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Grain Yield Evaluation of Maize Genotypes at Different Planting Dates

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Abstract

The genotypic yield potential of maize is influenced by planting dates. A study was conducted in Rampur, Chitwan, Nepal, in 2013/14 to determine the best planting dates for maize genotypes. Every week from April, 2013 to March, 2014, four maize genotypes viz Hybrid RML-4/RML-17, RML-32/RML-17, ACROSS-9944/ACROSS-9942, and S99TLYQ-B were planted. The maximum grain production (5565 kg/ha) was recorded in August, followed by February (5266 kg/ha), June (4475 kg/ha), and July (4255 kg/ha). The lowest yield was obtained in November planting (2572 kg/ha) followed by December planting (3019 kg/ha). During August planting, the maximum grain yields were obtained in RML-4/RML-17 (7392 kg/ha) followed by RML-32/RML17 (6606 kg/ha) and ACROSS-9944/ACROSS-9942 (5004 kg/ha). The QPM genotype S99TLYQ-B produced the highest grain yield (4198 kg/ha) in February planting. Maize grown in the winter had a larger yield potentiality than maize grown in the rainy season. This study suggests that RML-4/RML-17, RML-32/RML17, and ACROSS-9944/ACROSS-9942 should be planted in August (winter season) and S99TLYQ-B in February (spring season) for maximizing production.

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Keyword
Grain yield, Maize, Planting dates and Varieties.

Introduction

Maize is Nepal's the second most important cereal crop in terms of both area and productivity. Maize cultivation has an area of 8.49 million ha, and a productivity of 2.3 t/ha (MoAD, 2013). It accounts for around 25% of overall cereal production, 6.54% of AGDP, and 3.15% of GDP (MoAD, 2013). Hills account for 70.23% of maize area, followed by Terai (19.32%), and mountain (10.45%) (MoAC, 2009/10). Almost all of the maize grown in the mid hills (1.3 million mt) and high hills (0.18 million mt) is consumed by humans, with just a small percentage being fed to animals. However, poultry and animal feeds account for more than 80% of Terai production (0.38 million mt), while the remaining 20% is used for industrial (10%) and human use (10%). (NMRP, 2011). It is farmed on 875660 hectares of land, with an average yield of 2.119 t/ha (MoAC, 2009/10), which is quite low when compared to neighboring nations' yields. Because there is a chance that unfavorable climatic circumstances will develop after planting or during the growth season, either early or late planting can result in reduced yield. As a result, determining the best sowing dates for maize types is critical for increased crop production. Nepal is a small country with a wide range of natural environments. Weather conditions change dramatically throughout the year. Maize must be cultivated from ideal sowing dates in order to utilize moisture, nutrients, and sun radiation. The planting date of maize has an impact on plant population, plant development, the time it takes for reproductive organs to develop, pollination, and harvest, hence choosing the right planting time for maize cultivation is critical to its success. It had been claimed that delaying sowing till the end of October reduced maize grain output (McCormick, 1971). Tanaka and Hara (1974) in India found that when sowing was postponed till the end of October, the 1000 seed weight was reduced, resulting in a variance in maize grain production. In Nepal, very little research has been done to establish the best sowing dates for maize genotypes. Therefore, this study was carried out to identify the best planting dates for maize genotypes in the Terai region of Nepal.

Materials and Methods

Plant materials

The maize genotypes used in this study were S99TLYQ-B, RML4/RML17, RML32/RML17, and ACROSS-9944/ACROSS-9942. All these genotypes were received from National Maize Research Program, Rampur, Chitwan, Nepal.

Experimental Site

The experiment site has a subtropical climate and is located at 27o40'N latitude, 84o19' E longitude, and 228 masl height. Maize was grown on a sandy silt loam with a pH of 5.0, a medium total nitrogen concentration (0.130%), a high soil accessible phosphorous (279 kg/ha), a high soil available potassium (215 kg/ha), and a high organic matter content (2.70%) (NMRP, 2012).

Climatic Observation

Table 1 shows the meterological data for temperature, rainfall, and relative humidity during the crop growth season.

Table 1. Meterological data at Rampur, Chitwan, Nepal during 2013-2014.

Month	Mean temperature (^{0}C)			Total Rainfall (mm)	Relative Humidity (%)
	Maximum	Minimum	Average		
April (2013)	34.6	16.0	25.3	34.2	87.1
May	35.0	23.9	29.45	375.9	89.2
June	34.2	26.3	30.25	667.5	92.2
July	33.3	33.7	33.5	16.1	93.6
August	23.6	28.0	25.8	7.5	88.6
September	30.06	29.30	29.68	13.0	79.90
October	27.33	26.21	26.77	0.4	77.76
November	21.73	20.17	20.95	0.0	72.08
December	17.40	16.66	17.03	0.0	73.85
January (2014)	18.53	16.19	17.36	0.3	70.88
February	18.95	16.97	17.96	5.2	68.78
March	21.93	20.91	21.42	3.4	66.66

(NMRP, 2014)

Experimental Design and Crop Husbandry

The trial was planted in 2013/14 at Rampur, Chitwan, Nepal. From the second week of April, 2013 to the last week of March, 2014, four genotypes, S99TLYQ-B RML4/RML17, RML32/RML17, and ACROSS-9944/ACROSS-9942, were planted in every week. The design was randomized complete block design with four replications (weeks as replication). The planting was repeated four times at seven-days intervals each month. Two to three seeds were sowed at 75 cm row to row and 25 cm plant to plant spacing, and after two weeks, one plant/hill was thinned. The plot size was 2 rows of 5 meters (1.5 m × 5 m), with the entire plot being used to determine the final harvest. Each trial used fertilizer @ FYM 10 t/ha and 120:60:40 kg NPK/ha. The other half of the nitrogen was divided into two halves and applied at 20-24 and 40-45 days after sowing as a basal dose, with the entire dose of phosphorous and potash applied at the time of final field preparation. Weeding and irrigation were carried out according to the guidelines provided by National Maize Research Program, Rampur, Chitwan, Nepal. 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).

Data Analysis

All collected data were entered in Microsoft Excel 2010 and analyzed by using MSTAT-C. 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. Upon significant F-test results, means were compared using Least Significant Difference test (Steel and Torrie, 1980).

Results and Discussion

The effect of genotypes and planting dates on yield was found to be highly significant (Table 2). RML-32/RML-17 produced the highest grain yield (4846 kg/ha), followed by RML-4/RML-17 (4837 kg/ha).The grain yield of S99TLYQ-B was the lowest (2979 kg/ha). August planting had the highest grain yield production (5565 kg/ha), followed by February (5266 kg/ha), June (4475 kg/ha), and July plantings (4255 kg/ha). The lowest yield (2572 kg/ha) was obtained in November planting, followed by the highest yield (3019 kg/ha) in December planting. The maize grain yield was as a function of genotypes and sowing dates. The genotypes were found highly significant ($P< 0.01$) for grain yield. Differences in ear length, rows per ear, and grains per row, as well as grain size, caused differences in variety for grains (Ali et al., 2015). The similar result was reported by Akbar et al. (2009) who evaluated, found variation among maize varieties, and identified high yielding maize varieties. Different researchers have reported significant amount of variability in different maize populations including top-crosses and open pollinated varieties (Sampoux et al., 1989). Grzesiak (2001) also observed considerable genotypic variability among various maize genotypes. The coefficient of variation (CV) for grain yield was observed high (28.7%), the higher CV indicated that there was a higher influence of environments in the expression of character i.e., grain yield.

The grain yield varied with sowing dates. Optimum sowing date resulted in higher grain yield than early and late planting dates (Otegui et al. 1995). The highest yield was found when maize varieties were sown in August (Lal, 1973; Saberi, 2014). Maize grown in the winter has a larger yield potential than maize grown in the rainy season. Insects, diseases, and weeds are not a serious problem throughout the winter, but parrots are a nuisance during the maturity period. During the winter season, the crop receives more sunlight, has a higher rate of photosynthesis, and assimilates more nutrients. In the winter, fertilizer use efficiency is higher. During the winter season, these conditions contribute to increased grain production. The impacts of planting dates and genotypes on each other were found to be highly significant (Table 3). The highest grain yields were found in RML-4/RML-17 (7392 kg) followed by RML-32/RML17 (6606 kg/ha) and ACROSS-9944/ACROSS-9942 (5004 kg/ha) in February planting. The genotype S99TLYQ-B (2084 kg/ha) produced the lowest yield when planted in November. In our study maize genotypes responded differently with planting dates for grain yield. Similar results were reported by Lauer et al. (1999), Graybill et al. (1991) and Fairey (1980). 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 sowing dates might cause different environmental conditions from emergence to seed filling (Dahmardeh, 2012).

Table 2. Effect of different genotypes and date of planting on grain yield of maize (kg/ha) at Rampur, Chitwan, during 2013/14.

SN	Factors	Levels	Grain yield (kg/ha)
1	Genotypes	1. S99TLYQ-B	2979
		2. RML-4/RML-17	4837
		3. RML32/RML-17	4846
		4. ACROSS-9944/ ACROSS 9942	3029
F-test		**	
2	Dates of planting	1. April (Baisakh)	3913
		2. May (Jesth)	3370
		3. June (Aasad)	4475
		4. July (Shrawan)	4255
		5. August (Bhadra)	5565
		6. September (Aswin)	3559
		7. October (Kartik)	3954
		8. November (Mangsir)	2572
		9. December (Paush)	3019
		10. January (Magh)	3238
		11. February (Falgun)	5266
		12. March (Chaitra)	3889
Grand mean		3923	

F test	**
LSD (0.05)	2234.1
CV (%)	28.7

** Significant at the 0.01 probability level

Table 3. Interaction effect of different genotypes and date of planting (month) on grain yield (kg/ha) of maize at Rampur, Chitwan during 2013/14.

Sowing Months	Genotypes			
	RML-4/RML-17	**RML-32/RML-17**	**ACROSS-9944/ ACROSS-9942**	**S99TLYQ-B**
1. April (Baisakh)	5225	4843	2624	3353
2. May (Jesth)	3897	4174	2057	3353
3. June (Aasad)	6894	5784	2314	2907
4. July (Shrawan)	5541	4934	3375	3169
5. August (Bhadra)	7392	6606	5004	3258
6. September (Aswin)	3219	3483	3792	3741
7. October (Kartik)	3554	5690	4186	2388
8. November (Mangsir)	2775	3177	2252	2084
9. December (Paush)	3722	3653	2396	2305
10. January (Magh)	4217	3897	2252	2584
11. February (Falgun)	6649	6520	3698	4198
12. March (Chaitra)	4963	5384	2400	2809
Mean	4837	4846	3029	2979
Grand mean	3923			
F test	**			
LSD (0.05)	2234.1			
CV (%)	28.7			

** Significant at the 0.01 probability level

Conclusions

During August planting, the genotypes RML-4/RML-17, RML-32/RML17 and ACROSS-9944/ACROSS-9942 produced the highest grain yields, while QPM genotype S99TLYQ-B produced the highest grain yield in February. Based on the result of this experiment it can be concluded that the higher grain yields in hybrids RML-4/RML-17, RML-32/RML-17, and open pollinated variety ACROSS-9944/ACROSS-9942 can be obtained by planting them in early winter season especially in September and QPM genotype S99TLYQ-B in spring season especially in February at Chitwan condition of Nepal.

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