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The Ecoscan 8(3&4): 241-244, 2014
AN INTERNATIONAL BIANNUAL JOURNAL OF ENVIRONMENTAL SCIENCES

TEMPORAL GROWTH PERFORMANCE OF INDIAN MYRRH (*COMMIPHORA WIGHTII)* RAISED BY SEEDLINGS AND CUTTINGS FROM SAME GENETIC STOCKS IN THE EXTREMELY ARID THAR DESERT OF INDIA

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ABSTRACT

Growth trends in plants raised from seeds and those from stem cuttings of *Commiphora wightii* were compared for four years (2008-2011) and it was observed that the plants raised from seeds grew consistently better than those raised from cuttings. In the fourth year, primary branch diameter, main stem diameter and sturdiness in the seed raised plant increased by 43.4, 33.7 and 18.4 %, respectively with respect to stem cutting raised plants. However, number of primary branches in plants grown from either of the source showed non-significant difference. Since plant raised from seeds are superior compared to those raised through stem cuttings, this can be a viable alternative in conservation of germplasm of this threatened species as well as early attainment of stem thickness suitable for tapping its oleo-gum resin.

KEY WORDS
Commiphora wightii
Propagule
Seedling
Cutting.

Received : 10.04.2014
Revised : 22.07.2014
Accepted : 06.10.2014

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INTRODUCTION

Commiphora wightii (Arn.) Bhandari, a well-known herbal popularly known as guggal belongs to family Burseraceae. It is a tall shrub that has a thick main stem with crooked knotty branches. Oleo-gum resin in its exudates commonly known as guggal or Indian myrrh or Indian bdellium is used in the Allopathic, Ayurvedic and Unani systems of medicines due to its anti-inflammatory, antirheumatic, hypocholesteremic, hypolipidemic and antifertility activities (Satyawati, 1991; Tajuddin *et al.,* 1997). Recent studies have shown that the plant of *Commiphora wightii* possesses anti-cancer activity (Singh *et al.,* 2007; Xiao and Singh, 2008). Of late, *Commiphora wightii* has become endangered because of its poor seed setting, poor seed germination in nature, slow growing habit and excessive and unscientific tapping for its gum resin by the pharmaceutical industries and traditional healers (Kumar and Shankar, 1982; Bhatt *et al.,* 1989; Rao *et al.,* 1983; Mertia, *et al.,* 2010; Sinha *et al.,* 2012). This plant is incorporated in Data Deficient category of IUCN's Red Data list. The plant is prevailing to arid, rocky tract of Rajasthan and Gujarat in India and adjacent part of Pakistan. However, in this species a sharp decline has been observed in its natural population. Augmenting its depleting native populations requires a protocol for its speedy multiplication and large scale plantation. Raising it through vegetative propagation of stem cuttings is a common practice though sporadic reports on seed germination do exist (Yadav *et al.,* 1999). There is, however, little information on growth performance of guggal plants raised from seeds and its comparison with those from stem cuttings. This study was therefore, conducted with the objective to evaluate the comparative growth performance of plants raised from seeds and stem cuttings, so as to assess the potential of seeds as propagation material without harming the natural stand on one hand and making available large number of quality seedlings for its reboisement on the other hand.

MATERIALS AND METHODS

Pinkish red fruits of *C. wightii* which are multi seeded drupe or 'Pyrene', were collected from its 'Dantiwara' provenance at the clonal seed orchards at Regional Research Station of CAZRI, Jaisalmer (26°55'N, 70°57'E and 224 m above sea level) in June, 2007. Immediately after collection, fruits were pulped by hand rubbing in fresh tap water contained in a bucket. Thereafter, seeds were dried in shade for a few days. Of the dried seeds, floating lighter seeds in water were discarded and heavier seeds were collected for sowing. Simultaneously, stem cuttings, each with a mean diameter of 9.4 $\pm$ 1.0 mm, having a length of 17 cm

(Mertia and Nagrajan, 2000) were also taken from the branches of the same provenance. The provenance 'Dantiwara' characterized by sub-erect plant growth habit, greenish white stem bark colour with knotty and crooked branching type. Seeds and stem cuttings of *Commiphora wightii* were planted on 1 August 2007 in black polybags (20 × 8.5 cm size and 0.012 cm gauge) filled with nursery mixture, which was composed of sand, silt and FYM in the ratio of 2:1:1. One seed was sown in each of the 50 polybags that were placed in a plot. Stem cuttings 50 in number and treated with a fungicide, 0.05 percent Hg_2Cl_2 for 30 seconds was planted one each in a polybag. Both sets of polybags were left under nursery shade of 50% light intensity, and regular nursery practices of watering, weeding etc., were carried out throughout the nursery period.

Transplantation

Later, seedlings and rooted stem cuttings were transplanted at a spacing of 4 m x 6 m in first week of February 2008. The experimental field has sandy skeletal, calcareous soil, typic torripsamments. The soil is deficient in organic carbon (0.08 %), available nitrogen (6.5 kg/ha), phosphorus (215 kg/ha) and in potassium (6.9 kg/ha) with pH of 7.9. The experiment was laid out in completely randomized block design and replicated four times in its natural habitat of rocky and shallow soils.

Data collection and analysis

On each lift date, height and stem collar diameter, were determined in samples of 10 plants of each stock type. Height was determined from the stalk collar to the base of the terminal bud. The stalk collar diameter was determined at a position to ground line from the plants and the main stem diameter was determined at the position of first branching.

After transplantation, observations were recorded on their survival, number of primary branches, stalk collar diameter, main stem diameter, primary branch diameter and crown spread at yearly interval while plant height at half yearly intervals up to 36 months and then followed to yearly intervals for four consecutive years (2008-2011) in the month of August and February. Data were analyzed to work out standard deviation and subjected to T Test. Comparative growth performance of plants raised from seeds and stem cuttings over a period of four years was also examined.

RESULTS AND DISCUSSION

Survival in seed raised and stem cutting raised plant after the four years was 86.4 and 68.6%, respectively. The higher growth was recorded in seed raised plants compared to those raised from stem cuttings in all the four consecutive years viz., 2008 to 2011. On an average, height of plants raised from seeds (128.0 cm) after four years was 51.4% higher than those from stem cuttings (84.5 cm) and this difference was statistically significant. The difference in height of plants raised from seed and those from stem cuttings was 3.7 cm in the first year, finally increased to 43.5 cm in the fourth year. The growth in height of the seedlings recorded an increase of 7.6 and 51.4% over those raised vegetatively (Table 1). Half yearly height

Table 1: Differences in growth response between cuttings and seedlings of *Commiphora wightii*

Parameter	First year		Second year		Third year		Fourth year	
	Cutting	Seedling	Cutting	Seedling	Cutting	Seedling	Cutting	Seedling
Height (cm)	48.5SD:12.34	52.2SD:11.82	60.8SD:9.56	70.3SD:8.75	72.4SD:12.44	105.2SD:17.22	84.5SD:12.22	128.0 [a]SD:15.24
Number of primary Branches	3.5SD:1.23	3.8SD:1.27	3.9SD:1.35	4.2SD:1.42	4.6SD:3.51	5.0SD:4.65	5.8SD:3.81	8.4SD:7.11
Primary branch diameter (mm)	6.9SD:3.51	8.3SD:4.47	8.6SD:5.25	10.8SD:7.80	9.2SD:6.84	12.8SD:9.22	10.6SD:6.43	15.2 [a]SD:8.53
Main stem diameter (mm)	5.8SD:1.16	6.3SD:1.48	9.5SD:2.15	11.2SD:2.86	11.6SD:3.04	20.5SD:5.61	17.5SD:8.25	23.4 [a]SD:9.54
Stalk collar diameter(mm)	13.4SD:1.46	17SD:2.15	14.2SD:2.57	18.8SD:3.42	17.3SD:2.88	41.7SD:5.52	22.2SD:3.63	52.2 [a]SD:7.12
Crown diameter (cm)	47SD:11.44	80.5SD:20.12	50SD:13.46	83.4SD:15.71	52SD:14.82	195SD:50.14	57.8SD:18.53	256.0 [a]SD:42.22
Sturdiness (stem diameter/height)	1.19SD:0.12	1.20SD:0.14	1.56SD:0.24	1.59SD:0.26	1.60SD:0.24	1.94SD:0.41	2.07SD:0.61	2.45 [a]SD:0.84

[a] Significantly different from the corresponding observation as per T- Test ($p < 0.05$), SD - Standard deviation

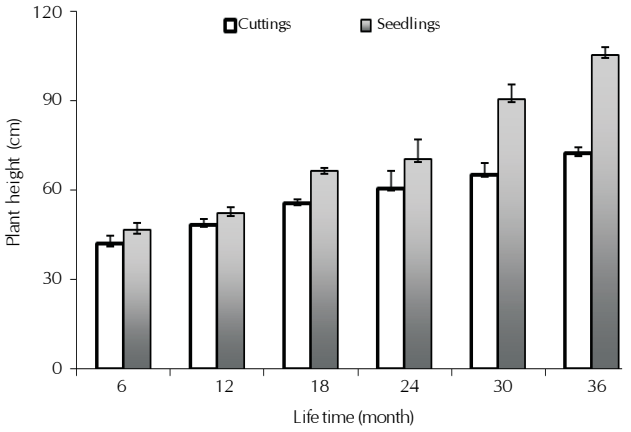

Figure 1: Temporal variation in plant height (cm) of *Commiphora wightii* propagated by cuttings and seedlings

gain distinctly varied in both the group of plants (Fig. 1). Monthly height increment was significantly higher in plants raised from seeds than stem cuttings. Growth in height was strongly seasonal. Height growth in 6th (10.18%) and 18th (18.99%) months (August) showed higher gains in both types of plants than in the 12th (7.62%) and 24th (15.62%) months (February), indicating that major height growth in guggal at its early stages occurs between February to August. This is due to the fact that rains in July to August bring a spurt in leafing in the guggal plants resulting in good foliage (Mertia *et al.,* 2010; Sinha *et al.,* 2012) and that enables it to support higher growth of plants during this period. Because of the same reason, diameter of the primary branch in plants raised from seeds was 43% more than those from stem cuttings, the difference being statistically significant. Throughout the experimental period, the numbers of primary branches were also found higher in the plants raised from seeds than those from cuttings but their differences were found non-significant.

The diameter of the main stem was also found significantly higher in all the four consecutive years (2008-11) in the plants raised from seeds (Table 1). It is pertinent to note that main stem diameter in vegetatively grown plants remained less throughout, compared to those grown from seeds. Similarly, stalk collar diameter at the end of fourth year was highest in plants raised from seeds though the range of percent increase was low in first and second year. Thicker collars of saplings facilitates higher survival and imparts better growth potential than those having thinner stem as seen in Douglasfir plants (Ritchie *et al.*, 1992). Girth sizes (stem thickness) also affect the gum yielding capacities of the plant as reported in *Boswellia serrata* and *Sterculia urens* (Mishra *et. al.,* 2012). More vigor in stem collar would make long term establishment of the guggal plants successful in a high wind regime prevalent in arid zone that may damage its canopy (Mertia *et al.*, 2010). Crown spread showed significant differences (Table 1). The maximum canopy spread was recorded in plants raised through seeds than stem cutting. The increase in the crown spread during the first year was higher in comparison to second year (71.2% and 66.8%) but at the end of fourth year the plant showed vigorous crown spread in seed raised plants (256 cm) in comparison to those from stem cuttings (57.8 cm).

Sturdiness, the ratio of main stem diameter to height, varied significantly among stock types; the seed raised plants being sturdier than those from stem cuttings. The value of sturdiness in the first, second, third and fourth year was 9, 7, 12 and 18% higher in seed raised than the cutting raised plants (Table 1). Higher sturdiness in seed raised plants showed better performance over those raised from stem cuttings in the prevailing harsh situation of the Thar desert. The results of the present study are also supported by the several authors such as; Kieinschmit (1978), Arnold (1990) and McGranahan *et al.,* (1999) in *Pinus radiata*, Stelzeret *et al.*, (1998) and Frampton *et al.* (2000) in *Pinus taeda*, Hu *et al.*, (1999) in *Cunninghamia lanceolata*, Warrier and Ganesan (2010) in *Casuarina equisetifolia*.

Present study therefore, proves the superiority in the growth performance of plants raised through seeds when compared to those raised from stem cuttings in *Commiphora wightii*. Better performance in seed raised plants in the present study might be due to the superiority of provenance 'Dantiwara' as it had a very good vigour due to which it was selected for growing in Jaisalmer in the year 2001. Superior guggal provenance has equal chances to produce seeds that may result in either superior or inferior plants. But guggal is predominantly apomictic (Gupta *et al.,* 1996), bypassing the requirement of fertilization and resulting in seeds that seem to carry superior growing character of mother plants to its offspring. This finding thus opens up a new vista of multiplying this threatened species through seeds on one hand and maintaining desirable growth attributes of mother stock on the other. As such poor coppicing in guggal also limits availability of stem cutting in large number at shorter intervals for vegetative propagation, which is a common way to multiply it.

Superior performance of seed raised plants over cutting raised plants in *Commiphora wightii* in first four years has a bearing on time to attain maturity (= stem thickness); this duration is reduced to get oleo-gum resin early, making it economically, a more viable option. It is therefore concluded that in order to have success in guggal plantation programme, its mother plant with a good vigor and fecundity (Zobel and Talbert, 1984) in seed orchards need to be identified as future source of seeds to raise healthy seedlings and quality planting material.

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