

Effect of Hydropriming on Field Emergence, Crop Performance and Seed Yield of Maize Parental Lines during Winter and Spring-Summer Season

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ABSTRACT Seeds of parental lines viz. CM 202, CM111, CM500 and CM501 of maize were subjected to pre-sowing hydropriming and its efficacy was evaluated on their field emergence, vegetative growth, flowering and seed yield during winter and spring summer seasons. Hydropriming treatments (12 h at 25°C and 48 h at 10°C, followed by 12 h at 25°C) significantly improved the field emergence, its rate, uniformity and early seedling growth but had no effect on vegetative growth, flowering behaviour and seed yield of the parental lines in both the seasons. The beneficial effects of hydropriming were less pronounced in spring summer than winter season due to prevalent sub-optimum temperatures in spring summer. Among hydration treatments, 24 h at 25°C was found to be more promising than 48 h at 10°C followed by 12 h at 25°C. The study highlighted the potential of hydropriming treatments in improving field emergence and early seedling growth during winter and spring -summer seasons.

Keywords: Maize, parental lines, seasons, hydropriming, field emergence, crop performance

Maize is primarily grown as a monsoon crop in the North India and its seed production is also undertaken in this season. But prevailing high temperature and humidity with intermittent rains in monsoon results in incidence of diseases and pests affecting the seed yield and quality. In addition, problem of maintaining isolation distance from commercial crop is another major constraint encountered during seed production in this season. The seed production can also be taken up profitably during winter (October-April) or early spring-summer (February-May) season for ensuring availability of hybrid seed in monsoon (June-October) season for commercial cultivation. In northern India, the winter and spring-summer maize is sown in October-November and January-February, respectively, when the minimum ambient temperature fluctuates between 6-12°C and 2-8°C respectively. Maize being a crop of tropical origin, requires a minimum and optimum temperature of 10°C and 25°C respectively for growth and development [1, 2] and the prevailing sub-optimum temperatures in these seasons adversely affect the field emergence and early vegetative growth.

Various seed treatments have been devised to improve rate and uniformity of field emergence in

a number of crop species [3]. Among them, hydropriming is reported to have beneficial effect on field emergence, crop stand, seedling growth under low and sub-optimal temperatures [4-8] and flowering behaviour [9, 10]. Thus the present study was undertaken to evaluate the efficacy of pre-sowing hydropriming on field emergence, its rate, vegetative growth, flowering behaviour and seed yield of maize parental lines in winter and spring-summer seasons.

MATERIALS AND METHODS

Parental lines of two popular maize hybrids Ganga-5 [(CM202 × CM111) × CM500] and Ganga-11[(CM202 × CM111) × CM501] namely CM202, CM111(inbreds), CM500 and CM501 (OPVs) were used for the study. For hydropriming, seeds (1200 seeds of each genotype) were spread over water saturated filter paper in plastic boxes with lid for 24 h at 25°C (T_2) and 48 h at 10°C followed by 12 h at 25°C (T_3). The hydrated seeds were air dried for 12 h at room temperature. Unsoaked seeds were used as control (T_1). The primed seeds were sown in the fields of Indian Agricultural Research Institute, New Delhi in winter (7 November 1997) and spring-

summer (17 February 1998) season. The experiment was laid in split plot design with four replications in plots of 15 m² size (4 rows) with a spacing of 75 cm x 25 cm. Genotypes were allotted in main plots with pre-sowing seed treatment in sub-plots.

Field emergence was recorded after 7, 14 and 21 days after sowing (DAS) in both the seasons. Field emergence (%) was computed as follows

$$\frac{\text{Number of seedlings emerged in four rows}}{\text{Total number of seeds sown}} \times 100$$

Rate of field emergence was computed by formula suggested by Kotowski [11]. After final emergence, 5 seedlings from each plot were picked randomly, oven dried (80°C ± 1°C/24 h) and weighed for seedling dry weight. Plant height (cm), number of leaves per plant, duration of flowering (days) and protandry (days) were recorded at peak flowering on ten randomly selected plants in each plot. Days to 50 per cent flowering (tasselling and silking) and seed yield were recorded on plot basis. Duration of protandry was measured as difference between initiation of anthesis in tassel and emergence of first silk. Number of days from opening of first to last spikelet in tassel and emergence to total drying of silk in a cob was recorded for measuring the duration of tasselling and silking, respectively. Weather data for the period of experiment was obtained from the Meteorological Observatory, Indian Agricultural Research Institute, New Delhi.

RESULTS AND DISCUSSION

Rapid and uniform emergence is essential for optimum field emergence and plant stand under all environmental conditions and especially under sub-optimum conditions. Seedling emergence, establishment and growth of maize are influenced by climate, soil and management factors [12] wherein temperatures below 10°C adversely affect the field emergence and plant stand [1]. In the present study, sub-optimum temperatures i.e. 10-11°C and 5-9°C prevalent in winter and spring-summer season, respectively had pronounced effect on field emergence, rate of emergence and early seedling growth of parental lines. Pre-sowing seed treatments significantly enhanced field emergence (Table 1), rate of emergence and seedling growth (Table 2) in both the seasons wherein the treatment effect was more evident in winter season. Although, the final field emergence (21DAS) among genotypes was improved by 5.5 to 7.3 per cent and 8.3 to 9.6 per cent respectively over control in winter and spring

summer season but the treatment effects on field emergence were more pronounced at early stage (7 DAS) (12.0-28.9% : winter and 10.6-12.5%: spring-summer) than the later (14 and 21 DAS). In the study, rate of field emergence and seedling growth was improved by 6.4 - 13.6 and 1.6 - 6.0 per cent respectively in winter and by 8.2 - 18.8 and 1.0 - 5.9 per cent respectively in spring-summer season. Hydropriming had pronounced effect on field emergence, its rate and early seedling growth. The environmental effect was dominant over genotypic effect as the improvement in above traits was less in spring-summer when the temperatures are lower than that in winter season.

Bennett and Waters [4] reported that emergence response of genotypes is cultivar/genotype dependent. All the genotypes showed improvement over control in above traits due to pre-sowing hydration. The inbred line CM111 exhibiting lower field emergence due to low initial seed germination and vigour (Table 1) as compared to other parental lines, however responded to a greater level to these seed treatments in terms of field emergence. Gubbels [13] also reported that hydropriming was more effective in improving emergence and seedling growth of low vigour seeds than high vigour seeds.

Although both the priming treatments had beneficial effect on field emergence and seedling growth but hydropriming at 25°C (T₂) was more promising than low temperature hydropriming (T₃). Our results confirms the earlier reports [4, 5, 8, 9 and 14].

Pre-sowing hydration treatments have been reported to prepone the flowering of parental lines in hybrid seed production plots [8, 9]. However in our study, the beneficial effect of hydropriming persisted only till early vegetative growth and these treatments failed to improve the plant height, flowering behaviour (days to flowering, duration of flowering and duration of protandry), seed yield and test weight of the parental lines in both the seasons. The initial advantage in seedling emergence and early growth in above seasons was not carried over upto later growth stages of the crop. Similar results have been reported by Gubbels [13] that pre-sowing hydropriming (at 32°C) increased the rate and percentage of field emergence and seedling fresh weight in the field but failed to enhance number of ears per plant and grain yield.

Harris *et al.* [7] reported that on-farm seed hydration in maize significantly improved field emergence, early seedling growth, crop performance and yield under wide range of environments under rainfed conditions. The results of our study,

Table 1. Effect of hydropriming on field emergence (%) of maize genotypes in winter (W) and spring summer (SS) season

Genotype	Germination(%)		Field emergence (%)					
			Winter			Spring-Summer		
	Winter	Spring-Summer	7 DAS	14 DAS	21 DAS	7 DAS	14 DAS	21 DAS
CM202	93	93	65.61(54.13)	81.24(64.43)	82.18(65.12)	64.21(53.21)	75.41(60.33)	76.40(61.00)
CM111	88	87	65.15(53.88)	80.15(63.60)	81.25(64.40)	62.86(52.50)	74.95(60.05)	76.09(60.82)
CM500	97	95	69.00(56.20)	86.81(68.97)	87.81(69.80)	64.11(53.21)	78.95(62.80)	79.62(63.27)
CM501	98	96	69.73(56.69)	83.53(66.21)	85.00(67.39)	64.58(53.50)	77.55(61.80)	78.49(62.45)
C.D.(P=0.05)			1.841	2.22	1.84	N.S.	1.53	1.41
Pre-sowing Treatment								
T ₁			61.90(51.90)	78.82(62.65)	80.62(63.92)	59.37(50.40)	72.02(58.09)	73.00(68.71)
T ₂			79.77(57.31)	85.85(68.07)	86.56(68.65)	66.79(54.82)	79.92(63.43)	80.01(64.07)
T ₃			69.44(56.47)	84.13(66.69)	85.07(67.46)	65.66(54.13)	78.20(63.92)	79.13(62.87)
C.D. (P=0.05)			0.805	1.140	1.060	0.891	1.109	1.051

T₁: Control ; T₂: Hydropriming for 24 h at 25°C ; T₃ : Hydropriming for 48 h at 10°C, followed by 12 h at 25°C; Arc sine values in parenthesis

Table 2. Effect of hydropriming on field emergence rate and seedling growth of maize genotypes in winter and spring summer season

Genotype	Field Emergence Rate		Seedling dry weight (g)	
	Winter	Spring-Summer	Winter	Spring-Summer
CM202	30.54	29.11	3.24	3.56
CM111	30.24	28.99	3.64	3.77
CM500	32.40	29.74	3.72	3.86
CM501	31.92	29.60	3.97	4.15
C.D.(P=0.05)	1.206	NS	NS	NS
Pre-sowing Treatment				
T ₁	29.27	27.36	3.54	3.73
T ₂	32.59	30.74	3.73	3.92
T ₃	31.99	29.97	3.65	3.86
C.D. (P=0.05)	0.533	0.648	0.102	0.157

T₁: Control ; T₂: Hydropriming for 24 h at 25°C ; T₃ : Hydropriming for 48 h at 10°C, followed by 12 h at 25°C

confirmed the effectiveness of hydropriming in improving field emergence, its rate and early seedling growth under sub-optimum temperatures. Thus pre-sowing seed hydration can be adopted at farmers' level for improving field emergence and early vegetative growth of maize parental lines in winter and spring-summer seasons under north Indian conditions.

ACKNOWLEDGEMENT

Thanks are due to the National Seeds Corporation, New Delhi; University of Agricultural Sciences, Dharwad and Directorate of Maize Research, New Delhi for providing genetically pure seeds of the parental lines.

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