



ISSN: 2521-2931 (Print)
ISSN: 2521-294X (online)

CODEN : MJSAEJ

DOI : <http://doi.org/10.26480/mjsa.02.2018.06.08>



GRAIN YIELD AND YIELD ATTRIBUTING TRAITS OF MAIZE GENOTYPES UNDER DIFFERENT PLANTING DATES

Ashik Bk^{1*}, Jiban Shrestha², Roshan Subedi¹

¹Institute of Agriculture and Animal Science, Lamjung Campus, Lamjung

²National Commercial Agriculture Research Program, Pakhribas, Dhankuta, Nepal

*Corresponding Author Email: ashik.bishwo@gmail.com

This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

ARTICLE DETAILS

Article History:

Received 12 November 2017
Accepted 12 December 2017
Available online 1 January 2018

ABSTRACT

Winter planting of maize in Inner Tarai region of Nepal is affected by planting dates. This experiment was conducted at research field of National Maize Research Program (NMRP) Rampur, Chitwan, Nepal from September to March in 2016 to 2017 to evaluate the yield performance of maize varieties under various planting dates. The experiment was conducted in factorial randomized complete block design (RCBD) with three replications in which eight treatments consisted of different combinations of two maize varieties (S03TEY-FM and RML-95/RML-96) and four planting dates (4th, 14th, and 24th September and 4th October). The results showed that the effect of planting dates on grain yield was highly significant. Similarly, the effect of varieties on grain yield was significant. Moreover, the interaction effect of them was significant. The earlier planting of maize varieties (September 4) produced the higher grain yield than later planting (October 4). Therefore, maize varieties should be planted in early September during winter season for achieving higher production.

KEYWORDS

Planting dates, maize varieties, grain yield

1. INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crops grown during the summer season in Nepal. It is the second most important staple crops after rice both in terms of area and production. Its area, production, and productivity in Nepal are 882395 ha, 2145291 t, and 2431 kg respectively [1]. Maize occupies about 40.6% area of the total food crops in the hills and 26.05% in the country. It shares about 23.15% of total edible food production in Nepal [1]. The overall demand for maize driven by increased demand for human consumption and livestock feed is expected to grow by 4% to 6 % per year over the next 20 years [2].

In recent years, the hybrid maize has been scaled up in the valleys and low hills of different parts of the country. Commercialization of hybrid maize production in the high input supply areas is strongly demanded and that would provide greater contribution to national economic growth [3]. Therefore, to cope the demand for feeds by various feed industries located in tarai and inner tarai and to insure the food security in the hills of Nepal, increased in maize production per unit area through the adoption of hybrid cultivars is only the viable option. So it is necessary to access the performance of hybrid varieties in this climatic scenario with intervention of best planting and suitable maize variety for higher yields.

In the tarai, valleys and low-lying river basin areas (both Bari and Khet lands), maize is grown in the winter and spring seasons with partial irrigation [3]. It had been reported that maize grain yield was reduced when sowing was delayed ending of October [4]. In Nepal very, little work was done on the effect of sowing date and varieties on the performance of maize. A researcher reported that sowing date had a significant effect on grain yield of maize and, October 1 seeding out yielded November 1 and December 1 seeding by 36.5 and 53.0 %, respectively [5]. However, the cultivar varied significantly in their yield potential.

Therefore, present works was carried out to study the effect of sowing date and cultivar on grain yield of maize. Here two variety of maize namely, one RML-95/ RML-96 (hybrid) and the other OPVs S03TEY-FM and four planting date with 10 days of intervals starting from September 4, 2016 to October 4, 2016 were used for the experiment.

2. MATERIALS AND METHODS

2.1 Description of experimental site

The experiment was conducted at research field of National Maize Research Program, Rampur, Chitwan, Nepal during winter season of the year 2016. Maize was sown on sandy silt loam, strongly acidic soil (pH 5.0), medium in total nitrogen (0.130%), high in soil available phosphorous (279 kg/ha), high in soil available potassium (215 kg/ha) and high in organic matter content (2.70%) (NMRP, 2012). The geographical location of the experiment site was located at 27°04'N latitude, 84°19' E and 228 masl and has sub tropical climate. The climatic parameters taken during crop growing period was shown as below table.

Table 1: Meteorological data during the crop growing period at Rampur, Chitwan, Nepal, 2016-

| Months | Mean daily temperature (°C) | | | Total Rainfall (mm) |
|------------------|-----------------------------|---------|---------|---------------------|
| | Maximum | Minimum | Average | |
| September (2016) | 32.32 | 24.89 | 28.60 | 631.40 |
| October | 31.82 | 21.25 | 26.54 | 42.70 |
| November | 28.58 | 13.71 | 21.14 | 0.00 |
| December | 23.81 | 10.15 | 16.98 | 0.00 |
| January (2017) | 23.98 | 7.86 | 7.86 | 13.80 |
| February | 26.88 | 12.47 | 19.67 | 3.40 |
| March | 29.49 | 16.64 | 23.06 | 64.50 |
| April | 33.44 | 21.52 | 27.48 | 77.60 |

2.2 Experimental design and cultural practices

Two genotypes namely S03TEY-FM, and RML-95/RML-96 were sown in every 10 days of interval from September 4 to October 4 of 2016. The design was randomized complete block design replicated three times with each four sowing dates. In each planting; it was replicated 3 times at ten days intervals. Spacing 60 cm row to row and 25 cm plant to plant spacing was maintained and two to three seeds are sown and after two weeks thinned one plants/hill. Plot size was 2 rows of 5 meter (1.2 m × 5.0 m) during 2016 in which, whole plot was used to assess final harvest. Fertilizer @ FYM 10 t/ha and 120:60:40 kg NPK kg/ha was applied for each experiment. Half dose of nitrogen and full dose of phosphorous and potash was applied as basal dose at the time of final land preparation

and remaining half of nitrogen was divided into two; one part applied at 20-24 and 40-45 days after sowing. Weeding and irrigation was done as per recommendations. The details of treatments used in the experiment was shown as below table;

Table 2: Treatments combination of experiment conducted at NMRP, Rampur, Winter, 2016

| Treatments | Planting date and Variety |
|------------|------------------------------|
| T1 | September-4+ RML-95/RML-96 |
| T2 | September-4+ S03TEY-FM |
| T3 | September-14 + RML-95/RML-96 |
| T4 | September-14 + S03TEY-FM |
| T5 | September-24 + RML-95/RML-96 |
| T6 | September-24 + S03TEY-FM |
| T7 | October-4+ RML-95/RML-96 |
| T8 | October-4+ S03TEY-FM |

2.3 Field measurements

Data of various yield attributes were recorded. Yield attributing characters such as; number of harvested ears, ear length and cob diameter, number of kernels per ear, thousand grain weight (TGW) or test weight, grain yield, were recorded. Grain yield (kg/ha) at 15% moisture content was calculated using formula adopted by a group researcher [6,7].

2.4 Statistical analysis

The statistical analysis of data's were done using computer software MSTATC version 1.3 applying 5% level of significance.

3. RESULTS AND DISCUSSION

Determination of sowing dates for maize varieties is very crucial for better crop yield. Grain yield of maize influenced by varieties and planting dates. Cob diameter has highly significant and no. of grain per cob was found significant and other trait showed non-significant result for variety. Whereas, in planting days, highly significant results were found for cob length and cob diameter, and significant result were observed for no of grains/per cob, no. of rows per cob, test weight but non-significant for no of ears per plot. Along with varieties, winter maize has higher production potential than the rainy season maize. Pests like insects, diseases, weeds are not problem during winter season but sometimes parrot is a problem during maturity period. Crop receives longer sunshine duration, higher rate of photosynthesis and assimilates utilization occurs during winter season. Fertilizer use efficiency is higher in winter season. These factors contribute higher production during winter season.

3.1 Yield attributing characters

Yield attributing characters such as; number of harvested ears, ear length and cob diameter, number of kernels per ear, thousand grain weight (TGW) or test weight, grain moisture content (%), grain yield, were recorded

Table 3: Mean effects of planting date, and varieties on No. of ears per hectare, Cob length, Cob diameter, NO. of grain/cob, no. of rows/cob and Test weight at NMRP Rampur, during winter season, 2016/17

| Treatments | No. ears/ha | Cob length (cm) | Cob diameter (cm) | No. grains/cob | No. of rows/cob | 1000 grain weight (g) |
|--|-------------|-----------------|-------------------|----------------|-----------------|-----------------------|
| Varities | | | | | | |
| S03TEY-FM | 58889 | 13.13 | 4.198 | 382.0 | 13.13 | 281.0 |
| RML95/RML96 | 65000 | 13.57 | 4.485 | 423.6 | 13.87 | 335.2 |
| F-test (<0.01) | 0.035 | 0.243 | 0.001 | 0.030 | 0.054 | 0.001 |
| LSD _{0.05} | 5597.9 | 0.766 | 0.1561 | 37.12 | 0.782 | 29.57 |
| Planting dates | | | | | | |
| Sept 4, 2016 | 63611 | 14.32 | 4.573 | 428.2 | 13.60 | 330.3 |
| Sept 14, 2016 | 65556 | 12.08 | 4.183 | 368.1 | 13.03 | 329.0 |
| Sept 24, 2016 | 55278 | 13.70 | 4.463 | 386.0 | 12.87 | 301.7 |
| Oct 4, 2016 | 63333 | 13.30 | 4.147 | 428.9 | 14.50 | 271.5 |
| F-test (<0.01) | 0.064 | 0.004 | 0.002 | 0.058 | 0.027 | 0.029 |
| LSD _{0.05} | 7916.7 | 1.084 | 0.2207 | 52.50 | 1.106 | 41.82 |
| Interaction (Varities × planting dates) | | | | | | |
| Grand Mean | 61944 | 13.35 | 4.342 | 402.8 | 13.50 | 308.1 |
| F-test (<0.01) | 0.093 | 0.027 | 0.093 | 0.029 | 0.133 | 0.944 |
| LSD _{0.05} | 11195.8 | 1.532 | 0.3121 | 74.24 | 1.564 | 59.14 |
| CV% | 10.3 | 6.6 | 4.2 | 10.6 | 6.7 | 11.0 |

3.2 Number of harvested ears

The effect of planting date and all their interaction effects on Number of ears / ha were found non-significant. Only the effect of genotypes was found significant different on the No. of ears/ha. Higher no of ears/ha was found in RML95/RML96 (65000 ears/ha) followed by S03TEY-FM 58889

ears/ha.

Table 4: Interaction result of Variety and Planting Date on No of ear/ha at NMRP, Rampur during winter season 2016

| Varieties | Planting Dates | | | |
|-------------|----------------|---------------|---------------|-------------|
| | Sept 4, 2016 | Sept 14, 2016 | Sept 24, 2016 | Oct 4, 2016 |
| S03TEY-FM | 56111 | 60000 | 54444 | 65000 |
| RML95/RML96 | 71111. | 71111 | 56111 | 61667 |

3.3 Ear length

The effect of variety found non-significant result, but the planting date and their interaction were significant for ear length. The variety RML-95/RML-96 had longer ear length (15.25 cm) in September 4 planting followed by the variety S03TEY-FM in September planting (13.93 cm). The variety S03TEY-FM has shortest cob length (11.4 cm) in September 14 planting.

Table 5: Interaction result of Variety and Planting Date on Cob length at NMRP, Rampur during winter season 2016.

| Varieties | Planting Dates | | | |
|-------------|----------------|---------------|---------------|-------------|
| | Sept 4, 2016 | Sept 14, 2016 | Sept 24, 2016 | Oct 4, 2016 |
| S03TEY-FM | 13.39 | 11.40 | 13.81 | 13.93 |
| RML95/RML96 | 15.25 | 12.77 | 13.60 | 12.67 |

3.4 Ear diameter

The effects of variety and planting date individually were found highly significant and the interactions effect was non-significant result. Variety RML-95/RML-96 has more diameters (4.80 cm) in September 4 planting followed by September 24 planting (4.40 cm).

Table 6: Interaction result of Variety and Planting Date on Cob diameter at NMRP, Rampur during winter season 2016

| Varieties | Planting Dates | | | |
|-------------|----------------|---------------|---------------|-------------|
| | Sept 4, 2016 | Sept 14, 2016 | Sept 24, 2016 | Oct 4, 2016 |
| S03TEY-FM | 4.347 | 3.967 | 4.307 | 4.173 |
| RML95/RML96 | 4.800 | 4.400 | 4.620 | 4.120 |

3.5 No of row/cob

The effects of variety and planting date individually were found significant. These results are in agreement with findings of who observed significant effect of sowing dates on number of rows/ ear [8]. Variety S03TEY-FM has more number of rows per cob (14.87) in October 4 planting followed by RML-95/RML-96(14.27) in September 4 planting and 14.13 in October 4 planting.

Table 7: Interaction result of Variety and Planting Date on No of row/cob at NMRP, Rampur during winter season 2016

| Varieties | Planting Dates | | | |
|-------------|----------------|---------------|---------------|-------------|
| | Sept 4, 2016 | Sept 14, 2016 | Sept 24, 2016 | Oct 4, 2016 |
| S03TEY-FM | 12.93 | 12.73 | 12.00 | 14.87 |
| RML95/RML96 | 14.27 | 13.33 | 13.73 | 14.13 |

3.6 Number of kernels (grains) per ear

The effect of variety, planting date and their interactions on the no. of grains /ear was significantly different. Here, the no. of grain per ear was higher (487.5 grains) of Variety RML-95/RML-96 in September 4, 2016 planting followed by the variety S03TEY-FM in October 4, 2016 (453.0 grains). The lowest no. of grains/cob was observed from the variety S03TEY-FM (349.3 grains) in September 14 planting. The effect of variety, planting date and their interactions results on the no. of grains /ear was significantly different. Here, the no. of grain per ear was higher (487.5 grains) of Variety RML-95/RML-96 in September 4, 2016 planting followed by the variety S03TEY-FM in October 4, 2016 (453.0 grains)

Table 8: Interaction result of Variety and Planting Date on No of grain/cob at NMRP, Rampur during winter season 2016

| Varieties | Planting Dates | | | |
|-------------|----------------|---------------|---------------|-------------|
| | Sept 4, 2016 | Sept 14, 2016 | Sept 24, 2016 | Oct 4, 2016 |
| S03TEY-FM | 369.0 | 349.3 | 356.5 | 453.0 |
| RML95/RML96 | 487.5 | 386.8 | 415.4 | 404.7 |

3.7 Thousand Grains Weight (TGW) or Test weight

The effects of genotype were highly significant, planting dates were significant and their interactions on 1000 grain weight were non-significant differences. The variety RML-95/RML- 96 has the highest 1000 gains weight (361.3 g) in September 4 planting followed by September 14 planting (351.7 g). The lowest 1000 grain weight was recorded from the

variety S03TEY-FM (248.3 g) in October 4 planting.

Table 9: Interaction result of Variety and Planting Date on 1000 grain weight in g (Testwt) at NMRP, Rampur during winter season 2016.

| Varieties | Planting Dates | | | |
|-------------|----------------|--------------|--------------|------------|
| | Sept 4,2016 | Sept 14,2016 | Sept 24,2016 | Oct 4,2016 |
| S03TEY-FM | 299.3 | 306.3 | 270.0 | 248.3 |
| RML95/RML96 | 361.3 | 351.7 | 333.3 | 294.7 |

The effects of genotype were highly significant, planting dates were significant and their interactions on 1000 grain weight were non-significant differences. The variety RML-95/RML-96 has the highest 1000 gains weight (361.3 g) in September 4 planting followed by September 14 planting (351.7 g). The lowest 1000 grain weight was recorded from the variety S03TEY-FM (248.3 g) in October 4 planting.

3.8 Grain yield

Grain yield is determined by the yield attributes of crop. Grain yield is a function of various Combined result of two variety and four sowing date showed that the effects of date of sowing was highly significant and varieties on grain yield individually were significant and the Interaction effects of them were also found significant. The hybrid variety RML-95/RML-96 produced the highest grain yield (8433kg/ha) in September 4, 2016 planting followed by 7486 kg/ha in September 14 and 6337 kg/ha in September, 24 planting. The variety S03TEY-FM also produced more grain yield in October 4 planting (6012 kg/ha) followed by 5346 kg/ha in September 14 planting respectively. The lowest yield was produced by the genotype S03TEY-FM (4830 kg/ha) in September 24, planting.

Table 10: Mean effect of planting date, and varieties on grain yield kg/ha at NMRP Rampur, during winter season, 2016.

| Treatments | GrainYield (kg/ha) |
|---|--------------------|
| Varieties | |
| S03TEY-FM | 5055 |
| RML95/RML96 | 7116 |
| Mean | |
| F-test(<0.01) | <.001 |
| LSD _{0.05} | 420.8 |
| Planting dates | |
| Sept 4,2016 | 6903. |
| Sept 14,2016 | 6416. |
| Sept 24,2016 | 5504. |
| Oct 4,2016 | 5519. |
| Mean | |
| F-test (<0.01) | <.001 |
| LSD _{0.05} | 595.1 |
| Interaction (Varieties × planting dates) | |
| Grand Mean | 6085 |
| F-test (<0.01) | 0.043 |
| LSD _{0.05} | 841.5 |
| CV% | 7.9 |

Table 11: Interaction result of Variety and Planting Date on grain yield at NMRP, Rampur during winter season 2016

| Varieties | Planting Dates | | | |
|-------------|----------------|--------------|--------------|------------|
| | Sept 4,2016 | Sept 14,2016 | Sept 24,2016 | Oct 4,2016 |
| S03TEY-FM | 5372 | 5346 | 4671 | 4830 |
| RML95/RML96 | 8433 | 7486 | 6337 | 6207 |

The hybrid variety RML-95/RML-96 produced the highest grain yield (8433kg/ha) in September 4, 2016 planting followed by 7486 kg/ha in September 14 and 6337 kg/ha in September, 24 planting. The variety S03TEY-FM also produced more grain yield in October 4 planting (6012 kg/ha) followed by 5346 kg/ha in September 14 planting respectively. The lowest yield was produced by the genotype S03TEY-FM (4830 kg/ha) in September 24, planting. A researcher reported that grain yield of maize was affected by genotypes and date of planting at Rampur Chitwan Nepal [9]. Lesser grain August was due to less population because a lot of plants were lodged due to the rainy season in month of August. Optimum sowing date resulted in higher grain yield than early and late planting dates [10]. The result is in confirmation with a large group of researchers who reported that grain yield was reduced by delay in sowing [11-15].

4. CONCLUSION

Among the different planting date in winter season starting from September 4 to October 4, 2016 with 10 days of interval, the RML-95/RML

-96 hybrid and S03TEY-FM OPV maize varieties produced higher grain yield during first week of September planting in Inner Tarai region of Nepal. Therefore, maize varieties should be planted in early September to achieve the higher grain yield.

REFERENCES

- [1] MoAD. 2016. Statistical information on Nepalese agriculture, 2015/2016 (2072/2073). Agribusiness Promotion and Statistics Division, Singha Durbar, Kathmandu, Nepal.
- [2] Paudyal, K.R., Ransom, J.K. 2001. Resource use efficiency and effective incentives of Nepalese maize farmers. In: N. P. Rajbhandari, J. K. Ransom, K. Adhikari and A. E. F. Palmer (eds.) Sustainable Maize Production System for Nepal. Proceedings of a maize Symposium, December 3-5, 239-245.
- [3] Pathik, D.S. 2002. Maize research achievements and constraints. In: Rajbhandari, N.P., J.K. Ransom, K. Adhikari and A.F.E. Palmer (eds.) Sustainable maize production systems for Nepal: Proceedings of a maize symposium held, December 3-5, 7-12. Kathmandu, Nepal. Kathmandu: NARC and CIMMYT.
- [4] McCormick, S.J. 1971. The effect of sowing date on maize (*Zea mays* L.) development and yields of silage and grain. Proceedings of the Agronomy Society of New Zealand, 1, 51-65.
- [5] Rahman, A.M., Magbou, E.L., Abdelatif, E.N. 2004. Effects of sowing date and cultivar on the yield and yield components of maize in Northern Sudan. Seventh Eastern and Southern Africa Regional Maize Conference, Hudeiba Research Station
- [6] Carangal, V.R., Ali, S.M., Koble, A.F., Rinke, E.H., Sentz, J.C. 1971. Comparison of S1 with testcross evaluation for recurrent selection in maize. Crop Science, 11, 658-661. DOI: 10.2135/cropsci1971.0011183X001100050016x
- [7] Shrestha, J., Koirala, K., Katuwal, R., Dhami, N., Pokhrel, B., Ghimire, B., Prasai, H., Paudel, A., Pokhrel, K., KC, G. 2015. Performance evaluation of quality protein maize genotypes across various maize production agro ecologies of Nepal. Journal of Maize Research and Development, 1 (1), 21-27. DOI: <http://dx.doi.org/10.5281/zenodo.34282>
- [8] Hassan, K.H. 1998. Response of some maize cultivars to early planting dates under saline condition at siwa oasis. Annals of Agricultural Sciences Cairo, 43, 391-401.
- [9] Bahadur, B.K.S., Karki, T.B., Shrestha, J., Adhikari, P. 2015. Productivity of maize genotypes under different planting dates. Our Nature, 13 (1), 45-49. DOI: <http://dx.doi.org/10.3126/on.v13i1.14208>
- [10] Otegui, M.E., Nicolini, M.G., Ruiz, R.A., Dodds, P.A. 1995. Sowing date effects on grain yield components for different maize genotypes. Agronomy Journal, 87, 29-33.
- [11] Jaliya, M.M., Falaki, A.M., Mahmud, M., Sani, Y.A. 2008. Effect of sowing date and NPK fertilizer rate on yield and yield components of quality protein maize (*Zea mays* L.). ARPN Journal of Agricultural and Biological Science, 3 (2), 23-29.
- [12] Namakka, A., Abubakar, I.U., Sadik, A.I., Sharifai, A.I., Hassas, A.H. 2008. Effect of sowing date and Nitrogen level on yield and yield components of two extra early maize varieties (*Zea mays* L.) in Sudan Savanna of Nigeria. ARPN Journal of Agricultural and Biological Science, 3 (2), 01-05.
- [13] Aziz, A., Rahman, H., Khan, N. 2007. Maize cultivar response to population density and planting dates for grain and biomass yield. Sarhad Journal of Agriculture, 23 (1), 25-30.
- [14] Khan, H., Arif, M., Gul, R., Ahmad, N., Khan, I.A. 2002. Effect of sowing dates on maize cultivars. Sarhad Journal of Agriculture, 18 (1), 11-15.
- [15] Zaki, M.S., Shah, P., Hayat, S. 1994. Effect of sowing date on maize and non-flooded land rice. Sarhad Journal of Agriculture, 10 (2), 191-199.