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Effect of fertilizer and lime on the performance of ginger in goraneem based agroforestry system

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Abstract: The present study was conducted to investigate the effect of fertilizer and lime on the performance of ginger in Goraneem *(Melia azedarach)* based agroforesrty system. The experiment was consisted of four treatments i.e. T_1 (no fertilizer), T_2 (Cowdung @ 10 t ha^{-1}), T_3 (T_2+Dolochoon @ 240 kg ha^{-1}), T_4 (T_3+Recommended doses of N, P, K, S, Zn) and tested crop was local variety of ginger. The experiment was laid out in Randomized Complete Block design (RCBD) with 5 replications. Almost all studied parameters were found to be influenced by the treatments used in this investigation. The values of all growth parameters of ginger (Plant height, number of leaves per plant, number of tillers per plant, Length of leaf blade) found highest in T_4, which was followed by T_3. Significantly the lowest values were observed in all above parameter in T_1 but the values of all yield contributing parameters (number of fingers per plant, fresh finger weight per plant, dry finger weight per plant, fresh rhizome weight per plant, dry rhizome weight per plant) of ginger was found highest in T_4 (26.37 t ha^{-1}) which was followed by T_3 (26.13 t ha^{-1}) and become lowest (13.60 t ha^{-1}) in T_1. Yield found in T_4 and T_3 was statistically similar. The study revealed that for economic production of ginger under Gora neem trees from slide acidic soil, dolochoon with cowdung can be used instead of chemical fertilizer.

Key words: Fertilizer, Dolochoon, Ginger, Agroforestry, Goraneem.

Introduction

Ginger (*Gingiber officinalis*) is traditionally known, as shade tolerant spices crop and sometimes grown in the homestead, hill and forest areas under shading conditions. It is one of the most common spice-cum condiments in Bangladesh. Ginger as a spice is used in all vegetarian and non vegetarian meat or fish preparation. Commercial extraction of ginger oil in Bangladesh is meagre whereas ginger oleorasin has a high commercial demand in bakery, soft drinks (like ginger ole), curry powder, carbonated drinks, manufacture of ginger oil (for herbal medicine) oleorasin essences etc. (Anon, 2006).The demand of ginger is increasing in home and abroad due to its above multiple uses. Ginger is a high value crop and has a good production and export potentials (Siddique, 1995). Bangladesh produces 43,000 thousand m ton of ginger from 7,692 thousand ha of areas (BBS, 2003). We have no scope to increase the command area of ginger by reducing other field crop because there is a strong limitation of cultivable lands, which are engaged for staple food production. Under these circumstances agroforestry practices is the main alternative. Production of ginger in association with tress and shrubs in and around the homestead/tree orchard is an agroforestry system. There are many mango, litchi and timber orchards in northern part of Bangladesh, which are the potential area for production of ginger as agroforestry practice. Woodlot of Goraneem is increasing day by day in the area. People are preferred Goraneem for its fast growing nature, easy establishment and insect repellent timber properties. A few farmers using these orchards for ginger production and the performance of ginger are very poor due to its poor management. This spices crop can be grown easily under partial shading conditions of mango, litchi, Goraneem and other woodlots, but its demand of nutrients has not yet been standardized from the scientific point of view. Although some sporadic studies for ginger was done in different light levels but no systematic information is available on growth and yield of ginger under trees at different doses of fertilizer application. So, it is needed to evaluate the growth and development of ginger gown under agroforestry system with different nutrient status through applying different doses of fertilizer and manures. With this view, the present investigation was undertaken to know the growth and yield performance of ginger under Goraneem at different fertilizer application.

Materials and Methods

The present research work was carried out at farmer's Ghoraneem woodlot adjacent to the Hajee Mohammad Danesh Science and Technology University (HSTU) research farm, Dinajpur during the period from April 2005 to December 2005. The woodlot was three years old, the mean height and diameter at breast height (dbh) of Goraneem trees were 11.5 m and 37.5 cm respectively. The available monthly average sunlight for ginger (under Goraneem canopy) during study period was 31259 lux. (Approximately 40% shade). The site of the experiment is situated between 25°13 latitude and 88° 23 longitudes at the elevation of 40 m above the sea level. The experiment was laid out in a medium high land belongs to the AEZ of old Himalayan piedmont plain area. The soil texture was sandy loam (Sand, silt and clay 62, 25 and 13 % respectively) with pH 5.0. The structure of the soil was fine and the organic matter, total N, P, K, S, Zn & B content was 1.20%, 0.06%, 29.35 µg/gm soil, 0.21 meq per 100 gm soil, 6.13, 0.73 & 0.27 µg/gm soil, respectively. The experiment consisted of Four treatments i.e. T_1 (no fertilizer), T_2 (Cowdung @ 10 t ha^{-1}), T_3 (T_2 + Dolochoon @ 240 kg ha^{-1}), T_4 (T_3+Recommended doses of N, P, K, S and Zn) and the local variety of ginger is used in this experiment. The experiment was laid out in RCBD with 5 replications. The land was opened in the first week of April, 2005 and then prepared thoroughly by spading and cross spading to obtain a good tilth. Each plot size was 2.5 m × 1.2 m and replication to replication distance was 2 m. The crop was established during the second week of April 2005. The seed rhizomes of ginger were planted maintaining 50 × 25 cm spacing at

a depth of 7.5- 8 cm. All intercultural operations and management practices were done throw the growing season. The studied parameters were plant height, tiller number, leaf number, finger number (branch of rhizome), finger fresh weight, finer dry weight, rhizome fresh weight, rhizome dry weight as well as yield of ginger. Data were analyzed using MSTAT and mean separation was performed followed by LSD.

Results and Discussion

Plant height: Plant height varied significantly due to the treatments used in the experiment (Table 1). Plant height gradually increased with increase of fertilizer elements. The tallest plant (61.33 and 87.39 cm) was recorded in T_4 at the 120 and 180 days after planting (DAP), respectively followed by T_3 (54.95 and 64.19 cm). On the contrary, significantly the shortest plants (45.63 and 50.89 cm) were observed at 120 and 180 DAP, respectively in T_1. However, moderate plant height was recorded in the treatment T_2. The similar height was also found by the IIRS, Wynad, kerala (2001).

Tiller number: Number of tiller per plant varied significantly by the treatments (Table 1). Significantly the highest number of tillers per plant i.e. 6.26 and 15.03 was recorded in T_4 at the 120 and 180 DAP, respectively followed by T_3 (5.69 and 11.02). On the contrary, significantly the lowest number of tillers per plant was recorded in T_1 (3.09 and 5.46 at 120 and 180 DAP, respectively). Patra (1998) reported that growth parameter in case of turmeric was increased consistently as the application rates of N, P and k was increased.

Leaf number: The influencing pattern of number of leaves per plant was similar to that of plant height and number of tiller (Table 1). Significantly the highest number of leaves per plant was found in T_4 at both the 120 and 180 DAP (75.43 and 207.20 respectively) followed by T_3 (67.12 and 140.00 respectively). On the other hand, significantly the lowest number of leaves per plant was found in T_1 at both 120 and 180 DAP (42.35 and 70.62, respectively).

Finger number: Number of finger per plant is an important yield contributing parameter. There were significant variations due to the effects of fertilizer doses on number of fingers per plant (Table 2). Significantly the highest values of number of fingers were found in T_4 at all sampling dates (10.79, 29.09 and 40.03 at 120, 180 and 240 DAP, respectively) followed by T_3 (9.94, 16.92 and 23.84 at 120, 180 and 240 DAP, respectively). Significantly the lowest number of fingers per plant was found in T_1 at all sampling dates and the values were 6.63, 8.08 and 10.83 at 120, 180 and 240 DAP, respectively.

Finger fresh weight: The highest finger fresh weight per plant was 91.09, 198.5 and 246.7 g at 120, 180 and 240 DAP, respectively (Table 2) found in T_4 followed by T_3 (90.90, 198.2 and 244.6 g at 120, 180 and 240 DAP, respectively). T_3 and T_4 produced statistically similar finger fresh weight at all sampling dates. Significantly lowest finger fresh weight per plant (51.13, 66.39 and 133.3 g at 120, 180 and 240 DAP, respectively) was found in T_1. Application of Dolochoon reduces the acidity which may be the causes of maximum accumulation of photosynthates in the finger under shading condition.

Finger dry weight: Finger dry weight per plant was significantly influenced by different treatments like finger fresh weight (Table 2). The highest finger dry weight per plant was 5.53, 21.21 and 26.18 g at 120, 180 and 240 DAP found in T_4 followed by T_3 (5.52, 20.48 and 25.88 g at 120, 180 and 240 DAP, respectively). T_3 and T_4 produced statistically similar finger dry weight at all the sampling dates. Significantly the lowest finger dry weight per plant was 3.10, 3.89 and 7.16 g at 120, 180 and 240 DAP, respectively was found in T_1.

Rhizome fresh weight: The highest rhizome fresh weight per plant were 23.92, 42.30 and 45.14 g at 120, 180 and 240 DAP recorded in T_4, was statistically identical and followed by T_3 (23.54, 41.09 and 44.98 g at 120, 180 and 240 DAP, respectively). The lowest rhizome fresh weight per plant was 17.73, 17.44 and 29.94 g at 120, 180 and 240 DAP, respectively in T_1, which was identical to T_2 (Table 3). Thakur *et. al.* (1997) found almost similar result reported that N and p fertilizer rates on ginger yield and nutrient uptake N and p rates up to 100 kg N and 60 kg P_2O_5/ha significantly increased rhizome yield of ginger.

Rhizome dry weight: The dry weight of rhizome was varied by the different fertilizer doses similar to that of rhizome fresh weight (Table 3). The highest rhizome dry weight per plant was 5.03, 7.79 and 5.53 g at 120, 180 and 240 DAP, respectively observed in T_4 followed by T_3 (4.89, 7.32 and 5.52 g at 120, 180 and 240 DAP, respectively). Except the value of 180 DAP other two sampling dates produced statistically similar dry rhizome in both T_3 and T_4. The lowest rhizome dry weight per plant (2.29, 2.71 and 3.10 g at 120, 180 and 240 DAP, respectively) was found in T_1. Except the value of 120 DAP, other two sampling dates produced significantly different rhizome dry weight per plant with T_2. Aiyadurai (1966) reported that N fertilization of the crop with 50 to 100 kg N/ha significantly increased yield by 18 to 32 percent and improved the dry matter content of rhizome.

Table 1. Effect of fertilizers on Plant height, number of leaf per plant and number of tiller per plant of ginger at different DAP

Treatment	Plant height (cm)		Number of leaves/plant		Number of tiller/plant	
	120 DAP	180 DAP	120 DAP	180 DAP	120 DAP	180 DAP
T_1	45.63 d	50.89 d	42.35 d	70.62 d	3.09 d	5.46 d
T_2	51.60 c	57.95 c	61.20 c	112.00 c	5.24 c	8.24 c
T_3	54.94 b	64.19 b	67.12 b	140.00 b	5.69 b	11.02 b
T_4	61.33 a	87.39 a	75.43 a	207.20 a	6.26 a	15.03 a

Table 2. Effect of fertilizers on number of finger and finger weight per plant of ginger at different DAP

Treatment	Number of finger/plant			Finger fresh wt./plant (g)			Finger dry wt./plant (g)		
	120 DAP	180 DAP	240 DAP	120 DAP	180 DAP	240 DAP	120 DAP	180 DAP	240 DAP
T_1	6.630 d	8.087 d	10.83 d	51.13 c	66.39 c	133.3 c	3.103 c	3.893 c	7.167 c
T_2	8.347 c	14.44 c	16.68 c	66.80 b	161.0 b	181.0 b	3.753 b	15.23 b	17.45 b
T_3	9.947 b	16.92 b	23.84 b	90.90 a	198.2 a	244.6 a	5.520 a	20.48 a	25.88 a
T_4	10.79 a	29.09 a	40.03 a	91.09 a	198.5 a	246.7 a	5.537 a	21.21 a	26.18 a

Table 3: Effect of fertilizers on weight of rhizome per plant of ginger at different DAPs

Treatment	Rhizome fresh wt./plant (g)			Rhizome dry wt./plant (g)		
	120 DAP	180 DAP	240 DAP	120 DAP	180 DAP	240 DAP
T_1	17.73 b	17.44 b	29.94 b	2.293 b	2.713 d	3.103 c
T_2	18.10 b	18.42 b	30.12 b	2.413 b	3.320 c	3.753 b
T_3	23.54 a	41.09 a	44.98 a	4.893 a	7.320 b	5.520 a
T_4	23.92 a	42.30 a	45.14 a	5.030 a	7.790 a	5.537 a

In a column the values bearing same letter(s) do not differ significantly

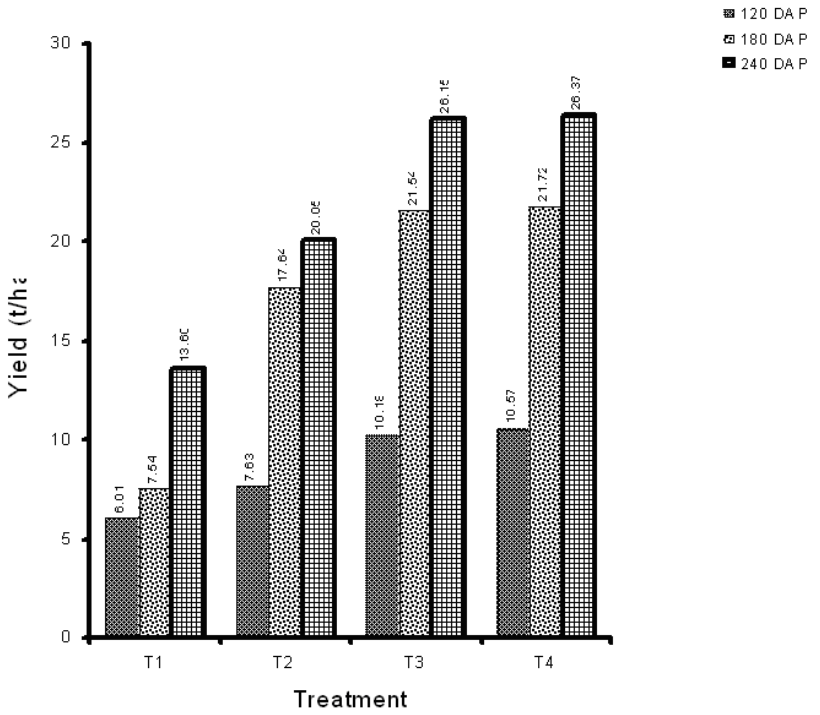

Figure1. Effect of fertilizer and lime on fresh yield (t ha^{-1}) of ginger

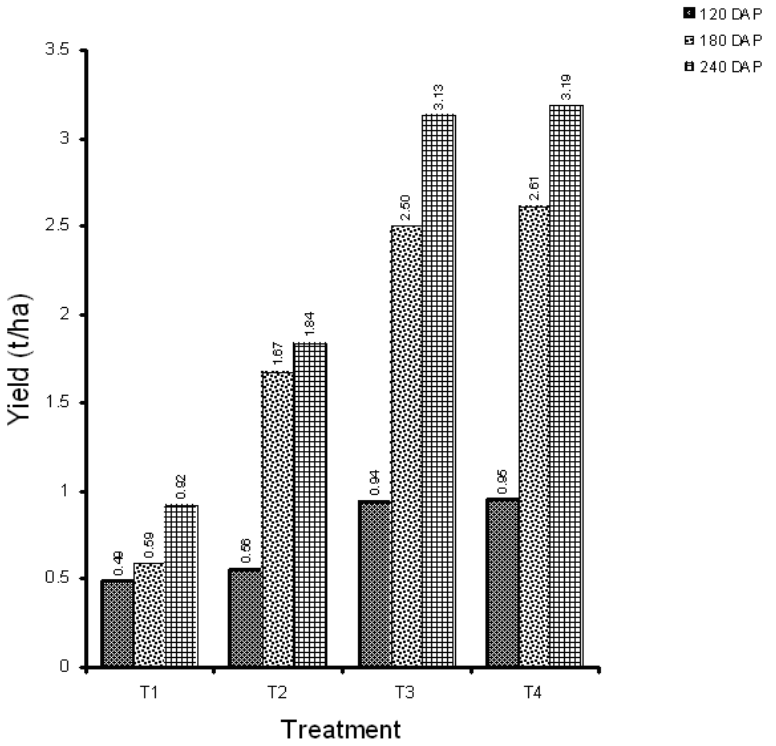

Figure2. Effect of fertilizer and lime on dry yield (t ha^{-1}) of ginger

Fresh yield: Yield recorded as per plant was also expressed in to t ha^{-1}. Fresh yield was significantly influenced by treatments (Fig. 1). The highest fresh yield was found in T_4 (10.57, 21.72 and 26.37 t ha^{-1} at 120, 180 and 240 DAP, respectively) followed by T_3 (10.18, 21.54 and 26.15 t ha^{-1} at 120, 180 and 240 DAP, respectively). Significantly the lowest fresh yield of different sampling dates was found in T_1 (6.01, 7.54 and 13.60 t ha^{-1}, respectively). T_3 and T_4 produced statistically similar fresh yield at all the sampling dates. T_2 produced 7.63, 17.64 and 20.05 t ha^{-1} at 120, 180 and 240 DAP, and respectively which were significantly different from T_1 and T_3. IISR studied on nutrient requirement of ginger in wynad, kerala, they found the positive effect of higher dose of nutrient on the yield of ginger. Among the 16 levels of N and k, three combinations viz, 150 kg N, 50 kg k, 150 kg N, 100 kg k and 150 kg N, 150 kg k/ha were found to be significantly superior with respect to yield. The optimum dose of N and K was quadratic equation as 144 kg and 109 kg/ha, respectively (Anon.2001). Miah *et al.* (2005) found 23.76 t ha^{-1} fresh yield of ginger under 25% artificial shade (75% PAR) which was more or less similar to this findings.

Dry yield: Dry yield of ginger was also influenced by the treatments and the influencing pattern was quite identical to fresh yield of rhizome (Fig. 2). The highest dry yield was found in T_4 (0.95, 2.61 and 3.19 t ha^{-1} at 120, 180 and 240 DAP, respectively) followed by T_3 (0.94, 2.50 and 3.13 t ha^{-1} at 120, 180 and 240 DAP, respectively). Significantly the lowest dry yields of rhizome at different sampling dates were found in T_1 (0.49, 0.59 and 0.92 t ha^{-1}, respectively).

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