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EFFECT OF SOWING MEDIA AND GIBBERELLIC ACID ON THE SEEDLING ESTABLISHMENT AND GROWTH OF *BOUGAINVILLEA GLABRA, IXORA COCCINEA* AND *ROSA CHINENSIS*. 1: SHOOT CHARACTERS

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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 seedling establishment and growth 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 and TS+SD gave significantly (P<0.05) greater number of days to bud break, leaf area, leaf fresh weight and leaf dry weight per plant. Application of GA_3 at 100ppm gave higher value of all the characters studied except number of days to bud break, where no significant difference was observed among the different concentrations. Bougainvillea was significantly (P<0.05) higher than the other plants in all the characters except days to bud break. The Combination of TS+SD medium and GA_3 at 100ppm concentration is recommended for the good growth and development of the shoot characters.

Keywords: Gibberellic Acid, Sowing Media, Bougainvillea glabra, Ixora coccinea, Rosa chinensis

INTRODUCTION

The increase in popularity and demand of ornamental plants in developing countries of the world (including Nigeria) may not be unconnected with the roles they play in beautification, modification of the micro climate and the control of erosion (Karikari and Mathews, 1990). However, a number of problems are encountered in their establishment particularly at their seedling stages due to inadequate growth requirements (Oxygen, CO_2 and other Nutrients) and unsuitable growing media which leads to poor seedling establishment and near total loss of the whole plants (Adriance and Brison, 2000). The commonest medium for raising ornamental plants is the soil and this according to Olosunde and Fawusi (2003) has limitations which includes heterogeneity with regard to physical properties (i.e. texture, structure, colour, bulk density and water holding capacity) and chemical properties (i.e. PH).

Good medium is the basic requirement in producing healthy and vigorous plants capable of good seedling establishment. Lamont and O'Connell (1987) reported that the quality of container grown ornamental plants is in broad terms dependent on the physical and chemical composition of the medium and the growing environment among others.

In addition to growing media, growth regulators such as Indole acetic acid (IAA), Indole butyric acid, gibberellic acid (GA_3), naphthalene acetic acid and naphthalene acetamide are being used to stimulate rooting in cuttings (Singh and Krishnamurthi, 1967; Ahmed, 2000 and Malik, 2000). Chemical growth regulators are extensively used in ornamental horticulture industry to reduce plant height and maintain high quality plants during marketing. Janick (1979) reported that plant growth regulators such as gibberellic acid control some processes in the plants such as root growth, prevention or promotion of root elongation, flowering and fruit development. He added that very small concentrations of this acid can produce major growth changes in plants.

Gibberellins (GAs) are plant hormones that regulate growth and influence various developmental processes, including stem elongation, germination, dormancy, flowering, sex expression, enzyme induction and leaf and fruit senescence (Anonymous, 2003). Gibberellic acid is a very potent hormone whose natural occurrence in plants controls their growth and development and hence concentration and timing of application are critical in obtaining profound effects (John, 1987). Korkutal *et al*. (2008) also added that the application time, application dose, the age of the plant and method of application (i.e. by foliar spray or cuttings immersion) are important in obtaining better results. Anonymous (2007) reported that GA_3 is known to have profound effects on overcoming dormancy, premature flowering, increased fruit set, hybridization, increased growth, frost protection and root formation.

MATERIALS AND METHODS

The experiment was conducted in two seasons between July, 2008 to March, 2009 (i. e. Wet and Dry season). 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 concentrations 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 on number of days to bud break, number of leaves per plant, leaf area per plant, leaf fresh weight per plant and leaf 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).

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RESULTS

Number of Days to Bud break

Top soil mixed with poultry manure took significantly higher number of days for the bud to break than the other two treatments which were statistically at par in both seasons as well as in the combined.

There was no significant difference observed with regard to GA_3 application in all the seasons and the combined . *Bougainvillea* and *Ixora* took statistically longer days to break their buds than *Rosa* (Table 1).

Number of Leaves Per Plant

The number of leaves produced by TS (14.2 and 7.4) and TS+SD (11.1 and 8.9) did not differ statistically from one another and were significantly higher than those produced in TS+PM medium. In both seasons, GA_3 applied at 100ppm gave significantly higher number of leaves per plant (12.0 and 7.8 respectively) than 0ppm (7.1 and4.3) and 200ppm (8.2 and 5.3) concentrations. There was no significant difference between the number of leaves induced by 0 and 200ppm concentrations (Table 2).

The number of leaves produced by *Bougainvillea* was significantly higher than those produced by *Ixora* and *Rosa* except in the dry season where it did not differ significantly ($P<0.05$) with *Rosa* (Table 2).

Leaf Area Per Plant

Table 3 shows the leaf area per plant of the different plants as affected by sowing media and GA_3 treatment. In the wet season TS gave statistically higher leaf area than the other sowing media while during the dry season and the combined TS+SD gave a higher leaf area than the other media except in the combined where the difference between TS+SD and TS was not significant.

Application of 100ppm GA_3 resulted in a significantly greater leaf area per plant followed by 200ppm concentration in the wet season and the combined. However, leaf area at 0 and 200ppm did not differ significantly ($P<0.05$) with one another in the dry season but recorded significantly lower measurement compared to 100ppm concentration. *Bougainvillea* produced significantly higher leaf area than the other plants in all the seasons and the combined while the least was *Ixora* in the dry season.

Leaf Fresh Weight Per Plant

The TS+SD medium significantly produced greater leaf fresh weight than TS which was in turn significantly greater than TS+PM in both planting seasons and the combined (Table 4). Gibberellic acid (GA_3) at 100ppm gave significantly greater leaf fresh weight than 0 and 200ppm concentrations which did not differ significantly ($P<0.05$) in all seasons and the combined. *Bougainvillea* had significantly greater leaf fresh weight when compared with *Ixora* and *Rosa* in all the seasons and the combined while *Rosa* had significantly higher leaf fresh weight than *Ixora.* No statistical difference ($P<0.05$) was however observed between *Rosa* and *Ixora* during the wet season.

Leaf Dry Weight Per Plant

With respect to leaf dry weight per plant, the planting medium TS+SD gave significantly greater leaf dry weight than TS+PM but was statistically at par with TS in the wet season. During the dry season and in the combined analysis, TS+SD resulted in significantly greater leaf dry weight than TS which was in turn significantly higher than TS+PM (Table 5).

A significant difference in leaf dry weight was observed with GA_3 treatment at 100ppm, being greater than 0 and 200ppm concentrations in both planting seasons. No statistical difference was obtained between 0 and 200ppm concentrations.

Bougainvillea had significantly greater leaf dry weight (0.21g and 0.16g) compared to *Ixora* and *Rosa* except in the dry season where it was at par (0.12g) with Rosa (Table 5).

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

Treatment	Days to Bud break		
Sowing media	**Wet season**	**Dry season**	**Combined**
TS	9.02a	11.97a	10.50a
TS+PM	2.66b	2.72b	2.69b
TS+SD	8.75a	14.25a	11.50a
SE (±)	0.740	1.701	1.260
GA_3 concentration (ppm)			
0	7.27	9.44	8.61
100	6.33	8.80	8.51
200	6.85	10.19	7.56
SE (±)	0.740	1.701	1.260
Plant species			
Bougainvillea	7.30a	10.66	8.98a
Ixora	8.66a	10.19	9.43a
Rosa	4.47b	8.08	6.27b
SE (±)	0.740	1.701	1.260

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 the number of leaves per plant of *Bougainvillea, Ixora* and *Rosa* planted at Bayero University Kano in 2008/2009.

Treatment	Number of leaves per plant		
Sowing media	**Wet season**	**Dry season**	**Combined**
TS	14.22a	7.38a	10.80a
TS+PM	1.91c	1.08b	1.50b
TS+SD	11.13a	8.88a	10.01a
SE (±)	0.740	0.961	0.840
GA_3 concentration (ppm)			
0	7.08b	4.30b	5.69b
100	12.00a	7.77a	9.88a
200	8.19b	5.27b	6.73b
SE (±)	0.740	0.961	0.840
Plant species			
Bougainvillea	11.88a	7.38a	9.63a
Ixora	8.22b	4.22b	6.22b
Rosa	7.16b	5.75a	6.45b
SE (±)	0.740	0.96	0.840

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 the leaf area (cm^2) per plant of *Bougainvillea, Ixora* and *Rosa* planted at Bayero University Kano in 2008/2009.

Treatment	Leaf area		
Sowing media	**Wet season**	**Dry season**	**Combined**
TS	56.59a	23.28b	39.94a
TS+PM	3.92c	1.74c	2.83b
TS+SD	47.96b	34.96a	41.46a
SE (±)	2.910	3.461	3.531
GA_3 concentration (ppm)			
0	19.52c	9.86b	14.69c
100	62.24a	34.97a	48.60a
200	26.71b	15.15b	20.93b
SE (±)	2.910	3.461	3.531
Plant species			
Bougainvillea	51.48a	25.08a	38.28a
Ixora	27.20b	12.49b	19.84c
Rosa	29.80b	22.40a	26.10b
SE (±)	2.910	3.461	3.531

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 4: Effect of sowing media and GA_3 concentration on the leaf fresh weight (g) per plant of *Bougainvillea*, *Ixora* and *Rosa* planted at Bayero University Kano in 2008/2009.

Treatment	Leaf fresh weight		
Sowing media	**Wet season**	**Dry season**	**Combined**
TS	0.51b	0.27b	0.39b
TS+PM	0.02c	0.01c	0.02c
TS+SD	0.63a	0.43a	0.53a
SE (±)	0.021	0.040	0.032
GA_3 concentration (ppm)			
0	0.29b	0.17b	0.23b
100	0.54a	0.33a	0.44a
200	0.34b	0.21b	0.27b
SE (±)	0.021	0.040	0.032
Plant species			
Bougainvillea	0.55a	0.32a	0.44a
Ixora	0.30b	0.14c	0.22c
Rosa	0.32b	0.24b	0.28b
SE (±)	0.021	0.040	0.032

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 5: Effect of sowing media and GA_3 concentration on the leaf dry weight (g) per plant of *Bougainvillea, Ixora* and *Rosa* planted at Bayero University Kano in 2008/2009.

Treatment	Leaf dry weight		
Sowing media	**Wet season**	**Dry season**	**Combined**
TS	0.21a	0.12b	0.16b
TS+PM	0.04b	0.01c	0.02c
TS+SD	0.22a	0.20a	0.21a
SE (±)	0.021	0.011	0.021
GA_3 concentration (ppm)			
0	0.12b	0.08b	0.10b
100	0.21a	0.15a	0.18a
200	0.14b	0.09b	0.11b
SE (±)	0.021	0.011	0.021
Plant species			
Bougainvillea	0.21a	0.12a	0.16a
Ixora	0.12b	0.08b	0.10b
Rosa	0.14b	0.12a	0.13b
SE (±)	0.021	0.011	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

DISCUSSION

The result of this study indicated that plants grown on the TS+PM medium took fewer days for their buds to break than those planted on the other media types. This relates to the observation made by Adams *et al.* (2003) that a good soil medium is the basic resource in producing healthy and thriving plants. The longer number of days taken by the plants during the dry season for their buds to break may be due to the lower daily temperatures in line with lower sunshine hours (photoperiodism) which invariably affected the physiological processes taking place within the plants that brought about such a delay.

Similarly, number of leaves per plant produced on TS and TS+SD media was significantly higher than TS+PM medium for all the seasons and the combined. This trend may not be unconnected with the assertion made by Olosunde and Fawusi (2003) that the best medium for raising ornamental plants is the soil which has heterogeneity with regard to physical properties (i.e. texture, structure, colour, bulk density and water holding capacity) and chemical properties (i.e. PH and nutrient status). The TS (loam) and the TS+SD proved to be more drained and more aerated thereby promoting rapid absorption of nutrients leading to growth as reported by Yusuf (1989).

With regard to leaf area per plant, TS and TS+SD produced significantly greater leaf area than TS+PM and the combined. However in the dry season, TS+SD medium produced the highest leaf area per plant than others.

This may be due to presence of growth requirements and adequate aeration which might have caused differences in both physical and chemical properties leading to a differential leaf area formation. This is in agreement with the findings of Beardsell and Nichols (1982) that the physical composition of the medium can have a profound effect on the supply of air and water to the growing medium.

The TS+SD medium produced significantly higher leaf fresh weight than the other media types in all the seasons and combined. This could be attributed to availability of nutrients, adequate drainage, better aeration and low bulk density in the medium. Similar observation was made by Adams *et al.* (2003) who reported on the effect of different growing media on the growth of *Dieffenbachia maculata* that plants confined to a container needs a rich, porous medium for their growth and better seedling establishment.

The TS+SD medium gave significantly heavier leaf dry weight per plant throughout the sampling periods except in the wet season where there was no difference with TS medium. This is in accordance with the findings of Lamont and O'Connell (1987) who reported that the quality of container grown ornamental plants is in broad terms dependent on the physical and chemical composition of the medium and the growing environment among other things.

No visible effect was observed with regard to number of days to bud break with application of all the three GA_3 concentrations in all the seasons. This may be attributed to inability of GA_3 in initiating bud break in plants especially when used singly as reported by Anonymous (2008) and Korkutal *et. al* (2008). Application of 100ppm GA_3 gave significantly higher number of leaves per plant and leaf area per plant compared to the 0 and 200ppm concentrations in all the seasons and the combined. This trend is in consonance with the earlier findings by Sarkar *et al.* (2002) who reported that application of 100ppm of GA_3 on soybeans enhanced plant heights, number of branches, number of leaves, leaf area, number of flowers, number of pods and number of seeds per plant.

With the application of 100ppm of GA_3 leaf fresh weight per plant and leaf dry weight were found to be higher compared to 0 and 200ppm concentrations. This could be linked to the role of GA_3 in increasing growth, tissues differentiation and enhanced dry matter accumulation in plants as reported by Anonymous (2003), Anonymous (2007) and Anonymous (2008).

The TS+SD medium with 100ppm of GA_3 concentrations produced the greater leaf fresh and dry weights per plant compared to TS and TS+SD and other GA_3 concentrations. Application of 100ppm of GA_3 on *Bougainvillea* was found to produce the highest leaf area per plant compared to the 0 and 200ppm concentration and other plants under study. The trend in *Bougainvillea* could be linked to the role of GA_3 in promoting shoot growth as reported by Kamuro (2005) in an experiment with Camphora trees. The least leaf area was with *Ixora* under "0" application of GA_3 probably due to its genetic make up and the structure of its leaves which are smaller and thicker than those of either *Bougainvillea* or *Rosa*.

CONCLUSIONS

Based on the outcomes of the experiment, it can be inferred that TS+SD medium and GA_3 at 100ppm concentration resulted in greater growth and may be recommended for use in these three ornamental plants for better shoot growth. Of these three plants, *Bougainvillea* responded better to the sowing media and the GA_3 concentration. More studies on this using other hormones or a combination of the hormones are recommended in order to determine which hormone and which concentration will induce greater growth and flowering of these plants.

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