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Effect of Paclobutrazol Concentrations and Dipping Period on Rooting of Soft Wood Cuttings of Guava (*Psidium guajava*)

Mohammad Ayaz, [1]Syed Asghar Hussain and [1]Nawab Ali
Pakistan Tobacco Company, Pakistan
[1]Department of Horticulture, Agricultural University Peshawar, Pakistan

Abstract: Effect of different concentrations of Paclobutrazol and dipping period on rooting of softwood cutting of Guava was studied at Ornamental Nursery, NWFP Agricultural University, Peshawar. Fresh softwood cuttings of Guava having 3-4 leaves were dipped in 0, 10, 20, 30, 40, 50 and 60 ppm solution of Paclobutrazol for 1, 2, 3, 4 and 5 h and were planted in plastic tubes and covered with polythene sheet for maintaining humidity. In various Paclobutrazol concentration 60 ppm resulted in maximum cutting success (73.3%), rooting (69.5%), shoot length (24.3 cm), number of branches (4.3), number of roots (87.1) and root volume per plant (1.64 cm^3). In various dipping period five hours dipping resulted in maximum cutting success (34.9%), rooting (30.1%), shoot length (10.6 cm) and number of roots (47.2) while four hours dipping resulted in maximum number of branches (2.6) and root volume per plant (1.05 cm^3). In interaction maximum cutting success (81.7%), shoot length (28.8 cm)and number of branches (5.3) was observed in 60 ppm Paclobutrazol concentration and 2 h dipping. 60 ppm Paclobutrazol concentration and 3 h dipping period gave maximum rooting (80%), number of roots (102.7) and root volume per plant (1.76 cm^3).

Key words: Guava, cuttings, dipping period, paclobutrazol

INTRODUCTION

Guava (*Psidium guajava L.*) belongs to family Myrtaceae. Some of the important varieties grown in Pakistan are Sufeda, Surkha, Karila shaped or Pear shaped, Early red and Chatidar etc. Guava is generally propagated from seeds but seedlings are not true to type. Efforts have been made to propagate guava through cuttings and layering. Layering although, successful but is a laborious job. Propagation through cutting has been practiced by different scientists through the application of various root promoting hormones. Hafeez *et al.* (1988 and 1991) and Mukhtar *et al.* (1998) got success in soft wood cutting of guava through application of Paclobutrazol as root promoting hormone. Similarly Singh (1998) conducted experiment on regeneration of guava through stooling with the aid of Paclobutrazol and got 93.33% rooting success. Similarly Debnath and Maiti (1990) got more than 70% rooting from soft wood cutting of guava by treating with various concentrations of IBA, NAA and IAA. Paclobutrazol (Trade name = Bonzi, Clipper, Cultar etc) is a potent inhibitor of giberellin biosynthesis resulting in internode shortening and long term growth suppression on many monocot and dicot plants. The growth suppression in upper region results in root initiation at the bottom of cuttings (Hafeez, 1988). The present research study was initiated to see the effect of Paclobutrazol concentration and dipping period on rooting success and growth of guava softwood cuttings.

MATERIALS AND METHODS

The research study "Effect of Paclobutrazol concentrations and dipping period on rooting of soft wood cutting of guava" was conducted in the Ornamental Nursery, NWFP Agricultural University Peshawar. Cuttings from the shoot tips of Guava were taken and dipped in 0, 10,20,30,40,50 and 60 ppm Paclobutrazol solution for 1,2,3,4 and 5 h before planting. The tip cuttings with 4 leaves were taken from 18th–21st July 2001 and after treatment were planted in plastic tubes having garden soil + FYM as a media. The experiment was laid out as randomized complete block design with 2 factors factorial arrangement. Forty cuttings were taken for each treatment and total number of cutting treated was 4200. The experiment was replicated three times.

RESULTS AND DISCUSSION

Cutting success: The significantly maximum cutting success of 73.3% was obtained from 60 ppm solution as compared to the minimum of 3.0 and 3.8% from 20 and 10 ppm Paclobutrazol solution, respectively (Table 1). Similarly maximum success (34.9%) was got in 5 h dipping

and minimum (16.2%) in 1 h dipping period. In interaction, dipping of cutting for 2 h in 60 ppm Paclobutrazol solution gave the highest success of 81.7% while no success was observed by treating cuttings with 10 ppm solution for 3 h.

Hafeez *et al.* (1988) reported 90. 11 to 94. 44% cutting success of leafy tip cutting when treated with 3, 6 and 12 ppm Paclobutrazol for 24 h. Similarly Mukhtar *et al.* (1998) reported 47 and 64% success with 3 ppm and 1000 ppm Paclobutrazol, respectively. The ability of Paclobutrazol in root initiation may be related to its antigiberellin activity. Rooting is generally inhibited by giberellin as observed by Brain *et al.* (1960) and Kefford (1973). Treatments with anti giberellin compounds, at least in some instances have promoted root formation (Kefford, 1973). The roots once formed take up nutrients from the soil and supply to upper portion for immediate use and photosynthesis. That is why the leaves of successful cuttings remained intact and also started fresh growth.

Rooting percentage: Maximum rooting percentage (69.5) was obtained from 60 ppm Paclobutrazol and minimum

(1.8) from 10 and 20 ppm (Table 2). Similarly in various dipping periods, cuttings dipped for 5 h gave the highest rooting success of 30.1% while in interaction cuttings dipped for 3 h in 60 ppm Paclobutrazol concentration gave the significantly highest rooting success (80%) while minimum success was obtained in most of the lower concentrations at various dipping period. Hafeez *et al.* (1988) and (1991) observed 94.44 and 94% rooting with 12 ppm paclobutrazol and Mukhtar *et al.* (1998) got 64% rooting with 1000 ppm paclobutrazol treatment of tip cutting of Guava. High concentration of paclobutrazol and more dipping period helped to suppress giberellin, which generally inhibit adventitious roots formation. With such suppression there might be more cell division at the basal portion of cutting thus resulting in callus formation and more rooting percentage.

Shoot length: Significantly maximum shoot growth per plant (24.3 cm) was recorded for 60 ppm Paclobutrazol solution (Table 3). The cuttings dipped for 5 h gave highest shoot growth of 10.6 cm. In interaction between paclobutrazol solution and dipping period, the maximum shoot growth of 10.6 cm was observed in 2 h dipping in 60 ppm Paclobutrazol solution produced more shoot growth (28.8 cm). Various dipping periods in 10 and 20 ppm paclobutrazol along with control had a poor shoot length. Obviously more number of leaves and roots have been observed in the above mentioned treatments. More number of leaves and roots may have resulted in high

Table 1: Effect of Paclobutrazol concentrations and dipping period on percent cutting success of softwood cuttings of Guava

Paclobutrazol concentration (ppm)	Dipping period (hours) 1	2	3	4	5	Mean
0	25.0e-g	20.0e-I	20.8e-I	19.2e-I	19.2e-I	20.8c
10	3.3jk	4.2jk	0.0k	7.5ijk	4.2jk	3.8e
20	3.3jk	0.8k	2.5k	4.2jk	4.2jk	3.0e
30	2.5k	4.2jk	9.2h-k	53.3cd	51.7d	24.1c
40	8.3h-k	12.5g-k	10.8g-k	13.3f-k	20.0e-i	13.0d
50	175.0e-j	30.0e	27.5ef	22.5e-h	66.7bc	32.8b
60	53.3cd	81.7a	80.8ab	72.5ab	78.0ab	73.3a
Mean	16.2d	21.9c	21.7c	27.5b	34.9a	

LSD value for Paclobutrazol concentration at α 0 05 = 6.48
LSD value for dipping period at α 0 05 = 5.48
LSD value for Paclo. Conc. X dipping at α 0 05 = 14.49

Table 2: Effect of Paclobutrazol concentrations and dipping period on rooting percentage of softwood cuttings of Guava

Paclobutrazol concentration (ppm)	Dipping period (hours) 1	2	3	4	5	Mean
0	11.7d-f	9.2d-f	10.0d-f	9.2d-f	6.7ef	9.3cd
10	0.0f	1.7f	0.0f	5.0ef	2.5f	1.8d
20	0.8f	0.8f	0.8f	3.3f	3.3f	1.8d
30	0.0f	1.7f	5.8ef	49.2c	48.3c	21.0b
40	5.8ef	10.0d-f	7.5ef	10.8d-f	16.7d-f	10.0c
50	11.7d-f	25.8d	22.5de	17.5d-f	61.7bc	27.8b
60	49.2c	78.3ab	80.0a	68.3ab	71.7ab	69.5a
Mean	11.3c	18.2b	18.1b	23.3b	30.1a	

LSD value for Paclobutrazol concentration at α 0 05 = 7.88
LSD value for dipping period at α 0.05 = 6.66
LSD value for Paclo. Conc. x dipping period at α 0.05 = 17.62

Table 3: Effect of Paclobutrazol concentrations and dipping period on shoot length (cm)

Paclobutrazol concentration (ppm)	Dipping period (hours) 1	2	3	4	5	Mean
0	4.4h-k	4.4h-k	4.2i-k	3.9i-k	4.0i-k	4.2de
10	0.0k	2.9i-k	0.0k	2.5jk	1.7jk	1.4f
20	2.1jk	2.5jk	1.9jk	3.9i-k	1.9jk	2.5ef
30	0.0k	1.4jk	6.6f-j	11.1e-g	11.1e-g	6.0cd
40	4.9h-k	5.8g-k	7.0f-j	10.2e-h	8.8e-i	7.3c
50	6.3g-j	12.4ef	11.7e-g	13.1de	21.4bc	13.0b
60	18.8cd	28.8a	25.2ab	23.9a-c	25.0ab	24.3a
Mean	5.2c	8.3b	8.1b	9.8ab	10.6a	

LSD value for Paclobutrazol concentration at α 0.05 = 2.66
LSD value for dipping period at α 0.05 = 2.25
LSD value for Paclo. Conc. X dipping period at α 0.05 = 5.95

Table 4: Effect of Paclobutrazol concentrations and dipping period on number of branches per plant

Paclobutrazol concentration (ppm)	Dipping period (hours) 1	2	3	4	5	Mean
0	0.7gh	0.3gh	0.3gh	0.0h	0.3gh	0.3de
10	0.0h	0.0H	0.0H	0.3gh	0.0H	0.1e
20	0.3gh	0.7gh	0.3gh	1.3fg	0.3gh	0.6d
30	0.0h	0.3gh	1.0gh	3.7cd	4.0b-d	1.8c
40	2.3ef	2.3ef	2.3ef	3.3de	4.7a-c	3.0b
50	1.0gh	3.0de	3.0de	4.7a-c	5.3a	3.4b
60	3.7cd	5.3a	4.7a-c	5.0ab	3.0de	4.3a
Mean	1.1c	1.7b	1.7b	2.6a	2.5a	

LSD value for Paclobutrazol concentration at α 0.05 = 0.49
LSD value for dipping period at α 0.05 = 0.42
LSD value for Paclo. Conc. X dipping period at α 0.05 = 1.09

Table 5: Effect of Paclobutrazol concentrations and dipping period on number of roots per plant

Paclobutrazol concentration (ppm)	Dipping period (hours) 1	2	3	4	5	Mean
0	15.3l-o	17.7l-o	15.7l-o	13.3l-p	16.3l-o	15.7e
10	0.0p	10.3m-p	0.0p	8.3n-p	7.7op	5.3f
20	7.3op	9.7n-p	6.3op	25.0j-m	8.3 n-p	11.3ef
30	0.0p	7.7op	19.0l-o	64.0de	60.0d-f	30.1d
40	38.7h-j	35.3h-k	25.7i-l	40.0g-i	17.0cd	42.1c
50	22.7k-n	48.7f-h	54.0e-g	79.7bc	80.3bc	57.1b
60	69.0cd	90.7ab	102.7a	86.3b	86.7b	87.1a
Mean	21.9c	31.4b	31.9b	45.2a	47.2a	
LSD value for Paclobutrazol concentration at α 0.05					= 6.61	
LSD value for dipping period at α 0.05					= 5.59	
LSD value for Paclo. Conc. X dipping period at α 0.05					= 14.8	

Table 6: Effect of Paclobutrazol concentrations and dipping period on root volume per plant (cm^3)

Paclobutrazol concentration (ppm)	Dipping period (hours) 1	2	3	4	5	Mean
0	0.38h-j	0.40h-j	0.39h-j	0.41h-j	0.39h-j	0.39d
10	0.0k	0.31i-k	0.0k	0.23i-k	0.21jk	0.15e
20	0.18jk	0.22i-k	0.19jk	0.54g-i	0.22ijk	0.27de
30	0.0k	0.19jk	0.41h-j	1.57a-d	1.35c-f	0.70c
40	1.2ef	1.15f	0.78g	1.34c-f	1.39b-f	1.17b
50	0.68gh	1.14f	1.27d-f	1.61a-c	1.61a-c	1.26b
60	1.51a-e	1.71ab	1.76a	1.63a-c	1.57a-d	1.64a
Mean	0.56c	0.73b	0.69b	1.05a	0.96a	
LSD value for Paclobutrazol concentration at α 0.05					= 0.14	
LSD value for dipping period at α 0.05					= 0.12	
LSD value for Paclo conc. X dipping period at α 0.05					= 0.32	

photosynthesis and more photosynthate material. The increasing photosynthate material may have shown its impact on length of shoots as described by Marshall and Waring (1985).

Number of branches per plant: Maximum number of branches plant^{-1} (4.3) was obtained from 60 ppm Paclobutrazol treatment while minimum branches (0.1) in 10 ppm solution (Table 4). Similarly in case of dipping period maximum number of branches plant^{-1} (2.6 and 2.5) were obtained in 4 and 5 h dipping periods, respectively while minimum branches plant^{-1} (1.1) were in 1 h dipping. Dipping of cuttings in 60 and 50 ppm Paclobutrazol solution for 2 h and 5 h, respectively gave the highest number of branches (5.3) while the low concentration of Paclobutrazol solution gave the least number of branches plant^{-1} in various dipping period.

The shoot growth was more on plants treated with high concentration of Paclobutrazol for longer period, which help in the production of more branches. Similarly high concentration and more dipping period have increased number of roots, which might have manufactured comparatively more cytokinins. High cytokinin produced in turn may have resulted in more number of branches. Troughton (1956) reported increase in number of branches with increasing roots and declared root to shoot ratio most important for survival and environmental adaptation of plants.

Number of roots per plant: Cuttings treated with 60 ppm Paclobutrazol solution gave maximum root number plant^{-1} (87.1). Similarly in dipping period maximum number of roots plant^{-1} (47.2 and 45.2) were obtained in 5 and 4 h dipping, respectively while in interaction, the maximum roots plant^{-1} (102.7) were produced on plants dipped for 3 h in 60 ppm Paclobutrazol solution (Table 5).

Mukhtar (1998) reported maximum number of roots per plant (136) with high (1000 ppm) paclobutrazol treatment while Hafeez (1988) got 30.19 roots with 3 ppm paclobutrazol treatment of softwood cutting of guava. Singh (1998) got 48.3 primary roots and 138.54 secondary roots by stooling with the aid of 2500 ppm paclobutrazol.

Significant increase in number of roots with high concentration of paclobutrazol and more dipping period may have allowed the cutting to absorb well the growth regulator. Due to this cell division may have been promoted which in turn increased the number of roots as observed by Mukhtar *et al.* (1998). The increase in number of roots is necessary to provide anchor to the high shoot length and to keep shoot-root ratio in balance. With the increase in shoot growth, the root growth also increases which help in the increase in the number of roots.

Root volume (cm^3): The significantly maximum root volume plant^{-1} (1.64 cm^3) was in 60 ppm Paclobutrazol solution. In dipping period, 4 h dipping produced maximum root volume plant^{-1} (1.05 cm^3). Root volume was also more on plant, cuttings of which were treated with high concentrations of Paclobutrazol for longer period while root volume decreased with decrease in concentration and also dipping period (Table 6).

Increase in root volume can also be correlated with number roots. With increase in root number per plant, root volume also increased. As more number of length roots was observed in 60 ppm paclobutrazol concentration and more dipping period therefore, it also resulted in more root volume.

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