IJPS INTERNATIONAL JOURNAL OF PLANT SCIENCES
Volume **8** | Issue 1 | January, 2013 | 131-133

RESEARCH ARTICLE

Physiological and morphological response of maize (*Zea mays* L.) inbred lines under drought condition

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SUMMARY

The present study was conducted to assess drought tolerant and grain yield traits in maize. Seventeen stable and productive inbred lines were evaluated under drought condition. Results revealed that, The analysis of variance in respect to four drought tolerant and twelve yields and yield attributing characters indicated highly significant differences among the genotypes as revealed by 'F' test. Among the inbred lines, SKV-70, CML-249, CML-357 showed the better mean values for drought tolerant traits *viz.*, SPAD chlorophyll meter reading (SCMR), specific leaf area(SLA), anthesis silking interval (ASI), carbon isotope discrimination ($\Delta^{13}C$) in desirable direction. Lines NAI-143, NAI-156, SKV-70 had higher yielding ability along with good drought tolerance ability compared to other inbred lines.

Key Words : SPAD chlorophyll meter reading (SCMR), Specific leaf area (SLA), Anthesis silking interval (ASI), Carbon isotope discrimination ($\Delta^{13}C$)

How to cite this article : Venkatesha, K.T., Asif, M., Vijay Kumar, K.V. and Shivanna, H. (2013). Physiological and morphological response of maize (Zea mays L.) inbred lines under drought condition. *Internat. J. Plant Sci.*, **8** (1) : 131-133.

Article chronicle : Received : 17.08.2012; **Revised :** 30.09.2012; **Accepted :** 19.11.2012

Maize (*Zea mays* L.) is the third most important crop among the cereal crops grown in India. Maize grain is gaining popularity in our country due to huge demand, particularly for poultry feed industry. Besides, maize has diversified uses as food and industrial raw materials. Maize acreage and production have an increasing tendency with the introduction of hybrids due to its high yield potential.

A good number of inbreds developed recently is available at the All India Coordinated Research Project on Maize, Zonal Agricultural Research Station, Mandya whose combining ability has not yet been studied for utilization in hybrid development programme. Most efficient use of such materials would be possible only when adequate information on the amount and type of genetic variation and combining ability effects in the materials is available. A wide array of biometrical tools is available to breeders for characterizing genetic control of economically important traits as a guide to decide upon an appropriate breeding methodology to involve in hybrid breeding. The present investigation was carried out to identify the drought tolerant inbred lines along with high yielding ability by evaluating them under drought condition in field.

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MATERIALS AND METHODS

Seventeen high yield potential inbred lines were evaluated under controlled moisture condition along with two checks NAH 2049 and NAH-1137 in a Randomized Complete Block Design with two replications at Zonal Agricultural Research Station, V.C. Farm, Mandya, University of Agricultural Sciences, Bangalore, which is located at a latitude of $12^o 30^I$ N, longitude of $76^o 50^I$ E and altitude of 694.65 meters above mean sea level (MSL). The spacing between rows was 75 cm and between plants was 30 cm and one plant per hill was maintained. Observations were recorded on four drought tolerant traits *viz.*,SPAD chlorophyll meter reading (SCMR), specific leaf area(SLA), anthesis silking interval (ASI), carbon isotope discrimination ($\Delta^{13}C$) and yield and yield attributing traits *viz*., days to 50 per cent tasseling, days to 50 per cent silking, days to 50 per cent anthesis, plant height, ear height, ear length, ear diameter, number of kernel rows per cob, number of kernels per row, test weight, shelling percentage and yield per plant.

The data were subjected for analysis of variance for all the characters studied as per the method suggested by Panse and Sukhatme (1967).

RESULTS AND DISCUSSION

Mean value for SCMR ranged from 10.35 (KUI-1411) to 28.39 (SKV-70) among lines with an average of 18.86 and showed significance variance. SCMR was positively related with the water use efficiency (WUE) reported by Zhang *et al.* (2006). Specific leaf area ranged from 190.97cm²/g (KUI-1411) to 57.04 cm²/g (SKV-70), analysis of variance also showed the significance variation for this trait. Same trend was observed by Zebarth *et al*. (2002), Tumbo *et al*. (2000) and Costa *et al.* (2001).

For each genotype days to anthesis and days to silking was taken and difference between this will give the anthesis and silking interval (ASI). It as an indirect selection criterion for improving grain yield under drought stressed conditions. The range for anthesis silking interval was from 1.0 days (KUI-1411) to 4.0 days (SKV-57) and showed the significant variation. Similar results were reported by Banziger *et al*. (2002), Edmeades *et al*. (2000). The $\Delta^{13}C$ ranged from 3.09 (SKV-70) to 4.51 (SKV-57) among lines and reported the significance variation. Similar results were observed by Zhang *et al*, (2006), Dacron *et al*. (2006) (Table 1).

The variances for the sixteen different drought tolerance and yield and yield attributing traits are presented in (Table 2). Significant and positive variance was present for all traits among the inbred lines.

Table 1: Mean performance of lines for drought tolerant, yield and yield attributing traits in maize

LINES	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8	X_9	X_{10}	X_{11}	X_{12}	X_{13}	X_{14}	X_{15}	X_{16}
SKV-70	28.39	57.04	1.50	3.09	58.00	59.50	50.50	123.90	51.00	12.05	13.43	12.40	23.40	92.80	15.75	65.60
CML-407	27.88	64.24	2.00	3.10	56.50	58.50	53.00	147.70	71.50	11.24	14.46	13.40	19.90	85.11	21.35	73.30
NAI-148	25.52	66.13	1.50	3.21	57.00	58.50	58.00	131.40	63.50	7.84	11.21	11.30	23.60	88.05	15.35	66.56
CML-249	24.09	72.68	2.50	3.25	56.00	58.50	58.00	132.50	66.00	10.71	13.17	14.40	12.20	84.72	19.85	41.30
CML-357	24.34	73.13	2.00	3.29	55.50	57.50	58.50	147.55	45.50	13.52	14.56	13.40	25.00	85.15	13.70	74.15
NAI-143	22.61	73.49	2.00	3.32	55.50	57.50	59.50	97.40	54.00	7.36	11.43	11.60	17.70	86.15	19.30	91.39
SKV-69	22.21	77.06	2.50	3.43	55.00	57.50	58.50	136.80	50.50	12.13	14.37	14.60	26.10	81.81	20.65	42.31
NAI-156	22.38	71.34	2.50	3.39	54.00	57.50	52.00	96.70	56.00	10.38	11.64	10.60	14.00	85.33	16.85	83.37
NAI-147	21.30	81.09	2.50	3.46	56.00	58.50	51.50	158.80	63.00	9.29	9.82	11.60	24.30	81.64	10.30	56.82
SKV-66	19.50	99.08	2.50	3.54	55.00	57.50	57.00	99.10	59.50	12.12	13.45	11.40	24.60	80.33	17.70	43.80
KUI-1411	10.35	190.97	1.00	5.28	57.50	58.50	51.00	96.70	50.00	7.60	12.23	10.80	19.00	90.40	20.80	79.19
CML-322	10.70	141.21	4.00	4.97	51.50	58.50	56.00	147.70	61.00	10.73	14.50	17.40	25.00	93.63	14.90	39.40
HKI-1040	12.38	139.92	5.00	4.86	50.50	58.50	56.50	99.10	53.50	11.54	11.61	11.60	23.30	90.72	19.20	71.95
SKV-5	11.40	139.92	6.50	4.62	50.00	56.50	53.50	135.70	44.50	12.56	13.16	10.80	24.40	81.14	14.80	49.50
SKV-58	12.67	122.21	3.50	4.59	53.00	56.50	56.00	141.50	42.50	5.99	12.56	12.40	25.00	86.10	13.45	71.36
SKV-19	12.77	120.56	3.50	4.52	54.00	57.50	57.00	158.60	47.00	14.13	13.38	11.80	37.90	92.00	14.05	87.85
SKV-57	12.12	119.52	4.00	4.51	54.50	58.50	58.50	96.30	47.50	11.60	12.80	12.80	27.60	77.98	15.75	36.75
Mean	18.86	100.56	2.88	3.91	54.68	57.97	55.59	126.32	54.50	10.63	12.81	12.49	23.12	86.06	16.69	63.21
S.E.±	0.17	0.27	0.40	0.01	0.28	0.37	0.27	0.85	1.45	0.15	0.25	0.08	0.08	0.60	0.56	1.08
C.D. (P=0.05)	0.35	0.54	0.78	0.02	0.56	0.72	0.53	1.69	2.86	0.30	0.50	0.17	0.16	1.18	1.11	2.14
C.D. (P=0.01)	0.46	0.72	1.04	0.02	0.75	0.96	0.70	2.24	3.80	0.40	0.67	0.22	0.21	1.57	1.47	2.84

Drought tolerant traits : X_1: SCMR values, X_2: Specific leaf area (cm²/g), X_3: Anthesis and silking interval (ASI), X_4: Carbon isotope discrimination ($\Delta^{13}C$) **Yield and yield attributing traits:** X_5: Days to 50% tasseling, X_6: Days to 50% silking, X_7: Days to 50% anthesis, X_8: Plant height (cm), X_9: Ear height (cm), X_{10}: Ear length (cm), X_{11}:Ear width (cm), X_{12}:Number of kernel rows per cob, X_{13}: Number of kernel per row, X_{14}: Shelling percentage, X_{15}:100- grain weight (g), X_{16}: Yield per plant (g)

Table 2: Analysis of variance for drought tolerant, grain yield and its contributing characters in maize

Sources of variation	Mean sum of squares							
	d.f	SCMR values	Specific leaf area(SLA)	Anthesis and silking interval(ASI)	$\Delta^{13}C$	Days to 50% tasseling	Days to 50% silking	Days to 50% anthesis
Replication	1	0.25	0.04	0.02	0.02	4.18	3.31	0.14
Genotypes	16	59.94**	1676.89**	3.04**	0.51**	4.91**	2.03**	6.47**
Error	16	0.18	0.49	1.17	0.68	0.84	0.84	0.63

Sources of variation	Mean sum of squares									
	d.f	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear width (cm)	No of kernel rows per cob	Number of kernel per row	Shelling percentage	Test weight (g)	Yield per plant(g/p)
Replication	1	12.78	8.74	0.00	0.65	0.05	0.00	7.67	0.25	9.18
Genotypes	16	533.50**	344.31**	9.23**	1.95**	3.64**	55.27**	20.28**	32.60**	819.57**
Error	16	4.17	13.75	0.14	0.4	0.05	0.06	2.60	2.04	6.59

* and ** Indicate significance of value at P=0.05 and 0.01, respectively

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