Reprint ISSN 1923-7766 (Web Version)

International Journal of Experimental Agriculture

(Int. J. Expt. Agric.)

Volume: 12 **Issue: 2** **September 2022**

Int. J. Expt. Agric. 12(2): 1-4 (September 2022)

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ISSN-1923-7766 (Online)
Int. J. Expt. Agric. 12(2):1-4(September 2022)

EFFECT OF TEMPERATURE ON GERMINATION, FLOWERING AND POD FILLING STAGES OF MUNGBEAN GENOTYPES

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Accepted for publication on 10 August 2022

ABSTRACT

Islam MT, Khatoon M, Akter SE (2022) Effect of temperature on germination, flowering and pod filling stages of mungbean genotypes. *Int. J. Expt. Agric.* 12(2), 1-4.

Climate is changing and air temperature is rising due to increasing concentration of CO_2 and other atmospheric greenhouse gases. The rise in atmospheric temperature causes detrimental effects on growth, yield, and quality of the crop varieties by affecting their phenology, physiology, and yield components. The effect of different temperature on four mungbean genotypes (MM-8, MI-12, Binamoog-8 and Binamoog-11) was investigated at germination, flowering and pod formation stage to find out temperature tolerant genotype. Germination of the mungbean genotypes was investigated under different temperature levels (20, 25, 30, 35 and 40^0C). The experiment was laid out in CRD with three replications. The highest germination (97.16%) of mungbean genotypes was found in 30^0C followed by 35^0C (94.25%). MM-8 and MI-12 showed the highest germination (97.00%). Binamoog-11 produced shorter root whereas Binamoog-8 had shorter shoot. The mungbean genotypes were again investigated under high temperature (38^0C) at flowering and pod filling stage for 3 days in plant growth chamber along with ambient temperature. The experiment was laid out in RCBD with three replications. High temperature (38^0C) at flowering and pod filling stage significantly decreased yield and yield attributes. MM-8 produced the highest seed yield followed by Binamoog-11 under the temperature treatments.

Key words*: mungbean, temperature, germination, flowering, pod formation, yield*

INTRODUCTION

Mungbean (*Vigna radiata* L. Wilczek) is one of the most important crops of global economic importance. The raw and mature seeds are rich in nutrients including carbohydrates, protein, fibers, minerals, antioxidants like flavonoids (Quercetin-3-Oglucoside), and phenolics (Guo *et al*. 2012). In addition to being the prime source of human food and animal feed, it plays an important role in maintaining the soil fertility by enhancing the soil physical properties and fixing atmospheric nitrogen (Naik *et al*. 2020). Despite being an economically important crop, overall production of mungbean is low (838 kg ha^{-1}) (BBS 2021) due to abiotic and biotic stresses (Islam *et al*. 2006; Bangar *et al*. 2018). It has raceme type of inflorescence with asynchronous flowering. The number of fruits with developing seeds increases after fruit setting stage and reaches to maximum seed growth stage but during this period the plant is still growing vegetative. Therefore, developing reproductive sinks are competing for assimilates with vegetative sinks. Number of fruits and seeds is related with photosynthetic rate that determines through leaf area and dry matter production (Islam and Razzaque, 2010). Per cent solar radiation interception and rate of dry matter production increased with leaf area development (Hamid *et al*. 1990). Mungbean yield is predetermined by the potential of a given variety and the environment. Pulse crops are generally cultivated during the dry season, when water deficit or unavailability of soil moisture is a common occurrence (Islam *et al*. 2005; Islam and Razzaque, 2007). In Bangladesh, summer mungbean is generally cultivated in March-May and high temperature (34-38^0C) often affects its growth and yield. However, mungbean varieties respond variably to drought and temperature stress depending on stress duration, growth stage, and variety of the crop (Basu *et al*. 2016; Fahad *et al*. 2017; Pooja *et al*. 2019; Kumar *et al*. 2020 and Islam 2022). Optimum temperature for potential yield of mungbean lies between 28-30^0C (Poehlman l991). High temperature disrupts water, ion and organic solute movement across plant membranes which interfere with photosynthesis and respiration. High temperature stress causes direct negative impact on flower retention in mungbean (flower shading up to 79%) and consequently on pod formation (Kumari and Verma, 1983). High temperature (36^0C) at pre-flowering and flowering stages decreases photosynthetic rate, biomass and yield in mungbean (Islam 2018 and Islam 2015). Increases in temperature resulted in changes in the fluorescence parameters in two varieties of beans, but to a different extent (Pastenes and Horton, 1996). Efforts of scientists developing heat and drought tolerant mungbean varieties are long (Khattak *et al*. 2006; Singh and Singh, 2011; Yuliasti and Reflinur, 2015). However, information regarding their tolerance to high temperature is less. When physiological basis of yield and yield-forming components under temperature stress are understood, it is possible to improve yields of a mungbean crop. So, the effect of temperature on four mungbean genotypes was investigated at germination, flowering and pod formation stage.

MATERIALS AND METHODS

Two experiments were conducted with four mungbean genotypes *viz*. Binamoog-11, MM-8, Binamoog-8 and MI-12 in plant growth chamber at Bangladesh Institute of Nuclear Agriculture (BINA) during March to May, 2022. In experiment one six temperature treatments *viz*. 20, 25, 30, 35, 40^0C and ambient were imposed on mungbean genotypes for 7 days in plant growth chamber. The experiment was laid out in a completely randomized design with three replications. Three hundred seeds of each mungbean genotype for each temperature treatment were soaked in tissue paper in Petri dishes. Then those genotypes were exposed to each temperature treatment in plant growth chamber.

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Data on germination%, root and shoot length were recorded. In experiment two mungbean genotypes were sown in pots. Each pot contained 8 Kg of soils. The experiment was laid out in a Randomized Complete Block Design with three replications. Recommended dose of fertilizers was applied and other cultural practices were followed as and when required. Temperature treatments *viz.* (i) Ambient, (ii) 38^0C at flowering and (iii) at pod filling stages were imposed for 3 days in a controlled plant growth chamber (RH 80%, CO_2 330 ppm). Data on plant height, number of branches plant^{-1}, seeds pod^{-1}, pod length, pods plant^{-1}, 1000-seed weight, straw and seed yield plant^{-1}were taken at maturity. Data were analyzed statistically and means were compared by DMRT.

RESULTS AND DISCUSSION

The highest germination% of mungbean genotypes was found in 30^0C followed by 35^0C (Table 1). Binamoog-10 had shorter root and Binamoog-8 had shorter shoot. MM-8 showed the highest germination followed by MI-12 (Table 2). Among the genotypes the longest plant was found in MI-12 followed by MM-8 (Table 3). The highest number of branches plant^{-1} was found in MM-8. Binamoog-11 showed the highest number of seeds pod^{-1}. The longest pod length was found in MI-12 followed by Binamoog-11. MM-8 produced the highest number pods plant^{-1} followed by Binamoog-11. MM-8 had lower 1000-seed weight compared to others. The highest straw weight plant^{-1} was produced by followed by Binamoog-8. Plant height, number of branches plant^{-1} and pod length did not show significant difference at different temperature levels (Table 4). High temperature both at flowering and pod filling stage similarly decreased number of seeds pod^{-1}, pods plant^{-1} and straw weight plant^{-1}. Thousand seed weight decreased more at high temperature at flowering stage. The highest seed weight plant^{-1} was produced by MM-8 followed by Binamoog-11 (Table 5). The highest seed weight plant^{-1} was produced in ambient temperature. Yield and yield attributes were significantly affected by high temperature (38^0C) at flowering followed by pod filling stage (Table 6). The results are agreed with Islam 2015; Sunayana *et al*. 2016; Islam 2018; Islam 2022).

Table 1. Effect of different temperature levels on germination, root length and shoot length of mungbean genotypes

Temperature levels	Germination (%)	Root length (cm)	Shoot length (cm)
20^0C	83.11c	5.91c	19.58b
25^0C	92.83b	6.20b	21.18a
30^0C	97.16a	6.99a	21.16a
35^0C	94.25a	7.14a	20.65a
40^0C	80.50d	5.89c	16.84c

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT

Table 2. Performance of mungbean genotypes on germination, root length and shoot length under temperature treatments

Genotypes	Germination (%)	Root length (cm)	Shoot length (cm)
Binamoog-11	90.22b	6.27b	19.99a
MM-8	97.00a	6.58a	20.01a
Binamoog-8	90.86b	6.41ab	19.08b
MI-12	97.00a	6.44ab	20.46a

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT

Table 3. Combined effect of mungbean genotype and temperature on germination, root length and shoot length

Genotype x Temperature	Germination (%)	Root length (cm)	Shoot length (cm)
Binamoog-11×20^0C	86.46f	5.63i	20.70bcd
Binamoog-11×25^0C	89.66cd	6.16defg	21.76b
Binamoog-11×30^0C	91.66bc	6.53cd	20.36bcde
Binamoog-11×35^0C	93.66ab	6.99ab	20.16bcde
Binamoog-11×40^0C	79.66i	5.93efghi	16.96f
MM-8×20^0C	89.00cd	6.30def	19.80cde
MM-8×25^0C	94.00ab	6.33de	21.00bc
MM-8×30^0C	95.66a	7.30ab	21.43bc
MM-8×35^0C	93.33ab	7.00ab	21.16bc
MM-8×40^0C	80.00hi	5.96efghi	16.66f
Binamoog-8×20^0C	81.33ghi	5.83ghi	18.76e
Binamoog-8×25^0C	88.66de	6.23defg	21.00bc
Binamoog-8×30^0C	91.66bc	6.90bc	18.86e
Binamoog-8×35^0C	91.66bc	7.00ab	20.00cde
Binamoog-8×40^0C	83.00g	5.73hi	16.76f
MI-12×20^0C	89.66cd	5.90fghi	19.06de
MI-12×25^0C	94.00ab	6.06efgh	20.96bc
MI-12×30^0C	93.66ab	7.43a	24.00a
MI-12×35^0C	91.33bc	7.10ab	21.30bc
MI-12×40^0C	81.33h	5.93efghi	16.96f

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT

Table 4. Effect of temperature treatments on morphological attributes and yield of mungbean genotypes

Temperature treatments	Plant height (cm)	Branches plant^{-1}(no.)	Seeds Pod^{-1}(no.)	Pod length (cm)	Pods plant^{-1}(no.)	1000- seed wt. (g)	Straw wt. plant^{-1}(g)	Seed wt. plant^{-1}(g)
Ambient temperature	37.71a	2.08a	10.58a	7.60a	12.67a	40.09a	10.12a	5.74a
38^{0}C at flowering	38.71a	1.75a	9.58b	7.39a	11.67b	33.56c	7.78b	4.59c
38^{0}C at pod filling	37.87a	1.83a	9.58b	7.23a	12.42ab	36.41b	7.32b	4.93b

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT

Table 5. Performance of mungbean genotypes on morphological attributes and yield under temperature treatments

Genotypes	Plant height (cm)	Branches plant^{-1}(no.)	Seeds pod^{-1}(no.)	Pod length (cm)	Pods plant^{-1}(no.)	1000- seed wt.(g)	Straw wt. plant^{-1}(g)	Seed wt. plant^{-1}(g)
Binamoog-11	34.51b	1.56b	10.33a	7.59ab	13.11b	38.68a	7.26c	5.46b
Binamoog-8	34.40b	1.56b	9.11b	6.64c	11.33c	38.30a	8.72ab	4.53c
MI-12	42.85a	1.11c	10.11a	8.01a	10.11d	39.31a	8.04bc	4.54c
MM-8	40.62a	3.33a	10.11a	7.39b	14.44a	30.45b	9.59a	5.81a

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT

Table 6. Combined effect of mungbean genotype and temperature on morphological attributes and yield

Genotype × Temperature	Plant height (cm)	Branches plant^{-1}(no.)	Seeds pod^{-1}(no.)	Pod length (cm)	Pods plant^{-1}(no.)	1000- seed wt. (g)	Straw wt. plant^{-1}(g)	Seed wt. plant^{-1}(g)
Binamoog-11× Ambient temperature	32.96de	1.67de	11.00ab	7.97ab	14.33abc	42.94a	8.02d	6.07b
Binamoog-11×38^{0}C at flowering	36.62cde	1.67de	9.33d	7.67abcd	13.33bcd	36.27c	7.73de	5.00de
Binamoog-11×38^{0}C at pod filling	33.96de	1.33e	10.67abc	7.13cde	11.67def	36.85c	6.03ef	5.30cd
Binamoog-8×Ambient temperature	34.29de	1.33e	9.33d	6.90def	12.33de	42.50a	10.86ab	4.90def
Binamoog-8×38^{0}C at flowering	32.29e	1.00e	9.00d	6.80ef	10.67efg	35.21cd	4.57f	4.03h
Binamoog-8×38^{0}C at pod filling	36.62cde	2.33cd	9.00d	6.23f	11.00ef	37.20c	10.73bc	4.67ef
MI-12×Ambient temperature	40.96abc	1.33e	11.33a	8.27a	11.00ef	44.49a	8.78cd	4.93de
MI-12×38^{0}C at flowering	44.96a	1.00e	10.00bcd	7.83abc	10.33fg	34.07de	7.67de	4.50fg
MI-12×38^{0}C at pod filling	42.62ab	1.00e	9.00d	7.93ab	9.00g	39.38b	7.67de	4.20gh
MM-8×Ambient temperature	42.62ab	4.00a	10.67abc	7.27bcde	13.00cd	30.44fg	12.80a	7.07a
MM-8×38^{0}C at flowering	40.96abc	3.33ab	10.00bcd	7.27bcde	15.33a	28.69g	11.13ab	4.83ef
MM-8×38^{0}C at pod filling	38.29bcd	2.67bc	9.67cd	7.63abcd	15.00ab	32.22ef	4.83f	5.53c

Values having common letter(s) in a column do not differ significantly at 5% level as per DMRT

CONCLUSION

The highest germination % of mungbean genotypes was found at 30^{0}C followed by 35^{0}C. High temperature (38^{0}C) at flowering and pod filling stage significantly decreased yield and yield attributes of the mungbean genotypes. MM-8 and Binamoog-11 showed better germination and seed yield under the temperature treatments.

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