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Research Article

Character association for fruit yield and yield traits in *Salacia chinensis* L.: A threatened medicinal plant

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Abstract
An experiment was undertaken to study the correlation and path analysis in thirteen accessions of *Salacia chinensis* L. Correlation study revealed that plant height, plant spread, fruit diameter, fruit weight, seed diameter, seed length and seed weight had positive significant correlation with fruit yield per plant at both genotypic and phenotypic levels. According to path analysis the seed length, plant height and seed diameter recorded positive and high direct effects on fruit yield per plant while, seed weight, fruit length and leaf length had high negative direct effects on fruit yield per plant. Thus based on correlation and path analysis, the traits *viz*., plant height, plant spread, fruit diameter, fruit weight, seed diameter, seed length and seed weight can be considered as selection indices for high yield.

Key words
Salacia chinensis, Correlation, Path analysis, Fruit yield.

Introduction

Salacia chinensis L. (Syn. *S. prinoides* DC.), it is a medicinally important perennial, woody climbing shrub belonging to the family Hippocrateaceae, which has since been incorporated into the Celastraceae family. It is commonly known as 'Saptarangi' and 'Saptachakra' in Ayurvedic medicine, a traditional system of medicine in India (Govindaraj *et al*., 2009; Singh *et al*., 2010). It is widely distributed in the tropical and subtropical areas of the world, especially in India, Sri Lanka, China and South East Asian countries such as Thailand, Indonesia and also in a torrid zone area such as Brazil (Govindaraj *et al*., 2009; Muraoka *et al*., 2011). It occurs in pockets mainly around the Sahyadri–Konkan corridor area of the northern Western Ghats (Patwardhan *et al*., 2015). The roots, root-barks, stems, dried parts and water extraction of whole plant have been extensively used in the ayurvedic system of Indian traditional medicine and in South West Asia it is used to treat a variety of ailments (Sikarwar and Patil, 2012). Biologically active compounds, such as salacinol, kotalanol, neokotalanol, neosalacinol, salaprinol, mangiferin, phenolic glycosides, and triterpenes have been isolated from the plant. The plant and its extracts have been evaluated for number of activities like anti-diabetic, anti-hyperlipidemic, anti-inflammatory, tonic and blood purifier *etc*. (Majid *et al*., 2016)

Its extensive use has resulted in over-exploitation and uncontrolled harvest from the wild. In addition, lack of organized cultivation practices, insufficient attempts for the replacement of harvested plants, poor seed germination and poor regeneration capacity, restricts the propagation of *S. chinensis* (Majid *et al*., 2016) reducing the species to a threatened status. The conservation of this species is possible through selection of superior types and creating an assemblage. In the present study an attempt was made to evaluate the direct and indirect association among the various variables of thirteen *S. chinensis* accessions through correlation and path analysis.

Materials and Methods

The experiment was conducted at the Field Gene Bank of Division of Plant Genetic Resources, ICAR-Indian Institute of Horticultural Research (IIHR), Bengaluru. The thirteen *S. chinensis* accessions *viz.*, ACC-1, ACC-2, ACC-3, ACC-4, ACC-5, ACC-6, ACC-7, ACC-8, ACC-9, ACC-10, ACC-11, ACC-12 and ACC-13 were collected from different places from wild by exploration and maintained in Field Gene Bank. Recommended cultural practices were

adopted for proper growth and stand of the plants (Kurian and Sankara, 2007). Observations were recorded for thirteen characters from all the replications, belonging to the different accessions taken in study. The characters viz., plant height, plant spread, leaf length, leaf width, leaf area, petiole length, fruit length, fruit diameter, fruit weight, seed length, seed width, seed weight and fruit yield per plant were studied (Plate 1). The data recorded were analyzed as suggested by Al-jibouri *et al.* (1958) for correlation coefficient analysis and by Deway and Lu (1959) for path coefficient analysis.

Results and Discussion

The correlation study reveals the degree of inter relationship of plant characters for improvement of yield as well as important quality parameters in any breeding programme and a complex association exists among plant characters. Fruit yield per plant had positive and highly significance association with plant height (0.93), plant spread (0.91), fruit diameter (0.59), fruit weight (0.49), seed diameter (0.49) and seed weight (0.40), while it showed positive significant correlation with seed length (0.34) in Table 1. The results are in agreement with the findings of Kakaraparthi *et al*. (2013), Ahmad and Khaliq, (2002), Rahman *et al*. (2010) in plants like ashwagandha, *Ocimum* and tea respectively. Linear relationship between these mentioned characters and fruit yield per plant suggest that selection method of crop improvement should mainly be focused on these characteristics. As the roots of *S. chinensis* L. are economically important due to their medicinal properties, destructive harvesting is commonly practiced. It is, therefore, important to have more number of plants of *S. chinensis* for conservation and sustainable use. The species is usually propagated by seeds, thereby signifying the importance of superior genotypes with good fruit yield and seed set. The path analysis showed that the association of the independent character with dependent variable is due to their direct effect on it. If the correlation between dependent variable and independent character is due to direct effects of the character, it reflects a true relationship between them and hence selection can be made for such character to improve dependent variable. But, if the association is mainly through indirect effect of the character *i.e.*, through another component character, the breeder has to select for the later through which the direct effect is exerted.

Path analysis was done for fruit yield per plant (Table 2). Among the twelve yield components, seed length, plant height and seed diameter recorded positive and high direct effect on fruit yield per plant. The characters *viz*., seed weight, fruit length and leaf length showed negative and high direct effect towards fruit yield per plant. Hence, based on correlation and path analysis, the characters *viz*., plant height (0.93), plant spread (0.91), fruit diameter (0.59), fruit weight (0.49), seed diameter (0.49) and seed weight (0.40), may be considered as selection indices for high fruit yield per plant.

From the study it is revealed that the fruit yield was negatively affected by leaf length, petiole length, fruit length and seed weight. The results indicates that the vegetative growth is not contributing to the reproductive development, may be due to assimilates which is stored in previous season on plant is helps for development of fruits in current season. Similar observation was made through correlation studies also. Hence, selection for fruit yield should be based on plant height rather than the size of the fruits. path analysis study in *S. chinensis* L., concluded that improvement in fruit yield per plant could be brought by selection for component characters like seed length, plant height, seed diameter, plant spread, leaf area, leaf width and fruit weight.

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Table 1. Simple correlation co-efficient among important quantitative character in *Salacia chinensis* L. accessions.

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	**1.0000**	0.9900**	-0.3022	0.2035	0.1032	0.1698	0.1932	0.4805**	0.4388**	0.2033	0.3873*	0.3062	0.9394**
2		**1.0000**	-0.1201	0.3584*	0.2567	0.1410	0.1655	0.4517**	0.4028**	0.1971	0.3718*	0.3075	0.9113**
3			**1.0000**	0.4751**	0.5232**	-0.0410	0.1316	0.1013	0.1154	0.1818	0.0619	0.1108	-0.3066
4				**1.0000**	0.7974**	-0.5254**	0.0623	-0.1141	-0.1278	-0.0226	0.0616	0.0427	0.1964
5					**1.0000**	-0.2693	0.1615	0.0586	-0.0776	0.0526	0.0062	0.0786	0.0940
6						**1.0000**	0.4276**	0.8056**	0.7566**	0.6666**	0.6559**	0.6876**	0.2363
7							**1.0000**	0.6442**	0.7013**	0.9165**	0.7758**	0.8179**	0.2895
8								**1.0000**	0.9171**	0.8461**	0.8820**	0.8610**	0.5937**
9									**1.0000**	0.8905**	0.9400**	0.9325**	0.4992**
10										**1.0000**	0.9296**	0.9486**	0.3468*
11											**1.0000**	0.9889**	0.4940**
12												**1.0000**	0.4083**
13													**1.0000**

Correlation r => 5% = 0.3160 1% = 0.4076 * Significant at 5 % ** Significant at 1 %

1. Plant height (m)
2. Plant spread (m)
3. Leaf length (cm)
4. Leaf width (cm)
5. Leaf area (cm^2)
6. Petiole length (cm)
7. Fruit length (cm)
8. Fruit diameter (cm)
9. Fruit weight (g)
10. Seed length (cm)
11. Seed diameter (cm)
12. Seed weight (g)
13. Fruit yield per plant (Kg/plant)

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Table 2. Path coefficient of biometrical traits on fruit yield

	1	2	3	4	5	6	7	8	9	10	11	12	rG
1	**0.5022**	0.5034	-0.1518	0.1022	0.0518	0.0853	0.0970	0.2413	0.2204	0.1021	0.1945	0.1538	0.9394
2	0.2185	**0.2180**	-0.0262	0.0781	0.0560	0.0307	0.0361	0.0985	0.0878	0.0430	0.0811	0.0670	0.9113
3	0.1220	0.0485	**-0.4039**	-0.1919	-0.2113	0.0166	-0.0531	-0.0409	-0.0466	-0.0734	-0.0250	-0.0447	-0.3066
4	0.0300	0.0529	0.0702	**0.1477**	0.1177	-0.0776	0.0092	-0.0169	-0.0189	-0.0033	0.0091	0.0063	0.1964
5	0.0196	0.0489	0.0996	0.1518	**0.1904**	-0.0513	0.0308	0.0112	-0.0148	0.0100	0.0012	0.0150	0.0940
6	-0.0125	-0.0104	0.0030	0.0387	0.0198	**-0.0736**	-0.0315	-0.0593	-0.0557	-0.0491	-0.0483	-0.0506	0.2363
7	-0.1186	-0.1015	-0.0807	-0.0382	-0.0991	-0.2623	**-0.6135**	-0.3952	-0.4303	-0.5623	-0.4760	-0.5018	0.2895
8	0.0389	0.0365	0.0082	-0.0092	0.0047	0.0652	0.0521	**0.0809**	0.0742	0.0685	0.0714	0.0697	0.5937
9	0.0608	0.0558	0.0160	-0.0177	-0.0107	0.1047	0.0971	0.1270	**0.1384**	0.1233	0.1301	0.1291	0.4992
10	0.3180	0.3084	0.2845	-0.0354	0.0823	1.0428	1.4338	1.3238	1.3932	**1.5645**	1.4543	1.4841	0.3468
11	0.1919	0.1842	0.0306	0.0305	0.0031	0.3250	0.3843	0.4370	0.4657	0.4605	**0.4954**	0.4899	0.4940
12	-0.4316	-0.4334	-0.1561	-0.0602	-0.1108	-0.9692	-1.1528	-1.2136	-1.3143	-1.3370	-1.3938	**-1.4094**	0.4083

Diagonal indicates direct effect rG genotypic correlation with fruit yield per plant@ Characters

Residual effect =0.1578 * Significant at 5% ** Significant at 1 %

1. Plant height (m)
2. Plant spread (m)
3. Leaf length (cm)
4. Leaf width (cm)
5. Leaf area (cm^2)
6. Petiole length (cm)
7. Fruit length (cm)
8. Fruit diameter (cm)
9. Fruit weight (g)
10. Seed length (cm)
11. Seed width (cm)
12. Seed weight (g)

Plate 1. *Salacia chinensis* a. Plant b. Flower c.Fruits d. Seeds