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EFFECTS OF NATURAL AND SYNTHETIC ROOTING SUBSTANCES ON ROOTING AND SHOOTING PERFORMANCE IN DRAGON FRUIT (HYLOCEREUS SP.)

Poudel Sujata*, **Gautam Ishwori Prasad**, **Shrestha Surendra Lal**, **Dhakal Mira**, **Ghimire Dipendra**, **Pandey Suprabha**
Nepal Agricultural Research Council, National Horticulture Research Centre, Khumaltar, Lalitpur, Nepal

Rijal Anuja
Nepal Agricultural Research Council, National Potato Research Program, Khumaltar, Lalitpur, Nepal

Shrestha Jiban
Nepal Agricultural Research Council, National Plant Breeding and Genetics Research Centre, Khumaltar, Lalitpur, Nepal

*E-mail: sujatapoudel40@gmail.com
ORCID: 0000-0002-4003-1333

ABSTRACT
Dragon fruit is an emerging fruit in Nepal. The covered area of this fruit has been expanding during the last few years. Vegetative propagation through stem cutting is the easiest and cheapest method for large-scale propagation to produce genetically identical plants. Synthetic rooting hormones have proven to be effective, but their high cost limits their use. Therefore, more research in vegetative propagation using natural substances is needed. The purpose of this study was to investigate how natural substances and synthetic hormones affect the rooting and vegetative growth of dragon fruit stem cuttings in Khumaltar, Lalitpur. The experiment was developed from September 4, 2020 to January 19, 2021. Three treatments were evaluated in a completely randomized design (CRD) with five replications: i) no hormone application (control), (ii) Aloe vera gel (1 mL cutting^{-1}), and (iii) indole-3-butyric acid (IBA) powder (0.5 g cutting^{-1}). Root and shoot growth were evaluated. The results showed that the aloe vera treatment produced the highest number of shoots (2.2) and roots (9.9), similarly to the IBA treatment. The aloe vera treatment considerably increased shoots (30.35 cm) and roots (25.92 cm) length, coinciding with an increase in root (4.55 g) and shoot (102.6 g) weights compared to the other treatments. However, there were no significant differences in shoot diameter in all the treatments. Finally, natural substances that are locally available, such as Aloe vera gel, could be used as an efficient root promoting substance for dragon fruit cuttings.

KEY WORDS
Dragon fruit, root, shoot, auxin, aloe vera.

Dragon fruit (*Hylocereus* sp.) is a semi epiphytic climbing cactus native to Central America with a triangular green stem. It can be grown in tropical and subtropical climates (Le Bellac et al*.,* 2006). Red skinned and white fleshed (*Hylocereus undatus*), red skinned and red fleshed (*Hylocereus polyrhizus*), and yellow skinned and white fleshed (*Hylocereus megalanthus*) are the three cultivated species of the genus Hylocereus. It is a popular export crop in Thailand and Vietnam, and it's gaining popularity in Nepal as well. The white fleshed dragon fruit was introduced in Nepal from Vietnam. Veterinary Doctor Jagannath Rai brought dragon fruit from the United States through a friend in 2000 (2057 B.S.), which was the earliest record of its introduction. However, in recent years, commercial cultivation of white fleshed dragon fruit has begun in the Kavre district. Red fleshed is becoming increasingly popular these days. There is a huge scope for expansion of dragon fruit cultivation in

different pocket areas of Nepal with dry tropical and subtropical climates (up to 1500 masl) with temperatures of 20-30 ^{o}C and annual rainfall of 500-1500 mm (Aatreya et al., 2020). The dragon fruit is used to treat a variety of diseases and has high economic value (Suryono, 2006). It is used as both a fruit crop and an ornamental plant. Seeds or cuttings are typically used to propagate the fruit. Cuttings, on the other hand, are preferred for commercial planting since they allow for faster growth and harvesting within 2 to 3 years of plant establishment. Although seed propagation is very easy, but seeds are not true to type due to cross pollination (Andrade et al., 2005). For commercial fruit production, propagation through cutting is quite common and faster. The aerial or fibrous roots grow from the base of cuttings, that offer anchoring for the vine cactus (Zee et al., 2004). Some species root easily (without the use of rooting hormone), whereas others do not (Hartmann et al., 2002; Blythe et al., 2004). As a result, before planting, saplings should be dipped in the rooting substance. However, good rooting substances must be easily available, economically attractive and ecologically fit to reduce external inputs as well as improve the quantity and quality of rooting in cutting (Rajan and Singh, 2021). This experiment was conducted to determine the effects of indole-3-butyric acid (IBA) and aloe vera on the establishment of stem cuttings and to determine the best rooting substance option for better growth of cuttings of dragon fruit.

MATERIALS AND METHODS OF RESEARCH

This research was carried out in a polyhouse at the National Horticulture Research Centre in Khumaltar, Lalitpur, Nepal, which is located in a hilly region with a subtropical climate at 85^{o}2'E longitude, 27^{o}4' N latitude and 1275 m above sea level. The experimental soil is clayey loam. In the polyhouse during the experiment, the temperature was maintained at 20 °C to 30 °C which is the temperature range for dragon fruit cultivation.

Experimental details and cultural practices. The experiment had three treatments and five replicates for each treatment in a completely randomized design (CRD). Cuttings were dipped in indole-3-butyric acid (IBA) powder, Aloe vera gel (local Aloe vera), and control. The HRDDRA001 dragon fruit genotype, which was obtained from Cambodia, was replicated at NHRC, Khumaltar, and used as planting material (stem cuttings) for the study. On the first day, five stem cuttings (about 20 cm long) were obtained from each treatment and placed in the shade to dry the wound. The next day, the cuttings' basal parts (excluding control) were dipped in readily available IBA powder and Aloe vera gel and allowed to absorb for 15 seconds. Top soil, sand, and cow dung were mixed thoroughly at a 2:1:1 ratio, with four kilograms of vermicompost and half kilogram of bone meal added as well. Each polythene bag (20 cm long and 11 cm wide) was filled to three-quarters capacity with the soil mixture. The cuttings were soaked before being placed in a soil mixture and kept in a poly house. In the evenings, water was sprayed over the cuttings. After two months of planting, the potted plants were given a top dressing. Irrigation and weeding were done on a weekly basis, or earlier if necessary. At the end of this study, all of the data was recorded on 19th January, 2021.

Data Collection. Cuttings' growth was measured in terms of fresh weight and length, revealing that the rate of growth varied with cutting age. At 105 days after cuttings were planted, the diameter of the stem (averaged from the top, middle, and bottom portions of each sapling), the number and length of shoots (portion above the ground), and the fresh weights of root and shoot were measured.

Statistical analysis. MS-Excel 2016 was used to enter the data. GenStat (version 15.0, VSN International Ltd., England and Wales) was used to evaluate the collected data. The least significant difference (LSD) test was used to identify the significant differences between treatments at a 5% level of significance (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Shoot diameter. The average shoot diameter did not differ significantly between the treatments (Table 1). In grapevine cuttings, Aloe vera was discovered as a rooting substance

to be more promising than synthetic hormones (Jamal Uddin et al., 2020). By increasing cell membrane permeability, photosynthesis, and nitrogen uptake rate, GA3 content in aloe vera gel enhanced plant growth (Padmaja et al., 2007). Auxin aids in the elongation of cells, which helps to increase the shoot diameter.

Shoot length. The average length of shoot of cuttings differed significantly across the treatments. The longest shoots (30.35 cm) were found in cuttings treated with Aloe vera gel, whereas the shortest (22.40 cm) were found in the control treatment (Table 1). When compared to control, the treated cuttings produced more shoot growth. Aloe vera is rich in as gibberellins and salicylic acid, which promote and increase growth (Hamouda et al., 2012). In addition, Reddy et al. (2005) reported that auxin stimulates linear stem growth in scented geranium cuttings due to cell elongation.

Table 1 – Effect of rooting aloe vera and indole-3-butyric acid on shoot and root growth.

Treatment	Shoot diameter (mm)	Shoot length (cm)	Shoot number
Control	35.9	22.40	1.2
Aloe vera gel	36.4	30.35	2.2
IBA	37.4	26.45	2.05
Grand mean	36.6	26.4	1.82
F test	Ns	**	**
LSD (0.05)	-	4.49	0.52
CV%	17.2	12.4	20.9

Shoot number. The results revealed that treatments had a significant effect on the number of shoots. In aloe vera-treated cuttings, the average number of shoots per cutting was the highest (2.2) (Table 1). Aloe vera may have boosted the number of shoots in the cuttings. The IBA treatment enhanced the number of shoots more than the control did. These findings are consistent with those of Siddiqua et al. (2019), who observed that in dragon fruit, the largest number of sprouts and shoots were recorded at 90 days after planting (DAP) (2.43) when treated with IBA 7000 ppm, whereas the lowest numbers (1.41) were observed in control. Pervaiz et al. (2007) observed similar results in Barbados cherry. Auxin is produced by IBA that impacts the hypocotyls and branching of shoots (Starder et al., 2011).

Root number. The findings revealed that treating cuttings had a considerable effect on the average number of roots per cutting (Figure 1). The Aloe vera and IBA treatments were significantly different from the control. The Aloe vera treatment had the highest average number of roots (9.9) per cutting, while the control had the lowest average number of roots (8.7). The cuttings treated with exogenous auxin performed similarly to Aloe vera. There is a correlation between primordia division and endogenous or exogenous auxin in root initiation. Fathi and Ismailpor (2000) backed up this claim, claiming that auxin promotes root development in cuttings. According to El-Sherif (2017), auxin (IAA), Aloe vera helps to stimulate the root in a populous plant. IBA was reported to be promising for increasing the number of roots in dragon fruit by Ahamad et al. (2016) and Seran and Thiresh (2015).

Root length. Aloe vera had the longest root length per cutting (25.92 cm), which was statistically similar to IBA (24.32 cm) (Figure 1). Ahmad et al. (2016) found that IBA treatment increased the root length in dragon fruit when compared to control. The natural substance was suggested by Dunsin et al. (2016) as an alternative of rooting hormone for enhanced root growth. Bajwa et al. (1977) observed that treating dragon fruit roots with IBA at a concentration of 100 ppm increased the length of the roots. The difference in root length between treatments could be attributed to the use of IBA, which causes the hydrolysis of nutritional reserves in cuttings in order to lengthen root.

Fresh Shoot weight. The fresh weight of the shoots differed significantly between the treatments (Figure 2(a)). The Aloe vera treatment had the highest mean fresh weight of shoot per cutting (102.6 g), followed by IBA (90.2 g), and the control treatment had the lowest (83 g). This finding is comparable to that of Siddiqua et al. (2019), who found that on 90 days after planting, dragon fruit cuttings treated with IBA 7000 ppm had the highest shoot dry weight (11.12 g). The control (6.85 g) had the smallest shoot dry weight of Dragon fruit cuttings. This could be attributable to earlier sprouting, a bigger number of leaves and leaf

area, and a higher fresh weight of the shoot. Shukla and Bist (1994) in Pear, Shirol and Patil (1992) in Ixora produced similar results.

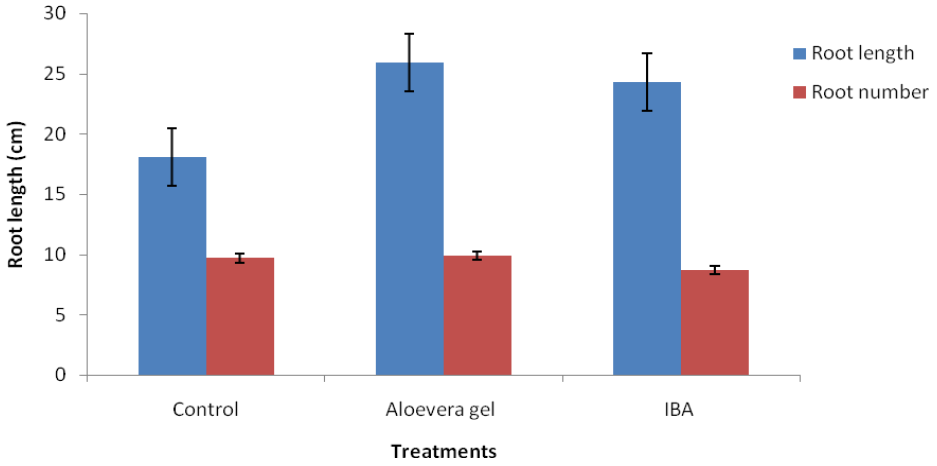

Figure 1 – Effect of aloe vera and IBA on root length and number in dragon fruit cuttings.

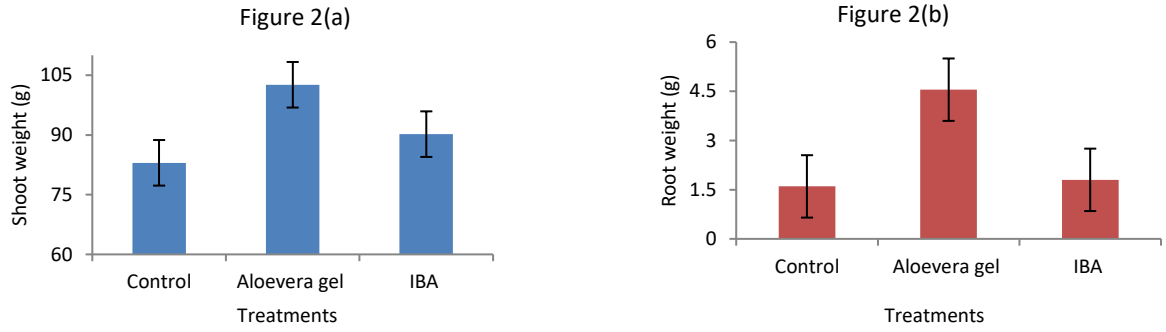

Figure 2(a)(b) – Effect of aloe vera gel and IBA on shoot and root weight of dragon fruit cuttings.

Fresh Root weight. The fresh weight of roots was analyzed statistically, and there were highly significant differences between the treatments (Figure 2(b)). The average fresh weight of the roots was 1.6 g to 4.55 g. Aloe vera-treated cuttings had the highest root weight (4.55). The root weight of the IBA-treated cuttings was marginally higher (1.8 g) than the control treatment (1.6 g). The number of roots is connected to the growth in root weight. In comparison to control cuttings, IBA-treated cuttings had a larger root weight (Seran and Thiresh, 2015). IBA increased the number of roots, which allowed the roots to absorb more nutrients from the soil, resulting in better root growth. On dragon fruit, Ahmad et al. (2016) found that treatment with IBA (100ppm) produced the highest average dry weight of root (0.8g) while Control produced the lowest (0.2 g). Increased IBA concentration resulted in a greater mean dry weight of roots, which is similar to the findings of Reddy et al. (2005). In the case of roses, higher IBA concentrations resulted in increased root dry weight (Yeshiwas et al., 2015). According to Jamal Uddin et al. (2020), Aloe vera and IBA have similar results in boosting root numbers in grape stem cutting, which is directly related to root weight.

CONCLUSION

The study's findings revealed that Aloe vera gel had an effect on rooting number, length, and weight in cuttings, which was followed by treatment with the synthetic hormone Indole-3-Butyric acid. The use of aloe vera gel had a major effect on the diameter, number, length, and weight of the shoots. As a result, natural substances such as aloe vera gel may be a viable rooting substance alternative to synthetic rooting hormones for dragon fruit cutting.

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