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Correlation Studies in Wood Apple (*Feronia limonia* L.) in Bundelkhand Region of Uttar Pradesh

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ABSTRACT

The present investigation was carried out in thirty genotype of wood apple at department of Fruit Science, college of Horticulture, Banda University of Agriculture & Technology, Banda (UP) during 2019-20. Phenotypic correlations were worked out among twenty characters of Wood Apple to know the nature of association existing among the characters. Correlation among the quantitative characters was worked out. In correlation studies of Fruits weight was showed significant and positive association between length of fruit (0.712**), diameter of fruit (0.810**) and width of fruit (0.648**). Length of fruit showed significant positive correlations at phenotypic levels with Specific gravity (0.0.534**), Diameter of fruit (0.787**). Leaf length showed significant positive correlations with leaf width (0.517**), significant but negative correlation was observed with pectin content (0.417*).

Leaf width showed significant negative correlations with Specific gravity (-0.438*) and Non-reducing sugar (-0.460*). Seed length showed significant positive correlations with Reducing sugar (0.592**) and total sugar (0.418*) However, it was observed that a significant negative correlation exists with respect to No. of seed per fruit (-0.398*). Seed width showed significant negative correlations with Vitamin C (-0.508**). Total soluble solid was showed significant negative correlations with vitamin C (-0.570**). Reducing sugar showed significant positive correlation (0.786**) with non-reducing sugar. However, non-reducing sugar was significant positive correlation with total sugar (0.843**).

Keywords: *Wood Apple, Correlation Coefficient, Variability, Character Asoociation.*

INTRODUCTION

Wood apple (*Feronia limonia* L.) is a native fruit of India and Sri Lanka belongs to family Rutaceae. It is commonly known as Elephant-apple, monkey fruit, curd fruit and locally known as Kaithbel or Kaitha. It is one of the hardy fruits tree mostly found in arid and semi-arid climatic regions mainly southern, central dry forests and Bundelkhand regions of Uttar Pradesh.

It is commonly grown as a border plant in addition to being found wild form in jungles. In the market, fruit are available from first week of October to March during ripening periods.

It is also cultivated in Thailand, Malaysia, Cambodia and Southern part of Asia. In India it is also cultivated in Maharashtra, Andhra Pradesh, Tamil Nadu, Kerala, Karnataka, Madhya Pradesh, Rajasthan, Uttar Pradesh and Western part of Himalayas. Wood Apple is an erect and slow-growing tree and bearing fruit is round to oval, 5-12.5 cm wide, with a hard woody, greyish - white, scurfy rind. The fruit is a hard-shelled, many-seeded berry with pinkish-brown, aromatic sour-sweet pulp. Pulp is brown, mealy, odorous, resinous, astringents, acidic or sweet. The different part of plant (leaf, stem, bark, fruit and seed) have been used for curing various diseases (Joshi et al., 2011 & Sharma et al., 2012)

The age of the plant varies from 13 to 70 years with yield potentiality in mother plants varying from 650 to 1085 kg of fruit/plant having the fruit weight between 130 and 225 g. Fruits length varies between 7.3 to 8.9 cm while breadth between 7.2 and 8.4 cm. Fruit size (length× breadth) varies in relation to fruit weight (Ghosh et al., 2010). The fruit exhibits excellent nutritional and medicinal properties. Traditionally the fruit has been used for relief against the diarrhea, dysentery, tumors, asthma, wounds, cardiac debility and hepatitis (Ilango & Chitra, 2009).

Their fruit is a hard shelled, sticky textured and has numerous seeds, which make it difficult to eat by hand. The fruit is rich in iron, protein and minerals, especially calcium and phosphorus (Rao et al., 1989). The flesh is refreshing and aromatic and tastes sour-sweet. The excellent flavour nutritive value and medicinal characteristics of fruit indicate a potentially for processing to value added products. The plant parts like leaf, stem, bark, fruit, and seed have been used for curing various diseases (Sharma et al., 2012). The fruits contain a myriad of phytochemicals such as polyphenols, phytosterols, saponins, tannins, coumarins, triterpenoids, vitamins, amino acids, tyramine derivatives, etc. (Dar et al., 2013)

MATERIALS AND METHODS

The present investigation was carried out at Department of Fruit Science, college of Horticulture, Banda University of Agriculture & Technology, Banda (UP) during 2019-20. Thirty genotypes were collected from Bundelkhand region Banda, Mahoba, Jhansi, Hamirpur and Jalon district of Utter Pradesh. Twenty-five fruits of *wood apple* were randomly selected from all the direction of marked and selected genotypes, and the bulk of sample of all the selected trees from each site collected then kept into bags and tagged by the number and subjected to physico-chemical analysis in laboratory. Physical parameters like fruit weight measure by electronic weighting machine and fruits length, fruits width shell thickness seed size spine length, and seed size were estimated with the help of digital Vernier Callipers. The differences exhibited by the genotypes for various characters studied were tested for significance by using analysis of variance technique (Snedecor & Cochran, 1967). Ascorbic acid was determined by using 2, 6-Dichlorophenol- indophenols visual titration method (Johnson, 1948). Sugars content were estimated using Fehling's solutions (Lane & Eynon, 1923) and the method as described by (Rangana, 2010), Reducing sugars (Nelson, 1944). The percentage of non-reducing sugars was obtained by subtracting the values of reducing sugar from total sugars and multiplying by 0.95 (Somogyi, 1952). The two years' data obtained during experimentation was statistically analysed as per method given by Panse and Sukhatme (1985) and results were evaluated at 5% level of significance. In this study, correlation coefficient was worked out for phenotype, genotype and environment by using the formula outlined by Johnson et al. (1955).

Table -1(a): Studied of correlation coefficients of quantitative characters of twenty-five genotypes on wood apple (*Feronia limonia* L.)

Parameters	Fruit weight (g)	Length of fruit (cm)	Diameter of fruit (cm)	Width of fruit (cm)	Shell thickness of fruits (cm)	Leaf length (cm)	Leaf width (cm)	Seed length (mm)	Seed width (mm)	Seed weight (g)
Fruit weight (g)	1									
Length of fruit (cm)	0.712**	1								
Diameter of fruit (cm)	0.810**	0.787**	1							
Width of fruit (cm)	0.648**	0.384	0.872**	1						
Shell thickness of fruits (cm)	-0.252	-0.249	-0.124	0.014	1					
Leaf length (cm)	-0.303	-0.204	-0.247	-0.210	-0.047	1				
Leaf width (cm)	-0.107	-0.333	-0.243	-0.101	-0.196	0.517**	1			
Seed length (mm)	0.138	0.043	0.054	0.046	0.081	-0.082	0.134	1		
Seed width(mm)	0.249	-0.041	-0.058	-0.055	-0.324	0.078	0.275	0.216	1	
Seed weight (g)	0.015	0.143	0.146	0.102	0.025	0.085	0.035	0.169	-0.056	1
Specific gravity (g/cm3)	0.116	0.534**	0.366	0.123	-0.029	0.022	-0.438*	-0.124	0.024	0.285
No. of seed per fruit	-0.002	0.159	0.080	-0.007	-0.065	0.240	-0.123	-0.398	-0.162	-0.011
TSS(^{0}Brix)	0.331	0.235	0.242	0.176	-0.212	-0.282	0.208	-0.035	0.207	0.262
Acidity (%)	-0.025	0.054	-0.023	-0.076	-0.110	0.137	0.003	-0.290	-0.106	0.256
Reducing sugar (%)	0.049	-0.024	0.153	0.247	0.245	-0.054	0.069	0.592**	-0.223	0.182
Non-reducing sugar (%)	0.160	0.224	0.073	-0.069	0.133	-0.139	-0.460*	0.119	-0.034	0.141
Total sugar (%)	0.140	0.140	0.147	0.108	0.232	-0.123	-0.273	0.418*	-0.155	0.203
Vitamin C (mg/100g)	-0.180	-0.069	0.026	0.095	0.058	0.179	-0.053	-0.234	-0.508**	-0.215
Protein (%)	-0.125	0.025	0.147	0.202	0.356	-0.201	0.023	-0.173	-0.125	-0.306
Pectin (%)	0.125	-0.138	-0.052	0.032	-0.310	-0.417*	-0.068	0.066	0.131	-0.045

Significance 0.05- (0.396) * and Highly significance 0.01 (0.505) **   Cont…….

Table -1(b): Studied of correlation coefficients of quantitative characters of twenty-five genotypes on wood apple (*Feronia limonia* L.)

Parameters	Specific gravity (g/cm3)	No. of seed per fruit	TSS (Brix)	Acidity (%)	Reducing sugar (%)	Non-reducing sugar (%)	Total sugar (%)	Vitamin C (mg/100g)	(Protein (%))	Pectin (%)
Fruit weight (g)										
Length of fruit (cm)										
Diameter of fruit (cm)										
Width of fruit (cm)										
Shell thickness of fruits (cm)										
Leaf length (cm)										
Leaf width (cm)										
Seed length (mm)										
Seed width(mm)										
Seed weight (g)										
Specific gravity (g/cm3)	1									
No. of seed per fruit	0.114	1								
TSS(^{0}Brix)	-0.104	-0.035	1							
Acidity (%)	0.383	0.273	0.040	1						
Reducing sugar (%)	-0.097	-0.312	-0.042	-0.168	1					
Non-reducing sugar (%)	-0.001	0.043	0.063	-0.194	0.331	1				
Total sugar (%)	-0.044	-0.146	0.011	-0.216	0.786**	0.843**	1			
Vitamin C (mg/100g)	0.140	0.000	-0.570**	0.280	0.036	-0.224	-0.120	1		
Protein (%)	0.156	-0.083	0.098	0.097	0.026	-0.287	-0.176	0.119	1	
Pectin (%)	-0.272	-0.106	0.022	-0.191	-0.069	0.099	0.026	0.142	-0.307	1

Significance 0.05- (0.396) * and highly significance 0.01 (0.505) *

Correlation coefficients

Phenotypic correlations were worked out among twenty characters of wood apple genotype know the nature of association existing among the characters. The results are presented in Table - 1(a) and 1(b). The result pertaining to correlation at phenotypic levels between fruit weight and other related characters are presented first followed by correlation among the characters.

Fruits weight showed significant and positive association between length of fruit (0.712**), diameter of fruit (0.810**) and width of fruit (0.648**) Similar pattern was also observed by Cosmulescu (2013) in walnut. Non-significant but positive correlation was found with respect to seed length, seed width, seed weight, specific gravity, No. of seed per fruit, TSS (Brix), acidity and Non-reducing sugar while non-significant negative correlation was found with Vitamin C and Protein content.

Length of fruit showed significant positive correlations at phenotypic levels with Specific gravity (0.534**), Diameter of fruit (0.787**) and non-significant but positive correlation with fruit width, seed weight, No. of seed per fruit, TSS (^{0}Brix), acidity and Non-reducing sugar. A non-significant negative correlation was found with shell thickness of fruits Badiyala et al. (2004)

Leaf length showed significant positive correlations with leaf width (0.517**) and non-significant but positive correlation with No. of seed per fruit, Vitamin C. However, significant but negative correlation was observed with pectin content (0.417*).

Leaf width showed significant negative correlations with Specific gravity (-0.438*) and Non-reducing sugar (-0.460*). It was also observed that a non-significant but positive correlation exist with seed length and TSS (Brix) similar results were also recorded by Gaikwad et al. (2017) in citrus.

Seed length showed significant positive correlations with Reducing sugar (0.592**) and total sugar (0.418*) content while non-significant but positive correlation was found with seed width. However, it was observed that a significant negative correlation exists with respect to No. of seed per fruit (-0.398*) and non-significant but negative correlation with Vitamin C. Similar findings were noticed by Gaikwad et al. (2005).

Seed width showed significant negative correlations with Vitamin C (-0.508**) and non-significant but negative correlation with number of seed per fruit. However, non-significant but positive correlation found with TSS (Brix) and pectin content.

Total soluble solid was showed significant negative correlations with vitamin C (-0.570**) and non-significant positive correlation with non-reducing sugar, total sugar, Protein and Pectin. Similar pattern was reported in mango by Patel et al. (2016) Kevadiya (2006), Rathod (2007) and Majumder (2012).

Reducing sugar showed significant positive correlation (0.786**) with non-reducing sugar. However, non-reducing sugar was significant positive correlation with total sugar (0.843**) similar results were reported by (Srimathi et al., 2001) in Mahua and non-significant negative correlation with Vitamin C and pectin content. The findings of this study are in agreement with the results reported by Rekha et al. (2011) in sapota, Singh et al. (2004c), Pradeep Kumar et al. (2006) and Bhowmick and Banik (2008) in mango.

CONCLUSION

Fruits weight showed significant and positive association at phenotypic level was found between fruits weight with Length of fruit, Diameter of fruit and width of fruit. Diameter of fruit showed significant and positive association at phenotypic level was found between Diameter of fruit width of fruit. Length of fruit showed significant positive correlations at phenotypic levels with specific gravity (g/cm3) and Diameter of fruit. Leaf length showed significant positive correlations with leaf width, However, it observed significant negative correlation with pectin content. TSS (ºBrix) showed significant

negative correlations with Vitamin C. Reducing sugar observed significant positive correlation with non-reducing sugar. However, non-reducing sugar showed significant positive correlation with total sugar.

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