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Effect of spacing and depth of planting on growth and yield of onion

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Abstract: A field experiment was conducted at the Horticulture farm of Bangladesh Agricultural University, Mymensingh during the period from October 2001 to January 2002 to study the effects of spacing, and depth of planting on the growth and yield of two varieties of onion. There were three levels of plant spacing (viz., 20cm × 20cm, 20cm × 15cm and 20cm × 10cm) and two levels of depth of planting (viz., 2cm and 4cm). The experiment was laid out in RCBD with 3 replications. The plant spacing showed significant effects on most of the growth and yield characteristics. Wider spacing produced the maximum number of leaves per plant, longest plant height, maximum diameter and fresh weight of bulb while the closer spacing produced maximum yield of bulb (12.08 t/ha). Bulb yield was significantly higher at lesser depth of planting. The combined effect of spacing and depth of planting was found to be significant on most of the growth and yield parameters. The combination of 20cm × 10cm spacing with 2cm depth of planting gave significant higher yield (12.82 t/ha) compared with other treatment combinations.
Key words: Depth, onion, spacing and yield.

Introduction

Onion production is greatly influenced cultivars and agronomic practices (Mondal *et al.*1986; Mondal, 1991). To increase the per hectare yield of onion, emphasis must be given on adopting improved varieties, plant spacing, depth of planting and other cultural measures. Several researchers in many countries have shown that varieties and plant spacing had profound effects on the growth and yield of onion (Pandey *et al.* 1991, Bhonden *et al.* 1995 and Kumar *et al.* 1998).Successful bulb production depends on the plant spacing. Spacing affects the plant growth, size of bulb, yield as well as the quality of the produce (Purewal and Dargan, 1962; Badaruddin and Haque, 1977; Rahim *et al.* 1983). Planting at proper spacing increases the quality and size of bulb (Nichols and Heydecker, 1964). 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 (Decampose *et al.* 1968; Singh and Rathore, 1977; Nehra *et al.* 1988). Depth of planting of bulb is an important consideration in the production of onion.

The depth of planting depends on varieties, bulb size, depth of ploughed layer, moisture content of the soil and climatic conditions. It also influence the emergence period (Farrag, 1994). Considering the above stated situations, the present study has been undertaken to determine the optimum plant spacing for maximizing the yield of onion by bulb to bulb method and to identify the depth of planting of bulbs for higher yield.

Materials and Methods

The experiment was carried out at the Horticulture Farm of the Bangladesh Agricultural University, Mymensingh during the period from October 2001 to January 2002 to study the effect of spacing and depth of planting on the growth and yield of two varieties of onion grown from sets.Onion bulbs (set) were used as planting material. Two onion varieties, namely Taherpuri and BARI Piaz-1 were used in the experiment.

The experiment consisted of two factors, which were as: Factor A: It consisted of 3 spacings as: (i) 20cm × 20cm (S_1), (ii) 20cm× 15cm (S_2) and (iii) 20cm× 10cm (S_3); Factor B: It consisted of 2 depth of planting: (i) 2cm (D_1) and (ii) 4cm (D_2). The experiment consisting of 6 treatment combinations was laid out in Randomized Complete Block Design (RCBD) with three replications. The whole field was divided into three blocks each containing 6 plots. In total, there were 18 unit plots. The treatment combinations were randomly assigned to each unit plot so as to allot one treatment combination only once in each block. The size of unit was (1 m × 1.2 m). The distance between the blocks was 1m and that between plots were 50 cm. Selected uniform bulbs were planted in the experimental plots on October 25, 2001 following the treatment specifications. After planting the bulbs, various kinds of intercultural operations were accomplished for better growth and development of the plants. Weeding and mulching were accomplished as and whenever necessary to keep the crop free from weeds, for better soil aeration and to break the crust. It also helped in soil moisture conservation. Data on the following parameters were recorded on Percentage of seedling emergence, Plant height, Leaves number per plant, Pseudostem diameter, Fresh weight of leaves, Dry matter content of leaves, Root number per plant, Types of bulb, Bulb diameter, Fresh weight of bulb, Dry matter content of bulb, Yield of onion the sample plants during the course of experiment significance of the difference among the means was evaluated by Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1984).

Results and Discussion

Effect of different spacing on the growth and yield of onion grown from sets: The effect of plant spacing on emergence of seedling, fresh weight of leaves per plant, tallest plant, Leaves number per plant, Pseudostem diameter, dry matter content of leaves, number of root per plant, split bulbs diameter of bulb, fresh weight of bulb dry matter of bulb and Bulb yield were found to be significant. The tallest plant and Leaves number per plant were recorded at different days after planting (DAP) viz., at 20, 30, 40, 50, 60 and 70 DAP. The plant height and number of leaves per plant increased gradually with the passing of time after planting, but at 70 DAPS, plant height and number of leaves per plant decreased slightly due to drying of tip of leaves**.** From the results, it was observed that at each DAP the wider spacing produced higher percentages of plant emergence than the closer spacing. The 20 cm × 20 cm plant spacing gave maximum percentage of plant emergence (96.78%), the tallest plant

(49.28 cm)(Table 1), maximum Pseudostem diameter (1.43 cm), fresh weight of leaves per plant (13.87 g), dry matter content (12.18%), number of roots per plant (42.69), percentage (58.33%) of split bulb, bulb diameter (4.25 cm), bulb weight (37.86 g), dry matter of bulb (10.90%).The maximum yield (1.45 kg/plot) and yield 12.08 (t/ha)were obtained from 20 cm × 10 cm spacing (Fig.1)and the 20 cm × 10 cm plant spacing produced comparatively lower values on all the mentioned parameters except yield per plot and yield per hectare (Table 2). Higher results at wider spacing were probably due to less interplant competition for water, nutrients and light. This result has an agreement with the results of Rashid and Rashid (1976), Kumar *et al.* (1998) , Khushk *et al*. (1990) ; Rizk *et al*. (1991) ; Mehla *et al*. (1993), Nichols and Heydecker ,1964 and Verma (1972). The increased results at the wider spacing were probably due to the availability of more nutrients, moisture, light and space etc. But this result is contradictory with the findings of Das and Dhyani (1956) and Harun-or-Rashid (1998), who obtained taller plant from closer spacing.

Table 1. Effects of spacing on the seedling emergence and plant height of onion at different DAP

Treatments	Seedling emergence (%)						Plant height (cm) at					
	5DAP	6DAP	7 DAP	8 DAP	9 DAP	10DAP	20DAP	30DAP	40 DAP	50 DAP	60 DAP	70 DAP
Spacing												
S_1	17.68a	34.59a	52.37a	72.43a	91.24a	96.78a	29.25 a	33.65a	39.56a	46.23a	49.28a	46.30a
S_2	15.98b	31.55b	49.24b	69.58b	89.82ab	94.95a	27.05b	31.27b	36.79b	42.49b	46.03b	43.13b
S_3	13.67c	26.84c	43.47c	67.04c	87.99b	93.71a	25.13c	30.22c	35.27c	41.81c	44.00c	41.02c

In a column, the figures having similar letter (s) do not differ significantly at 5% level of significance, S_1 : 20 cm x 20 cm ,S_2 : 20 cm x 15 cm, S_3 : 20 cm x 10 cm, DAP: Days After Planting

Table 2. Effects of spacing on the growth, yield and yield components of onion

Treatments	Pseudostem diameter (cm)	Fresh weight of leaves/ plant (g)	Dry matter content of leaves (%)	Root number/plant	Bulb diameter (cm)	Fresh weight of bulb (g)	Dry matter content of bulb (%)	Split bulbs (%)	Bulb yield kg/plot
Plant spacing									
S_1	1.43a	13.87a	12.18a	42.69a	4.25a	37.86a	10.90a	58.33a	1.29b
S_2	1.30b	12.89ab	11.92a	41.61ab	3.86b	32.17b	9.56b	49.17b	1.34b
S_3	1.18c	11.87b	11.56a	40.52b	3.47c	24.14c	9.09c	41.67c	1.45a

In a column, the figures having similar letter (s) do not differ significantly at 5% level of significance, S_1 : 20 cm x 20 cm, S_2 : 20 cm x 15 cm, S_3 : 20 cm x 10 cm

Table 3. Effects of spacing, depth of planting and variety on the seedling emergence and plant height of onion at different DAP

Treatments	Seedling emergence (%)						Plant height (cm) at					
	5DAP	6DAP	7 DAP	8 DAP	9 DAP	10 DAP	20DAP	30DAP	40 DAP	50 DAP	60 DAP	70 DAP
Depth of planting												
D_1	18.85a	37.24a	55.08a	74.17a	92.34a	97.30a	27.46a	32.04a	37.81a	44.01a	46.74a	43.78a
D_2	12.71b	24.75b	41.64b	65.20b	87.03b	93.07b	26.83b	31.39b	36.61b	43.01a	46.13a	43.20a

In a column, the figures having similar letter (s) do not differ significantly at 5% level of significance; D1: 2 cm, D_2: 4 cm, DAP: Days after planting

Table 4. Effects of spacing, depth of planting and variety on the growth, yield and yield components of onion

Treatments	Pseudostem diameter (cm)	Fresh weight of leaves/ plant (g)	Dry matter content of leaves (%)	Root number/plant	Bulb diameter (cm)	Fresh weight of bulb (g)	Dry matter content of bulb (%)	Split bulbs (%)	Bulb yield kg/plot
Depth of planting									
D_1(2 cm)	1.36a	13.71a	11.97a	42.24a	4.13a	32.46a	10.91a	53.33a	1.44a
D_2(4 cm)	1.25b	12.05b	11.80a	40.97b	3.59b	30.32b	8.79b	46.11b	1.28b

In a column, the figures having similar letter (s) do not differ significantly at 5% level of significance.

Effect of depth of planting on the growth and yield of onion grown from sets: The effect of different depth of planting on plant height and emergence percentage of bulb at different days after planting was significantly influenced due to variation in depth of planting.However, the shallower planting produced relatively higher percentage of seedling emergence than deeper planting of bulbs. Higher percentage of seedling emergence (97.30%), the maximum plant height (46.74 cm) (Table 3), Pseudostem diameter (1.36 cm), fresh weight of leaves per plant (13.71 g), dry matter of leaves (11.97%), number of root (42.24), split bulbs (53.33%), bulb diameter (4.13 cm), bulb fresh

weight (32.46 g), dry matter content of bulb (10.91 %), yield of bulb 1.44 kg/plot and bulb yield (12.00 t/ha)(Fig.2) were observed in 2 cm depth of planting and the lower values were recorded at 4cm depth of planting on all the mentioned parameters (Table 4).

Table 5. Combined effects of spacing and depth of planting on the seedling emergence and plant height of onion at different DAP

Treatment Combinations	Seedling emergence (%)						Plant height (cm) at					
	5 DAP	6 DAP	7 DAP	8 DAP	9 DAP	10 DAP	20 DAP	30 DAP	40 DAP	50 DAP	60 DAP	70 DAP
$S_1 D_1$	20.91a	40.98a	59.77a	77.34a	94.05a	98.42a	29.59a	34.30a	40.14a	47.43a	49.59a	46.58a
$S_1 D_2$	14.45c	28.20c	44.96c	67.53c	88.43bcd	95.15ab	28.92a	33.00b	38.97ab	45.02b	48.97a	46.01a
$S_2 D_1$	19.06a	37.93a	56.56a	74.46a	92.13ab	97.10a	27.33b	31.87c	37.88b	43.30bc	46.38b	43.41b
$S_2 D_2$	12.91c	25.18c	41.92c	64.70cd	87.52cd	92.79bc	26.78b	30.68d	35.71c	41.68c	45.67bc	42.84bc
$S_3 D_1$	16.59b	32.80b	48.89b	70.71b	90.83abc	96.13a	25.45c	29.95d	35.41c	41.31c	44.26cd	41.31cd
$S_3 D_2$	10.76d	20.88d	38.04d	63.36d	85.15d	91.29c	24.80c	30.48d	35.13c	42.32c	43.74d	40.73d

In a column, the figures having similar letter (s) do not differ significantly at 5% level of significance
S_1 : 20 cm x 20 cm, S_2 : 20 cm x 15 cm, S_3 : 20 cm x 10 cm; D_1 : 2 cm, D_2 : 4 cm; DAP: Days after planting

Table 6. Combined effects of spacing and depth of plant on the growth, yield and yield components of onion

Treatment Combinations	Pseudostem diameter (cm)	Fresh weight of leaves/plant (g)	Dry matter content of leaves (%)	Root number /plant	Bulb diameter (cm)	Fresh weight of bulb (g)	Dry matter content of bulb (%)	Split bulbs (%)	Bulb yield kg/plot
$S_1 D_1$	1.48a	14.70a	12.63a	43.45a	4.58a	38.92a	12.62a	60.00a	1.36b
$S_1 D_2$	1.38ab	13.04bc	12.12a	41.93ab	3.93abc	36.80a	9.18cd	55.00b	1.22c
$S_2 D_1$	1.35ab	13.70ab	11.98a	42.25ab	4.15ab	32.83b	10.47b	53.33b	1.43b
$S_2 D_2$	1.25bc	12.08cd	11.85a	40.97b	3.58bc	31.50b	8.65d	45.00c	1.26c
$S_3 D_1$	1.25bc	12.72cb	11.67a	41.03b	3.67bc	25.63c	9.65bc	45.00c	1.54a
$S_3 D_2$	1.12c	11.02d	11.45a	40.00b	3.28c	22.65d	8.53d	38.33d	1.36b

In a column, the figures having similar letter (s) do not differ significantly at 5% level of significance
S_1 : 20 cm x 20 cm, S_2 : 20 cm x 15 cm, S_3 : 20 cm x 10 cm; D_1 : 2 cm, D_2 : 4 cm

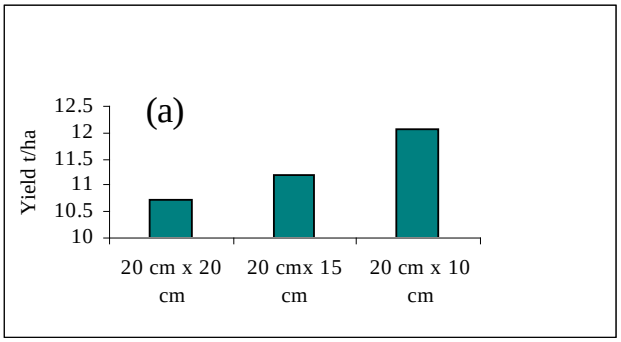

Fig. 1. Effects of spacing on the yield of onion

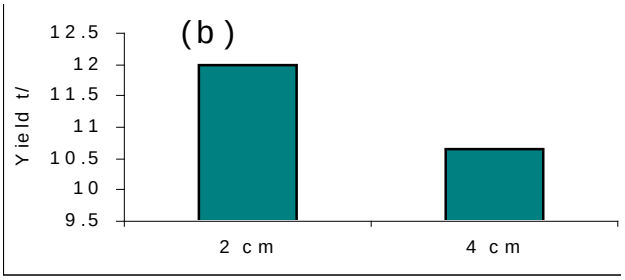

Fig. 2. Effects of depth of planting on the yield of onion

Effect of depth of planting on the growth and yield of onion grown from sets: The effect of different depth of planting on plant height and emergence percentage of bulb at different days after planting was significantly influenced due to variation in depth of planting.However, the shallower planting produced relatively higher percentage of seedling emergence than deeper planting of bulbs. Higher percentage of seedling emergence (97.30%), the maximum plant height (46.74 cm) (Table 3), Pseudostem diameter (1.36 cm), fresh weight of leaves per plant (13.71 g), dry matter of leaves (11.97%), number of root (42.24), split bulbs (53.33%), bulb diameter (4.13 cm), bulb fresh weight (32.46 g), dry matter content of bulb (10.91 %), yield of bulb 1.44 kg/plot and bulb yield (12.00 t/ha)(Fig.2) were observed in 2 cm depth of planting and the lower values were recorded at 4cm depth of planting on all the mentioned parameters (Table 4).

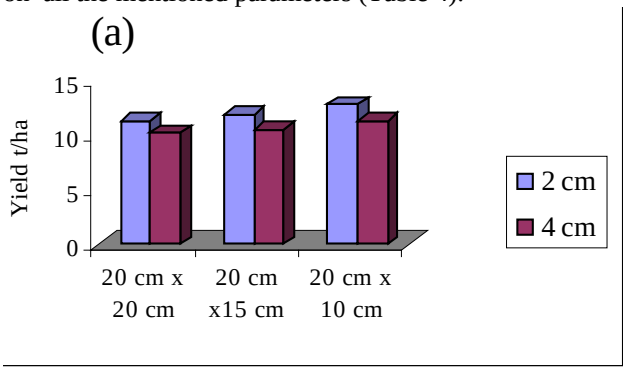

Fig. 3. Combined effects of (a) spacing and depth of planting on the yield of onion.

Interaction effect of different spacing and varieties on the growth and yield of onion grown from sets: The combined effect of spacing and depth of planting was significant on all the mentioned parameters.. Maximum percentage of seedling emergence (98.42%), the tallest plant (49.59cm), pseudo stem diameter (1.48 cm), fresh weight of leaves (14.7 g), dry matter of leaves (12.63%), number of roots (43.45) per plant, splitting percentage (60.00%), bulb diameter (4.58 cm), Dry matter content of bulb ranged between 8.53 to 12.62 % were recorded from the treatment combination of 20 cm x 20 cm spacing with 2 cm depth planting. The maximum yield of 1.54 kg/plot and yield (12.82 t/ha)(Fig.3) were found from the treatment combination of 20 cm × 10 cm spacing with 2 cm depth of planting and the minimum yield per plot and yield per hectare were recorded from the treatment combination of 20 cm × 20 cm spacing with 4 cm depth of planting

Since the closest spacing (20 cm × 10 cm) significantly produced higher bulb yield, it may be used for bulb production although the bulbs were smaller in type. The higher yield was observed at 2 cm depth of planting.

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