

Improvement of grafting success of mango through application of plant growth regulators

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ABSTRACT

The mango is generally propagated by grafting and grafting success depends on several factors. Physiological condition of scion and rootstock plays a vital role in grafting union where external application of plant growth regulators may be helpful to gear up better cambium activity for making grafting joint. Considering beneficial role of plant growth regulators, an investigation was carried out in a nursery of private farm during the year 2015 with different concentrations of NAA (10 ppm and 20 ppm) and GA₃ (5 ppm and 10 ppm) were applied through spray applications at different time intervals (1 day after grafting followed by 21 days after grafting and 7 days after grafting followed by 21 days after grafting) on grafts using scion of mango variety Mallika. The experiment was laid out in factorial Randomized Block Design (RBD) with five replications. The result showed that GA₃ @10 ppm resulted in highest grafting success (56.05%) with better growth of sprouted shoots. However, leaf number of sprouted shoots was comparatively lower in GA₃ treatment irrespective of doses. In case of all traits under study time of growth regulator application was significantly important irrespective of growth regulators and application of growth regulators at 1 day after grafting followed by the second spray at 21 days after grafting gave the better result. Therefore, GA₃ @10 ppm applied at 1 day and 21 days after grafting is recommended to improve grafting success in Mallika cultivar of mango.

Keywords: Mango grafting, GA₃, NAA, time of application

INTRODUCTION

Mango (*Mangifera indica* L.) 'The king of fruits' and is the choicest fruit crop of India for its rich taste, flavor, color, large scale production and diverse end usage. Mangoes contain antioxidants such as quercetin, fisetin, isoquercitrin, astragaloside, gallic acid and methyl gallate. All these properties protect our body against breast cancer, colon cancer, prostate cancer and leukaemia. It contains high level of vitamin C, fibre and pectin making it a perfect fruit that helps in controlling high cholesterol level. It also contains vitamin C, A and other different kinds of carotenoids. All these essential nutrients are beneficial for our immune system keeping it strong and healthy. Mallika is one of the important regular bearer hybrid varieties that got research attention among scientists and is popular among growers.

Mango being a highly heterozygous fruit crop is preferred to propagate through vegetative methods and among different types of vegetative propagation techniques grafting is the most common one and it resulted good success as compared to other methods (Ghosh and Bera,

2015). Successful grafting requires tissue reunion including formation of vascular connections between the stock and scion. Grafting initially triggers the secretion of pectin from cells at the cut site to adhere the rootstock and scion together. Dedifferentiated stem-cell like tissue, termed callus, then forms at both junctions until the grafted tissues join and plasmodesmata can bridge the connection site. Cambium, cortex and pith cells surrounding the phloem and xylem divide and, together with callus cells, differentiate into vascular tissues and connect the two junctions (Nanda and Melnyk, 2018). Effect of growth regulators as potential candidates involved in grafting process has been well acknowledged. Of these the most important hormones are auxin and cytokinin that play an important role in vascular system formation during root development and differentiation of vasculature in callus. Cytokinin accumulates in the rootstock and auxins accumulate in the scion portion due to the cutting process that consequently activates the genes associates with wound response and vascular development (Melnyk and Meyerowitz, 2015). On the other hand gibberellin like substances has a

significant role in plant growth regulation (Brian, 1959). Use of plant growth regulators in cuttings and layering in fruit crop propagation has been established but information regarding use of plant growth regulators in improving success in grafting or budding in different crops is scanty. It is well known that grafting success between compatible scion and rootstock type is depend upon the professional skill of grafting, external environment and management practices followed after grafting. Considering beneficial role of auxin and gibberellins in regulating cell physiology particularly in meristematic activities, the present experiment was conducted to find out any key role of these hormones in improving grafting success in mango.

MATERIALS AND METHODS

The present investigation was carried out in a nursery of a private farm at Jhargram of Paschim Medenipur of West Bengal during the year 2015. Climatic condition of area of study was dry subtropical. Different concentration of growth regulators and different application time were the two experimental factors in this research study. The first factor represented five different concentrations of growth regulators (T_1 - NAA @10 ppm, T_2 - NAA @20 ppm, T_3 - @GA₃5 ppm, T_4 - @GA₃-10 ppm, T_5 - Control or water spray). The second factor was two different application time of growth regulators (S_1 - 7 days after grafting followed by the second spray at 21 days after grafting and S_2 - 1 day after grafting followed by the second spray at 21 days after grafting). 14- months old healthy seedlings of local mango, grown in polybags were used as rootstock. Soft wood grafting technique was followed taking scions of Mallika mango cultivar. Five graft samples were taken in each replication. Grafting was done in the first week of September. All the grafted plants were kept under semi-shade condition after grafting for one month then shifted to open condition. Observations were recorded for the three parameters; viz., percentage of grafting success, height of sprouted shoots and leaf number, noted three months after grafting. The percentage of graft success estimated at 3 months after grafting and computed by the following formula:

$$\text{Percentage of graft success (\%)} = \frac{\text{Number of success graft}}{\text{Total number of graft done}} \times 100$$

The data were statistically analyzed by factorial randomized block design (RBD) with five replicates, and each replicate included 5 samples per treatment. The means for all the treatments were calculated; analysis of variances (ANOVA) was performed by using SPSS version 24.0 at $P < 0.05$ probability level is regarded as statistically significant. Duncan Multiple Range Test (DMRT) (Duncan, 1955) was conducted to compare effect of different plant growth regulator combinations and date of spray on grafting success rate, height of sprouted shoots and leaf number of sprouted shoots.

RESULTS AND DISCUSSION

Grafting success

The percentage of grafting success without any growth regulator treatment was 44.49% which was *at par* with the results of NAA @10 ppm with 44.04%. GA₃ @ 5 ppm treatment resulted in the lowest rate (42.05%) of grafting success among all other treatments while GA @ 10 ppm contributed the maximum rate of grafting success with 56.05%, followed by NAA @20 ppm with 48.09% grafting success rate (Table 1). Time of growth regulator applications also revealed significant difference. The growth regulator application at 1day after grafting followed by the second spray at 21 days after grafting showed 48.36% grafting success while the growth regulator application at 7days after grafting followed by the second spray at 21 days after grafting showed 46.75% grafting success and the lowest grafting success of 44.49 % was noted in control. The different doses of growth regulator application and at different time interval were highly significant in case of GA @10 ppm while dose and time of growth regulator application showed no significant differences in case of GA @ 5 ppm as presented in Figure (1. a). Role of plant growth regulators in improving grafting success may be explained from the fact that phytohormones act as signal molecules at the sites of action resulting into cell growth and tissue differentiation, especially at the graft interface (Aloni *et al.*, 2010). Thus influence the scion–rootstock relationship by signalling both above and below graft union (Kondo *et al.*, 2014). Growth regulator like auxin released from the vascular bundle of stock and scion induces compatible unions through differentiation of vascular tissues, act as morphogenic substances as a result accelerate

Table 1: Effect of different doses and schedule of application of growth regulators on grafting success, height and leaf number of sprouted shoots

Treatments	Grafting success rate (%)	Height of sprouted shoot (cm)	Leaf number of sprouted shoot
T1 (NAA @10 ppm)	44.04 ^{bc}	8.15 ^a	8.31 ^a
T2 (NAA @ 20 ppm)	48.09 ^b	7.66 ^a	8.51 ^a
T3 (GA ₃ @ 5 ppm)	42.05 ^c	7.09 ^b	7.70 ^b
T4 (GA ₃ @ 10 ppm)	56.05 ^a	7.81 ^a	7.51 ^b
T5 (Control)	44.49 ^{bc}	6.75 ^b	8.34 ^a
S ₁	46.75 ^b	6.68 ^b	8.01 ^a
S ₂	48.36 ^a	8.68 ^a	8.01 ^a
S ₀ (Control)	44.49 ^b	6.75 ^b	8.34 ^a

grafting success (Pina and Errea, 2005). On the other hand, gibberellin like substances has a significant role like auxin in natural plant growth regulation (Brian, 1959). Nanda and Melnyk (2018) explained that Gibberellins (GAs) are diterpenophyto hormones with an important role

in plant development, particularly in regulating plant growth, as GAs promote cell expansion, cell differentiation and cell proliferation. GAs also stimulate xylogenesis in cambium tissue. The role of GAs in wounding is becoming clearer and appears that GAs are important for cell expansion

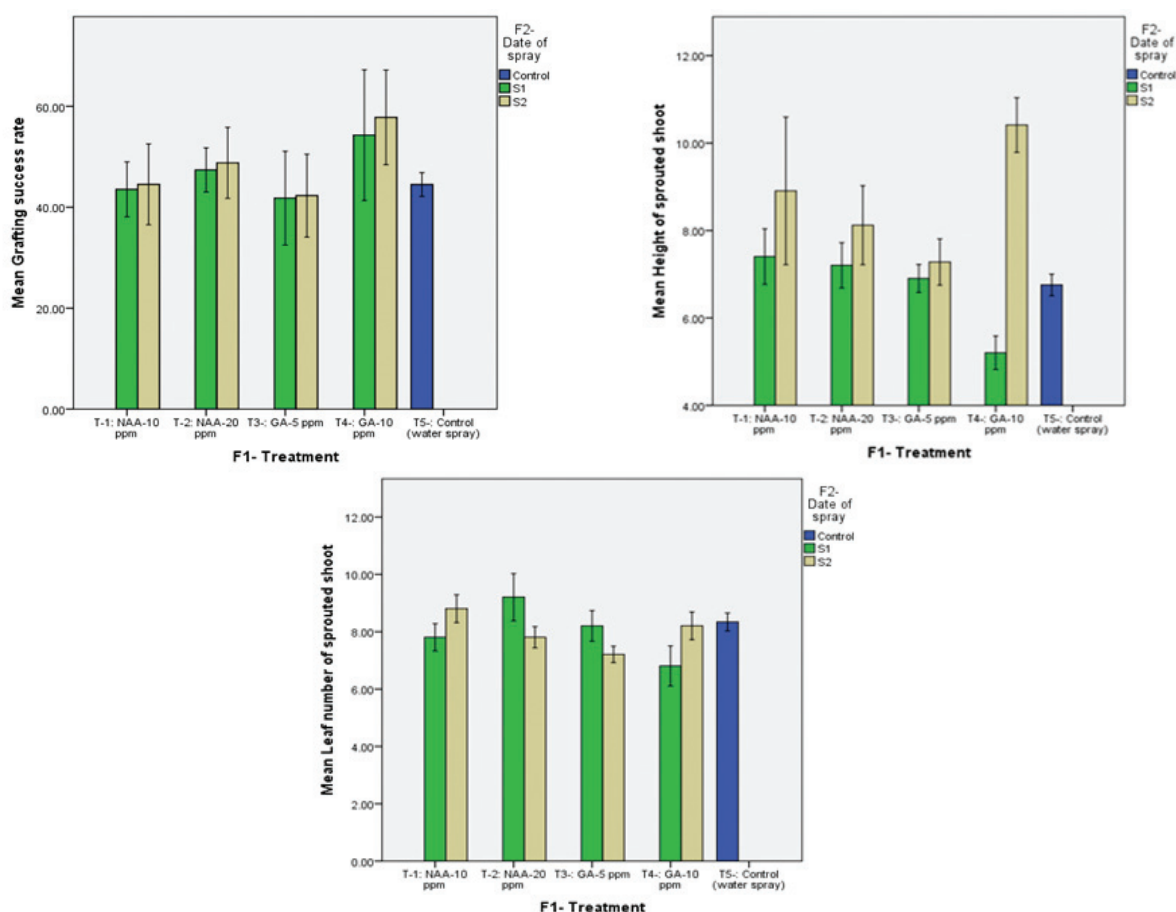


Fig. 1: (a) Effect of different doses and time of growth regulators application on grafting success rate (b) Effect of different doses and time of growth regulators application on height of sprouted shoots (c)Effect of different doses and time of growth regulators application on leaf number of sprouted shoots of Mango cv. Mallika

to seal the wound, whereas auxin is important for vascular tissue proliferation and reconnection across the graft junction. In the present experiment also, application of GA specifically at 10 ppm concentration revealed outstanding result when applied immediately after accomplishment of grafting.

Height of sprouted shoots

Among different growth regulator doses, maximum sprouted shoot height was observed in NAA @ 10 ppm (8.15 cm) which was at par with GA₃ @ 10 ppm (7.81 cm) and NAA @ 20 ppm (7.66 cm) and lowest in control (6.75 cm) (Table 1). Different time of growth regulator application expressed significant differences with height of sprouted shoots. The growth regulator application at 1 day after grafting followed by the second spray at 21 days after grafting showed highest height of sprouted shoot i.e. 8.68 cm while the growth regulator application at 7 days after grafting followed by the second spray at 21 days after grafting showed 6.68 cm in height of sprouted shoot and was at par with no regulator application or control (6.75 cm). Interactions between growth regulators and time of spray in sprouted shoot height was highly significant and maximum shoot height was observed with the application of GA₃ @ 10 ppm when applied at 1 day after grafting followed by the second spray at 21 days after grafting (Fig. 1.b). Different doses of NAA application also revealed significant difference with different time of application and in case of all treatments, the application of growth regulator revealed more effective when applied at 1 day after grafting followed by the second spray at 21 days after grafting (Fig. 1.b). Better shoot growth due to NAA may be due to the fact that auxin influence the production and function of cytokinin, which is produced in roots and translocate to the scion, where it maintains significant plant processes such as shoot growth (Elfving and Visser, 2006).

Leaf number of sprouted shoots

The leaf numbers of sprouted shoots were not influenced by different doses of growth regulators application. However, maximum numbers of leaves in sprouted shoots (8.51) were observed in NAA @ 20 ppm application which was at par with no growth regulator or water applications (8.34) and NAA @ 10 ppm (8.31) respectively. The lowest leaf number of sprouted shoots (7.51) was observed

in GA₃ @ 10 ppm which was *at par* (7.70) with GA₃ @ 5 ppm. Similarly, no significant difference was observed among different time of growth regulator applications with control.

CONCLUSION

From the present study, it was revealed that plant bio-regulators have a significant role in improving grafting success and increasing shoot growth. But time of application is important factor to get the desired result. In Mallika cultivar of mango, it was observed that spraying of GA₃ @ 10 ppm immediately after grafting followed by 21 days after grafting significantly influences grafting success and shoot growth.

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