

Effect of vernalization on seed production of onion

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Abstracts: An experiment was conducted at the Horticultural Farm, Bangladesh Agricultural University (BAU), Mymensingh during the period from October 2010 to April 2011. The present study was aimed at determining the effect of vernalization on the yield of onion seed. The experiment consisted three levels of Vernalization (viz., vernalization of mother bulbs at 5°C ± 1 and 10°C ± 1 and no vernalization). Bulbs of 20±1g size of local cultivar Taherpuri were used as planting material and were vernalized at the duration of 14 days in freezing. Yield and quality of onion seeds significantly influenced by vernalization. Bulbs were vernalized in a refrigerator at a calibrated temperature of 5 ± 1°C and 10 ± 1°C. Plant produced from the bulbs vernalized at 5±1°C temperature prior to planting gave maximum leaves at 15, 30 and 45 DAP (19.91, 26.47 and 30.84 leaves per plant, respectively). Maximum seeds (189.05g) per umbel were produced by the plants that were vernalized in 5±1°C. The highest seed yield per plot (915.89g) was found from the cold treatment at 5±1°C. Early plant emergence was noticed for longer vernalization treatment. Cold treatment of mother bulbs influenced the plant to produce maximum number of leaves.

Keywords: Onion, Vernalization, Bulb

1. Introduction

Onion (*Allium cepa* L.) is one of the most important winter spice crop grown during rabi season 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, 2001). It is also used as preservative and medicine. In Bangladesh, the demand for onion is augmenting day by day; where the area under onion cultivation is not increasing rather it is decreasing. The average yield of onion in Bangladesh is only 3.45 t/ha (FAO, 2002). Onion is chiefly used as spice crop in Bangladesh. Its demand is increasing day by day with the increasing population of the country. It is cultivated all over the country but extensively cultivated in the Faridpur, Dhaka, Rajshahi, Comilla, Jessore, Dinajpur, Mymensingh, Rangpur, and Pabna. Bangladesh has produced 127 thousand metric ton onion bulbs from 34 thousand hectares of land during 2000-2001 growing season (BBS, 2001). The yield of onion in the country is very low (4018 kg/ha in 1998) as compared to the world average yield (17269 kg/ha) and it remained nearly same for the last five years (FAO, 1999). The unavailability

of good quality onion seeds is partly responsible for low yield in Bangladesh (Bokshi *et al.*, 1989).

Quality seed yield of onion depends on genotype, locality, season and method of seed production (Brewster, 1994). In Bangladesh 150 metric tons of onion seed were produced against an annual requirement of 300 metric tons (Rahim *et al.*, 1993). Small amounts of seeds are produced in some districts like Faridpur, Natore and Rajshahi. There is a large gap prevailing in the country to meet up the requirements of onion seed.

Vernalization is a technique to initiate flowering in onion. Proper vernalization temperature of mother bulb stimulate early flowering and produces a heavier yield of seed (Jones and Mann, 1963). During the month of April and May, Nor'wester is a regular incidence in Bangladesh that affects the flower and flowering stalk to a great extent. Early flowering leading to early harvesting before the commencement of Nor'wester could save the onion seed crop. Hence, vernalization of mother bulbs might be a measure to ensure early flowering resulting in the production of early seed crop.

The piece of research work was undertaken to find out the optimum vernalization temperature to achieve the best possible yield of the local variety of onion “Taherpuri” under the existing agroclimatic conditions of Bangladesh.

2. Materials and Methods

In this chapter the materials and methods that were used in carrying out the experiment have been described. Experimental sites, soil, experimental, material, methodology, design of experiment, raising of seed crop, data collection, statistical analysis of collected data have been described below.

2.1. Experimental Site

The present research work was conducted at the Horticultural Farm, Bangladesh Agricultural University, Mymensingh during the period from October 2010 to April 2011. The experimental area is located at 24°46' N latitude and 90°24' E longitude. The elevation of the area is approximately 19m from average sea level.

2.2. Soil

The experimental area belongs to Old Brahmaputra Flood Plain (FAO, 1988) under the AEZ number-9. The field was a medium high land and above inundation level and texturally silty loam with a pH value 6.8.

2.3. Climate

The climate of the experimental area was sub-tropical, characterized by heavy rainfall during the month of April to September and scanty rainfall during October to March (Anon.1999).

2.4. Experimental Material

Onion bulbs of the local cultivar, Taherpuri were collected from Durgapur of Rajshahi district, Bangladesh. The Average size of the bulb was 20 ± 0.5 g.

2.5. Design and Layout of the Experiment

The one-factor experiment was laid out in a randomized complete block design with three replications. In each block the land was divided into thirty-six plots in the experiment. The size of each unit plot was $1\text{m} \times 1\text{m}$.

2.6. Experimental Treatments

- i. No vernalization at (V_0)
- ii. Vernalization at $5 \pm 1^\circ\text{C}$ (V_1)
- iii. Vernalization at $10 \pm 1^\circ\text{C}$ (V_2)

2.7. Vernalization of Mother Bulbs

Selected bulbs of the same size were put in white cotton cloth bags. Bulbs were then vernalized separately in a refrigerator calibrated at $10 \pm 1^\circ\text{C}$ and $5 \pm 1^\circ\text{C}$ and $25 \pm 3^\circ\text{C}$.

2.8. Cultural Operations

2.8.1. Land Preparation

Land of the experiment field was opened on 06 October, 2011 with a disc plough drawn by a tractor. The soil was then allowed to dry up and subsequent ploughings were followed by a power tiller. Each ploughing was followed by laddering to break clods into small pieces. Weeds and stubbles were removed and the land was finally leveled by laddering. Thus it was prepared to a good tilth.

2.8.2. Planting of Mother Bulbs

Bulbs were taken out of the refrigerator 4 hours prior to planting and then kept under fan for 3 hours for surface drying. They were set at upright position (Novak, 1983) and at a depth of 2.5cm (Bhardwaj *et al.*, 1991).

2.8.3. Gap Filling

Rotten and unsprouted bulbs of the experimental plots were replaced by healthy ones of the same treatment from the border within 7 days of planting.

2.8.4. Irrigation

Afterwards irrigation was done by flood method. During irrigation care was taken to avoid water flow from one plot to another.

2.8.5. Weeding

Weeding was done for four times to keep the crop free from weeds and to break the soil crust. The major weeds were *Cynodon dactylon* L., *Cyperus rotundus* L., and *Chenopodium album*.

2.8.6. Control of Diseases and Insects

Rovral 50WP (2500 ppm ; HRDP,1995) was sprayed at 10 days interval to control purple blotch disease (caused by *Alternaria porri*). Dimcron 100WSC (2000 ppm; HRDP, 1995) was also sprayed once at 36 DAP to control onion thrips (*Thrips tabaci*).

2.8.7. Staking

Staking was provided by using dhaincha sticks to keep the scape erect and to protect them from lodging by strong wind and storm.

2.8.8. Harvesting

Mature seed umbels were harvested when 10-20% capsule were splitted and exposed their black seed (Pandey *et al.*, 1992). The seed crop was harvested from 12 March to 01 April, 2011.

2.9. Data Collection

To assess duration of vernalization on the yield and quality of onion seeds data on different growth, yield, and quality parameters were collected from starting of plant emergence to germination of the harvested seed. Data are collected from selected plants in each unit plot. To avoid border effect with the highest precision, 5 plants were selected randomly from each plot.

3. Results and Discussion

3.1. Effect of Vernalization on Plant Emergence (%)

Early plant emergence was observed in the bulbs which were vernalized before planting as compared to non vernalized ones. It was also found that the longer was the vernalization temperature the earlier and the higher was the plant emergence. It took 5 days to attain about 90% emergence for $5\pm 1^\circ\text{C}$ and 70% emergence for $10\pm 1^\circ\text{C}$ cold treated bulbs while it was about 45% plant emerged on the day 5 in case of non vernalized bulbs (Fig 1).

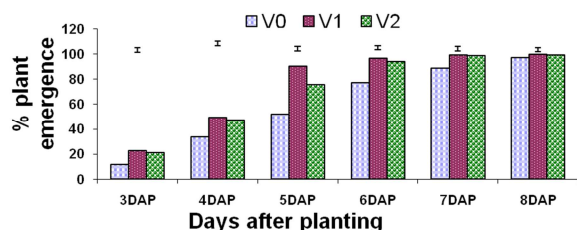


Figure 1. Effect of vernalization treatment on plant emergence in onion cv. Taherpuri. V_0 =Control, V_1 =Vernalization at $5\pm 1^\circ\text{C}$, V_2 =Vernalization at $10\pm 1^\circ\text{C}$. Vertical bars indicate LSD (0.05).

3.2. Effect of Vernalization on Number of Leaves / Plant

Fig 2. Showed vernalization effect on leaves. Vernalization significantly influenced the number of green leaves at 15, 30 and 45 DAP (Appendix III). Plant produced from the bulbs vernalized at $5\pm 1^\circ\text{C}$ temperature prior to planting gave maximum leaves at 15, 30 and 45 DAP (19.91, 26.47 and 30.84 leaves per plant, respectively). The minimum number of green leaves were produced by the control treatment (bulbs stored at room temperature) at 15, 30 and 45 DAP (16.05, 19.66 and 26.03 per plant, respectively). Good foliage indicates higher growth, development and productivity of plant.

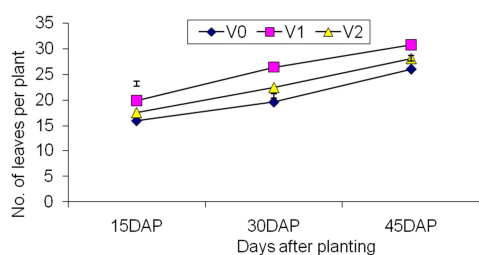


Figure 2. Effect of vernalization treatment on Number of leaves/ plant in onion. V_0 =Control, V_1 =Vernalization at $5\pm 1^\circ\text{C}$, V_2 =Vernalization at $10\pm 1^\circ\text{C}$. Vertical bars indicate LSD (0.05).

3.3. Effect of Vernalization on Plant Height

Duration of vernalization significantly affected the plant height at 15, 30 and 45 DAP (Tab.1). At 15 DAP the tallest plant (27.58 cm) was obtained from the bulbs that were vernalized into $5\pm 1^\circ\text{C}$ (V_1) temperature prior to planting. The shortest plant (23.44 cm) for the same was recorded from the bulbs having no vernalization treatment (control). Significantly tallest plant at 30 DAP and 45 DAP (38.05 and

44.71cm respectively) were produced by the bulbs those were vernalized into $5\pm 1^\circ\text{C}$ temperature. Minimum plant height (29.70 cm and 35.93 cm at 30 and 45 DAP) was recorded from the bulbs having no vernalization (V_0).

Table1. Effect of vernalization on plant height

Vernalization treatment	Plant height (cm)		
	15DAP	30DAP	45DAP
V_0	23.44	29.70	35.93
V_1	27.58	38.05	44.71
V_2	26.59	35.75	42.06
LSD at 5%	0.485	0.560	0.544
LSD at 1%	0.680	0.785	0.763
Level of significance	**	**	**

V_0 =Control, V_1 =Vernalization at $5\pm 1^\circ\text{C}$, V_2 =Vernalization at $10\pm 1^\circ\text{C}$, **=significant at 1% level of probability

3.4. Effect of Vernalization on Percent Flowering Plants

Percent flowering plant was significantly increased with the increase in the cold treatment at the temperature $5\pm 1^\circ\text{C}$ (V_1) (99.14% and 99.43% at 52 DAP and 57 DAP, respectively) (Tab. 2). Relevant results were published by Behairy and Habbasha (1979), Aguiar *et al.* (1983), Ramos and Ramos (1993) and Msika *et al.* (1997) who observed earlier and higher flowering for vernalized bulb planting. High temperature ($28-30^\circ\text{C}$) during storage inhibits inflorescence initiation and prevents floral initiation (Rabinowitch, 1990). On the other hand $8-12^\circ\text{C}$ storage temperatures were optimum for the occurrence of such events (Brewster, 1994). The exposure to low temperatures either in natural winter or in artificial cold treatment that causes induction of flowering in several plant species, among them onion, is called vernalization (Pinthus, 1985; Flood & Halloran, 1986).

Table 2. Effect vernalization on percent flowering plants

Vernalization treatment	Percent flowering plants						
	27D AP	32D AP	37D AP	42D AP	47D AP	52D AP	57D AP
V_0	4.26	42.06	53.34	66.00	85.19	91.94	96.43
V_1	7.82	73.61	81.17	90.64	98.09	99.14	99.43
V_2	6.46	68.82	78.69	88.26	96.27	97.80	99.15
LSD at 5%	0.138	0.854	1.074	1.206	1.070	2.196	1.993
LSD at 1%	0.193	1.198	1.505	1.691	1.501	3.079	2.794
Level of significance	**	**	**	**	**	**	**

V_0 =Control, V_1 =Vernalization at $5\pm 1^\circ\text{C}$, V_2 =Vernalization at $10\pm 1^\circ\text{C}$, **= significant at 1% level of probability

3.5. Effect of Vernalization on Height of Flowering Stalk (cm)

The longest scape (99.98cm) was produced by the plants raised from the bulbs vernalized at $5\pm 1^\circ\text{C}$ and it was found to be statistically similar (99.66cm) with the plant that received vernalization at $10\pm 1^\circ\text{C}$. The shortest (97.40 cm) flowering stalk was produced by the plant raised from the bulbs having no vernalization treatment (Fig. 3). It is known that most varieties of West Africa have a major handicap which is the emission of floral stalks I n the first year of cultivation. This phenomenon would greatly contribute to the reduction of yields in sensitive varieties (Rouamba, 1993; Sanders & Cure, 1996). Several works have shown that the emission of floral stalks of the onion plant in the first year of cultivation, widely known as early flowering or bolting is due to climatic factors notably low temperatures.

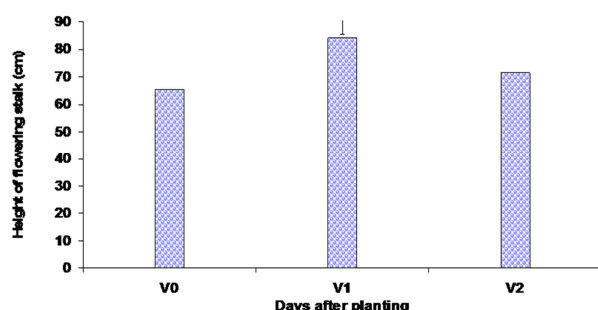


Figure 3. Effect of Vernalization on height of flowering stalk (cm). V_0 =Control, V_1 =Vernalization at $5\pm 1^\circ\text{C}$, V_2 =Vernalization at $10\pm 1^\circ\text{C}$. Vertical bars indicate LSD (0.05).

3.6. Effect of Vernalization on the Number of Umbels/Plant

Vernalization treatment for $5\pm 1^\circ\text{C}$ temperature showed highest performance (99.98 per plant) but it was statistically similar to $10\pm 1^\circ\text{C}$ (99.66 per plant) vernalization treatment. The lowest number of umbels for the same parameter (97.40 per plant) was given by the bulbs without vernalization treatment (control) (Tab.3). Similar results were also reported by Aguiar (1984).

Table 3. Effect of vernalization on the number of umbel/ plant

Vernalization treatment	Number of umbels/plant
V_0	5.32
V_1	8.30
V_2	7.81
LSD at 5%	0.419
LSD at 1%	0.588
Level of significance	**

V_0 =Control, V_1 =Vernalization at $5\pm 1^\circ\text{C}$, V_2 =Vernalization at $10\pm 1^\circ\text{C}$

**=significant at 1% level of probability

3.7. Effect of Vernalization on the Number of Flower Buds Per Umbel

It was apparent that maximum number of flower buds per umbel (250.20) was recorded in the plant raised from the $5\pm 1^\circ\text{C}$ cold treatment and it was statistically similar to $10\pm 1^\circ\text{C}$ (203.82) cold treatment (Fig.4) The lowest number of flower buds per umbel (167.43) was recorded in the plant raised from no treatment (V_0).

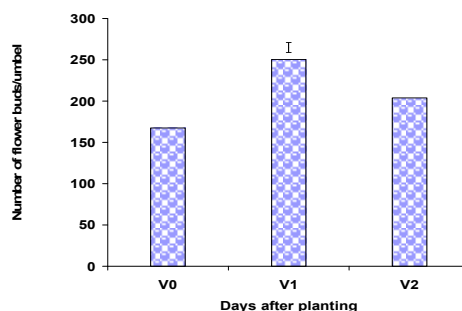


Figure 4. effect of vernalization on the number of flower buds per umbel. V_0 =Control, V_1 =Vernalization at $5\pm 1^\circ\text{C}$, V_2 =Vernalization at $10\pm 1^\circ\text{C}$. Vertical bars indicate LSD (0.05).

3.8. Effect of Vernalization on Percent Harvested Umbels

Cold treatment for $5\pm 1^\circ\text{C}$ showed early and rapid harvesting pattern. Thus it was obvious that cold treatment for $5\pm 1^\circ\text{C}$ produce highest number 98.13 at 137 DAP. The lowest number produce (90.55) at 137 DAP (Fig.5). Cold treatment of bulb for $5\pm 1^\circ\text{C}$ and $10\pm 1^\circ\text{C}$ maintained statistical similarity within themselves in these regard. It was observed that 98.13% umbels were harvested at 137 DAP from $5\pm 1^\circ\text{C}$ treated plant while it was 90.55% for non vernalized plant.

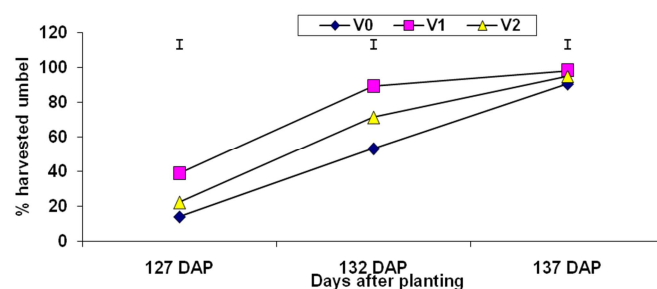


Figure 5. Effect of vernalization treatment on Percent harvested umbels in Onion. V_0 =Control, V_1 =Vernalization at $5\pm 1^\circ\text{C}$, V_2 =Vernalization at $10\pm 1^\circ\text{C}$. Vertical bars indicate LSD (0.05).

3.9. Effect of Vernalization on the Number of Seeded Fruits/ Umbels

The number of seeds per umbel was significantly varied due to different cold treatment. Duration of cold treatment at 5°C found to be the best (412.22 seeds/umbel) to produce seed in the umbel. The lowest number (218.43 seeds/umbel) was recorded from the bulbs planted without cold treatment V_0 (Tab.4). About the average temperatures prevailing during time of bulb production; we note that they

were lower in the normal season (17.33 °C). As result, the bulbs from plants which do not bolt in such conditions produce seed (S22) with good resistance to bolt. Currah et al. (1993) suggested with a view to improve resistance of varieties to bolt a possibility based on this behavior. It consists to select bulbs from plants with no floral stalks following an artificial very cold treatment.

Table 4. Main effect of vernalization on the Number of seeds/umbel

Vernalization treatment	Number of seeds/ umbels
V ₀	218.43
V ₁	412.22
V ₂	369.67
LSD at 5%	3.13
LSD at 1%	4.39
Level of significance	**

V₀=Control, V₁=Vernalization at 5±1°C, V₂=Vernalization at 10±1°C,

**=significant at 1% level of probability

3.10. Effect of Vernalization on Seed Yield/Plot

Seed yield per hectare varied significantly increased of cold treatment .The highest seed yield per plot (91.05 g) was found from the cold treatment at 5±1°C. The lowest seed yield per hectare was recorded from the plot (82.07 g) with control. Vernalization significantly influenced seed yield per plot. The highest seed yield (95.89 g) was given by the bulbs those were subjected to vernalization at 5±1°C and the lowest seed yield (69.25 g) was given by the bulbs having no vernalization treatment (Fig 6). Increasing seed yield with vernalization treatment was observed by Aguiar *et al.*, (1983). Ershov and Lukonina (1977) also reported that high seed yield was obtained when bulbs were stored at low temperature. Onion, being a biennial crop needs vernalization of bulbs before flowering. The vernalization treatments depend upon the varieties and existing climatic condition.

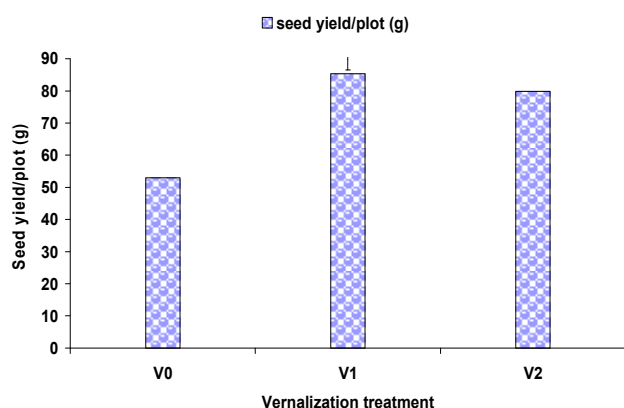


Figure 6. Main effect of vernalization on seed yield/plot. V₁=Vernalization at 5±1°C, V₂=Vernalization at 10±1°C, V₀=Control

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