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EVALUATION OF MAIZE PRODUCTIVITY UNDER DROUGHT CONDITION

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Abstract: Drought contributes to reduced maize production in Nepal especially in mid hill region. To identify the drought tolerant high yielding maize genotypes, one hundred four genotypes were evaluated at mid hill districts (Doti, Surkhet and Dailekh) in 2011 summer. All the genotypes were tested in a randomized complete block design with three replication. The grain yield was highly significant for genotypes, location but non significant for G × L interaction. The genotypes namely Manakamana-4, Upahar and TLBRS SO7F16 produced high yield under drought condition.

Key words: drought, summer season and grain yield.

INTRODUCTION

Drought is defined as shortfall water availability sufficient to cause losses in yield. It affects maize grain yield to some degree at almost all growth stages, but the crop is the most susceptible during flowering. A major effect of drought is embryo abortion, which is related to the inhibition of photosynthesis and the subsequent reduction in assimilates available to developing kernels. Water stress hastens tasseling, pollen dehiscence and delays silking. Result is barrenness due to failure of pollination. Yield reduction of 50 % or more are recorded when drought occurs during sensitive flowering stages (Claassen and Shaw 1970).Significant yield losses in maize from drought are expected to increase with global climate change as temperature rises and rainfall distribution changes in production areas.

Majority of maize fields in Nepal are under rainfed condition. Nepal faces serious problems of shortage of water due to low and irregular rain fall which resulted in heavy crop losses. In the view of various climatic change models scientists suggested that in many regions of world, crop losses due to increasing aridity will further increase in future (Athar and Ashraf 2005). Thus, the threat and effects of shortage of water on crop productivity are becoming more alarming. In Nepal maize productivity is lower as compared to other Asian countries because maize is grown mostly under rainfed condition with fluctuating rainfall. Different effective measures should be adopted to increase the crop yield. The selection of different maize genotypes with considerable water stress tolerance has been considered an economic and efficient means of utilizing drought-prone areas when combined with appropriate management practices to reduce water loss and increase grain yield (Rehman et al 2005).

Genetic improvement of adaptation to drought is addressed through conventional approach by selecting for yield. In Nepal breeding works on drought tolerance development is still lacking and there is no single maize variety for drought tolerance. Therefore this study was conducted during dry period of summer season in 2010 in mid hill districts to identify drought tolerant high yielding maize genotypes.

MATERIALS AND METHODS

One hundred four maize genotypes were evaluated at mid hill region; Surkhet, Dailekh and Doti in 2011 summer. The experimental designs were randomized complete block designs with three replications. Planting was done in May in the both years. Row to row 75

cm and plant to plant 25 cm was maintained. Plot size was 4 rows with 5 meter length. Organic matter @ 10 ton FYM ha^{-1} was applied during the field preparation. Fertilizer dose at 120:60:40 NPK kg ha^{-1} was applied in the experimental field. Nitrogen half dose, P_2O_5 and K_2O in full doses were used in the planting time. Remaining half doses of nitrogen again divided into two proportions whose first half dose applied on 21 days after sowing at time of weeding and second dose was applied as side dressing on 45 day after sowing. The maize was grown in sandy loam upland soil under rainfed condition. All intercultural operations were done as usual. The statistical analysis of data was carried out using MSTAT program.

RESULTS AND DISCUSSIONS

The results at Doti revealed that grain yield was non significant. The grain yield ranges from 1631.09 kg ha^{-1} (Farmer's Variety) to 6482.77 kg ha^{-1} (SO1SIWQ-1). The genotypes S01SIWQ-1 (6482.77 kg ha^{-1}), Iquitos-9328RE (5668.2 kg ha^{-1}) and Synthetic C (4992.81 kg ha^{-1}) were first, second and third genotypes respectively in terms of higher grain production.

At Surkhet the grain yield was significant among the tested genotypes. The grain yield ranges from 1185.54 kg ha^{-1} (Mustang local) to 8602.77 kg ha^{-1} (TLBRS07F16). The highest grain yield was produced by genotypes TLBRS07F16 (8602.77 kg ha^{-1}) followed by Manakamana-4 (7090.82 kg ha^{-1}) and S97TLYGHAyB (3) (7070.29 kg ha^{-1}) respectively.

The finding of the experiment at Dailekh showed that grain yield was non significant. The grain yield ranges from 192.125 kg ha^{-1} (S02G29YQ) to 2814.368 kg ha^{-1} (Rpop-2). The genotypes RPop-2 (2814.368 kg ha-1) gave highest yield followed by SyntheticB (2736.565 kg ha^{-1}) and RampurS03F08 (2556.277 kg ha^{-1})

The genotypes and location were highly significant but G × L interaction was non significant for grain yield. TLBRS07F16 produced highest grain yield 4943.08 kg ha^{-1} followed by Manakamana-4 (4138.28 kg ha^{-1}), Upahar (4088.6 kg ha^{-1}) respectively.

Table 1: Analysis of maize genotypes for grain yield (kg ha^{-1}) during summer season of 2011 at mid hill districts of Nepal (Doti, Surkhet and Dailekh)

S.N.	Genotypes	Doti	Surkhet	Dailekh	Combined
1	Terai Pool Yellow	4508.57	5390.22	1123.064	3591.88
2	BLSBRSo7F10	3080.45	3693.67	2146.803	2934.3
3	BLSBRSo7F12	2907.82	3807.26	1894.065	2927.11
4	TLBRS07F14	4718.17	5184.42	1367.718	3739.96
5	TLBRS07F16	4090.05	8602.77	2459.817	4943.08
6	R Pop-1	3223.62	6063.69	2344.533	3823.82
7	R Pop-2	2614.48	5340.18	2814.368	3714.44
8	R Pop-3	2803.11	5067.29	1815.216	3473.17
9	R Pop-4	3324.59	6065.88	1998.628	3790.75
10	Synthetic A	3073.42	6076.69	1735.843	3604.82
11	Synthetic B	3373.92	5756.3	2736.565	4043.14
12	Manakamana-4	3200.62	7090.82	2089.161	4138.28
13	Across 9331 RE	3619.38	6032.73	2216.324	3850.93
14	Across 033	2300.46	4881.15	1140.601	2816.57
15	So3TLYQ-AB-01	3350.11	5001.73	1318.818	3179.98
16	So3TLYQ-AB-02	3669.9	5580.89	1956.078	3659.68
17	Across 9942 /Across 9944	2819.16	7013.96	1115.148	3984.57
18	P501 SRCO /P502 SRCO	3579.12	4220.03	1442.614	3196.09
19	Rampur S03 F08	2103.08	5911.53	2556.277	3576.78
20	S99TLYQ-HG-AB	3913.81	2987.81	1176.753	2748.82
21	S99TLWQ-B	2095.52	5440.63	1951.373	4044.39

22	S01SIYQ	2796.73	5015.42	1638.672	3199.23
23	S01SIWQ-2	2698.29	4031.73	632.784	2682.83
24	S00TLYQ-B	2898.78	5873.57	1633.987	3604.64
25	S00TLWQ-B	1760.85	6846.63	1243.608	3285.1
26	RampurS03FQ-02	2420.36	5378.05	1612.141	3203.37
27	Poshilo Makai-1	2638.44	3902.75	1971.65	2799.43
28	Obatanpa	4333.21	4311.84	1679.812	3524.59
29	S99TLY-GH-B	2584.36	4565.12	1530.144	2909
30	So1SIWQ-3	3548.2	4341.21	559.373	3299.44
31	S99TLYQ-B	2591.54	4103.34	1331.827	2748.45
32	S99TLYQ-A	3541.18	5248.8	1384.031	3466.25
33	Celaya00HGYA*HGYB	2924.54	3890.57	2940.277	3146.02
34	Cotaxla0024	2199.14	4122.3	1782.212	2655.89
35	RampurS03F08	2344	5519.26	1741.574	3278.89
36	RampurSo3F06	2798.46	4752.31	1970.865	3202.44
37	Pop 35C1	4588.01	5214.43	1968.858	3904.62
38	Heterotic Group A	3432.95	4950.59	1403.953	3447.83
39	Heterotic Group AB	2701.74	4957.42	2362.771	3324.47
40	Heterotic Group B	2906.27	4689.57	1953.61	3163.01
41	Resunga composite	3277.49	6177.97	2529.84	4076.56
42	Upahar	3949.71	6719.69	1557.793	4088.6
43	Cotaxla S9627	1976.93	4133.65	1485.427	2673.03
44	Takfa S9624	2819.86	4927.69	1317.312	3074.05
45	Rampur So3Fo2	1505.84	5422.43	2162.196	3003.25
46	Pozarica S9627RE	2330.38	4497.51	1980.8	2996.94
47	SO128	2920.65	4639.77	1484.382	3156.14
48	Across 9531 RE	3881.39	5311.37	1734.651	3727.45
49	Aqua Fria S0031	3606.76	6152.08	1681.652	3777.32
50	PHRA PHUTABAT S0031	3811.37	6252.83	1433.14	3967.35
51	Pool-17	3385.78	3606.04	1120.251	2846.09
52	Arun-1EV	2788.24	5754.35	1394.573	3293.79
53	Arun-4	2239.8	3332.51	543.122	2110.23
54	So3TEY-FM (RE)	2789.96	4056.85	1139.723	2665.23
55	So3TEY-SEQ 99SIYQ	3047.07	4590.43	1035.796	3250.79
56	Across-2401	2357.9	4211.79	661.605	2386.63
57	Across 2401/Across 2402	3492.64	2935.84	478.118	2337.11
58	Pop 445/Pop 446	2887.85	4714.04	368.627	2704.06
59	Rampur So3E02	2626.72	3249.06	1215.916	2377.09
60	Pop 445	2726.04	3804.97	627.869	2427.9
61	Pop 446	2869.23	2821.69	443.482	2125.68
62	S97TEY GH A yB (3)	2807.66	4078.39	384.46	2564.77
63	Khumal yellow/Pool-17	3865.13	5231.69	1122.552	3502.08
64	RC/Pool-17	4069.22	3349.08	1015.32	2948.17
65	Pop 44/Pool-15	3713.63	2959.57	658.238	2549.55

66	Bangalore-9745	3829.51	6283.04	740.267	3683.85
67	Iquitos-9328 RE	5668.2	3739.58	1282.092	3634.05
68	Pozarica-9531	3648.8	6797.18	1980.235	4068.73
69	Takfa S9536	3924.5	2435.42	1046.421	2705.99
70	SIN-IBP-UTYF	2777.46	5406.94	1050.782	3108.52
71	S99TLYQ-AB	3040.76	2407.27	857.516	2387.69
72	S00TLYQ-AB	4697.98	5898.04	1376.627	4048.89
73	Coollerazo S02SIYQ	2294.16	2721.68	333.678	2137.66
74	Celaya S99SIWQ	3417.71	3227.14	220.591	2360
75	S01SIWQ-1	6482.77	3401.58	205.407	3670.17
76	S02G29YQ	2533.5	2502.65	192.125	1817.98
77	BGBYPOP	4761.46	3059.24	1191.739	3074.92
78	Manakamana-2	2421.9	4731.61	991.624	2773.05
79	Manakamana-3	4480.13	6051.76	1610.541	4051.47
80	Synthetic C	4992.81	5004.55	1243.524	3784.64
81	Rampur composite	2856.01	5268.71	1712.941	3382.77
82	Khumal yellow	3791.63	4945.28	1637.814	3519.84
83	Arun-2	3350.79	6036.69	1095.111	3531.84
84	Arun-1	3455.97	3547.19	336.523	3058.05
85	Gulmi-2	2189.28	3989.71	1925.48	2684.12
86	Deuti	2338.05	5434.56	1409.778	3053.46
87	Shitala	2340.99	5052.81	681.631	2758.5
88	OEHPW	4051.25	6556.65	1399.634	4028.66
89	Mustang local	2092.03	1185.54	342.714	1741.93
90	EEYC1	3508.86	6295.14	944.146	3581.4
91	Across 847	3276.64	1454.43	351.08	1713.84
92	Narayani	3321.52	2724.12	674.635	2253.39
93	ZM-301	3555.25	4100.14	835.054	3024.07
94	PL15C7SRC	2939.92	4480.55	1412.078	2910.9
95	Early Mid Katumani	1753.75	2900.5	1013.584	1885.54
96	GLSYW	3603.4	5400.53	2148.497	3624.44
97	Gaurav	2965.94	6271.26	1102.85	3499.2
98	RML-4/NML-2	3039.56	5404.01	2452.371	3485.42
99	S97TLYGH AyB (3)	2305.24	7070.29	1404.444	3561.76
100	ZM-621/Pool-15	3345.91	5913.98	912.847	3280.89
101	Lamaquina-0027	4016.61	5435.36	1471.414	3628.72
102	S00TLY-1AB	2611.4	6878.76	2171.524	3922.49
103	Pool-27	3904.36	4147.45	1054.912	3090.51
104	Farmer's Variety	1631.09	4304.48	1522.259	2442.76
	Grand mean	3183.084	4791.56	1390.92	3194.52
	F-test	ns	*	**	(Genotype) ** (Location)** (G × L) ns
	CV%	35.92	33.32	44.4	38.4
	LSD (0.05)	2267.48	3166.16	1224.94	1972

*** Significant at 0.01 level. * Significant at 0.05. ns, Non significant*

CONCLUSION

Higher grain yield is important indication for identifying drought tolerant genotypes. The genotypes namely TLBRS07F16, Manakamana-4 and Upahar were superior in terms of production hence they are promising genotypes for drought tolerance for mid hill region of Nepal but further research is needed to strengthen this finding.

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