TEMPERATURE STRESS AT DIFFERENT STAGES OF GROWTH AND ITS EFFECT ON PHENOPHASE IN TWO VARIETIES OF MUNG BEAN GROWN DURING SUMMER SEASON

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Abstract: Two varieties of mung beansvizPusa 9531 and Pusa Vishal were used in the present investigation under pot culture conditions.The plants were grown under natural and temperature elevated conditions throughout the season.To know the critical stage, plants were exposed for 15 days at elevated temperature at early vegetative stage (0-15) days, (15-30)days ,(30-45) days , and (45-60)days stage. For the rest of the period, plants were grown under natural conditions. The results revealed that phenophase was altered due to elevated temperature.It enhanced flower initiation but decreased total number of flowers, pod numbers and pod setting percentage. The seed number per pod and seed weight decreased affecting the grain yield of the plant in both the varieties. The critical stage was found during pod development stage (45-60) days followed by flower initiation and grain development stage (30-45)days .However the plants exposed to high temperature (15-30)days stage showed the recovery after exposure to natural conditions.

Keywords: Phenophase**,** elevated temperature,Summer mung bean, pod setting, grain yield

INTRODUCTION

The temperature is of key importance for plant development, influencing the rate of photosynthesis, flowering and even pod setting or grain filling. The summer mungis being grown in Delhi and adjacent area as a catch crop between rabi and kharif season, in an area of assured irrigation facility. During its growth and development phases, plant faces the rising temperature particularly during grain development phase. High temperature stress during germination and flowering, and drought and salinity stresses during the entire life cycle of the crop cause considerable yield losses in mungbean, Singh and Singh (2011).Exposure to extreme temperature during flowering may have a damaging effect on fertilization and grain development leading to lower yield (Porter,2005). The high temperature also affect the total dry matter production leading to poor pod set and grain yield, Panwar and Srivastava, 2012, Srestha *et al.*,2006.The temperature variations during the plant growth and development disturbs the plant metabolism that consequently affect the dry matter production and productivity of the plant crops, (Farooq *et al.*, 2009a).

Elevating air temperature stress during critical growth stages may be the key driver for maximum yielding potential in mung bean and other crops, (Oweis and Hachum, 2001).In response tohigher temperatures flowering and ripening are accelerated, with a significant reduction in the number of days to the flowering and maturity (Rahaman*et al*., 2009).The weight of mature grains was found to be most sensitive to heat stress occurring early in the grain-filling period. Stress may also be critical when it occurs during grain filling, as it may result not only in a reduction in the extent of grain filling (Wardlaw and Moncur 1995), but also in more rapid cell death and in the earlier occurrence of harvest ripeness.

The global climatic change may affect through various abiotic stresses, but fluctuation in temperature during summer may affect the yield potential in summer mung bean. The selection of temperature tolerant types and to know the critical phase as affected by high temperature was the main aim of this experiment.

MATERIAL AND METHODOLOGY

In the experiment two cultivars Pusa Vishal and Pusa 9531 of mung bean were used. The seeds of both cultivars were obtained from Indian Agricultural Research Institute (I.A.R.I) Pusa, New Delhi.The earthen pot experiment was conducted during summer on 28thMarch onwards in year 2012.12'' earthen pots were divided into two sets.The first set plants were grown under prevailing environmental conditions at the experimental site whereas the elevated conditions work artificially made by covering the plants under the transparent polythene sheet, so that the light may not be curtailed. To know the critical stage, the plants were exposed to high temperature by putting the plants under coverage for a period of 15 days. After exposing the plants in high temperature they were transferred to natural conditions as per the given lay out.

Experimental varieties: Two varieties of mung bean Pusa Vishal and Pusa 9531 were selected. During presentation of experimental details, Pusa 9531 is represented as V1 and Pusa Vishal as V2.

Experimental treatments

The treatments of the plants during experiments were divided into 6 treatments.

T1-Under natural condition throughout the growing season (0-60 days)

T2-Under elevated condition throughout the growing season (0-60 days)

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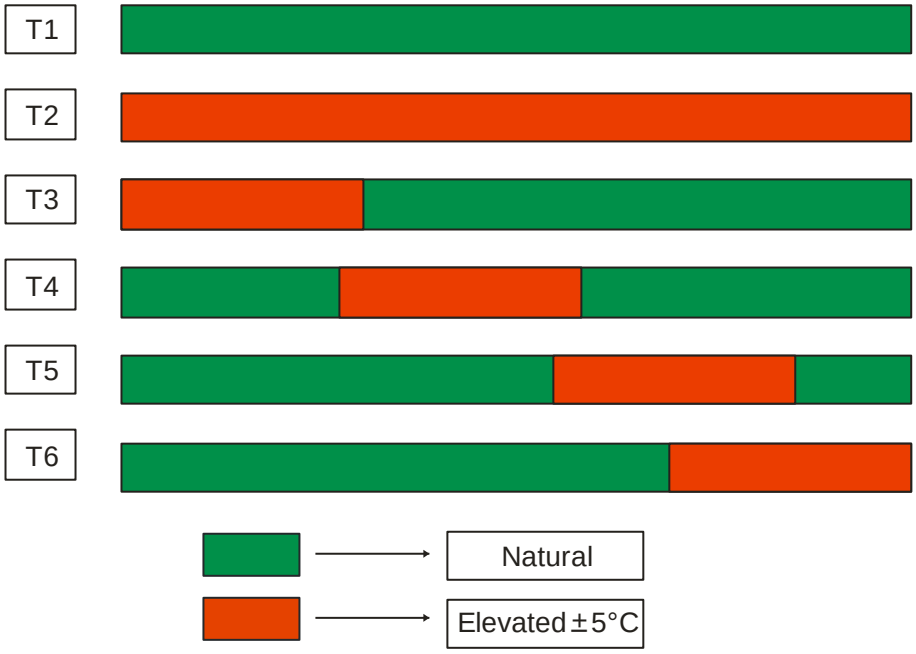
T3-Upto 15 days under elevated temperature then shifted to natural conditions
T4–Upto 15 days under natural, 16-30 days under elevated temperature, then shifted to natural conditions
T5-Upto 30 days under natural conditions and 31-45 days under elevated temperature, then shifted to natural conditions.
T6-Upto 45 days under natural conditions and then shifted to elevated condition



After the exposure , the effect was noticed in the phenophases, including flower initiation, total number flowers, total number of pods noted per plant, pod setting percentage. Whereas the number of seed per pod , 100 seed weight and grain yield per plant was noted after the post harvest stages in both the varieties in a replicated trial.

RESULT AND DISCUSSION

The plants were raised during the summer season with the maximum temperature range (32 -42 °C) and minimum (15-30 °C) under natural conditions,butas a result of climatic change, the maximum temperature has grown upto 45 °C for1 or 2 days in May and June. 2012 summer was hottest in decades in Delhi.The average maximum temperature in Delhi for May and June was 41.57°C , the highest since 1980.(Refer TOI Report ,July 3,2012).It is estimated that this temperature may further rise in the coming future. The sudden variation in temperature may hamper the growth and yield of the plants due to the metabolic changes brought about and also changes in the phenophases.High temperatures caused significant declines in shoot dry mass, relative growth rate (RGR) and net assimilation rate (NAR) in pearl millet, maize, and sugarcane, though leaf expansion was minimally affected (Ashraf and Hafeez, 2004, and Wahid, 2007).During the vegetative stage, high day temperature can cause damage to compensated leaf photosynthesis, reducing CO_2 assimilation rates reported by Hall (1992).Increase in temperature within optimal ranges shortens time to flowering in cowpea (Craufurd*et al.*, 1996), soybean (Baker *et al*., 1989) and peanut (Awal and Ikeda, 2002).Lower seed yields at super-optimal temperatures are due mainly to a decreased number of fruits and a smaller seed size ,(Prasad *et al.*, 2002).

The Table -1 and 2 shows that Pusa 9531 flowered late than Pusa Vishal, whereas the exposure to high temperature either throughout or early phase(0-15) days hastened the flower initiation,with adverse effect on total number of flowers and pod numbers. When the plants were exposed to high temperature at later stage did not affect the total number of flowers produced (T5 and T6), but drastically reduced the pod setting percentage, resulting in poor pod number per plant. The adverse effect of elevated temperature was noted on the seed number per pod. When exposed to high temperature on the later phase of growth and development (T5 and T6), were at par with T2,T5 and T6, whereas the early exposure(0—15) days did not affect the seed number per pod and seed size.The grain yield per plant showed that variety Pusa 9531 had higher pod number than Pusa Vishal, whereas Pusa Vishal had more number of seeds per pod along with 100 seed weight. The variety Pusa 9531 was found relatively tolerant to pusa Vishal. The most critical stage was found the pod development to maturity stage (T6) followed by (T5).

Table 1. Effect of temperature stress on various stages of phenophasein Pusa 9531 variety.

Treatments	Number of days, taken for flowering	Total Number of flowers	Pod setting percentage	Number of pods/plant	Number of seeds per pod	100 seed weight	Yield /plant(g)
T1	36	46	60.58	27	9.06	4.02	7.04
T2	31	42	57.95	24	7.90	3.26	5.21
T3	30	42	60.51	26	9.02	4.25	5.76
T4	34	45	62.71	28	8.79	4.05	5.19
T5	32	46	55.05	25	7.82	3.75	4.25
T6	34	45	55.27	24	8.11	3.22	4.92

Table 2. Effect of temperature stress on various stages of phenophaseinPusa Vishal variety.

Treatments	Number of days, taken for flowering	Total Number of flowers	Pod setting percentage	Number of pods/plant	Number of seeds per pod	100 seed weight	Yield /plant(g)
T1	34	45	52.33	22	10.04	4.76	6.42
T2	30	39	50.28	20	8.53	4.0	4.32
T3	29	40	57.13	23	9.21	4.78	5.54
T4	31	43	51.51	22	8.88	4.65	5.04
T5	31	42	49.05	20	8.87	3.92	4.23
T6	30	45	48.56	19	8.90	3.76	4.87

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