

## Assessing the variability and relationship among fruit and seed characters of soap yielding *Sapindus mukrossii* Gaertn

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### ABSTRACT

Ritha, *Sapindus mukrossii* belongs to family Sapindaceae. It is the important multipurpose medicinal tree of low and mid hilly regions of Himachal Pradesh. Its fruits are an important source of revenue to the farmers. The fruits are graded according to their size and colour to fetch good price in the market. Fruits of *Sapindus mukrossii* were studied over a wide range of its distribution from N 32°10' to 32° 42' and E 75°45 ' to 76°01' of the lower subtropical region of North-Western part of Shivalik Himalayas. The fruits collected were mixed thoroughly and individual seed source was maintained properly for further studies. The fruit diameter variability ranged between 12.00-23.67 mm and the highest fruit diameter was recorded in the Bhagot (Chamba) accession, whereas the rind weight ranged between 0.23-0.59 g/seed and the maximum weight of the rind per seed was recorded in the Chubari (Chamba) accession. The best fruit and seed characters were that of Bhagot (Chamba) collection. Seed weight was positively and significantly related with rind thickness. Fruit weight was positively correlated with the rind weight (0.529) and was also positively correlated with fruit diameter (0.351).

**Key words:** *Sapindus mukrossii*, variability, fruit characters, Chamba, soap yielding.

### INTRODUCTION

Ritha, *Sapindus mukrossii* belongs to the plant order Sapindaceae and family Sapindeae. The species is widely grown in upper reaches of the Indo-Gangetic plains, Shivaliks and sub-Himalayan tracts. The tree is found in the moister tracts up to an elevation of 1500 m amsl in Himachal Pradesh. It is a fairly large, deciduous tree, usually up to 12 m in height. Bark is dark to pale yellow, fairly smooth, with many

vertical lines of lenticels and fine fissures exfoliating in irregular wood scales. Fruit is globose, fleshy, single-seeded drupe, sometimes two drupes together, about 1.8-2.5 cm across. Seeds are 0.8-1.3 cm in diameter, globose, smooth, black and loose in dry fruit. The tree is leafless until March-April when the new leaves appear. The fruit remains on the tree till January or later, the bunches of round brown or orange coloured fruits being conspicuous when the tree is leafless. The plant is propagated by

either direct sowing or from nursery raised seedlings.

Fruit contains the proteins viz aspartic acid, glutamic acid, lysine, serine, glycine, arginine, alanine, valine, leucine/ isoleucine, proline and tryptophan. The essential oils such as triglycerides, oleo-diarachidin glyceride, dioleo-palmitin, dioleo-stearin and dioleo-arachidin have been derived from the fruit of the Reetha (Ni W et al 2006). The fruit and seed are regarded as a cure for epilepsy in northern India. The rind of fruit, whose active ingredient is saponins, is used as soap. Soapnuts are also used as detergent for polishing jewellery. Seeds of a single species, when collected from different sources or from different altitudes, differ in viability and performance (Isik 1986, Todaria and Negi 1995, Chauhan et al 1996). The fruits of Ritha are sold in the market at the high prices based upon their fruit characters. An attempt has been made in this study to record provenance variation in relation to fruit characteristics of the tree in order to develop a strategy for the production of quality plantations for agro-forestry farming.

## MATERIAL AND METHODS

Ripe fruits of *Sapindus mukrossii* were collected over a wide range of its distribution from the lower subtropical region of North western part of Shivalik Himalayas. For each collection, mature

seeds were harvested from individual tree (candidate tree). The study area covered the longitudinal and latitudinal ranges between N 32°10' to 32° 42' and E 75°45 ' to 76°01'. Thirteen individual trees were selected based on the tree characters (Table 1). Twenty fruits per replication and sixty fruits per tree were selected randomly from the lot for recording observations. The fruits collected were mixed thoroughly and individual seed source was maintained properly for further studies. The various fruit characters viz fruit diameter, fruit weight, rind weight, rind thickness, seed diameter and seed weight were taken in account to measure the fruit characters.

The harvested seeds were brought to the laboratory and allowed to sundry for 48 hours. The fruit kernel thickness, fruit weight, diameter, kernel weight etc were recorded in the laboratory.

## RESULTS AND DISCUSSION

### *Survey studies*

The area under study is the natural growing region of the *Sapindus mukrossii*. This area covers the altitudinal ranges from 567 to 1098 m amsl. The trees grow very well in the valley as well as on the slopes. Its fruits are sold by the farmers at good price. The naturally growing trees are not managed by the farmers, however, they are good source of revenue from the wasteland. The harvesting starts from January onwards

till March. The marketing of the fruits is done by the middlemen who purchase the fruit while it is on the tree and harvest it with bamboo sticks with which sickle and bag is tied at the distal end to avoid the fruit wastage. No cooperative or societies exist for harvesting purpose (Negi and Bhalla 2002). The fruit grading is done on the basis of the colour as shown in the Table 1. The light coloured fruits fetch good price in the market as compared to dark one. The further studies and enquiries at New Delhi and Amritsar have revealed that the prices vary from Rs 50 to 70/kg between the marketing by the farmers and purchasing by the end users. The farmers do not get

good price due to non availability of government controlled market of medicinal plants in the region of its occurrence. Ritha fruit is considered as minor fruit and permission from the department of forest is required for its harvesting, however, recently its systematic cultivation has been started in the state and state medicinal plant board has set some guidelines for marketing its produce through the panchayats and self help groups.

The large size of the seeds and difficult to weather rind of the fruit makes its regeneration difficult under natural conditions. As the majority of the fruits are

Table 1. Morphological characters of *Sapindus mukrossii* trees

Tree No/collection	Altitude (m) amsl	Tree height (m)	DBH (m)	Fruit colour
T1 Mangla (Chamba)	1004	10.23	1.78	light
T2 Bhagot (Chamba)	994	8.78	1.98	light
T3 Saru-1 (Chamba)	978	9.45	1.56	light
T4 Udaypur (Chamba)	967	7.69	1.76	light
T5 Chubari (Chamba)	678	8.34	1.89	dark
T 6 Mahala (Chamba)	1098	11.60	2.00	light
T7 Saru-2 (Chamba)	676	9.35	1.68	light
T8 Chaned (Chamba)	1001	10.12	1.79	light
T9 Koti (Chamba)	1012	11.23	1.98	light
T10 Nani khad (Chamba)	719	12.34	2.09	light dark
T11 Barangal (Chamba)	789	9.45	1.99	light
T12 Sihunta (Chamba)	656	10.34	1.89	dark
T13 Sadwan (Kangra)	567	11.12	2.06	very dark

exploited for selling in the market, there is little scope for natural regeneration of good genotypes. If scientific cultivation of this species is taken in the hilly region of the Shivalik region which has peculiar climate, there is great scope of boosting farm income in the future.

### ***Variation studies***

The perusal of the data analysis revealed a good variability among the accessions. The fruit diameter variability ranged between 12.00-23.67 mm and the highest fruit diameter was recorded in the Bhagot collection (Table 2), whereas, the

rind weight ranged between 0.23-0.59 g/seed and the maximum weight of the rind per seed was recorded in the Chubari collection. The maximum rind thickness to the tune of 2.08 mm was recorded in the Bhagot accession. The seed weight and seed diameter varied from 0.24-0.49 g/seed and 11.0-15.00 mm, respectively. The fresh fruit weight ranged from 0.64-0.90 g/fruit. Overall the Bhagot collection showed the better fruit characters as compared with the rest of the collections. Differences in seed weight between populations could have been a result of differences in the environmental conditions, eg nutrients, light or water, to which the mother plants were

Table 2. Fruit characters variability in the *Sapindus mukrossii* provenances

Fruit character/ Tree Number	Fruit Diameter (mm)	Rind weight (g/seed)	Rind thickness (mm)	Seed weight (g)	Seed diameter (mm)	Fresh Fruit weight (g)
T1	20.67	0.35	1.81	0.29	12.67	0.75
T2	23.67	0.53	2.08	0.25	11.00	0.90
T3	16.33	0.52	1.90	0.24	13.00	0.78
T4	22.33	0.50	1.79	0.24	12.00	0.77
T5	21.00	0.59	1.73	0.24	12.67	0.67
T6	20.67	0.51	1.85	0.30	15.00	0.84
T7	22.00	0.50	1.92	0.49	11.00	0.88
T8	21.00	0.50	2.05	0.30	15.00	0.84
T9	18.67	0.51	1.72	0.24	11.00	0.79
T10	12.17	0.40	2.03	0.24	12.00	0.64
T11	19.00	0.43	1.51	0.30	11.00	0.79
T12	20.00	0.35	1.41	0.38	12.00	0.82
T13	12.00	0.23	1.76	0.40	11.00	0.76
SE	1.47	0.027	0.06	0.06	1.10	0.026
CD	3.03	0.055	0.12	0.12	2.21	0.053

subjected during the growing season (Gutterman 1992).

**Correlation analysis**

A correlation matrix computed for different characters of seed and fruit of different collections of *Sapindus mukrossii* showed a significant and negative relationship between seed weight and fruit diameter and also between rind weight and seed weight (Table 3). Seed weight was positively and significantly related with rind thickness. This means that the fruits with better soap contents may have low seed weight. Fruit weight was positively correlated with the rind weight (0.529). It was also positively correlated with fruit diameter (0.351). Rind weight was

positively related with fruit diameter and seed diameter, however, the negative correlation was found between rind weight and rind thickness which was not significant. Fruit diameter and rind thickness were negatively correlated (-0.352). Similarly, rind thickness and seed diameter were also negatively correlated (-0.187). The significant negative correlation of the seed weight with the rind weight and seed diameter indicates inverse relation between them. This means that the seeds with higher seed weight may not have large rind weight and diameter. The correlations observed for seed and fruit characters in *Sapindus mukrossii* are consistent with those of earlier studies in *Acacia catechu* (Ramachandra 1996), *Terminalia* spp. (Chauhan 1998),

Table 3. Correlation among fruit characters of the *Sapindus mukrossii*

Fruit characters	Fruit weight (g)	Seed weight (g)	Rind weight (g)	Fruit diameter (mm)	Rind thickness (mm)	Seed diameter (mm)
Fruit weight (g)	1					
Seed weight (g)	0.013	1				
Rind weight (g)	0.529**	-0.474**	1			
Fruit diameter (mm)	0.351*	-0.330*	0.369*	1		
Rind thickness (mm)	0.050	0.475**	-0.072	-0.352*	1	
Seed diameter (mm)	0.295	-0.344*	0.374*	0.247	-0.187	1

\*Significant at 0.01 per cent level

\*\* Significant at 0.05 per cent level.

*Dalbergia sissoo* (Singh and Pokhriyal 2000), *Betula* spp. (Holm 1994), and *Pinus brutia* (Isik 1986) and some heathland plants (Vera 1997).

## CONCLUSIONS

Fruit characters were found to be quite variable and may serve as the source of further improvement of the species. Overall, the Bhagot (Chamba) collection recorded the best fruit and seed characters. Seed weight was positively and significantly related with rind thickness. Fruit weight was positively correlated with the rind weight (0.529) and was also positively correlated with fruit diameter (0.351). Rind weight was negatively related with seed weight.

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