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Performance of Maize Varieties for Yield and Yield Attributes in Mustang, Nepal

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Abstract

The performance of open pollinated varieties of maize were tested with the local variety in high hills region of Nepal. Six maize varieties were tested in RCB design replicated four times during April-November of 2023 in Mustang, Nepal. Ganesh-2, Local rato, Manakamana-5, Manakamana-6, Ganesh-1 and Lumlepahelo were the six maize varieties used to evaluate the performance of different varieties of maize for yield and yield attributes. pH of research field soil was neutraland texture was sandy loam. Ear and plant height, days to 50% flowering, leaf number, cob diameter and length, grain rows number per cob and grains number per row were recorded from ten sample plants from each plot while stover and grain yield were recorded from the net plot area of 2.4 m2 during research period. The results revealed that Ganesh-1 had significantly taller height of plant at 120 days after sowing also number of leaf below main cob and main cob height from ground level was also more in Ganesh-1. Local ratowas shorter in height and leaf below main cob was also significantly lowest. Days to 50 % tasseling and silking was very early in Local rato while it was very late in Ganesh-1. Cob length and diameter, kernels count per row, stover and grain yield were observed significantly higher in Ganesh-1. In terms of grain yield, Ganesh 1 was followed by Manakamana 6 and Ganesh 2. Almost all parameters were observed lowest in Local rato. Thus, it was concluded that Ganesh-1 showed the better results in terms of yield attribute and yield in the Mustang district of Nepal.

Keywords: Anthesis-silking interval, flowering, Ganesh 1, hill-hills

Introduction

Maize is the third important cereal worldwide after wheat and rice due to its high adaptability and productivity. It was first domesticated by the indigenous people of Mesoamerica. Mexico is known to have a greater diversity of maize varieties (Khan et al., 2019). It is grown in various climates around the world but produces the best yields when grown in mild temperature with enough water (Aldrich et al., 1978).

Maize is usually grown during April-August without irrigation, either as a mono-crop or relay crop together with millet. It is also grown in spring and winter in the river basins, valley, inner-terai and Terai with irrigation. Greater than two-thirds of the maize grown in the high hills andmid is eaten by the farmers themselves. Maize is a traditional crop primarily cultivated in the rain fed up land of the hills. For many maize growers in the hilly regions, maize farming is an integral part of their way of life (Adhikari, 2000). About 70% of the maize is grown in the mid-hills, 20% in the Terai, and 10% in the high-hills (Pathik, 2002). Maize is grown in different areas of Nepal, from the Terai regions to high-hills, covering both the eastern and western parts of the country. However, its production and yield are much lower than what is possible, both globally and in South Asia. In Nepal, maize is grown in 985,565 ha area with3,106,397 Mt production, while in Mustang district the maize crop is grown in area of 67 hectare with 99 Mtproduction and yield of 1.48 mt/ha. (MoALD, 2023).

Maize is used for food, animal feed, fodder, and as raw material in industries. Almost every part of the plant has economic value. Due to the versatile application of maize, it stands out from other cereals crop. Expansion of the poultry and livestock based industry because of the population growth there is increase in the demand of the maize (Tripathi & Shrestha, 2016). Maize makes up 25.4% of the country's total edible food production (MoALD, 2020). Maize comes in two main colors: white and yellow. White maize is preferred for human consumption because it tastes better than yellow maize and also it has high palatability compared to the yellow maize and it is also used as animal feed in the hilly areas of Nepal (Bastola et al., 2021a). Yellow maize is basically used in making poultry feed as it helps improve the color of egg shells(Bastola et al., 2021a), though it is also eaten by people and used for cattle feed. Yellow maize is grown all over Nepal.

A study by Adhikari et al. (2018) found differences in traits such as how long it takes to silk and tassel, plant height, yield attributes, grain yield andhusk cover of cob among fourteen early maize types. Farmers still have limited options for choosing their preferred crop varieties. To spread the use of modern varieties, it's important to explore a variety of crops that fit specific farming needs and respect cultural preferences, considering the diverse conditions across the country (Joshi et al., 2002). Olaoye (2009) highlighted the importance of testing maize varieties in different agro-ecological areas to

assess their ability to adapt, yield potential, and resistance to diseases, in order to identify the best varieties for farmers to grow. Maize productivity is often limited by various factors such as poor seed quality, outdated technology, low soil fertility, imbalanced nutrients, and poor farming practices, low input use, pest and disease infestations, and competition from weeds. Using a genetically improved genotype alongside effective management practices can boost crop yields, leading to higher economic returns for farmers compared to traditional farming methods. Selecting maize varieties adapted to local climates and implementing proper management practices can further improve yields. Maize varieties impact growth characteristics, directly affecting final yields (Olakojo & Iken, 2001), and they differ in nutrient uptake, weed competitiveness, and utilization of solar energy. So, to test the best suitable variety of maize in the Kobang, Mustang district of Nepal this research was conducted.

Materials and Methods

Location of the Experiment

The research was conducted in the research field of Shree Janaadarsha Amarsingh Secondary School, Kobang, Mustang during April to November of 2023. The soil of research field was neutral in pH and textural class is sandy loam. The elevation of the field was 2540 m above sea level.

Experimental Details

To evaluate six varieties of maize randomized complete block design was used which was replicated four times. Four varieties; Ganesh 2, Manakamana 5, Manakamana 6 and Ganesh 1 which was released from Nepal Agricultural Research Council (NARC) were used and two varieties; Local rato and Lumlepahelo which were cultivated by the farmers were used as local check. Individual plot of size 2.4 m × 2 m with 0.5 m distance between two plots and 1 m between replication was maintained. 60 cm × 25 cm planting spacing was maintained among all the plots for planting.

Cultivation Practices

Planting of maize seeds was done in 28th April, 2023 with 2 seeds per hill at the depth of 4-5 cm and thinning operation was carried out at 20 days after sowing maintaining one plant per hill. NPK was applied at the dose of 100:50:40 NPK kg/ha. Full dose of PK and ½ nitrogen dose was applied at planting time and remaining ½ dose of nitrogen applied at 50 DAS. Weeding was done at 30 and 50 DAS and earthing-up was done simultaneously at 50 DAS. As no any severe disease and pest symptoms were seen during the cropping period so no bactericides, fungicides and insecticides were applied. Harvesting of the maize were done during November, 2023.

Data Recorded and Analysis

Ten samples were randomly selected from each experimental plot for measuring plant height from 30 to 120 DAS at an interval of 30 days, number of leaf, main cob height from the ground level were and average value is computed. Days to 50 % flowering was calculated when fifty percent of the total plant in the plots showed the tassel and silk and days from planting was computed for each plots. Cob diameter and length, grain rows number per cob, grains number per rowwere calculated from the average of 5 randomly selected maize cobs at the time of harvesting. Grain and stover yield were measured from the net plot area and yield was converted to t/ha adjusting the moisture at 14 %. All the data thus obtained were averaged through Excel 10 and data was analyzed using R-stat and results were subjected to LSD at 5% significance level for their mean value comparison based on Gomez and Gomez (1984).

Results and Discussion

Plant Height

There is no significant difference in the plant height at upto 90 DAS among different varieties of maize but at 120 DAS significant difference was observed in plant height among different varieties (Table 1). Significantly taller plant height was observed in variety Ganesh 1 (293.2 cm) which was significantly equal with Manakamana 6, Ganesh 2 and Lumlepahelo.

Table 1

Height of maize plant at 30, 60, 90 and 120 days after sowing

Varieties	Plant height (cm)			
	30DAS	60DAS	90DAS	120DAS
Ganesh 2	12.45	42.10	124.50	276.90^{ab}
Local rato	12.27	46.20	123.00	243.00^{c}
Manakamana 5	13.20	41.20	122.75	272.25^{b}
Manakamana 6	13.52	39.67	124.50	283.45^{ab}
Ganesh 1	13.25	43.85	128.50	293.20^{a}
Lumlepahelo	11.55	42.60	121.25	275.20^{ab}
Grand mean	12.04	39.61	115.30	252.52
F-test	NS	NS	NS	***
$LSD_{0.05}$	2.07	6.20	14.65	16.98
CV, %	10.80	9.70	7.80	4.10
SEm (±)	0.69	2.06	4.86	5.63

Note. DAS: Days after sowing, ***: Significant at 0.1% probability, Treatment means with different letter(s) indicates significant at 5% probability level.

Lowest plant height was recorded in Local rato (243 cm). Tripathi and Shrestha (2016), Bastola et al. (2021b) and Hussain and Hassan (2014) also found significant difference in plant height.

Leaf Number Below and Above Main Cob, Main Cob Height from Ground Level and Days to Flowering

Significant difference was observed in leaf number below and above main cob, main cob height from ground level, days to tasseling and silking and anthesis-silking interval among varieties (Table 2). Manakamana 6 (5.5) had highest leaf number above main cob which was statistically similar with Ganesh 2 and Ganesh 1 while lowest number of above main cob was recorded in Local rato (3.55). Highest number of leaf below main cob was seen in Ganesh 1 (10.79) while lowest in Local rato (4.15).Bastola et al. (2021b) also observed significant variation in leaf number below main cob among different varieties of maize. Main cob height from ground level was significantly more in Ganesh 1 (122.3 cm) which was followed by Manakamana 6 (94.4 cm), Lumlepahelo (91.90 cm), Manakamana 5 (85.3 cm), Ganesh 2 (75.55 cm) while significantly less height was observed in Local rato (41.5 cm). Nayaka et al. (2015) and Bastola et al. (2021a) also observed significant variation in the main cob height from ground level among the test varieties.Since the number of leaf below main cob was recorded more Ganesh 1 and lowest in Local rato which cause similar variation in main cob height in ground level. Local rato had faster 50 % tasseling and silking while significantly very late tasseling and silking were seen in Ganesh 1. Vashistha et al. (2013) also observed significant variation among varieties in tasseling days while Akbar et al. (2008) and Tripathi and Shrestha (2016) observed significant variation among varieties for days to silking. Anthesis-silking interval was recorded highest in Local rato (4.25 days) which was similar with Ganesh 1 (3 days) statistically while lowest anthesis-silking interval was seen in Ganesh 2 (1 day). Bastola et al. (2021b) also found significant variation in anthesis-silking interval among different varieties of maize.

Table 2

Number of leaf below and above main cob, main cob height from ground level, days to tasseling and silking and anthesis-silking interval

Varieties	Number of leaf above main cob	Number of leaf below main cob	Main cob height from ground level (cm)	Days to 50 % tasseling	Days to 50 % silking	Anthesis-silking interval (days)
Ganesh 2	5.10^{ab}	7.40^{c}	75.55^{c}	123.00^{c}	124.00^{c}	1.00^{c}
Local rato	3.55^{c}	4.15^{d}	41.50^{d}	94.75^{d}	99.00^{d}	4.25^{a}
Manakamana 5	4.95^{b}	8.60^{b}	85.30^{bc}	128.25^{b}	130.25^{b}	2.00^{bc}
Manakamana 6	5.50^{a}	9.35^{b}	94.80^{b}	130.50^{ab}	132.00^{b}	1.50^{bc}
Ganesh 1	5.00^{ab}	10.79^{a}	122.30^{a}	133.00^{a}	136.00^{a}	3.00^{ab}
Lumlepahelo	4.90^{b}	8.90^{b}	91.90^{b}	129.50^{ab}	131.00^{b}	1.50^{bc}
Grand mean	4.70	7.98	80.97	111.07	112.90	4.58
F-test	***	***	***	***	***	*
$LSD_{0.05}$	0.49	1.04	13.83	3.50	3.61	1.78
CV, %	6.70	8.40	10.80	1.90	1.90	53.5
SEm (±)	0.16	0.34	4.61	1.16	1.19	0.59

Note. *** and *: Significant at 0.1% and 5% probability respectively, Treatment means with different letter(s) indicates significant at 5% probability level.

Yield Attributes of Maize

Significant variation among different varieties was observed in cob diameter, cob length, number of kernel rows per cob and number of kernels per rows (Table 3). Manakamana 6 (4.38 cm) had larger cob diameter which was statistically similar with Ganesh 1, Ganesh 2 and Manakamana 5 while lower cob diameter was seen in Lumlepahelo (3.52 cm). Bastola et al. (2021a) and Maruthi and Rani (2015) and also recorded variation in diameter of cob. Cob length was more in Ganesh 1 (19.55 cm) while lowest was recorded in Local rato (13.3 cm).Bastola et al. (2021b) and Maruthi and Rani (2015) and also recorded variation in length of cob. Similarly, number of kernel rows per cob was observed high in Manakamana 6 (13.93) which was followed by Lumlepahelo (13.67), Ganesh 2 (12.8) and Manakamana 5 (12.58) but lowest was recorded in Local rato (9.75). Sesay et al. (2016) and Khan et al. (2019) also measured significant differences in number of kernel rows per cob. Highest number of kernels per rows was seen in Ganesh 1 (30.8) which was statistically similar with Manakamana 6 (26.71) and Lumlepahelo (26.02) while lowest number of kernels per rows was observed in Local rato (15.55). Singh et al. (2013) and Bastola et al. (2021b)also hadsimilar findings in number of kernels per row.

Table 3

Cob diameter, cob length, number of kernel rows per cob and number of kernels per rows

Varieties	Cob diameter (cm)	Cob length (cm)	Number of kernel rows per cob	Number of kernels per rows
Ganesh 2	4.32^{a}	15.25^{bc}	12.8^{ab}	23.75^{b}
Local rato	4.02^{b}	13.30^{c}	9.75^{c}	15.55^{c}
Manakamana 5	4.16^{ab}	15.59^{bc}	12.58^{ab}	24.07^{b}
Manakamana 6	4.38^{a}	16.92^{b}	13.93^{a}	26.71^{ab}
Ganesh 1	4.36^{a}	19.55^{a}	12.25^{b}	30.80^{a}
Lumlepahelo	3.52^{c}	15.38^{bc}	13.67^{a}	26.02^{ab}
Grand mean	3.96	15.10	11.58	22.94
F-test	***	**	***	***
$LSD_{0.05}$	0.38	2.40	1.26	5.06
CV, %	4.50	10.00	6.70	13.70
SEm (±)	0.09	0.80	0.42	1.68

Note. *** and **: Significant at 0.1% and 1% probability respectively, Treatment means with different letter(s) indicates significant at 5% probability level.

Grain and Stover Yield, Harvest Index and Shelling Percentage

There was significant variation in grain and stover yield, harvest index and shelling percentage among different varieties of maize (Table 4). Highest grain yield was obtained in Ganesh 1 (14.61 t/ha) which was followed by Manakamana 6 (12.09 t/ha), Ganesh 2 (11.44 t/ha), Manakamana 5 (10.58 t/ha), Local rato (9.7 t/ha) and significantly lowest grain yield was recorded in Lumlepahelo (8.89 t/ha). Hussain et al. (2004), Prasai et al. (2015) and Bastola et al. (2021b) also measured significant differences among the maize varieties in grain yield. Highest number of cob diameter, cob length and number of kernels per rows in Ganesh 1 variety cause the highest grain yield than other varieties. Also, stover yield was seen highest in Ganesh 1 (88.83 t/ha) and significantly lowest stover yield was observed in Local rato (22.43 t/ha). But the harvest index was observed highest in Local rato (0.43) while lowest was seen in Ganesh 1 (0.16). Dawadi and Sah (2012) also measured significant variation in stover yield and harvest index in different varieties of maize. The shelling percentage was measured highest in Lumlepahelo (71.25 %) which was statistically similar with Ganesh 2 (71.12 %), Local rato (69.85 %) and Manakamana 6 (66.55 %) and lowest shelling percentage was recorded in Ganesh 1 (61.39 %). Singh et al. (2013) and Bastola et al. (2021b) also had similar findings in the shelling percentage of maize.

Table 4

Grain and stover yield, harvest index and shelling percentage

Varieties	Grain yield (t/ha)	Stover yield (t/ha)	Harvest index	Shelling %
Ganesh 2	11.44^{bc}	35.37^{cd}	0.32^{b}	71.12^{a}
Local rato	9.70^{bc}	22.43^{d}	0.43^{a}	69.85^{ab}
Manakamana 5	10.58^{bc}	52.38^{b}	0.20^{cd}	64.32^{bc}
Manakamana 6	12.09^{b}	52.06^{b}	0.23^{c}	66.55^{abc}
Ganesh 1	14.61^{a}	88.83^{a}	0.16^{d}	61.39^{c}
Lumlepahelo	8.89^{c}	41.17^{bc}	0.22^{cd}	71.25^{a}
Grandmean	11.32	49.5	0.89	61.38
F-test	***	**	***	*
$LSD_{0.05}$	13.85	2.38	0.05	5.71
CV	18.90	14.10	13.30	5.60
SEm (±)	4.60	0.79	0.02	1.89

Note. ***, ** and *: Significant at 0.1%, 1% and 5% probability respectively, Treatment means with different letter(s) indicates significant at 5% probability level.

Conclusion

Among six varieties highest plant height was seen in Ganesh 1 variety at 120 DAS, Also, leaf number below main cob, main cob height from ground level and days to 50 % flowering was measured highest in Ganesh 1 variety. Grain yield and stover yield were also recorded highest in the Ganesh 1. In terms of grain yield Ganesh 1 was followed by Manakamana 6 and Ganesh 2. Based on this research finding Ganesh 1 is found better in Kobang, Mustang area which is located in the high hills region of the Nepal.

Conflict of Interest

There is no conflict of interest regarding the publication of this article.

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