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Research Paper

Standardization of cultivation techniques of *Artemesia absinthium* - an important medicinal plant of Kashmir Himalayas

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ABSTRACT

***Artemisia absinthium* (wormwood) belonging to the family Asteraceae is a very important species in the history of medicine, formerly described as "the most important master against all exhaustions". It is a species known as an important medicinal plant in Indian temperate Himalayan region. Due to having strong fragrance and pungent taste it has ability to defend itself from the herbivore animals and is a known to have anti-worm and anti-insecticidal properties. The species grows from 60 to 120 cm in height with a woody, hardy rosette and high branch bearing stem. The leaves of the plant, probably the best known species, have been used in medicines and such beverages as absinthe. The whole plant is an aromatic tonic and formerly enjoyed a high reputation in debility of the digestive organs. The species was cultivated in division of forest products and utilization to standardize its cultivation techniques under different spacing's and nitrogen dosages. The total four spacing's cm (S_1 :10×10 , S_2 :10×20, S_3 :10×30, S_4:10×40) and four nitrogen applications kg/ha (N_1 : 0, N_2 : 50, N_3 :75, N_4 : 100) were applied and the trail was laid using factorial randomized complete block design (RCBD), accordingly the data was analyzed in R Studio, version 4.2.2, 2022 to determine the best treatment combinations for better growth of the species under temperate conditions. The growth parameters like height, collar diameter, number of branches, plant fresh weight (g), plant Dry weight (g), seed weight/plant were recorded highest in S_3, N_4 treatments and S_3N_4 treatment combination**

Key words: Aromatic, cultivation, medicine, temperate, wormwood.

Artemesia absinthium is an aromatic and medicinal plant containing essential oil commonly known for the use of variety of human diseases, cosmetics as well as in pharmaceutical industry (Pandey. and Tripathi, 2011). *Artemisia absinthium* is commonly used in the preparation of aperitifs, bitters, and spirits (absinthe) as part of food industry (Mishra *et al*., 1999). The genus Artemisia is among the largest and widely distributed in Asteraceae family. *Artemisia absinthium* is commonly known as "wormwood", which grows in the hilly districts of Indian Himalyan region up to 1500 m elevation (Gaur, 1999). Artemisia absinthium is the important one among 45 species represented by genus Artemisia in the Indian flora (Shah, 2014), and it is naturally distributed in Jammu and Kashmir region. Artemisia absinthium is distributed in Alpine to Cold Arid zone (Ladakh) (10000ft above msl) in Leh Forest Division and few locations of its distribution are Nobra, Nyoma, Choglamsar, Durbuk etc (Davis, 1975).

This species posses strong fragrance and pungent taste which is useful for the plant for defending themselves from the herbivore animals. The name wormwood implies that it is a powerful worming agent, because of its usage for hundreds of years to expel tapeworms, threadworms, and especially roundworms from dogs, cats, and humans (Grieve, 1971).

The herb Artemisia absinthium is a, perennial plant with fibrous roots. Its leaves area lternate, stalked, and ex-stipulate. The leaf blade is triangular; both sides of the leaves are densely covered with silver-hair

(CHMP, 2009). The flowers of worm wood are pale yellow in color tubular, and clustered in spherical bent-down heads (capitula), which are in turn clustered inleafy and branched panicles (Wasim, 2010). Flowering is from early summer to early autumn; pollination isanemophilous (Thomas, 2000). The fruit is a small achene; seed dispersal is by gravity. The wormwood rhizomes are fibrous; taproot is short, twiggy, with many shoots and covered by silky hairs as overground parts of the plant.The flowering period is from July to September or even October. The above-ground parts die at the end of the growing season. The ripe fruit of wormwood, being a small achene, is not crowned by a tuft of hairs or pappus, so is dispersed by gravity. The seeds are long (up to 1 mm), cylindrical, flat, and gray-brown in color. One plant can produce up to 100,000 of seeds. The aerial parts of wormwood have a strong characteristic odor, while the root has a warm and aromatic taste.

Wormwood is native to temperate regions, its habitats ranging from Europe, Scotland, Scandinavia, to the Mediterranean Sea, to far south up to North Africa, in the East up to Siberia and northern India. *Artemisia absinthium* naturally grows in uncultivated fields and roadsides, on rocky slopes, preferring arid, non-acidic ground, loam or sandy loam, rich in nitrogen, phosphorus and potassium, often forms colonies (Mau, *et al*., 1985).Within India, it has been recorded in the Himalayan region across Jammu & Kashmir in an altitude range of 1500-2700 m or 5000-7000ft (Chopra, 1956).

The plant is easily propagated by division or cutting of roots, or by ripped seeds in the autumn. Propagation by seeds is done by growing seeds in trays or beds in the month of February and then transplanting the seedlings to field in March. Propagation by cuttings is done by cutting off a few unwoody shoots with a sharp knife in the summer and remove the leaves to the tip. The cuttings are then kept in sand soil mixture, high humidity is important here, because cuttings without roots cannot absorb water, but lose it through the leaves. After a few weeks, the small rooted cuttings can be moved to field for transplanting (Annonymous, 2004).

Cultivated plantations of wormwood can be exploited up to 10 years, and raw material can be harvested twice a year. Production of wormwood essential oils is available from the steam distillation (with yields around 0.4%) mainly from Morocco, China, India, and Bulgaria (usually less than 20 tons annually).

Artemisia absinthium is a bitter, aromatic, frutescent (shrubby) perennial plant. The useful parts are leaves, flowering tops, roots, stem and mostly all parts of the plant. They are used in chronic fevers, swellings, inflammation of liver, menstrual disorders. It is a remedy for digestions and debility. Flowers are vermifuge, tonic in intermittent fever. Herb yields an essential oil, called wormwood oil which is used externally in rheumatism. Whole plant, seeds, flowers and roots of the Worm wood are used to make herbal medicines in Ayurveda, Homeopathy, Unani, Siddha and even in Modern medicine (Shaikh, 2013).

The demand for medicinal plants including wormwood has increased tremendously at Global level, which causes huge pressure on wild collection. The unscientific and unsystematic collection from wild “adds fuel to the fire.” As the consequence, the rates of exploitation may exceed those of natural regeneration. Also, the natural habitats are fast depleting. Therefore, it is need of the hour to standardize the propagation techniques of important medicinal plants in temperate Himalayas (Mushtaq *et. al*, 2022).

MATERIALS AND METHODS

Study Area: The study was carried out in Nursery of Division of Forest products and Utilization, Faculty of Forestry, SKUAST-Kashmir, Jammu and Kashmir, India in the year 2021-22 for standardization of cultivation techniques of *Artemesia absinthium* species. The experimental site falls in a mid to high altitude characterized by hot summers and very cold winters. The average precipitation is 690 mm most of which was received from December to April in the form of snow and rains. The total rainfall (mm) during the experimentation period was 281.2 and 418.80 mm, respectively and means temperature was 24°c.

Treatment details: The experiment was laid using 50 cuttings per treatment in three replication under four levels of spacing cm (S_1 **:**10×10 , S_2 **:**10×20, S_3 **:**10×30, S_4**:**10×40) and five levels of nitrogen application kg/ha **(**N_1 : 0, N_2 : 50, N_3 :75, N_4 : 100) through factorial randomized complete block design (RCBD), accordingly the data was analyzed in R Studio, version 4.2.2, 2022 (R Development Core Team, 2022).

Duration of the study: The study was carried out for 2 years. The seeds of *Artemesia absinthium* were collected in March, 2021 from wild forests of Kashmir region of Jammu and Kashmir State and were sowed in trays. The Seedlings were transplanted in field in May; 2021 and data for observations were recorded in November, 2021 and November, 2022.

Observations Recorded: Collar diameter, Height (cm), Plant fresh weight (g), Plant Dry weight (g), seed weight/plant, No. of branches/plant

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Seedling of wormwood



Mature plant-bearing seeds

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RESULTS AND DISCUSSION

Artemesia absinthium native to Himalayan region is one of the most popular medicinal plant species around the world. The leaves have immense medicinal uses, particularly anti-helmenthic properties. The species is listed in prioritirized medicinal plants by the National medicinal plant board of the country.

The data in Table 1 illustrates that significant difference was found among spacing and nitrogen application, where maximum height was observed in case of S_3 (75.95 cm) and N_4 (76.2 cm). It was also found that there exists a significant interaction between spacing and application of nitrogen where maximum height of 80.4 cm was observed in case of S_3XN_4. The results are in concurrence with the study of Rao, *et al*, 1988 who studied the effect of plant spacing and nitrogen levels on Plant height, herbage yield and essential oil yields and nutrient uptake of geranium (*Pelargonium graveolens* L. Her Ex Ait) in central institute of medicinal and aromatic plants at Bangalore.

Table 1: Effect of Spacing and Nitrogen fertilizer on Height (cm) of *Artemisia absinthiam*

	N1	N2	N3	N4	Sub Mean
S1	60.5	65.5	68.8	70.0	66.20
S2	65.8	67.4	69.0	72.0	68.55
S3	70.0	74.6	78.8	**80.4**	**75.95**
S4	72.5	74.8	**76.2**	76.2	75.07
Sub mean	67.20	70.57	73.20	**74.80**	
CD (p≤0.05)	**S= 0.11** **N=0.62** **SxN = 1.01**	S_1 **:**10×10 cm, S_2 **:**10×20 cm, S_3 **:**10×30 cm, S_4**:**10×40cm N_1 : 0, N_2 : 50 kg/ha., N_3 :75 kg/ha, N_4 : 100 kg/ha			

The color diameter was recorded highest in S_3 and N_4 and in treatment combination S_3N_4 (Table-2). This may be due to the reason that upto certain spacing plant growth occurs in *Artemisia absenthium* and after full growth there is no effect of spacing. The species also shows higher growth as fertilizer dosage increases due to the fact that either the soil is deficient in nitrogen or the species requires abundant nitrogen for its growth.

Table 2: Effect of Spacing and Nitrogen fertilizer on collar diameter (mm) of *Artemisia absinthiam*

	N1	N2	N3	N4	Sub Mean
S1	6.2	7.0	7.5	8.8	7.37
S2	7.2	8.5	8.9	9.2	8.45
S3	8.2	8.7	9.6	**10.5**	**9.25**
S4	7.5	7.8	8.5	9.4	8.30
Sub mean	7.27	8.0	8.62	**9.47**	
CD (p≤0.05)	**S= 0.11** **N=0.28** **SxN = 0.41**	S_1 **:**10×10 cm, S_2 **:**10×20 cm, S_3 **:**10×30 cm, S_4**:**10×40cm N_1 : 0, N_2 : 50 kg/ha., N_3 :75 kg/ha, N_4 : 100 kg/ha			

The other growth parameters like No. of branches, Plant fresh weight (g), Plant Dry weight (g), seed weight/plant were also recorded highest in S_3, N_4 treatments and S_3N_4 treatment combination.

(Table-3,4,5,6) due to the reason that *Artemisia absinthium* needs appropriate spacing for its growth and plant spread and high dosages of nitrogen for higher biomass and seed weight. The results are in accordance with the study of Singh, *et al*, 1996 who studied the effect of effect of plant spacing and nitrogen levels on growth, herb and oil yields of Lemongrass (*Cymbopogon flexuosus* (Steud.) Wats. var.Icauvery) at Central Institute of Medicinal and Aromatic plants, Bangalore, India.

Table 3: Effect of Spacing and Nitrogen fertilizer on Number of branches of *Artemisia absinthium*

	N1	N2	N3	N4	Sub-Mean
S1	3.0	5.0	6.0	8.0	5.5
S2	6.0	8.0	9.0	11.0	8.5
S3	8.0	9.0	11.0	**12.0**	**10.0**
S4	7.0	8.0	6.0	9.0	7.5
Sub mean	6.0	7.5	8.0	**10.0**	
CD (p≤0.05)	**S = 0.99**	S_1 :10×10 cm, S_2 :10×20 cm, S_3 :10×30 cm, S_4:10×40cm			
	N= 1.05	N_1 : 0, N_2 : 50 kg/ha., N_3 :75 kg/ha, N_4 : 100 kg/ha			
	SxN = 1.18				

Table 4: Effect of Spacing and Nitrogen fertilizer on Plant Fresh weight (g) of *Artemisia absinthiam*

	N1	N2	N3	N4	Sub-Mean
S1	255.5	304.6	365.0	398.8	330.97
S2	325.8	380.5	427.7	450.0	396.0
S3	390.0	435.9	490.0	**510.5**	**456.60**
S4	290.5	310.8	345.6	340.5	321.85
Sub mean	315.45	357.95	407.07	**424.95**	
CD (p≤0.05)	**S = 8.52**	S_1 :10×10 cm, S_2 :10×20 cm, S_3 :10×30 cm, S_4:10×40cm			
	N = 15.47	N_1 : 0, N_2 : 50 kg/ha., N_3 :75 kg/ha, N_4 : 100 kg/ha			
	SxN = 38.62				

Table 5: Effect of Spacing and Nitrogen fertilizer on Plant dry (g) of *Artemisia absinthiam*

	N1	N2	N3	N4	Sub Mean
S1	65.5	74.8	82.8	90.0	78.27
S2	72.5	76.6	80.5	92.0	80.40
S3	85.0	88.8	95.5	**98.0**	**91.82**
S4	73.5	77.4	82.0	78.5	77.85
Sub mean	74.12	79.40	85.20	**89.62**	
CD (p≤0.05)	**S = 2.34**	S_1 : 10×10 cm, S_2 :10×20 cm, S_3 :10×30 cm, S_4:10×40cm			
	N = 2.91	N_1 : 0, N_2 : 50 kg/ha., N_3 :75 kg/ha, N_4 : 100 kg/ha			
	SxN = 3.09				

Table 6: Effect of Spacing and Nitrogen fertilizer on seed weight per plant (g) of *Artemisia absinthiam*

	N1	N2	N3	N4	Sub Mean
S1	2.5	2.8	3.5	5.8	3.65
S2	3.5	5.2	6.4	7.6	5.67
S3	8.0	9.8	10.5	10.7	**9.75**
S4	7.4	9.2	8.6	7.8	8.25
Sub mean	5.35	6.75	7.25	**7.97**	
CD (p≤0.05)	**S = 0.28**	S_1 : 10×10 cm, S_2 :10×20 cm, S_3 :10×30 cm, S_4:10×40cm			
	N = 0.41	N_1 : 0, N_2 : 50 kg/ha., N_3 :75 kg/ha, N_4 : 100 kg/ha			
	SxN = 0.77				

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The results were also inferred through gg pair plots which are well represented in (Fig. 1 and 2) utilizing gg plot2 library of R Studio. From Fig.1 and Fig.2 it can be seen that their exist good amount of correlation between growth parameters under both the factors.

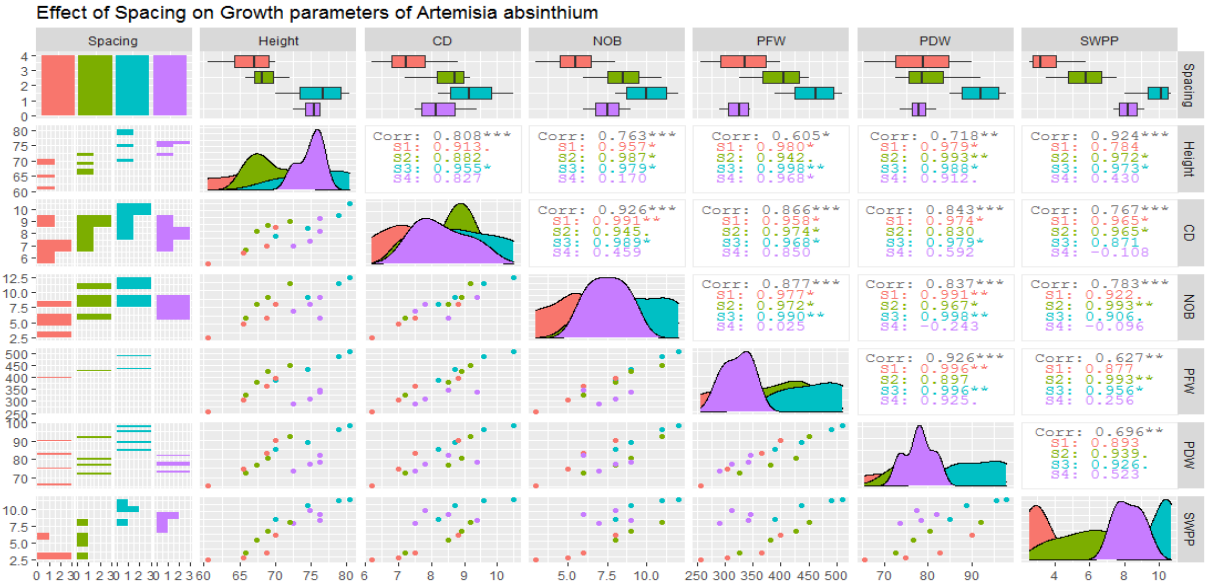


Fig. 1: GG pairs plots of effect of spacing on growth parameters of Artemisa absinthium

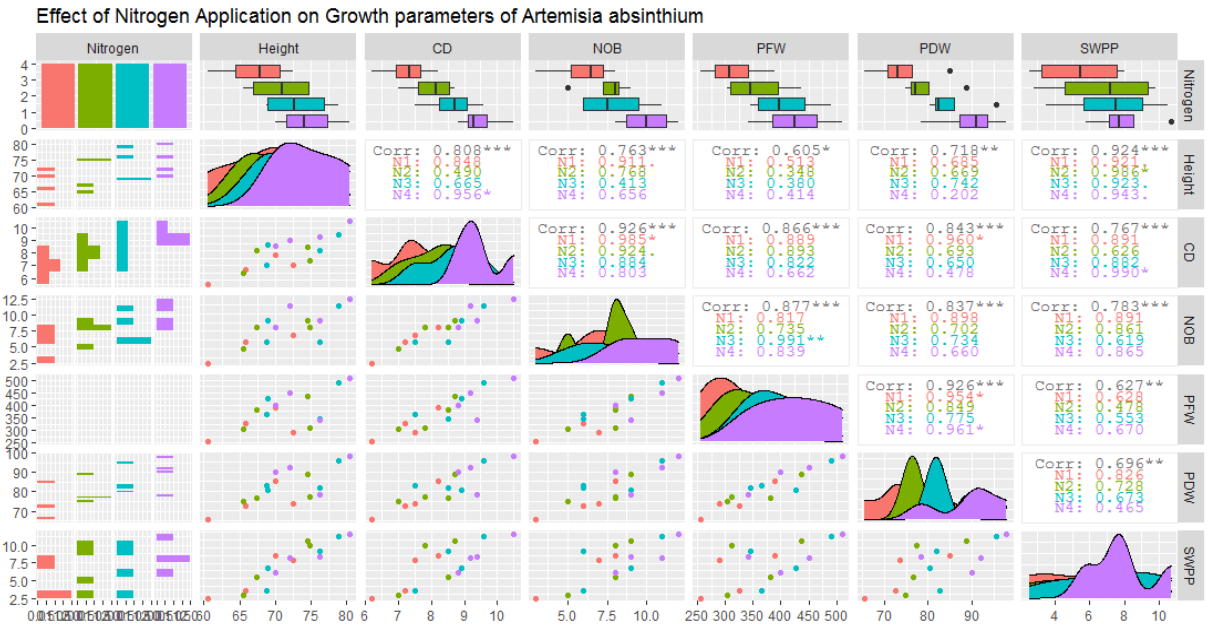


Fig. 2: GG pairs plots of effect of Nitrogen on growth parameters of Artemisa absinthium

CONCLUSION

Artemisia absinthium was cultivated in division of forest products and utilization to standardize its cultivation techniques under different spacing's and nitrogen dosages. Total four spacing's and four nitrogen treatments were analyzed to determine the best treatment combinations for better growth of the species under temperate conditions. It was concluded that the species can be cultivated as cash crop under temperate conditions of Kashmir valley subjected to 10×30 cm spacing and 100 kg of nitrogen per hectare.

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