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Performance evaluation of maize in Jumla district of Nepal: from yielding perspective

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Abstract

The performance evaluation of maize genotypes at a specific growing region is a key to crop improvement. The objectives of this study were to evaluate grain yield of maize genotypes at Bijayanagar (Mahatgaun VDC) and Tallo Lorpa (Dillichaur VDC), Jumla District of Nepal during spring seasons of 2012 and 2013. The maize genotypes were significant ($P< 0.05$) for grain yield, days to tasseling and silking and disease scoring where as anthesis-silking interval, plant height and ear height were non significant. The pooled analysis of the results showed that the highest grain yield was produced by Ganesh-1 (4830 kg/ha) followed by KKT-POP (4408 kg/ha), KKT-14 (3952 kg/ha) and MGU-08 (3913 kg/ha, respectively. From this study, Ganesh-1, KKT-POP, KKT-14 and MGU-08 could be preferable choice for cultivation in Jumla district of Nepal

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Keyword
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Introduction

Maize (*Zea mays* L.) is one of the most important cereal crops in the world after wheat and rice (Golbashy et al., 2010). It is cultivated in a wider range of environments than wheat and rice because of its greater adaptability (Koutsika-Sotiriou, 1999). Maize is second major crop after rice in term of area and production in Nepal (MoALD, 2017). The farm level yield of maize (2.55 t/ha) is not satisfactory as compared to attainable yield (5.7 t/ha) in Nepal (MOAD, 2017; Karki et al., 2015). Maize production in the area suffers much from low fertility, low management, lack of improved varieties, and very severe infections of foliar diseases like turcicum leaf blight, high infestations of striga and stalk borers (Assefa, 1998). As a result, evaluating the performance of hybrid maize genotypes in specific agro ecology on different traits is very crucial.The environmental conditions affect the performance of maize genotypes which requires a breeding program that needs to take into account the consequences of environment and genotype interaction in the selection and release of improved varieties.The karnali region is rich diversity for local maize germplasm. The need of local germplasm collection, their evaluation and utilization for the development of Pools Populations and varieties is only the means to develop the new OPVs for higher grain yield production as well

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as to fit in the existing cropping systems. Jumla, 2,531 square kilometer (sq.km) area with altitude ranging from 915 to 4,679 meters from amsl, is a unique district located in the far north-western part of Nepal. The plane lands in Jumla district are located at the altitude of about 2,350 meters (Shrestha, 2002). The area under maize cultivation in karnali zone represents only 1.16% of the total maize cultivated area and its maize production represents only 0.78% of the total maize production in Nepal. The average maize productivity in karnali zone was 1.66 t/ha which was 15% lower as compared to average national productivity of maize (MoAD, 2012). There is no single maize variety released for karnali zone up to now. Therefore, this study was carried out to identify high yielding maize varieties suitable for karnali zone of Nepal.

Materials and Methods

Plant materials

The maize genotypes used in this study were DLP-01, DLP-14, DLP-16, DLP- Pop (DLP-01, DLP-14, DLP-16 and DLP-18), HML-04, HML-08, HML-28, HML-Pop (HML-04, HML-08, HML-28 and HML-05), JML-27, JML-30, JML-32, JML-Pop (JML-27, JML-30 and JML- 32), KKT-02, KKT-03, KKT-14, KKT-Pop (KKT-02, KKT-03 and KKT-14), MGU-03, MGU-08, MGU-15, MGU-PoP (MGU-03, MGU-08 and MGU-15), Dolmu Pop (DLP-01, DLP-14 MGU-03 and MGU-14), Jumka Pop (JML-14, JML-26, KKT-02 and KKT-03), Karnali Pool Yellow (HML-25, KKT-18 and HML-18), Karnali Pool White (DLP-05, DLP- 17, HML-11, MGU-14 and MGU-30), Ganesh-1 and Pool-17 (check variety). All these genotypes were received from National Maize Research Program, Rampur, Chitwan, Nepal.

Experimental site, crop husbandry and experimental design

Twenty six maize genotypes (including Ganesh-1 and Pool-17) during spring seasons of 2012 and 2013 at Bijayanagar (Mahatgaun VDC) and Tallo Lorpa (Dillichaur VDC), Jumla. There were 2 sites i. e. Site 1 and Site 2 at Tallo Lorpa, Jumla. The longitude of Tallo Lorpa is 82° 16', latitude 29° 19' and altitude 2540 m. Similarly, The longitude of Bijayanagar is 82° 10', latitude 29° 17' and altitude 2580 m. The genotypes were tested in plot size of two rows of three meter length in randomized block design with two replications and plant spacing of 75 × 25 cm2. The plots were fertilized with 120:60:40 N:P2O5:K2O kg/ha in the form of urea, di-amonium phosphate (DAP), and murate of potash (MoP). Entire dose of phosphorus and potash was applied at the time of sowing while urea was added in three split doses and also 15 t/ha farm yard manure (FYM) was incorporated in soil at the time of land preparation. Irrigation was applied as per the requirement of crop. All the trials received standard cultural practices to control weeds and pests.

Data recording and measurements

Plants harvested from central two rows were used on data measurements. Days to anthesis were counted from sowing to until 50% of plants had shed their pollen and days to silking were recorded from sowing to 50% plants extruded their silks. Anthesis silking interval (ASI) was calculated as the difference between silking and anthesis interval. Plant height and ear height was measured as the distance from ground to the tip of the tassel and the base of the uppermost ear respectively on five plants per plot. Disease scoring was done from 1 to 5 scale (Payak & Sharma, 1983; Shrestha et al., 2019). Grain yield (kg/ha) at 15% moisture content was calculated using fresh ear weight with the help of the formula adopted by

Carangal et al. (1971) and Shrestha et al. (2018) to adjust the grain yield (kg/ha) at 15% moisture content.

Data Analysis

All collected data were entered in Microsoft Excel 2016 and analyzed by using GENSTAT (version 14th edition; VSN International, Hemel Hempstead, UK). All the data collected were statistically analyzed using the analysis of variance (ANOVA) procedure described by Gomez and Gomez (1984) for randomized complete block design (RCBD) experiments. Separation of treatment means for significant difference was done by using the Fisher least significant difference (F-LSD) procedure at 0.05 probability level (Obi, 1986; Shrestha, 2019).

Results and Discussion

The findings of maize experiments at Bijaynagar, Jumla showed that the grain yield was highest in KKT-POP (6594 kg/ha), JML-30 (4271 kg/ha) and DLP-14 (3141 kg/ha) respectively. The days to 50% tasseling varied from 98 days (HML-28) to 140 days (KKT-02 and KKT-03) and silking varied from 102 days (HML-04, HML-28) to 145 days (KKT-02 and KKT- 03). The plant height varied from 102 cm (HML-08) to 157 cm (DLP-16) and ear height from 40 cm (DLP-01) to 74 cm (KKT-pop). The disease score varied from 1.5 (HML- 04 and KKT-02) to 3 (HML-28 and Ganesh-1).

The findings of the maize experiments at Tallo Lorpa, Jumla showed that The grain yield was highest in Ganesh-1 (6210 kg/ha), JML-30 (6203 kg/ha) and KKT-14 (5466 kg/ha) respectively. The days to 50% tasseling varied from 102 days (MGU-pop and HML-04) to 157 days (KKT-02) and silking varied from 107 days (DLP-pop and MGU-pop) to 153 days (KKT-14). The plant height varied from 104 cm (Pool-17) to 187 cm (Jumka-pop) and ear height from 51 cm (DLP-01) to 104 cm (KKT-14). The disease score varied from 2 (DLP-01, HML-04, HML-pop, JML-27, JML-30, KKT-14, Karnali pool yellow and Karnali pool white) to 3 (DLP-14).

The pooled analysis of maize experiments at Tallo Lorpa and Bijaynagar showed that grain yield ranges from 1776 kg/ha (DLP-01) to 4830 kg/ha (Ganesh-1). The grain yield was highest in Ganesh-1 followed by KKT-POP (4408 kg/ha), KKT-14 (3952 kg/ha), MGU-08 (3913 kg/ha), Karnali Pool White (3482 kg/ha), Karnali Pool Yellow (3402 kg/ha) and KKT- 03 (3392 kg/ha) respectively.

Table 1. Grain yield and agronomic traits of maize genotypes evaluated at Bijayanagar, Jumla district during spring season of 2012 and 2013

SN	Genotypes	50% tasseling (days)	50% silking (days)	ASI (days)	Plant height (cm)	Ear height (cm)	Disease Score (1-5)	Grain yield (kg/ha)
1	KKT-03	140	145	5	153	59	2	2183
2	KKT-14	124	130	6	153	64	2	3018
3	KKT-Pop	124	130	6	177	74	2.5	6594
4	MGU-03	116	125	9	123	54	2	2666
5	MGU-08	119	124	5	111	47	3	2634

6	MGU-15	119	121	2	118	54	2	1927
7	MGU-Pop	107	111	4	149	67	2	2952
8	Dolmu Pop	106	113	7	145	61	2.5	2733
9	Jumka Pop	107	111	4	147	73	2	2432
10	Karnali Pool Yellow	105	109	4	134	71	2	2910
11	Karnali Pool White	116	122	6	148	77	2.5	3173
12	Pool-17	116	122	6	144	54	2.5	2746
13	Ganesh-1	116	121	5	215	118	3	5060
14	DLP-01	104	106	2	140	40	2	1555
15	DLP-14	102	108	6	150	55	2	3141
16	HML-Pop	104	109	5	148	58	2.5	2615
17	JML-27	114	119	5	130	48	2	2808
18	JML-30	107	111	4	141	61	2	4271
19	JML-32	111	116	5	123	47	2	2779
20	JML-Pop	109	114	5	119	51	2	2467
21	KKT-02	140	145	5	104	52	1.5	2891
22	DLP-16	112	116	4	157	68	2	2728
23	DLP-Pop	99	104	5	128	73	2	3052
24	HML-04	99	102	3	114	36	1.5	1391
25	HML-08	109	113	4	102	35	2.5	1850
26	HML-28	98	102	4	129	44	3	2336
	Grand mean	112	117	5	139	59	2.2	2881
	CV%	10.45	9.4	24.2	15.5	23.4	22.4	13.5
	F test	*	*	*	*	ns	ns	*

*ns = non-significant at 5% level of significance, * = Significant at 5% level of significance*

Table 2. Grain yield and agronomic traits of maize genotypes evaluated at Tallo Lorpa (Site 1), Jumla district during spring season of 2012 and 2013.

SN	Genotypes	50% tasseling (days)	50% silking (days)	ASI (days)	Plant height (cm)	Ear height (cm)	Disease Score (1-5)	Grain yield (kg/ha)
1	KKT-03	132	136	4	169	77	2.5	5326
2	KKT-14	145	153	8	182	104	2	5466
3	KKT-Pop	140	145	5	173	88	2.5	3972
4	MGU-03	122	126	4	164	88	2.5	3322
5	MGU-08	121	125	4	173	68	2	4278
6	MGU-15	125	128	3	153	81	2	1339
7	MGU-Pop	102	107	5	145	63	2	4496
8	Dolmu Pop	107	111	4	145	72	2	3795
9	Jumka Pop	124	128	4	187	98	2.5	3792
10	Karnali Pool Yellow	123	127	4	129	71	2	4540
11	Karnali Pool White	126	130	4	128	57	2	4052
12	Pool-17	122	126	4	104	42	2.5	3235
13	Ganesh-1	140	145	5	184	77	2.5	6210
14	DLP-01	104	109	5	111	51	2	1705
15	DLP-14	109	114	5	133	62	3	3942
16	HML-Pop	109	114	5	154	82	2	3698
17	JML-27	111	113	2	176	90	2	3171
18	JML-30	109	113	4	173	75	2	6203
19	JML-32	109	113	4	115	46	2.5	2275
20	JML-Pop	144	147	3	127	85	2.5	3071
21	KKT-02	157	162	5	178	97	2.5	3088
22	DLP-16	107	113	6	119	57	2.5	3868
23	DLP-Pop	102	107	5	130	71	2.5	3760
24	HML-04	102	109	7	120	38	2	2723
25	HML-08	107	113	6	133	70	2.5	4066

26	HML-28	107	113	6	135	66	2.5	2131
	Grand mean	119	124	5	148	72	2.3	3751
	CV%	10.7	10.3	26	15.1	22.9	12.9	34.11
	F test	*	*	*	*	ns	*	*

*ns = non-significant at 5% level of significance, * = Significant at 5% level of significance*

Table 3. Grain yield and agronomic traits of maize genotypes evaluated at Tallo Lorpa (Site 2), Jumla district during spring season of 2012 and 2013.

SN	Genotypes	50% tasseling (days)	50% silking (days)	ASI (days)	Plant height (cm)	Ear height (cm)	Disease Score (1-5)	Grain yield (kg/ha)
1	KKT-03	114	119	5	118	65	2	2697
2	KKT-14	109	115	6	136	45	2	3373
3	KKT-Pop	117	123	6	146	44	2.5	2659
4	MGU-03	109	117	8	99	43	2	2811
5	MGU-08	111	117	6	122	36	2.5	3535
6	MGU-15	109	115	6	100	38	2	1493
7	MGU-Pop	111	116	5	130	44	2	1648
8	Dolmu Pop	109	115	6	116	44	2	2179
9	Jumka Pop	109	117	8	134	39	2	3169
10	Karnali Pool Yellow	113	119	6	92	43	2	2563
11	Karnali Pool White	113	119	6	131	33	2.5	2952
12	Pool-17	118	123	5	123	32	2.5	2659
13	Ganesh-1	115	122	7	148	38	2.5	3221
14	DLP-01	104	111	7	147	53	2	2070
15	DLP-14	109	115	6	149	51	2	1700
16	HML-Pop	113	119	6	137	46	2.5	2336
17	JML-27	111	116	5	144	48	2	2666
18	JML-30	113	119	6	144	38	2	1264
19	JML-32	109	117	8	142	47	2	3642

20	JML-Pop	109	114	5	119	44	2	3388
21	KKT-02	107	113	6	137	46	1.5	2846
22	DLP-16	107	112	5	156	46	2	1755
23	DLP-Pop	111	115	4	125	48	2	2400
24	HML-04	109	115	6	122	43	1.5	2438
25	HML-08	111	117	6	136	46	2.5	2207
26	HML-28	109	114	5	131	41	3	2036
	Grand mean	111	117	6	130	44	2.1	2527
	CV%	3.2	1.9	19.7	27.02	11.7	19.3	22.5
	F test	*	*	*	ns	ns	*	*

*ns = non-significant at 5% level of significance, * = Significant at 5% level of significance*

Table 4. Mean of the gain yield and agronomic traits of maize genotypes evaluated at Jumla district (Bijaynagar and Tallo Lorpa) during spring season of 2012 and 2013.

SN	Genotypes	50% tasseling (days)	50% silking (days)	ASI (days)	Plant height (cm)	Ear height (cm)	Disease Score (1-5)	Grain yield (kg/ha)
1	KKT-03	128.67	133.33	4.67	146.7	67	2.16	3392
2	KKT-14	126	132.67	6.67	157	71	2	3952
3	KKT-Pop	127	132.67	5.67	165.3	68.7	2.5	4408
4	MGU-03	115.67	122.67	7	128.7	61.7	2.16	2933
5	MGU-08	117	122	5	135.3	50.3	2.5	3913
6	MGU-15	117.67	121.33	3.67	123.7	57.7	2	1587
7	MGU-Pop	106.67	111.33	4.67	141.3	58	2	3032
8	Dolmu Pop	107.33	113	5.67	135.3	59	2.16	2902
9	Jumka Pop	113.33	118.67	5.33	156	70	2.16	3131
10	Karnali Pool Yellow	113.67	118.33	4.67	118.3	61.7	2	3402
11	Karnali							

	Pool White	118.33	123.67	5.33	135.7	55.7	2.33	3482
12	Pool-17	118.67	123.67	5	123.7	42.7	2.5	2880
13	Ganesh-1	123.67	129.33	5.67	182.3	77.7	2.66	4830
14	DLP-01	104	108.67	4.67	132.7	48	2	1776
15	DLP-14	106.67	112.33	5.67	144	56	2.33	2928
16	HML-Pop	108.67	114	5.33	146.3	62	2.33	2883
17	JML-27	112	116	4	150	62	2	2882
18	JML-30	109.67	114.33	4.67	152.7	58	2	3338
19	JML-32	109.67	115.33	5.67	126.7	46.7	2.16	2899
20	JML-Pop	120.67	125	4.33	121.7	60	2.16	2975
21	KKT-02	134.67	140	5.33	139.7	65	1.83	2941
22	DLP-16	108.67	113.67	5	144	57	2.16	2784
23	DLP-Pop	104	108.67	4.67	127.7	64	2.16	3071
24	HML-04	103.33	108.67	5.33	118.7	39	1.66	2184
25	HML-08	109	114.33	5.33	123.7	50.3	2.5	2708
26	HML-28	104.67	109.67	5	131.7	50.3	2.83	2168
	Grand Mean	114.21	119.36	5.15	138.8	58.4	2.2	3053
	CV,%	7.6	7.3	24.5	14.1	23.5	12.3	28.2
	LSD0.05	14.24	14.28	2.06	32.07	22.52	0.445	1412.6
	F-test	**	**	ns	*	ns	**	*

*ns = non-significant at 5% level of significance, * = Significant at 5% level of significance, ** = significant at 1% level of significance*

The genotypes were found significant (P< 0.05) for grain yield. These results are in line with those of Kunwar and Shrestha (2014), Shrestha (2016) and Prasai et al. (2015) who reported significant differences among maize cultivars for grain yield.Other traits namely disease score, days to 50% tasseling and silking were highly significant (P< 0.01) where as plant height significant and ear height and ASI were non significant. Difference in days to tasseling and silking among maize genotypes were also observed by Prasai et al. (2014), Dhakal et al. (2017) and Kunwar et al. (2014).

Result of combined analysis over year showed that there was highly significant (P< 0.01) influence of genotypes on days to tasseling and days to silking. Hussain et al. (2011) reported differential pattern of maize varieties for plant height. Ear height was significant for genotypes that results get sufficient validation from the findings of Nazir et al. (2010) and

Ahmad et al. (2011). Grain yield was significant and this results was similar to the results were reported by Akbar et al. (2009) who evaluated and identified high yielding maize varieties among different genotypes tested.

The reason for differences in grain yield among the maize genotypes under different locations was due to their variation in their genetic makeup. The grain yield of maize is the most important and complex quantitative character controlled by numerous genes. The gain yield of maize under different environment conditions may be due to both environmental and genetic effect. Different researchers have reported significant amount of variability in different maize populations including top-crosses and open pollinated varieties (Sampoux et al., 1989). These results are in line with those of Grzesiak (2001), who also observed considerable genotypic variability among various maize genotypes under different location.

Conclusions

The study showed variation for almost all the traits studied among the maize genotypes, which is an indication of the presence of sufficient variability and can be exploited through selection. The highest grain yield was one of the basic criteria for identifying superior varieties. The genotypes KKT-POP, KKT-03, KKT-14, MGU-08, Ganesh-1, Karnali Pool White and Karnali Pool Yellow were found superior in their grain yield potentiality in Jumla district. So these maize genotypes were found suitable genotypes for Karnali zone of Nepal.

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