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EFFECT OF PGR'S ON ROOT AND SHOOT PARAMETERS OF HARD WOOD CUTTINGS IN GUAVA (*PSIDIUM GUAJAVA* L.) CV. LUCKNOW-49

G. Samlind Sujin*, Ajish Muraleedharan, S. Kumar and A. Markandayan.

Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Chidambaram-608002 (Tamilnadu), India.

Abstract

The present investigation was conducted in the Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalainagar, during 2017 to 2019. The experiment was conducted in completely randomized block design with sixteen treatments in three replications. The sixteen treatments comprised of growth regulators *viz.*, IBA, IAA, NAA, 2,4 D and paclobutrazol with three different concentrations of 3000, 4000 and 5000 ppm each. The results of the above experiment revealed that the treatment IBA @ 3000 ppm recorded significantly maximum rooting percentage (89.62%), number of roots per cuttings (12.52), root length (13.51cm), fresh weight of roots (1.96g) and dry weight of roots (73.88mg). The lowest root parameters were recorded in the control. The various shoot parameters *viz.*, days required for bud sprouting (14.08), the number of sprouts per cuttings (3.22), fresh weight of shoot (4.17g), dry weight of shoot (1.52g) and survival percentage of rooted cuttings (90.49%), length of shoot (11.15cm) were observed maximum in the hard wood cuttings treated with IBA @ 3000 ppm as compared to the control. It can be concluded that the growth regulator IBA @ 3000ppm performed the best based on the root and shoot parameters when compared to other treatments.

Key words: Guava, Hard wood cuttings, IBA, IAA, NAA, 2, 4 D and Paclobutrazole.

Introduction

Guava (*Psidium gujava* L.), the "Poor man's fruit" or "Apple of the tropics" belongs to the family Myrtaceae. It is suitable for tropical and subtropical climate. It is one of the important species that can tolerate a wide range of soil and climatic conditions. The tree is fairly salt and drought - resistant and can be grown on a variety of soils *viz.*, sand, clay, loam, deep, shallow, acidic and alkaline soils with pH ranging from 4.5 to 8.5. It is commercially grown in India, Pakistan, South Africa, Florida, Hawaii, Brazil, Colombia, Cuba, Venezuela, New Zealand, Phillipines and Thailand (Tate, 2000). It is an evergreen tree and one of the major fruit crops of alluvial plains of India. In India, it is either grown in the rainy season (July - September) or in the winter season (November - December). It occupies fifth position in terms of area and fourth position in terms of production of fruits in India. It is considered to be the exquisite, nutritionally valuable and remunerative crop. It produces more delightful aromatic fruits under low maintenance (Thaipong and Boonprakob, 2005).

In recent years, guava is getting more popularity in the international trade due to its nutritional value and various processing products like jelly, jam, sherbat, ice cream, cheese, canned fruit, RTS, nectar, squash and powders (Singh *et al.,* 2005).

Guava is propagated sexually by seeds and asexually by budding, grafting. layering and cutting (Zamir *et al.*, 2003 and Chandra *et al*., 2004). Vegetative propagation of guava is widely practiced to ensure true to type and early bearing of fruits. Propagation by cutting from mature trees may be one of the important options to avoid the genetic segregation and maintain the quality of variety.

The demand of quality planting stocks of fruit crops like guava is growing rapidly. Conventional methods of propagation such as air layering, inarching or stooling cannot fully meet the requirement of planting stock,

***Author for correspondence :** samlindsujin@gmail.com

because of the dependency of weather conditions and low success rate. Therefore, there is a urgent need to develop cost effective protocol, which is fast and can provide the same, high quality genetically true to type planting material. The use of growth regulators in enhancing rooting for cuttings is well documented for guava. To overcome the drawbacks, intermittent mist systems are widely used for semi-hardwood, hardwood and herbaceous cuttings. Many workers have used growth regulators in different species. There are numerous natural and synthetic auxins: indoleacetic acid (IAA), indolebutyric acid (IBA), naphthaleneacetic acid (NAA) and 2, 4-diclorophenoxyacetic acid (2,4-D). Synthetic auxins are utilized for several purposes in horticulture and agriculture for the formation of adventitious roots from stem cuttings.

Auxins particularly IBA, NAA and IAA have been reported to induce rooting in many of the plant species with varied success. However, the response to different growth substances varied from species to species, changing physiological and environmental conditions. Most of the workers have reported IBA and NAA as better growth regulator than other for inducing rooting in cutting and layering due to their stable nature.

In modern times, air layering propagation techniques using growth regulators during rainy seasons are being used to achieve more success. However, the rooted layers obtained, have low rooting and survival percentage after transplantation in the field. Paclobutrazol is probably the most widely used PGR in the production of fruit crops because of its wide range of efficacy and moderate to long-lasting response. Application of paclobutrazol, particularly when delivered as a spray, delay flower development and reduce flower size. Paclobutrazol is absorbed by roots, stems and to a lesser extent by leaves. But now a days it is used for inducing rooting of cutting.

Any selection based product and quality is prepared preferably through vegetative means. Thus, there is need to standardize vegetative propagation methods, especially cuttings is the most economical method of vegetative propagation (Davies and Hartman, 1988).

Propagation through air layering is a time consuming process and hence necessitated a search for alternate but effective means of vegetative propagation. Guava if propagated through seed, exhibit a great variation than vegetatively propagated plants. Vegetative propagation is, therefore, inevitable in guava. Several woody perennials are successfully and rapidly propagated through use of cuttings. In this context, rapid methods of propagation become very important when planting material is limited due to scarcity of a clone or varieties.

However an important fruit crops like guava requires proved and specific way to solve the various problem related to clonal propagation to meet the increasing demand of fruit growers.

Keeping the above facts in view, an experiment was conducted to facilitate rapid multiplication of guava though hard wood stem cutting in short span of time using IAA, IBA, NAA, paclobutrazol 2,4 D with different concentrations.

The present study aims:

1. To study the effect of different concentration of IBA, IAA, NAA Paclobutrazol and 2,4 D on root initiation of guava cuttings.
2. To study the effect of different concentration of IBA, IAA, NAA Paclobutrazol and 2,4 D on shoot initiation of guava cuttings.
3. To select the best growth -regulator for maximum root initiation and survival of guava cuttings.

Materials and methods

The present investigation was carried out at Annamalai University Orchard, Department of Horticulture, Faculty of Agriculture, Annamalai University, Annanalai Nagar during 2017 - 2019.

Preparation of cuttings

Uniformly thick shoot with one year old wood at the base and current years growth at the upper portion was selected and 15 cm long hard wood cutting with 3-4 nodes was made from middle portion of the shoot .The cuttings were given with slant cut at the base and circular cut at the top and was kept in running water for few minutes before treatment with growth regulators.

Preparation of growth regulators solution

Different concentrations of poclobutrazol were prepared according to the formula *i.e.* 1 mg of growth-regulator in 1 liter of water, to make 1 ppm of solution (Hortman and Kester, 1983).

For preparation of 3000 ppm, 4000 ppm and 5000 ppm of IBA, IAA, NAA and 2, 4, D solution, (3, 4 and 5 grams) of each chemical were taken and were dissolved in 50 percent ethanol, and then distilled water was added to make the required volume.

Treatments

T_1- IAA @ 3000 ppm

T_2- IAA @ 4000 ppm

T_3-IAA @ 5000 ppm

T_4- IBA @ 3000 ppm
T_5- IBA @ 4000 ppm
T_6- IBA @ 5000 ppm
T_7- NAA @ 3000 ppm
T_8- NAA @ 4000 ppm
T_9- NAA @ 5000 ppm
T_{10}-Pbz @ 3000 ppm
T_{11}-Pbz @ 4000 ppm
T_{12}-Pbz @ 5000 ppm
T_{13}- 2, 4 D @ 3000 ppm
T_{14}-2, 4 D @ 4000 ppm
T_{15}- 2, 4 D @ 5000 p
T_{16}- control (Distilled water)

The prepared cuttings were kept dipped in the growth regulators solution as per the soaking periods (20 minutes). The treated cuttings were planted singly in the polybags of 15cm size filled with sand, soil, FYM and red earth mixture. The cuttings were planted slantely to get more contact with the medium and easy absorption of nutrients. The experiment was laid out in Completely Randomised Block Design with three replications. Twenty cuttings per treatment were used.

Results and discusson

Rooting percentage

A significant effect of the growth regulators was observed on the rooting percentage of cuttings. The maximum rooting percentage (89.62%) was obtained in T_4 (IBA @ 3000 ppm) and was followed by T_6 (IBA @ 5000 ppm) with 83.33%. The rooting was found to be minimum (29.57%) in control (Table. 1). Nanda (1975) opined that exogenous auxin application breaks starch into simple sugars and enhances the mobilization of sugars which are needed to a greater extend for the production of new cells and for the increased respiratory activity in regenerating new root primordial. Weaver (1972) suggested that IBA translocates poorly. It retained near the site of application and is therefore very effective in root initiation process. Rooting of cuttings are intensified by IBA through polysaccharide hydrolysis which provides energy for meristematic tissues and thereby for root primordial formation (Husen and Pal. 2007).

Number of roots per cutting

Maximum number of roots per cutting (12.52) was obtained with cuttings treated IBA @ 3000 per cutting (T_4) followed by cutting treated with IBA @ 5000 ppm (T_6). The number of roots per cutting was significantly low (5.56) in control (Table 1). The reason for the better rooting and increase in root growth with various auxins treatment might be due to maximum utilization of sugar and starch after hydrolysis (Singh *et al*., 2001). Hartman *et al*., (2002) reported that application of IBA would be more effective to increase the rooting ability of guava cuttings. The results are in conformity with the findings of Celik *et al*., (1993) in guava.

Root length

The root length was found to be significantly highest (13.51 cm) in T_4 (IBA @ 3000 ppm) which was followed by T_6 in (IBA @ 5000 ppm) (11.29cm) and 10.26 cm in T_1 (IAA @ 3000 ppm). The root length was found to be minimum (5.86cm) in control (Table 1). The increased length of root may be due to auxin which plays an important role in the metabolic activity and cell division process of cuttings, resulting in increased growth of roots (Edmond *et al*., 1997). The increase in root length may also be due to the effect of growth regulator IBA on the metabolic translocation and carbohydrates metabolism

Table 1: Effect of PGR's on root parameters in guava (*Psidium guajava* L.) cv. Lucknow-49

Treatment details	Rooting (%)	No. of roots cutting^{-1}	Root length (cm)	Fresh weight of roots cutting^{-1} (g)	Dry weight of roots cutting^{-1} (g)
T_1 – IAA @ 3000 ppm	74.35	10.36	10.26	1.72	6.33
T_2 – IAA @ 4000 ppm	70.06	10.28	10.22	1.63	66.41
T_3 – IAA @ 5000 ppm	64.80	10.09	8.59	1.89	64.03
T_4 – IBA @ 3000 ppm	89.62	12.52	13.51	1.96	73.88
T_5 – IBA @ 4000 ppm	78.1	10.09	10.81	1.71	69.42
T_6 – IBA @ 5000 ppm	83.33	11.04	11.29	1.91	70.80
T_7 – NAA @ 3000 ppm	62.57	9.64	9.12	1.70	62.33
T_8 – NAA @ 4000 ppm	59.66	9.08	9.33	1.65	58.41
T_9 – NAA @ 5000 ppm	55.71	8.64	9.04	1.48	55.21
T_{10} –Pbz @ 3000 ppm	52.38	9.45	10.80	1.45	52.86
T_{11} – Pbz @ 4000 ppm	47.18	8.50	8.69	1.41	50.32
T_{12} – Pbz @ 5000 ppm	43.32	8.35	8.16	1.38	48.10
T_{13} – 2, 4 D @ 3000 ppm	40.37	7.04	6.91	1.35	44.10
T_{14} - 2, 4 D @ 4000 ppm	36.50	7.22	8.60	1.32	44.96
T_{15} - 2, 4 D @ 5000 ppm	32.62	7.18	8.03	1.27	43.98
T_{16} – control(Distilled water)	29.57	5.56	5.86	1.17	39.16
S.Ed	1.02	0.49	0.51	0.05	0.11
CD (P=0.05)	2.09	1.01	1.04	0.11	1.46

Table 2: Effect of PGR's on shoot parameters in guava (*Psidium guajava* L.) cv. Lucknow-49

Treatment details	Days taken for appearance for first sprout	No. of sprouts cutting^{-1}	Shoot length (cm)	Fresh weight of shoot cutting^{-1} (g)	Dry weight of shoot cutting $^{-1}$ (g)	Survival percentage of rooted cutting(%)
T_1 – IAA @ 3000 ppm	18.04	2.42	9.10	3.50	1.34	83.32
T_2 – IAA @ 4000 ppm	18.83	2.70	9.41	3.48	1.22	80.02
T_3 – IAA @ 5000 ppm	20.00	2.41	10.08	3.03	1.20	78.38
T_4 – IBA @ 3000 ppm	14.08	3.22	11.15	4.17	1.52	90.49
T_5 – IBA @ 4000 ppm	16.05	2.65	9.79	2.66	1.27	84.97
T_6 – IBA @ 5000 ppm	14.74	3.11	10.33	3.49	1.43	87.14
T_7 – NAA @ 3000 ppm	18.35	1.32	9.87	3.35	1.28	75.15
T_8 – NAA @ 4000 ppm	19.45	1.45	9.06	3.11	1.31	72.96
T_9 – NAA @ 5000 ppm	21.33	1.28	10.29	2.20	1.21	70.25
T_{10} –Pbz @ 3000 ppm	22.50	2.30	8.38	2.98	1.17	69.11
T_{11} – Pbz @ 4000 ppm	22.53	2.11	9.83	2.68	1.20	66.60
T_{12} – Pbz @ 5000 ppm	22.72	1.70	8.68	2.82	1.36	54.10
T_{13} – 2, 4 D @ 3000 ppm	23.50	2.22	7.25	2.48	1.12	53.02
T_{14} - 2, 4 D @ 4000 ppm	24.53	2.71	7.50	2.43	1.10	58.02
T_{15} - 2, 4 D @ 5000 ppm	22.69	1.71	7.89	2.14	1.13	40.12
T_{16} – control(Distilled water)	26.22	0.86	6.63	2.04	1.03	32.74
S.Ed	0.32	0.05	0.14	0.16	0.07	1.28
CD (P=0.05)	0.65	0.11	0.29	0.33	0.14	2.61

which may be involved on root length. These findings are in line with those of Haq (1992) and Trujillo (2002) in guava.

Fresh weight of roots

The growth regulators tried at different concentrations significantly increased the fresh weight of roots per cuttings. Application of IBA @ 3000 ppm (T_4) produced the maximum fresh weight (1.96 g) and was followed by IBA @5000 ppm (T_6). The fresh weight of the roots per cutting was found to be minimum (1.17g) in control (Table 1). IBA concentration increases the fresh weight of the rooting (Sardoei, 2014). The results are in conformity with the findings of Zamir *et al*., (2003) in guava.

Dry weight of roots

In respect of the dry weight, cuttings treated with different growth regulators recorded significantly high dry weight over control. Application of IBA @ 3000 ppm (T_4) recorded the maximum dry weight of root (73.88g) and was followed by IBA @ 5000 ppm (T_6) with 70.80 g (Table 1). The dry weight of roots was found to be minimum (39.1 mg) in control. The present findings are in conformity with the report of Bacarin *et al*. (1994) and Giri *et al*., (2004) in guava.

Shoot parameters

Days taken for appearance of first sprout

The days taken for appearance of first sprout are presented in table 2. The earliest sprouting (14.08 days) was noticed in T_4 (IBA @ 3000 ppm) followed by T_6 (IBA @ 5000 ppm) with 14.74 days. The duration for initiation of sprouts was delayed in control (26.22 days). Earliness in sprouting and increase in number of sprouts may be due to better utilization of stored carbohydrate, nitrogen and other factors with the help of growth regulator which promoted the shoot growth (Bhosale *et al*., 2014). The earlier sprouting in cuttings by 3000 ppm concentration is perhaps due to already differentiated cells, directly sprouted without any further differentiation.

Number of sprouts per cutting

Application of various growth regulators resulted in significant difference in number of sprouts per cutting. The treatment T_4 (IBA@3000 ppm) resulted in the highest number of sprouts (3.22 sprouts per cutting) closely followed by T_6 (5000 ppm) with 3.11 sprouts per cutting and T_3 (5000 ppm) while cutting showed minimum number of sprouts (0.86) in control (Table 2). The development of dormant bud into sprout is directly associated with the breakdown of reserve food and its mobilization into the growing region and auxin is involved in the process. The auxins activated shoot growth which resulted in the elongation of stems and the length of sprout through cell division accounting in the higher number of sprouts and longest sprout (Mukhtar *et al*., 1998) in guava. Similar findings were reported by Bleasdale (1984) and Mitra and Bose (1996) in guava.

Shoot length

The shoot length recorded was found to be very significant among the growth regulator treatments. Generally, the shoot length was found to increase with increases in concentrations of IBA, NAA, IAA, 2, 4 D and Paclobutrazol. The shoot length was found to be the highest (11.15 cm) in T_4 (IBA @ 3000 ppm). It was followed by 10.33 cm in the treatment T_6 (IBA @ 5000 ppm). The length of the shoots was the minimum (6.63 cm) in control (Table 2). The increased shoot length obtained in cuttings treated with growth regulators was due to the increase in cell division and cell elongation because of the actions of auxins.

Fresh and dry weight of shoots per cutting

Fresh weight of shoots per cutting (4.17 g) and dry weight of shoots per cutting (1.52 g) recorded the highest in the treatment T_4 (IBA @ 3000 ppm) and was followed by the treatment T_6 (IBA @ 5000 ppm) which recorded the fresh weight of 3.49 g and dry weight of 1 .43 of shoot per cutting respectively (Table 2). The fresh and dry weight of shoots per cutting was found to be minimum (2.04 and 1.03 g) in control. The application of IBA has increased the number of sprouts per cutting and number of leaves per cutting which in turn increases the fresh and dry weight of the shoots cutting^{-1}. The results are in conformity with the findings of Abdul Kareem *et al.* (2013).

Survival percentage

There was significant difference in the survival percentage of guava cuttings in the field. The rooted cuttings obtained in T_4 (IBA @ 3000 ppm) resulted in the highest survival percentage in the field (90.49%) and was followed by T_6 (IBA @ 5000 ppm), which recorded 87.14%. The survival percentage of the rooted cuttings was recorded the least (32.74%) in control (Table 2). The reason for the better shoots growth which has been augmented by some role in absorption and translation of the nutrients from the soil which is probably taking active path in various plant metabolic process. Noor Rahman *et al.*, (2004) in guava reported that the high concentration of auxin included the maximum number of' root with the survival percentage. Fachinello *et al.*, (2005) reported that hardwood cuttings showed constant metabolic activity and continuous development are the stake that generally has greater survival percentage to hardwood cuttings, when using growth regulators. The value of high percentage of rooting and root length observed in IBA with concentration of 3000 ppm may be linked to increase metabolic activity of the hormone in young tissues and can be attributed this fact possibly the concentration of higher carbohydrates has great survival percentage.

Finally, it could be concluded that the higher rooting of cuttings, maximum number of sprouts and the maximum survival percentage of cuttings was be obtained by application of IBA @ 3000 ppm soaked for 20 minutes in guava.

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