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FLOWERS' SHEDDING UNDER HIGH TEMPERATURE IN MUNGBEAN (*VIGNA RADIATA* (L.) WILCZEK)

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Abstract

Segregating populations were developed through induced mutations and hybridization using local and exotic mungbean genotypes to select mutants/recombinants tolerant to flowers shedding under high temperature. Entire segregating population showed flowers shedding under high temperature. But 242 recombinants/mutants were advanced to phenotypic uniformity following consecutive selection on the basis of new flowers production on the same raceme from where flowers were shed under high temperature. These recombinants/mutants were evaluated to rate the new flowers production on terminal raceme of the main stem at 90% pods maturity and to collect basic information about flowers shedding under high temperature. Out of 242 recombinants/mutants, 163 showed 10-20% (moderately tolerant) and 79 showed more than 40% (susceptible) flowers shedding from terminal raceme on the main stem recorded at 90% pods maturity. Only opened flowers shed under high temperature. Buds and pods at any stages did not shed due to high temperature. Humidity fluctuations had no effect on the flowers shedding in mungbean.

Introduction

Mungbean is the main kharif (July to October) pulse crop of Pakistan. It produces flowers in different flushes in a cluster of 10-20 flowers on each terminal raceme. Since flowers' shedding is a common phenomenon in this crop therefore, pods formation in comparison to total flowers produced is very low (Kumari & Varma, 1983). Increased flower shedding under high temperature, precipitation and desiccating winds during flowering period in legumes have been reported by different researchers (Sinha, 1977; Rainey & Griffiths. 2005). Significant flowers' shedding above 40°C in mungbean was reported by Tickoo *et al*., (1996). Khattak *et al.*, (2006a) has reported an absence of resistance to flowers shedding under high temperature in mungbean. In wheat, heat tolerant genotypes have been reported by various researchers (Dhanda & Munjal, 2006; Tahir *et al.*, 2006).

Basic information about the effect of high temperature (above 40°C) on flowers' shedding and production of new flowers after shedding due to high temperature in mungbean is lacking in the available literature. Such information can help to breed mungbean genotypes with special morphology which may be useful to reduce seed yield losses under high temperature during flowering stage of the crop. The present report gives an account of the observation recorded during the efforts to breed mungbean genotypes through hybridization and induced mutation for tolerance/escape mechanism to flowers shedding under high temperature.

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Materials and Methods

High yielding mungbean mutants and recombinants were developed through consecutive selections (2005-2006) from segregating populations generated through induced mutations by irradiating mungbean varieties i.e., NM 92 and NM 98 through gamma rays using ^{60}Co gamma cell and by hybridization of VC 1482C x NM92, VC 1560D x NM92 and NM 98 x VC 3902A, respectively. Advanced mutants and recombinants were evaluated in 7 sets of trials in Randomized Complete Block Design with 3 replications for flowers' shedding under high temperature in field at Nuclear Institute for Food and Agriculture (NIFA), Peshawar during summer (March –June) 2007.

Each mutant/recombinant was planted in 2 rows of 4m length with plant-to-plant and row-to-row spacing of 10cm and 30cm, respectively. Ten competitive plants were randomly selected in each replication to record percent flowers' shedding only from the terminal raceme on the main stem of a plant at 90% pods maturity. Average percent flowers' shedding was calculated on the basis of 3 replications in order to rate each mutant/recombinant for flowers' shedding behaviour.

Ratings for tolerant, moderately tolerant and susceptible genotype were made as follow:

Percent flowers' shed from the terminal raceme on the main stem of a plant at 90% pods maturity	Rating
10-20	Tolerant
20-40	Moderate tolerant
>40	Susceptible

Results

Number of advanced recombinants/mutants evaluated along with parents in 7 different sets of trials, and those showed moderate tolerance and susceptibility to flowers shedding under high temperature (above 40°C) during flowering are presented in Table 1. All recombinants/mutants and their parents were susceptible to opened flowers shedding under high temperature. Out of 242 recombinants/mutants, 163 produced new flowers after flowers' shedding under high temperature and the average flowers' shedding recorded at terminal raceme on the main stem of selected plants at 90% pods maturity were in the range of moderately tolerant. 79 recombinants/mutants were unable to produce new flowers on the same raceme of main stem and average flowers' shedding exceeded 40% from terminal raceme on the main stem of selected plants at 90% pods maturity. Buds and pods shedding were not observed due to high temperature.

Humidity and temperature fluctuations during this season are presented in Fig. 1. Flowers' shedding due to high temperature from first flower flush was observed at the end of April and at the beginning of May. Similarly, rise in temperature at the second week of June caused drastic flowers drop from the third flowering flush. Humidity had no effect on the flowers' shedding, as there were negligible fluctuations in humidity during this season.

Table 1. Number of evaluated, moderate tolerant and susceptible mutants derived from NM 92 and NM98 and recombinants selected from VC 1482C x NM 92, VC 1560D x NM 92 and NM 98 x VC 3902A evaluated for flowers' shedding under high temperature during summer 2007 at NIFA, Peshawar.

Mutants/ cross/parent	Numbers of trials	Evaluated progenies	Moderate tolerant progenies	Susceptible progenies
Mutants derived from NM 92	2	72	48	24
Mutants derived from NM 98	2	67	55	12
VC 1482C x NM 92	1	32	19	13
VC 1560D x NM 92	1	40	24	16
NM 98 x VC 3902A	1	31	17	14
NM 92 (Parent)	-		Susceptible	
NM 98 (Parent)	-		Moderately tolerant	
VC 1482C, VC 1560D and VC 3902A(Exotic parents)	-		Susceptible	

Discussion

Mungbean plants produce large number of flowers but drops up to 60% prior to pod initiation (Khattak *et al.,* 1998). The main physical causes of flowers' shedding in this crop are precipitation and desiccating winds. High temperature (above 40°C) during flowering also causes huge flowers' shedding. Genotypic differences for number of flowers produced in mungbean have been reported (Kumari & Verma, 1983) but genetic tolerance for flowers' shedding under high temperature is absent in the existing germplasm of this crop (Khattak *et al.,* 2006a). High temperature caused shedding of only opened flowers from mungbean plant and not buds and pods. This indicates that high temperature may cause drying up of stigma and ovary or it disturbs anthers viability due to which hybridization may fail and thus flower shed without initiating pod. Similar results of low pod setting has been reported for hybrid seed setting under high temperature (summer season) than normal planting season i.e., kharif (Khattak *et al*., 1998). The induction of mechanism to escape or compensate flowers' shedding under high temperature through induce mutation could be one of the solutions to cope with the problem of yield losses due to high temperature. Induced mutations have already been used successfully for the development of disease resistant and large seeded chickpea and mungbean genotypes (Khattak *et al.,* 2006b, 2007 & 2008).

Conclusion

Mungbean is a short duration crop and can be cultivated in available niches among crops but this need to breed genotypes tolerant to flowers' shedding under high temperature (above 40°C). Current findings and earlier researchers' reports have shown the absence of tolerance to flowers' shedding under high temperature in the existing mungbean germplasm. No success has been achieved through induced mutation in the induction of tolerance to flowers' shedding under high temperature using mungbean varieties NM 92 and NM 98 during the current efforts. Breeding genotypes with the potential to produce more new flowers on the same racemes from where that shed under high temperature is an effective compensating mechanism of the losses occur due to flowers' shedding under high temperature in mungbean. Mutants/recombinants selected during current project on the basis of new flowers' production on the raceme faced flowers' shedding under high temperature can be used as germplasm in breeding programmes to explore the trait to develop and evolve commercial varieties.

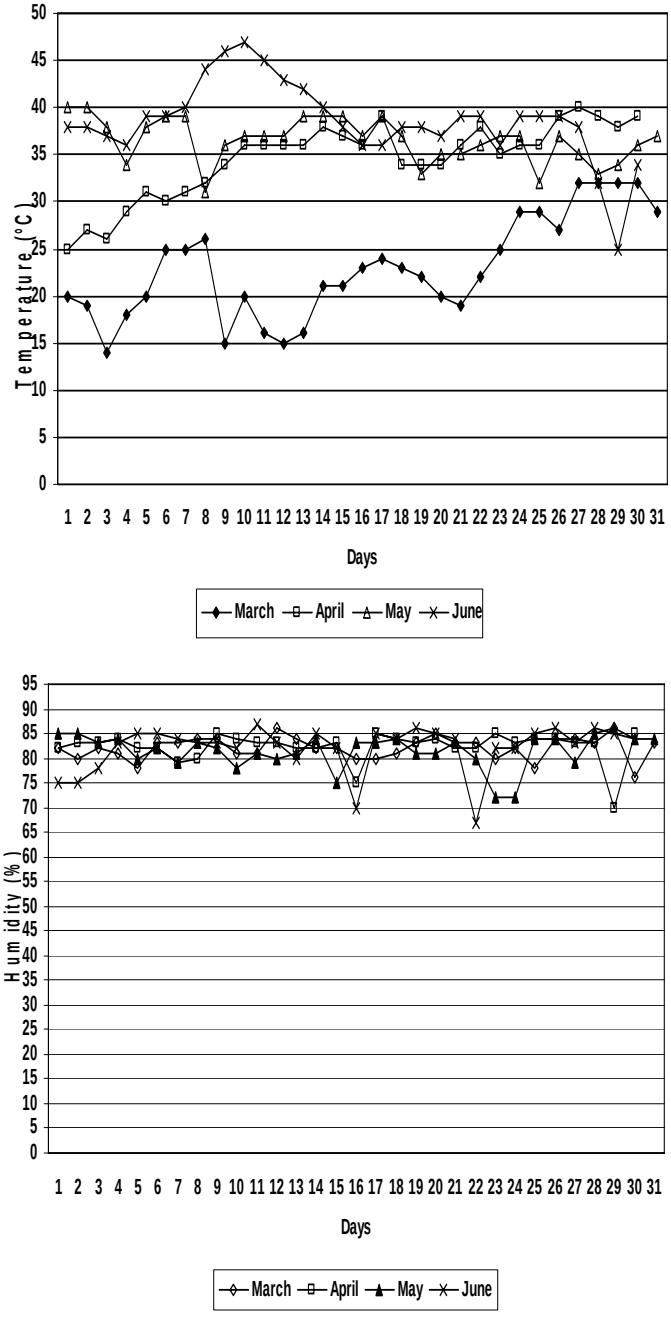

Fig. 1. Temperature and humidity fluctuations during summer 2007 at Peshawar.

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References

Dhanda, S.S. and R. Munjal. 2006. Inheritance of cellular thermo tolerance in bread wheat. *Plant Breeding*, 125(6): 557-564.

Khattak, G.S.S., I. Saeed and S.A. Shah. 2008. Breeding high yielding and disease resistant mungbean (*Vigna radiata* (L.) Wilczek) genotypes. *Pak. J. Bot*., 40(4): 1411-1417.

Khattak, G.S.S., I. Saeed and T. Muhammad. 2006a. Breeding for heat tolerance in mungbean (*Vigna radiata* (L.) Wilczek). *Pak. J. Bot*., 38(5): 1539-1550.

Khattak, G.S.S., M. Ashraf, I. Saeed and B. Alam. 2006b. A new high yielding mungbean (*Vigna radiata* (L.) Wilczek) variety "Ramzan" for the agro climatic conditions of NWFP. *Pak. J. Bot*., 38(1): 301-310.

Khattak, G.S.S., M. Ashraf, R. Zamir and I. Saeed. 2007. High yielding desi chickpea (*Cicer arietinum* L.) variety "NIFA-2005". *Pak. J. Bot*., 39(1): 93-102.

Khattak, G.S.S., M.A. Haq, M. Ashraf and Said Hassan. 2002. Yield and yield components at various flowers flushes in mungbean (*Vigna radiata* (L.) Wilczek). *Breeding Science*, 52: 61-63.

Khattak, G.S.S., M.A. Haq, S.A. Rana, T. Elahi and P. Srinives. 1998. An efficient technique for crossing mungbean (*Vigna radiata* (L.) Wilczek). *Thai J. Agri. Sci*., 31: 577-582.

Kumari, P. and S.K. Varma S.K. 1983. Genotypic differences in flower production/shedding and yield in mungbean (*Vigna radiata*). *Indian J. Plant Physiol*., 26: 402-405.

Rainey, K.M. and P.D. Griffiths. 2005. Inheritance of heat tolerance during reproductive development in snap bean (*Phaseolus vulgaris* L.). *J. Amer. Soc. Hort. Sci*., 130(5): 700-706.

Sinha, S.K. 1977. Food legumes: Distribution adaptability and biology of yield. *In*: *Food and Agriculture Organisation of the United Nations, Plant Production and Protection Paper* No. 3.pp. 124, Rome, FAO.

Tahir, I.S.A., N. Nakata, A.M. Ali, H.M. Mustafa, A.S I. Saad, K. Takata, N. Shikawa and O.S. Abdullah. 2006. Genotypic and temperature effects on wheat grain yield and quality in a hot irrigated environment. *Plant Breeding*, 125(4): 323-330.

Tickoo, J.L., Gajraj, R. Matho and C. Manji. 1996. Plant type in mungbean (*Vigna radiata* (L.) Wilczek). pp. 197-213. In: *Proceedings Recent Advances in Mungbean Research, Indian Society of Pulses Research and Development*, (Eds.): A.N. Asthana and D.H. Kim. Indian Institute of Pulses Research, Kanpur, India.

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