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PHENOTYPIC VARIABILITY OF DIFFERENT GENOTYPES IN WOOD-APPLE (*FERONIA LIMONIA* L.) GERMPLASM IN BUNDELKHAND REGION OF UTTAR PRADESH, INDIA

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ABSTRACT

Bundelkhand region is rich in biodiversity of wood apple but it's less harnessed. The agro-climatic conditions of Bundelkhand have great potential for its commercial cultivation. Keeping these points in view, twenty-five genotypes of wood apple, fruit samples with shoot were collected from diverse areas of the Bundelkhand region of Uttar Pradesh and analysed for various physico-chemical attributes and results of the study revealed wide range of variability in morphological quantitative and qualitative etc. The quantitative variability of different genotypes in wood apple viz for diameter of fruit (4.73cm to 7.75cm), seed weight (24.01g to 30.71g) and number of seed per fruit (103 to 657.50). Therefore, based on morphological quantitative and bio-chemical quality attributes, genotypes FS/WA-3, FS/WA-4, FS/WA-5, FS/WA-6, FS/WA-8, FS/WA-10 and FS/WA-25 were screened as promising genotypes. These promising genotypes can be recommended for commercial multiplication, growing at farmer's fields and conservation in the field gene bank for further evaluation and crop improvement.

Key words : Wood apple (*Feronia limonia* L.), Variability, Morphological parameter, Seed size, Fruits size.

Introduction

The wood apple (*Feronia limonia* L.) is a native fruit of India and it is commonly known as elephant-apple, monkey fruit, and curd fruit, locally known as Kaithbel or Kaitha. Fruits are rich in nutritional value along with high antioxidant contents. It is one of the hardy fruit trees mostly found in arid and semi-arid climatic regions mainly southern, central dry forests in Bundelkhand regions of Uttar Pradesh. Bundelkhand region has a rich biodiversity of wood apples. The agro-climatic conditions of Bundelkhand have great potential for its commercial cultivation, due to its hardy nature, long shelf life of fruit and rich nutritional value. The Number of indigenous species found among them *Feronia limonia* found as cultivated and wild form in India. The distribution status

of wood apples is wide in the country with low germplasm variability. Because of deforestation and urbanization, the germplasm erosion status of this fruit tree is very high. Hence the tree needs high collection priority (Gupta *et al.*, 1996). The fruit is rich in iron, protein and minerals, especially calcium and phosphorus (Rao *et al.*, 1989). The fruits contain a myriad of phytochemicals such as polyphenols, phytosterols, saponins, tannins, coumarins, triterpenoids, vitamins, amino acids, etc. (Dar *et al.*, 2013).

Keeping these points in view, the present investigation on the Phenotypic variability of different genotype in Woodapple (*Feronia limonia* L.) germplasm in Bundelkhand region of Uttar Pradesh to find out the morphological physico-chemical attribute promising

genotypes for further utilization, conservation multiplication, crop improvement and commercial growing under Bundelkhand regions of Uttar Pradesh

Materials and Methods

The present investigation was carried out at the Department of Fruit Science, College of Horticulture, Banda University of Agriculture & Technology, Banda (U.P.), India; during 2018-2019 and 2019 - 2020. Twenty-five genotypes were collected from Bundelkhand region Banda, Mahoba, Hamirpur, Jalaun and Jhansi districts of Uttar Pradesh. Twenty-five fruits *wood apple* were randomly selected from all the directions of trees. Each site was collected then kept in bags and tagged by the number and subjected to physico-chemical analysis in the laboratory. Physical parameters like seed weight were measured by an electronic weighing machine, and visually observed by pulp colour, fruit shape, leaf shape, tree shape and fruit colour.

results were also supported by Yadav *et al.* (2018), Singh *et al.* (2016) and Ghosh *et al.* (2012). In wood apple, Mukhopadhyay *et al.* (2002) and Pavani *et al.* (2017) in Bael, Abhilash *et al.* (2018) in Kagzi lime and Singh and Singh (2005b) in Mahua and Singh *et al.* (2015) in Aonla. Variability in fruit colour of wood apple might be due to different ratios of flavonoids, glycosides, saponins, tannins, and carotenoid along with the stage and time of fruit harvesting simultaneously with genetic makeup and agro-climatic condition of the growing area.

The pulp colour was recorded immediately after the harvest. The pulp colours were found: yellowish, light yellow, white, brown and brownish white. Among them, one genotype was yellowish, eight genotypes were light yellow, one genotype was white, ten genotypes were brown and five genotypes were brownish. Similar results were also supported by Yadav *et al.* (2018), Singh *et al.* (2016) Ghosh *et al.* (2012), Vijaya Kumar *et al.* (2013) and Sharma *et al.* (2014) also noted a wide range of

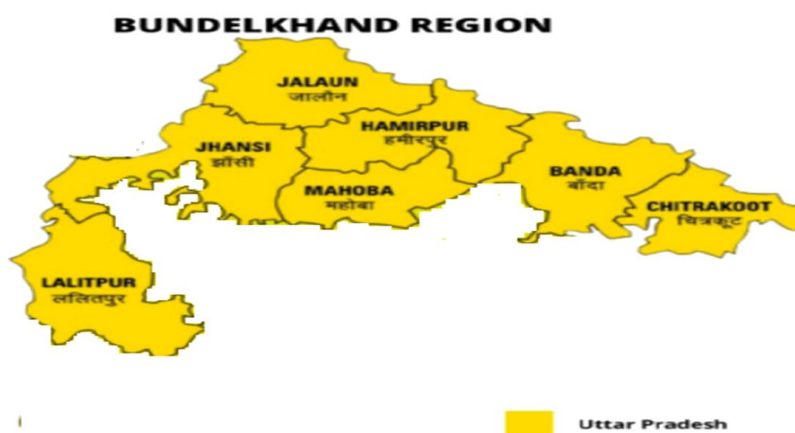


Fig. 1 : Map of study area.

Results and Discussion

The observation with respect to fruit shape revealed that there were four types of fruit shapes *viz.*, round, oval, flatted and triangular. Out of twenty-five genotypes, twelve are round, seven are oval, three are flattened and three are triangular. Fruit shape variability of different genotypes of wood apple was also in conformity with the findings of Khan *et al.* (2019) Pandey *et al.* (2013), Shyamala Devi *et al.* (2018), Singh *et al.* (2016), Ghosh *et al.* (2012), Vijayakumar *et al.* (2013) and Sharma *et al.* (2014). The fruit colour was recorded immediately after the harvest. The types of fruit colours observed were white, light green, white brown, white green, light brown and brown. Among these, eleven genotypes had white colour, one was light green (FS/WA-2), four were white brown, five were white green colour, two were light brown colour and one was a brown colour. Similar

variation in pulp colour among the different genotypes of Wood apple. The tree shape that was observed namely: spreading, erect, oval, irregular and round shape. Among them, three genotypes had spreading shapes, eight genotypes had erect shapes, five genotypes had oval shapes, seven genotypes had round shapes and two genotypes were irregular shaped. Similar findings were noticed in Pandey *et al.* (2013), Shyamala Devi *et al.* (2018), Sappandi *et al.* (2005), Yadav *et al.* (2018), Singh *et al.* (2016) Ghosh *et al.* (2012) in Wood apple Abhilash *et al.* (2018) in Kagzi lime and Singh and Singh (2005b) in Mahua, Singh *et al.* (2015) in Aonla Inamdar *et al.* (2000) in Jamun and Pavani *et al.* (2017) in bael. However, leaf shape revealed all genotypes possess obtuse-shaped apex leaves and the base leaf is of cuneate shape (FS/WA- 1 to FS/WA-25). These results are accord with the earlier findings of Yadav *et al.* (2018), Singh *et*

Table 1 : Variation of different physical parameters of wood apple (*Feronia limonia* L.).

Genotype	Fruit shape	Fruit colour	Pulp colour	Leaf shape		Tree shape	Seed shape
				Apex	Base		
FS/WA-1	Round	White	Yellowish	Obtuse	Cuneate	Spreading	Oblong
FS/WA-2	Round	Light green	White	Obtuse	Cuneate	Spreading	Oblong
FS/WA-3	Oval	White green	Brown	Obtuse	Cuneate	Spreading	Oblong
FS/WA-4	Oval	White	Brown	Obtuse	Cuneate	Erect shape	Oblong
FS/WA-5	Round	White brown	Brown	Obtuse	Cuneate	Round shape	Oblong
FS/WA-6	Flatted	White	Brown	Obtuse	Cuneate	Round shape	Oblong
FS/WA-7	Round	White green	Light yellow	Obtuse	Cuneate	Round shape	Oblong
FS/WA-8	Round	Brown	Light yellow	Obtuse	Cuneate	Round shape	Oblong
FS/WA-9	Round	White	Light yellow	Obtuse	Cuneate	Round shape	Oblong
FS/WA-10	Round	White	Light yellow	Obtuse	Cuneate	Round shape	Oblong
FS/WA-11	Oval	Light brown	Brownish white	Obtuse	Cuneate	Round shape	Oblong
FS/WA-12	Oval	Light brown	Brownish white	Obtuse	Cuneate	Erect shape	Oblong
FS/WA-13	Triangular	White	Brownish white	Obtuse	Cuneate	Erect shape	Oblong
FS/WA-14	Triangular	White	Brownish white	Obtuse	Cuneate	Erect shape	Oblong
FS/WA-15	Triangular	Greenish white	Brownish white	Obtuse	Cuneate	Erect shape	Oblong
FS/WA-16	Round	Brown white	Brown	Obtuse	Cuneate	Erect shape	Oblong
FS/WA-17	Round	Greenish white	Brown	Obtuse	Cuneate	Oval shape	Oblong
FS/WA-18	Round	Light white	Brown	Obtuse	Cuneate	Oval shape	Oblong
FS/WA-19	Round	White	Brown	Obtuse	Cuneate	Oval shape	Oblong
FS/WA-20	Oval	Whitish brown	Light yellow	Obtuse	Cuneate	Oval shape	Oblong
FS/WA-21	Oval	White	Light yellow	Obtuse	Cuneate	Oval shape	Oblong
FS/WA-22	Flatted	White	Light yellow	Obtuse	Cuneate	Erect shape	Oblong
FS/WA-23	Flatted	Greenish white	Light yellow	Obtuse	Cuneate	Erect shape	Oblong
FS/WA-24	Round	Brownish white	Brown	Obtuse	Cuneate	Irregular shape	Oblong
FS/WA-25	Oval	White	Brown	Apex	Base	Irregular shape	Oblong

Treatment	Diameter of fruit (cm.)			Seed weight (g.)			No. of seed per fruit		
	2018-2019	2019-2020	Pooled Data	2018-2019	2019-2020	Pooled Data	2018-2019	2019-2020	Pooled Data
FS/WA-1	6.61	6.74	6.67	28.67	29.24	28.95	462.33	471.33	466.83
FS/WA-2	6.41	6.54	6.48	28.87	29.45	29.16	341.00	347.67	344.33
FS/WA-3	6.55	6.68	6.62	29.13	29.71	29.42	292.33	298.00	295.17
FS/WA-4	6.33	6.46	6.40	27.03	27.57	27.30	127.67	130.33	129.00
FS/WA-5	5.69	5.80	5.75	30.25	30.85	30.55	651.00	664.00	657.50
FS/WA-6	6.69	6.83	6.76	29.80	30.40	30.10	439.33	448.33	443.83
FS/WA-7	6.87	7.01	6.94	25.71	26.22	25.97	102.33	104.00	103.17
FS/WA-8	5.36	5.46	5.41	27.79	28.35	28.07	523.00	533.33	528.17
FS/WA-9	6.62	6.76	6.69	28.10	28.66	28.38	433.00	441.67	437.33
FS/WA-10	6.51	6.54	6.53	24.57	25.06	24.81	340.67	347.33	344.00
FS/WA-11	6.31	6.43	6.37	29.68	30.28	29.98	264.00	269.33	266.67
FS/WA-12	4.90	4.99	4.95	28.51	29.08	28.79	284.33	290.00	287.17
FS/WA-13	6.73	6.86	6.80	30.19	30.79	30.49	181.67	185.33	183.50
FS/WA-14	6.35	6.48	6.41	27.60	28.15	27.88	610.00	622.33	616.17
FS/WA-15	6.54	6.67	6.60	27.83	28.38	28.11	484.00	494.00	489.00

Table 1 continued....

Table 1 continued....

FS/WA-16	6.17	6.30	6.24	28.86	29.44	29.15	326.00	332.33	329.17
FS/WA-17	6.08	6.20	6.14	30.32	30.93	30.63	172.67	176.33	174.50
FS/WA-18	5.10	5.20	5.15	23.77	24.24	24.01	535.67	546.33	541.00
FS/WA-19	5.64	5.75	5.69	30.40	31.01	30.71	428.00	436.33	432.17
FS/WA-20	6.62	6.75	6.68	28.84	29.41	29.13	320.00	326.33	323.17
FS/WA-21	4.99	5.09	5.04	25.92	26.44	26.18	326.33	333.00	329.67
FS/WA-22	4.64	4.74	4.69	26.93	27.47	27.20	120.33	122.67	121.50
FS/WA-23	5.15	5.25	5.20	29.43	30.02	29.73	288.00	294.00	291.00
FS/WA-24	4.66	4.75	4.71	28.86	29.44	29.15	110.33	112.67	111.50
FS/WA-25	6.07	6.19	6.13	27.69	28.24	27.97	385.33	393.00	389.17
C.D.	0.13	0.34	0.17	0.48	1.60	0.83	18.85	23.56	10.95
SE(m)	0.05	0.12	0.06	0.17	0.56	0.28	6.61	8.27	3.74
Average	5.98	6.10	6.04	28.19	28.75	28.47	341.97	348.80	345.39
Range	4.64- 6.87	4.74- 7.01	4.69- 6.94	23.77- 30.40	24.24- 31.01	24.01- 30.71	102.33- 651.00	104.00- 664.00	103.17- 657.50

al. (2016) Ghosh *et al.* (2012) in wood apple; Awasthi and More (2009) in Ber, Singh and Singh (2005b) in Mahua, Singh *et al.* (2015) in Aonla was reported similar results. In general, seed shape can be scored as a combination of magnitudes, or by a single magnitude that indicates the percentage of similarity to a given geometric object. Seed shape can be determined by the length/width ratio of the wood apple. The study revealed wide variation in wood apple shape among the 25 genotypes. Out of 25 genotypes, all have oblong-shaped seeds (FS/WA-1 to FS/WA-25). Similar variations in the seed shape of wood apples were reported by Shyamala Devi *et al.* (2018), Yadav *et al.* (2018), Singh *et al.* (2016), Pandey *et al.* (2013) and Sappandi *et al.* (2005).

The maximum diameter of fruit was recorded for the genotype FS/WA-7 (7.75 cm) followed by genotype FS/WA-13 (6.80cm). However, the lowest diameter of fruit was observed in the Wood apple genotype FS/WA-22(4.73cm) followed by genotype FS/W-24 (4.71 cm). The range value from 4.73cm to 7.75cm. These results are in conformity with the earlier findings of Shyamala Devi *et al.* (2018), Ghosh *et al.* (2012), Pandey *et al.* (2013), Namdev (2010), Vijaya Kumar *et al.* (2013) and Sharma *et al.* (2014). This was in concurrence with the earlier findings of Sappandi *et al.* (2005) in Wood apple; Abhilash *et al.* (2018) in Kagzi lime and Kareddy (2003) in Charoli (*Buchanania lanzan*). The highest seed weight (30.71g) was recorded by the genotype FS/WA-19 followed by FS/WA-17(30.63g), whereas lowest seed weight (24.01g) was recorded in the genotype FS/WA-18. Singh *et al.* (2016) observed that the seed weight of

wood apple ranged between 2.36 to 7.93g. Similar variations in seed weight of wood apple were reported by Shyamala Devi *et al.* (2018), Yadav *et al.* (2018) from 2.4-7.9g, Singh *et al.* (2016) from 2.36-7.93g, Pandey *et al.* (2013) from 7.83-15.66g and Ghosh *et al.* (2012). The number of seeds/fruits was observed maximum (657) in the genotype FS/WA-5, followed by the genotype FS/WA-14 (616). In contrast, minimum seed/fruit (103) was recorded by the genotype FS/WA-7 followed by FS/WA-24 (111). Similar variations in the number of seeds/fruits were reported by Yadav *et al.* (2018), Ghosh *et al.* (2012), Vijaya *et al.* (2013) and Sharma *et al.* (2014), noted the great variability in seed size of wood apple and Pandey *et al.* (2006) in Bael fruit.

Conclusion

Based on the results significant variation was observed in physio-chemical traits of different wood apple genotypes by which it may be concluded that the study of wood apple genotypes showed wide genetic diversity in the existing population of rain-fed areas of Bundelkhand region of the Uttar Pradesh, in quantitative, qualitative traits morphological and biochemical traits. Among these genotypes, genotypes FS/WA-3, FS/WA-6 and FS/WA-25 were screened as promising genotypes. These promising genotypes can be recommended for commercial multiplication, growing at farmer's field and conservation in the field gene bank for further evaluation and release as cultivars in the future.

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