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Effect Of Silver Nanoparticles Using Terminalia ArjunaOnRooting Of BoerhaaviaDiffusaL. Stem Cuttings

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Abstract

*Boerhaaviadiffusa*L. is a valuable medicinal plant indigenous to India, commonly called Punarnava**.** The whole plant, especially the roots, is effectively used to cure several diseases. An experiment was carried out to study the effect of the silver nanoparticlesusing *Terminalia arjuna*on the rooting performance of *B. diffusa*and to find an easy and cost-effective method of propagation of this species. The number of roots and root length per cutting from stems were measured. The maximum number of sources and size was observed with a 3 mg/l silver nanoparticle concentration. The growth regulators were beneficial for better growth, and the values in the experimental were significantly superior in control. The present study indicates that AgNPsarea helpful plant growth regulator that can be used in the vegetative propagation of *B. diffusa*.

Keywords:*B. diffusa*, Silver Nanoparticles,*Terminalia arjuna*, Root length, number of roots, Growth regulator

Introduction

*B. diffusa*L. is a herbaceous member of the family Nyctaginaceae. Its English name is spread hogweed, and in Sanskrit,*Punarnava*. It is widely distributed in the tropics and subtropics. *B. diffusa* is a wild perennial herb that may be encountered in terrestrial habitats, ranging from managed grasslands, wastelands and agroecosystems to significant forest gaps. It has a long history of use by several indigenous communities in India (Chopra *et al.*, 1956). It is beneficial in curing several health problems.

The species of *Boerhaavia* have been used for medicinal purposes in different parts of India. The whole plant,mainly the roots,is effectively used to cure several diseases, including Jaundice. The root and aerial parts of *B. diffusa* were used in Ayurveda to treat diabetes. It stimulates the functioning of the heart and kidney and has been found to affect treatingdiabetes, Jaundice, breast cancer resistance and general debility (Ahmed-Belkacem*et al.*, 2007; Pari and Satheesh, 2004; Nalamolu*et al.*, 2004). It is also used in curing epilepsy and abdomen pain due to congestion of blood, seminal weakness and blood pressure (Gaitonde*et al.*, 1974). Pharmaceutical studies have demonstrated that *Boerhaavia*possesses diuretic and anti-inflammatory potential (Bhalla*et al.*, 1968).The most common vegetative methods used in the plantation aregrafting, budding, layering and rooting of stem cuttings. Propagation by stem or branch cuttings is the easiest and cheapest method to multiply plus trees/elite trees to establish clone plantations and orchards and obtain higher genetic gains. Regeneration of cuttings depends on physiological, biochemical and anatomical conditions, which are further influenced by factors like season, age of the mother tree, auxin levels, growing media, moisture level, nutrient status, temperature etc.

Hormones promote rooting and are naturally present within the plants (endogenous);now, nanoparticles can be applied to the plant (exogenous) during vegetative propagation. The rooting in stem cuttings varies according to the genetic potential of trees. Cuttings of some tree species like poplars, mulberry and willows are quite easy to root even without nanoparticles. The root, leaves, aerial parts and the whole plant of *B. diffusa* are used in different parts of India (Meghalaya, Rajasthan, Orissa, Uttar Pradesh, Haryana, Gujarat etc.) as well as worldwide for the treatment of some disorders,e.g. liver complaint, kidney disorders,

rheumatism etc. The plant is bitter, astringent, cooling, anthelmintic, diuretic, aphrodisiac, cardiac stimulant, diaphoretic, emetic, expectorant, anti-inflammatory, febrifuge and laxative, besides being an active ingredient in tonics (Singh et al., 2002; Parveen*et al.*, 2007). It is helpful in all types of inflammation. Half a tablespoon of plant powder taken thrice with water relieves one from menstrual trouble, and its fruit paste and paste of *Piper nigrum* fruits are taken once daily for seven days to cure a cold (Lal and Yadav, 1983). Root decoction is used to treat fever (Bedi, 1978). It is reportedly used to treat internal inflammation, dyspepsia, oedema, Jaundice, cough, hemorrhoids, pulmonary cavitations, anaemia, and enlargement of the spleen, abdominal pain, abdominal pain, abdominal tumours and cancers. It is also an anti-stress agent (Kirtika and Basu, 1956; Dhar*et al.*, 1968).

Materials and Methods

The *Boerhaavia* is the largest genera with 40 species. It belongs to the family Nyctaginaceae, primarily distributed in the world's tropical, subtropical, and temperate regions. In India, this genus represents six species such as *B. diffusa*, *B. chinensis*, *B. erecta*, *B. repens*, *B. rependa*, and *B. rubicunda*. *B. diffusa* is indigenous to India; it is found throughout the warmer parts of the country up to an altitude of 2000 m in the Himalayan region. It is abundant in wastelands and fields after the rainy season (Thakur *et al.*, 1989).

Collection of Sample Specimens

The present study was conducted at the PG and Research Department of Botany, J.J College of Arts and Science, Pudukkottai. The samples were collected from within the Campus after consulting the *Flora of J.J. College Campus* (Palaniappan*et al.*, 2008). The branch cuttings of *B. diffusa* with 12 cm diameter and about 9-10 cm length were collected in December 2021and up to January 2022from the College Campus. The branch cuttings were prepared and surface sterilized with 0.1% Mercuric chloride solution designed in water.

Rooting Medium and filling in poly bag containers

The experiment was conducted from December 2021 to March 2022 to study the effect of the silver nanoparticles on the rooting performance of *B. diffusa*and to find an easy and cost-effective method of propagation of this species. After the surface sterilization,five cuttings were treated with different silver nanoparticles in 100, 200, 300, 400 and 500 ppm concentrations for 24 hours. The control was treated with water only.

Planting of Cuttings in Greenhouse

The Silver nanoparticles powder was dissolved at 1g/l in 50% ethyl alcohol. Then the cuttings were dipped for 24 hours in the rooting. After hormonal treatment, the cuttings were planted horizontally in plastic trays filled with soil, sand and farmyard manure in the ratio of 2:1:1 and shifted to the greenhouse. The cuttings were placed in the greenhouse in the College gardento maintain ambient humidity and temperature that helps in rooting cuttings. At the interval of every 15 days, the samples were uprooted, and observations of rooting of cuttings were recorded. Observations were made on many cuttings rooted and root length.Thenparameters were recorded for 45 days for each treatment.

The cuttings were planted immediately after treatment with nanoparticles in the polythene bags filled with rooting medium. One-third of the length of the cuttings was inserted in the rooting medium. The basal ends of the cuttings were dipped in 0.2% Bavistin solution just before planting to prevent the attack of pathogens. Each treatment had five cuttings. In all 30 (6 treatments (5mgAgNPs+ 1 Control) cuttings of this species were planted.

Sampling for data on rooting

After every 15 days, the cuttings were carefully removed; rooting percentage, number of roots and length (at least one source greater than 0.50 cm in length) were recorded for each treatment. Samples from basal portions were collected on days 0 (before the culture in the mist chamber), 15, 30, and 45 for the study. There were six replications with five cutting samples per concentration.

Parameters of Vegetative Growth Studied

In the present study, the parameters analyzed are the number of roots and rootlength. Thenumber of roots per cutting was measured.A standard 30 cm scale measured the length of the main branches.

Data Analysis

All experiments were set up in a completely randomized design. Data presented in the table are treatments of 5 replicates. Data were analyzed using analysis of variance (ANOVA), and means were compared using Turkey's test at the 0.05 level of significance. The results of the subculture experiment were expressed in terms of mean values±SE and were recorded after every 15 days.

Results and Discussion

The data on various aspects of rooting cuttings of *B. diffusa* L. as influenced by treatments with silver nanoparticles are presentedunder appropriate headings.

Number of roots

The data regarding the number of roots initiated per stem for rooting as influenced by the silver nanoparticles is presented in Table 1.There were significant differences inthe time required for rooting in treatments with different concentrations. The data analysis showed a substantial increase in the number of roots produced at a concentration of 3mg/l of AgNPs compared to other concentrations like 2mg/l, 4mg/l, 5mg/l and 1mg/1, respectively. All the growth regulator treatments showed significantly increased rooting than the control.

Length of Roots

The data regarding the number of roots initiated per stem for rooting as influenced by the growth regulator silver nanoparticles is presented in Table 2.There were significant differences in the length of rooting among treatments with different concentrations ofAgNPs. The size of the roots in the cuttings was substantial. The data analysis showed a significant increase in the length of roots produced at a concentration of 3mg/l of AgNPscompared to other concentrations of 4mg/l, 2mg/l, 1mg/l and 5mg/1, respectively. All the growth regulator treatments gave significant length in rooting than the control group.

Table 1: Effect of different Concentrations of AgNPs on Number of Roots per Stem cutting of *B. diffusa*at 15-day intervals

Treatments AgNPs (mg l^1)	**No. of roots per stem cutting at**		
	15d	**30d**	**45d**
Control	0.75±0.14	1.00±0.03	1.75±0.21
1.0	1.00±0.06	1.50±0.22	2.50±2.88
2.0	1.25±0.02	2.00±0.05	3.50±4.18
3.0	**2.00±0.09**	**3.50±0.09**	**5.25±0.48**
4.0	1.50±0.02	2.25±0.01	3.25±4.18
5.0	0.75±0.04	1.25±0.08	2.75±0.41

Table 2: Effect of different Concentrations of AgNPs on Length of Roots per stem cutting of *B. diffusa*at 15-day intervals

Treatments AgNPs (mg l^1)	**Length of roots (cm.) at**		
	15d	**30d**	**45d**
Control	0.750±0.14	1.000±0.03	1.750±0.21
1.0	0.750±0.23	1.125±0.32	2.375±0.32
2.0	1.250±0.22	1.875±0.05	2.750±0.11
3.0	**1.875±0.42**	**2.250±0.21**	**3.125±0.22**

4.0	1.250±0.02	2.250±0.01	2.750±0.31
5.0	0.75±0.07	1.25±0.18	1.750±0.36

Conclusion

The experiment was conducted to study the effect of the silver nanoparticles on the rooting performance of *B. diffusa*and to find an easy and cost-effective method for the propagation of this species. The groups observed the maximum number of roots and most significant root length in 3mg/l of AgNPs for 24 hours. This study has revealed that AgNPsare a functional plant growth regulator that can be used in the vegetative propagation of *B. diffusa*.

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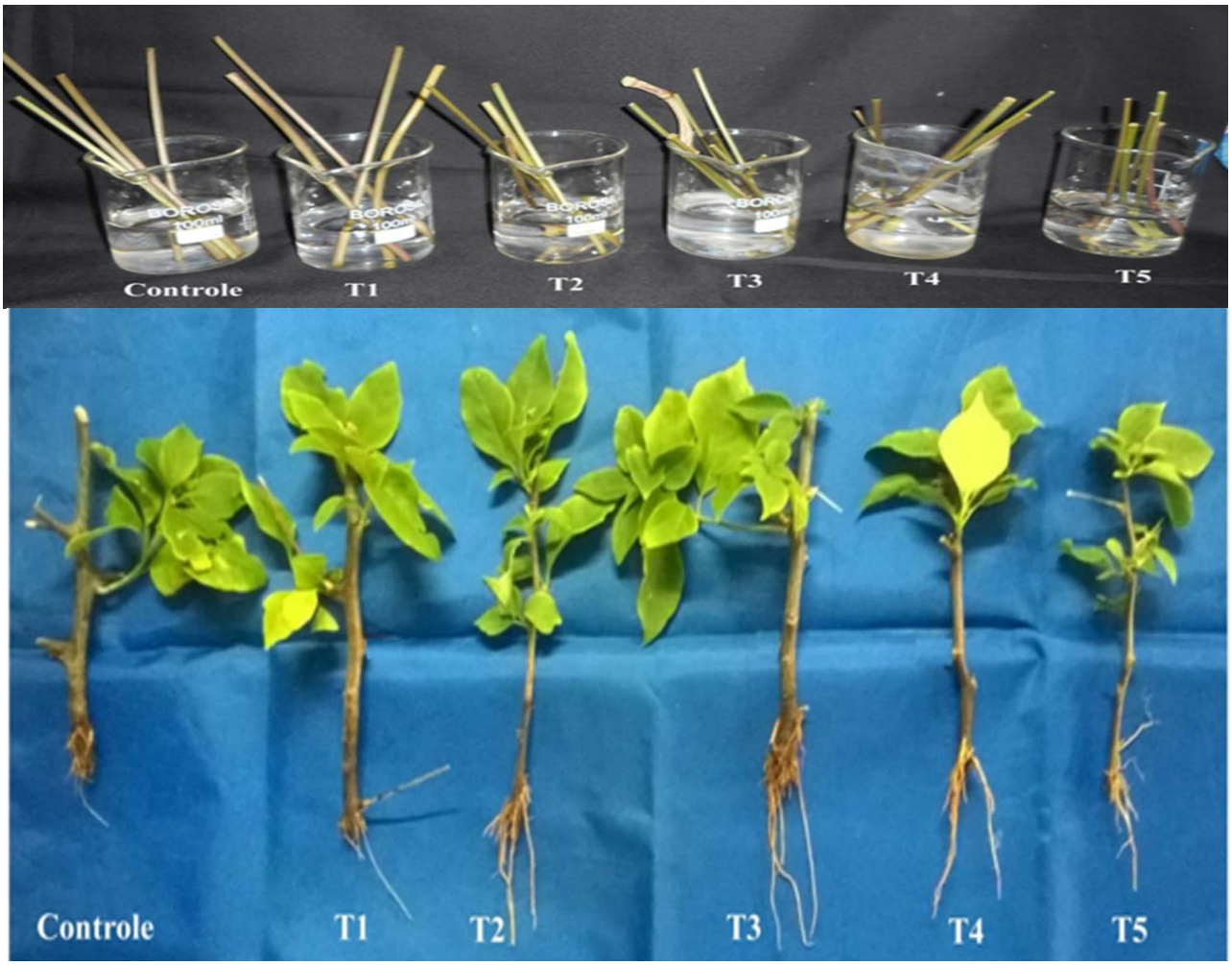

Image No: 1. *B. diffusa* stem cuttings treated with different concentrations of AgNPs