Turmeric Growth and development under Tropical Nursery Conditions at Basmath Tahsil of Hingoli district in Maharashtra

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Abstract: The present investigation has mainly devoted to find out the correlation between soil characteristics and different stages of turmeric crop. Here, in the study, rate of germination, growth and health status of the crop and yield of turmeric have mainly been correlated with soil characteristics. The data on effect of soil type on fruit yield per plant was represented in the present study. The average yield of turmeric grown only in soil ranges from 0.7728 kg to 1.5792 kg. The minimum yield of turmeric was obtained in soil from the study site 1 (Viregaon) while the maximum yield was obtained in at study site 28 (Kurunda). The average yield of turmeric grown in soil with biomass ranges from 0.6636 kg to 1.8228 kg. The minimum yield of turmeric was obtained in soil from the study site 4 (Kaudgaon) while the maximum yield was obtained in at study site 25 (Murumba). The average yield of turmeric grown in soil with chemical fertilizer ranges from 0.42 kg to 1.36 kg. The minimum yield of turmeric was obtained in soil from the study site 19 (Satefal) while the maximum yield was ontained in at study site 3 (Telagaon).
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Introduction

Turmeric (*Curcuma longa*) is an important spice used in many culinary preparations (Balashanmugam and Chezhiyan, 1986). It is a tropical herb, of either Indian or Chinese origin (Chattopadhyay et al., 2004). India was the only significant producer and supplier of turmeric to the international market (Davamani and Christopher, 2006) prior to 1980 (Madhuri et al., 2006) However, in recent years China, Costa Rica, Peru and Pakistan have also emerged as the producers of turmeric (Meerabai et al., 2000 and Davis, 2007) and are now competing with India in world market (Olojede et al., 2009). The crop is cultivated in central and southern states of the country mostly in Andhra Pradesh, Orissa, Tamil Nadu, Maharashtra, Kerala, Bihar and Assam (Pullipalayam and Muthuraman, 2008 and Rao and Rao, 1988). Iran, Libya, Japan, Morocco, USA, UK and Singapore are the major importers of Indian turmeric **(**Sigrist**,** et al., 2011**).**

Turmeric is one of the most important and ancient spices of India (Ahmed, et al., 1981). There is very good commercial value for the by-products like spice oils, oleoresins and others (Alireza and Farhang, 2011). Turmeric has an intrinsic property of imparting a typical flavor and colour due to the presence of the chemical ***Curcumin*** (Jagadeeswaran and Murugappan, 2005). India is one in the World, in terms of production, consumption and higher exports (Harikrishna, et al., 2002). Indian turmeric has gained popularity in the global market and is considered the best due to the high curcumin content (Rao and Reddy 1977). The origin of turmeric is unknown, but it probably originated in western India. The yellow spice is botanically referred to as *Curcuma longa L.* It belongs to the family Zingiberaceae (Ahmed et al., 1981). The commercial part is rhizome or underground stem. The Indian vernacular names are pasupu, haldi, manjal, etc.

India has a rich history of using plants for medicinal purposes. Turmeric (*Curcuma longa L.*) is a medicinal plant extensively used in Ayurveda, Unani and Siddha medicine as home remedy for various diseases (1, 2). C. *longa L.*, botanically related to ginger (Zingiberaceae family) is a perennial plant having a short stem with large oblong leaves and bears ovate, pyriform or oblong rhizomes, which are often branched and brownish-yellow in color. Turmeric is used as a food additive (spice), preservative and colorings agent in Asian countries, including China and South East Asia (Oosterbaan, 1990). It is also considered as auspicious and is a part of religious rituals. In old Hindu medicine, it is extensively used for the treatment of sprains and swelling caused by injury (Anonymous, 1973). In recent times, traditional Indian medicine uses turmeric powder for the treatment of biliary disorders, anorexia, coryza, cough, diabetic wounds, hepatic disorders, rheumatism and sinusitis (Balashanmugam and Subramanian, 1991). In China, C. *longa* is used for diseases associated with abdominal pains (Balashanmugam, et al., 1993). The colouring principle of turmeric is the main component of this plant and is responsible for the anti-

inflammatory property (Sigrist, et al., 2011 and Farooqi and Zafar, 2009).

Study Area

The present study deals in Basmath tahsil of Hingoli district. It lies between 19^0 19' 12''N and 77^0 19' 12''E. Mean sea level rewarded in between 540 and 364meter. Study area occupies 932.38 sq.km of area Also Basmath tahsil comprise 151 villages.

Materials and Methods

Turmeric crops are harvested after 244 days from the date of cultivation on the date of 2 February 2012 and Observed for usable and non-usable. From useable and non-useable ingredient the yield of useable ingredient is measured by electrical weight balance (in kg) for all 108 plants.

Germination and Growth of Turmeric

Present study deals with collection of soil sample from study area by using random sampling method. Using above sampling method 36 soil samples are collected and placed at viregaon Village for further operation. Out of these 36 samples, each sample divided into 3 bags and designated by letters A, B and C. A- bag contains only soil sample, B- bag contains soil with biomass, C- bag contain soil with chemical fertilizers.

This sample classification has been bag prepared. In this way total 108 samples are prepared for A, B and C bag. On the date of 19 may 2011 seeds had been sowed in all 108 bags and seed germination observation made between the period of 5 June 2011 to 12 June 2011.

Seed germination observation has been made and it consists of following pattern. First observation made after 45 days from the date of calculation on the date of 5 July 2011. Second observation has been made after 75 days on the date of 5 August 2011. In this way total 7 Observation made. During these 7 observation height of bark, height of plant and length of leafs determined with the help of measuring tape. Leafs, and foliage measured in numbers with the help of above measured in numbers with the help of above 5 methods and attempts has been made to study the growth of turmeric plant.

Fig. 1 showing cultivation of plants in necessary conditions in from of study area

Results & Discussion:

The results on seed germination as influenced by bio fertilizer and chemical fertilizer application and their interaction are presented in table 4.1 to 4.1.1 and (figure 4.1 to 4.1.3). The number of seed germinated in bag A was 9 irrespective on application of bio fertilizer and chemical fertilizer on day 17. While 8 seeds were germinated in bag B which was treated with bio fertilizer on day 15 and 10 seeds were germinated in bag C which was treated with chemical fertilizer on day 16. The difference in number of germinated seeds due to application of bio fertilizer and chemical fertilizer was found to be significant.

The results obtained from the studies carried out on the effect of soil, bio fertilizer and chemical fertilizer on the yield of turmeric are as follows.

The data on effect of soil type on fruit yield per plant was represented in table 5.1 and figure 5.1. The average yield of turmeric grown only in soil ranges from 0.7728 kg to 1.5792 kg. The minimum yield of turmeric was obtained in soil from the study site 1 (Viregaon) while the maximum yield was obtained in at study site 28 (Kurunda).

The results of the turmeric yield in soil with biomass addition were represented in figure 5.2. The average yield of turmeric grown in soil with biomass ranges from 0.6636 kg to 1.8228 kg. The minimum yield of turmeric was obtained in soil from the study site 4 (Kaudgaon) while the maximum yield was obtained in at study site 25 (Murumba).

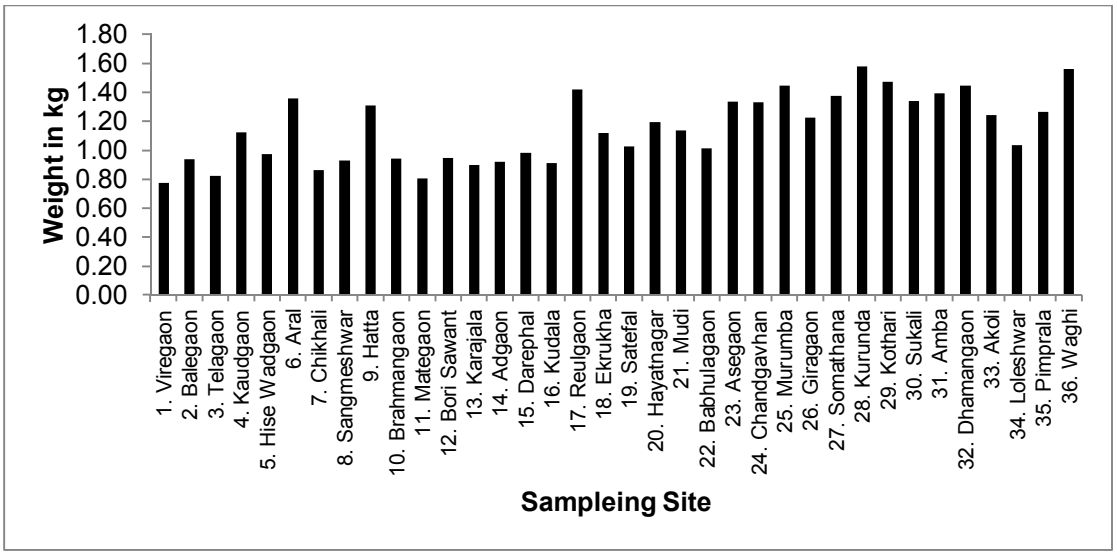

Fig 1: Turmeric weight Observation Data Bag: B in kg (Soil with Biomass)

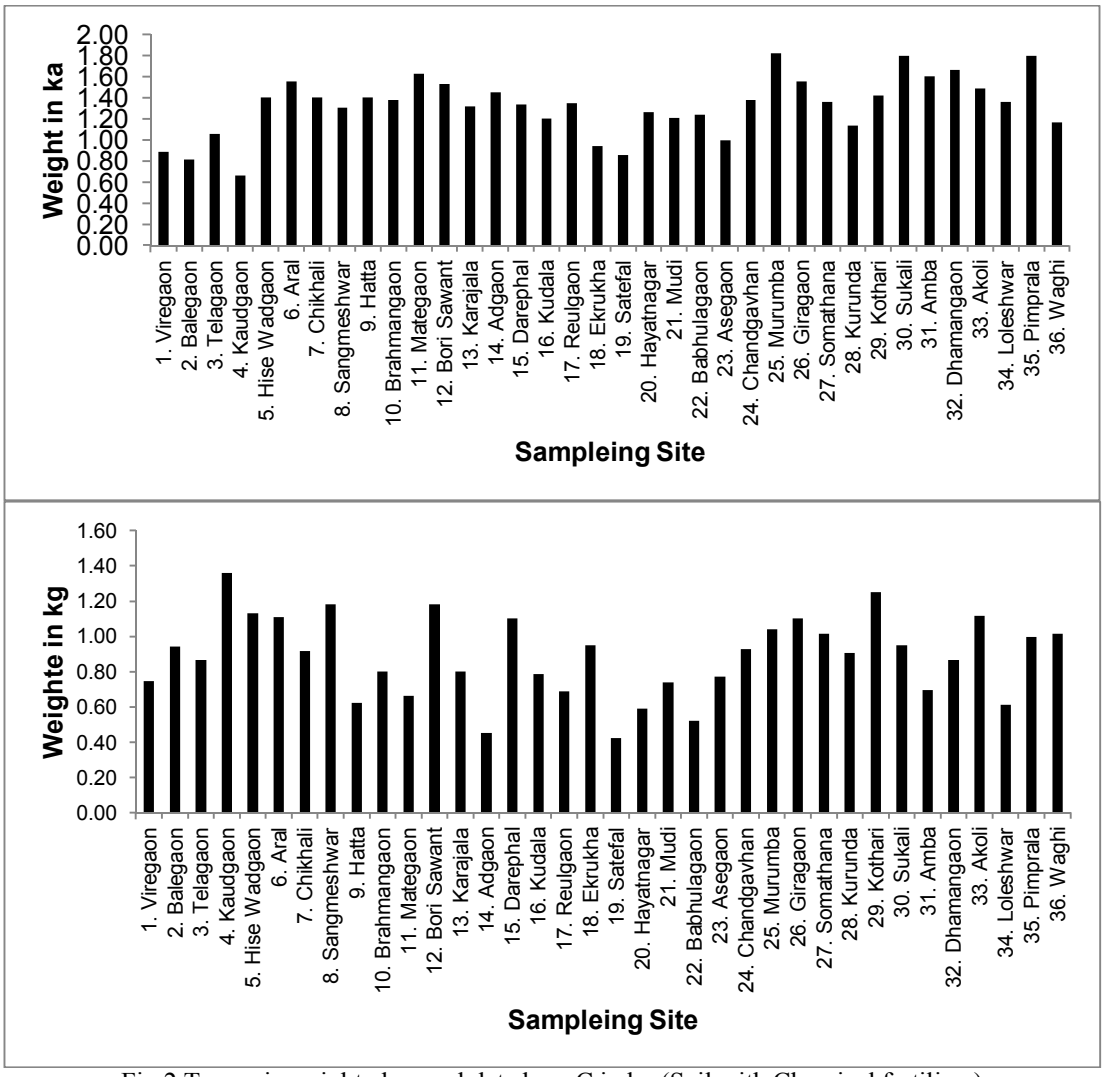

Fig 2 Turmeric weight observed data bag: C in kg (Soil with Chemical fertilizer)

The results of the present research work on turmeric yield in soil with chemical fertilizer addition were represented in table 5.3 and figure 5.3. The average yield of turmeric grown in soil with chemical fertilizer ranges from 0.42 kg to 1.36 kg. The minimum yield of turmeric was obtained in soil from the study site 19 (Satefal) while the maximum yield was obtained in at study site 3 (Telagaon).

The turmeric yield per plant was significantly influenced by bio fertilizer levels. The highest fruit yield of 1.8228 kg per plant was recorded in soil of Murumba with addition of bio fertilizer which was followed by only soil of Kurunda and soil with chemical fertilizer treatment of Kaudgaon.

Effects of soil type, biomass and chemical fertilizer on turmeric growth and health status

In the present investigation, the average height of bark of the plant was obtained as 11.03 cm in bag: A, 10.44 cm in bag: B and 9.06 cm in bag: C after 45 days. The average height of plant of the plant was obtained as 31.75 cm in bag: A, 36.53 cm in bag: B and 28.86 cm in bag: C after 45 days. The average length of leaf was obtained as 27.25 cm in bag: A, 24.86 cm in bag: B and 25.17 cm in bag: C after 45 days. The average number of leaf was obtained as 2.03 in bag: A, 1.89 in bag: B and 1.56 in bag: C after 45 days. The average number of foliage was obtained as 1.33 in bag: A after 45 days. The average height number of foliage was obtained as 1.19 in bag: B after 45 days' his average number of foliage was obtained as 1.17 in bag: C after 45 days.

In the present investigation, the average height of bark of the plant was obtained as 57 cm in bag: A, 57 cm in bag: B and 65 cm in bag: C after 218 days. The average height of plant of the plant was obtained as 171 cm in bag: A, 171 cm in bag: B and 192 cm in bag: C after 218 days. The average length of leaf was obtained as 101 cm in bag: A, 101 cm in bag: B and 111 cm in bag: C after 218 days. The average number of leaf was obtained as 24 in bag: A, 24 in bag: B and 24 in bag: C after 218 days. The average number of foliage was obtained as 3 in bag: A after 218 days. The average number of foliage was obtained as 3 in bag: B after 218 days. The average number of foliage was obtained as 3 in bag: C after 218 days.

The above our findings were supported by several researchers. Dash et al, 2005; Belnar et al, 2001) conducted a field experiment to study the effect of integrated nutrient management on growth and dry matter accumulation of soybean. Results of the investigation showed that plant height (42.18 cm), number of branches plant-1 (4.31), leaf area index (3.01), dry matter accumulation (16.63 g/plant), number of nodules plant-1 (3.46), their dry weight (6.66 Mg/plant) and seed yield (14.72 q/ha) were found to be higher with the application of crop residue at 5 t ha^{-1} + FYM at 5 t ha^{-1} + Zn at 5 kg ha^{-1} over FYM at 5 t ha- 1 (40.29 cm, 4.16, 2.83, 16.10 g/plant, 2.67, 4.78 mg/plant, 13.65 q/ha, plant height, number of branches/plant, leaf area index, dry matter accumulation, number of nodules/plant, dry weight of nodules and seed yield, respectively).

Kannan et al 2006; Melda, and Ceyhun, 2008) reported that the application of nitrogen through different organic sources significantly influenced the tomato growth and yield. Among the different organic sources, substitution of 100 per cent N through FYM recorded higher plant height, number of branches plant-1 and yield comparable with that of 100 per cent RDN through urea.

Effects of soil type, biomass and chemical fertilizer on turmeric yield

The production of economic yield in any crop generally depends upon the cumulative effects of interactions among several factors such as genetic makeup of crop variety, climatic factors, mineral nutrition and cultural practices adopted. Various environmental factors such as temperature, light, rainfall and relative humidity that prevail during different plant growth stage and development exert considerable influence on vegetative growth, seed yield and seed quality, as well as the incidence of certain pests and diseases. The seed yield and quality depend upon the production of photosynthesis and their distribution in the plant.

Synthesis, accumulation and translocation of photosynthesis depend on the building up of efficient photosynthetic structures in the early stage of the plant cycle. The later stages of development are concerned to the production and activity of sink (reproductive structure). The developing seed represents strong sink to attract and accumulate the assimilates. The development of a sink in a plant, which is greatly influenced by environmental condition and nutrition are also connected with an efficient translocation system in the plant. The source sink relationship must be proper in the plant for achieving higher yields. The growers can expect economic yields only when they resort to grow crops during favorable conditions with adequate nutrition, besides adopting appropriate cultural practices.

The data on effect of soil type on fruit yield per plant was represented in the present study. The average yield of turmeric grown only in soil ranges

from 0.7728 kg to 1.5792 kg. The minimum yield of turmeric was obtained in soil from the study site 1 (Viregaon) while the maximum yield was obtained in at study site 28 (Kurunda). Mohanty and Sarma (1978) observed the highest rhizome yield with farmyard manure at 25 t ha^{-1} and N, P2O5 and K2O at 75, 50 and 50 kg ha^{-1} respectively in the tribal region of Orissa. Rao and Swamy (1978) stated that turmeric was an exhaustive feeder of major nutrients and higher yield was reported under fertile soil conditions.

The results of the turmeric yield in soil with biomass addition were represented in table 5.2 and figure 5.2. The average yield of turmeric grown in soil with biomass ranges from 0.6636 kg to 1.8228 kg. The minimum yield of turmeric was obtained in soil from the study site 4 (Kaudgaon) while the maximum yield was obtained in at study site 25 (Murumba). Poul et al. (2004) conducted an experiment to study the effect of organic and inorganic nutrients on growth, yield and nutrient uptake by Tomato. In their study, they analyzed FYM for organic carbon, total N, P and K which were found to contain 17.20, 0.86, 0.32 and 0.40 per cent, respectively.

Bonde et al (2004) conducted an experiment to study the effect of different organic residues on physical and chemical properties of soil in cotton soybean inter-cropping in Vertisol. They analyzed the FYM and were known to contain 0.48 per cent nitrogen, 0.25 per cent phosphorus and 0.47 per cent potassium. Dademal and Dongale (2004) conducted an experiment to study the effect of manures and fertilizers on growth and yield of okra and nutrient availability in lateritic soils of Konkan. According to them, the FYM was reported to contain 1.18 per cent nitrogen, 0.95 per cent phosphorus and 1.09 per cent potassium.

Ghuman and Sur (2006) and Colombo, et al. (2010) conducted an experiment to study the effect of manuring on soil properties and yield of rain fed wheat during 1994-2000 in a loamy sand soil at the Soil Research Farm of Punjab Agricultural University, Ludhiana. They analyzed and reported that the FYM on an average contained 0.60 per cent nitrogen, 1.20 per cent phosphorus and 1.30 per cent potassium.

Kler and Walia (2006) opined that the treatment supplemented with FYM along with crop residue incorporation and green manuring recorded higher growth components viz., dry matter accumulation and leaf area index over chemical farming in wheat under maize-wheat cropping system and it also proved beneficial in boosting up the crop yields by 12.40 per cent compared to chemical fertilizers.

Ghuman and Sur (2006) conducted an experiment to study the effect of manuring on soil properties and yield of rainfed wheat during 1994-2000 in a loamy sand soil at the Research Farm of Punjab Agricultural University, Ludhiana. Application of FYM at 18 t ha^{-1} (3434.00 kg/ha) recorded significantly more yield by 10.70 per cent than FYM at 6 t ha^{-1} (3156 kg/ha) during first year of investigation.

Kannan et al, 2006 and Georgios et al, 2011, reported that the application of nitrogen through different organic sources significantly influenced the tomato growth and yield. Among the different organic sources, substitution of 100 per cent N through FYM recorded higher plant height, number of branches plant-1 and yield comparable with that of 100 per cent RDN through urea.

Balyan et al (2006) conducted an experiment to study the effect of integrated nutrient management on maize during kharif 2001 and 2002 in a sandy clay loam soil at Dryland Farming Research Station, Bhilwara which revealed that application of FYM at 10 t ha^{-1} significantly increased final plant height (10.26 per cent) and dry matter accumulation per plant (18.36 per cent) which ultimately enhanced uptake of N, P and K by the crop and was 36.32, 39.32 and 26.01 per cent increase than no FYM on mean value basis over application of 100 per cent RDF. On mean value basis, the application of 100 per cent RDF increased plant height (8.17 %), dry matter accumulation plant -1 (12.90 %) and N, P, K uptake by 20.49, 39.32 and 18.09 per cent, respectively.

Madhuri et al, (2006) conducted studies on the effect of organic manure and biofertilizers on growth and yield of turmeric at the College of Agriculture, Nagpur during 2003- 2004. Application of N:P2O5:K2O at 120:60:60 kg ha^{-1} recorded higher plant height, number of leaves, size and surface area of leaves, girth of pseudostem, number of tillers plant-1 and fresh yield (t/ha) of turmeric over FYM applied at 10 t ha^{-1} in combination with bio-fertilizer.

Santoshkumar and Shashidhara (2006) conducted a field experiment to study the effect of integrated nutrient management in chilli genotypes at Main Agricultural Research Station, Dharwad, during kharif 2002 under rainfed conditions on a medium black soil. Application of organics viz., FYM at 10 t ha^{-1} along with 100 per cent RDF resulted in higher fruit yield (813 kg/ha) over 100 per cent RDF (702 kg/ha) followed by the combined application of FYM at 5 t ha^{-1} + chilli stalk at 5 t ha^{-1} along with 100 per cent RDF + secondary and micronutrients + bio-fertilizers (727 kg/ha) with the genotype byadagi dabbi.

The results of the present research work on turmeric yield in soil with chemical fertilizer addition were represented in table 5.3 and figure 5.3. The average yield of turmeric grown in soil with chemical fertilizer ranges from 0.42 kg to 1.36 kg. The minimum yield of turmeric was obtained in soil from the study site 19 (Satefal) while the maximum yield

was obtained in at study site 3 (Telagaon). Govind Sheo et al. (1990) stated that number of rhizomes plant-1 and diameter of rhizomes were found to be more at 60 kg nitrogen. Yamgar and Pawar (1991) recorded the highest rhizome yield (240.28 q ha^{-1}) with 120:60:60 kg N, P2O5, K2O ha^{-1}. Pandey (1992) stated that vegetative growth and rhizome yield parameters increased with increasing nitrogen rate and greater fresh rhizome yield (33 t ha^{-1}) was recorded at 160 kg N ha^{-1}.

Singh et al, 1992; Hodges, 1996, obtained the highest fresh rhizome yield (434.66 g plant-1), cured rhizome yield (85.66g plant-1) and curcumin content (4.16 per cent) with 80 kg N and 80 kg K2O ha^{-1}. Pal et al (1993) obtained higher rhizome yield (98.00 q ha^{-1}) with 120 kg N +120 kg K2O than its control (61.57 q ha^{-1}). Banafar and Tiwari (1995) obtained higher fresh rhizome yield (225 q ha^{-1}) by the application of 100 kg P2O5 ha^{-1}.

Growth characters Positive response were obtained by way of increased plant height and tillering with 112.5 kg N, 112.5 kg P2O5 and 200 kg K2O ha-1 (Rao, 1973). Rao and Reddy (1977) observed that full dose of N, P2O5 and K2O increased the plant height, leaf number and leaf area.

Mohanbabu (1981); Shah and Muthuswami (1981); Rathinavel (1983) reported that supplemental increase in N, P2O5 and K2O content resulted in greater plant height, increased number of leaves, leaf area and number of tillers plant-1. Application of N, P2O5 and K2O expressed no significant interaction effect on turmeric (Rao and Rao, 1988).

Shah et al. (1988) and Balashanmugam; Subramanian (1991) reported that application of higher dose of N, P2O5 and K2O increased plant height, number of leaves, number of tillers, leaf area, leaf length and leaf breadth. Phosphorous was found to induce root development, while potassium was observed to be involved in transportation of carbohydrates to rhizomes (Balashanmugam and Subramanian 1991).

Conclusions

In the present investigation, the average height of bark of the plant was obtained as 11.03 cm in bag: A, 10.44 cm in bag: B and 9.06 cm in bag: C after 45 days. The average height of plant of the plant was obtained as 31.75 cm in bag: A, 36.53 cm in bag: B and 28.86 cm in bag: C after 45 days. The average length of leaf was obtained as 27.25 cm in bag: A, 24.86 cm in bag: B and 25.17 cm in bag: C after 45 days. The average number of leaf was obtained as 2.03 in bag: A, 1.89 in bag: B and 1.56 in bag: C after 45 days. The average number of foliage was obtained as 1.33 in bag: A after 45 days. The average height number of foliage was obtained as 1.19 in bag: B after 45 days. The average number of foliage was obtained as 1.17 in bag: C after 45 days.

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