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RESEARCH ARTICLE

Application of indole butyric acid (IBA) during layering improves the rooting in guava

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Abstract

The present research was carried out to improve the rooting in guava with the application of Indole Butyric Acid (IBA) different concentrations and layering time at Horticulture farm Malakandair, The University of Agriculture Peshawar, during 2016. Five levels of IBA concentrations i.e. control, 50ppm, 100ppm, 150ppm and 200ppm were applied to guava layered branches during four different date of transplanting. Data showed that different parameters such as number of days to root appearance, root length, number of roots, shoot length, number of shoots, number of leaves, leaf area, chlorophyll contents and percentage survival of plants were significantly affected. Higher success percentage was noted in layering treated with 200 ppm of IBA, detached 4th week as compared to control in 1st week. Maximum root length, number of roots, shoot length, number of shoots, number of leaves, leaf fresh weight , leaf area, chlorophyll contents except number of days to root appearance were noted in 200 ppm in fourth week. While minimum root length, number of roots, shoot length, number of shoots, number of leaves , leaf fresh weight, leaf area, chlorophyll contents and percentage survival of mother plant except number of days to root appearance were noted in control in 1st week. Therefore IBA improve all the morphological traits of guava and thus 200 ppm of IBA is recommended for better growth and development. The main idea of the study was to use the treatment of IBA for the improvement of rooting. For this purpose, we tried to improve rooting of guava using IBA and vegetative propagation. Also it will save the time of the breeder to produce true to type plants.

Key words: IBA, layering, guava, survival, vegetative propagation

Introduction

Guava (*Psidium guajava* L.) is an important subtropical fruit, belongs to the family Myrataceae. It is native to tropical America i.e. Peru, Mexico and Cuba. Its cultivation reported early in the 17th century. Guava fruit contain 10 times more vitamin C than tomatoes, while its juice contains 2 to 5 times more vitamin C than the fresh orange juice. It provides certain essential compounds including protein, water, Ca, P, Fe, thiamine, riboflavin and niacin. Squashes and juices are mostly made from guava fruit (Hartmann *et al.*, 1981). Guava is usually propagated through seed. After extraction, seed are sowed frequently otherwise viability is affected. Seedlings trees are not true to type and generally long lived, which bear fruit of variable size and quality.

Guava is propagated by both, sexual (seeds) and asexual (vegetative parts) method of propagation. Plants propagated through seeds do not perpetuate the exact characters of a particular superior selection in comparison with vegetatively propagated fruit trees. Asexually guava can be successfully propagated by cutting, layering, grafting and budding. Among all the methods of propagation, air layering is one of the oldest techniques which are cheapest, rapid and simple. That's the reason Layering has drawn the attention of guava growers. Through many of them are hardy to root, but can be propagated successfully by using certain root initiating hormones. PGRs are synthetic products, when applied to plants produce reaction almost identical to those caused by natural hormones. Indole Butyric Acid (IBA) is a type of auxin, a growth promoting hormone.

It is believed that leaves on layering and cutting strongly promote root initiation. New techniques have been discussed by scientist all over the world to improve guava production and quality. Invitro propagation and other vegetative methods for breeding were proved very well (Papadatou *et al.*, 1990). These breeding techniques enable researchers to select plants resistant to diseases and environmental stresses (Jaiswal and Amin, 1992). The rooting ability of air layered shoots is decided by several factors that vary with the crops, cultivar and biochemical constituents of the clone (*viz*., carbohydrates, nitrogen, sugars, starch, phenols, auxins levels etc.) and the climatic conditions prevailing in the season (*viz*., temperature, relative humidity, rain fall etc.) of layering. Plant produced through this technique has high multiplication rate, uniform in phenotype, disease free and vigorous growth as compared to conventional growth (Adetiloye *et al.*, 2020). To promote better rooting of a guava layers, all these factors should be at optimum level. However, the success in layering of guava and other fruit crops depends upon mother plants, time of planting, rainfall, humidity, temperature, rooting media, growth media, plant growth regulators and care at the time of removal of bark by ringing of shoots. The present research was designed to explore the response of guava layering after treating with lower concentrations of IBA.

Materials and methods

The research was laid out in RCBD with Split plot Design, replicated 3 times and each replication contains 20 layered branches. Treatments of both the factors as main plot (Transplanting time) (D1= 1st, D2 = 2nd , D3 = 3rd, D4 = 4th weeks), Sub Plot (IBA concentrations) (T0=Control T1 = 50 , T2 = 100, T3 = 150, T4 = 200 in ppm). The parameters like days to root appearance, number of days taken by each layering since time of planting to root appearance and then average value were calculated for each treatment. Length of root of each layered branch was measured in cm with ruler and after average value per layered and per treatment was worked out. The root system was made expose by gently washing the soil with water. After cleaning process number of roots layering-1 was counted. Then average value was calculated for each treatment. Twelve weeks later when the layer were detached from the mother plants and transplanted to moist cool place, the new growth of the plantlets were measured through tap in cm. The shoots number plant-1 was calculated in a sample eight plants and average were worked out. The number of leaves plant-1 was counted in a sample of eight plants and average were worked out. The leaf fresh weight was measured in a sample of eight plants with weight balance. Leaf area meter was used to calculate the leaf area. Chlorophyll contents were measured with the help of spade meter. Survival percentage was calculated as under

$$\text{Percentage of Survival plant} = \frac{\text{Number of plant survived}}{\text{Total number of plants}} \times 100$$

Results and discussion

Statistical analysis showed that date of planting and different IBA concentrations significantly affected root length, roots number, shoot length, number of shoots^{-1}, leaf fresh weight, leaf area, chlorophyll contents, survival of plant (Figures 1 to 8). Regarding interaction, earliest rooting was recorded in 200 ppm IBA treatment at 4th week while, late root appearance was recorded in control at 1st week. Regarding IBA concentrations minimum days to root appearance was recorded at 200 ppm concentration (34). In case of planting time earliest root induction was recorded when branch was detached at 4th week, followed by 3rd week while delayed rooting was noted at 1st week. Results showed that planting time and different concentrations of IBA encouraged early rooting in guava. It is due the small quantity of auxin present in root tip as compared to shoot tip. Hartmann *et al.,* (1982) showed that a gradual decrease in the mean value of days to root appearance with increase in IBA concentration up to 200 ppm.

Number of days to root appearance is significantly affected by IBA. Earlier, reports stated that IBA has direct concern with number of days to root appearance (Bleasdale, 1984). Regarding interaction of IBA maximum root length, number of roots plant^{-1}, shoot length, number of shoots plant^{-1} and number of leaves per plant was recorded at 200 ppm and in 4th week followed by 200 ppm in 3rd week while minimum was recorded in control in 1st week for all the traits. The maximum root length was recorded at 200 ppm concentration (4 cm), while minimum root length was observed in control in (2.6 cm). Regarding planting time maximum number of roots was recorded when branch was detached at 4th week and minimum root length was noted at 1st week. In the current study, root length was increased with increase in IBA concentration. Our results are similar to those reported by Vele et al., (2008), who also reported that by the application of exogenous auxin, root length was increased. Similarly, when different concentrations of IBA and NAA were applied to guava cuttings, their root length was significantly increase (Meahl, 1963). According to Vale *et al.*, (2008), highest rooting percentage, root length and root number had been observed by ABA application at the concentration of 3000 mg L-1. The number of concentrations related to the Root length is positively affected by layering. Manan *et al.,* (2002) got similar results at 1000 ppm (6.5 cm) and control (2.313 cm). In case of IBA concentration, the maximum number of roots plant^{-1} was recorded at 200 ppm concentration (25.5), while minimum number of roots was observed in control (16.3). While regarding planting time maximum number of roots was recorded when branch was detached at 4th week, followed by 3rd week, however, lowest number of root was noted at 1st week. Also increase in concentration of IBA up to 200 ppm the number of roots plant^{-1} was increased. It may be due to active movement of IBA in increases cell wall plasticity and cell division. More ever it is stimulated and then root like growth developed because of auxin application (Weaver, 1972). Blommaert (1958) recorded that in soft wood cutting 75 to 90 per cent rooting occurred with intermittent mist along with IBA treatment. Similarly (Sharma *et al.,* 1978) root formation time is reduced while number of roots increased when IBA applied at the concentration of (200 ppm). In case of IBA concentration maximum shoot length was recorded at 200 ppm concentration (7.9cm). While, In case of date of transplanting maximum shoot length was recorded when branch was detached at 4th week, followed by 3rd week. Patel *et al.,* (1996) reported that increase in IBA concentration increased root length, as a result increase nutrient and moisture uptake take place in the plants. It increased photosynthetic rate in the leaves and hence increased biomass accumulation occurred in plants which promote shoot growth. In case of IBA concentration maximum number of shoots was recorded at 200 ppm concentration (7.3).

While regarding planting time maximum number of shoots was recorded when branch was detached at 4th week, followed by 3rd week, however, delayed minimum number of shoot per plant was noted at 1st week. Growth regulators have the ability to improve root growth and facilitate nutrient and water uptake. Due to increase number of roots per plant, plant start to increased number of shoots to balance root and shoot ratio which is important for survival and environmental adaptation of plants (Troughton, 1956). In case of IBA concentration maximum number of leaves was recorded at 200 ppm concentration (25.5). While regarding planting time maximum number of leaves was recorded when branch was detached at 4th week, however, minimum number of leaves plant^{-1} was noted at 1st week. Regarding interaction the maximum leaf fresh weight was recorded at 200 ppm in 4th week, followed by 200 ppm in 3rd week while the minimum leaf fresh weight was recorded in control in 1st week. In case of IBA concentration maximum leaf fresh weight was recorded at 200 ppm concentration (7.6 g). While regarding planting time maximum leaf fresh weight was recorded when branch was detached at 4th week, however, minimum number of leaves per plant was noted at 1st week. Results showed that increase in IBA concentration leaf fresh weight increased. It may be due the effect of growth regulator on photosynthetic pigments which lead to increase photosynthesis. As a result leaf growth enhanced which also increased leaf biomass. Plant growth regulator improves structural morphogenesis of plastid. This improvement leads to increase biomass accumulation and leaf fresh weight also increased (Arteca and Donga, 1981). The maximum leaf area was recorded at 200 ppm concentration (128.1cm^2) while least leaf area was noted in control (41.2cm^2). In case of planting time maximum leaf area was recorded when branch was detached at 4th week. IBA application increased photosynthesis in the leaves. Due to increase in chlorophyll content improvement in photosynthesis occurs. This encourages new growth and leaf expansion hence exogenous application of plant grows the regulators play vital role in plant growth and development (Mandal and Kumar, 1989). Regarding interaction the maximum leaf area, chlorophyll contents and maximum percentage survival of plant was at recorded at 200 ppm in 4th week while minimum was recorded in control in 1st week. In case of IBA concentration maximum chlorophyll contents was recorded at 200 ppm concentration (38.5) while minimum chlorophyll contents was observed in control (32.3). While, the chlorophyll contents was recorded maximum when branch was detached at 4th week. Results shows that increased in IBA concentration and time of application significantly improve chlorophyll content. It may be due to the positive role of growth regulator in plant growth. Arteca and Donga (1981) reported that IBA application improve ultra-structural morphogenesis of plastids and increase in Rubisco activity. In case of IBA concentration the maximum percentage survival was recorded at 200 ppm concentration (50.0). In case of date of planting maximum plant survival was recorded when branch was detached at 4th week while minimum plant survival was noted at 1st week. Survival rate was significantly increased with increase in IBA concentration. It is attributed to the role of IBA in root induction and growth. Manan *et al.*, (2002) reported that guava cuttings treated with 1000 ppm IBA increased survival percentage. Our results conclude that IBA concentration at different transplanting time of layering is significantly improve growth and development of the guava layered branch. Almost all the growth parameters were significantly affected by different IBA concentration at different date of detachment of layered branch. From the results, it is concluded that guava branches detached on 4th week with application of 200 ppm IBA improve all the morphological traits in guava.

Figure 1: Root length influenced by IBA concentrations and layering time

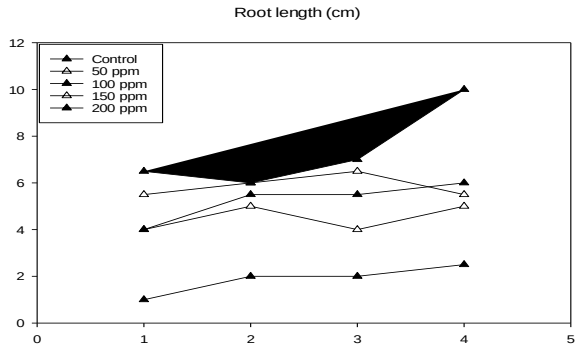


Figure 2: Number of Roots per plant influenced by IBA concentrations and layering time

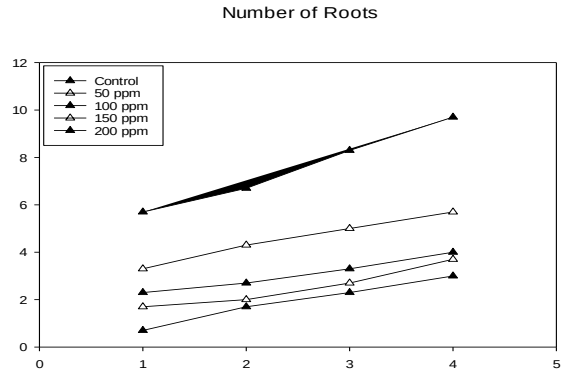


Figure 3: Shoot length (cm) influenced by IBA concentrations and layering time

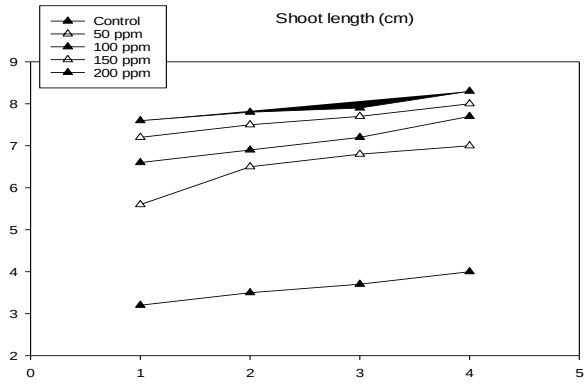


Figure 4: Number of shoots per plant influenced by IBA concentrations and layering time

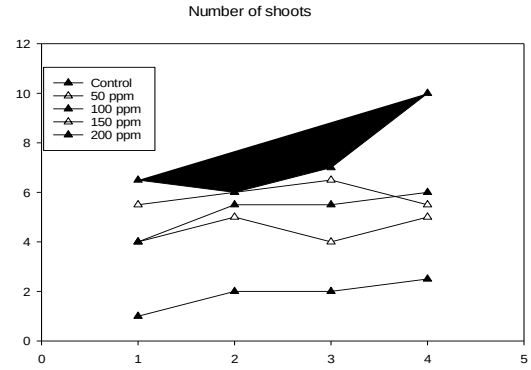


Figure 5: Leaf fresh weight (g) influenced by IBA concentrations and layering time

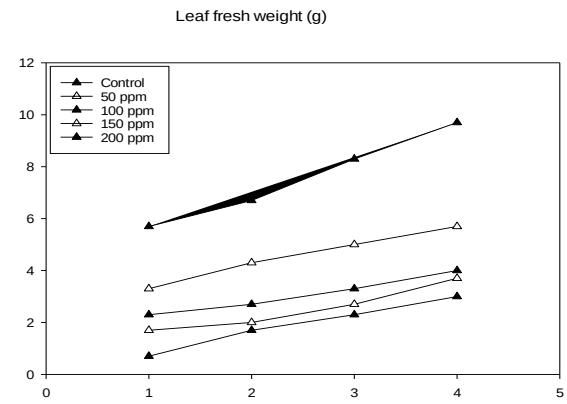


Figure 6: Leaf area (cm^2) influenced by IBA concentrations and layering time

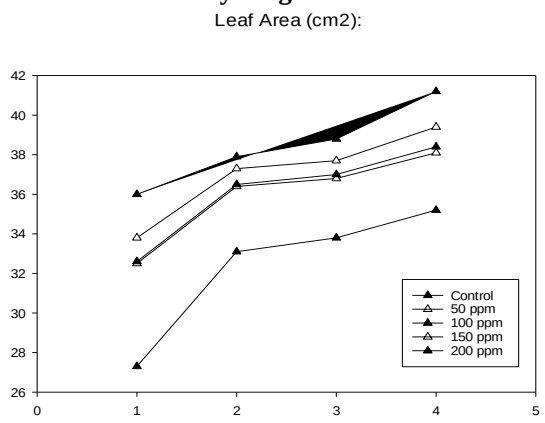


Figure 7: Leaf Chlorophyll content influenced by IBA concentrations and layering time

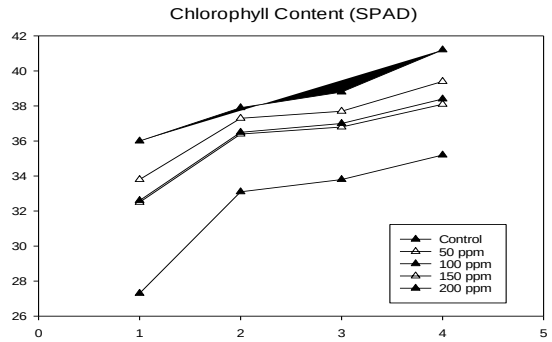
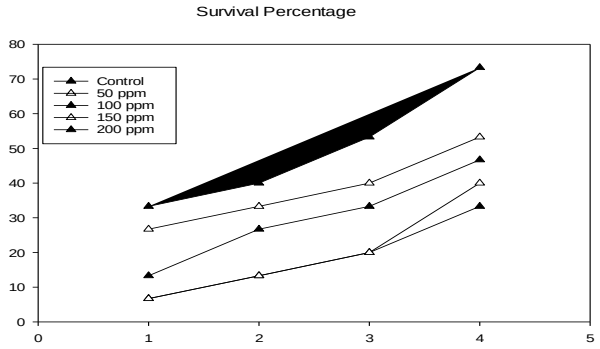


Figure 8: Survival percentage of the plant influenced by IBA concentrations and layering time



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