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Effect of planting method and rhizome size on the growth and yield of ginger

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Abstract: A field experiment was conducted to study the effect of planting method and rhizome size on the growth and yield of ginger under the logistic support of the 'Action Plan for Spices Project' of BAU, at the Horticulture Farm, Bangladesh Agricultural University, Mymensingh. The study comprised two factors viz. planting method and rhizome size. The main effects and the combined effects of three planting methods namely ridge method, furrow method and flat method with five rhizome sizes viz. 10-15g, 15-20g, 20-25g, 25-30g and 30-35g were evaluated. Planting methods and rhizome size and their combined effects showed significant influence on the yield and yield components of ginger. The highest yield (18.78 t/ha) was recorded from ridge method of planting followed by furrow (14.56 t/ha) and flat method (11.06 t/ha). The highest yield (19.64 t/ha) was recorded from 30-35g of rhizome size and the lowest (11.30 t/ha) was from 10-15g of rhizome size. The most satisfactory yield (22.78 t/ha) was found from the treatment combination of ridge method with 30-35g of rhizome size; while the poorest yield (8.34 t/ha) was obtained from the treatment combination of flat method with 10-15g of rhizome size.
Key words: Planting method, rhizome size, yield, Ginger.

Introduction

Ginger (*Zingiber officinale* Rosc.) belonging to the family Zingiberaceae is one of the most important spice crops in Bangladesh. Ginger, which is a herbaceous perennial, usually grown as an annual. It originated in South-East Asia. It is a plant of very ancient cultivation and the spice has long been used in Asia. It is one of the earliest oriental spices known to Europe and is still in large demand today (Purseglove *et al.* 1981).In Bangladesh about 7917 hectares of land is under ginger cultivation with an annual production of 48,185 metric tons (BBS, 2004). The main production regions of Bangladesh are Chittagong, Khagrachari, Bandarban,Rangamati, Tangail, Mymensingh, Dhaka and Rangpur. India is the largest producer and exporter of ginger in the world. Other major producers are China, Japan, Taiwan, Thailand, Jamaica, Nigeria, Sierra Leone and Australia. Amongst these countries, Jamaica and India produce the best quality ginger, followed by other countries (Purseglove *et al.* 1981). The average yield of ginger in Bangladesh is 5.59t/h, which is very low. Owing to absence of recommended standard production practices of ginger, the farmers of Bangladesh have been following their own traditional practices according to their own choice.

Ginger requires a warm and humid climate. It is mainly cultivated in the tropics from sea level to 1500 m. But it can be grown over more diverse conditions than most other spices. Ginger is extensively grown in the kharif season in Bangladesh. In spite of its immense importance, very little information is available on the agronomic aspects of the crop. Rhizome size and planting methods are the two important aspects of production system of different crops including ginger (Aiyadurai, 1966). It is well documented that planting methods and rhizome sizes have significant influences on the growth and yield of ginger. In Bangladesh, there are three planting methods of ginger production, such as flat method, furrow method and ridge method. In furrow method, under ground rhizomes are damaged by rotting during the rainy season. In flat method, in the rainy season if water logging in the field exists, causes heavy damage to yield. Ridge method can give significant higher yield than the other two methods. On the other hand, rhizome size is an important factor to have a good yield. In Bangladesh, the general tendency of the farmers is to select small rhizomes and furrow method of planting. It is observed that rhizome sizes and planting methods have significant influence on the growth and yield of different crops (Purewall and Daragan, 1957; Enyi, 1972; Taleb *et al.* 1973; Mannan and Rashid, 1983; Zaman *et al.* 2002, Islam, 2004) and it is likely that both the factors have similar effects on the yield of ginger. Rhizome size influences greatly on ginger growth and yield (Islam and Ahmed, 1986; Ahmed *et al.* 1988).Considering the above facts, the present study was undertaken to determine the suitable planting method as well as optimum rhizome size of zinger.

Materials and Methods

The experiment was persuaded under the logistic support of the 'Action Plan for Spices Project' of BAU, at the Horticulture Farm, Bangladesh Agricultural University, Mymensingh. The study consisted of the following treatments; planting methods: i) Ridge method (M_1), ii) Furrow method (M_2), iii) Flat method (M_3). Seed rhizome size: i) 10-15 g (S_1) ii) 15-20 g (S_2) iii) 20-25 g (S_3) iv) 25-30 g (S_4) v) 30-34 g (S_5). The two factor experiment was laid out in the Randomized Complete Block Design (RCBD) with three replications. The land was first divided into three blocks and then each block was divided into 15 unit plots. Thus, there were 45 unit plots in the experiment. The size of each unit plot was 3m × 2.4m. The treatments were then assigned randomly to the unit plots of each block so as to allot one treatment once in a block. The collected seed rhizomes were kept in underground soil before planting. The following doses of manure and fertilizers were applied as recommended in a report of Spices Research Centre, Bogra (Anon., 1999). Well decomposed cowdung-5 ton, Urea-304 kg, Triple super phosphate (TSP)- 267 kg, Muriate of potash (MP)- 233 kg, Gypsum-111 kg.The entire amount of cowdung was applied at the time of general land preparation and the entire quantity of TSP, Gypsum and half of MP were applied during final land preparation. The half of the urea was applied 50 days after planting. Remaining MP and Urea were used in two equal splits at 80 and 110 days after planting. Intercultural operation such as weeding, earthen up, insecticide and pesticide were done as and when necessary. The crop was harvested at a time on 25

December, 2005 when the leaves turned yellow and started to dry. Data on the following characters were collected from 10 plants, which were selected at random for each unit plot. Observations were made on emergence of seed rhizome, plant height, number of leaves per plant, number of tillers per clump, leaf length, leaf breadth, leaf area, weights of old mother rhizome, weights of primary and secondary rhizome per clump, yield per plant, dry weight of rhizome per clump, yields per plot and yield per hectare. The collected data were analyzed statistically and the means were compared with least significant difference (LSD) values.

Results and Discussion

Effect of planting method: Planting method significantly influenced the growth of plant (Table 1). There was trend to increase in plant height under the treatment of furrow method (34.75 cm) followed by ridge method (33.53 cm) and flat method (29.85 cm). It might be due to the moisture availability for the largest rhizome size enhanced emerging earlier and showed vigorous and rapid growth using the moisture and food nutrients, which resulted in taller plants. Planting method had also significant influence on the number of leaves per plant, number of leaves per plant, number of tillers per clump, weights of old mother rhizome, weights of primary and secondary rhizome per clump, yield per plant, dry weight of rhizome per clump, yields per plot and yield per hectare, (Table 1). Maximum number of leaves (26.06) per plant, number (15.43) of tillers per plant, weight of old mother rhizome (10.18 g) per plant, weight of primary rhizome (1736.40 g) per clump, weight of secondary rhizome (127.46 g) per clump, the maximum yield (119.56 g) per plant and the highest yield (4.50 kg) per plot were found under the treatment of Ridge method and the shortest values were found from flat method on all the mentioned parameters. It is fact that in the ridge method the soil texture is looser and so that the soil aeration is maximum and in the flat method the soil was more compact and thus the soil aeration was minimum. Ridge planting method produced the highest yield (18.78 t/ha) followed by the other planting methods. The lowest yield (11.06 t/ha) was recorded from flat method of planting. It might be due to the proper aeration of the loose soil of ridge method that produced more vigorous plant which helped in deposition of greater amount of assimilates to the rhizome in comparison with other planting methods. This finding agrees with the results of Enyi (1972).

Table 1. Effect of planting methods on the growth and yield of ginger

Treatment	Plant height (cm)	No of leaves/ plant	No of tillers/ clump	Wt. of old mother rhizome/ plant (g)	Wt. of primary rhizome/ clump (g)	Wt. of secondary rhizome/ clump (g)	Dry weight of rhizome/ clump (g)	Yield/ plant (g)	Yield /plot (kg)	Yield (t/ha.)
Ridge (M_1)	33.53	26.06	15.43	10.18	1736.40	127.46	279.66	119.56	4.50	18.78
Furrow (M_2)	34.75	22.82	13.19	9.95	1522.67	103.49	232.03	109.62	3.41	14.56
Flat (M_3)	29.86	19.19	10.14	8.08	979.73	99.02	210.04	88.69	2.65	11.06
Level of sig.	**	**	**	**	**	**	**	**	**	**

** = Significant at 1% level

Table 2. Effect of rhizome size on the growth and yield of ginger

Treatment	Plant height (cm)	No of leaves/ plant	No of tillers/ clump	Wt of old mother rhizome/ plant (g)	Wt of primary rhizome/ clump (g)	Wt of secondary rhizome/ clump (g)	Dry weight of rhizome / clump (g)	Yield/ plant (g)	Yield/plot (kg)	Yield (ton/ha)
S_1(10-15g)	26.30	19.55	10.64	6.98	1100.00	98.57	165.75	82.98	2.71	11.30
S_2(15-20g)	29.50	19.90	11.03	8.08	1126.67	107.85	189.38	93.19	2.97	12.41
S_3(20-25g)	34.75	23.35	12.48	9.46	1253.33	97.07	213.92	103.22	3.40	14.17
S_4(25-30g)	35.36	24.17	15.94	10.73	1612.89	117.37	342.77	115.26	3.95	16.48
S_5(30-35g)	37.64	26.47	14.50	11.77	1971.78	129.12	291.07	135.14	4.57	19.63
Level of sig.	**	**	**	**	**	**	**	**	**	**

** = Significant at 1% level

Effect of Rhizome size: Rhizome size had also significant influence on all the mentioned parameters (Table 2). The highest plant height (37.64cm), number of leaves per plant (26.47), number of tillers per clump (15.94), weight of old mother rhizome (11.77 g) per plant, amount of primary rhizome (1971.78 g) per clump, amount of secondary rhizome (129.12 g) per clump, the highest yield (135.14 g) per plant, the maximum yield (4.57 kg) per plot were found in 30-35g of rhizome while the lowest were found in 10-15g of rhizome. It might be due to the fact that plants produced from the largest rhizome size emerged earlier and showed vigorous and rapid growth using the initial reserve food materials in it. Patil and Borse (1980) observed that transplanted cut rhizome seedling gave the highest plant height. The maximum yield (19.63 t/ha) was recorded from the largest rhizome size. The smallest rhizome produced the lowest yield (11.30 t/ha). It might be due to the fact that yield produced from the largest mother rhizome showed vigorous and rapid growth using the initial more reserve food materials than the smallest rhizome (Table 2).

Table 3. Interactions of planting methods and rhizome size on the growth and yield of ginger

Treatment		Plant height (cm)	No of leaves/ plant	No of tillers/ clump	Wt of old mother rhizome/ clump (g)	Wt of primary rhizome/ clump (g)	Wt of secondary rhizome/ clump (g)	Dry wt. of rhizome (g)/ clump (g)	Yield/ Plant (g)	Yield/ plot (kg)	Yield (t/ha)
Method	Rhiz. size										
Ridge (M_1)	S_1(10-15g)	27.49	22.91	13.58	7.85	1466.66	117.06	210.75	97.92	3.80	15.84
	S_2(15-20g)	30.88	22.18	13.98	8.16	1500.00	127.52	241.78	108.70	4.00	16.66
	S_3(20-25g)	38.83	28.54	14.58	10.73	1600.00	80.14	265.48	117.30	4.26	17.78
	S_4(25-30g)	33.97	28.99	17.82	11.68	1800.00	147.70	376.82	125.76	5.00	20.84
	S_5(30-35g)	36.46	30.63	17.18	12.49	2315.34	164.90	303.47	148.14	5.46	22.78
Furrow (M_2)	S_1(10-15g)	27.21	20.20	10.41	7.79	1400.00	98.32	147.35	86.58	2.34	9.72
	S_2(15-20g)	30.43	21.09	11.66	9.21	1280.00	106.56	160.75	95.40	2.66	11.12
	S_3(20-25g)	35.21	23.91	13.43	10.17	1333.34	115.62	203.87	111.84	3.40	14.16
	S_4(25-30g)	39.99	26.62	16.68	10.62	1700.00	134.32	350.76	119.58	4.00	16.66
	S_5(30-35g)	40.92	22.28	13.75	11.98	1900.00	62.64	297.42	134.70	4.66	21.12
Flat (M_3)	S_1(10-15g)	24.20	15.55	7.44	5.30	433.34	80.32	139.15	64.44	2.00	8.34
	S_2(15-20g)	27.20	16.42	7.92	6.88	600.00	89.46	165.60	75.48	2.26	9.44
	S_3(20-25g)	30.19	20.55	9.44	7.48	826.66	95.44	172.41	80.52	2.54	10.56
	S_4(25-30g)	32.12	22.15	13.31	9.88	1338.66	105.34	300.75	100.44	2.86	11.94
	S_5(30-35g)	35.55	21.25	12.55	10.85	1700.00	124.56	272.31	122.58	3.60	15.00
Level of significant		**	**	**	**	**	**	**	**	**	**

** = Significant at 1% level

Combined effect of planting method and rhizome size: The result of the experiment revealed that all the studied parameters were significantly influenced by planting methods and rhizome sizes. Considering the plant height and the number of leaves per plant, furrow planting method with the largest rhizome size produced the tallest plant (40.92 cm) and the shortest plant (24.20 cm) was found from flat planting method with the smallest rhizome size. The maximum number of leaves (30.63) per plant was found from ridge method with the largest rhizome size. The treatment combination of flat method and the smallest rhizome size gave the lowest number of leaves (15.55) per plant.

The number of tillers per clump was highest (17.82) from ridge method with the largest rhizome size combination and that was the lowest (7.44) from flat method with 15-20 g of rhizome size.

The weight of old mother rhizome had been found to be highest (12.49 g) per plant from the treatment combination of ridge method with the largest rhizome size while that was the lowest (5.30) from flat method with the smallest rhizome size combination

The weight of primary rhizome was also the highest (2315.34 g) per clump in the treatment combination of ridge method with the largest rhizome size and that was the lowest (433.34 g) from flat method with the smallest rhizome size. In case of the weight of the secondary rhizome, the highest (164.90 g) per clump and the lowest (80.32 g) per clump respectively, were found from the same treatment combination as mentioned above.

In case of dry weight of rhizome per clump the treatment combination of ridge method with the largest rhizome size showed the best performance (376.82 g) and that was the lowest (139.15g) from flat method with the smallest rhizome size combination. Both the planting method and rhizome size played an important role on the growth and yield of ginger. They had remarkable influence on the all recorded parameters. The treatment combination of ridge method with the largest rhizome size showed the best performance in yield per plant (148.14 g), yield per plot (5.46 kg) and yield per hectare (22.78 tons) respectively, while the combination of flat method and the smallest rhizome size gave the poorest performance in yield of ginger (64.44 g/plant, 2.00 kg per plot and 8.34 t/ha, respectively).

The treatment combination of planting method and rhizome size exhibited significant variations on the yield components and yield of ginger. All the yield contributing components and yield showed highest value under the treatment combination of ridge method with the largest rhizome size and on the other hand, that was the lowest from the treatment combination of the flat method with the smallest rhizome size. Considering the situation of the present study, further investigation in different agro-ecological zones of Bangladesh for regional adaptability and other performances is suggested.

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