Biological Forum – An International Journal 14(2): 1413-1418(2022)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Evaluation of High Resin Yielding Half Sib Families of Chir Pine for Oleo-Resin Yield Traits in North Western Himalayas

Rajender Kumar[1*], Sankhyan H.P.[2] and Rajneesh Kumar[3]
[1]Ph.D. Scholar, Department of Tree Improvement and Genetic Resources,
Dr. Y S Parmar, University of Horticulture and Forestry, Nauni (Himachal Pradesh), India.
[2]Professor, Department of Tree Improvement and Genetic Resources,
Dr. YS Parmar, UHF, Nauni (Himachal Pradesh), India.
[3]Assistant Professor, Department of Forest Products,
Dr. YS Parmar, UHF, Nauni, (Himachal Pradesh), India.

(Corresponding author: Rajender Kumar)*
(Received 22 April 2022, Accepted 13 June, 2022)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: Availability of high resin yielding families of chir pine is scared in Himachal Pradesh, therefore, there is growing need to identify these families, so the research was conducted at the Shilli Conservation Reserve, Solan, Himachal Pradesh to evaluate the high resin yielding half sib families of chir pine for oleo-resin yield parameters. Chir pine was studied for various parameters like oleoresin yield, turpentine content, rosin content and rosin colour in 95 plants from different 19 seed sources. The trees with yellow (13 B) colour oleoresin are found to be higher yielder, followed by trees with yellowish-white colour (10 B) while trees with white (155 A & B) colour oleoresin have been observed to be low yielder. The seed of these high resin yielding families can be used in establishment of seed orchard to increase its number of populations so as to increase the overall resin production.

Keywords: Resin, Chir pine, Seed, Colour, Yield.

INTRODUCTION

Pinus roxburghii Sargent (Chir pine or long needle pine), is one of the most important conifers of north-western Himalayas and is an important timber and resin yielding species (Rawat *et al.,* 2014). The genus Pinus contains 110 to 120 species that are found in the Northern Hemisphere's temperate regions (Price *et al*., 1998), *Pinus roxburghii* Sargent, *Pinus wallichiana* Jackson, *Pinus gerardiana* Wall., *Pinus kesiya* Royleex Gord, and *Pinus armandi* French are the five pines native to India. *Pinus roxburghii* Sargent, for example, is one of the Himalayan region's most principal conifers, is commercially harvested for resin (CSIR, 1969) and influences the lives of various ethnic and other groups in the region. (Tiwari, 1994). *Pinus roxburghii* Sargent, also known as 'Chir-pine; Chir; Chil,' belongs to the Pinaceae. Chir pine covers 14,356 km^2 in the country's forests, where it is the most common species and accounts for more than 25 per cent of the total of the order Coniferales. It is distributed in the monsoon belt of the outer Himalaya from Arunachal Pradesh in India to north-western parts of Pakistan (Bhat *et al.,* 2016). Its bark is red-brown in colour and grows thick, deeply and longitudinally fissured andit reaches up to height of 55 m and over 100 cm diameter at breast height (Ghildiyal *et al.,* 2010). Among the many uses of Chir pine, one of the most common non-wood products is oleoresin, which is primarily obtained from it. Oleoresin is the mixture of two components i.e. volatile turpentine oil and solid transparent material (Chauhan *et al.,* 2022). The process of acquiring of resin is called as resin tapping (Hadiyane *et al.,* 2015). Earlier, India used to export resin, but now consumes all its production internally through its small- and large-scale industries. With the increase in day by demand of oleoresin, the dependency on the clones has increased significantly because the oleoresin production from natural stands is insufficient to meet the basic requirement of the resin-based industries (Dutt *et al*., 2019). To reduce the gap between the demand and supply it has now become necessary to identify superior progenies or clones through breeding programmes such as half-sib progeny evaluation. Therefore, this research was conducted at Shilli conservation reserve to evaluate the high resin yielding half sib families of chir pine for oleo-resin yield traits.

MATERIALS AND METHODS

The experiment was conducted at Shilli conservation reserve, Solan, Himachal Pradesh during 2020-2021 season where a block plantation of high resin yielders from19 seed source of Himachal Pradesh having high oleo resin properties, was established in 1982. Statistical design employed was Randomized Block

Design (RBD). The method employed for oleoresin collection was bore hole method as described by Lekha (2002a); Kumar and Sharma (2007) (Plate 1). The Girmit of 1.0-inch diameter was used for drilling holes as described by Lekha (2002b); Kumar and Sharma (2005). The holes were drilled with slight slope towards opening, so that oleoresin drains freely. The chemical stimulants (10% ethephon and 20% H_2SO_4) were sprayed with the help of spray bottle (Plate 1). The spouts were fixed in the holes tightly. The plastic-bags made of high-density polyethylene (HDPE) were attached to the spout of each hole with the help of tie for collection of oleoresins and replaced only when filled with oleoresin during the period of tapping (Plate 2). Analysis of oleoresin was done by recording various parameters like oleoresin color, turpentine content, rosin content and rosin color. Turpentine is semi fluid substances obtained by distillation of resin while rosin is solid form of resin obtained from pines mostly conifers. Oleoresin yield was also calculated from different half sib families of chir pine.

Plate 1. Application of bore hole method for oleoresin collection.

Plate 2. Oleoresin collection from different genotypes of *Pinus roxburghii* Sargent.

On the basis of color, oleoresin and rosin was categorized into three colors i.e. yellow, yellowish white and white. Twenty-five gram of oleoresin sample was taken in 1000 ml round bottom flask and 250 ml of water was added to it. The flask was fixed to Clevenger's apparatus and was heated with frequent agitation, until abolition commenced, heating was continued for about an hour and after cooling for at least 5 minutes the volumes of turpentine in the graduated portion of tube was noted. The distillation was continued until successive readings of the volume of turpentine did not differ (Persad, 1983). Turpentine content was extracted from oleoresin by using Clevenger's apparatus and calculated by the formula given below:

Turpentine per cent (ml/g) = $X/25 \times 100$

X = volume of turpentine in ml

Rosin content was calculated by using the formula given by Sharma (1987):

Rosin per cent = $Y/25 \times 100$

Where

Y = Weight of rosin in g

25 = Weight of sample in g

The data were statistically analyzed using software OPSTAT (Sheoran *et al.*, 1998).

RESULTS AND DISCUSSION

Oleoresin Yield. The data on oleoresin yield from various families is shown in Table 1 and Fig. 1. The average oleoresin yield was found to be 430.97 g. The highest oleoresin yield, 780.8 g, was found in the Hamirpur (T14) family. The Jassi (T5) family had the lowest oleoresin yield of 251 g. Oleoresin yield is hereditary and it depends upon the genetics of tree species (Papajiannopoulos, 2002). Environmental factors like light, temperature and moisture status of tree (Dudareva *et al.*, 2004). Highest oleoresin is reported in Hamirpur family because of their greater diameter. Trees having dark green needle colour have highest oleoresin yield. Similar results were reported by Chaudhari *et al.* (1992); Murtem (1998).

Table 1: Oleoresin yield, turpentine and rosin content of oleoresin.

Family	Families	Resin Yield (g)	Turpentine content (%)	Rosin content (%)
1	Mahasu (T1)	331 .2	20.54	78.27
2	Chanina (T2)	395.2	22.96	75.42
3	Soigni (T3)	320	23.77	76.78
4	Surami (T4)	309.6	21.79	78.43
5	Jassi (T5)	251	20.53	78.33
6	Bitroli (T6)	346	24.19	74.23
7	Surami (T7)	601	24.36	75.44
8	Bijhri (T8)	374	21.55	77.84
9	Majhin (T9)	373.8	23.95	75.23
10	Hamirpur (T10)	318.2	23.18	75.66
11	Hamirpur (T11)	507.4	22.43	76.67
12	Dharamshala (T12)	432.8	22.54	76.22
13	Bijhri (T13)	517	22.12	76.24
14	Hamirpur (T14)	780.8	25.4	72.68
15	Majhin (T15)	494.6	21.63	76.72
16	Chabhitra (T16)	368.4	21.25	77.32
17	Bharwain (T17)	579	22.25	75.46
18	Mahasu (T18)	462.2	19.45	78.60
19	Habroi (T19)	426.2	24.79	74.4
C.D.		174.688	2.10	1.88
SE(m+)		61.835	0.745	0.68

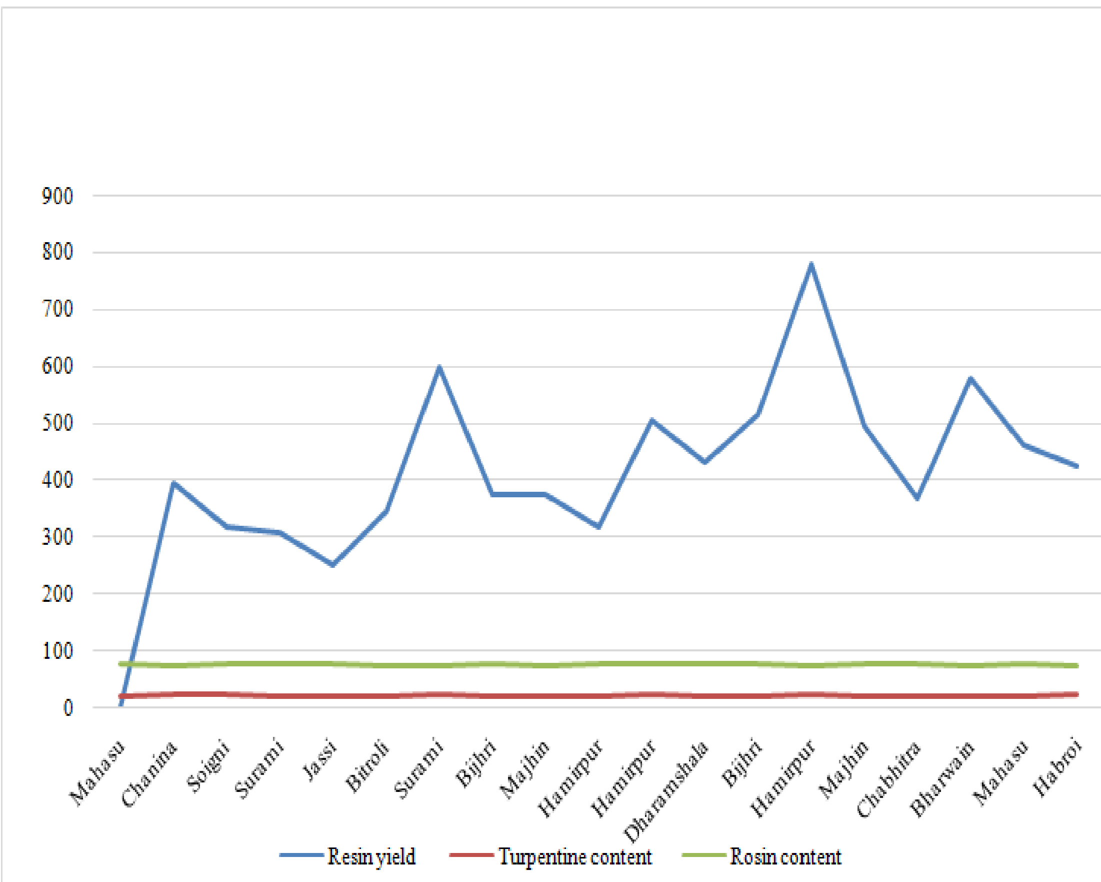

Fig. 1. Comparison of resin yield, turpentine content and rosin content among different half sib families.

Turpentine Content. Table 1 shows the data for the turpentine content of 19 half sib families. The turpentine content of oleoresin ranged from 19.45 (%) to 25.4 (%). Hamirpur (T14) family 25.4 (%) had the greatest proportion of turpentine content. For the Mahasu (T18) family, a minimum value of 19.10(%) was obtained. Turpentine content is related with oleoresin yield, it means if oleoresin yield of a tree species in high its turpentine content is automatically high. Similar result is reported by Sukarno *et al.* (2015a); Sukarno *et al.* (2020b) in *Pinus merkusii*.

Rosin Content. Rosin content of oleoresin of different half sib families was shown in Table 1. The Mahasu (T18) family had the highest rosin content 78.60(%), while the Hamirpur (T14) family had the lowest 72.68(%). Mahasu family have higher rosin content because of its greater needle length. Similar result was reported by Bhatt (2015); Sharma *et al.* (2015) in *Pinus roxburghii*.

Table 2: Oleoresin colour of *Pinus roxburghii* half-sib families.

Yellow 13B	**Yellowish white 10B**	**White155 A &B**
Mahasu T1	MahasuT2	Mahasu T5
Mahasu T3		
Mahasu T4		
Chanina T1	Chanina T4	Chanina T3
Chanina T2		
Chanina T5		
SoigniT2	SoigniT4	Soigni T1
Soigni T3		
Soigni T5		
Surami T3	Surami T2	Surami T1
	Surami T4	Surami T5
Jassi T2	Jassi T1	
Jassi T4	Jassi T3	
Jassi T5		
Bitroli T4	Bitroli T1	Bitroli T2
Bitroli T5		Bitroli T3
Surami T3	Surami T1	Surami T2
	Surami T5	Surami T4
Bijhri T1	Bijhri T3	Bijhri T2
	Bijhri T5	Bijhri T4
Majhin T1	Majhin T3	
Majhin T2	Majhin T4	
Majhin T5		
Hamirpur T2	Hamirpur T1	Hamirpur T3
	Hamirpur T4	
	Hamirpur T5	
Hamirpur T2	Hamirpur T1	Hamirpur T5
Hamirpur T4		Hamirpur T3
Dharmshala T2	Dharmshala T3	Dharmshala T1
Dharmshala T5		Dharmshala T4
Bijhri T3	Bijhri T1	Bijhri T2
	Bijhri T5	Bijhri T4
Hamirpur T1	Hamirpur T4	Hamirpur T3
Hamirpur T2		Hamirpur T5
Majhin T1	Majhin T2	Majhin T3
Majhin T4		
Majhin T5		
Chabhitra T3	Chabhitra T1	Chabhitra T2
	Chabhitra T4	Chabhitra T5
Bharwain T1	Bharwain T4	Bharwain T3
Bharwain T2		Bharwain T5
Mahasu T1	Mahasu T4	Mahasu T3
Mahasu T2		
Mahasu T5		
Habroi T4	Habroi T1	Habroi T2
	Habroi T3	Habroi T5

Oleoresin Content. The data related to oleoresin colour are presented in Table 2. It was observed that 38 genotype possessed yellow (13 B) coloured oleoresin, 29 genotype possessed yellowish white (10B) coloured oleoresin and 28 genotype possessed only white (155 A & B) coloured oleoresin. The trees with yellow (13 B) colour oleoresin are found to be higher yielder, followed by trees with white (155A& B) colour oleoresin have been observed to be low yielder. The low oleoresin yield of white coloured oleoresin families may be attributable to genetic constitution of families and can operate as an oleoresin yield indicator. Similar work has been reported by Sikarwar (2011) in *Pinus roxburghii* Sargent. Maximum percentage of rosin was observed in Mahasu (T18) family (78.6%) while the Hamirpur (T14) origin had the minimum rosin content. Hamirpur (T14) family 25.4 (%) had the greatest proportion of turpentine content. For the Mahasu (T18) family, a minimum value of 19.10(%) was obtained.

CONCLUSION

In the end it can be concluded that evaluation of chirpine diversity can be very useful in qualitative and quantitative improvement of different traits studied. Families which show higher oleoresin yield, rosin content, turpentine content and oleoresin content can be used for establishment of orchard to increase there population so as to increase the overall resin production.

FUTURE SCOPE

For future studies these families can be evaluated at molecular levels and superior families can be used in breeding programmes for improvement of tree species.

Acknowledgement. The authors great fully acknowledge the Department of Tree Improvement and Genetic Resources, Dr. Yashwant Singh Parmar, Nauni, Solan, Himachal Pradesh, India for providing the research facilities for this research.
Conflict of Interest. None.

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How to cite this article: Rajender Kumar, Sankhyan H.P. and Rajneesh Kumar (2022). Evaluation of High Resin Yielding Half Sib Families of Chir Pine for Oleo-Resin Yield Traits in North Western Himalayas. *Biological Forum – An International Journal*, *14*(2): 1413-1418.