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GROWTH AND YIELD RESPONSE OF ONION (*ALLIUM CEPA* L.) GENOTYPES TO DIFFERENT LEVELS OF FERTILIZERS

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Abstract

The influence of four levels of fertilizers *viz.* 0:0:0, 60:65:80, 120:130:160 and 240:260:320 kg/ha (N:P:K) on growth, yield and yield contributing characters of six onion genotypes *viz.* Thaherpuri Brown, BARI Onion 1, Faridpuri Bhati, Suksagar, Nasirbala and Pusa Red exhibited distinct variation in respect of all the characters under investigation in the field condition. The fertilizers at 120:130:160 kg/ha produced the maximum bulb yield (14.9 t/ha). Genotype Pusa Red gave the maximum bulb yield (17.2 t/ha) and Faridpuri Bhati had the lowest yield (11.8 t/ha). Pusa Red along with 120:130:160 kg/ha produced maximum bulb yield (18.3 t/ha). Correlation studies revealed that bulb yield was positively related with different yield components, but it showed non-significant negative relation with bulb dry matter content (%). The regression analyses showed that the rate of change of bulb yield was dependent upon the rate of change of plant height, number of leaves and roots, and root length. Increase in number of roots per plant appears very important in increasing the yield.

Introduction

Onion (*Allium cepa* L.) is one of the most important winter spice crops grown in Bangladesh. It ranks first in terms of area of cultivation and production amongst the bulb crops produced in the world (FAO 2002). Among the spice crops grown in Bangladesh, it ranks second in respect of production and area (BBS 2002). Onion is an integral part of our daily diet and its use is very common in almost all food preparations (Hossain and Islam 1994). It is also used as preservative and medicine (Vohra *et al.* 1994). In Bangladesh, the demands for onion are augmenting day by day, where the area under onion cultivation is not increasing rather it is reducing. As a result, Bangladesh has to import onion from other countries to meet its demand (Hossain and Islam 1994). The average yield of onion in Bangladesh is only 3.45 t/ha (FAO 2002). This is a very poor yield compared to other leading onion growing countries of the world. Lack of use of modern genotypes and optimum fertilizer dose may be a major constraint of maximum harvest (Shamima and Hossain 2000). Onion is a shallow rooted crop; a fairly high concentration of nutrient should normally be maintained at the surface of the soil for its optimum growth and yield. The importance of urea, triple super phosphate and muriate of potash on the growth and yield of vegetable crops is well-known. Onion genotypes vary in their nature of bulbing with wide range of production of yield parameters and yield. Hence, an investigation was undertaken with four levels of fertilizers along with six genotypes to find out a suitable treatment combination in respect of growth and yield of onion grown in the Rajshahi region of Bangladesh.

Materials and Methods

The experiment was carried out at the Botanical Garden of Rajshahi University, during the period from September 2001 to April 2002 for bulb production from seed. The experimental site was as a medium high land with the general ground elevation varying from 17-18 m above the mean sea level. The experimental area belongs to the soil tract Active Ganges Flood Plain (AEZ 10) (UNDP 1988) having clay loam in texture. The pH of the soil was 8.12 with organic matter content of 2.56%. There were four levels of fertilizers, (F_0 = 0:0:0, F_1 = 60:65:80, F_2 = 120:130:160 and F_3 = 240:260:320 kg/ha N:P:K) and six genotypes, (V_1 = Thaherpuri Brown, V_2 =

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BARI Onion 1, V_3 = Faridpuri Bhati, V_4 = Suksagor, V_5 = Nasirbala and V_6 = Pusa Red) which formed the treatment variables. The experiment consisting of 24 treatment combinations was laid out in randomized complete block design (factorial) with three replicates. The size of a unit plot was 0.9 m × 0.6 m. For raising seedlings, seeds were sown on the nursery bed. The field was prepared in due time. Well decomposed cowdung (WDC) was applied at the rate of 5 ton per hectare and the chemical fertilizers *viz.,* urea, TSP and MP were applied as the source of nitrogen (N), phosphorus (P) and potassium (K) respectively as per treatment. Total amount of WDC was applied just after ploughing the land. Total TSP, half MP and one-fourth urea were applied during the final land preparation and the remaining MP and Urea were applied into two equal installments after 14 and 34 days of planting as top dressing. Intercultural operations like gap filling, weeding, irrigation, plant protection etc. were done as and when required. Ten plants were randomly selected from each plot in such a way that the marginal effect was avoided and the data were recorded on plant height, number of leaves per plant, root number and length, dry matter content of bulb, bulb length, diameter, weight, and yield. Data regarding various parameters under study were statistically analyzed. The significance differences among the means was determined using DMRT (Gomez and Gomez 1984).

Results and Discussion

Effects of fertilizer levels: Different levels of fertilizers influenced growth, yield components and yield of onion (Table 1). The tallest plant and the maximum number of leaves and roots and root length per plant were found in F_3, while in the dwarf plant, the minimum number of leaves and roots and root length were found in the control. The highest dry matter accumulation ,bulb length, diameter and weight were obtained from F_2 treatment, whereas lowest dry matter content bulb length, diameter and weight were obtained from the control. F_2 treatment produced the maximum bulb yield (14.9 t/ha). Nandi *et al*. (2002) reported that growth and yield of onion were positively influenced by applying different doses of fertilizers. Mathuramalingam *et al.* (2002) had the same observation in growth and yield of onion. These results are in agreement with the findings of Malkouti *et al*. (2002).

Table 1. Growth, yield and yield components of onion as affected by fertilizers and genotypes.

Treatments	Plant height at harvest (cm)	No. of leaves at harvest	Root number	Root length (cm)	Bulb dry matter (%)	Bulb length (cm)	Bulb diameter (cm)	Bulb weight (g)	Bulb yield/ plot (kg)	Bulb yield/ha (ton)
Fertilizer										
F_0	23.6 c	5.9 d	32.9 d	10.4d	7.4 d	3.7 d	3.3 d	18.3 d	0.7 b	12.1 d
F_1	26.5 b	7.4 c	34.3 c	11.7 c	8.0 b	4.4 c	3.9 c	20.4 c	0.7 b	13.6 c
F_2	26.7 b	8.0 b	35.7 b	13.1 b	8.1 a	5.0 a	4.5 a	22.4 a	0.8 a	14.9 a
F_3	27.8 a	8.1 a	35.9 a	13.3 a	7.60c	4.7 b	4.2 b	21.8 b	0.9 a	14.6 b
Genotypes										
V_1	23.8 c	6.6e	33.3 e	10.6 e	7.8 c	3.9 e	3.5 e	18.7 e	0.7 c	12.5 e
V_2	25.9 b	7.2 d	34.0 d	11.2 d	8.2 b	4.3 d	3.8 d	19.8 d	0.7 c	13.1 d
V_3	20.4 d	6.1 f	32.6 f	9.9 f	8.1 b	3.6 f	3.2 f	17.7 f	0.6 e	11.8 f
V_4	25.1 bc	7.6 c	34.9 c	12.6 c	7.3 d	4.6 c	4.1 c	20.7 c	0.8 b	13.9 c
V_5	26.6 b	8.0 b	35.8 b	13.2 b	8.8 a	4.9 b	4.4 b	21.7 b	0.8 b	14.4 b
V_6	30.0 a	8.6 a	37.9 a	15.3 a	6.4 e	5.3 a	4.8 a	25.7 a	0.9 a	17.2 a

In a vertical column values having same letter(s) do not differ significantly at 1% level.

Effect of genotypes: Significant genotypic variation was observed in all the characters (Table 1). Pusa Red (V_6) showed maximum plant height, number of leaves and root, root length, bulb length ,diameter and weight per plant, whereas minimum height, leaves, root numbers and length,

bulb length, diameter and weight were recorded from Faridpuri Bhati (V_3). The genotype Nasirbala accumulated maximum bulb dry matter and Pusa Red accumulated minimum . The maximum bulb yield (17.2 t/ha) was obtained from Pusa Red and minimum yield (11.8 t/ha) was obtained from Faridpuri Bhati. Different genotypic effect obtained in the present study were similar to others (Rabbani *et al.* 1986 and Haque 1994).

Combined effects: The performances of yield and yield contributing parameters as influenced by different fertilizer levels and genotypes have been presented in Table 2. The combined effect of different fertilizer levels and genotypes were found to be insignificant in plant height and root length and significant in the remaining characters. The highest number of leaves and root numbers per plant were recorded from fertilizer F_3 (N:P:K @ 240:260:320 kg/ha) with Pusa Red, whereas

Table 2. Growth, yield and yield components of onion as affected by combined effect of fertilizers and genotypes.

Treatments (fertilizer × genotype)	Plant height at harvest (cm)	No. of leaves at harvest	Root numbers	Root length (cm)	Bulb dry matter (%)	Bulb length (cm)	Bulb diameter (cm)	Bulb weight (g)	bulb yield/ plot (kg)	Bulb yield/ha (ton)
$F_0 \times V_1$	22.3	5.2 n	31.5 o	8.8	7.5 l	3.1 i	2.8 o	16.3 p	0.6 lm	10.9 r
$F_0 \times V_2$	24.6	5.6 m	32.2 n	9.4	7.8 jk	3.5 h	3.1 n	17.4 o	0.6 j-l	11.5 q
$F_0 \times V_3$	19.0	4.4 o	30.9 p	8.1	7.5 l	2.8 j	2.5 p	15.3 q	0.6 m	10.2 s
$F_0 \times V_4$	23.7	6.2 l	32.9 m	10.8	6.8 no	3.9 g	3.4 lm	18.4 n	0.7 i-k	12.2 p
$F_0 \times V_5$	25.0	6.6 k	33.9 k	11.5	8.4 ef	4.2 f	3.7 k	19.4 l	0.7 i-k	12.4 o
$F_0 \times V_6$	27.0	7.3 i	35.9 e	13.5	6.1 p	4.6 e	4.1 h	23.3 d	0.8 c	15.6 d
$F_1 \times V_1$	23.8	6.6 k	32.9 m	10.2	7.8 k	3.8 g	3.4 m	18.4 n	0.7 i-k	12.2 p
$F_1 \times V_2$	25.7	7.3 i	33.6 l	10.8	8.4 f	4.2 f	3.7 k	19.4 l	0.7 g-i	13.0 m
$F_1 \times V_3$	20.3	6.2 l	32.3 n	9.5	8.2 g	3.5 h	3.1 n	17.3 o	0.6 k-l	11.5 q
$F_1 \times V_4$	25.1	7.6 h	34.3 j	12.2	7.5 l	4.5 e	4.0 hi	20.5 j	0.7 e-g	13.7 j
$F_1 \times V_5$	26.5	8.0 fg	35.3 g	12.8	9.1 b	4.9 d	4.3 g	21.4 h	0.8 d-f	14.3 h
$F_1 \times V_6$	29.1	8.6 d	37.6 c	14.9	6.8 n	5.3 c	4.7 d	25.4 c	0.9 l-b	16.9 c
$F_2 \times V_1$	24.4	7.3 i	34.3 j	11.5	7.9 ij	4.5 e	4.0 ij	20.4 j	0.7 f-h	13.5 k
$F_2 \times V_2$	26.5	7.9 fg	34.9 i	12.1	8.6 cd	4.8 d	4.3 g	21.4 h	0.8 d-f	14.3 h
$F_2 \times V_3$	21.0	6.7 k	33.6 l	10.8	8.7 c	4.2 f	3.7 k	19.4 l	0.7 g-i	13.0 m
$F_2 \times V_4$	25.7	8.3 e	35.6 f	13.5	7.7 k	5.2 c	4.7 e	22.4 f	0.8 c-d	15.0 f
$F_2 \times V_5$	27.7	8.6 cd	36.9 d	14.2	9.3 a	5.5 b	4.9 c	23.4 d	0.8 c	16.0 d
$F_2 \times V_6$	29.0	9.2 b	39.0 b	16.2	6.7 o	5.8 a	5.3 a	27.4 a	1.0 a	18.3 a
$F_3 \times V_1$	24.6	7.4 hi	34.4 j	11.7	8.0 i	4.2 f	3.7 k	19.9 k	0.7 g-i	13.2 l
$F_3 \times V_2$	26.7	7.9 g	35.1 h	12.3	7.9 ij	4.5 e	4.0 j	20.9 i	0.8 e-g	13.9 i
$F_3 \times V_3$	21.2	7.0 j	33.8 k	11.0	8.1 h	3.9 g	3.5 l	18.8 m	0.7 h-j	12.6 n
$F_3 \times V_4$	25.9	8.1 ef	35.8 e	13.7	7.1 m	4.9 d	4.3 g	21.9 g	0.8 c-e	14.6 g
$F_3 \times V_5$	27.3	8.8 c	37.1 d	14.4	8.5 de	5.1 c	4.6 f	22.8 e	0.8 cd	15.1 e
$F_3 \times V_6$	31.5	9.5 a	39.3 a	16.6	6.1 p	5.6 b	5.0 b	26.9 b	1.0 a	18.0 b
CV%	9.41	1.89	0.28	0.70	0.90	2.57	0.61	0.40	4.68	0.36

In a column values having same letter(s) do not differ significantly.

lowest leaf numbers and root numbers were recorded from Faridpuri Bhati without fertilizers. Nasirbala with fertilizer F_2 accumulated maximum dry matter and Pusa Red using fertilizer F_3 accumulated the minimum . On the other hand, maximum bulb length, diameter, weight and yield (18.3 t/ha) were obtained from fertilizer F_2 (N:P:K) @ 120:130:160 kg/ha with Pusa Red genotype. The minimum bulb length, diameter, weight and yield (10.2 t/ha) were obtained from genotype Faridpuri Bhati grown without fertilizers. These results are in partial agreement with the findings of Shakur and Rashid (1982) when they worked with different genotypes

Correlation and regression analyses: Correlation estimation was accomplished at phenotypic level and the results obtained have been presented in Table 3. The values of correlation revealed

that bulb yield showed significant positive correlation with plant height at harvest, leaves per plant, roots numbers and length, bulb length, diameter and fresh weight , but it showed non-significant correlation with percentage of dry matter content. In addition, these characters were also inter-correlated among themselves (Table 3). Similar correlation trend was reported by Rahman and Das (1985) in garlic.

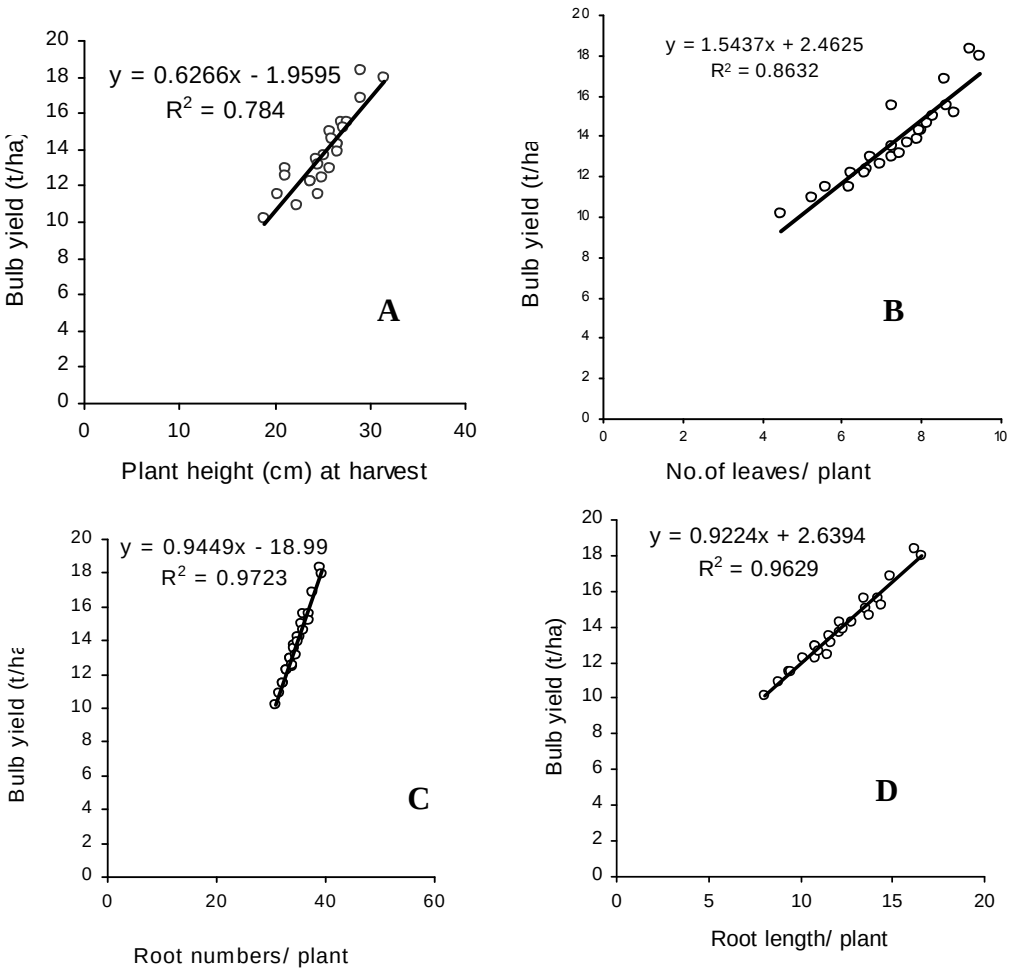

Fig. 1. Relationship between bulb yield and plant height at harvest (A), bulb yield and numbers of leaves/plant (B), bulb yield and root numbers/plant (C), bulb yield and root length/plant (D).

It was evident that bulb yield had positive, linear and highly significant relationship with plant height, number of leaves, root numbers and length per plant (Figs. 1A, B, C and D). Increase in number of roots per plant appears to be important in increasing the yield,whereas number of leaves per plant appear to have least effect on yield increase. Root length is not that important in the increasing the bulb yield.

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