

## SOURCE VARIATION IN KATTHA AND CUTCH CONTENTS IN KHAIR (*ACACIA CATECHU* WILLD.) IN SHIWALIK HILLS OF PUNJAB

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### ABSTRACT

To find out the source and within tree variations in kattha and cutch content, fifteen sources of khair were studied in the Shiwalik area of Punjab. To study within tree variation, kattha and cutch content was estimated taking samples from three different positions i.e.  $L_1$  (at breast height),  $L_2$  (50 % of tree height) and  $L_3$  (75% of tree height). Dry kattha, cutch and total solid content varied significantly within sources as well as positions. Maximum kattha (5.3 gm/100 gm of heartwood) was recorded in trees sampled from Salari-III where as cutch content was maximum (7.6 gm/100 gm of heartwood) in trees selected from Dhar source. The lower portion ( $L_1$ ) had maximum kattha content of 6.025 gm/100 gm of heartwood. Out of fifteen sources, Salari-III, Seonk, Pallanpur and Mansooh were found best with respect to kattha and cutch content.

**Key words** : Source variation, Khair, *Acacia catechu*, Kattha, Cutch, Shiwalik Hills, Punjab.

### Introduction

Khair (*Acacia catechu* Willd.) is a multi-purpose moderate-sized deciduous tree found throughout the greater parts of India except in very humid and temperate regions. It is common in the sub-Himalayan tract up to the Indus, eastwards to Assam and throughout the peninsula, particularly in the drier regions, ascending up to 900 m and sometimes found at 1,200m above msl (Troup, 1921). The tree is common in the Northern dry mixed deciduous forests, dry deciduous scrub forests and khair-sissoo forests in the Shiwalik hills of Punjab.

It is amongst the principal tree species commonly recommended for afforestation

programmes in the dry and frosty regions for soil and water conservation as well as production of wood, chiefly for manufacturing cutch and kattha.

Though a valuable tree, yet only sporadic studies have been done to find out the variation in kattha and cutch content in different regions and thereby to select superior genotypes among the populations. The yield of kattha from heartwood varies considerably depending upon the climate, locality and age of the tree. Maximum yield of kattha is obtained from trees felled in autumn or winter. Trees that are gnarled or crooked are found to give higher yield than straight stems (Anon., 1970). Freshly felled trees are reported to give higher kattha yield.

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Studies of Dobhal and Beri (1981) pointed out that outturn of cutch obtained from a given quantity of heartwood depends upon the quantity of heartwood and the efficiency of extraction process applied. The yield of kattha may be anywhere between 3 to 10 per cent of weight of heartwood. Heartwood containing more than 3 per cent of kattha is generally regarded as economically suitable material. The aim of this study was therefore, to find out the variations in kattha and cutch in different sources in the outer-Himalayan hills and select the best genotypes for further multiplication by vegetative means to establish clonal seed orchards.

### Material and Methods

Fifteen sources of khair were identified in the Shiwalik area of Punjab in the December, 2004 after extensive survey. In each source, three green standing trees were marked for felling in three different diameter classes in Gurdaspur, Dasuya and Ropar Forest Divisions. Geographical location, girth at breast height and total tree height (m) were recorded for all the trees separately (Table 1). The stem was then cut into logs of appropriate length depending upon the general form of the stem. Three cross sectional discs of 2 cm thickness per tree, one each from breast height ( $L_1$ ), 50 per cent of tree length ( $L_2$ ) and 75 per cent of tree length ( $L_3$ ) were taken with the help of saw for determining bark, heartwood and sapwood weight for individual samples, and extraction of kattha, cutch and total solid contents.

*Bark, sapwood and heartwood weight* : The samples were first weighed separately with bark intact, then after removing the bark to find out the respective proportion.

*Total Solids Content* : Extraction of 100 gm chips (1-2 mm) of heartwood with distilled water used in the ratio of 1:3 was carried out by boiling them in a pressure cooker continuously for 30 minutes. This was repeated three times by replacing the decoction each time. The decoction obtained was then concentrated and evaporated to dryness. The solids were then dried to zero per cent moisture by keeping it in oven at 60°C for 24 hours.

*Kattha content* : For each sample 200 gm chips (1-2 mm thickness) were boiled continuously for thirty minutes in a pressure cooker with distilled water using 1:3 ratio. Three extractions were carried out for each lot by replacing mother liquor each time. The mother liquor (decoction) collected from three boilings was filtered to remove the wood pieces and was concentrated with the care that temperature did not rise above 70°C. The concentration was practically continued till density ranges between 1.07-1.10. The concentrated material was kept over night in refrigerator at 8°C which facilitated crystallization of kattha. The crystallized matter was then filtered under vacuum to remove the remaining traces of mother liquor from the crystals. The residue was given two washings with 15 ml of ice cold water and then it was dried under vacuum to a constant weight.

*Cutch content* : The liquor obtained after filtration of kattha was evaporated till it formed a sticky paste. The material was dried first at room temperature and then in the oven at 60°C and the cutch percentage was expressed in dry weight basis.

The data of means for each parameter for each locality were calculated and

Table 1

Geographical Location of sources and average girth and height of the sampled trees

Source No.	Source	Forest Division	Altitude (m)	Longitude	Latitude	Girth (cm)	Height (m)
1	Sukret	Gurdaspur	458.4	75° 45' 48.878"E	32° 23' 39.726"N	78.33	8.82
2	Salari-I	Gurdaspur	454.2	75° 46' 04.395"E	32° 23' 48.742"N	77.33	8.21
3	Salari-II	Gurdaspur	473.6	75° 45' 43.059"E	32° 23' 37.532"N	65.33	7.85
4	Salari-III	Gurdaspur	581.8	75° 46' 42.246"E	32° 28' 20.155"N	77.00	9.79
5	Dhar	Gurdaspur	470.0	75° 45' 48.207"E	32° 24' 10.784"N	77.00	8.01
6	Katoli-I	Dasuya	581.8	75° 46' 42.246"E	32° 28' 20.155"N	72.50	8.91
7	Katoli-II	Dasuya	581.8	75° 46' 42.246"E	32° 28' 20.155"N	83.33	9.11
8	Patoli	Dasuya	532.7	75° 51' 27.954"E	31° 49' 50.347"N	71.67	8.84
9	Labbar	Dasuya	532.7	75° 51' 27.954"E	31° 49' 50.347"N	76.67	6.28
10	Mansooch	Gurdaspur	564.4	75° 46' 30.339"E	32° 24' 11.750"N	75.33	10.03
11	Doong	Gurdaspur	541.6	75° 44' 52.611"E	32° 25' 04.155"N	74.33	8.34
12	Ghar Badoli	Gurdaspur	652.2	75° 52' 39.921"E	32° 27' 25.850"N	83.00	7.46
13	Dunera	Gurdaspur	662.6	75° 52' 04.082"E	32° 27' 34.781"N	68.33	6.36
14	Seonk	Ropar	391.1	76° 46' 55.905"E	36° 48' 29.320"N	60.00	8.73
15	Pallanpur	Ropar	348.1	76° 42' 58.253"E	30° 51' 53.241"N	93.24	11.30

analysed statistically using randomized block design.

## Results and Discussion

*Weight of disc* : The weight of the disc taken from three different positions from sampled trees did not vary significantly among different sources (Table 2). However, the lower portion ( $L_1$ ) had maximum weight, which was due to higher girth at lower portion of the trees. The variation in the over bark, under bark and weight of bark at different portion of the trees was due to the taper of the tree which resulted in the difference (Table 2). The weight of heartwood varied significantly amongst the sources (Table 3). Maximum (1.282 kg/disc) heartwood in the disc was recorded in the trees sampled from Pallanpur, which is attributed to the maximum girth of these trees. The proportion of the bark, sapwood and heartwood in a tree depends upon locality factors, age, diameter, general form and other related characters. The relative proportion of heartwood and sapwood also varies within tree components. Hill (1952) and Bosshard (1966) found that various biochemical changes are responsible for conversion of sapwood into heartwood. Hence, the locality factors favouring such biochemical changes would naturally help in the conversion of sapwood into heartwood and as such the trees growing in different localities will vary in heartwood percentage.

*Dry Kattha content (gm/100 gm of heartwood)* : Dry kattha yield significantly varied within various sources studied (Table-4). Maximum dry kattha yield (5.302 gm/100 gm of heartwood) was recorded from Salari-III, however, Dhar, Ghar badoli, Seonk, Pallanpur, Monsooh, Katoli-I,

Katoli-II, and Salari-I were also statistically at par. Dry kattha yield was minimum (4.12 gm) from trees selected from Patoli (Table 4), which was significantly lower as compared to all other sources. Dry kattha content significantly varied in different portion of the trees. The lower portion ( $L_1$ ) had maximum (6.025 gm/ 100 gm of heartwood) kattha content followed by middle ( $L_2$ ) portion (4.18 gm/ 100 gm of heartwood) and upper ( $L_3$ ) portion (3.48 gm/ 100 gm of heartwood) of stem.

*Dry Cutch Content* : The cutch content also significantly varied amongst sources and position of the disc from the tree (Table 4). The trees selected from Dhar had the maximum (7.604 gm) cutch content, however it was at par with Salari-III, Seonk, Pallanpur, Ghar Badoli, Monsooh and Labbar. Whereas, tree sampled from Sukret had significantly minimum (5.93 gm) cutch content. The cutch content was significantly higher in the lower portion of the trees from all sources.

*Dry mixture* : The dry mixture content followed the similar trend as observed for kattha and cutch content (Table 4). The variation in kattha, cutch and total mixture content across different sources may be ascribed to variation in locality factors, site quality, and general form of trees and density of other associated species. (Gupta *et al.*, 1979; Rather, 1983; Kumar, 1998).

The variation in kattha and cutch content in different tree portions is due to various chemical changes which are responsible for formation of catechin in khair tree and these changes become more prominent with the increase in diameter and age and are more pronounced in basal portion of stem compared to upper portion of stem (Hill, 1952, Bosshard, 1966; Kumar,

**Table 2**  
*Weight of disc over bark, under bark and bark weights in discs at different heights*

Source No.	Source	Weight of disc over bark (kg)			Weight of disc under bark (kg)			Weight of bark (kg)					
		Disc position			Disc position			Disc position					
		L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	Mean	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	Mean	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	Mean
1	Sukret	1.571	1.314	0.566	1.147	1.426	0.937	0.478	0.947	0.1450	0.3770	0.0787	0.2000
2	Salari-I	1.025	0.925	0.690	0.880	0.873	0.524	0.356	0.584	0.1520	0.4010	0.3340	0.2990
3	Salari-II	0.937	0.760	0.661	0.786	0.794	0.625	0.532	0.650	0.1430	0.1340	0.1290	0.1350
4	Salari-III	1.155	0.870	0.770	0.931	0.971	0.691	0.655	0.772	0.1840	0.1770	0.1150	0.1580
5	Dhar	1.597	1.042	0.850	1.163	1.405	0.892	0.742	1.013	0.1920	0.1500	0.1080	0.1500
6	Katoli-I	1.449	1.307	0.480	1.078	1.270	1.117	0.403	0.930	0.1790	0.1900	0.0747	0.1480
7	Katoli-II	2.098	1.172	0.793	1.354	1.969	1.001	0.610	1.192	0.1290	0.1710	0.1870	0.1620
8	Patoli	0.640	1.072	0.530	0.747	0.574	0.583	0.394	0.517	0.0660	0.4890	0.1350	0.2300
9	Labbar	2.419	0.966	0.945	1.444	2.284	0.847	0.764	1.298	0.1350	0.1190	0.1810	0.1450
10	Mansooh	1.475	1.149	0.810	1.144	1.317	1.005	0.690	1.004	0.1590	0.1430	0.1190	0.1400
11	Doong	3.119	1.656	0.899	1.891	2.785	1.429	0.749	1.655	0.3330	0.2270	0.1500	0.2370
12	Ghar Badoli	2.278	1.014	0.580	1.290	1.986	0.857	0.477	1.107	0.2920	0.1570	0.1010	0.1940
13	Dunera	1.983	1.079	0.363	1.142	1.733	0.939	0.290	0.986	0.2510	0.1410	0.0747	0.1550
14	Seonk	2.266	1.204	0.650	1.374	2.197	1.132	0.572	1.300	0.0693	0.0727	0.0780	0.0733
15	Pallanpur	3.584	1.131	0.734	1.816	3.516	1.056	0.656	1.443	0.0673	0.0757	0.0783	0.0738
Mean		1.84	1.111	0.687	1.673	0.91	0.560		0.1660	0.2020	0.1290		
CD 0.05													
Source				NS			NS						NS
Position				0.33			0.31						NS
SxP				NS			NS						NS

Table 3

*Weight of sapwood and heartwood of disc at different positions*

Source No.	Source	Weight of sapwood (kg)				Weight of heartwood (kg)			
		Disc position				Disc position			
		L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	Mean	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	Mean
1	Sukret	0.403	0.287	0.227	0.306	1.023	0.649	0.251	0.641
2	Salari-I	0.356	0.293	0.224	0.291	0.517	0.231	0.132	0.293
3	Salari-II	0.349	0.286	0.404	0.346	0.445	0.339	0.128	0.304
4	Salari-III	0.299	0.313	0.231	0.281	0.672	0.379	0.425	0.492
5	Dhar	0.361	0.296	0.363	0.340	1.045	0.596	0.379	0.673
6	Katoli-I	0.396	0.392	0.185	0.324	0.874	0.725	0.217	0.606
7	Katoli-II	1.301	0.377	0.332	0.670	0.669	0.324	0.274	0.522
8	Patoli	0.196	0.184	0.204	0.195	0.378	0.399	0.191	0.323
9	Labbar	0.656	0.418	0.172	0.415	1.628	0.429	0.592	0.883
10	Mansooh	0.580	0.395	0.324	0.433	0.737	0.610	0.366	0.571
11	Doong	0.786	0.489	0.369	0.548	1.999	0.941	0.380	1.107
12	Ghar Badoli	0.679	0.424	0.303	0.469	1.307	0.433	0.174	0.638
13	Dunera	0.603	0.525	0.174	0.434	1.013	0.414	0.114	0.552
14	Seonk	0.552	0.416	0.317	0.428	1.644	0.715	0.256	0.872
15	Pallanpur	0.771	0.338	0.273	0.461	2.745	0.717	0.383	1.282
Mean		0.552	0.362	0.273		1.121	0.547	0.284	

CD 0.05

Source	NS	0.55
Position	0.12	0.24
SxP	NS	NS

1998; Karnik *et al.*, 1965; Jain, 1980). In the present study higher kattha content was recorded in the lower portion of sampled tree in all the sources.

### Conclusion

The kattha content was higher in

the trees selected from Salari-III site, out of 15 sources. However sources namely Seonk, Pallanpur and Mansooh were statistically at par with Salari-III, therefore for seed collection, seed orchard establishment and tree improvement programme, selection from these sources should be preferred.

**Table 4**  
*Effect of source and position on kattha and cutch yield*

Source No.	Source	Dry weight of Kattha/100 gm of heartwood				Dry weight of Kutch/100 gm of heartwood				Dry weight of mixture/100 gm of heartwood			
		Disc position				Disc position				Disc position			
		L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	Mean	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	Mean	L <sub>1</sub>	L <sub>2</sub>	L <sub>3</sub>	Mean
1	Sukret	5.750	4.000	3.130	4.293	6.547	6.507	4.733	5.929	12.30	10.51	7.86	10.22
2	Salari-I	5.830	4.750	3.850	4.809	6.713	6.727	5.747	6.396	12.54	11.47	9.60	11.20
3	Salari-II	6.743	4.177	2.627	4.516	8.500	6.710	4.700	6.637	15.24	10.89	7.33	11.15
4	Salari-III	6.300	5.553	4.053	5.302	8.373	7.497	5.723	7.198	14.67	13.05	9.78	12.50
5	Dhar	6.310	5.367	3.560	5.079	8.827	7.403	6.583	7.604	15.14	12.77	10.14	12.68
6	Katoli-I	5.890	5.240	3.500	4.877	7.153	7.113	4.483	6.250	13.04	12.35	7.98	11.13
7	Katoli-II	5.700	4.523	3.573	4.666	7.350	6.270	5.083	6.234	13.05	10.99	8.66	10.90
8	Patoli	5.973	3.893	2.497	4.121	8.140	6.360	4.517	6.339	14.11	10.25	7.01	10.46
9	Labbar	5.653	4.437	2.887	4.309	8.780	6.927	4.967	6.891	14.43	11.36	7.80	11.20
10	Mansooh	6.327	5.390	3.483	5.067	8.073	7.427	5.177	6.892	14.40	12.82	8.66	11.96
11	Doong	5.710	4.503	3.280	4.498	7.863	6.373	5.420	6.552	13.57	10.88	8.70	11.05
12	Ghar Badoli	5.933	5.340	4.330	5.201	7.687	6.827	6.307	6.940	13.62	12.17	10.64	12.14
13	Dunera	5.530	4.763	3.590	4.628	7.447	6.603	4.653	6.234	12.98	11.37	8.24	10.86
14	Seonk	6.263	4.700	4.103	5.022	7.833	7.027	6.243	7.034	14.10	11.73	10.35	12.06
15	Pallanpur	6.467	5.400	3.790	5.219	8.267	7.350	6.690	7.436	14.73	12.75	10.48	12.65
Mean		6.025	4.816	3.48		7.837	6.875	5.402		13.86	11.69	8.88	
CD 0.05													
Source				0.65				0.86				1.33	
Position				0.29				0.38				0.59	
SxP				NS				NS				NS	

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