http://dx.doi.org/10.4314/bajopas.v4i2.31

Bayero Journal of Pure and Applied Sciences, 4(2): 155 – 159
Received: February, 2011
Accepted: November, 2011
ISSN 2006 – 6996

EFFECT OF SOWING MEDIA AND GIBBERELLIC ACID ON THE GROWTH AND SEEDLING ESTABLISHMENT OF *BOUGAINVILLEA GLABRA, IXORA COCCINEA* AND *ROSA CHINENSIS*. 2: ROOT CHARACTERS

***Fagge, A. A. and Manga, A. A.**
Department of Agronomy, Faculty of Agriculture, Bayero University, P.M.B. 3011, Kano.
*Correspondence author: aafagge68@yahoo.com

ABSTRACT
Two pot experiments were carried out in the screen house of the Faculty of Agriculture Bayero University Kano (Latitudes 8^0 42^1N and $9^0 30^1$N) during the wet and dry seasons of 2008/2009 to investigate the effects of Sowing Media and Gibberellic acid (GA_3) concentrations on the growth and seedling establishment of three ornamental plant species. The treatments consisted of three sowing media (Top soil TS, mixtures of Top soil plus Poultry manure TS+PM and Top soil plus Sawdust TS+SD) in the ratio of 2:1, three GA_3 concentrations (0, 100 and 200ppm) and three plant species (Bougainvillea, Ixora and Rose); factorially combined and laid out in a completely randomized design with four repetitions. The results indicated that TS+SD medium gave significantly (P<0.05) higher number of roots and root lengths per plant while the least was with TS+PM medium. TS and TS+SD media were significantly higher than TS+PM medium in terms of root fresh weight and root dry weight per plant. Application of GA_3 at 100ppm compared to 0 and 200ppm concentrations gave significantly (P<0.05) better responses for all the root characters. The same trend was true for Bougainvillea compared to Ixora and Rosa. Hence, based on the outcomes of this experiment, combinations of TS+SD medium and GA_3 at 100ppm concentration are recommended for better root establishment, growth. and development in relation to the three plants under study.
Keywords: Gibbrellic Acid, Sowing Media, Bougainvillea glabra, Ixora coccinea, Rosa chinensis

INTRODUCTION

Ornamental horticulture embraces the art and science of propagating, growing, cultivating and displaying of ornamental plants which are utilized in landscape design where they form such features as roads, paths, walk, edgings, lawns, shrubs and shrubbery, standards, topiaries, hedges, rockery, flower beds and flowering trees (Adriance and Brison; 2000 and Khan, 2000). Ahmed (2000) reported that; government institutions, departments of agriculture and horticultural societies in several countries have now shown the way forward by providing teaching, research and training facilities as well as creating awareness and interest in the field of ornamental gardening.

The increase in demand for quality seeds and seedlings of ornamental plants according to Yusuf (1989) necessitated the need to reproduce ornamental plants species by easy methods of propagation to meet the ever-increasing demand for seedlings. Different growing media that are well aerated, well drained and with good water retention are used in establishing crop plants which are generally referred to as plant substrate or growing medium that comes in form of sand mixed with coconut fibre, rice ashes, and wheat offals (Adams *et al*., 1998). According to Olosunde and Fawusi (2003) one of the most important criteria for successful rooting is a reliable rooting medium. Similarly, Bruce (1993) and Wojtusik *et al*. (1994) reported that the percentage of rooting and quality of root can in many ways be directly linked to the medium itself and that the characteristics of the rooting container and the medium affects the rooting environment. Plants grown in pots, troughs, bags and other containers have restricted rooting due to demand on the medium for air, water and nutrients (Adams *et al*. 1998). Soil or material in combination are usually prepared and mixed to form a rooting environment free from pests, diseases and with adequate air-filled porosity, easily available water and suitable bulk density (Wojtusik *et al*., 1994).

Orlander *et al*. (1991) reported that low bulk densities as found in peat are known to promote root growth in conifers under adequate watering. Locally and readily available materials such as sawdust, peanut hull, rice hull, river sand, coconut fibre, farmyard manure and mixtures of these materials can be used (Ayodele, 1997; Ekwu and Mbah, 2001). Adam *et al*. (1998) however reported that wood fibres are being used to increase air-filled porosity of mixes, but the use of sawdust is limited due to their tendencies of having fungal growth.

According to Olosunde and Fawusi (2003) materials that could be added to the top soil to form a good rooting media includes; peat, leaf mould, plant residues, composted animal, old mortar and crushed bricks. Similarly, Adams *et al*. (2003) working on *Diffenbachia maculata,* reported that; the use of top soil and top soil mixed with either poultry manure or cow dung in different ratios as a growing media could also influence rooting in some ornamental plants.

Lamont and O'Connell (1987) asserted that manure mixed with growing media is fundamental in the sustenance of the dynamic balance of soil nutrients which is a necessity for fruits and healthy plants.

The use of growth regulators such as Indole acetic acid (IAA), indole butyric acid, gibberellic acid (GA_3), naphthalene acetic acid and naphthalene acetamide were also found to stimulate rooting in some cuttings (Singh and Krishnamurthi, 1967; Ahmed, 2000 and Malik, 2000). The objectives of the study were;

(a) To determine the most suitable medium for raising the seedlings of the three woody ornamental plants.
(b) To determine the optimum concentration of the GA_3 that gives the best seedling establishment.
(c) To determine which of the three plants gives the best seedling establishment with regard to growing medium and GA_3 concentration.

MATERIALS AND METHODS

The experiment was conducted in two seasons (Wet and Dry season of 2008/2009). The treatments consisted of three growing media (Top soil, Top soil mixed with Poultry manure and Top soil mixed with Sawdust), three woody plant species (*Bougainvillea glabra*, *Ixora coccinea* and *Rosa chinensis*) and three Gibberellic acid (GA_3) concentrations (0, 100 and 200 ppm) were factorially combined and laid out in a completely randomized design with four repetitions

The top soil, top soil mixed with either poultry manure or sawdust in the ratio of 2:1 was used to fill polythene bags measuring 13cm x 24cm, leaving sufficient space for irrigation. Stem cuttings of 20cm for each of the three plant species were planted after treatment with various concentration of GA_3 as per treatment and irrigated immediately.

The concentrations of 100 and 200ppm of GA_3 were prepared using the standard procedures as described by John (1987). Stock solution of the GA_3 was prepared by dissolving 0.125g of GA_3 powder in a 60ml of distilled water. This stock solution was then used to prepare the different concentrations of the GA_3 as follows:

- 25.0ml of stock solution diluted with 475.0ml of water in a 500ml flask = 100ppm
- 50.0ml of stock solution diluted with 450.0ml of water in a 500ml flask = 200ppm

The basal ends of the stem cuttings (i.e. the supposed rooting ends) for each of the three plants (about 5cm) having at least two buds were dipped into the solutions of the GA_3 as per treatment for one and a half hours, after which they were transplanted into the polythene bags.

Data were collected for the number of number of roots per plant, root length per plant, root fresh weight per plant and root dry weight per plant and these were subjected to analysis of variance (ANOVA) as described by Snedecor and Cochran (1967) using the general linear model in SAS (SAS, 1989) and the treatment means were separated using Duncan's multiple range test DMRT (Duncan, 1955).

RESULTS

Number of Roots Per Plant

TS+SD medium gave a significantly higher number of roots per plant compared to TS and TS+PM media. This was followed by TS medium that has significantly higher number of roots per plant than TS+PM (Table 1).

Application of 100ppm GA_3 gave significantly higher number of roots per plant than the other levels that were statistically similar.

Bougainvillea gave significantly higher number of roots compared to other plants except in the dry season where the number of roots were statistically at par with *Rose*.

Root Length Per Plant

A significant difference in terms of root length was found in which TS+SD has significantly higher root length per plant than TS which was in turn significantly higher than TS+PM medium (Table 2).

Application of GA_3 at 100ppm gave significantly longer roots than 0 and 200ppm concentrations. There was no significant difference observed between the 0 and 200ppm concentration.

Bougainvillea has significantly longer roots than *Ixora* and *Rosa* which were statistically at par with one another in the wet season. In the dry season, the shortest roots were observed on *Ixora,* in the case of the combined, *Bougainvillea* was observed to have longer roots than *Rosa* which was also significantly higher than *Ixora*.

Root Fresh Weight Per Plant

Sowing on TS+PM gave significantly lower root fresh weight than the other media that were statistically at par throughout the seasons and the combined (Table 3).

Application of GA_3 at 100ppm gave significantly heavier root fresh weights than the other levels which were statistically similar.

Bougainvillea produced significantly higher root fresh weights compared to *Ixora* and *Rose*. Similarly, *Rose* fresh root weight was significantly higher than *Ixora*.

Root Dry Weight Per Plant

In the wet season sowing on TS gave higher root dry weights than TS+SD which was in turn higher than TS+PM medium. In the dry season, TS+SD gave higher root dry weight while TS+PM still gave the lowest root dry weight (Table 4).

A highly significant difference was recorded for root dry weights. GA_3 at 100ppm concentration gave significantly higher root dry weight than 0 and 200ppm which were both statistically similar.

Bougainvillea was significantly higher than *Rosa* which was also significantly higher than *Ixora* in terms of root dry weight throughout the sampling period.

Table 1: Effect of sowing media and GA_3 concentration on number of roots per plant of *Bougainvillea, Ixora* and *Rosa* at Bayero University Kano in 2008/2009.

Treatment	Number of roots		
Sowing media	**Wet season**	**Dry season**	**Combined**
TS	22.75b	10.36b	16.55b
TS+PM	2.30c	1.13c	1.72c
TS+SD	28.66a	14.83a	21.75a
SE (±)	1.511	1.390	1.480
GA_3 concentration (ppm)			
0	13.44b	6.47b	9.95b
100	23.91a	12.19a	18.05a
200	16.36b	7.66b	12.01b
SE (±)	1.511	1.390	1.480
Plant species			
Bougainvillea	21.11a	10.27a	15.69a
Ixora	17.05b	6.30b	11.68b
Rosa	15.55b	9.75a	12.65b
SE (±)	1.511	1.390	1.480

Means followed with the same letter within a treatment group are not significantly different at 5% level of probability using DMRT. TS – Top Soil PM – Poultry manure SD – Sawdust

Table 2: Effect of sowing media and GA_3 concentration on root length (cm) per plant of *Bougainvillea, Ixora* and *Rosa* at Bayero University Kano in 2008/2009.

Treatment	Root length		
Sowing media	**Wet season**	**Dry season**	**Combined**
TS	8.19b	3.68b	5.93b
TS+PM	1.16c	0.59c	0.87c
TS+SD	10.18a	5.54a	7.86a
SE (±)	0.542	0.531	0.531
GA_3 concentration (ppm)			
0	5.13b	2.42b	3.77b
100	8.41a	4.55a	6.48a
200	5.98b	2.83b	4.41b
SE (±)	0.542	0.531	0.531
Plant species			
Bougainvillea	7.59a	4.04a	5.81a
Ixora	5.74b	2.10b	3.92c
Rosa	6.19b	3.67a	4.93b
SE (±)	0.542	0.531	0.531

Means followed with the same letter within a treatment group are not significantly different at 5% level of probability using DMRT.
TS – Top Soil PM – Poultry manure SD – Sawdust

Table 3: Effect of sowing media and GA_3 concentration on root fresh weight (g) of *Bougainvillea*, *Ixora* and *Rosa* at Bayero University Kano in 2008/2009.

Treatment	Root fresh weight		
Sowing media	**Wet season**	**Dry season**	**Combined**
TS	0.38a	0.17a	0.28a
TS+PM	0.05b	0.02b	0.04b
TS+SD	0.36a	0.22a	0.29a
SE (±)	0.020	0.020	0.021
GA_3 concentration (ppm)			
0	0.21b	0.10b	0.16b
100	0.35a	0.18a	0.27a
200	0.23b	0.13b	0.18b
SE (±)	0.020	0.020	0.021
Plant species			
Bougainvillea	0.39a	0.20a	0.30a
Ixora	0.15c	0.07c	0.11c
Rosa	0.25b	0.14b	0.20b
SE (±)	0.020	0.020	0.021

Means followed with the same letter within a treatment group are not significantly different at 5% level of probability using DMRT. TS – Top Soil PM – Poultry manure SD – Sawdust

Table 4: Effect of sowing media and GA_3 concentration on root dry weight (g) of *Bougainvillea, Ixora* and *Rosa* at Bayero University Kano in 2008/2009.

Treatment	Root dry weight		
Sowing media	**Wet season**	**Dry season**	**Combined**
TS	0.25a	0.09b	0.17a
TS+PM	0.04c	0.02c	0.03b
TS+SD	0.19b	0.12a	0.16a
SE (±)	0.010	0.010	0.021
GA_3 concentration (ppm)			
0	0.14b	0.05b	0.09b
100	0.21a	0.11a	0.16a
200	0.13b	0.07b	0.10b
SE (±)	0.010	0.010	0.021
Plant species			
Bougainvillea	0.22a	0.11a	0.17a
Ixora	0.09c	0.04c	0.07c
Rosa	0.17b	0.08b	0.12b
SE (±)	0.010	0.010	0.021

Means followed with the same letter within a treatment group are not significantly different at 5% level of probability using DMRT. TS – Top Soil PM – Poultry manure SD – Sawdust

DISCUSSIONS

Number of roots per plant was significantly higher with TS+SD medium compared to the TS and TS+PM media. This could be due to increased aeration and drainage leading to increased porosity that promotes root growth and development. Similar observations were reported by Olosunde and Fawusi (2003) that materials added to the top soil to form a good rooting medium includes peat, leaf mould, plant residues, composting animal, old mortar and crushed bricks. Hence the use of sawdust in this experiment was in agreement with the assertion by Adams *et al.* (1998) that wood fibres are being used to increase air-filled porosity of mixture but the use of sawdust is limited due to their tendencies of fungal growth in fresh forms.

TS+SD medium produced the longest root per plant compared to the TS and TS+PM media. This could be linked to the low bulk density of the TS+SD medium which invariably allows for greater root penetration leading to formation of longer roots even though the rooting environment was limiting in terms of size and depth. This is in accordance with the report by Wojtusik *et al.* (1994) that the soil or material in combination are prepared and mixed to form a good rooting environment free from pests, diseases and with adequate air-filled porosity, available water and suitable bulk density.

TS and TS+SD media gave higher root fresh weights per plant compared to the TS+PM medium. This may be due to the number of roots produced which can directly be correlated with their fresh weights. Longer roots denotes deeper penetration and therefore greater ability in absorption of water and nutrients leading to achievement of heavier root fresh weights in the two media compared to the TS+PM medium.

TS gave significantly heavier root dry weight in the wet season compared to TS+PM and TS+SD media. TS and TS+SD were at par in the combined. TS+SD medium however produced the heaviest root dry weights in the dry season probably due to greater water retention, aeration and availability of adequate nutrients that promoted root growth and dry matter accumulation. This trend may not be unconnected with an observation made by Bruce (1993) and Wojtusik *et al.* (1994) that the influence of the medium is felt even before rooting occurs due to water retention and aeration properties and that the percentage and quality of roots in terms of number, lengths and weights can in many ways be directly linked to the rooting medium itself.

A significant difference was observed with the application of 100ppm of GA_3 being higher than either the 0 or 200ppm concentrations in terms of number of roots per plant. This trend could also be associated with the role of GA_3 as reported by Anonymous (2003) in overcoming dormancy, premature flowering, increased fruit set, hybridization, frost protection and root formation. This was contrary to the recent findings of Anonymous (2008) that GA_3 has a negative effect on rooting. Korkutal *et al.* (2008) also reported that it has a negative effect on the rooting of grape berry. However, plants might have differential responses to GA_3 in terms of rooting as observed in the present experiment.

Application of 100ppm of GA_3 gave rise to longer roots compared to the other concentrations in the plants under study during the wet season and the combined. This is in line with the earlier observation by Janick (1979) that GA_3 application in plants can produce major growth changes such as root formation and root elongation.

Bhattacharya *et al.* (1978) reported an increase in number of roots of *Abelmoschus esculentus* (Moench) cuttings with increasing concentration of IAA (2.5mg/litre of water) and GA_3 (2.0mg/litre of water) and that the effect was more pronounced when the cuttings were cultured in medium containing IAA+ GA_3 than in the medium with only GA_3 or IAA.

The application of 100ppm of GA_3 was found to significantly increase root fresh weight and root dry weight per plant compared to the other concentrations. This result is in accordance with the recent findings by Balaguera-Lopez *et al.* (2009) in an experiment on seed germination and growth of Daniela hybrid tomato soaked for 36 hours in 0, 300, 600 and 900mg GA_3/litre of water and observed that germination percentage, root length, dry matter stem and root fresh matter and leaf area were highest with the 900mg GA_3 concentration. Similarly, in the field, plant height, stem, leaf and root fresh weights, total dry matter and netassimilation rate were found to have given the best response with the 900mg GA_3 concentration.

CONCLUSION

TS+SD medium was significantly higher than TS and TS+PM media with respect to number of roots and root lengths per plant. The least among the media types was the TS+PM medium. TS and TS+SD media were significantly higher than TS+PM medium in terms of root fresh weight and root dry weight per plant. The results also revealed that application of 100ppm GA_3 compared to 0 and 200ppm concentration and *Bougainvillea* compared to the other plants under study gave the best responses with regard to all the root characters. Based on the outcomes of this study, TS+SD and GA_3 100ppm are recommended for good growth and seedling establishment of these three ornamental plants.

REFERENCES

Adams, C. R., Bamford, K. M. and Early, M. P. (1998): *Principles of Horticulture*. 3rd Edition Butterworth – Heinemann. Pp 127 – 148.

Adams, B. A., Osikabor, B., Abiola, J. K., Jaycobs, O. J. and Abiola, I. O., (2003). *Effect ofDifferent Growing Media on the Growth of Dieffenbachia maculata* in Proceedings ofthe 21st Annual Conference of Horticultural Society of Nigeria (HORTSON). Pp 134-135.

Adriance, G.W. and Brison, F.R., (2000). *Propagation of Horticultural Plants*.1st Edition Biotech Books. Tri Nagar, New Delhi – India. Pp 633.

Ahmed, S., (2000). *Vegetative Propagation of Ornamental Plants* In: Malik, N., (2000):*Horticulture.* 1st Indian Edition. Biotech Books. Tri Nagar, New Delhi – India. Pp634–635.

Anonymous (2003). Gibberellins: A Short History. Retrieved fromhttp://www.planthormones.info Long Ashton Research Station.

Anonymous (2008). Auxins: Retrieved From Wikipedia, the Free Encyclopaediahttp://en.wikipedia.org/wiki/Auxins

Ayodele, V. I. (1997): Substrate for the Production of Ornamentals in Nigeria. Proceedingsof the 15th Annual Conference of Horticultural Society o Nigeria(HORTSON), Ago-Iwoye. Pp 58 – 61.

Balaguera-Lopez, H. E., Cardenas-Hernandez, J. F. and Alvarez-Herrera, J. G. (2009):Effect of Gibberellic Acid (GA_3) on Seed Germination and Growth of Tomato (*Solanum lycopersicum L.*). International Society for Horticultural Science (ISHS) – International Symposium on Tomato in theTropics. Pp 238 – 250.

Bhattacharya, S., Bhattacharya, N. C. and Malik, C. P. (1978): Synergistic Effect ofGibberellic Acid and Indole-3-Acetic Acid on Rooting in Stem Cuttings of*Abelmoschus esculentus Moench. Planta* **138:** 111 – 112.

Bruce, M. (1993): *Practical Woody Propagation for Nursery Growers.* Timer Press, Oregon-USA Vol. 1 Pg 669.

Duncan, D. B., (1955). Multiple Range and Multiple F Test. *Biometrice* 2: 1- 42.

Ekwu, G. and Mbah, B. N. (2001): Effects of Varying Levels of Nitrogen Fertilizers and Potting Media on the Growth and Flowering Response of Marigol (*argets erecta L.*). *Nigerian Journal Horticulture* Vol. 5: 105 – 109.

Manick, J., (1979). *Horticultural Science*. W.H. Freeman and Company.Sanfrancisco, USA.

John, M.R., (1987). Gibberellic Acid for Fruit Set and Seed Formation. California Rare Fruit Growers.*CFRG Journal* 19 (1): 10 – 12. Retrievedfrom www.actahort.org

Khan, D. A. (2000): Floriculture and Landscape Gardening: Department of Horticulture,University of Agriculture Faisalbad, PARC, Islamabad, Pakistan. Pp 539 569.

Korkutal, I., Bahar, E. and Gokhan, O., (2008). The Characteristics of Substances RegulatingGrowth and Development of Plants and the Utilization of GA_3 in Viticulture.*World journal of Agricultural Sciences* 4 (3): 321 – 325.

Lamont, G. P. and O'Connell, M. A. O., (1987). Shelf Life of Bedding Plants As Influenced by Potting Media and Hydrigels. *Scientia Horticulture* 31(5): 141 – 146.

Malik M. N., (2000). *Horticulture.* 1st Indian Edition. Biotech Books. Tri -Nagar, New Delhi, India. Pp 633.

Olosunde, O. M. and Fawusi, M. O. A., (2003). Effect of Growing Media on the Rooting of Queen of Philippines (Mussaenda Philippica): *Proceedings of the 21st AnnualConference of Horticultural Society of Nigeria.* Pp 121-126.

Orlander, G., Genimel, P. and Hend, J. (1991): *Site Preparation:* A Swedish Overview, B. C. FRDA. Rep. 05: Victoria BC; Forestry Canada. Pacific Region. Pg 62- 63.

Wojtusik, T., Boyd, M. T. and Felker, P. (1994): Effects of Different Media onVegetativePropagation of Prosopic Cuttings Under Solar Power. *Journal of ForestEcology and Management* **69** (1-3): 26 - 71.

SAS (1989). Statistical Application for Sciences (SAS/STAT) User Guide Version 64: 2 SASInst. Inc. Carry NC, USA.

Singh, S. and Krishnamurthi, S., (1967). *Fruit Culture in India.* 2nd Edition Indian Council of Agricultural Research, New Delhi, India. Pp 176-181.

Snedecor, G. W. and Cochran, W. G., (1976). *Statistical Methods.* The IOWA State University Press. 6th Edition. Ames, IOWA, USA. Pp593.

Yusuf, S., (1989). *Practical Guide for Growing of Flowering Plants in Islamabad and Rawalpindi.* 2nd Edition. Rawalpindi Fauji Fertilizer Co. Ltd. Pp 177.