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EFFECT OF WATER LOGGING ON VEGETATIVE GROWTH AND FRUIT YIELD OF BRINJAL

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ABSTRACT

Water logging is an important abiotic stress which affects seriously for growth and development of brinjal production. To find out adverse effect of water logging on vegetative growth and fruit yield of brinjal a pot experiment was conducted on Jute Agriculture Experimental Station, Bangladesh Jute Research Institute, Jagir, Manikganj. Thirty days old healthy brinjal plants were subjected to continuous flooding stress of different durations 0, 3, 6, 9 and 12 days. Earthen pots healthy brinjal plants were placed inside a larger concrete chamber and irrigated with tap water so that the water logging depth was maintained within 4-5 cm throughout the experimental period. Morphological parameters recorded include plant height, number of leaves, stem base diameter, leaf area, days to flowering and number of fruits per plant. Among three brinjal varieties Singnath perform better considering fruit production per plant. All the studied characters perform better at no water logging condition whereas the lowest performances at 12 days of water logging condition.
Key words: Brinjal, water logging stress, growth parameters, and fruit yield.

Introduction

Brinjal (*Solanum melongena* L.) is a most important, inexpensive hot-weather vegetable that is commonly grown in tropical and subtropical regions all over the world. It is one of the popular vegetables and highly cultivated and consumed in Asia countries specially Bangladesh. This plant is indigenous to India and is found throughout Asia, with China serving as a secondary source of origin. Furthermore, in terms of acreage and production, brinjal is the second most important vegetable crop after potato, and the most important traditional vegetable in Bangladesh (Sabina *et al*., 2021). According to the Bangladesh Bureau of Statistics (BBS), it is cultivated by roughly 150,000 poor farmers on 50,955 hectares, with a total yield of 507,000 metric tons in 2018. In term of nutrition value of the brinjal, nutrients, minerals, antioxidants, vitamins, dietary fiber, and body-building components and proteins are abundant in it. Hence, Brinjal has a high nutritional content that is comparable to tomato (Choudhary, 1976). It also contains 0.7 milligrams of iron, 13.0 milligrams of sodium, 213.0 milligrams of potassium, 12.0 milligrams of calcium, 26.0 milligrams of phosphorus, 5.0 milligrams of ascorbic acid, and 0.5 milligrams of vitamin A per 100 gram serving, and offers 25.0 calories (Saeedifar *et al*., 2014). China, India, Egypt, Turkey, and Iran are the top five brinjal producers, with production of 28.4, 13.4, 1.2, 0.82, and 0.75 million tons, respectively (Taher *et al*., 2017). In Bangladesh, an average yield of 10.00 tons per hectare has been recorded which is comparatively lower than that produced by the other countries (Anon, 2017). In Bangladesh, brinjal can be grown all year in Bangladesh, but it is most productive during the winter months. It should be grown in well-fertilized soil with plenty of compost for maximum yields (Hossain, 2013). Although several types of varieties of the brinjal are cultivating in numerous zones of Bangladesh, they have varying yield potentials, and their yield appears to be impacted greatly by several biotic and abiotic stresses (Sabina *et al*., 2021). Infestation of diseases and pests are examples of biotic factors, while drought, water logging, salinity, cold and heat stress are examples of abiotic stresses that reduce productivity (Prabhavathi and Rajan, 2007). As a result of climate change, irregular climate conditions represent a significant threat to humanity, environment and crop production. Main cause of crop losses in worldwide is the environmental stress, reported average yield reduction of major crops by more than 50% (Bray *et al*., 2000). Global climate change makes the water logging more drastic, frequent and unpredictable (Jackson and colmer, 2005). Increased internal ethylene concentration, low stomatal conductance, decreased leaf, root, and shoot development, alterations in osmotic potential and nutrient uptake, and reduced chlorophyll content and photosynthesis are all responses of the plants to water logging (Ashraf *et al*., 2011). Oxygen deficiency is the key result of water logging induces the sensitivity of crops like tomato, brinjal, annona species growth and yield (Ezin *et al*., 2010). Moreover 10% agricultural land of Russia, 16% of soil and irrigated crop production areas of Bangladesh, Pakistan, India and China are affected by water logging (FAO, 2015). Although water is chemically harmless, some physical features interfere with free gas exchange, causing plants to be injured or killed when completely submerged (Jackson and Ricard, 2003). In terms of yield, vegetable crops are more susceptible to water logging than field crops. This experiment was conducted to evaluate the performance of different brinjal varieties against different water logging conditions.

Materials and Methods

An experiment was conducted at Jute Agriculture Experimental Station, BJRI, Manikganj during the period from September to December, 2020 in pot culture to find out the water logging effect on growth performance and fruit yield of brinjal. The crop was sown on 20th September, 2020. Seeds of brinjal cultivars were surface sterilized by keeping the seeds in 1% HgCl2 solution for 2 min, followed by rinsing thoroughly with distilled water. Twenty-five seeds were sown per pot (15 inches in height and 16 inches in diameter) containing 40 kg soil. The atmospheric temperature fluctuated within a range of 29-31 0C at day and 18-27 0C at night. The relative humidity fluctuated between 71 and 83% at day and night, respectively. Water logging induced at 30 DAG (Days after germination). Three brinjal varieties i.e., BARI bt begun-4 (V_1), Tal (V_2), Singnath (V_3) with five different i.e. 0 (W_0), 3 (W_1), 6 (W_2), 9 (W_3) and 12 (W_4) days of water logging were used as treatments. Water logging depth was 4-5cm from the base of the plant. Crop was harvested at the period of horticultural maturity. Completely Randomized Design (CRD) with a two factors and three replications were used in this experiment. There were five plants per pot and 3 pots were considered as a replication. Each replication contains 15 plants. The collected data on different growth and yield related characters were subjected to statistical analysis following ANOVA technique. Differences among treatment means were adjusted by Duncan's Multiple Range Test with the help of a computer based statistical package program MSTAT-C (Gomez and Gomez, 1984).

Results and Discussion

Growth performances and fruit for different varieties of brinjal are shown in Table 1. The parameters were significantly different from each other. In the case of morphological characters like plant height, number of leaves, base diameter and leaf area V_2 (Tal) perform superior to other two varieties whereas in Table 1 it was shown that the plant height of V_1 (BARI bt begun-4) was lowest among three varieties. Number of leaves were minimum in V_1 similarly the base diameter and leaf area of BARI bt begun-4 were minimum among the three varieties. This research finding also revealed that the variety namely Tal responded very early flowering whereas Singnath (V_3) and BARI bt begun-4 (V_1) responded in late. Among the three varieties of brinjal researcher found that Singnath produced the maximum number of fruits per plant whereas BARI bt begun-4 and Tal produced the lower number of fruits per plant respectively. Growth performances and fruit in different water logging conditions are shown in Table 2. The yield and yield contributing characters in different water logging condition were statistically significant. Brinjal an important vegetable which is highly sensitive to water logging (Zohura, 2021). Flood-stressed plants have increased stomata resistance and restricted water intake, resulting in an internal water deficit (Folzer *et al*., 2006) and oxygen deficiency. Stomata closure is responsible for the decrease in transpiration and photosynthesis (Liao and Lin, 1994). Plants exposed to flooding for an extended period of time may suffer root injuries, which can reduce photosynthetic capacity by causing biochemical changes in photosynthesis (Loreti *et al*., 2016).When roots are submerged with excess water, the anoxic (absence of oxygen) condition hinders root growth and send signal to the rest of the plant to reduce shoot growth and plant productivity (Tareq*et al.*, 2020). Plant height, numbers of leaves, base diameter, leaf area, days to flowering and fruits yield of different varieties of brinjal are remarkably differ when compared to the control plants. The data obtained indicates that different varieties of brinjal are adversely affected by different flooding conditions (Table 2). In the case of the interaction effects of varieties of brinjalalong with water logging treatments indicate that the prolonged water logging condition reduces the yield contributing characters of brinjal compare to control treatment (Table 3). This reduction may be due to restricted nitrogen supply and increased ethylene production is attributed to cause leaf growth reduction (Adhikari and Paje, 1993).

Table 1. Effect of varieties on vegetative growth and fruit yield of brinjal in water logging condition

Variety	Plant height (cm)	No. of leaf	Base diameter (mm)	Leaf area (cm^2)	Days to flowering	No. fruits/plant
BARI bt begun-4	16.813c	4.0667b	5.354c	60.83c	71.20a	7.4700a
Tal	26.801a	4.4000a	6.987a	86.49a	62.20c	6.3100b
Singnath	20.142b	3.8000 b	5.994b	71.57b	67.44b	7.5700a
CV	8.97	10.1	7.11	4.58	2.73	9.51
LSD	1.4254	0.3089	0.3248	2.5011	1.3678	0.5064

Table 2. Effect of different water logging treatments on vegetative growth and fruit yield of brinjal

Water logging (days)	Plant height (cm)	No. of leaf	Base diameter (mm)	Leaf area (cm^2)	Days to flowering	No. fruits/plant
0	29.21a	6.22a	7.74a	148.15a	52.53e	11.78a
3	25.63b	5.00b	6.71b	91.50b	60.28d	8.50b
6	19.75c	4.00c	5.87c	72.53c	68.05c	6.83c
9	16.08d	3.00d	5.16d	28.42d	73.17b	4.92d
12	15.59d	2.22e	5.07d	24.24e	80.71a	3.55e
CV	8.97	10.1	7.11	4.58	2.73	9.51
LSD	1.8402	0.3987	0.4193	3.2288	1.7659	0.6538

Table 3. Combined effect of variety and water logging treatments on vegetative growth and fruit yield of brinjal

Variety X Treatment	Plant height (cm)	No. of leaf	Base diameter (mm)	Leaf area (cm^2)	Days to flowering	No. fruits/plant
V_1xW_0	22.65def	6.0000a	6.9200c	123.42c	62.00gh	12.25a
V_1xW_1	20.69efg	5.0000b	5.24gh	78.60f	67.00ef	8.50cd
V_1xW_2	15.33ij	4.0000c	4.99gh	53.66h	71.67d	7.25e
V_1xW_3	12.86ij	3.00d	4.82gh	25.68ijk	73.00cd	5.50fg
V_1xW_4	12.53j	2.33de	4.79h	22.80k	82.33a	3.85hi
V_2xW_0	37.527a	6.67a	8.64a	175.69a	43.33j	10.85b
V_2xW_1	32.533b	6.00a	8.65a	106.31d	53.33i	7.50 de
V_2xW_2	25.14cd	4.00c	6.63cd	94.07e	64.33fg	5.75f
V_2xW_3	19.53fg	3.00d	5.54efg	31.14i	71.67d	4.50gh
V_2xW_4	19.28g	2.33de	5.47fgh	25.26jk	78.33b	2.95i
V_3xW_0	27.46c	6.00a	7.65b	145.35b	52.25i	12.25a
V_3xW_1	23.66de	4.00c	6.25cde	89.58e	60.50h	9.50c
V_3xW_2	18.78gh	4.00c	5.98def	69.85g	68.15e	7.50de
V_3xW_3	15.85hi	3.00d	5.13gh	28.43ij	74.85c	4.75fgh
V_3xW_4	14.96ij	2.00e	4.96gh	24.65jk	81.45a	3.85hi
CV	8.97	10.1	7.11	4.58	2.73	9.51
LSD	3.1873	0.6906	0.7263	5.5925	3.0586	1.1324

The negative effect of flooding in plant growth, number of leaves, base diameter, leaf area, days to flowering and fruit yield could be due to reduction of photosynthetic rate. Cessation of plant growth due to flooding was also observed in tomato (Ezin *et al.*, 2010). All of these plant species showed growth reduction to varying extents in waterlogged conditions. The obtained data also indicates that the ultimate fate of prolonged water logging is the death of brinjal plant. Ezin *et al.*, (2010) reported that, the extent of the alteration of reproductive growth varies with plant species and genotype and with the time and duration of flooding. Reductions in yield were also associated with fewer and smaller fruits.

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