

Influence of propagules and growth regulators on the performance of underutilized spice - Spiny coriander (*Eryngium foetidum* L.)

A Samad*, B Singh & P R Gajurel

North Eastern Regional Institute of Science and Technology (Deemed to be University),
Nirjuli -791 109, Arunachal Pradesh, India.

*E-mail:asamad969@gmail.com

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Abstract

An experiment was conducted to study the effect of propagules of spiny coriander (*Eryngium foetidum* L.) as influenced by growth regulators in the Forestry Nursery of North Eastern Regional Institute of Science and Technology during 2018 and 2019. Spiny coriander is an underutilized culinary spice; a medicinal and aromatic plant that belongs to the family Apiaceae. The study consisted of 14 treatments involving two levels of propagules like stem cuttings (S_1) and suckers (S_2) and seven levels of growth regulators namely Indole Butyric Acid (IBA) and Indole-3 Acetic Acid (IAA) [each at 0, 500, 1000 and 1500 ppm]. The results indicated that the treatment T_9 involving sucker (S_2 + IBA 500 ppm) was found better in terms of growth and it was comparable with T_{12} (S_2 + IAA 500 ppm) during both years. Suckers treated with IBA 500 ppm and IAA 500 ppm showed significantly superior performance over the stem cuttings. It is concluded that suckers (7-10 cm) of *Eryngium foetidum* may be used as propagating material for commercial cultivation, as it is an easy, quick and economical method of propagation.

Keywords: growth regulator, stem cutting, sucker

Spiny coriander (*Eryngium foetidum* L.) is a culinary spice, aromatic and medicinal leafy, underutilized herbal species that belongs to the family Apiaceae. It is known by various common and local names in different languages such as Spiny coriander, Culantro, Bandhonia, Mandhonia (Assamese), Bangladhonia, Bilatidhonia (Bengali) (Singh *et al.* 2014). It is widely used as spice and condiment for its unique pungent, aroma and essential oil. Mainly used for garnishing, flavouring and seasoning

curries, chutneys, sauces, salads and many other dishes. The leaf is also a good source of several nutrients including minerals, vitamins, carotenoids, antioxidants and phytosterols (Ramcharan 1999; Paul *et al.* 2011; Singh *et al.* 2013). The aroma gives a characteristic flavour to the dishes and the requirement of this crop is rapidly increasing (Mozumdar *et al.* 2016).

E. foetidum is usually propagated by seeds, sucker and offshoots, but low germination

rate, higher price and scarcity of seeds seems a limiting factor for expanding its cultivation of it (Mozumdar *et al.* 2012). The easiest and most successful method of multiplication of *E. foetidum* is through the vegetative propagation method. Hence, the present experiment was undertaken to study the performance of two propagating materials *viz.*, stem cuttings and suckers of *E. foetidum* as influenced by growth regulators, so that large scale production of planting materials using low-cost vegetative propagation techniques can be done towards remunerative commercial cultivation of the culinary herb.

The experiment was conducted at the Forestry Nursery of North Eastern Regional Institute of Science and Technology, Nirjuli, Arunachal Pradesh (27°7'38" N Latitude and 93°44'19" E Longitude at an Altitude of 112 m from MSL) from September to December 2018 and 2019. The soil texture of the experimental plot was sandy, well-drained with pH 5.9 and organic carbon 0.07%. The initial nutrient status of soil was 0.07% N, 0.25% P and 0.36% K. Well rotten farm yard manure at the rate of 5 kg bed⁻¹ was mixed thoroughly at the time of final nursery bed preparation. The average monthly maximum temperature range was 32° C (September) to 26.9° C (December), whereas the minimum monthly mean temperature ranged from 23.9° C (September) to 12° C (December) during the experiment period. The highest monthly mean rainfall was recorded from 470.7 mm (September) to the lowest 18.8 mm (December), the relative humidity ranged from 86% (September) to 73.8% (December) during the experimental period.

The experiment was laid out in factorial Randomized Block Design (RBD) with three replications consisting of 14 treatments involving two Factors; Factor A: Propagules - Stem cuttings (S_1) and Suckers (S_2), Factor B: Growth regulators namely Indole Butyric Acid (IBA) and Indole-3 Acetic Acid (IAA) - seven levels. The treatment combinations are: $T_1=S_1$ + Distilled water (control), $T_2=S_1$ + IBA 500 ppm, $T_3=S_1$ + IBA 1000 ppm, $T_4=S_1$ + IBA 1500 ppm, $T_5=S_1$ + IAA 500 ppm, $T_6=S_1$ + IAA 1000

ppm, $T_7=S_1$ + IAA 1500 ppm, $T_8=S_2$ + Distilled water (control), $T_9=S_2$ + IBA 500 ppm, $T_{10}=S_2$ + IBA 1000 ppm, $T_{11}=S_2$ + IBA 1500 ppm, $T_{12}=S_2$ + IAA 500 ppm, $T_{13}=S_2$ + IAA 1000 ppm and $T_{14}=S_2$ +IAA 1500 ppm.

Propagating materials of *E. foetidum* were collected from the Nonpu and Lekha villages of Papum Pare district in Arunachal Pradesh. Propagating materials *viz.*, Stem cuttings of 7 - 10 cm length (S_1) and Suckers of 7-10 cm height (S_2) were properly prepared. The basal portions of the propagating materials were properly treated with growth regulators by the quick dip method as per the methodology of Rekha (2008) with suitable modification. Total 672 number of treated propagules were planted on 9th October in properly prepared 42 nursery beds of 1 m x 1 m size with 16 propagules per bed and plants were harvested on 24th December during both years. Watering was done twice a week throughout the experimental period. Observations were recorded periodically on various shoot and root parameters and data obtained from the experiments were statistically analysed by Fisher's method of Analysis of Variance (ANOVA) (Gomez & Gomez 1984).

The results revealed that propagules and growth regulators influenced the shooting and rooting significantly. The minimum days taken to first sprout was 15.50 days after planting (DAP) in T_9 followed by T_2 (15.67 DAP), while the maximum time of 19.83 DAP was observed in T_1 . It was observed that stem cuttings took more days for the first sprouting. This might be because auxins induce stimulus for regeneration of roots and the suckers performed better than stem cuttings. The maximum number of sprouts per plant was recorded in T_5 (1.95) at par with T_2 (1.83), against the minimum number of sprouts recorded in T_{11} , T_{13} , followed by T_1 (Table 1). This might be due to the presence of more nodes on stem cuttings and physiological activities influenced by the growth regulators in cuttings. The maximum length of the sprouted shoot was observed in T_9 (8.45 cm), which are at par with T_{12} (7.84 cm), while the minimum shoot length of 3.01 cm found in T_1 (Table 1).

The maximum number of leaves per cutting recorded in T_9 (6.00) followed by T_{12} (5.39) and the minimum number of leaves 3.45 found in T_1 (Table 1). This might be due to the initiation of the maximum number of roots in suckers which help in better nutrition and water absorption resulting in a greater number of leaves in T_9 and T_{12} as compared to T_1 and T_8 . The highest fresh weight of shoot per plant found in T_9 (4.98 g plant⁻¹), which is at par with T_{12} (4.86 g plant⁻¹), while the lowest fresh weight of shoot per plant was observed in T_1 (0.83 g plant⁻¹), coupled with a similar trend of the dry weight of shoots plant⁻¹ (Table 1). This might be due to the production of more shoot length and leaves which results in better biomass production in T_9 and T_{12} as compared to T_1 and T_8 . It might be presumed that suckers might have got sufficient food materials as influenced by hormones for induction of root and shoot as compared to stem cuttings. Similar findings were also reported by Kaur and Kaur (2017), Siddiqua *et al.* (2018) and Kakade *et al.* (2019). The vigour of the propagules was assessed in terms of number of sprouts plant⁻¹, length of the sprouted shoot (cm), number of leaves plant⁻¹, number of roots plant⁻¹, length of roots (cm) and biomass produced. The biomass productivity of the planting materials under different treatments was assessed in terms of the fresh and dry weight of shoots and roots (g plant⁻¹).

Significant effects were also observed among different treatments for root parameters. The maximum number of roots per plant was observed in T_9 (17.00), followed by T_{12} (16.17) and T_{11} (16.00), while the lowest number of roots per plant was recorded in T_1 (5.50) (Table 2). This might be due to the influence of growth regulators in metabolic activities that help in the initiation of more roots in T_9 and T_{12} as compared to T_1 . It is well known that hormones regulate different aspects of plant growth and development including cell division, cell elongation and differentiation. Similar findings were also reported by Patel *et al.* (2017). The longest root was recorded in T_9 (14.07 cm), which is followed by T_{10} (12.33 cm), while the minimum length was observed

in T_1 (5.67 cm) (Table 2). It might be due to fact that the application of growth regulators might enhance the formation of callus and differentiation of vascular tissue resulting in elongation of roots in T_9 and better performance in suckers as compared to stem cuttings of *E. foetidum*. Maximum fresh weight of roots per plant was recorded in T_9 (2.48 g plant⁻¹) which is at par with T_{12} (2.38 g plant⁻¹) and T_{11} (2.36 g plant⁻¹), while the minimum fresh weight of roots per plant was recorded in T_1 (0.27 g plant⁻¹), coupled with a similar trend in dry weight of roots per plant (Table 2). This might be due to the formation of a greater number of root biomass along with an increased length of roots in T_9 and T_{12} as compared to T_1 . Similar results were also reported by Kaur and Kaur (2017), Siddiqua *et al.* (2018), Kakade *et al.* (2019).

The percentage of rooting was significantly highest in T_9 (91.17%), followed by T_{12} (88.75%), while the lowest rooting percentage was recorded in T_1 (37.09%) (Table 2). The rooting percentage was observed significantly higher under the treatments of sucker than the stem cuttings. This might be because a lower concentration of IBA 500 ppm and IAA 500 ppm leads to better root formation in suckers than stem cuttings of *E. foetidum*. A similar result was also observed by Grewal *et al.* (2005) in chrysanthemum. The highest survival percentage of 88.96% recorded in T_9 , which was at par with T_{12} (87.09%), followed by T_{13} , while the lowest survival percentage was observed in T_1 (34.38%) (Table 2). It was found that stem cuttings of *E. foetidum* survived poorly than the suckers because of a smaller number of roots and leaves produced in stem cuttings. The increase in survival percentage of the suckers with more biomass productivity in T_9 , T_{12} and T_{13} might be due to profuse rooting and shoot production as influenced by the growth regulators in comparison to stem cuttings. The results are in conformity with Pandey *et al.* (2011) in stem cuttings of *Ginkgo biloba*. The poor performance of the stem cuttings might be due to insufficient food materials for the induction of roots and shoots.

Table 1. Effect of propagules as influenced by growth regulators on the performance of shooting parameters of *Eryngium foetidum*.

Treatments	Days taken to first sprout (DAP)	Number of sprouts plant ⁻¹	Length of sprouted shoot (cm)	Number of leaves plant ⁻¹	Fresh weight of shoot (g plant ⁻¹)	Dry weight of shoot (g plant ⁻¹)
Propagules (Factor A)						
S ₁ (Stem cuttings)	17.64	1.45	3.68	4.03	1.68	0.45
S ₂ (Suckers)	16.72	1.08	7.03	4.91	4.01	1.00
CD (0.05)	0.87*	0.13*	0.44*	0.32*	0.22*	0.03*
Growth regulators (Factor B)						
Distilled water (Control)	19.09	1.06	4.40	3.64	1.57	0.36
IBA 500 ppm	15.58	1.49	6.23	5.17	3.60	1.01
IBA 1000 ppm	17.50	1.27	5.23	4.14	2.53	0.59
IBA 1500 ppm	16.58	1.14	4.89	4.11	2.85	0.72
IAA 500 ppm	16.25	1.54	6.14	5.06	3.62	0.93
IAA 1000 ppm	17.42	1.17	5.54	4.53	3.15	0.79
IAA 1500 ppm	17.84	1.18	5.08	4.62	2.63	0.68
CD (0.05)	1.61*	0.24*	0.83*	0.59*	0.42*	0.06*
Treatments (A × B)						
T ₁ (S ₁ + Control)	19.83	1.10	3.01	3.45	0.83	0.22
T ₂ (S ₁ + IBA 500 ppm)	15.67	1.83	4.00	4.34	2.21	0.64
T ₃ (S ₁ + IBA 1000 ppm)	18.00	1.41	3.64	3.67	0.98	0.27
T ₄ (S ₁ + IBA 1500 ppm)	16.84	1.27	3.39	3.73	1.23	0.26
T ₅ (S ₁ + IAA 500 ppm)	17.00	1.95	4.45	4.73	2.37	0.67
T ₆ (S ₁ + IAA 1000 ppm)	18.00	1.34	3.84	4.22	1.94	0.53
T ₇ (S ₁ + IAA 1500 ppm)	18.17	1.27	3.45	4.06	2.14	0.55
T ₈ (S ₂ + Control)	18.34	1.02	5.79	3.84	2.30	0.50
T ₉ (S ₂ + IBA 500 ppm)	15.50	1.16	8.45	6.00	4.98	1.39
T ₁₀ (S ₂ + IBA 1000 ppm)	17.00	1.13	6.83	4.61	4.07	0.90
T ₁₁ (S ₂ + IBA 1500 ppm)	16.34	1.00	6.39	4.51	4.47	1.17
T ₁₂ (S ₂ + IAA 500 ppm)	15.50	1.12	7.84	5.39	4.86	1.20
T ₁₃ (S ₂ + IAA 1000 ppm)	16.83	1.00	7.25	4.84	4.36	1.05
T ₁₄ (S ₂ + IAA 1500 ppm)	17.50	1.09	6.72	5.17	3.13	0.81
S. Em ±	0.27	0.05	0.30	0.13	0.23	0.06
CD (0.05)	2.28*	0.34*	1.17*	0.84*	0.59*	0.08*

* Significant at P=0.05

Table 2. Effect of propagules as influenced by growth regulators on the performance of rooting parameters and survival percentage of *Eryngium foetidum*.

Treatment	Number of roots plant ⁻¹	Length of longest root (cm)	Rooting percentage (%)	Fresh weight of roots (g plant ⁻¹)	Dry weight of roots (g plant ⁻¹)	Survival percentage (%)
Propagules (Factor A)						
S ₁ (Stem cuttings)	7.14	7.03	45.69	0.37	0.10	44.40
S ₂ (Suckers)	13.93	9.35	82.74	1.93	0.37	80.47
CD (0.05)	0.70*	0.37*	2.72*	0.12*	0.01*	3.16*
Growth regulators (Factor B)						
Distilled water (Control)	7.67	6.00	55.14	0.80	0.16	51.44
IBA 500 ppm	12.75	10.78	72.56	1.45	0.29	70.42
IBA 1000 ppm	10.42	9.50	60.00	1.15	0.24	58.44
IBA 1500 ppm	10.92	7.46	61.46	1.32	0.26	60.72
IAA 500 ppm	12.83	8.89	70.43	1.50	0.30	68.54
IAA 1000 ppm	9.84	7.29	65.01	1.03	0.22	63.54
IAA 1500 ppm	9.34	7.44	64.90	0.82	0.18	63.96
CD (0.05)	1.28*	0.70*	5.09*	0.22*	0.04*	5.90*
Treatments (A x B)						
T ₁ (S ₁ + Control)	5.50	5.67	37.09	0.27	0.07	34.38
T ₂ (S ₁ + IBA 500 ppm)	8.50	7.50	53.96	0.42	0.12	51.88
T ₃ (S ₁ + IBA 1000 ppm)	6.67	6.67	41.05	0.33	0.09	40.00
T ₄ (S ₁ + IBA 1500 ppm)	5.84	7.19	43.13	0.29	0.07	42.71
T ₅ (S ₁ + IAA 500 ppm)	9.50	8.17	52.08	0.61	0.16	50.00
T ₆ (S ₁ + IAA 1000 ppm)	6.17	7.06	45.21	0.30	0.08	44.58
T ₇ (S ₁ + IAA 1500 ppm)	7.84	7.02	47.30	0.40	0.12	47.30
T ₈ (S ₂ + Control)	9.83	6.34	73.21	1.34	0.25	68.50
T ₉ (S ₂ + IBA 500 ppm)	17.00	14.07	91.17	2.48	0.46	88.96
T ₁₀ (S ₂ + IBA 1000 ppm)	14.17	12.33	78.96	1.96	0.39	76.88
T ₁₁ (S ₂ + IBA 1500 ppm)	16.00	7.73	79.79	2.36	0.45	78.75
T ₁₂ (S ₂ + IAA 500 ppm)	16.17	9.60	88.75	2.38	0.44	87.09
T ₁₃ (S ₂ + IAA 1000 ppm)	13.50	7.52	84.80	1.76	0.37	82.50
T ₁₄ (S ₂ + IAA 1500 ppm)	10.83	7.85	82.50	1.24	0.23	80.63
S.Em ±	0.64	0.36	3.08	0.14	0.02	3.04
CD (0.05)	1.82*	0.98*	7.21*	0.32*	0.06*	8.34*

* Significant at P=0.05

It was observed that among the treatments, suckers treated with IBA 500 ppm and IAA 500 ppm showed comparatively better results than stem cuttings for shooting and rooting parameters. Based on the findings of the present experiment, it can be inferred that vegetative method of propagation by suckers of spiny coriander was significantly promising and reliable. From the study, it can be concluded that 7 - 10 cm height suckers treated with IBA 500 ppm or IAA 500 ppm is a successful technique in generating, planting material, as it is an easy, quick and economical method of propagation.

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