Acta Scientific AGRICULTURE (ISSN: 2581-365X)

Volume 7 Issue 1 January 2023

Research Article

Sowing Variability Measurement of Maize Hybrids and Observation of Physiological Changes from Supplement Different Rate of Nitrogen

Ram Prakash Srivastava[1] Saket Kumar[2]*, Avinash Verma[3], Sagar Kumar[1] and Rajesh Singh[4]

[1]Department of Agriculture, Chandigarh School of Business Jhanjeri Mohali Punja, India

[2]Department of Environment and Sustainable Development, IESD, BHU Varanasi, India

[3]Assistant Professor, Quantam University Roorkee Uttrakhand India

[4]Department of Genetics and Plant Breeding, IAS BHU Varanasi, India

***Corresponding Author:** Saket Kumar, Department of Environment and Sustainable Development, IESD, BHU Varanasi, India.

Received: July 28, 2022

Published: December 15, 2022

Abstract

The field experiment was conduct with factorial arrangement in RBD with three replications. In this experiment observed large-scale adoption of eight maize inbred lines in single environment at Agricultural field BHU Varanasi during Kharif (Rainy) season 2015. Four sowing dates were designed as a main plot and 4 level of N (0, 60, 120 and 170 kg/ha) applied in selected sub plot. The different sowing date expressed significant effect in maize hybrid grain yield, number of kernels per row, number of kernels per ear, 1000-grain weight, biomass, harvest index and plant height to sheath. The highest grain yield of maize inbred lines were observed with June 29 ranged 10683-11843 (kg/ha) during Kharif season 2015. N application was significantly affected on different traits expect number of kernels per row and number of kernels per ear. The recorded grain yield was 10683-11843 kg/ha from 120 kg/ha N while control produced of 11653 kg/ha maize hybrid grains. Results increasing N from 120 kg/ha to 175 kg/ha decreased grain yield of maize hybrids.

Keywords: Maize Hybrid; Sowing Date; N; Grain yield

Introduction

Maize (*Zea mays* L.) is a summer growing crop in India, requiring temperatures between 25- 30°C during day and cool nigh [1], under tropical and subtropical regions. It is suitable for mechanical cultivation during entire developments, between 30° north and 30° south. Such types maize is grow in different environmental condition [2], its yields is depends upon primary application of hybrids; especially it produces by single-cross hybrids. Maize hybrids are a cash crop i.e., principal sources of income [3]. It improved farmer's lifestyle and economic growth from 6.54% rate of GDP in India [4]. Maize growing patterns are hetero-genous In India due to different agro-ecological zones [5]. The maize hybrid crop is growing in short time, that widely grown in about 3 months with different yields. Izhar and Chakraborty [6] were distributed hybrid breeding programs and developed a viable economical hybrid maize variety, from potential gene action [7].

Fertilizer application is one of the easiest and fast ways to increasing maize hybrids grain yield per unit area and observed more maize productivity from N supplementation and grain yield determined from grain number and grain weight of maize hybrids. N is increase maize crop height, wide and leaf length that increases leaf area index [8]. The recommended N fertilizers rate is old in India; therefore, a need to up-date fertilizers recommendation in each agro-ecological zone for hybrid maize crop production according to soil type irrigation availability. In this paper is discussing physiological changes and yield components of selected maize hybrid to which entitled "Sowing Variability Measurement of Maize Hybrids and Observation of Physiological Changes from Supplement Different Rate of N" for maize hybrid yield improvement.

Materials and Methods

Experiment field design

The experiment was carried out in single environments viz. Agricultural Research Farm, BHU Varanasi, its climatic conditions are most favourable for *Kharif* season 2015. The experiment was designed as RBD with three replications in which selected 8 inbred lines (CM-212, CM-145, CM-126, CM-118, CM-104, CM-105, V-338, V-336) according to Srivastava., *et al.* [9] along with one check as Malviya Makka Hybrid (MMH-2) in each replicate.

Inbred lines	Pedigree	Characteristic features
CM-212	A, Theo21	Early maturity, average plant height & cob height.
CM-145	Peru330	Early maturity, tall plant, cob height & straight leaf.
CM-126	PTR(Puerto)	Early maturity, Average plant height & high yields.
CM-118	6cL33xAlmora local	Early maturity, medium plant & good yields.
CM-104	Pop 31	Medium maturity, NCLB resistance & average yields.
V-338	B1045010	Early maturity, timely silking & highly yields.
CM-105	USA/AccNo.2132 (Alm)3-2-f-#B#-Almora	Medium maturity, high yielding & good silking.
V-336	CML145, P63CDHC181-3-2-1-4#2-BBBB##F-BBBBB#	Early maturity, wide tassel angle & orange grains.
MMH-2	HUZM 185 X HKI 1105	Medium maturity, Yellow & semi-flint grains.

Table 1: Selected inbred lines list from parental polymorphic survey.

Each plot consisted of 3 x 3m^2 having six rows, line to line space was 70 cm and plant to plant space was 20 cm, respectively. Fifteen seeds were sowed in per lines. The nitrogen fertilizers were applied according to Kumar., *et al.* [10] as 0, 60, 120 and 170 kg/ha during sowing and after germination of maize.

Evaluation of maize and yield components

The maize hybrids were subjected for adaptability of maize hybrids in different sub plots. Maize hybrids grain yield and there components were measured after 50 % flowering from five randomly chosen competitive plants. On the basis of maize hybrid traits such as, days to 50% tasseling, days to 50% silking, maize hybrid grain yield, number of kernels per row, number of kernels per ear, 1000-grain weight, biomass, harvest index and plant height to sheath were evaluated.

Leaf area index

Maximum leaf length (L) and maximum leaf width (W) were measured in per plots of 30 hybrids (cross) and leaf area index (LAI) were calculated from the leaf area according to the Montgomery [11].

Leaf area = L x W x 0.75

LAI = leaf area per plant **x** plant number per plot/plot area

Analysis of variance (ANOVA)

The maize hybrids yield and yield components were analysis on the basis of MSTAT-c software and means compared using Duncan's Multiple Range Test. Mean performance of different genotypes were analyzed on the basis of LSD 5 and 1%.

Daily weather data of BHU during *Kharif* Season 2015								
Name of Soils	Tm. (0C)		RH. (%)		Rainfall (mm)		Pan Evaporation (mm)	Sunshine (hr)
	Max.	Min.	Morning	Evening	Min.	Max.	0.96	1.86
Alluvial	23.27	11.19	89.93	50.89	0.12	4.24		

Table 2: Meteorological data of Agricultural farm BHU environment during *Kharif* season 2015.

	N	
0DAS	60DAS	90DAS
212.35	204.2	196.39

Table 3: Measured soils nitrogen rate at 0days, 60 days and 90 days during *Kharif* season 2015.

Result and Discussions

Physiological key processes identification associated with yield measurements and determination of phenotypic associations with potentially increase the efficiency of maize hybrid breeding. Maize hybrid grain is a functional product of dry matter accumulation and harvest index. Dry matter accumulation was start from maize hybrids maturity, in turn integration and interception of light from light utilization in over life cycle. Maize hybrid physiological processes were associated with genetic improvement that determined from following traits.

Plant height to sheath (cm)

The plant height to sheath is an important trait for growth and development. It directly linked with the plant productive potential in related to grain yield. The plant height to sheath was measured in cm after days to 75 % flowering. The sowing data of different inbred lines were ranged from 143.56 to 146.56 (cm) during 14 June 2015, June 29 showing ranged 148.47 to 153.83 (cm), July 14 showing ranged 151.76-154.46 (cm), and July 29 showing plant height ranged from 141.39-145.67 (cm) during *Kharif* season 2015. The optimum plant height is positively correlated to productivity [24]. The plant height was minimum in control and according to N treatment increasing plant height from 0-175 kg/ha N fertilizers but as like plant height increasing no increases grain yield after supplements of N fertilizers at 175 kg/ha.

Maize hybrid grain yield

Maize hybrids sowing date and N effect was significantly express in the form of grain yield. The grain yield of different inbred lines were ranged from 9213-9286 (kg/ha) during 14 June 2015, June 29 showing ranged 10683-11843 (kg/ha), July 14 showing ranged 7511-7563(kg/ha), and July 29 showing plant height ranged from 6563-7166 (kg/ha) during *Kharif* season 2015. The highest grain yield (11648 kg/ha) was recorded from June 29 and lowest grain yield (6813) and 120 kg/ha N was more effective for highest maize hybrids grain yield (68742 kg/ha). The increasing N treatment from 0 to 175 kg/ha was also increases grain yield (from 6371-68742 kg/ha); but further decreases grain yield, if increases N fertilizers (175 kg/ha). Grain yield of maize inbred lines were measured in kg/ha after harvesting of maize crop and removal of grains.

Grj [12] demonstrated different sowing date on increasing corn yield and function in Arlington in Mexico and they recorded decrease grain yield in late sowing from 0 to 80 kg/ha nitrogen rate. Arif., *et al*. [13] demonstrated as like sown maize hybrid crop's higher grain yield. Higher grain yield was obtained by mid sowing (29 June) and lower grain yield recorded from the late sown crop on 29 July. The maize hybrid grain yield was increases from first sowing date to 3rd sowing date and further maize hybrid grain yield start declining. Earliest sown crop showed lesser grain yield due to weather condition such as absence of rain and easily loss moisture. The significant correlation between grain yield and 1000 grain weight revealed an association with sowing date and supplements of N fertilizers. The highest grain yield (238.7 kg/ha) was observed from 120 kg/ha N fertilizers and lowest grain yield (235.3kg/ha) observed to control (Jaliya., *et al*. [14] and Namakka., *et al.* [15] who shown reduced grain yield by delay in sowing.

1000 grain weight

The 1000 grain weight of maize inbred lines was measured manually after harvesting of maize hybrid crops. The 100-grain weight of *Kharif* season 2015 was ranged from 271.46-298.54 during June 14, 268.68-289.56 during June 29, 281.63-284.63 during July14 and 271.22-279.67 during July 29. The highest 1000-grain weight (286.51kg/ha) was recorded from sown June 29 and lowest recorded (277.13 kg/ha) from June 14 during *Kharif* season 2015. The delayed sowing date was probably decrease 1000 grain weight from decrease translocation of photosynthesis during ripening maize grains [16].

Number of kernels per row

Number of kernels per row of maize inbred lines was measured also manually after harvesting of maize crop. Number of kernels per row was ranged from 41.47-47.45 during 14 June 2015, June 29 shown ranged 49.97-522.47, July 14 shown ranged from 46.52-48.43, and July 29 was shown number of kernels ranged from 41.13-46.54 during *Kharif* season 2015.

Number of kernels row per ear

The Number of kernels row per ear was observed from manually after harvesting of maize crops. Number of kernels row per ear was ranged from 14.52-14.71 during June 14, 15.37-15.73 during June 29, 13.25-13.78 observed during July 14 and 12.45-13.16 was observed during July 29. Grain yield improvement is highly associated with kernel number that associated with rate of dry matter accumulation [20] during establishment of silking. Rate of dry matter accumulation is probably an indication of maize development conditions, rather than increase kernel number.

Harvest index

Harvest index was measurement after harvesting of maize crop and kernels from the plants. The harvest index was ranged from 0.51-55 during June 14, 0.55-0.59 during June 29, 0.52-0.56 and

Plant Height to sheath (cm)	Sowing Date			
	June 14	June 29	July 14	July 29
CM-212	145.43	153.83	152.56	143.41
CM-141	143.56	151.56	152.43	141.56
CM-126	141.51	152.62	153.19	139.55
CM-118	145.61	149.53	151.76	142.67
CM-104	145.31	150.46	152.56	141.39
V-338	146.56	151.54	153.31	144.73
CM-105	143.71	146.47	153.68	143.43
V-136	146.43	149.87	154.46	142.83
MMH-2	149.64	152.28	153.57	145.67
Grain yield (kg/ha)	June 14	June 29	July 14	July 29
CM-212	9218	11648	7511	6813
CM-141	9213	10683	7563	7126
CM-126	9227	11343	7653	6824
CM-118	9283	11568	7636	6563
CM-104	9285	11464	7536	7155
V-338	9226	11347	7642	7132
CM-105	9265	11843	7714	6846
V-136	9286	11347	7463	7166
MMH-2	9189	11653	7573	7149
1000 grain weight	June 14	June 29	July 14	July 29
CM-212	277.13	286.51	284.37	273.42
CM-141	273.09	289.56	282.71	276.92
CM-126	275.19	284.61	281.63	279.54
CM-118	271,46	268.68	283.56	277.89
CM-104	276.89	289.52	281.61	278.57
V-338	289.54	285.83	282.53	271.22
CM-105	298.54	284.71	284.63	278.71
V-136	273.46	287.54	283.67	279.67
MMH-2	275.52	288.57	281.57	278.74

Table 4: Observed yield and yield components variance of maize inbred lines during *Kharif* season 2015.

0.45-0.48 during July 29. Such types harvest index of maize crops is showing minute differences.

Biomass

Biomass of maize crop was ranged from 14132-14189 during June 14, 17153-18023 during June 29, 12213-12489 during July 14 and 11363-11656 showed during July 29. The highest biomass (17153 kg/ha) was observed from sown maize hybrids during June 29 and lowest biomass observed (12563kg/ha) from sown July 29 during *Kharif* season 2015. The highest biomass (13742) was observed from 120 kg/ha N while lowest recorded to control (11486). Maize hybrids growth biomass is more responsible for higher grain yield in per unit area of plot and higher returns grain yield was observed by Amanullah., *et al.* [17]. The maize hybrids grain yield increases due to balance availability of N fertilizers which was associated with increased maize hybrids root growth due to more soil nutrients and moisture during crop growing. Similarly, Anbessa and Juskiw [19] recorded that biomass of maize hybrids yield was increased with the rate of N fertilizer increases. Maize hybrid grain yield and there components were showed better grain yield than check in two environments during *Kharif* season 2015. Yield improvement of maize hybrid was mainly associated with cob girth preparation during silking.

Number of kernels per row	Showing Date			
	June 14	June 29	July 14	July 29
CM-212	43.43	49.97	46.52	41.13
CM-141	41.47	51.56	47.67	43.54
CM-126	43.56	51.52	47.45	45.72
CM-118	43.67	52.46	46.87	44.53
CM-104	44.56	51.65	48.43	46.54
V-338	46.62	51.56	46.72	41.54
CM-105	45.56	50.51	46.92	43.73
V-136	47.45	52.47	46.75	41.56
MMH-2	45.34	53.67	47.49	43.72
Number of Kernels row per ear	June 14	June 29	July 14	July 29
CM-212	14.71	15.45	13.63	13.12
CM-141	14.66	15.73	13.61	13.16
CM-126	14.63	15.43	13.56	12.45
CM-118	14.65	15.62	13.78	12.79
CM-104	14.58	15.71	13.52	12.57
V-338	14.52	15.37	13.56	12.77
CM-105	14.57	15.45	13.25	12.57
V-136	14.55	15.43	13.75	12.46
MMH-2	14.52	15.46	13.52	12.78

Table 5: Observed number of kernels per row and number of kernels row per ear of maize inbred lines during *Kharif* season 2015.

Biomass (kg/ha)	Showing Date			
	June 14	June 29	July 14	July 29
CM-212	14146	17153	12368	11363
CM-141	14189	17157	12361	11366
CM-126	14167	17153	12375	11554
CM-118	14189	18023	12213	11385
CM-104	14163	17153	12489	11656
V-338	14167	17167	12395	11467
CM-105	14178	17157	12575	11646
V-136	15132	17235	12646	11646
MMH-2	14173	18042	12675	11967
Harvest Index	June 14	June 29	July 14	July 29
CM-212	0.53	0.56	0.55	0.48
CM-141	0.51	0.59	0.54	0.49
CM-126	0.53	0.56	0.56	0.47
CM-118	0.55	0.57	0.53	0.46
CM-104	0.53	0.58	0.56	0.45
V-338	0.52	0.59	0.53	0.45
CM-105	0.54	0.56	0.52	0.46
V-136	0.52	0.57	0.54	0.47

MMH-2	0.53	0.55	0.52	0.45
LAI	June 14	June 29	July 14	July 29
CM-212	3.9	4.6	4.2	3.5
CM-141	3.7	4.4	4.2	3.1
CM-126	3.5	4.3	3.9	3.7
CM-118	3.7	4.6	4.5	3.5
CM-104	3.5	4.4	4.3	3.3
V-338	3.6	4.7	4.5	3.4
CM-105	3.4	4.5	4.3	3.6
V-136	3.6	4.4	4.2	3.2
MMH-2	3.3	4.3	4.1	3.6

Table 6: Observed biomass, harvest index and leaf area index of maize inbred lines during *Kharif* season 2015.

*Means observed by similar letters using ANOVA at 5% probability level.

Leaf area index (LAI)

The leaf area index was measured after days to 75% silk-ing. Leaf area index ranged from 3.4-3.9 during June 14, 4.3-4.7 observed during June 29, 3.9-4.5 observed during July 14 and 3.1-3.7 was observed during July 29. Different sowing date and N treatment was significantly affected LAI of different maize varieties indicating leaf size of different maize varieties in selected plots. Maximum LAI was observed 4.6 in July10 from supplements of 175 kg/h N while minimum LAI recorded 2.4 from sown maize hybrids 14 June during *Kharif* season 2015. Higher LAI was association with N supplements that increased leaf number and leaf area in short duration. Interaction effect of maize hybrids sowing date and N fertilizer demonstrated plant growth and leaf area index increased from N fertilizer increasing last sowing date. Different rates of N treatment were non-significant affected mean LAI (Table 2). The higher leaf area index was recorded from all maize varieties applied with full recommended nitrogen rates as compared to control. Leaf morphology of maize hybrid was determined from 75% brown husk in the selected environments. The old maize hybrid leaf was better performance than newer maize hybrids due to greater tolerance in environments and new maize leaf was limited.

The oldest maize hybrid suffers from greater yield loss because it extracted from available water before entering the critical flowering period [21], and young maize hybrid was showed greater ability to tolerate in low resource availability. Maize hybrids leaf morphology was interact with available water and sun light; it significantly recorded by linear measurement [22]. An association developed between increased N use efficiency and low availability of N, moisture and nutrients in soil. The dry matter accumulation exhibited moderate level of ability to tolerance in grain-filling period [23]. Maize hybrids yield stability is highly desirable to breeding programs from supplement of N fertilizer during *Kharif* season 2015.

Conclusions

Grain yield is a key using genetic improvement that influence maize hybrid from functional leaf senescence. Maize hybrids grain yield improvement is progress to genetic gain from new hybrid propagation. The only N level is showed significant effect of maize hybrid production. The highest grain yield recorded from 120 kg/ha N and grain yield progress from early sown maize hybrids. Late sown maize hybrids were decreased dry matter accumulation due to losses grain weight. Higher grain yield was recorded from medium supplements of N as good plant height to sheath and LAI observed from recommended dose supplements. This study express that medium (recommended) dose of N (120kg/ha) produces 68742kg/ha maize hybrids grain yield.

Acknowledgments

The authors are grateful to Department of Genetics and Plant Breeding, Institute of Agricultural Sciences, BHU Varanasi for their constant encouragement and providing the resources to carry out my research work.

Bibliography

1. Birch CJ., *et al*. "Agronomy of maize in Australia in review and prospect". In: CJ Birch, SR Wilson, eds. Versatile Maize - Golden Opportunities: 5th Australian Maize Conference, City Golf Club, Toowoomba (2003): 18-20.

2. Farrell T and K Keeffe. "Maize". NSW Department of Primary Industries (2007).

3. FAOSTAT. "The Food and Agricultural Organization of the United Nations: the statistical database (2015).

4. Adediran JA and VA Banjoko. "Response of maize to N, P and K fertilizers in the Savanna zone of Nigeria". Communication *Soil Science and Plant Analysis* 26 (2003): 593-606.

5. "Diallo Nutritional genomics: manipulating plant micronutrients to improve human health". *Science* 285 (2012): 375-379.

6. Izhar T and Chakraborty M. "Combining ability and heterosis for grain yield and its components in maize inbreds over environments (*Zea mays* L.)". *African Journal of Agricultural Research*8 (2013): 3276-3280.

7. Koppad N. "Identification of superior parental combinations based on three way cross hybrid performance in maize (*Zea mays* L.)". M.Sc. Thesis. University of Agricultural Sciences. Dharwad. 91 (2007).

8. Jokela WE and Randall GW. "Corn yield and residual soil nitrate as affected by time and rate of nitrogen application". *Agronomy Journal* 81 (1989): 720-786.

9. Srivastava RP., *et al*. "Additional Sources of Resistance for Southern Corn Leaf Blight in Indian Maize Germplasm". *The Indian Journal of Agricultural Sciences* 7.9 (2017): 723-729.

10. Kumar S., *et al*. "Evaluating interactive effect of initial screening hybrids in different environmental condition" *International Journal of Agriculture Sciences* 9.20 (2017): 4204-4208.

11. Montgomery. "Further evidence that zinc is required throughout the root zone for optimal growth and development". *Plant Soil* 150 (1911): 247-253.

12. Grj GS. "Effect of delayed planting of wet season maize crops on grain yield". *Indonesian Journal of Crop Science* 4.2 (2006): 53-62.

13. Arif M., *et al*. "Response of maize varieties to different planting methods". *Sarhad Journal of Agriculture* 17.2 (2001): 159-163.

14. Jaliya MM., *et al*. "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 (2008).

15. Namakka A., *et al*. "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 (2008).

16. Ahmad M., *et al*. "Response of maize to P levels and plant density". *Sarhad Journal of Agriculture* 23.1 (2007): 69-73.

17. Amanullah M and Asif Almas LK. "Agronomic efficiency and profitability of fertilizers applied at different planting densities of maize in Northwest Pakistan". *Journal of Plant Nutrition* 35 (2012): 331-341.

18. Moser SB. "Effects of pre-anthesis drought stress and nitrogen on yield, nitrogen use efficiency, and grain minerals of tropical maize varieties". Dissertation for Award of PhD. degree Natural Sciences at Swiss federal Institute of Technology Zurich (2004).

19. Anbessa Y and Juskiw P. "Review: strategies to increase nitrogen use efficiency of spring barley". *Canadian Journal of Plant Science* 92.4 (2004): 617-625.

20. Echarte L and Tollenaar M. "Kernel set in maize hybrids and their inbred lines exposed to stress". *Crop Science* 46 (2004): 870-878.

21. Campos H., *et al*. "Improving drought tolerance in maize: a view from industry". *Field Crops Research* 90 (2004): 19-34.

22. Bhatt M and Chanda SV. "Prediction of leaf area in Phaseolus vulgaris by non-destructive method". *Bulgarian Journal of Plant Physiology* 29 (2003): 96-100.

23. Tollenaar M., *et al*. "Physiological basis for grain yield improvement in maize". *Crop Science* 44 (2004): 2086-2094.

24. Saeed J. "Protein phosphates activity is required for light inducible gene expression in maize". *The EMBO Journal* 12 (2001): 3497-3505.