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EFFECT OF IRRIGATION AND DURATION OF MOTHER BULB VERNALIZATION ON THE GROWTH, YIELD AND QUALITY OF ONION SEED

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ABSTRACT

An experiment was conducted at the Horticultural Farm of Bangladesh Agricultural University, Mymensingh during October 2000 to April 2001 to determine the effects of irrigation and duration of mother bulb vernalization on the yield and quality of onion seed. These were four levels of irrigation (no irrigation, irrigation for 1, 2 and 3 times) and four levels of duration of vernalization (vernalization for 0, 7, 14 and 21 days). Bulbs of 20±0.5 g size of local cultivar Taherpuri were used as a planting material and were vernalized at a temperature of 10 ± 1^0C. Yield and quality of onion seed were significantly influenced by the application of irrigation and duration of mother bulb vernalization independently. The highest length of flowering stalk, number of seeds per umbel, seed yield per umbel, seed yield per plant and seed yield per hectare were observed from the crop irrigated 3 times and mother bulbs of which were vernalized for 21 days. Irrigation for three times with 14 days vernalization produced the highest number of umbels per plant and showed the best germination percentage. The highest 1000 seed weight was recorded in the plants irrigated 2 times and vernalized for 21 days. In most cases, irrigation for 2 and 3 times; vernalization for 14 days and 21 days showed identical performance. Vernalization of mother bulbs enhanced flowering by 10 days.

Key Words: *Onion, irrigation, vernalization, seed*

INTRODUCTION

Onion (*Allium cepa*) is chiefly used as spice in Bangladesh. Its demand is increasing day by day with the increasing population of the country. At present total production of onion in the country is about 6.33 lakh ton against the requirement of 14.7 lakh tons (Anon., 2007). The yield of onion in the country is very low (4.48 t ha^{-1}) compared to those of the major onion growing countries (25-30 t ha^{-1}). Onion bulb is mainly produced from seeds. The average yield of onion seed in Bangladesh is very low (370 to 500 kg ha^{-1}) as against that (1000-1200 kg ha^{-1}) of the world as noted from (HRDP, 1995 and Brewster, 1994). The total requirement of onion seed in Bangladesh is about 212.6 t $year^{-1}$. Out of those, actual trade of onion seed is 180 t $year^{-1}$ (Seraj, 1999). There is a large gap prevailing in the country to meet the requirement of onion seed. Although the climate of Bangladesh is congenial to the production of high quality onion seed; farmers are not making use of modern technologies for its production (Bokshi *et al.,* 1989). Some farmers follow conventional methods for raising onion seed crop and use limited irrigation or not at all. But literature indicates that the use of irrigation could improve yield and quality of seed to a great extent (Bhonde *et al.,* 1989). Onion plants are biennials, and require vernalization of bulb for flower initiation (Brewster, 1994). Proper vernalization temperature of mother bulb stimulates early flowering and produces heavier yield of seed (Jones and Mann, 1963). During the month of April and May, storm with heavy rainfall is a regular incidence in Bangladesh that affects the onion seed crop adversely and destroys the flower and flowering stalk to a great extent. Early flowering leading to early harvesting before the commencement of heavy rainfall could save the onion seed crop. Hence, vernalization of mother bulbs of our local cultivar might be a measure to ensure early flowering resulting in the production of early seed crop. Considering the above facts the experiment was conducted to evaluate the effects of irrigation and duration of bulb vernalization on the yield and quality of onion seed.

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MATERIALS AND METHODS

The experiment was conducted at Horticultural Farm of Bangladesh Agricultural University, Mymensingh during October 2000 to April 2001. The experiment was laid out in split plot design with three replications considering irrigation (No irrigation, irrigation for one, two and three times) in the main plot and duration of vernalization (No vernalization, vernalization for 7, 14 and 21 days) of mother bulb in the subplot. Unit plot size was 1m × 1 m. Selected bulbs of the same size (20±0.5g) of local cultivar Taherpuri were put in white cotton cloth bags and vernalized in a refrigerator calibrated at 10±1^{o}C temperature. Vernalization was given for 21, 14 and 7 days to adjust different duration of vernalization as per treatment. The vernalization temperature was used according to Peters (1990). Bulbs were taken out of the refrigerator 4 hours prior to planting and then kept under fan for 3 hours for surface drying. Bulbs were planted on 15 November 2000. The plant spacing was 20 cm X 25 cm. Fertilizers were used as per recommendation. Polythene was lined around each main plot at a depth of 1 m to prevent the run-off and seepage of water from an irrigated plot to the nearby non-irrigated plot. The irrigation schedule commenced on 4 December, 2000 and applied at an interval of 20 days. Water was applied to the experimental plots up to make the soil saturated. Mulching, weeding, plant protection measure and staking were done as and when needed. The Mature bulbs were harvested when 10-20% capsules were splitted and exposed their black seeds (Pandey *et al*., 1992). The seed crop was harvested periodically from 27 March to 12 April, 2001. Harvested umbels were dried; seeds were harvested, cleaned and dried until they reached safe moisture content (Brewster, 1994). Seeds were then kept in polythene bag, which were kept in refrigerator at 8±1^{o}C. Seed germination test was conducted in the incubation room of Seed Pathology Laboratory, BAU-DANIDA, Mymensingh set at 23^{o}C and 70% RH (Brewster, 1994). It was performed following TP (Top of Paper) method and in sterile Petri dish. Data were collected on plant growth, yield contributing traits, yield and seed quality traits. Data were statistically analyzed. The mean separation was done by LSD test.

RESULTS AND DISCUSSION

Significant variations were observed in all the characters studied except plant emergence, per cent flowering plants and per cent harvested umbels. Irrigation did not influence significantly the number of leaves per plant at 15 days after planting (DAP) but it showed a significant influence on number of leaves per plant at 30 and 45 DAP. An increasing trend of leaf production was observed due to irrigation treatment. Both at 30 and 45 DAP the highest number of leaves was produced by the plants receiving 3 times irrigation and that were statistically identical with those produced with 2 times irrigation (Fig. 1). In both cases, the lowest number of leaves was found in no irrigation treatment. Irrigation did not significantly influence the plant height at 15 DAP. At 30 DAP maximum plant height was recoded in the plants irrigated 2 times and it was statistically similar with those of the plants irrigated once and twice. At 45 DAP maximum plant height was recoded in the plants irrigated 3 times and it was statistically similar with the plants irrigated twice (Table 1). The shortest plants both at 30 and 45 DAP were found in no irrigated plot. Flowering stalk attained its maximum height in the plots irrigated 3 times, but it was statistically similar with the height of flowering stalk produced by the plants having 2 times irrigation. The highest number of umbels per plant was found in plants irrigated 3 times which was statistically identical with those of the plants produced with two times irrigation. Non-irrigated plants produced the lowest number of umbel. In case of number of flower buds per umbel and number of seeded fruits per umbel, similar trend of results was observed as in the number of umbels per plant. Data revealed that number of seeded fruits per umbel increased with increasing irrigation but it was also found that 3 times irrigation was statistically similar with those of the plants produced with 2 times irrigation. Globerson *et al.* (1987) reported that irrigation during flowering gave maximum fruit set and excess water reduced the number of fruits per umbel. The highest percentage of seeded fruit per umbel was found in the plants irrigated 3 times, followed by those produced with 2 times irrigation. The plants that were not irrigated gave the lowest percentage of seeded fruit. As it was found that irrigation had significant effect on the per cent seeded fruit, as it could be assumed that irrigation might have influenced the number of seeds per umbel. The maximum number of seeds per umbel was given by the plants irrigated 3 times and it was different from those produced with

2 times and 1 time irrigation. Non-irrigated plants gave minimum number of seeds per umbel. The highest amount of seeds per umbel was obtained from the plants irrigated 3 and 2 times which was statistically different from those produced with other irrigation treatments. Seed yields per plant, per plot and per hectare were also significantly influenced by irrigation frequencies (Table 1).

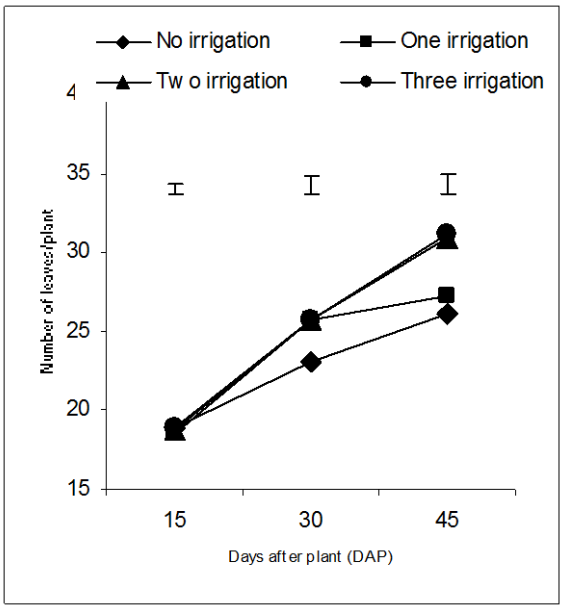

Figure1. Effect of irrigation on leaf number of onion (Vertical bars indicate LSDat 0.05 level).

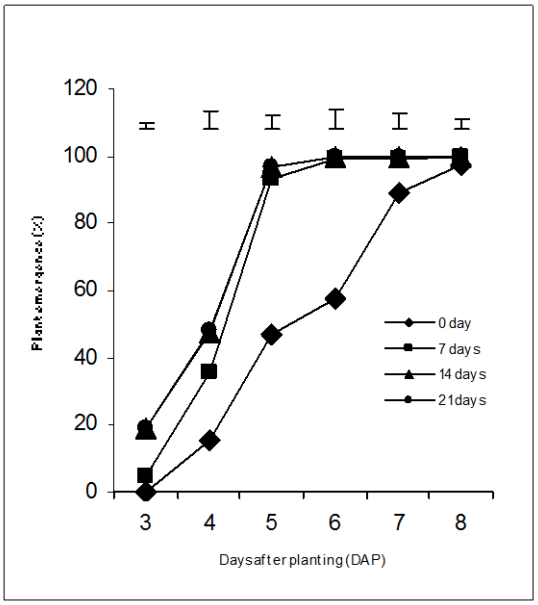

Figure 2. Effect of duration of mother bulb vernalization on plant emergence of onion. (Vertical bars indicate LSDat 0.05 level).

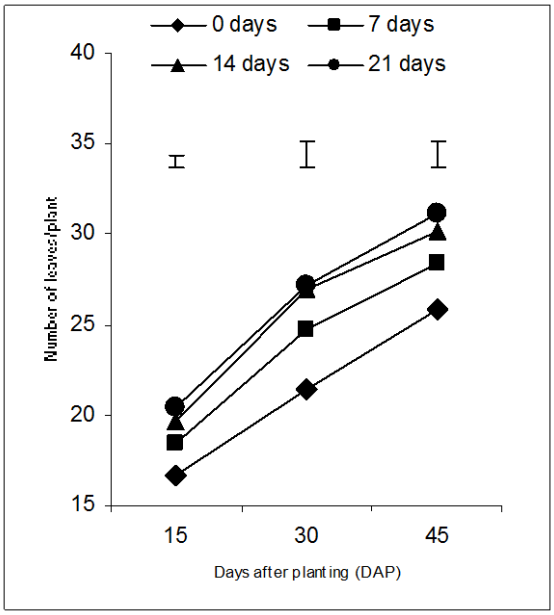

Figure 3. Effect of duration of mother bulb vernalization on number of leaves in onion.

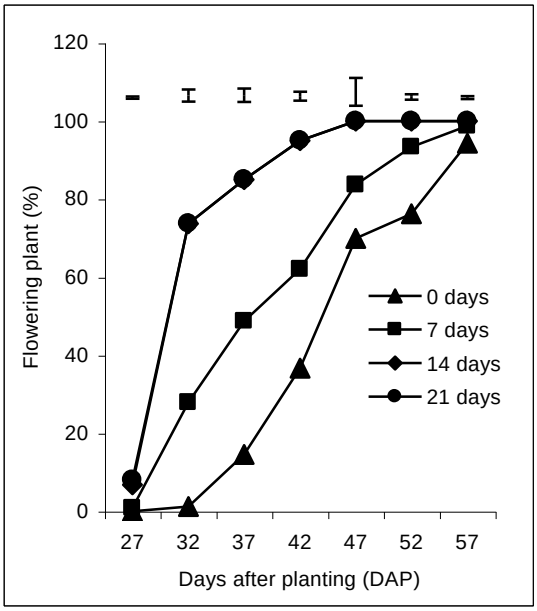

Figure 4. Effect of duration of mother bulb vernalization on per cent flowering plants in onion.

Maximum 1000-seed weight was recoded when the frequency of irrigation was 3 resulting in maximum seed germination percentage and it was statistically similar with those produce with 2 irrigations for both the characters. In contrast, MacGillivray (1948) reported that there was no significant difference in seed germination among the seeds produced with different irrigation treatments. Irrigation application resulting in producing heavier and larger seeds might have had rich initial food reserve and ultimately helped for better germination.

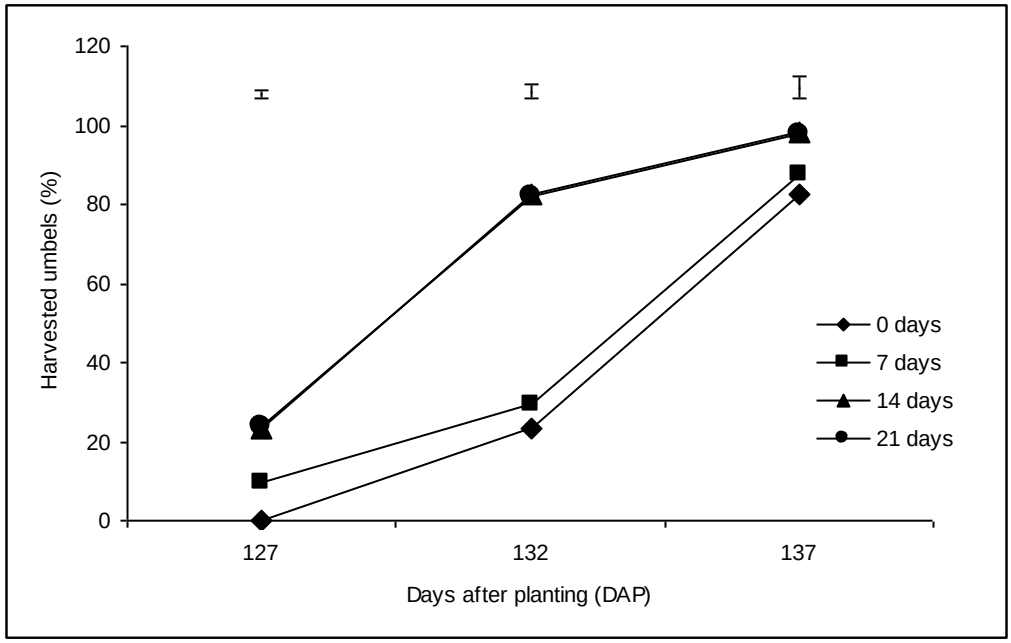

Figure 5. Effect of duration of mother bulb vernalization on per cent harvested umbels in onion cv. Taherpuri. The vertical bars indicate LSD at 0.05 level.

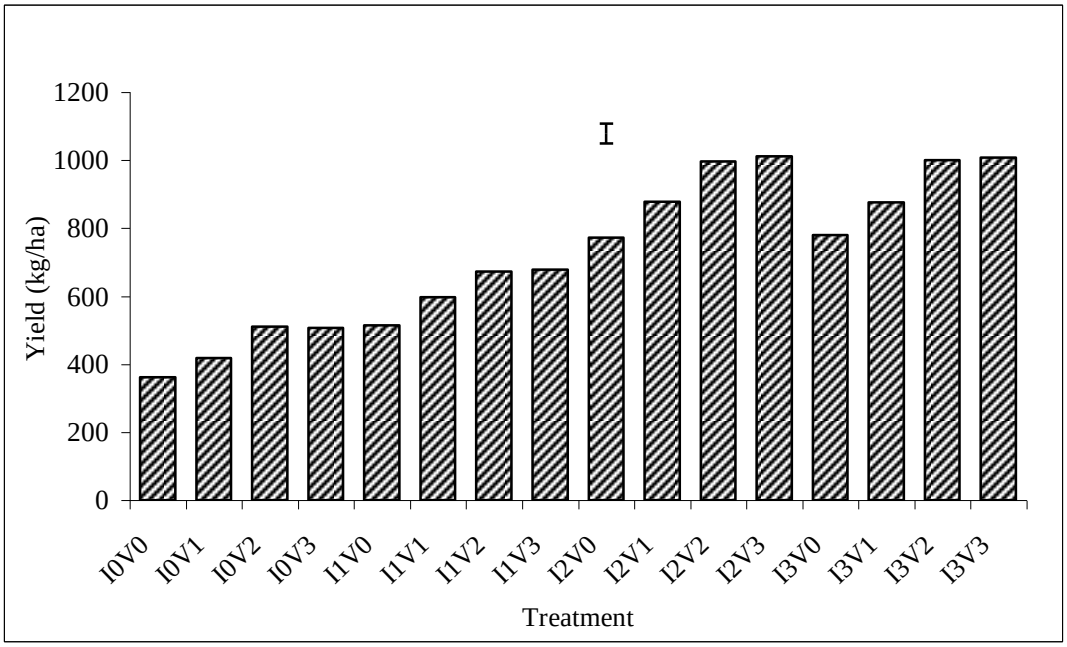

Figure 6. Interaction effect of irrigation and duration of mother bulb vernalization on seed yield of onion cv. Taherpuri. The vertical bars indicate LSD at 0.05 level.

Duration of vernalization had significant effect on plant emergence from 3 to 7 DAPS, but it had no significant effect at 8 DAP (Fig. 1). It took 6 days to attain 100% emergence for 14 and 21 days cold treated bulbs while it needed 8 days to attain about 98% plant emergence in case of nonvernalized bulbs. Leaf and root primordia were observed on the mother bulbs that were vernalized but in nonvernalized bulbs no such events were observed. Early initiation of leaf and root primordia was possibly responsible for early emergence. Jones and Mann (1963) stated that proper storage temperature of mother bulbs stimulate the development of new leaf primordia. Duration of vernalization significantly influenced the number of leaves at 15, 30 and 45 DAP (Fig. 2). Plants produced from the bulbs vernalized for 21 days prior to planting gave maximum number

of leaves per plant at 15, 30 and 45 DAP (20.42, 27.12 and 31.2, respectively). But vernalization for 21 days and 14 days showed identical performance in this regard. Significantly, the tallest plants at 15, 30 and 45 DAP were produced by the bulbs that were vernalized for 21 days, but similar effect was found with 14 days vernalization treatment. The shortest plants were observed in non-vernalized plants at 15, 30 and 45 DAP. Percent flowering plant^{-1} significantly increased with the increase in the duration of cold treatment up to 14 days, after which although it increased but in all cases statistically similar results were observed for 14 and 21 days Vernalization (Fig. 2). Vernalization for 14 and 21 days enhanced complete flowering by 10 days compared to non-vernalized plants. The longest scape was produced by the plants raised from the bulbs vernalized for 21 days and it was found to be statistically similar with 14 days vernalization followed by 7 days vernalization treatment. In case of number of umbels per plant, vernalization for 21 days showed the highest performance which was identically followed by 14 days vernalization treatment. The lowest number of umbels per plant was produced by 0 days vernalization treatment preceded by 7 days vernalization treatment. Similar trend was found in respect of number of flower buds umbel^{-1} as in the umbel number per plant. Cold treatment for 21 days showed early and rapid harvesting pattern. Thus it was obvious that cold treatment for 21 days tended to shorten the life cycle of onion seed crop compared to untreated bulbs. Cold treatment of bulbs for 14 and 21 days maintained similarity within themselves in this regard. It was observed that 98.12% umbels were harvested at 137 DAP from 14 days cold treated plant while it was 82.59% for nonvernalized plant at same DAP (Fig. 3). Maximum number of seeded fruits, seeds umbel^{-1}, maximum seed weigh umbel^{-1}, plant^{-1}, plot^{-1} and ha^{-1} were found in 21 days vernalization treatment identically followed by 14 days vernalization treatment. The lowest performance in these cases was noticed in nonvernalized treatment. Bulbs cold treated for 14 days gave maximum 1000 seed weight (3.77 g) which was statistically similar with that produced under 21 days cold treatment of mother bulb. The lowest weight of 1000 seed was given by the bulbs without cold treatment, which was similar to that of 7 days cold treatment. The highest germination was observed in the vernalizatin treatment of 21 days. This was followed by 14 days treatment.

The interaction effect of irrigation and vernalization of mother bulb was not significant except seed yield plant^{-1}, plot^{-1} and ha^{-1}. Maximum seed weight was obtained from the plants having treatment combination of 3 times irrigation with 21 days vernalization of mother bulb (Table 2). The highest value was identically followed by treatment combination of 2 times irrigation with 14 days or 21 days cold treatment and 3 times irrigation with 14 days cold treatment of mother bulb. The minimum seed weight plant^{-1} was found in the plants having the treatment combination of no irrigation and no vernalization and it was followed by the treatment combination of no irrigation with 7 days vernalization. Similar trend was also observed in case of seed yield per plot and per hectare. A range of variation of seed yields from 361.30 to 1008.83 kg ha^{-1} was observed due to the interaction effect. Maximum seed yield was found from 3 times irrigation and 21 days vernalization treatment combination and lowest seed yield was recorded from no irrigation and no vernalization treatment and this was different from the seed yield of all other treatment combinations (Fig. 4). Onion cultivar Taherpuri was the best yielder of seed, which responds well to irrigation. Irrigation was in general helpful to get good yield and high quality seed. Discontinuing irrigation at milk stage gave high yield of good quality seeds with economy of labour and water (Bhonde *et al*,. 1996). Early flowering shortens the life cycle of onion. Because of early flowering onion plants are exposed to different adverse condition (High temperature, disease incidence, early rainfall etc.) for a short period than the nonvernalized plants. This might have contributed to obtain higher seed yield due to longer vernalization.

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