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INFLUENCE OF NPK FERTILIZER AND SPACING ON GROWTH PARAMETERS OF ONION (*Allium cepa* L. var. BARI piaz-1)

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The productivity of onion crop is poor due to inappropriate management and agronomic practices in Bangladesh. To figure out the effect of NPK fertilizer rate and spacing on growth parameters of onion a field experiment was conducted. The treatments were consisting of N fertilizer (0, 80,120 and 160 kg/ha), P fertilizer (0, 30, 50 and 70 kg/ha), k fertilizer (0, 50, 75 and 100 kg/ha) and three plant spacing viz., 10 cm × 10 cm, 15 cm × 10 cm and 20 cm × 10 cm. The experiment was designed in RCBD with three replications. Analysis of results indicates that the interaction effect of NPK rate and spacing shows significant ($P<0.05$) effect on plant height. Highest plant height was obtained in 20 cm × 10 cm spacing and application of 160 kg N/ha, 70 kg P/ha and 100 kg K/ha respectively. Moreover, maximum number of leaves was also found by plants spaced at 10cm and application of highest dose of fertilizers. Lowest plant height and number of leaves was attained in 10 cm × 10 cm spacing and without NPK fertilizer application. The total result analysis reveals that best growth performance of onion was found from 20 cm × 10 cm spacing combined with 160 kg N/ha, 70 kg P/ha and 100 kg K/ha fertilizer amendment.

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INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important spice crop grown all over Bangladesh. It belongs to the family *Alliaceae*. Onion is one of the oldest cultivated vegetable which vestige back at least 5000 years and the center of origin of the crops is west China and the desert lying east of the Caspian Sea (Jones and Mann., 1996). The most important character of onion is its flavor, which increases the taste of food and widely used to increase the taste of different types of food. Onions contains phytochemical compounds such as phenolics and flavonoids that basic research shows to have potential anti-inflammatory, anti-cholesterol, anticancer and antioxidant properties (Yang et al., 2004). The dietary habit of Bangladeshi people is tied up with onion and an average consumption of 25g per day per person is considered essential (HRDP, 1995). On an average the total annual requirement of onion in Bangladesh is 16, 50,000 MT but its production is 10,52,000 MT (Anon, 2012). So, there is acute shortage of onion (36.24%) in relation to its requirement. Fertilizer is the vital input that play significant role in exploring the highest yielding capacity of onion. Judicious application of fertilizer has great impact on growth and yield of crop plants. In order to obtain satisfactory results the nutrients should be applied in optimum dose. It was reported that the application of NPK markedly increased the growth of onion (Faheema et al., 2009; Amin et al., 2007 and Ghaffoor et al., 2003).

The optimum time of this crop ranges from the last week of December to first week of January. However, due to changing climatic condition and existing cropping pattern farmers are planting onion up to mid-February after harvesting some rabi crops (Anon., 2011). Spacing affects the onion plant growth, size of bulb, yield as well as the quality of the product (Badaruddin and Haque, 1977; Rahim et al*.,* 1983). Planting of bulb or seeding at proper spacing increase the quantity and size of the bulb but too low or high spacing influences the growth parameters of onion. Many workers reported that wider spacing caused higher yield per plant, although the closer spacing gave higher yield per unit area due to increased plant density up to a certain limit (Singh and Rathore., 1977; Nehra et al., 1988). In view of these, the present study was conducted to figure out the influence of NPK fertilizers rates and intra row spacing on onion growth parameters related to yield of onion.

MATERIALS AND METHODS

Description of the study area

An experiment was carried out during the Rabi season of 2012-2013 at the horticultural farm of Bangabandhu Sheikh Mujibur Rahman Agricultural University in Gazipur, Bangladesh. The site is situated at 24.09°N latitude and 90.25°E longitude with the elevation of 8.2 meter from sea level (Anon.,1994). The experimental area is under the sub-tropical climate which is characterized by heavy rainfall, high humidity, high temperature, relatively long day during April to September and scanty rainfall, low humidity, low temperature and short day period during October to March. The later period is favorable for onion cultivation.

Experimental material

Onion variety named BARI piaz-1 was used as a test crop for the experiment. It is popular and largely cultivated variety in the experimental area and processes reddish brown bulb color with pungent smell and can mature in 130-140 days. Its yield potential is 12-16 t/ha. This variety is capable of seed production in Bangladesh climatic condition and tolerant to thrips, aphids, purple blotch and stemplyllum blight disease.

Design and layout of the experiment

The experiment was laid out in a Factorial Randomized Complete Block Design (RCBD) with three replications.

Experimental Procedure

Seeds of BARI piaz-1 variety were soaked overnight in water as suggested by Lipe and Skinner (1979) and allowed to sprout in a piece of cloth keeping in the sunshade for two days. Transplanting of seedlings was done on 27th January, 2013. At the age of 44 days, the seedlings were transplanted in the main field with the spacing of 10 cm x 10 cm, 15 cm x10 cm and 20 cm x 10 cm. At the time of lifting the seedlings, care was taken to avoid any mechanical injury to the seedlings. 1.5 kg cowdung and 30 g of zypsum were applied in each plot (1.2 m^2). The amount of NPK was applied treatment wise.

The entire amount of cowdung, phosphorus, sulphur, ½ of N and K was applied during land preparation. The rest of N and K were applied in two equal splits as top dress at 25 and 50 DAP. The source of N, P, K and S was Urea, TSP, MOP and Gypsum respectively. After each weeding a light irrigation was given with the help of a hose pipe or watering can. Flood irrigation was also given when needed. Different agronomic practices were conducted as per the recommendation made for the onion for all plots during experimental time. When 80% plants exhibits neck fall, harvesting of onion bulbs was done. Curing of onion with top portion was done for three days under a shed. Tops were separated from bulbs with knife leaving 2 cm neck, at ambient temperature (25.6±2.6) °C and then bulbs were stored in a well-ventilated house.

Data analysis

The collected data on various parameters under study were statistically analyzed using MSTATC computer package programme. The means for all the treatments were calculated and analyses of variances for all the characters were performed by F-variance test. The significance of the differences among the pairs of treatment means was evaluated by the Tukey's W test at 5% level of probability

RESULTS

Influence of spacing and fertilizer on plant height:

Plant height was recorded at 10 days interval starting from 25 days after planting (DAP) up to 55 DAP. Spacing and fertilizer (NPK) significantly influenced plant height at all DAP except 55 DAP (Table 1). At 25 DAP, significantly the maximum plant height was recorded in S_3 (20 cm × 10 cm) (18.07 cm) closely followed by S_2 (15 cm × 10 cm) (17.6 cm) and the minimum plant height in S_1 (10 cm × 10 cm) (16.31 cm). The similar trend was also found at 35 DAP in respect of plant height. At 45 DAP; the maximum plant height was recorded in S_3 (20 cm × 10 cm) (3.99 cm) and the lowest from S_2 (15 cm × 10 cm) which was identical with S_1 (10 cm × 10 cm). Plant height was statistically insignificant to each other in respect of different spacing at 55 DAP.

Fertilizer (NPK) had significant effect on plant height at all DAP (Table 1). The tallest plant was obtained from F_3 treatment (N: P: K: 160-70-100 kg/ha) (18.98 cm) closely followed by F_2 treatment (N: P: K: 120-50-75 kg/ha) (18.77 cm) and the shortest plant was recorded from F_0 (control treatment). The similar trend of result in respect of plant height was obtained at 55 DAP due to applied fertilizers. At 45 DAP, the F_3 treatment gave the maximum plant height (36.54 cm) which was followed by F_2 treatment (36.31 cm) while F_0 treatment gave the lowest plant height. At 55 DAP, the maximum plant height (38.13 cm) was recorded with F_3 treatment which was closely followed by F_2 treatment (37.64 cm) and its minimum value from F_0 treatment.

Table 1. Main effect of spacing and fertilizer on plant height of late plantedonion var. BARI piaz-1 at different growth stages

Treatment	Plant height (cm)			
Spacing (S)	25 DAP	35 DAP	45 DAP	55 DAP
S_1 (10 cm × 10 cm)	16.31 b	23.89 b	32.29 b	34.49 ns
S_2 (15 cm × 10 cm)	17.68 a	27.30 a	31.99 b	34.71 ns
S_3 (20 cm × 10 cm)	18.07a	27.03 a	33.99 a	34.84 ns
Fertilizer (F)				
F_0 (N : P : K: 0-0-0 kg/ha)	15.09 c	22.52 c	26.93 d	29.03 c
F_1(N : P : K: 80-30-50 kg/ha)	16.58 b	24.75 b	32.24 c	33.90 b
F_2(N:P : K: 120-50-75 kg/ha)	18.77 a	28.08 a	36.31 a	37.64 a
F_3(N:P: K:160-70-100 kg/ha)	18.98 a	28.95 a	36.54 a	38.13 a
CV (%)	3.01	4.72	2.42	6.57

Means followed by different letters in a column differed significantly at 5% level of probability by Tukey's W Test;
DAP = Days after planting; ns = non-significant

The interaction of spacing and fertilizer was found significant in case of plant height at 45 DAPS but insignificant at 25, 35 and 55 DAP (Table 2). At 45 DAP, the highest plant height was observed from S_3F_3 (37.87 cm) which was closely followed by S_1F_3 (37.65 cm) and S_3F_2 (and 37.00 cm) and the lowest plant height from S_1F_0 (23.70 cm)

Table 2. Interaction effect of spacing and fertilizer on plant height of late planted onion var. BARI piaz-1

Spacing X Fertilizer	Plant height (cm)			
	25 DAP	35 DAP	45 DAP	55 DAP
	Ns	Ns		Ns
S_1 F_0	13.95	19.69	23.70 g	27.27
S_1 F_1	15.52	22.67	32.80 cd	34.77
S_1 F_2	17.72	26.04	35.01 bc	37.80
S_1 F_3	18.04	26.04	37.65 a	38.12
S_2 F_0	15.65	24.67	29.07 ef	29.70
S_2 F_1	17.01	25.59	30.86 de	33.92
S_2 F_2	18.98	29.33	33.92 c	37.53
S_2 F_3	19.06	29.62	34.12 c	37.67
S_3 F_0	15.68	23.21	28.03 f	30.13
S_3 F_1	17.22	25.99	33.07 cd	33.02
S_3 F_2	19.61	28.87	37.00 ab	37.60
S_3 F_3	19.78	30.05	37.87 a	34.60
CV (%)	3.10	4.72	2.42	6.57

Means followed by different letters in a column differed significantly at 5% level of probability by Tukey's W Test.
S_1 = 10 cm × 10 cm, S_2 = 15 cm × 10 cm, S_3 = 20 cm × 10 cm,
F_0 = N: P: K: 0-0-0 kg/ha, F_1 = N: P: K: 80-30-50 kg/ha, F_2= N: P: K: 150-50-75 kg/ha and
F_3 = N: P: K: 160-70-100 kg/ha; DAP = Days after planting; ns = non-significant.

Influence of spacing and fertilizer on leaves/plant

Number of leaves per plant did not differed significantly due to the different plant spacings at 25, 35, 45 and 55 DAP (Table 3). Number of leaves per plant varied significantly due to different levels of NPK fertilizers at all DAP (Table 3). At 25 DAP, the maximum number of leaves per plant (3.7) was recorded from F_3 (N: P: K: 160-70-100 kg/ha) which was closely followed by F_2 (N: P: K: 120-50-75 kg/ha) (3.61) and the lowest number of leaves per plant was found from F_0 (N: P: K: 0-0-0 kg/ha) (3.24). However, there was no significant difference between F_1 and F_0 treatment in respect of number of leaves per plant at 25 DAPS. The highest number of leaves per plant was recorded from F_3 (5.00) which was closely followed by to F_2 (4.88), while the lowest number of leaves per plant was recorded from F_0 (4.16) at 35 DAP. At 45 DAP, the highest number of leaves per plant was recorded from F_3 (6.31) which was closely followed by F_2 (6.09) and the lowest number of leaves per plant was observed from F_0 (4.43).

At 55 DAP, the highest number of leaves per plant was recorded from F_3 (6.33) which was statistically similar to F_2 (6.22) and F_1 (5.90) and the lowest number of leaves per plant was recorded from F_0 (4.46) (Table 4).Significant differences were recorded for the combined effect of different levels of spacing and different doses of NPK fertilizer on number of leaves per plant that showed only for 45 DAP (Table 4). At 45 DAP, the maximum number of leaves per plant was observed from S_2F_3 (6.38) which was significantly identical with S_1F_3, S_1F_2, S_3F_3, S_3F_2, S_2F_2, S_1F_1, S_3F_1 and S_2F_1 exhibited 6.33, 6.27, 6.22, 6.10, 5.910, 5.50, 5.44 and 5.30, respectively, while S_1F_0 gave the lowest (4.40) number of leaves per plant which was closely followed by S_2F_0 (4.45) and S_3F_0 (4.43).

Table 3 Influence of spacing and fertilizer on leaves/plant of onion var. BARI piaz-1

Treatment	Leaves/plant			
Spacing (S)	**25 DAP**	**35 DAP**	**45 DAP**	**55 DAP**
S_1	3.49 ns	4.62 ns	5.62 ns	5.55 ns
S_2	3.45 ns	4.60 ns	5.52 ns	5.78 ns
S_3	3.53 ns	4.78 ns	5.55 ns	5.85 ns
Fertilizer (F)				
F_0	3.24 b	4.16 c	4.43 c	4.46 b
F_1	3.38 b	4.62 b	5.41 b	5.90 a
F_2	3.61 a	4.88 ab	6.09 a	6.22 a
F_3	3.76 a	5.00 a	6.31 a	6.33 a
CV (%)	4.65	5.72	6.80	8.41

Means followed by different letters in a column differed significantly at 5% level of probability by Tukey's W Test.
S_1 = 10 cm × 10 cm, S_2 = 15 cm × 10 cm, S_3 = 20 cm × 10 cm,
F_0 = N: P: K: 0-0-0 kg/ha, F_1 = N: P: K: 80-30-50 kg/ha, F_2= N: P: K: 150-50-75 kg/ha and
F_3 = N: P: K: 160-70-100 kg/ha; DAP = Days after planting; ns = non-significant.

Table 4. Interaction effect of spacing and fertilizer on leaves of late planted onion var. BARI piaz-1 at different growth stages

Spacing	Leaves/plant			
X	25 DAP	35 DAP	45 DAP	55 DAP
Fertilizer	ns	ns		ns
S_1 F_0	3.23	4.00	4.40 b	4.433
S_1 F_1	3.33	4.70	5.50 ab	5.600
S_1 F_2	3.57	4.83	6.27 a	6.023
S_1 F_3	3.83	4.93	6.33 a	6.140
S_2 F_0	3.27	4.23	4.47 b	4.467
S_2 F_1	3.37	4.40	5.30 ab	6.023
S_2 F_2	3.60	4.83	5.91 a	6.283
S_2 F_3	3. 63	4.93	6.38 a	6.350
S_3 F_0	3.23	4.23	4.43 b	4.467
S_3 F_1	3.43	4.77	5.44 ab	6.083
S_3 F_2	3.67	4.97	6.10 a	6.367
S_3 F_3	3.80	5.13	6.22 a	6.487
CV (%)	4.65	5.72	6.80	8.41

Means followed by different letters in a column differed significantly at 5% level of probability by Tukey's W Test.S_1 = 10 cm × 10 cm, S_2 = 15 cm × 10 cm, S_3 = 20 cm × 10 cm
F_0 = N: P: K: 0-0-0 kg/ha, F_1 = N: P: K: 80-30-50 kg/ha, F_2= N: P: K: 150-50-75 kg/ha and
F_3 = N: P: K: 160-70-100 kg/ha; DAP = Days after planting; ns = non-significant

DISCUSSIONS

Influence of spacing and fertilizer on Plant height

The plant height was found the highest at wider spacing (20 cm x 10 cm). It might be due to less competition among the plants for light, CO_2 and nutrients. Highest plant height was achieved in N: P: K: 160:70: 100 kg/ha dose. This is in agreement with the findings of Khan et al., (2003) who reported that wider spacing produced the tallest plant. Ghafoor et al., (2003) who reported that Phulkara onion variety gave the best results with regard to plant height (56.17 cm) under N: P: K: 150: 100: 100 kg/ha. The present finding gave a little bit long plant height as well as the fertilizer dose than reported results. It may be due to the difference of variety as well as the growing environment.

Influence of spacing and fertilizer on Leaves/plant

The leaves/plant was found the highest at wider spacing (20 cm x 10 cm). It may be indicates highest spacing help plants to obtain surface area for maximizing leaves. Highest plant height was achieved in N: P: K: 160: 70: 100 kg/ha dose. These results are further reported by Baloch et al., (1991) who reported that the highest number of leaves/plant (17.0) was obtained with N:K: 125-100 kg/ha. Singh and Mohanty et al*.,* (1998) also reported that number of leaves/plant were greatest with N: K: 160- 80 kg/ha. Al-Madini et al*.,* (2000) found that increasing the application of NPK fertilizer significantly increased the plant growth. It may be due to increase of NPK fertilizer which stimulates the leafy growth as well as vigorous nodes and internodes.

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