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Research Article

EFFECT OF PLANTING DATES ON THE YIELD AND QUALITY OF TRUE SEEDS OF ONION

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Abstract

The present study was stimulated by the problem of onion seed production where seed production is possibly only winter period after which rapid increase in temperature as well as early shower adversely affect the quality of seed. To overcome this situation a field experiment was undertaken to find out the optimum planting time for maximizing quality true seeds of onion. The experiment was laid out in a randomized complete block design with four replications. The treatments were five planting dates viz. 1 October, 15 October, 30 October, 15 November and 30 November to achieve the objective. The research work was done at On-Farm Research Division, BARI, Bogra during September, 2010 to June, 2011. The results revealed that the growth parameters, seed yield components, health and quality of harvested seeds were significantly influenced by the different treatments. Results showed that among different planting dates, 15th November was the best for seed and quality.

Key word: Planting date; yield; quality; true seeds

Introduction

Onion (*Allium cepa* L.) is one of the most important spice crops in Bangladesh. It was introduced into the Asian sub-continent from Palestine (MacGillivary, 1961). Onion has great economic importance due to its medicinal and dietetic values. It is widely used as condiment, salad and dressing of food. The average consumption of onion in Bangladesh is 25 g/head/day (BBS, 2010). It is grown in almost all the districts of Bangladesh; its commercial cultivation is concentrated in Faridpur, Dhaka, Rajshahi, Comilla, Mymensingh, Jessore, Rangpur and Pabna (BBS, 2010). Onion is grown in about 318,000 acres of land. The annual production is 894,000 tons of onion bulbs (BBS, 2010).

Onion is a biennial crop. It completes vegetative phase with bulb production in the first year. The bulbs are used as planting material for production of true seed in the second year. The demands of quality true seeds are increasing day by day. The price of true seeds is also high. The seeds available in the market are poor in quality. The total production of onion seed in Bangladesh is about 150 tons/year but the requirement is more than 900 tons (BBS, 2009). Climatic condition of Bangladesh is not suitable for the production of true seed by seeds to seed method (Rashid, 1976). Onion is a thermo and photosensitive crop (Brewster, 1994). The optimum temperature for onion cultivation is 13-14°C (Rashid, 1983).

In Bangladesh, onion seeds are produced during winter period (Rabi season). Foggy weather at early stage of crop growth and early rain at the flowering stage adversely affect the seed crop. The north-western heavy wind almost may lead to partial or total damage of the seed crop. Thus, the time of planting of bulbs for true seed production in a particular area need to be determined for quality true seed production of onion (Anonymous. 2010).

Planting date may vary in different localities as well as agro-ecological zones and even from year to year at the same place. The environmental conditions greatly influence growth and development of onion plant. Different growth phases of onion have different environmental requirements (Rashid, 1983). Keeping all these above facts in view, the present study was undertaken with the following objective:

To determine the appropriate planting date on the yield and quality of true onion seeds.

Materials and Methods

The experiment was carried out at On-Farm Research Division, Bangladesh Agricultural Research Institute

(BARI), Bogra during the period of September, 2010 to June 2011.

Soil and climate

The experimental area is situated at the western part of Bogra district under Level Barind Tract of Agroecological Zone 25 (AEZ-25). Geographically the experimental field is located at 24.6° N latitude and 89.3ºE longitude at an average elevation of 20 m above the sea level. The soil is clay loam in texture. The pH value was 5.65. The total rainfall during the cropping season (September-April) was 351 mm. Monsoon started in the month of May and ceased after September. Rest of the months had received feeble rainfall.

Land preparation

The experimental field was opened with a power tiller at the month of September, 2010. The land was thoroughly prepared by ploughing and cross ploughing followed by laddering. The subsequent operations were done with harrow, spade, hammer etc. The weeds and stubbles were collected and removed from the field. The surface was leveled with a harrower (ladder) driven by a power tiller. Irrigation and drainage channels were made around the plots. The corners of the plots were trimmed by the spade. The lay-out of the experiment was prepared according to the design of experiment.

Design of experiment

The field experiment was laid out in a Randomized Complete Block Design (RCBD) with four replications. The field was divided into four blocks after final land preparation. Each block was divided into five experimental units. The treatments were assigned in each block at random. The size of each unit plot was 1m × 3m. Block to block and plot to plot distance were 100 cm and 50 cm, respectively.

Plant spacing

Row to row and bulb to bulb were 25 cm and 20 cm, respectively. Each plot had four rows. Fifteen seed bulbs were sown in each row.

Treatments

Dates of planting were the treatments of the experiments. Five planting dates such as 1 October (T_1), 15 October (T_2), 30 October (T_3), 15 November (T_4) and 30 November (T_5) were tested in the experiment.

Variety

BARI Piaj-1 was used in the research program. It was released by Spices Research Centre (SRC) of Bangladesh Agricultural Research Institute (BARI), Bogra, Bangladesh.

Application of fertilizer and manure

The crop was fertilized with recommended doses of fertilizers and manure at the rate of 250, 275, 150, 110, 3 and 5 kg/ha Urea, Triple superphosphate (TSP), Muriate of potash (MoP), Gypsum, Zinc oxide and Boric acid, respectively (Anonymous, 2010). In addition, cowdung was applied at the rate of 10 t/ha. The entire amount of TSP, Gypsum, Zinc oxide, Boron, one third of Urea and one third of MoP were applied at the time of final land preparation. Rest of the Urea and MoP were applied in three equal installments at 30, 50 and 70 days after planting (DAP).

Irrigation and drainage

Water was sprinkled with a watering can after emergences of the shoots at 10 DAP. Afterword each plot was irrigated at 30, 50, 70 and 105 DAP to keep the field soil nearly at field capacity. Excess water was drained out properly as and when necessary.

Intercultural operations

First weeding was done by hand picking just after 15 days of shoot emergence. The second weeding was done by "Khurpi"(hand weeder) at 35 DAP. Rovral (50 WP) @ 2g/l of water were sprayed at 15 days interval starting from 30 DAP upto 120 DAP. Admire were applied @ 0.5 ml/l of water at 105 and 120 DAP.

Staking

Staking of each shoot was made by plastic strips and bamboo sticks. The bamboo sticks were placed in around the plots. About 4-5 cm of each stick was inserted into the soil. The plastic strips were tied between the sticks along the rows of the shoots.

Data collection

Data on different growth parameters and yield parameters were collected at different growth stages of the plants.

Emergence (%) per plot

The numbers of seed bulbs were counted after emergence of shoot above the ground level during 7-15 DAP. Percent emergence in each plot was calculated by the following formula:

$$\text{Emergence (\%)} = \frac{\text{Number of seed bulbs emerged}}{\text{Total number of seed bulbs planted}} \times 100$$

Plant height

Twenty plants were randomly selected at 60 DAP in each plot. The height was measured from the ground level to the tip of the longest leaf. The average plant height was expressed in centimeter (cm).

Number of leaves per plant

Twenty plants were selected at random in each plot. The number of leaves of the 20 selected plants was counted at 60 DAP.

Leaf area index (LAI)

Leaf area index is the ratio of leaf area to the ground area. An area of one square meter was selected at the centre of each plot. The plants were uprooted at 60 DAP. The leaves were separated from the pseudo-stem and washed in running tap water. Free water from the surface of each leaf was dried by soaking with tissue paper. Individual leaf was splited longitudinally into two halves by a sharp knife. Leaf

area was measured by an automatic leaf area meter (LI 3000, USA). Each half of the leaf was placed into the leaf area meter. Total area of all leaves of one square meter in each plot was then calculated. Leaf area index was determined by the following formula:

$$\text{Leaf area index} = \frac{\text{Total leaf area}}{\text{Total ground area}} = \frac{\text{Total leaf area sq m}}{1\,\text{sq m}}$$

Length and diameter of the pseudo-stem

Twenty pseudo-stems were selected at random. The length was measured from ground level to the point of leaf initiation at 60 DAP. Diameter of the pseudo-stem was measured just above the ground level at 60 DAP. The data were expressed in centimeter (cm).

Number of stalks per plant

Twenty plants were selected at random from each plot. The number of stalks of the plants were counted in each plot at 90 DAP.

Number of umbel per plant

Twenty plants were selected at random. The number of umbels of the selected plants was recorded after completion of flowering in each plot. The average of 20 plants was computed.

Umbel diameter

The diameter at the middle of the umbel was measured from 20 umbels of 20 randomly selected plants at maximum flowering stage in each plot and expressed in centimeter (cm).

Number of flowers per umbel

The numbers of flowers in each umbel was counted from randomly selected 20 umbels at maximum flowering stage in each plot.

Harvesting and processing

The duration of crop is 145 to 150 days. When the seeds inside the capsules become black and 25-30% black seeds were exposed on the umbel, then each umbel was cut with 5-7 cm flower stalk. Harvesting was continued for 3-7 days. The umbels were sun dried. Threshing was done by light beating and hand rubbing of the umbels. The seeds were cleaned and sun dried for 3-4 days until seed moisture reduced to below 8%. The seeds of individual plots were processed separately and contained in a separate brown paper bag and preserved for further use.

Number of seeds per umbel

It was counted from randomly selected 10 umbels of selected plants at maximum fruit set stage.

Weight of 1000-seeds

One thousand seeds were selected at random from each plot. The 1000-seed weight was recorded on an electric balance and expressed in gram (g).

Seed weight per plant

Twenty plants were selected at random from each plot and the seeds were harvested. Seed weight were recorded on an electric balance and expressed in gram (g).

Seed weight per plot

Total amount of seeds of each plot were bulked and weight in gram (g) was recorded.

Seed moisture content (%)

The moisture content of seeds was determined by universal type moisture meter (Oriental Apparatus Workshop, India). Two hundred gram of seed was used for each test. The moisture meter measures electrical conductivity through a predetermined thickness of measured seed and the reading was converted to a moisture percentage through a calibrated dial. To add confidence to the result, the machine was cross checked periodically obtaining results from an ISTA prescribed oven method. Tests were replicated according to the requirement for each sample.

Seed germination

Germination test was carried out in a plastic tray at On Farm Research Division, BARI, Seujgari, Bogra according to the International Rules for Seed Testing (ISTA, 1996). Sand was used as substrate for germination test. The plastic tray was filled with moist sand. Adequate moisture was maintained in the substrate. Four hundred pure seeds were taken at random from each treatment. One hundred seeds were placed in each tray and were considered as a replication. There were four replications for each treatment. Number of normal seedlings, abnormal seedlings, dead seeds and ungerminated seeds were counted. The first counting was done on the 6^{th} and the second counting on the 12^{th} day after placing the seeds on the substrate. Germination percentage was determined by the following formula.

$$\text{Germination (\%)} = \frac{\text{Number of normal seedlings}}{\text{Number of seeds tested}} \times 100$$

Seed borne infection

Seed samples from each treatment were subjected to seed health test by Blotter incubation method following the procedure of International Rules for Seed Testing (ISTA, 1996). Three pieces of 9 cm diameter filter papers (Whatman No. 1) were soaked in distilled water and placed at the bottom of a plastic Petri dish. Four hundred seeds were taken at random from each treatment. Twenty five seeds (25) were placed on filter paper in each petri dish. Sixteen petri-dishes were used for each treatment. The petri-dishes were incubated for 7 days. Seed borne infection was recorded. Temporary slides were prepared and examined under the compound electric microscope and identified with the help of appropriate keys. The numbers of infected seeds with fungal pathogen were recorded. The results were expressed in percentage as follows:

$$\text{Seed borne infection (\%)} = \frac{\text{Number of infected seeds}}{\text{Number of seeds tested}} \times 100$$

Analysis of data

The data collected on various parameters related to the experiments were subjected to statistical analysis according to the design of experiment by MSTAT computer package program. Differences among the treatment means were compared following Duncan's Multiple Range Test (DMRT).

Results and Discussion

The effect of planting dates on the growth parameters of BARI Piaj-1 are presented in Table 1. Planting date had significant effect on the emergence of bulbs. The maximum emergences of bulbs were 98.33% recorded in T_4. It was statistically similar in T_3 and T_5. The lowest emergence (85.42%) was obtained from T_2. Plant height was significantly influenced by the planting dates. The highest plant height was recorded in T_4, T_3 and T_5. The lowest plant height was (33.13 cm) was obtained from T_2. Plant height was 33.58 cm in T_1. The number of leaves/plant was 18.09 in T_4 and 8.51 in T_1. Leaf area index differed significantly with the planting dates. The highest leaf area index was (3.97) recorded in T_4. The lowest leaf area index was 0.34 in T_2. It was identical in T_1. The leaf area index of T_3 and T_5 was statistically similar. The highest length of the pseudo-stem was 8.21cm in T_4 and 7.88 cm in T_3. It differed significantly from all other dates of planting. The lowest length of the pseudo-stem was 3.88 cm in T_2 and 4.38 cm in T_1. The diameter of the pseudo-stem was significantly different in different dates of planting. The highest diameter of the pseudo-stem (4.85 cm) was recorded in T_4. Diameter of the pseudo-stem was statistically identical in T_3 and T_5. The diameter of the pseudo-stem in T_1 was statistically identical with that of T_2.

The highest number of stalks (4.65)/plant was recorded in T_4. The number of stalk/plant was statistically identical in T_3, T_4 and T_5. The number of stalk/plant was low in T_1 (Table 2). The number of umbel/plant in T_4 was significantly different from T_1 and T_2 (Table 2). It was statistically similar in T_3 and T_5. There was no difference between T_1 and T_2 treatment (Table 2). The highest umbel diameter was 6.96 cm in T_4 which was statistically similar to that in T_3 and T_5. The lowest umbel diameter was 2.96 cm in T_2. The number of flowers/umbel was 545.4 in T_4. It was statistically identical with that of T5. The number of flowers/umbel was 186.03 in T2 which was identical to that in T_1 (Table 2). The number of seeds/umbel was 299.97 in T_4. It was significantly higher than that of all other treatments. The number of seeds/umbel was low (93.02) in T_2. It was similar in T_1 and T_2.

Table 1: Effect of planting dates on the growth parameters of BARI Piaj-1

Treatment	Bulb emergence/plot		Plant height (cm)	No. of leaves/plant	Leaf area index	Pseudo-stem	
	Number	(%)				Length (cm)	Diameter (cm)
T_1	54.75ab	91.25 ab	33.58 b	8.51 b	0.38 c	4.38 c	1.41 c
T_2	51.25b	85.42 b	33.13 b	8.66 b	0.34 c	3.88 c	1.55 c
T_3	55.00 ab	91.67 ab	48.50 a	16.74 a	3.15 ab	7.88 ab	3.88 b
T_4	59.00 a	98.33 a	52.38 a	18.09 a	3.97 a	8.21 a	4.85 a
T_5	57.75 a	96.25 a	48.06 a	14.82 a	3.12 b	6.85 b	3.43 b
LSD $_{(0.05)}$	4.38	7.30	7.49	3.18	0.78	1.10	0.66
CV (%)	5.12	8.53	8.04	9.01	9.51	8.16	9.07

Means followed by the same letter in a column did not differ significantly at the 5% level by DMRT. T_1= 1st October, T_2= 15th October, T_3= 30th October, T_4= 15th November and T_5= 30th November.

Table 2: Effect of planting dates on seed yield parameters of BARI Piaj-1

Treatment	No. of stalk/ plant	No. of umbel/plant	Umbel diameter (cm)	No. of flowers/ umbel	No. of seeds/ umbel
T_1	1.80 c	1.43 b	3.01 b	188.95 c	94.48 c
T_2	2.30 c	1.35 b	2.96 b	186.03c	93.02c
T_3	4.50 a	4.25 a	6.16 a	465.30 b	251.26 b
T_4	4.65 a	4.66 a	6.96 a	545.40 a	299.97 a
T_5	3.65 ab	4.04 a	6.03 a	501.70 ab	270.92 b
LSD $_{(0.05)}$	1.71	2.14	1.29	58.41	11.23
CV (%)	8.41	9.96	9.73	9.43	9.68

Means followed by the same letter in a column did not differ significantly at the 5% level by DMRT. T_1= 1st October, T_2= 15th October, T_3= 30th October, T_4= 15th November and T_5= 30th November.

The highest 1000-seed weight (4.17 g) was recorded in T_4 (Fig. 1). There was no statistical variation between T_3 and T_5. Thousand-seed-weight was the lowest (1.13 g) in T_2. It was statistically similar with T_1. The seed weight/plant (5.38 g) was the highest in T_4. The seed weight was 0.56 g/plant in T_2 which was statistically identical to that of T_1.

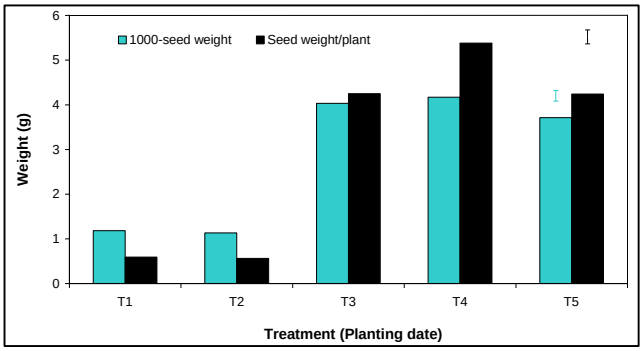

Fig. 1: Effect of planting dates on 1000-seed weight and seed weight per plant of BARI Piaj-1. T_1= 1st October, T_2= 15th October, T_3= 30th October, T_4= 15th November and T_5= 30th November.

[The vertical bars represent LSD at 5% level of significance]

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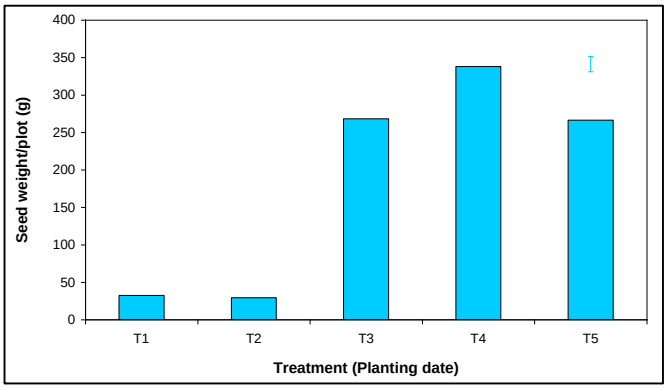

Fig. 2: Effect of planting dates on seed yield per plot of BARI Piaj-1.

[T_1= 1st October, T_2= 15th October, T_3= 30th October, T_4= 15th November and T_5= 30th November. The vertical bar represents LSD at 5% level of significance.]

The results of the effect of planting date of onion seed weight/plot are presented in Fig. 2. The highest seed weight (338 g/plot) was recorded in T_4. The lowest seed weight/plot in T_1 and T_2. T_3 and T_5 were identical in seed weight/plot

The seeds were harvested from the plants sown at different dates and subjected to quality test. The moisture content of the seeds of all the plots was similar (Table 3). But there were significant differences in seed germination. Maximum germination (84%) was recorded in T_4 followed by T_3 (77%) and T_5 (76%). Low germination was recorded in T_1 and T_2. The incidence of seed borne pathogen differed significantly among the treatments. The lowest fungal pathogen (4.25 %) (*Alternaria porri*) was recorded in T_4 which was statistically different from all other treatments. The other treatments were similar in seed borne infection (Table 3).

Seed yield was 1127 kg/ha when planting was done on the 15th November. It was the lowest on 1st to 15th October planting. In case of seed health, the maximum germination (84%) and lower population of seed borne fungi (*Alternaria porri*) was 4.25% due to bulbs planting on 15th November. The lower germination and higher population of seed borne fungi (*Alternaria porri*) was found when bulb planting was done on 1st and 15th October. The findings of this study is supported by the findings of Singh and Singh (1984); Roy (1994); Rizk *et al*. (1996); Abedin *et al*. (1999) and Muktadir (2000). They reported the highest seed yield and lower population of seed borne fungi (*Alternaria porri*) due to bulbs planting on 15th November. Similar findings have been reported by Krishnaveni (1990) who noted that bulb planting in the 2nd and 3rd weeks of November gave the highest seed yield as well as the germination was 86-90%. The present findings also supported by Uddin *et al*. (2012) who stated that the highest seed yield of 1065 kg/ha from crops planted on 10th November which was identical to that of 20th November (1044 kg/ha). Similar findings were reported by Khan (2011). He got higher seed yield (966 kg/ha) and germination (80%) when bulb planting was done on 10th November.

Table 3: Effect of planting dates on seed health and quality of BARI Piaj-1

Treatment	Moisture (%)	Germination (%)	Seed borne fungi (%)
T_1	7.46	44 c	6.50 a
T_2	7.45	45 c	6.50 a
T_3	7.50	77 b	5.75 a
T_4	7.45	84 a	4.25 b
T_5	7.50	76 b	5.75 a
LSD $_{(0.05)}$	NS	4.25	1.32
CV (%)	7.23	3.03	10.65

Means followed by the same letter in a column did not differ significantly at the 5% level by DMRT. NS= Not significant. T_1= 1st October, T_2= 15th October, T_3= 30th October, T_4= 15th November and T_5= 30th November.

Conclusion

Based on the results of the experiment the optimum date of planting of mother bulb for true seed production of onion at Bogra region in Bangladesh is 15th November.

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