VEGETATIVE PROPAGATION OF *ULMUS LAEVIGATA* BY STEM CUTTINGS

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KANWAR, B. S., BHARDWAJ, S.D., & SHAMET, G.S. 1996. Vegetative propagation of *Ulmus laevigata* by stem cuttings. Cuttings taken from one-year-old branches of 25-year-old trees were tested under nursery conditions to evaluate the effect of auxin, season and cutting portion on the rooting potential of *Ulmus laevigata*. Maximum rooting (63.3%) was recorded when cuttings prepared from basal portions were treated with 1.5% IBA formulation during winter (February). In the rainy season best rooting was achieved when cuttings from basal portions were treated with 0.5 % NAA + 1.0 % IBA. In rooting characteristics (except mean root length), basal portions in winter and the rainy season were quite effective in enhancing the root quality.

Key words: *Ulmus laevigata* - stem cuttings - rooting potential - auxin - season - portion - root quality

KANWAR, B. S., BHARDWAJ, S.D., & SHAMET, G.S. 1996. Pembiakan tampang *Ulmus laevigata* melalui keratan batang. Keratan-keratan diambil daripada ranting berumur setahun daripada pokok berumur 25 tahun telah diuji di bawah kondisi tapak semaian untuk menilai kesan auksin, cuaca dan bahagian keratan ke atas potensi pengakaran *Ulmus laevigata*. Pengakaran maksimum (63.3%) telah direkodkan bila keratan pangkal dirawat dengan 1.5% perumusan IBA pada musim sejuk (Februari). Pada musim hujan pengakaran terbaik telah dicapai apabila keratan di pangkal dirawat dengan 0.5% NAA + 1.0% IBA. Di dalam ciri-ciri pengakaran (kecuali kepanjangan akar min), bahagian pangkal di musim sejuk dan musim hujan agak berkesan di dalam menambah kualiti pengakaran.

Introduction

Ulmus laevigata is an important species sought after under the National Social Forestry and Van Lagao Roji Kamao Programmes in valley and mid-hill regions of Himachal Pradesh, India. The species finds favour with the rural people on account of its multiple uses and fast growth habit. Large scale nursery production is, however, hampered by irregular and infrequent seeding and low seed viability under natural conditions. In fact no formal attempt has been made to standardise the nursery technique of the species. Therefore, to avoid the problem of seedling production, other means of propagation have been explored. It is well known that propagation through cuttings is simple, cheap and rapid compared to other conventional vegetative methods. Studies were undertaken to standardise nursery technique of the species by the use of auxins, different cuttings portions and propagation seasons through stem cuttings.

Material and methods

Collection and preparation of cuttings

Stem cuttings were made from one-year-old branches of *Ulmus laevigata* trees (ca. 25-y-old) growing in Dadour Forest, Sundernagar (Mandi District) on 17 Jan and 5 July for winter and rainy season plantings respectively. The disease- and pest-free shoots were divided into two portions (apical and basal parts) before planting them in the departmental nursery of Dr. YS Parmar University of Horticulture and Forestry, Nauni, Solan located in the mid-hills of North India (30° 51 N', 76° 11'E, 1000 m a.s.l. The area represents a sub-tropical climate with binodal pattern of monsoon rains. Out of the average annual rainfall of 1000 mm, 70% is received during the monsoon season (July - August). The mean daily temperature varies from a maximum of 34 °C in June to a minimum of 2 °C in January. The experiment was a randomized block design with three replications and 13 treatments. Each treatment comprised twenty cuttings.

Preparation of rooting powder

The rooting powder was each prepared by dissolving a calculated amount of auxin (IBA, NAA and combinations) in a small quantity of absolute alcohol in a beaker. A known amount of previously weighed activated charcoal was then added to it. This was accompanied by constant stirring and additions of small amount of absolute alcohol until a homogenous slurry was formed. The alcohol was evaporated by keeping the beaker overnight covered with a piece of muslin cloth. The powder was then stored in a blackened plastic jar for subsequent treatment of cuttings.

The basal ends of cuttings were dipped into the containers and excess powder was removed by gentle taping against the jar. The cuttings were planted in open nursery beds with the help of a dibler at 10 × 15 cm spacing. The planted cuttings were regularly weeded and irrigated as and when required. Plants were protected against diseases and pests during the rooting period by spraying with 0. 2% Bavistin every fortnight and by drenching the soil with 0.2 % aldrin at the end of May. Rooting (%), mean root number and root length (cm) were measured after 18 weeks and the data were subjected to angular (rooting percentage) and square root transformations for statistical analysis.

Results and discussion

Effect of auxins

The data with respect to rooting behaviour during the winter and rainy seasons are presented in Tables 1 and 2 respectively. Table 1 shows that mean rooting was

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Source of auxins: IAA (indole acetic acid), IBA (indole butyric acid) and NAA (naphthalene acetic acid) from LOBA Chemie Pvt. Ltd., Bombay, India.

highest (63.3%) when basal cuttings were treated with 1.5 % IBA formulation during winter. The results are, however, on a par with NAA 0.5% + IBA 1% which resulted in 53.5 % success. However, in the rainy season (Table 2), NAA 0.5% + IBA 1.0% treated based cuttings registered maximum mean rooting (50%) which was statistically similar to the NAA 0.5% + IBA 0.75 % and IBA 1.5% treatments. A number of workers have reported that exogenous application of auxins trigger adventitious root formation in stem cuttings (Nanda & Anand, 1970, Nanda 1975, Puri & Shamet 1988). It was evident from the present studies that IBA alone was superior during winter but in the rainy season IBA-NAA combinations were required to enhance rootability of the cuttings. The findings are in agreement with those of Purkayastha and Kumar (1973) who reported that IBA in combination with other auxins induced rooting in *Albizia lucida* due to the synergistic action of the combination. It was also evident that the beneficial effect of IBA increased with the increase in concentration up to a certain optimum level. The results confirm the findings of Chauhan and Reddy (1974), Pathak *et al.* (1975) and Hartmann and Kester (1986) who pointed out that supraoptimal concentrations have retarding effect on rooting characteristics.

Table 1. Effects of different auxin formulations and cutting portion on rooting behaviour of *Ulmus laevigata* cuttings during winter

Treatment	% rooting		No. of roots/cutting		Root length(cm)	
	Apical	Basal	Apical	Basal	Apical	Basal
Control	0.0(0.9)	20.0(26.1)	0.0(0.7)	1.7(1.4)	0.0	18.2
IBA 0.5%	10.0(18.4)	23.3(28.8)	2.3(1.7)	2.7(1.8)	16.9	24.4
IBA 1.0%	16.7(23.9)	43.3(41.2)	4.7(2.3)	3.7(2.0)	36.6	27.2
IBA 1.5%	30.0(33.2)	63.3(52.8)	6.0(2.5)	3.7(2.2)	23.6	63.4
IBA 2.0%	16.7(23.9)	13.3(21.1)	3.3(2.2)	2.0(1.6)	18.5	13.5
NAA 0.5%	10.0(18.4)	16.7(23.4)	1.0(1.2)	2.3(1.7)	7.7	26.7
NAA 1.0%	6.7(12.6)	30.0(33.2)	1.7(1.4)	2.3(1.7)	7.2	26.7
NAA 1.5%	13.3(26.6)	36.7(37.2)	2.7(1.7)	3.7(2.0)	16.9	20.7
NAA 2.0%	16.7(23.9)	13.3(21.1)	3.3(2.0)	3.0(1.9)	13.3	42.2
NAA 0.5% + IBA 0.25%	20.0(26.1)	33.3(34.9)	2.3(1.7)	2.7(1.8)	8.7	29.9
NAA 0.5% + IBA 0.5%	13.3(23.9)	26.7(30.3)	3.3(1.9)	4.7(2.1)	21.7	38.4
NAA 0.5% + IBA 0.75%	23.3(28.8)	46.7(45.0)	3.7(2.0)	5.3(2.3)	16.2	44.1
NAA 0.5% + IBA 1.0%	23.3(28.1)	53.5(46.9)	4.3(2.2)	2.7(1.8)	25.5	18.0
Mean	15.4(22.2)	32.3(34.8)	3.0(1.8)	3.0(1.9)	16.4	30.3

	Percentage rooting		No of roots/cutting		Root length (cm)	
	SED	LSD(0.05)	SED	LSD(0.05)	SED	LSD(0.05)
Auxin	3.7	7.3	0.1	0.3	7.0	14.0
Cutting portion	1.4	2.9	0.1	ns	2.7	5.5
Auxin x cutting portion	5.2	10.3	0.2	0.2	9.9	19.7

Figures in parentheses are the transformed values.

Table 2. Effects of different auxin formulations and cutting portion on rooting behaviour of *Ulmus laevigata* cuttings during the rainy season

Treatment	% rooting		No. of roots/cutting		Root length(cm)	
	Apical	Basal	Apical	Basal	Apical	Basal
Control	0.0(0.9)	0.0(0.9)	0.0(0.7)	0.0(0.7)	0.0	0.0
IBA 0.5%	13.3(21.1)	0.0(0.9)	2.3(1.7)	0.0(0.7)	7.2	0.0
IBA 1.0%	26.7(31.8)	20.0(26.9)	3.7(1.8)	2.3(1.7)	18.4	22.3
IBA 1.5%	43.3(41.2)	23.3(35.0)	5.0(2.3)	5.3(2.4)	24.5	15.5
IBA 2.0%	20.0(26.1)	26.7(31.0)	3.3(2.0)	4.3(2.2)	12.7	11.8
NAA 0.5%	10.0(15.5)	6.3(9.5)	1.3(1.3)	1.0(1.0)	8.9	6.1
NAA 1.0%	16.7(23.4)	0.0(0.9)	2.7(1.8)	0.0(0.7)	15.6	0.0
NAA 1.5%	16.7(23.9)	6.7(9.5)	2.7(1.7)	1.3(1.2)	10.7	5.7
NAA 2.0%	6.7(12.6)	3.3(6.8)	1.8(1.2)	3.0(1.3)	3.3	6.7
NAA 0.5% + IBA 0.25%	26.7(30.3)	30.0(33.0)	1.3(1.3)	3.3(1.9)	10.3	13.8
NAA 0.5% + IBA 0.5%	26.7(28.1)	23.2(28.8)	2.0(1.6)	3.7(2.0)	10.7	20.6
NAA 0.5% + IBA 0.75%	40.0(29.2)	40.7(39.2)	3.7(2.0)	5.3(2.3)	21.1	19.3
NAA 0.5% + IBA 1.0%	43.3(21.2)	50.0(45.0)	3.7(2.0)	3.3(1.9)	26.5	14.9
Mean	22.3(23.4)	17.7(20.5)	2.5(1.7)	2.5(1.7)	13.1	10.5

	Percentage rooting		No. of roots/cutting		Root length (cm)	
	SED	LSD(0.05)	SED	LSD(0.05)	SED	LSD(0.05)
Auxin	4.3	8.7	0.2	0.4	2.8	0.1
Cutting portion	1.7	3.4	0.1	ns	1.8	2.2
Auxin x cutting portion	6.1	12.2	0.3	0.6	3.7	7.9

Figures in parentheses are the transformed values.

Root number and root length were also significantly affected by different rooting formulations. IBA alone or in combination with NAA proved to be more efficacious. IBA 1.5% treatment registered a maximum mean root length of 63.4 cm in winter. This was on a par with NAA 0.5% + IBA 0.75% treatment which recorded 44.1 cm mean root length. However, in the rainy season, application of NAA 0.5% + IBA 1% formulation gave a maximum value of 26.5 cm. A more or less similar trend was observed in the development of roots where IBA 1.5% and NAA 0.5% + IBA 0.75% produced high values of 6.0 (apical) and 5.3 (basal) in winter, and 5.3 (basal) in the rainy season. Weaver (1972) has reported that NAA is more toxic than IBA and responsible for poor root development in cuttings. Since IBA translocates poorly, it is retained at the site of application and is persistent and therefore, more effective in root promotion and development.

Effect of cutting portion

It was evident from the studies that during winter rooting was enchanced when cuttings were prepared from the basal portions. Rooting was significantly higher (32.3%) compared to the apical portions (15.4%). However, in the rainy season, the cuttings prepared from apical portions (22.3%) had a slight edge over those from the basal portions (17.7%). Thus no conclusion regarding the effect of a particular type on rooting can be made. The variation in rooting potential of two types seems to be due to physiological nature of cuttings. Nanda (1970) opined that rooting ability of cuttings depends on the endogenous level of growth regulating substances and exogenous application of auxins, which may therefore be promotive, ineffective or even inhibitory for rooting. High rooting in the basal portions during winter may be attributed to favourable climate, higher levels of endogenous auxins and other root promoting substances. During late winter as soon as the temperature rises (from mid-January onwards), the reserve carbobydrates are mobilized and used in root initiation and development process. A more or less similar trend was observed in the production of root and their lengths. The basal portions of winter planted cuttings had longer roots (30.3 cm) than the apical portions (16.4 cm). In the rainy season, however, the reverse was the case, i.e. apical portions produced longer roots (3.1 cm) than the basal portions (10.5 cm). Mean root number was also higher in the basal portions during winter (3.0) than in the rainy season (2.5).

Season plays an important role in rooting and rooting characteristics of cuttings (Nanda *et al.* 1968, Nanda & Kochhar 1985, Pal 1989). The effect is clearly visible in the present study as cuttings rooted better in winter than in the rainy season. The variation in seasonal rooting response may be attributed to the physiological nature of the cuttings. A number of workers have shown that rooting is facilitated when the endogenous level of auxins and carbobydrate food reserves are in abundance (Hartmann & Kester 1986). The root system as evidenced by its length, number and symmetry was better in winter. The failure of cuttings to produce a good root system in the rainy season may be due to a higher rate of metabolism, low enzymic activity (Nanda 1970, Haissig 1974) and above all, increased inhibitor to promoter ratio (Blake & Bentley 1985).

Conclusion

Ulmus laevigata can be propagated through stem cuttings, preferably in winter. Maximum rooting (63.3 %) was recorded when cuttings prepared from basal portions were treated with 1.5% IBA formulation during winter. The technique can be used for large scale multiplication of superior clones for planting in seed orchards or directly in the field.

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