This column covers information on the introduction and cultivation practices of new, under-utilized and other economic plants in India. The information shall be contributed articles by authors or compiled by editors.

Contribution of articles by plant growers, agronomists, horticulturists and floriculturists with cultural practices, seed source and economics are solicited.

Cultivation prospects of endangered species *Celastrus paniculatus* Willd.

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Abstract

***Celastrus paniculatus* Willd.** is an important Ayurvedic medicinal plant gaining popularity in the primary healthcare systems and in herbal drug formulations. Its seed oil is reported to be beneficial in stimulating intellect and sharpening the memory. It has also been reported as nervine tonic, rejuvenant, anti-depressant, anti-oxidant, free radical scavenger, etc. Over-exploitation of the plant has put this species in endangered category. Work was initiated on its cultivation and the results obtained are presented in the paper. Maximum seed germination of 74.75% was achieved after Gibberellic acid treatment (350mg/l) and survival rate of seedlings was 73.72%. Plants raised from seeds flowered and set fruits in the 3rd year. The cytological study confirmed chromosome number of the species as 2n=46. Meiotic studies revealed regular formation of 23 bivalents per PMC. The species, however, exhibited seed shattering character. Chemical analysis of seeds of six accessions raised at experimental farm was also done to compare percentage of oil yield and other properties of wild and cultivated samples. The seeds on solvent extraction yield 55% (w/v) thick, pinkish red coloured and faintly aromatic oil. The cultivation practices/procedure developed will serve as a reliable and reproducible protocol for cultivation of this species.

Keywords: *Celastrus paniculatus*, *Malkanguni*, Free radical scavenger, Nervine tonic, Endangered, Cultivation, Seed oil.

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Introduction

***Celastrus paniculatus* Willd.** (Family — *Celastraceae*) commonly known as *Malkanguni*, *Jyotishmati*, Intellect Tree and Bitter Sweet, is an important Indian medicinal, deciduous, forest climber, growing in sub-Himalayan tracts up to 2000m in Central India, Western Ghats, Eastern Ghats extending to Rajmahal hills in Bihar and Orissa up to 1500m elevation (Wealth of India, 1992). The oil extracted from the seeds has tranquilizing effect, besides being a central muscle relaxant, anti-emetic, anti-ulcerogenic and


Fig. 1 : Mature seeds


Fig. 2 : Seedlings at 2-leaf stage


Fig. 3 : Seedlings at 4-leaf stage

Fig. 4 : Celastrus paniculatus vegetative stage

adaptogen with memory enhancing properties (Handa, 1998). In Indian traditional system of medicine, *Celastrus* is used as an appetizer, laxative, emetic, aphrodisiac, brain tonic and used for the treatment of cough, asthma, leprosy, paralysis, leucoderma, rheumatism, gout and headache (Vaidyaratnam, 1994). The bark is reported to have abortifacient activity. It is one of the components of the drug "Mentat Syrup" recommended for memory enhancing and mental disorders (Nadkarni, 1954). More recently, it has been reported to be an anti-depressant (Barnwal & Singh, 2000). Recent literature also suggest that the oil of ***C. paniculatus*** and its extract exhibit the following actions: antiviral (Bhakuni *et al*, 1969), antibacterial (Patel & Trivedi, 1962), insecticidal (Atal *et al*, 1978), analgesic, anti-inflammatory (Ahmad *et al*, 1994; Dabral & Sharma, 1983), antifatique (Kakrani *et al*, 1985), antispermatogenic (Wangoo & Bidwai, 1988), hypolipidaemic (Khanna *et al*, 1991), sedative (Ahumada *et al*, 1991) and anticonvulsant (Joglaker & Balwani, 1967). Nalini *et al* (1986) also reported that chronic treatment with its oil produced improvement in IQ scores, learning ability, and decreased the content of catecholamine metabolites in mentally retarded children. It is one of the constituents of Rumalaya and Gerifort (Dabral & Sharma, 1983). Reactive oxygen species (ROS) are involved in ageing and age associated neurodegenerative diseases and it has been reported that to possess antioxidant effects in *in vitro* tests (Russo *et al*, 2001). Recently, Kumar and Gupta (2002) confirmed the antioxidant property of ***C. paniculatus*** by decreasing the lipid peroxidation. The effect of the extract showed the maximum cognitive enhancing property.

Fig. 5 : Profuse flowering

Fig.6 : Panicle

Indeterminate over-exploitation from natural sources to meet the growing demand by pharmaceutical industry has resulted in depletion of its population in the forests. The seeds showed erratic, poor germination and under natural conditions have been found to germinate after remaining dormant for one or two years. Consequently, the cultivation and improvement of this valuable medicinal plant is seriously handicapped. Realizing the threat of extinction there is a need to develop propagation protocols, conservation strategies and commercial cultivation of this plant. Moreover, its cultivation and multiplication will meet the increasing demand of the seed oil in pharmaceutical industry.

Fig. 7 : Fruit capsules

Materials and Methods

Seeds were collected from Palampur, Himachal Pradesh during October, 1996. For morphological study of seeds, parameters such as shape, colour, number of seeds /fruit, weight, density and volume were taken. Weight of 100 seeds in triplicate using electronic balance and size comprising length, breadth and thickness (10 replicates) with the help of vernier calliper were determined. Viability of seeds was tested by the tetrazolium method. Volume of 100 seeds was calculated using water displacement method. Seed density was calculated as follows:

Seed density (g/cc) = Seed weight (g) / Seed volume (cc)

Following treatments were given to seeds: (i) Seeds were treated with concentrated sulphuric acid for 30 seconds and then thoroughly washed with distilled water; (ii) Seeds were also treated with absolute ethyl alcohol for 1, 2 and 3 hours and petroleum ether for 3, 6 and 12 hours; (iii) Seeds were also soaked in different concentrations of gibberellic acid ranging from 50-550mg/l for 36 hours at 30°C; (iv) Mechanical scarification without and with 24 hours washing was also applied.

Fifty seeds were taken for each treatment in four replicates. The seeds were then allowed to germinate in petridishes. These were kept in seed germinator maintained at 25 ± 2°C and 80 ± 5% humidity. The total number of germinated seeds were counted after 24 days of germination from each set of replication and on the basis of average the percent germination was recorded.

For meiotic studies, young floral buds were fixed in chloroform, ethyl alcohol and acetic acid in the ratio of 4:3:1 for 24 hours. These were washed thoroughly and stored in 70% ethyl alcohol. The anthers excised from flower buds were squashed in 1% Acetocarmine.

A part of the seeds harvested from our plantation at Chatha farm was subjected to oil extraction and the other part was kept for plant propagation. The seeds were dried and coarsely grounded. The coarse powder of seeds was extracted with 5 parts petroleum ether (40-60°C) in a Soxhlet apparatus for 16 hours. The extracts were then concentrated *in vacuo* and concentration was continued to completely remove the solvent. The percentage of oil yield was calculated. Qualitative characters of the oil were analyzed by standard ph-armacopoeial method (Annon, 1966).

Results and Discussion

Seed biology: Data on seed morphology and viability are given in Table 1. The colour of seeds was reddish brown enclosed in scarlet aril, which stains yellowish orange (Fig.1). Seeds have unpleasant odour and taste. The average weight of 100 seeds was 1.636g. The length, breadth and thickness of seeds were 4.98, 1.7 and 1.32 mm, respectively. The volume of 100 seeds was found to be 0.80cc. Seed density and viability were 1.88g/cc and 96.8%, respectively.

Seed germination and development of seedlings: All the seed treatments resulted in higher percentage of germination than the control. The data in Table 2 reveal that maximum percent germination (74.75%) was recorded in seeds pretreated with GA3 350 and 400mg/l; afterwards it decreased. Treatment with petroleum ether, ethyl alcohol and conc. sulphuric acid improved the germination percentage as revealed in Table 2. Alcohol for 3 hours and petroleum ether treatments for 6 hours almost doubled the germination percentage. No promising results were observed in other treatments such as acid scarification and stratification without and with 24 hours continuous washing in running tap water. Dormancy in freshly harvested seeds was primarily related to the inhibitory influence of hard seed coat (Rekha *et al*, 1998). Highest germination percentage in treated seeds was 74.75% as compared to 11.50% in control and survivalists of seedlings was calculated after 72 days as 73.72% (Figs. 2 & 3).

Cultivation: When the seedlings were 8-10 cm in height these were carefully dug up from the nursery beds without injury to the root system of the plant. The seedlings were immediately transplanted in beds at spacing of 1.5m apart. Weeding was done as often as found necessary and hoeing twice a month. Proper care is needed till plantlets reach a height of 50cm. Afterwards it can come up well in stony and gravelly soils. It has low fertility and moisture demand and do not require tillage.

Phenology: Plants raised in our experimental farm (September, 1997) commenced floral bud initiation during 3rd week of March (2001), progressed to a peak in the 2nd week of May and then

Table 1 : Seed morphology and viability of *Celastrus paniculata*

Character	Range	Mean	S.E.
Wt. of 100 seeds (g)	1.596-1.723	1.636	± 0.02
Seed Length (mm)	4.4-5.1	4.98	±0.35
Seed Breadth (mm)	1.5-2.1	1.79	±0.06
Seed Thickness (mm)	1.2-1.5	1.32	±0.03
Volume of 100 seeds (cc)	0.79-0.82	0.80	±0.04
Seed Density (g/cc)	1.912-1.946	1.88	±0.03
Seed Viability (%)	95.0-98.0	96.8	±0.58

declined and ended in June first week (Figs.4, 5 & 6). Fruits become mature generally during Septembe-October (Fig. 7). It commences flowering and fruiting at the age of 3 to 4 years. Plants show seed shattering character.

Cytology: The diploid chromosome number of this species was conformed as 2n = 46 as earlier reported by Raghavan in 1959. Meiotic studies reveal regular formation of 23 bivalents per PMC consisting of both rod and ring types. The -rod bivalents were, however, dominant. The average chiasmata per PMC was recorded as 29.43 ± 0.32 and 26.49 ± 0.18 at diakinesis and metaphase I, respectively as seen from a total of 70 PMCs. No abnormality was observed during any of the meiotic stages and synapsis was perfect. At metaphase I all the bivalents moved to the equator of the spindle. They disjunct and 23 chromosomes segregated to each pole of anaphase I. Pollen viability percentage, however, was 85.31.

Seed oil profile: An analysis of the six accessions raised at experimental farm showed that seeds contained approximately 55% (w/v) pinkish red to

Table 2 : Effect of different treatments on seed germination of *Celastrus paniculatus* under laboratory conditions

Treatments	Concentrates (mg/l)	Germination (%)
Control		11.50
Acid scarification (min)	5	20.50
Ethyl alcohol (hr)	1	17.25
	2	20.20
	3	26.20
Petroleum ether (hr)	3	16.20
	6	22.00
	12	14.51
GA_3 (mg/l)	50	27.20
	100	32.75
	150	33.25
	200	44.00
	250	55.25
	300	66.50
	350	74.75
	400	74.75
	450	37.50
	500	31.50
	550	23.50
Mechanical scarification	-	22.75
Mech.scari.+24 hr washing	-	25.25
CD at 5%	1.85	

Table 3 : Chemical analysis of *Celastrus paniculatus* seeds harvested from experimental field

Genotype	Oil (w/v) (%)	Colour	Refractive Index (25°C)	Sp. gravity (25°C)	Acid value	Ester value	Saponification value
RL-9805	54.55	PR	1.4719	0.8313	25.24	269.93	296.36
RL-9806	56.18	PR	1.4715	0.8412	18.63	284.71	292.12
RL-9808	53.94	BR	1.4720	0.8380	22.93	283.03	286.36
RL-9812	56.32	BR	1.4710	0.7854	28.32	291.74	287.59
RL-9818	55.41	PR	1.4720	0.7993	30.62	284.69	288.64
RL-9822	57.29	PR	1.4728	0.8229	25.93	290.36	284.32

PR = Pinkish red
BR = Brownish red

brownish red coloured, faintly aromatic, thick and optically active oil (Table 3). It was observed that the accession RL-9822 yield the highest oil percent (57.29%). In general, acid value of oil in the accession RL-9806 was lowest than those of other accessions. High saponification value was observed in seed oil of genotype RL-9805. Earlier Srivastava *et al* (1990) have reported the chemical analysis of seeds from wild population. Our results are in conformity with the observations of Srivastava *et al*, 1990.

Conclusion

The results revealed that this high value medicinal plant can be grown as agro-forestry crop on wastelands or barren and marginal lands where no irrigation facility is available. It can also be grown as live hedge around agricultural fields as it is hardy and is not browsed by cattle (Fig.4). It is a crop with low capital investment and long productive period. The inter-space can be effectively utilized for growing shade loving medicinal herbs. Cultivation of this plant can help in conservation as well as sustainable supply of quality plant produce to the industry. There has been found no difference in the percentage of the oil of the sample from both wild and cultivated accessions.

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