Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(5): 2190-2193
Received: 14-07-2017
Accepted: 15-08-2017

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Performance evaluation of different growth regulators on propagation of Chinese juniper (*Juniperus chinensis* Var. *pyramidalis*) in subtropical zone

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Abstract
The present investigation was carried out to study the effect of different growth regulators on propagation of Chinese juniper (*Juniperus chinensis* Var.Pyramidalis) in subtropical zone of West Bengal under natural ventilated polyhouse at Mondari farm of Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal, during 2014-15 and 2015-16. All parameters were significantly varied among the treatments during investigation (IAA @1000ppm, IAA@2000ppm, IAA @3000ppm, IBA @1000ppm, IBA @2000ppm, IBA @3000ppm, NAA @1000ppm, NAA @2000ppm, NAA @3000ppm and Control). After studying of two consecutive years, it has been found that tip cutting of this plant treated with NAA (2000-300ppm) followed by IBA at 3000 ppm in the month of July is found better for propagation towards of its multiplication in subtropical zone.

Keywards: *Juniperus chinensis* Var. Pyramidalis, Propagation, Growth regulators, Sub-tropical zone.

Introduction
Chinese juniper (*Juniperus chinensis* Var. Pyramidalis) is a very important ornamental attractive foliage tree, natives of China growing wide range of climate all over the world belongs to family Cupressaceae. It is densely growing as prickly small tree or large shrub reaching 3-5meter height with formal growth, tapering upwards to a fine point reported by Bose *et al* (2008) [1]. This plant is used for garden decoration around green lawn or in a rockery or besides garden paths at a centain distance to develop a symmetrical pyramidical structure. This plant closely planting can make a good hedge or a wall. This plant is well responded in topiary work and potted plant for home gardening is also used. Now it is also used in indoor decoration for short duration during occasion of various graceful ceremonies. There is other benefit of the Utah juniper has potential for use in water-conserving landscapes reported by Cope and Rupp (2013) [2-5]. However, there is a tremendous demand of this plant due to rapid urbanization in township area in the state of West Bengal, when it graceful foliage appeared very attractive during round the year, besides these advantages, this plant is too much hardy and easy to maintenance for gardening. It is commonly propagated by seed, but it is unable to set seed in our situation. So, multiplication is a problem faced by the different nursery growers. However, rapid multiplication of this plant is a problem and wastage of propagating material very often takes place due to sparse rooting and unavailability of a suitable combination of varieties of growth regulator in the sub-tropical environment. Randhawa and Mukhapadhaya (2000) [6] said that best method of propagation of *Juniperus chinensis* is cutting or layering.

Materials and Methods
The experiment was carried out under naturally ventilated poly house at Horticultural Research Farm, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, West Bengal. The cuttings were taken from healthy mother plant, which is maintained scientifically in the university germplasm collection centre under AICRP-Floriculture of BCKV. Newly growing shoots (tip portion of branches) up to 4-5 inches were taken two times in a year on first day of June and July. After cutting, the cut ends were treated with 0.2% Copper oxy-chloride for 15 minutes followed by treatment with different growth regulator solutions. A cutting bed was prepared with sterilized coarse sand containing up to a depth of 6 inches. Then cut end of cuttings were placed inside sand bed up to a depth of one inch. During investigation micro-environment of the cuttings bed had temperature range of around 25-32ºC, light intensity 1500-1750 foot candle and humidity 85-90%. Every day misting with water was provided through forgers in the evening hours.

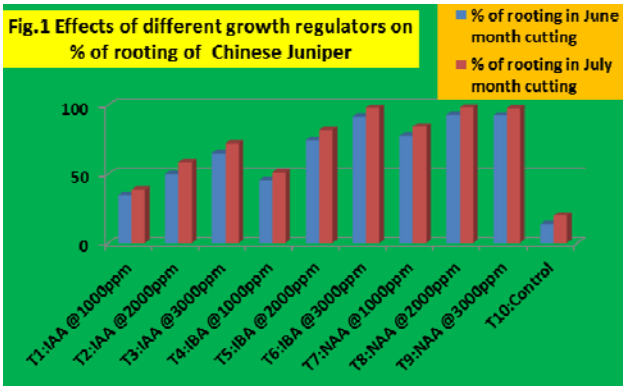
Rooted cuttings were planted in the earthen pots (growing media content with soil and cowdung manure in the ratio of 3:1). The experiment was laid out in Randomized Block Design with ten treatments replicated thrice and the statistical analysis of the data was carried out following Fisher's Analysis of Variance Technique as described by Gomez and Gomez (1984) [3]. The treatments comprised of different concentrations of IAA (1000 ppm, 2000 ppm and 3000 ppm), IBA (1000 ppm, 2000 ppm and 3000 ppm) and NAA (1000 ppm, 2000 ppm and 3000 ppm) and without treatment (control). Observation was recorded up to three and half months (90 days for rooting and 15 days for plant survivability in earthen pots) with the parameters of percentage of rooting, number of roots per cutting, root length, days required for root initiation and percentage of plant survivability in pots.

Results and discussion

The effect of different growth regulators at various concentrations were significant among the treatments for percentage of rooting, number of roots per cutting, root length, days required for root initiation and plant survivability in pots as reflected in Table1 and 2.

Table 1: Effects of different growth regulators on rooting behaviour of *Juniperus chinensis* Var. Pyramidalis

Treatments	% of root appeared		No. Of roots/cutting		Root length(cm)	
	Cutting taken on 1st day of June	Cutting taken on 1st day of July	Cutting taken on 1st day of June	Cutting taken on 1st day of July	Cutting taken on 1st day of June	Cutting taken on 1st day of July
IAA @1000ppm	34.67	38.67	3.00	3.67	5.33	8.33
IAA @2000ppm	50.00	58.67	4.33	5.33	9.00	14.00
IAA @3000ppm	65.00	72.33	7.00	8.33	7.67	11.67
IBA @1000ppm	45.67	51.33	8.67	9.33	7.33	10.33
IBA @2000ppm	74.67	82.00	8.33	9.33	10.67	12.33
IBA @3000ppm	91.67	98.00	11.67	14.33	13.00	15.00
NAA @1000ppm	78.00	84.67	8.67	10.33	8.00	10.00
NAA @2000ppm	93.33	98.33	13.33	16.00	13.33	16.67
NAA @3000ppm	92.67	97.67	10.67	12.00	8.67	12.00
Control	13.67	20.00	2.33	3.33	3.00	4.00
SE (±)	1.88	1.79	0.48	0.51	0.62	0.57
CD at 5%	5.59	5.32	1.43	1.51	1.83	1.7
CV (%)	5.1	4.42	10.7	9.56	12.44	8.66

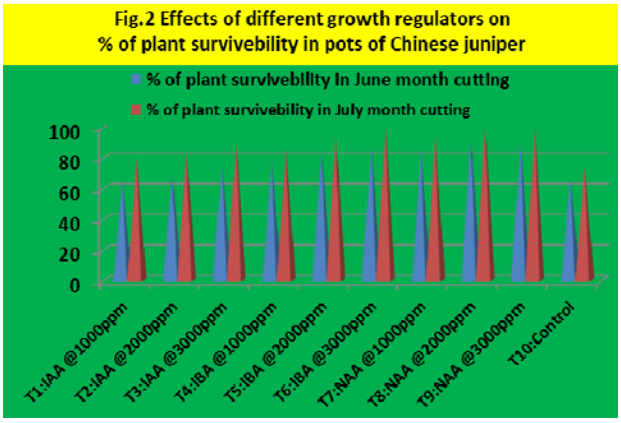


There is also variability of success rate in terms of above cited parameters, when cuttings were taken from June to July month each year. After three months of observation, it had been found that the highest percentage (fig.1) of rooting in cutting bed was obtained with NAA @ 2000ppm (98.33% and 93.33% in June and July month respectively) followed by IBA @ 3000ppm(98% and 91.67%) and NAA @3000ppm (97.67% and 92.67%),whereas, very low percentage of rooting was found in Control (13.67% and 20%). Number of roots per plant is an important factor for plant survivability in earthen pots. Here, IBA (June and July, 11.67 and 14.33) and NAA (June and July, 10.67 and 12.0) at higher concentration (3000ppm) were brought maximum number of roots per cutting and very few number of roots was observed in Control (2.33 and 3.33) in comparison to others treatments. The magnitude of root production in terms of root length of cuttings was found to have same trend with above mentioned growth regulators (IBA of 3000ppm and NAA at 2000ppm) markedly influence to promote maximum root length up to 13.0 -13.33cm in June and 15-16.67cm in July and very stunted growth was noticed in Control (1.0 and 1.07cm). Overall July month cutting is better than June month cutting in all most all the growth regulators.

Table 2: Effects of different growth regulators on days required for rooting and plant survivability in pots of *Juniperus chinensis* Var. Pyramidalis cuttings.

Treatments	Days required for root initiation		% of plant survivability in pots	
	Cutting taken on 1st day of June	Cutting taken on 1st day of July	Cutting taken on 1st day of June	Cutting taken on 1st day of July
IAA @1000ppm	70.00	60.00	65.00	80.00
IAA @2000ppm	66.33	54.67	68.00	84.00
IAA @3000ppm	55.00	46.67	75.00	90.00
IBA @1000ppm	51.33	42.00	78.00	86.00
IBA @2000ppm	48.00	40.00	82.00	94.00
IBA @3000ppm	48.00	36.33	88.00	100.00
NAA @1000ppm	42.33	36.33	85.00	94.33

NAA @2000ppm	38.33	33.33	92.00	100.00
NAA @3000ppm	36.67	30.00	89.67	100.00
Control	79.33	72.33	67.67	74.33
SE (±)	1.24	1.37	1.27	1.55
CD at 5%	3.69	4.06	3.77	4.59
CV (%)	4.02	5.24	12.78	2.97



The earliest emergence of root was noticed (in both the months) at NAA @3000ppm (36.67 and 30.0 days respectively) which was followed by NAA @ 2000ppm (38.33 and 33.33 days), whereas most delayed root development process was noticed in Control (79.33 and 72.33 days). Plant survivability of newly rooted cuttings in pots (rooted cuttings were transferred in the earthen pots) also differed significantly among the treatment. Highest plant survivability of 100 % (July month cutting) was recorded with NAA (2000 and 3000ppm) and IBA @3000ppm (fig.2) and very poor response in this aspect was noticed in control (74.33) in comparision to others treatments. Here, also July month cutting is dominated to June month cutting in all growth regulators.

From above results in Chinese Juniper cuttings, with increase of IAA and IBA doses from 1000 to 3000 ppm proportionately increased percentage of rooting, number of roots per cutting and root length in both months of cutting, but in case of NAA positive response was found with increase of growth regulators concentration from 1000 to 2000 ppm in all most all the cases and higher dose found negative response. John *et al* (1996) [4] reported that Rocky Mountain Juniper cuttings with1.6 or 3.0/h indole-3-butyric acid (IBA) accelerated rooting by several months and increased overall rooting success by up to 36%, whereas Kevin and Larry (2013) [5] observed that Utah juniper (*Juniperus osteosperma* Torr.) was vegetatively propagated using tip cuttings from juvenile plants and rooting was most successful (69%) when cuttings were treated with indole butyric acid (IBA) in talc (0.8% ai), struck in 2:1 perlite: peat (v:v) rooting substrate, provided bottom heat, and kept on a mist bench covered by a white polyethylene tent in a greenhouse environment with supplemental lighting. When NAA doses increase simultaneously to effectively reduce the days required for rooting and others growth regulators of higher concentrations were also to bring earliness of rooting. Plant survivability in earthen pots containing 3 parts soil and one part cowdung manure of newly rooted cutting, it was observed that with higher concentration from 2000 to 3000ppm of NAA and IBA of highest dose (3000ppm) markedly influence in plant survivability up to 34.53% more than control.

Conclusion

However, the above results it may be concluded that all growth regulators have positive response on all parameters studied related to propagation of *Juniperus chinensis* Var. Pyramidalis. The most remarkable findings were noted that tip cutting of this plant with NAA @ 2000 to 3000ppm is the best followed by IBA @ 2000ppm for rapid multiplication of this plant in sub-tropical zone of West Bengal during rainy season.

Photographs showing the effect of growth regulators on propagation of *Juniperus chinensis* Var. Pyramidalis in subtropical zone

Fig 3: Effect of different IAA concentration on rooting of *Juniperus chinensis* Var. Pyramidalis

Fig 4: Effect of different IBA concentration on rooting of *Juniperus chinensis* Var. Pyramidalis

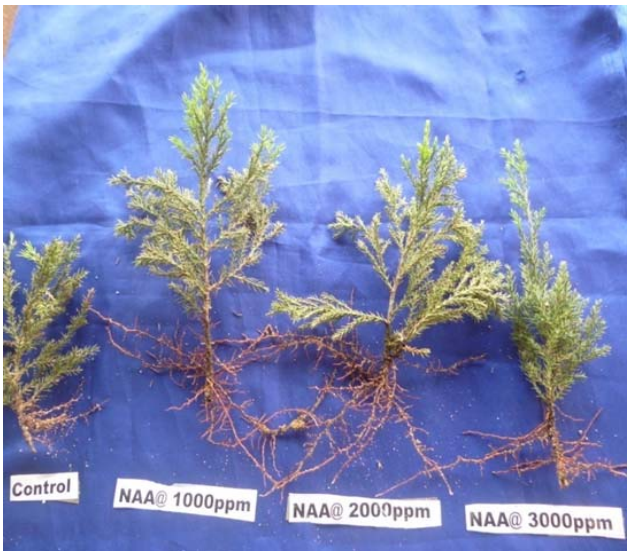


Fig 5: Effect of different NAA concentration on rooting of *Juniperus chinensis* Var.Pyramidalis

Fig 6: Effect of different concentrations of growth regulators on rooting of firebush

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