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Vegetative propagation of Guggul [*Commiphora wightii* (Arn.) Bhan.]: A commercially important and threatened medicinal plant species

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ABSTRACT

Vegetative propagation of *Commiphora wightii* through semi-hardwood branch cuttings was undertaken in the experimental nursery of College of Forestry, Navsari Agricultural University, Navsari. Total five treatments of different concentration of IBA (control, 500, 1000, 1500, 2000 ppm) in three repetitions were undertaken with completely randomised design. Maximum establishment of 90 per cent with significantly superior number of leaves (7.2) and branches (3.64) along with the maximum length of shoot, length of root and number of roots (91.26 cm, 21.93 cm and 8.16, respectively) were recorded in semi-hardwood branch cuttings of *C. wightii* treated with IBA@1000 ppm as compared to other treatments. Moreover, cuttings treated with 1000 ppm IBA exhibited increase in length of shoot, number of leaves per plant, number of branches, length of root and number of roots per plant of 86.97%, 188%, 30.94%, 74.32% and 226.4%, respectively as compared to the control. Thus, *C. wightii* can be propagated by using its semi-hardwood cuttings treated with 1000 ppm IBA for production of quality planting materials.

Key words: Branch cuttings, *Commiphora wightii*, guggul, IBA, vegetative propagation

INTRODUCTION

Commiphora wightii belongs to family Burseraceae is one of the slow growing medicinal plant species. It is commonly known as Guggul in Hindi and Indian myrrh or Indian bdellium in English. Four species of the genus *Commiphora viz. C. wightii*, *C. agallocha*, *C. caudata and C. stocksiana* were reported from India (Patel et al., 2013 and Bishoyi et al., 2018). Out of these four species, *Commiphora wightii* is highly valued for its medicinally important guggul gum resin. It is a perennial, highly branched, thorny and woody shrub. It thrives well in arid, semiarid and rocky regions with scanty rainfall. The plant is normally with a long dormant phase having deciduous with dimorphic in nature (Dalal and Patel, 1995). *C. wightii* is distributed naturally in pockets of Rajasthan, Gujarat, Maharashtra and Karnataka, Madhya Pradesh in India and adjoining countries of Sind, Baluchistan and Afghanistan (Atal et al., 1975; Lal and Kasera, 2010). In India, Rajasthan and Gujarat have been identified as the main commercial centres (Mertia et al., 2010).

The plant has enormous economic value and a broad range of medicinal uses in both ancient and modern therapeutics. The plant yields medicinally important natural gum resin and has wide ethnobotanical usage (Singh and Pandey, 2006). Further, guggul gum is known to be hypolipidemic, hypocholestrolemic and antiobesity, astringent and antiseptic, antiarthritic, antimicrobial, antiinflammatory and anticancerous (Tripathi et al., 1968; Kasera et al. 2002; Urizar and Moore, 2003; Ishnava et al., 2010). The gum is also used in perfumery, calico- printing, fumigation, dyeing silk and cotton and as incense (Reddy et al., 2012).

Moreover, over a hundred metabolites of various chemical compositions were reported from the leaves, stem, latex, root and fruit samples. High concentrations of quinic acid and myo-inositol were found in fruits and leaves. *C. wightii* has been a key component in ancient Indian Ayurvedic system of medicine. The extract of gum guggul, called gugulipid, guggulipid, or guglipid, has been used in Unani and Ayurvedic medicine, for nearly 3,000 years in India (Mohan et al., 2019).

C. wightii has been included in IUCN Red data list whereas UNDP has listed this species as "Critically Endangered" (UNDP, 2008). The Govt. of India has banned the export of this species. Presently this species is under threat in its entire range of distribution in Rajasthan and Gujarat (Reddy et al., 2012). Several reasons such as low global and regional distribution, decline in population, narrow extent of occurrence, poor seed setting with meagre seed germination rate, over exploitation, are responsible for the plant being listed as endangered species (Mertia et al., 2010; Reddy et al., 2012). As there is inadequate replenish in their natural habitat, for the in situ as well as ex situ conservation of highly medicinally important plant, there is an immense need for multiplication and large scale commercial plantation (Diwakar et al., 2011).

The major constraint in cultivation and domestication of *C. wightii* is lack of availability of quality planting material due to delayed germination. In scientific observations, it was noticed that propagation of *C. wightii* through seeds is a not viable method due to its slow and erratic germination. Hence, there is need for alternative method to generate quality planting materials. Vegetative propagation through stem cutting is most common and successful method (Kumar et al., 2006; Thosar and Yande 2009; Hamayoun and Zahiryan, 2019). For the successful of propagation through stem cuttings, auxins play a vital role in coordination of plant growth and behavioural processes in the life cycle. While treatment of auxins given to the cuttings, mostly enter through the cut surface. Role of some auxins like IAA, IBA and NAA has been examined for their stimulatory effects on adventitious root formation in stem cuttings as well as on subsequent growth and survival of cuttings. It induces shoot apical dominance as the axillary buds are inhibited by auxin. When the apex of the plant is removed, the inhibitory effect is eliminated and the growth of lateral buds is enhanced (Kenney et al., 1969; Pop and Pamfil, 2011; Gehlot et al., 2014; Sure et al., 2018).

Since Guggul is placed in endangered category with immense medicinal values and, the recent trial was carried out with the objective to develop a suitable propagation technique for large scale production of quality planting material of *C. wightii* under South Gujarat conditions.

MATERIALS AND METHODS

The experiment was conducted at nursery of College of Forestry, Navsari Agricultural University, Navsari (Gujarat) during the year 2020. The healthy propagation material of semi hardwood branch cuttings for the experiment was collected from the Centre for Agroforestry, Forage crops and Greenbelt, Sardarkrushinagar Dantiwada Agricultural University Sardarkrushinagar, Dantiwada. Semi-hardwood portion of the branches of vigorously growing and disease pest free plant were selected for collection of propagation material. The stem cutting size of 8-10 mm diameter and 15 cm length were prepared by giving a slant cut at the base. The basal portion of the cuttings was dipped for 10 minutes in freshly prepared different concentrations of IBA solution as rooting hormone. Immediately after treatment with growth hormone IBA, cuttings were planted in the poly bags of size 6 × 8 inch which were properly filled with potting media comprising of soil+sand+FYM in the ratio of 2:1:1.

The cuttings were placed in open nursery and watered regularly. The experiment was laid out in completely randomized design with three repetitions having 20 cuttings in each repetition. Data were recorded daily for sprouting up to 30 days after planting and plants shoot developed from these sprouting containing branches and leaves were considered as establishment which were further considered for growth parameters observation. The

shoot parameters like shoot length (cm), number of branches per plant, number of leaves per plant and root parameters of root length (cm) and number of roots were recorded at 180 days after planting. The experimental data recorded on various parameters were statistically analysed as per the method suggested by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Influence of different concentrations of IBA on growth parameters of guggul branch cuttings are presented in (Table 1). From the perusal of data, it was observed that, different concentrations of IBA had a significant effect on growth parameters of guggul. Data indicated that branch cutting treated with 1000 ppm of IBA observed higher percentage of establishment (90.00%) and was at par with IBA 1500 ppm (83.33 %), whereas the minimum establishment percentage (56.66%) was recorded in cuttings treated with 500 ppm. Further, early sprouting initiation was observed in IBA @ 1500 ppm at 18 days which was at par with 2000 ppm and 1000 ppm at 18.33 and 21 days, respectively. Other parameters such as length of shoot, number of leaves per plant and number of branches per plant were recorded the highest in IBA @1000 ppm. The maximum length of shoot (91.26 cm), the highest number of leaves (7.20) and branches (3.64) were observed in cuttings treated with IBA @1000 ppm, whereas the minimum length of shoot (48.81 cm) and the minimum number of leaves (2.50) were recorded in control. The minimum number of branches (2.33) was recorded in cuttings treated with IBA @ 2000 ppm. These findings may be due to effect of growth hormone auxins, which would have triggered the activity of specific enzymes that promoted early sprouting. Early sprouting of cuttings will make the cuttings less dependent on stored food (Sen and Bose, 1967; Sure et al., 2018). Similar inference was made by Mishra and Kumar (2014) in guggul *Commiphora wightii* and Shwetha (2005) in *Bursera* spp.. Tripathi et al. (2014) reported length of root was higher and increased in IBA treatment, compared to similar concentration of IAA in C. *wightii*.

Table 1. Impact of different concentrations of IBA on survival and growth parameters of *Commiphora wightii* stem cuttings

Treatments		Establishment percentage (%)	Sprouting initiation (days)	Length of shoot (cm)	Number of leaves per plant	Number of branches per plant
T_1	Control	73.33	24.00	48.81	2.50	2.78
T_2	500 ppm	56.67	22.66	53.02	2.83	3.16
T_3	1000 ppm	90.00	21.00	91.26	7.20	3.64
T_4	1500 ppm	83.33	18.00	85.23	6.44	2.93
T_5	2000 ppm	73.33	18.33	78.93	4.67	2.33
Mean		75.33	20.80	72.07	4.66	2.93
SEm (±)		2.98	1.22	1.49	0.18	0.14
C D at 5%		9.51	3.92	4.75	0.59	0.46
C V %		6.85	10.23	3.61	6.77	8.40

Significant differences were noted in length of root and number of roots (Table 2). The highest length of root was recorded in 1000 ppm of IBA (21.93 cm) and found at par with 1500 ppm of IBA (19.91 cm) whereas the shortest length of root was recorded in control (12.58 cm). Further, the maximum number of roots (8.16) was recorded in IBA 1000 ppm and minimum was in control (2.50). The formation of adventitious roots is a high energy requiring process, which involves cell division, in which predetermined cells switch from their morphogenetic path to act as mother cells for the root primordial, hence need more reserve food material for root initiation (Aeschabacher et al., 1994; Sure et al., 2018).

Table 2. Impact of different concentrations of IBA on root parameters of stem cuttings of *Commiphora wightii*

Treatments		Length of root (cm)	Number of roots per plant
T_1	Control	12.58	2.50
T_2	500 ppm	16.35	4.16
T_3	1000 ppm	21.93	8.16
T_4	1500 ppm	19.91	6.00
T_5	2000 ppm	18.78	4.50
	Mean	17.84	5.06
	SEm (±)	0.65	0.20
	C D at 5%	2.09	0.65
	C V %	6.33	7.04

Fig. 1. Mother plants of Guggul

Fig. 2. Collection of branch cuttings

Fig. 3. Semi hardwood branch cuttings of Guggul

Fig. 4. Treated semi hardwood cuttings of Guggul

Fig. 5. Established plants from cuttings of Guggul

Fig. 6. Seedling of 1000 ppm IBA

Fig. 7. Uprooted seedling of Guggul

Fig. 8. View of seedlings developed from cuttings treated with different concentration of IBA

Further, different portion of a single branch vary in their rooting and sprouting response depending on the seasonal, physiological conditions and age factor, thus their response will differ under same environmental conditions. The increase in number of roots in the cuttings treated with IBA @ 1000 ppm can be attributed to the action of auxin activity which might have caused hydrolysis and translocation of carbohydrate and nitrogenous substances at the base of cuttings and resulted in accelerated cell elongation and cell division in suitable environment (Singh et al., 2003; Sure et al., 2018). Similar inference was made by Mishra and Kumar (2014) in Guggul and Shwetha (2005) in Bursera. Tripathi et al. (2014) reported length of root was higher and increased in IBA treatment as compared to similar concentration of IAA in *C. wightii*.

CONCLUSION

The experiment revealed that semi-hardwood branch cuttings of *Commiphora wightii* could be rooted at 500 to 2000 ppm concentration of IBA and had a significant effect on the growth and development parameters. IBA at 1000 ppm had strong beneficial effect than other different concentrations of IBA under open condition which influenced on growth and survival of cuttings of guggul. Therefore, *C. wightii* can be propagated by semi-hardwood branch cuttings at 1000 ppm IBA for production of planting materials. In fact, this technique is highly useful for multiplication of clones of this species.

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