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Production of Quality Croton (*Codiaeum variegatum*) Plants by Using Different Growing Media

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Abstract: For environmental sustainability it is the need of time to decrease the use of chemical fertilizers and increase the use of organic fertilizers by utilizing different composts. Therefore, the present study was initiated to evaluate the effect of different growing media on the growth of *Codiaeum variegatum* cultivar "Gold Sun". Different growing medium which includes normal soil, perlite, silt, sand, leaf compost, farm yard manure and spent composts (Button and Oyster) were used in different combinations for growing of croton plants. The results indicated that T_7 which was combination of sand + silt + leaf compost + spent compost (button) in ratio of (1:1:1:1), proved to be the best medium for growth and development of croton plants followed by T_9 (sand + silt + leaf compost + spent compost (oyster) (1:1:1:1). Analysis of potted medium reflected that medium with low nutrients, organic matter and water-holding capacities, can be amended with different organic materials with different combinations at different rates.

Key words: Potting medium · Properties of media · Gold Sun

INTRODUCTION

There is a continuing interest by using various agricultural by-products as an organic nutrient source for plants due to increasing awareness of environment-related issues, as well as the need to dispose of and use rising amounts of waste [1]. Recycling organic waste including dung of dairy cattle, poultry waste and animal litter are used as main source of organic matter for supply of essential minerals needed to plants [2-4]. A key advantage for using composted material is its potential to resist against root diseases [5] and also composts from waste material have the potential to substitute a significant proportion of peat in the growth medium of potted ornamentals [6].

Codiaeum variegatum is one of the most popular grown indoor plants which belongs to family Euphorbiaceae and comprised of around 1,300 species which are widespread in tropical regions of the world [7,8]. These tropical plants are native to Malaysia and East Pacific [9] and requires semi shade and well rotten compost for ideal growth. Croton plants have attained a prominent place among foliage plants due to its adaptation to indoor conditions, leaf shape, color range and specimen planting in the shaded landscape. Most of the croton species have narrow colored leaves. Foliage beauty of croton is fully depends upon potting media, because media plays a vital role in growth and production of plants [10,11]. A light, rich, well drained soil is considered ideal for croton and intense red color leaves were observed in growth media that contained compost [12] with a pH slightly below or above the neutral point [13]. These plants are notoriously rank feeders and require abundant quantities of plant food to attain maximum development. Therefore, adequate quantities of manure or compost need to be incorporated in the substrate to planting media [14].

The physical and chemical properties of soil, texture, structure, density, consistency, saturation percentage, color, organic matter as well as nitrogen, phosphorus and potassium concentration of soils are dominant factors affecting the use of soil as a media for plant growth. These properties determine the availability of nutrients to plants, mobility of water into or through soil and penetration of roots in the soil. Soil mixes play an important role in pot plant production. Their chemical and physical properties determine the nutritional status of potting media to sustain better plant growth [15]. Composition and nutritional status of media is reported by Khasa *et al.* [16] and Carlile [17] to be helpful to produce quality indoor plants with more number of leaves and greater size. The purpose of this study was to investigate the influence of growing substrates composition on the growth and development of a popular indoor plant croton

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grown as container plant. The chemical analysis of these medium are also correlated with growth and production performance of the croton.

MATERIALS AND METHODS

The present study was conducted in the Floriculture area, Institute of Horticultural Sciences, University of Agriculture, Faisalabad. Different substrates: perlite, spent compost of mushroom and farm yard manure (F.Y.M.) and leaf compost were used as main source for preparation of media with combinations of normal garden soil, sand and silt. Different treatment combinations were, T_0: soil (control), T_1: sand + perlite (1:1), T_2: sand + perlite + silt (1:1:1), T_3: sand + soil + farm yard manure. (1:1:1), T_4: sand + spent compost (button) (1:1), T_5: sand + perlite + spent compost (button) (1:1:1), T_6: sand + silt + leaf compost (1:1:1), T_7: sand + silt + leaf compost+ spent compost (button) (1:1:1:1), T_8: sand + perlite + spent compost (oyster) (1:1:1), T_9: sand + silt + leaf compost + spent compost (oyster) (1:1:1:1), T_{10}: sand + silt + spent compost (button) + spent compost (oyster) (1:1:1:1), T_{11}: silt + spent compost (button) + spent compost (oyster) (1:1:1) on the growth and development of *Codiaeum variegatum*.

Clay pots (12″ size) were filled with different potting media as described and 6″ long cuttings of croton cultivar "Gold Sun" were planted in it in the month of August. The experiment was carried out under natural green house conditions and laid out according to Complete Randomized Design having single cutting as experimental unit with three replications. Data were collected fortnightly. Observations on the following parameters were recorded using the standard procedure: number of sprouted buds, mortality rate (% age), number of leaves per plant, plant height (cm), leaf area (cm^2), number of roots per plant and root length per plant (cm). Data obtained was analyzed using Fisher's analysis of variance technique. The experiment was laid out in complete randomized design (CRD) having single cutting as experimental unit with three replications. Number of sprouted buds, number of shoots, number of leaves per plant, plant height (cm), leaf area (cm^2), number of roots per plant and root length (cm) were determined. The properties of each medium, including water holding capacity (saturation percentage), pH, total nitrogen, available phosphorus and available potassium were also determined. Significant means were compared by using Duncan's Multiple Range (DMR) test at 5% probability level [18].

Analysis of Media: Following information was procured in relation to each soil medium.

Water Holding Capacity (Saturation Percentage): The saturated soil paste was prepared according to US Salinity Laboratory Staff [19]. It was oven dried at 100 degree centigrade till the constant oven dried weight was observed. Saturation percentage was calculated by the formula:

$$\frac{\text{Loss in weight of soil}}{\text{Dry weight of soil}} \times 100$$

pH: The pH was measured by using digital ion analyzer (pH meter). Saturated soil paste was prepared with distilled water and allowed standing for one hour. Electrodes were inserted into the paste and was raised and lowered repeatedly until a representative pH reading was obtained by US Salinity Laboratory Staff [19].

Total Nitrogen: Kjeldahl's apparatus (Timberline Instruments, USA) was used for nitrogen determination. The nitrogen in the sample was converted to NH_4^+ form by digestion with concentrated H_2SO_4 and digestion mixture. On cooling the contents was transformed to 100 ml volumetric flask and made up the volume. The distillation was carried out in micro kjeldahl apparatus using boric acid and methyl red as indicator. The titration was done with standard H_2SO_4 to determine total nitrogen in soil sample [20].

Available Phosphorus: 1.25g of soil media was taken and 25 ml of extracting solution was added into it and shake for 30 min, then filtered. 1 ml of filtered material was taken in beaker and 3 ml of distilled water was added, then 1 ml of color developing reagent was added and stirred. It was stand for 15 min and reading was observed at 880mU on the Spectrophotometer, model spectrum 21. P was calculated by using the formula.

ppm from curve x 25 ml/ 1.25 gm x 5ml/ 1ml = ppm of P [21]

Available Potassium: The flame photo metric method was used for estimation of Potassium.

meq/1 pf K^+ = meq/1 of K^+ by calibration curve x 50 ml of sample [19].

RESULTS AND DISCUSSION

A comprehensive study on efficacy of various potting media was conducted and correlated between plant growing media, nutrients up take by plant and different growth response in plants.

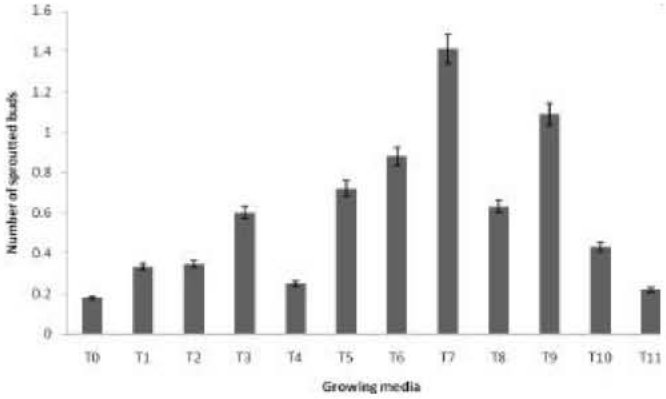

Fig. 1: Effect of different potting media on number of sprouted buds per plant of Croton

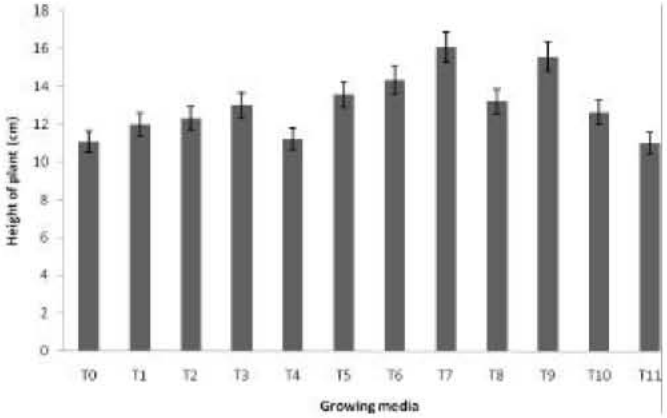

Fig. 2: Effect of different potting media on number of sprouted buds per plant of Croton

Data in Fig. 1 revealed that T_7 (sand + silt + leaf compost + spent compost (button) (1:1:1:1) had maximum (1.412) number of sprouted buds followed by T_9 (sand + silt + leaf compost + spent compost (oyster) (1:1:1:1) which gave 1.089 sprouted buds per plant and showed superiority over other treatments. The treatments T_8, T_3 and T_{10} were statistically at par with each other and showed non-significant results while T_0 (normal soil) had the minimum (0.179) number of sprouted buds per plant. An overview indicated that different manures in combination with soil exhibited better results. Increase in number of leaf buds per plant was evident after the application of organic residues which provided soil with high nutrients (N, P and K) concentration [3, 4, 22-24]. Several authors have reported that compost additives have significant effects on compost quality and thereby on plant growth by influencing the nitrogen availability [25, 26]. Data recorded on the number of leaves have indicated that the croton plants procured the maximum number of leaves in T_7. Visualizing an overall situation, it was observed that T_7 had maximum (14.59) number of leaves followed by T_9 which gave 14.05 leaves per plant. The treatments T_5, T_8, T_3 and T_{10} were statistically at par with each other and showed non significant results, while T_0 (normal soil) had the minimum (8.22) number of leaves. Results indicated that best results could be achieved by a combination of compost and soil. These results are in agreement with the finding of Riaz *et al.* [3], Younis *et al.* [4], Bugbee [10], Wilson *et al.* [11] and De Boddt and Verdonok [27]. Data on number of shoots have indicated that there occurred only one shoot for all the treatments no additional shoots were developed during this period of study. More time may be required for the development of secondary shoots.

Fig. 2 showed a significant superiority in plant height of T_7 (sand + silt + leaf compost + spent compost (button) (1:1:1:1) (16.08) and T_9 (sand + silt + leaf compost+ spent compost (oyster) (1:1:1:1) (15.58) over rest of the treatments, followed by T_6 (sand + silt + leaf compost (1:1:1) which ranked secured 2nd best position, but these were non significant among each other. T_0 (normal soil) (11.09) occupied the lowest height of plants. Martinez *et al.* [28] they obtained the highest plant height of dieffenbachia by using peat + bark as

Table 1: Properties of media

Treatment	pH	Total Nitrogen (%)	Available Phosphorous Conc.(ppm)	Available Potassium Conc. (meq l^{-1})
T_0	7.15	0.07	7.20	28.60
T_1	8.60	0.19	7.32	41.05
T_2	8.60	0.30	6.97	57.23
T_3	8.61	0.33	7.87	114.10
T_4	8.50	0.09	6.35	33.35
T_5	8.40	0.29	7.35	117.79
T_6	8.35	0.51	26.80	118.45
T_7	7.34	0.42	30.46	137.60
T_8	8.29	0.15	14.06	112.90
T_9	8.09	1.28	20.01	121.40
T_{10}	7.81	0.35	10.22	53.20
T_{11}	7.28	0.42	8.20	37.20

media and contemporary with the conclusions of Poole [29] and Logan *et al.* [30] who reported the suppressing effects on growth. It was observed that the normal soil alone showed very poor results as compared to other media. Results have indicated the combination of sand, silt, leaf compost and button gave the highest plant height as compared to other treatments. Results recorded on number of roots showed superiority of a single treatment over the others on the whole, T_7 (sand + silt + leaf compost + spent compost (button) (1:1:1:1) (37.15) and T_9 (sand + silt + leaf compost + spent compost (oyster) (1:1:1:1), (36.55) got the maximum and T_0 (normal soil) obtained lowest (27.30) number of roots. This gives an indication that it might contain nutrients in a low quantity for the inducement of the roots than mushroom substrate and leaf manure. These results are in accordance in with the findings of Riaz *et al.* [3], Younis, *et al.* [4], they obtained better root system by using german peat calcined clay and peat perlite as media respectively. These observations are dissimilar with the results of Poole and Conover [31].

It was noted that T_7, T_6 and T_9 with leaf compost as main source shows more leaf area as compared to rest of the treatments. However T_5 and T_8 with mushroom substrate has attained second position regarding leaf area. While (T_{10}, T_2, T_{12}) are non significant with T_8. T_0 with 100% soil gained lowest position.

It was noted that T_7 (sand + silt + leaf compost + spent compost (button) (1:1:1:1) and T_6 (sand + silt + leaf compost(0.50) occupied 2nd position with leaf compost as main source shows more leaf area as compared to rest of the treatments. While T_5 and T_8 with mushroom substrate has attained second position regarding leaf area. While (T_{10}, T_2, T_{12}) are non significant with T_8. T_0 with 100% soil gained the lowest position.

The physical and chemical properties of soil, texture, structure, density, consistency, saturation percentage, color, organic matter as well as nitrogen, phosphorus and potassium concentration of soils are dominant factors affecting the use of soil as a media for plant growth. These properties determine the availability of nutrients to plants, mobility of water into or through soil and penetration of roots in the soil. Soil mixes play an important role in pot plant production. Their chemical and physical properties determine the nutritional status of potting media to sustain better plant growth [15]. Data on water holding capacity showed a wide range of overlapping of the treatment means. This gross overlapping is difficult to establish the superiority of a single treatment over the others on the whole, T_{10} (sand + silt + spent compost (button) + spent compost (oyster) (1:1:1:1) got the maximum (71.69) and T_{11}: silt + spent compost (button) + spent compost (oyster) (1:1:1) (62.25) occupied 2nd position. T_0 (normal soil) obtained lowest (44.35). Composted manure plays an essential role for plants grown without fertilization because it causes positive initial plant growth due to increase porosity of soil, improvement in the physical structure, aggregation and saturation percentage of soil [32-34]. Overall response of croton based on different parameters varied with the pH of the media. Maximum number of buds sprouted / plant, number of leaves and plant height was observed in treatment T_7 (sand + silt + leaf compost+ spent compost (button) (1:1:1:1) with pH 7.34.

The number of buds, number of leaves and plant height has positive correlation with soil nitrogen contents [35]. This may be due to high nitrogen percentage. It was noted that T_7 (sand + silt + leaf compost+ spent compost (button) (1:1:1:1) got the maximum (30.46) and T_6 (sand + silt + leaf compost(26.80) occupied 2nd position with leaf compost as main source showed more available phosphorus as compare to rest of the treatments (Table 1). The minimum available phosphorus (6.35) was recorded in treatment T_4. The treatment T_5 and T_1 were

non-significant regarding available phosphorus. The minimum available potassium (28.60) was recorded in treatment T_0 (normal soil). The treatments showed a linear increase in available potassium and all the treatments gave significantly different results, while the highest was recorded in T_7 (137.6)

From the all above discussion it is cleared that the T_7 medium (sand + silt + leaf compost+ spent compost (button) (1:1:1:1) showed the best result for the production of croton plants. T_7 medium is considered best medium due to its texture, structure, density, consistency, saturation percentage, color, organic matter as well as nitrogen, phosphorus and potassium concentration.

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