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Effects of different seed priming techniques on the performance of maize hybrids planted under different sowing times

Muhammad Saleem [1], Mazher Farid Iqbal[2*], Shahroz Javed[1], Muhammad Kashif Khan[3], Muhammad Furqan Qamar[3], Saad Ullah Manzoor[3], Muzzammil Hussain[4] and Zahid Iqbal[5]

[1]Department of Agriculture (Extension) Khanewal
[2]Adaptive Research Station, Sialkot
[3]Department of Agronomy, Bahauddin Zakariya University, Multan
[4]Directorate of Agriculture (Farm Training and Adaptive Research) Gujranwala Zone
[5]Department of Agriculture (Extension) Sialkot
*Corresponding author: *mazherfareed2004@gmail.com*

Abstract

The present study was conducted to evaluate the effects of different seed priming techniques on the performance of maize hybrids planted under different sowing times at Agronomic Research Area, University College of Agriculture, Bahauddin Zakariya University, Multan during 2011. The crop sown on 1st March resulted in maximum plant population (5.16) per unit area while minimum plant population was recorded on 29 January (3.05). The statistically tested data showed that different sowing dates showed positive effects on plant height while varying maize hybrids and different seed priming protocols had non-significant effects on plant height. Similarly in different interactions among the factors tested during the experiment, maize hybrids and different seed priming techniques showed non-significant effects while all other interactions among all the factors included in the study showed significant effects on plant height. Maximum height were observed in 1st March (248.90cm) compared to 14th Feb (211.50cm) sown crop. Cobs of lager size were produced in the crop sown on 14th Feb while smaller cobs were recorded in 29 January and 1st March sowing. Maize hybrid P-32B33 (15.40cm) produced larger sized cob against the minimum in NK-8441 (13.66cm). The statistically analyzed data showed that individual and interactive effects of all the factors studied during the experiment had significant effects on grain yield. Maximum and minimum grain yield was produced by 1st March (4984 $kgha^{-1}$) and 1st Feb (4391 $kgha^{-1}$) respectively. Similarly, maize hybrid NK-8441 upshot maximum grain yield against the minimum in NK-8441. It was concluded that maize in this region must be planted from Mid-February to Early March for higher productivity. The maize hybrid Syngenta NK-8441 may be used as it gave better yields in semi arid conditions.

Keywords: Maize; Hybrid; Seed Priming; Techniques; Sowing; Times; Multan; Punjab; Pakistan.

Introduction

Maize (*Zea mays* L.) an important cereal crop, cultivated throughout the world. Among the cereals produced in Pakistan Maize (*Zea mays* L.) ranking 3rd after wheat and rice. The exploitation of maize in foodstuff and feed manufacturing given it a well-known ranking in a global agricultural economy. Maize refineries use crop for producing an array of consumable products and it is estimated that

worldwide maize yields almost 4000 industrial products (Sprague *et al*., 1988). However, farmers rarely provide the specific category of management necessary for such hybrids, mainly due to the lack of suitable crop husbandry package. Among the various cultural practices right planting geometry is of the utmost importance. Plant population is the factor that has changed most over the last six decades due to the tolerance of newly introduced hybrids varieties to high plant populations (Tollenaar and Lee, 2002). Several factors, such as hybrid maturity group, water availability, soil fertility and row spacing (Sangoi *et al*., 2002) are crucial in determining the number of plants per unit area. Less the line width of a more uniform plantation model has the potential to increase corn grain yield, in particular, when a high yielding hybrid is grown on the soils with a high fertility and ample irrigation (Sangoi *et al*. 1998). Conversely, when any environmental factors, or improper management practice, retards corn growth and development, the reduction of the row to row distances have little effect on grain yield, or improving or increasing the density of the optimal plant population necessary for the yield to maximization (Buntzen, 1992; Merotto *et al* 1997). Good crop establishment is a major constraint to maize production in spring season. In maize low soil temperatures in the spring delay and reduce seedling emergence, which require optimal temperature 25-28ºC for germination. Maize planted when soil temperature is 10ºC or even lower, which often impairs the imbibitions of water (Cohn and Obendorf, 1978). During chilling stress, Reactive Oxygen Species (ROS) are generated which may react with important macromolecules causing oxidative damage and impairing the optimal cellular functions (Farooq *et al.,* 2008). ROS in plants are scavenged by a variety of antioxidant enzymes and or lipid- and water-soluble molecules (Foyer *et al.,* 1994). Phenolic reserves may have been used for lignin biosynthesis or as antioxidants to counteract and scavenge free-radicals and protect from oxidative stress. High temperature during maturity stage of spring sown maize severely affects the grain filling. Maize crop is now being sown during late winter so that crop matures before excessive temperature. However, seeds and seedlings often experience adverse physical conditions in the seedbed and such temperature extremes may adversely affect germination and post germination growth. Therefore, the emergence and stand establishment of maize are often slow and extremely erratic due to chilling condition. Application of plant growth regulators or nutrients during pre-soaking, priming and other pre-sowing treatments in many crops have improved seed performance that results in overall plant growth and productivity particularly under adverse conditions, such as temperature extremes or salinity (Taylor and Harman, 1990; Pill and Finch- Savage, 1998; Afzal *et al.,* 2008; Bakht *et al.*, 2011). Environmental changes associated with different sowing dates (sunshine, temperature) have a modifying effect on the growth and development of maize plants. Each hybrid has an optimum sowing date, and the greater the deviation from this optimum (early or late sowing), the greater the yield loss (Sárvári and Futó, 2000; Berzsenyi and Lap, 2001). The challenge for maize growers is finding the narrow window between planting too early and planting too late (Nielson *et al*., 2002). Farmers who plant maize early are concerned about frost, poor emergence and early plant growth. On the other hand, farmers who plant late wonder what maturity hybrids to plant and how late planting might affect the final grain yield and grain moisture (Lauer *et al*., 1999). Either early planting or late planting can result in lower yield because the probability exists that unfavorable climatic conditions can occur after planting or during the growing season. Seed priming is a controlled hydration procedure that involves exposing seeds to low water potentials that hamper germination, but permits pre germinated physiological and biochemical changes to occur (Heydecker and Coolbear, 1977; Bradford, 1986 and Khan, 1992). Upon rehydration, primed seeds may exhibit faster rates of germination, more uniform emergence, greater tolerance to environmental stress, and reduced dormancy in many species (Khan, 1992; Ashraf and Foolad, 2005). However the study had been planned to evaluate the effects of planting date on grain yield and its component of maize hybrids and to compare the efficiency and profitability of different seed priming techniques to improve the performance.

Materials and Methods

The present study was conducted to evaluate the effects of different seed priming techniques on the performance of maize hybrids planted under varying sowing dates at Agronomic Research Area, University College of Agriculture, Bahauddin Zakariya University, Multan during 2011. The climate of the region is semi-arid and subtropical. Prior to seedbed preparation, pre-soaking irrigation of 10 cm was applied in the soil. When soil reached to required moisture level, the seedbed was prepared 2-3 times with tractor-mounted cultivator followed by planking. The experiment was laid out in randomized complete block design (RCBD) with split-split plot design having net plot size of 4 m x 3 m and replicated four

times. The Maize Hybrid (H_1= Pioneer-32B33 and H_2= Syngenta-NK-8441) were sown on 29th Jan, 14th Feb and 1st March 2011 on well prepared seed bed. Seed priming techniques were used as Hydro priming with distilled water (P_2) and Osmo priming with $CaCl_2$ (P_3) compared with Control (P_1). Sowing of maize was done by hand dibbling on ridges. Row to row distance was kept 75 cm and plant to plant was 20 cm. Fertilizers were applied @ 200 and 150 $kgha^{-1}$ nitrogen and phosphorus, respectively in the form of Urea and DAP. Full dose of phosphorus and one third dose of nitrogen was applied at the time of sowing. 2nd one third dose of nitrogen was applied at the time knee height stage and remaining nitrogen was `applied at tasseling stage. After first irrigation at proper moist condition hoeing was done to keep crop free from weeds and earthing up. Crop was affected by shoot fly attack 21 days after sowing. Carbofuran 5%G @ 25 $kgha^{-1}$ was applied for the control of shoot fly however three grains of insecticide per head was applied on the top portion of the plant in the main shoot. Crop was harvested on different times when reached to maturity. Ten plants were selected at random from each plot. Their heights were measured in centimeter with measuring tape and then taken its average. Total number of cobs of ten randomly selected plants from each plot was counted and then gets average to get number of cobs per plot. Cob length of ten randomly selected cobs from each plot was measured in cm with the help of measuring tape. At maturity, the cobs were separated, sun dried, threshed manually and the grain yield per plot was recorded. The grain yield was adjusted to 10% moisture contents and then converted into $kgha^{-1}$. Data regarding all the parameters were collected using standard procedures and were analyzed by using Fisher's analysis of variance technique and LSD test at 5% probability will be used to compare the differences among treatments' means (Steel *et al*., 1997). All other agronomic and plant protection measures were kept constant and uniform to avoid any biasness.

Results and Discussion

Plant population (m^{-2})

The statistical analysis of different sowing dates showed positive effects on plant population while different maize hybrids and different seed priming protocols showed non-significant effects on plant population. Similarly in case of different interactions maize hybrids and different seed priming techniques showed non-significant effects while all other interactions showed significant effects on plant population per unit area. The crop sown on 1st March resulted (5.16) in maximum plant population per unit area while minimum plant population was recorded on 29 January (3.05). Varying maize hybrids and different seed invigoration techniques tested during the course of experiment showed non-significant effects on plant population. Conversing about different interactions among all the factors, sowing dates and different maize hybrids interaction improved the plant population and maximum plant population was observed in both the hybrids included in the study in crops sown on 14th Feb and 1st March while minimum pant population per unit area was the result in case of both the hybrids in crop sown on 29 January. Maximum and minimum plant population was recorded in all seed enhancement techniques along with control in 1st March and 29 January sowing respectively (Table 1.1).

Table.1.1. Effect of different seed enhancement techniques on plant population per unit area of different maize hybrids cultivated under different sowing times

Sowing Dates	**S_1(29-January)**		**S_2(14-February)**		**S_3(01-March)**		**Means Priming**
Hybrids	**H_1 (P-32B33)**	**H2 (NK-8441)**	**H_1 (P-32B33)**	**H2 (NK-8441)**	**H_1 (P-32B33)**	**H2 (NK-8441)**	
P_1 (Control)	3.05 d	3.05 d	4.39 abc	4.52 abc	4.83 abc	4.88 abc	4.12
P_2 (Hydro-priming with distilled water)	3.11 d	3.22 d	4.30 bc	4.72 abc	4.75 abc	5.16 a	4.21
P_3 (Osmo-priming with $CaCl_2$)	3.27 d	2.86 d	4.19 bc	4.08 c	4.72 abc	4.91 ab	4.00

Means sharing the same letters within a column or a row showed non-significantly effect
LSD at 5% S= 0.18

Plant height (cm)

From table 1.2 showed that different sowing dates had positive effects on plant height while different maize hybrids and different seed priming protocols showed non-significant effects on plant height. Similarly in maize hybrids and different seed priming techniques showed non-significant effects while all other interactions among all the factors showed significant effects on plant height. Plants of maximum height were observed in 1st March (248.90cm) cultivated crop against the plants of minimum height in 14th Feb (211.50cm). However various seed enhancement techniques showed non-significant effects on plant height. Maximum plant height was recorded in both the hybrids included in the study in 1st March cultivated crop while minimum plant height was recorded in 29 January and 14th Feb. Similarly the interactions among sowing dates and seed enhancement techniques were also positively affected and maximum pant height was recorded in all seed priming techniques compared to control sown seeds in 1st March while the minimum plant height was recorded in hydro priming in 1st Feb cultivated crop. Maximum plant height was recorded in control of NK-8441 in 1st March sown crop while the minimum plant height was observed in both the hybrids in all seed priming protocols as well as control treatment in crop sown on 29 January. Tollenaar (1977) reported that decreased assimilate supply during the period after 2 to 3 week post-silking in maize had little effect on kernel growth rate, but reduced kernel weight at maturity because of shorter filling duration.

Table.1.2. Effect of different seed enhancement techniques on plant height (cm) of different maize hybrids grown under different sowing dates

Sowing Dates	S_1(29-January)		S_2(14-February)		S_3(01-March)		Mean Priming
Hybrids	H_1 (P-32B33)	H2 (NK-8441)	H_1 (P-32B33)	Hybrids	H_1 (P-32B33)	H2 (NK-8441)	
P_1 (Control)	206.5 f	204.5 f	218.9 cdef	211.5 ef	248.0 ab	248.9 a	223.06
P_2 (Hydro-priming with distilled water)	200.7 f	206.0 f	223.7 bcdef	219.5 cdef	242.3 abc	236.4 abcde	221.44
P_3 (Osmo-priming with $CaCl_2$)	203.4 f	208.3 f	211.5 ef	215.8 def	247.5 ab	239.7 abcd	221.02

Means not sharing the same letters within a column or a row differ significantly from each other
LSD at 5% S = 11.31

Cob length (cm)

From table 1.3 showed that different planting dates and maize hybrids differed statistically in cob length while, different seed priming techniques showed non significant effects. However all interactions among the entire factor differed significantly from each other for cob length except interactions among differing maize hybrids and seed priming techniques. Cobs of lager size were produced in the crop sown on 14th Feb while smaller cobs were produced in 29 January and 1st March sowing. Maize hybrid P-32B33 produced larger sized cob (15.40cm) against the minimum in NK-8441 (13.66cm). Different seed enhancement techniques showed nil effect on cob length. Larger and smaller sized cobs were produced by both the hybrids tested in 14th Feb and 29 January and 1st March sown crops respectively. Maximum and minimum length of cobs was recorded in seed priming protocols compared with control treatment in 14th Feb and 29 January and 1st March sowing. Nattering about the interactions among all the factors included in the study cobs larger in size were produced by control and hydro primed seeds of P-32B33 in 14th Feb sown crop while the minimum

cob length was the result in case of all the seed priming along with control in both the hybrids in 29 January and 1st March sown crop. Cirilo and Andrade (1994a) studied the result of planting time on growth and dry matter partitioning of maize crops grown without water and nutrient limits. Delayed planting decreased the number of calendar days as well as the thermal time from planting to grain maturation (Nielsen *et al*. 2002). Delays in planting date hastened development between seedling emergence and silking, decreasing cumulative incident radiation on the crop during the vegetative period.

Table.1.3. Effect of different seed enhancement techniques on cob length (cm) of varying maize hybrids grown under different sowing dates

Sowing Dates	S_1(29-January)		S_2(14-February)		S_3(01-March)		Mean Priming
Hybrids	H_1 (P-32B33)	H2 (NK-8441)	H_1 (P-32B33)	Hybrids	H_1 (P-32B33)	H2 (NK-8441)	
P_1 (Control)	13.90 e	14.33 bcde	15.32 a	15.04 abc	13.95 e	13.67 e	14.36
P_2 (Hydro-priming with distilled water)	13.68 e	13.76 e	15.40 a	15.08 ab	14.03 de	13.71 e	14.27
P_3 (Osmo-priming with $CaCl_2$)	14.08 cde	13.66 e	15.12 ab	14.95 abcd	13.75 e	13.58 e	14.19

Means not sharing the same letters within a column or a row differ significantly from each other

LSD at 5% S = 0.40

Grain yield (Kg ha^{-1})

Maximum and minimum grain yield was the product of 1st March (4984 kgha^{-1}) and 1st Feb (4391 kgha^{-1}) sown crop respectively (Table 1.4). Similarly, maize hybrid NK-8441 showed maximum grain yield however seed priming protocols osmo-priming resulted in minimum grain yield compared to control treatment. Interactions among different factors, maize hybrid NK-8441 resulted in maximum grain yield in 1st March sown crop against the minimum in P-32B33 in 1st Feb sowing in maize hybrids and planting dates interactions. Hydro-primed seeds of NK-8441 resulted in maximum while osmo-primed sees of P-32B33 gave minimum grain yield. Conferring about interaction of planting dates and maize hybrids, control and hydro-primed seeds showed maximum grain yield in 1st March sown crop whereas, minimum grain yield was recorded in osmo-priming and crop sown on 1st Feb. Similarly summing up the interactions among all the factors studied, maximum grain yield was produced by hydro-primed seeds of NK-8441 in 1st March sowing against the minimum in osmo-primed seeds of P-32B33 sown on 1st Feb. The weaker yield in 29th January sown crop are due to low soil temperature prevailing at germination stage resulted in delayed germination of plants and early inception of elevated temperature reduced the yield. In late planted maize during mid January and early march the temperature of the soil increased to considerable extent resulted in speedy and smooth emergence and the plants coincided with the ideal temperature prevailing for the growth of maize plants and resulted in improved outputs. Our results are in accordance to Claasen and Shaw, 1970; Hall *et al*., 1981. Filling period is often subjective to temperature (Derieux and Bonhomme, 1982). Grain yield outcomes were higher in 1st March sown crop which indicate that this is the ideal time for sowing maize crop for higher productivity as prevailing soil and ambient air temperature ideal for maize growth and development. These results are in line with Gozubenli *et al*. (2001) and Konuskan (2000) who found that there is a considerable varietal variation among maize hybrids.

Table.1.4. Effect of different seed enhancement techniques on grain yield (Kg ha^{-1}) of different maize hybrids grown under different sowing dates

Sowing Dates	S_1(29-January)		S_2(14-February)		S_3(01-March)		Mean Priming
Hybrids	H_1 (P-32B33)	H2 (NK-8441)	H_1 (P-32B33)	Hybrids	H_1 (P-32B33)	H2 (NK-8441)	
P_1 (Control)	3133 i	4053 cd	3714 ef	4064 cd	4391 b	4047 cd	3900.3 A
P_2 (Hydro-priming with distilled water)	3014 i	3136 i	3803 e	3147 hi	3383 gh	4984 a	3577.9 B
P_3 (Osmo-priming with $CaCl_2$)	2519 j	3525 fg	3072 i	3403 g	3929 de	4183 bc	3483.5 C

Means not sharing the same letters within a column or a row differ significantly from each other
LSD at 5% D = 128.92

Conclusion

It is concluded from the results of the present study that maize in semi-arid region of Multan must be planted from Mid-Feb to Early March for higher productivity. The maize hybrid NK-8441 may be used as it gives better yields in semi arid conditions of Multan.

References

Afzal, I., S.M.A. Basra, M. Shahid and M. Saleem, 2008. Physiological enhancements of spring maize (*Zea mays* L.) under cool conditions. Seed Sci. Tech. 36: 497–503.

Ashraf, M. and M.R. Foolad. 2005. Pre-sowing seed treatment- A short gun approach to improve germination, plant growth and crop yield under saline and non-saline conditions. Adv. in Agron. 88: 223-271.

Bakht, J., M. Shafi, Y. Jamal and H. Sher. 2011. Response of maize (*Zea mays* L.) to seed priming with NaCl and salinity stress. Span. J. Agri. Res. 9: 252–261.

Berzsenyi, Z. And Lap, D.Q. 2001. Effect of sowing time and N fertilisation on the yield and yield stability of maize (*Zea mays* L.) hybrids between 1991–2000. Acta Agron. Hung. 50: 309-331.

Bradford, K. J. 1986. Manipulation of seed water relations via osmotic priming to improve germination under stress conditions. Hort. Sci. 21: 1105-1112.

Buntzen, S. 1992. New Wave of Interest in Narrow Row Corn. 51:598–602. Crop Insights, Urbana.

Cirilo, A.G. and F.H. Andrade. 1994a. Sowing date and maize productivity: I. Crop growth and dry matter partitioning. Crop Sci. 34:1039-1043.

Claasen, M. M. and R. H. Shaw. 1970. Water deficits effects on corn. II. Grain components. Agro. J. 64:652-655.

Cohn, M. A., and Obendorf, R. L. 1978. Occurrence of stellar lesion during imbibitional chilling of *Zea mays* L. Am. J. Bot. 65: 50-56.

Derieux, M. and R. Bohnhomme. 1982. Heat units requirement for maize Hybrids in Europe. Results of the European FAO subnetwork. II. Period from silking to maturity. Maydica. 27:79-96.

Farooq, M., Aziz, T., Basra, S. M. A., Cheema, M. A., and Rehman, H. 2008. Chilling tolerance in hybrid maize induced by seed priming with salicylic acid. J. Agro. Crop Sci. 194: 161-168.

Foyer, C.H., M. Lelandais and K. J. Kunert. 1994. Photo oxidative stress in plants. Physiol. Plant. 92: 696–717.

Gozubenli, H., A.C. Ulger and O. Sener. 2001. The effect of different nitrogen doses on grain yield and yield-related characters of some maize genotypes grown as second crop. J. Agri. Fac. C.U., 16: 39-48

Hall, A. J., J. H. Lemcoff, and N. Trappani. 1981. Water stress before and during flowering in maize and its effects on yield, its components, and their determinants. Maydica 26:19-38.

Heydecker, W. and P. Coolbear. 1977. Seed treatments for improved performance - survey and attempted prognosis. Seed Sci. Tech. 5: 353-425.

Khan, A.A. 1992. Pre plant physiological seed conditioning. Hort. Rev. 13: 131-181.

Konuskan, O. 2000. Effects of plant density on yield and yield related characters of some maize hybrids grown in hatay conditions as second crop. M.Sc. Thesis, Science Institute. M.K.U., pp: 71

Lauer, J.G., Carter, P.R., Wood, T.M., Diezel, G., Wiersma, D.W., Rand, R. E., Mlynarek, M. J. 1999. Corn hybrid response to planting date in the Northern Corn Belt. Agro. J. 91:834- 839.

Merotto, J., A.M.L. Almeida and O. Fuchs, 1997. Aumento no rendimento de grãos de milho através doaumento da população de plantas. Ciência Rural Santa Maria, 27: 549–554.

Nielson, R. L., Thomison, P. R., Brown, G.A., Halter, A. L., Wells, J., and Wuethricc, K. L. 2002. Delayed planting date effects on flowering and grain maturation of corn. Agro. J. 94: 549-558.

Pill, W.G. and W.E. Finch-Savage. 1998. Effects of combining priming and plant growth regulator treatments on the synchronization of carrot seed germination. Ann. Appl. Biol. 113: 383–389

Sangoi, L., M. Ender and A. Merotto Jr., 1998. Dominância apical de híbridos de milho de diferentes épocas em três densidades de semeadura. In: Erechim, R.S. Anais (ed.), Reunião Anual Do Milho E Sorgo, 42, 1997, 382:31–6.

Sangoi, L., M.A. Gracietti, C. Rampazzo and P. Bianchetti, 2002. Response of Brazilian maize hybrids from different eras to changes in plant density. Fiel. Cro. Res. 79: 39–51.

Sárvári, M., and Futó, Z. 2000. Correlation between the sowing date, yield and grain moisture content of maize hybrids on chernozem soil. Deb. Egyet. Agrár. Közle. J. 1:32–41.

Sprague, G.F., D.A. Fuccillo, L.S. Perelman and M. Stelly. 1988. Corn and Corn Improvement, 3rd edition. American Society of Agronomy, Madison, Wisconsin.

Steel R.G.D., J.H. Torrie, D.A. Dicky. 1997. Principles and Procedures of Statistics, A Biometrical Approach. 3rd Ed. McGraw Hill, Inc. Book Co. N.Y. (U.S.A.), pp: 352-358

Taylor, A.G. and G.E. Harman. 1990. Concepts and technologies of selected seed treatments. Annl. Rev. Phytopath. 28: 321–339.

Tollenaar, M. and E.A. Lee. 2002. Yield potential, yield stability and stress tolerance in maize. Fiel. Crops Res. 75: 161–169.

Tollenaar, M. 1977. Sink-source relationships during reproductive development in maize. A review. Maydi. 22:49-75.

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