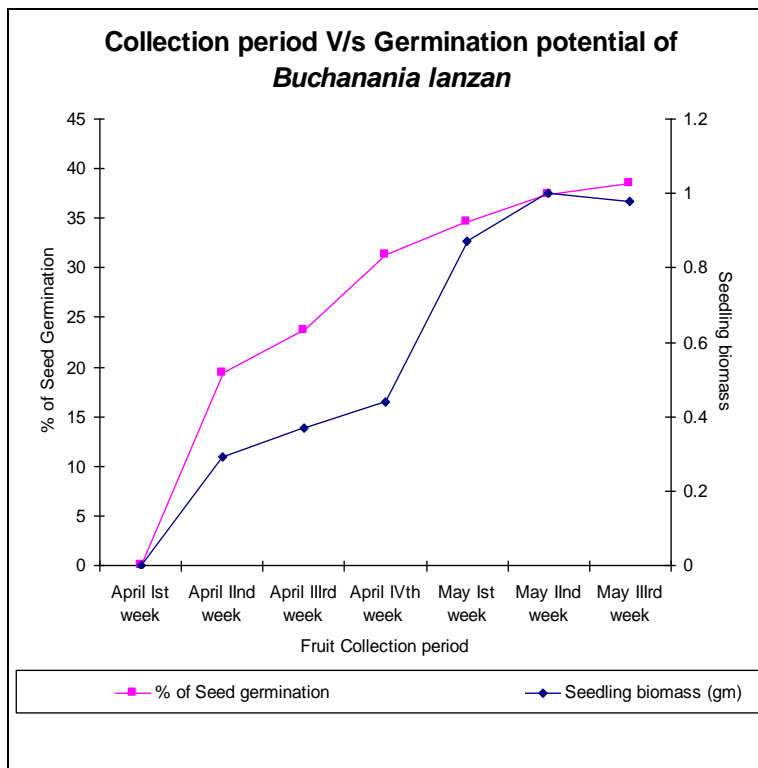


Figure 2. Collection Period vs Germination Potential of Buchanania lanzan

4.3. Biochemical Attributes

Table 3 contains week wise biochemical data on oil, protein and sugar content. The maximum values of oil (61.66%), protein (50.2%) and sugar (3.90%) were recorded in the 2nd week of May. The minimum values of oil (42%) protein (30%) and sugar (2.35%) were recorded in the 2nd week of April.

Statistical Analysis and interpretation of the results

Table 3. Biochemical Attributes in Terms of Percentage of Oil, Protein and Sugar vs Collection Periods of Fruits

| S. No. | Collection periods | % of oil | % of Protein | % of Sugar |
|--------|--------------------|----------|--------------|------------|
| I | April First week | 0 | 0 | 0 |
| II | April Second week | 42 | 30 | 2.35 |
| III | April Third week | 44 | 39 | 3.34 |
| IV | April Forth week | 50 | 44 | 3.40 |
| V | May first week | 57 | 47.2 | 3.60 |
| VI | May Second week | 61.66 | 50.20 | 3.90 |
| VII | May Third week | 62.0 | 48 | 3.82 |

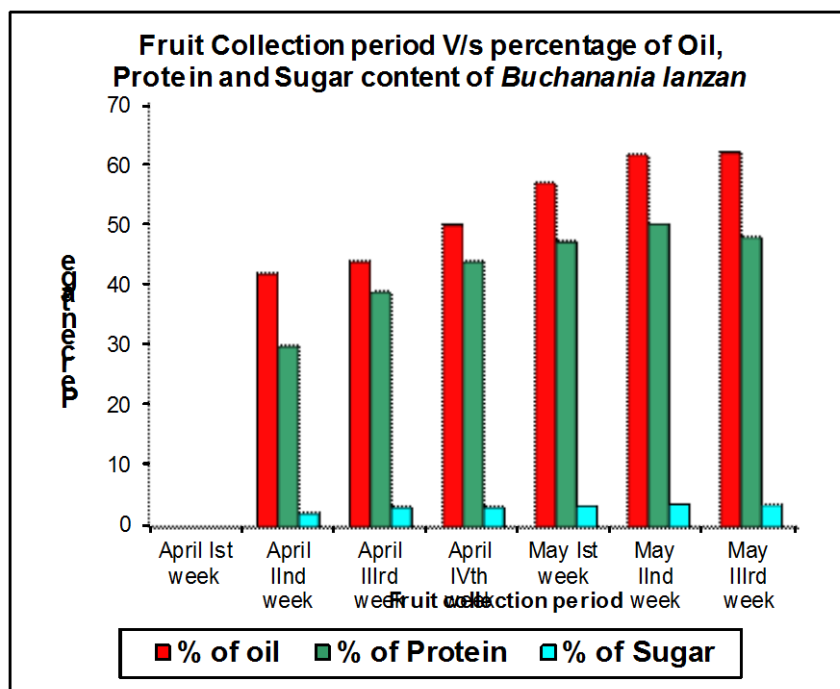


Figure 3. Fruit Collection Period vs Percentage of Oil, Protein and Sugar Content of *Buchanania lanzan*

5. Statistical Analysis

ANOVA Test

The Table 4 (ANOVA) shows one-way analysis of variance test for each parameter under study. In the last column of the table namely sig, the readings are 0.000. It is clear that all

these treatments differ significantly for parameters studied at 95% level of confidence. If the number 0.000 increases more than 0.05, the treatments may not differ significantly at 95% level of confidence. However, in this study, it is less than 0.05, Hence; F value in the adjoining column is more than the tabulated F value at 95% level of significance. Further, it indicates that all the treatments show significant difference between each other on different parameters. Further, it reveals that seeds collected in different weeks of April and May differ in seed weight, kernel weight, oil percent, protein percent, sugar percent, germination percent and seedling growth significantly. In other words, different collection periods affect the seeds significantly for the above parameters taken for study.

It is, thus, concluded that seed collection should be done from second to third week of May for quality seed collection with respect to fruit weight, kernel weight, germination percent and chemical content i.e. oil, protein and sugar contents.

Table 4. ANOVA

| | Sum of squares | df | Mean square | F | Sig |
|----------------------------|----------------|----|-------------|---------|------|
| Fruit weight | | | | | |
| Between groups | 872.483 | 6 | 145.414 | 111.347 | .000 |
| Within Groups | 18.283 | 14 | 1.306 | | |
| Total | 890.766 | 20 | | | |
| Kernel weight | | | | | |
| Between Groups | 91.699 | 6 | 15.283 | 36.602 | .000 |
| Within Groups | 5.846 | 14 | .418 | | |
| Total | 97.545 | 20 | | | |
| Oil percent | | | | | |
| Between groups | 8343.617 | 6 | 1390.603 | 156.035 | .000 |
| Within Groups | 124.770 | 14 | 8.912 | | |
| Total | 8468.387 | 20 | | | |
| Protein percent | | | | | |
| Between groups | 5610.819 | 6 | 935.136 | 419.290 | .000 |
| Within Groups | 31.224 | 14 | 2.230 | | |
| Total | 5642.043 | 20 | | | |
| Sugar percent | | | | | |
| Between groups | 34.365 | 6 | 5.727 | 52.767 | .000 |
| Within Groups | 1.520 | 14 | .109 | | |
| Total | 35.884 | 20 | | | |
| Germination percent | | | | | |
| Between groups | 3267.143 | 6 | 544.524 | 82.862 | .000 |
| Within Groups | 92.000 | 14 | 6.271 | | |
| Total | 3359.143 | 20 | | | |
| Seedling growth | | | | | |
| Between groups | 1658.015 | 6 | 276.336 | 128.782 | .000 |
| Within Groups | 30.041 | 14 | 2.146 | | |
| Total | 1688.056 | 20 | | | |

6. Conclusion

On the basis of observation and baseline data collected during this study, following recommendation are emerged:—

1. The practice of fruit harvesting in the study area of Chhindwara district is unscientific. The trees are severely lopped and branches of trees are hacked for rapid collection of unripe fruits. The overall situation strongly warrants institutional interventions for conserving this germplasm in the natural forest. The present practice of destructive harvesting could be reversed by educating forest dependent communities/tribal population about collection of ripe fruits at proper time i.e. from 2nd to 3rd week of

May without damaging the trees by organized collection. Training and awareness campaigns can stop the unhealthy competition for fruits collection.

2. Fruit collection needs to be done during 2nd / 3rd weeks of May as during this period only, fruits have maximum values of oil (61.6% to 62%), protein (50.2 to 48%), sugar (3.90 to 3.82), seed weight (182.55 to 182.85gm) and germination potential (37.33 to 38.5). (Fig-1 and Fig-2)
3. Unripe fruits are collected in the month of April from 2nd to 3rd week; it has impact adverse effect on natural regeneration of Chironji fruits. Therefore, fruits need to be retained on trees till peak maturity period i.e. 2nd to 3rd week of May, in order to increase the chances of natural regeneration.

7. Recommendations

1. Seed collection should be done from second to third week of May for quality seed collection with respect to fruit weight, kernel weight, germination percent and chemical content i.e. oil, protein and sugar contents.
2. Destructive harvesting could be checked by educating forest dependent communities/tribal population about collection of ripe fruits at proper time i.e. from 2nd to 3rd week of May without damaging the trees by organized collection.
3. Training and awareness campaigns can stop the unhealthy competition for fruits collection.

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