

EFFECT OF SPLIT APPLICATION OF POTASH FERTILIZER ON MAIZE AND SORGHUM IN PAKISTAN

Ashiq Saleem, Habib Iqbal Javed, Rashid Saleem,* Muhammad Ansar** and M. Amir Zia*

Abstract:The study was conducted in National Agricultural Research Centre, Islamabad during autumn 2007. In this study Maize hybrid (Pioneer 3062) and sorghum hybrid (Pioneer MR-Buster) were planted in Randomized Complete Block Design with three replications having a plot size of 5m x 3m. Plant to plant distance was 25 cm and row to row was 75 cm. A field experiment was conducted to investigate the effect of split doses of potash fertilizer on maize and sorghum. Potash fertilizer was applied @ 0, 60 and 120 kg ha^{-1} K $_2$ O as single, two split and three split doses at planting, after one month and after two months of planting. The experiment consisted of seven levels (0, 60, 30 + 30, 20 + 20 +20, 120, 60 +60 and 40 + 40 + 40 kg ha^{-1}). Grain yield in maize and sorghum showed positive relationship with increase in potash levels and increase in its number of split applications. The highest maize grain yield of 8014 kg ha^{-1} was observed in plots where 120 kg ha^{-1} of Potash was used in three splits. While minimum grain yield was recorded in control. In sorghum, maximum grain yield (4356 kg ha^{-1}) and stalk yield (13422 kg ha^{-1}) was recorded with the application of 120 kg ha^{-1} of Potash with three splits. All the parameters except plant height had significant effect in both maize and sorghum. Days to 50% silk in maize are significantly affected by potash when compared with control treatment, but there was no significant effect between single, two and three splits. The grain yields of these two crops increased significantly at K $_2$ O level of 120 kg ha^{-1} with three splits. Level of 120 kg ha^{-1} with three splits is recommended for potash application in maize and sorghum.

Key Words: Zea mays; Sorghum bicolor; Hybrids; Potash Fertilizer; Split Doses; Yield, Yield Components; Pakistan.

INRODUCTION

Maize (*Zea mays* L.) is the most important cereal of the world in terms of highest yield and production (FAO, 2009). In Pakistan, maize ranks as third cereal after wheat and rice. Khyber Pakhtunkhwa and Punjab are the major maize growing provinces. It is the main source of human diet at Khyber Pakhtunkhwa and especially in mountainous areas where peoples are very poor as it is the cheap source for human consumption. It is well known fodder crop. Maize is the most suitable fodder crop for making silage. Therefore, it is called the king of crops suitable for silage (Muhammad et al., 1990). It is being cultivated on 0.95 mha with annual production of 3.49 mt (GoP, 2009).

Hybrid maize is known to have in-

creased its production almost three fold. So, its fertilizer requirement becomes double. Furthermore, its time and method of application especially potash is essential for getting maximum crop yield.

Sorghum (*Sorghum bicolor* L.) is grown as fodder as well as for grain purpose in Pakistan. It is the principal source of energy, protein, vitamins and minerals for millions of the poorest people in these regions. Sorghum is grown in harsh environments where other crops grow or yield poorly. It is grown with limited water resources and usually without application of any fertilizer or other inputs.

The area under sorghum in Pakistan is 0.248 mha with annual production 0.154mt and change in production is 6.7% (GoP, 2009).

* Maize Programme, Crop Sciences Institute, National Agricultural Research Centre, Islamabad, Pakistan.

** PMAS- Arid Agriculture University, Rawalpindi, Pakistan.

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Fertilizers play a key role in achieving the potential of different crops. High yielding varieties of crops, especially maize and sorghum hybrids have high nutritional requirements generally give marked response to N, P and K fertilizer (Sharma and Das, 1982) while potassium plays an important role in the growth and development of the crops. Potassium is known to play a significant role in the activation of more than 60 enzymes which catalyze various metabolic process (Evans and Wildes, 1971) and uptake and translocation of nitrates from root to aerial parts of plants (Das et al., 1976). The thing that matters with regards to K_2O is its availability to plants rather than its presence in soil. The problem with the potassium is not its total amount of supply but its availability to crops (Rehman et al., 1982). In Pakistan, K status of soils is rapidly decreasing at the painful rate. The net K exhausting rate is even steeper $0.3 \text{ kg ha}^{-1} \text{ year}^{-1}$. This may be due to the trifling ($0.8 \text{ kg ha}^{-1} \text{ year}^{-1}$) use of K in Pakistan as compared to world average K use ($15.1 \text{ kg ha}^{-1} \text{ year}^{-1}$) (Ahmad and Rashid, 2003).

The objective of this study was to evaluate the response of split doses of potash fertilizer, its availability and quantity at proper stages to hybrid maize and sorghum. The application of single dose of potash at the time of planting increases the risk of its fixation and consequently plant can not take it properly while with split doses at different stages, the crop can utilize it properly when applied at split doses.

MATERIALS AND METHODS

A field experiment was conducted on maize and sorghum during autumn, 2007. The crop was sown on July 10, 2007 Maize Sorghum & Millet Programme research area and harvested on October 20, 2007 at National Agricultural Research Centre, Islamabad (latitude $33^{\circ} 42' \text{ N}$; longitude $73^{\circ} 08' \text{ E}$; altitude 518 m above sea level). Minimum rainfall was 36.5 mm in October and maximum (504 mm in July (Figure 1). About 84 % of this rainfall was received during monsoons (July - August).

The basal doses of Nitrogen (N) and Phosphorus (P) at the time of planting were applied @ 120 and 60 kg ha^{-1} uniformly to all treatments. Furadan insecticide @ 20.0 kg ha^{-1} was applied twice; at planting and after two weeks of planting. Primextra Gold @ 1.0 l ha^{-1} was used as pre-emergence herbicide to control weeds. Maize hybrid (Pioneer 3062) and sorghum hybrid (Pioneer MR-Buster) were used in this experiment. The experiment was sown in Randomized Complete Block Design with three replications having a plot size of $5 \text{ m} \times 3 \text{ m}$. Plant to plant distance was 25 cm and row to row 75 cm . Each plot consisted of four, 5 m long rows. The central two rows were used for data recording. Days to 50% silking, plant height, ear height, stalk yield and grain yield were recorded in maize while in sorghum plant height, stalk yield and grain yield were recorded. The potassium fertilizer treatments were as follows:

- T1= Check
- T2 = 60 kg at planting time
- T3= 120 kg at planting time
- T4= 30 kg at planting and 30 kg after one month
- T5= 20 kg at planting, 20 kg after one month and 20 kg after two months
- T6= 60 kg at planting and 60 kg after one month
- T7= 40 kg at planting, 40 kg after one month and 40 kg after two months

The data were analyzed statistically and means were compared by using LSD (Gomez and Gomez, 1987).

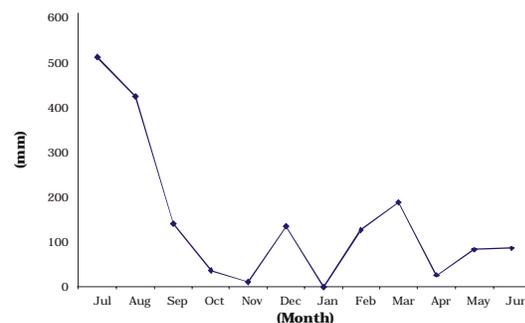


Figure 1. Rainfall data for 2007

**EFFECT OF SPLIT APPLICATION
RESULTS AND DISCUSSION**

Maize

Split application of potash had no significant effect on plant height within the treatments as compared to application of potash whatever the rate of fertilizer was. However, split application produced significantly lengthy plants compared with those of single application (Table 1). This showed that maize plants absorbed potassium with the passage of time during their growth period while single application at the time of sowing did not provide sufficient amount of potash to the plants at later stages of growth to increase the plant height.

Maximum ear height was observed when potash was applied in split application @ 60 + 60 and 40 + 40 + 40 kg ha⁻¹, which were statistically at par with each other but significantly higher than those of all other treatment. It showed that potash at the later stages of growth was utmost necessary to increase plant height and likewise ear height.

As regard days to 50% silking, no clear trend was observed. Asif et al. (2007) and Ali et al. (2004) observed that days to 50 % silk delayed with the application of higher dose of potassium fertilizer.

Higher stalk yield was observed when potash was applied at higher rate of 120 kg ha⁻¹ whether applied as full dose at sowing time or in split application. It showed that potash had a vital role in enhancing stalk

yield.

Almost similar trend in grain yield of maize was observed to that of stalk yield, showing that potash at higher rate viz., 120 kg ha⁻¹ increased both stalk and grain yield, particularly when applied in splits. Potash @ 120 kg ha⁻¹ in three splits gave the highest grain yield (8014 kg ha⁻¹) followed by its two split (6661 kg ha⁻¹). The lowest grain yields (2923 kg ha⁻¹) was observed in control treatment. The grain yield was significantly increased with three split of both potash levels compared to one and two split, which had no significant difference from each other. It is because of the fact that the quantity of potash available for 120 kg ha⁻¹ was equal to that of three split of 40 kg ha⁻¹. It means that 40 kg ha⁻¹ with three split of potash is equally good as single dose of 120 kg ha⁻¹. These results are in line with Shahzad et al. (1992). K application in all treatments significantly increased grain yield and reduced plant bareness in maize hybrids (Bukhsh, 2011).

Sorghum

Data regarding plant height showed non-significant differences among treatment means.

The highest stalk yield (13422 kg ha⁻¹) was recorded with three splits of potash applied @ 120 kg ha⁻¹ followed its two split (13022 kg ha⁻¹), which were at par with each other but significantly higher than all other treatments, showing that K application at

Table 1. Effect of split application of potash fertilizer on yield and yield components of maize and sorghum

Treatment	Maize				Sorghum			
	Days to 50% silking	Plant height (cm)	Ear height (cm)	Stalk yield (kg ha ⁻¹)	Grain yield (kg ha ⁻¹)	Plant height (cm)	Stalk yield (kg ha ⁻¹)	Grain yield (kg ha ⁻¹)
T1	55b	210b	103c	7333c	2923e	87	6489d	1333f
T2	57a	210b	101c	7600c	4073d	87	6578d	1556e
T3	55b	223ab	108bc	12667ab	6073bc	87	10667b	3422c
T4	56ab	226a	110abc	11822bc	4786d	88	9822c	2933d
T5	56ab	222a	108bc	11556bc	5761c	90	10356bc	3556c
T6	56ab	228a	116ab	12222bc	6661b	90	13022a	4000b
T7	57a	233a	121a	14356a	8014a	87	13422a	4356a
LSD	1.74	14.94	11.81	1795	724.9	ns	544.9	216.5
CV %	1.75	3.97	6.06	9.11	7.45	6.84	3.05	3.05

Means followed by same letter (s) do not differ significantly at 0.5% probability level; ns=non significant

higher dose could enhance above ground biomass, particularly when applied in splits. The reason is that the potash fertilizer binds with the soil particles and when it is applied in splits, the fertilizer is available to the crop at the proper time of utilization. The results are in line with those of Umar (2006).

The grain yield of sorghum was significantly affected with potash rate and method of application. The maximum grain yield (4356 kg ha⁻¹) was recorded with three split application of potash fertilizer @120kg ha⁻¹, which was significantly higher than those of all other treatments. It was followed by the same rate of potash fertilizer but applied in two splits (4000 kg ha⁻¹). The minimum grain yield (1333 kg ha⁻¹) was recorded in control treatment. Solankey et al. (1993) observed similar results with two split doses.

LITERATURE CITED

- Ahmad, N. and Rashid, M. 2003. Fertilizers and their use in Pakistan. Extension Bulletin. NDFC. Islamabad. p. 112.
- Ali, T. Anwer, S. Shah, W.A. and Ahmed, B. 2004. Response of maize hybrid/cultivars to various levels of potassium and irrigation frequencies. *J. Agron.* 3(3): 201-207.
- Arif, M. Amanullah and Anwar, M. 2007. Phenology, leaf area and yield of spring maize (cv Azam) as affected by levels and timings of potassium application. *World Appl. Sci. J.* 2 (4): 299-303.
- Bukhsh, M. A. A. H. A. Riaz, A. Iqbal, J. Hussain S. Atique, R. and Ishaque, M. 2011. Potassium application reduces bareness in different maize hybrids under crowding stress conditions. *Pakistan J. Agric. Sci.* 48(1):41-48.
- Das, K.C. Mishra A. and Pandey J. 1976. Split application of potash for rice. *Indian Potash J.* 1(1): 13-16.
- Evans, H.J. and Wildes, R.A. 1971. Potassium and its role in the enzyme activation. In Potassium its biochemistry and physiology. Proceedings. Colloquium. Intern. Potash Inst. 8:13-29.
- FAO. 2009. F.A.O. statistical year book data base results. Record 984 symbol and abbreviation.
- GoP, 2009. Economic Survey of Pakistan, Economic Wing, Ministry of Food, Agriculture & Livestock, Islamabad, Pakistan.
- Gomez, K.A. and Gomez, A.A. 1987. Statistical procedures for agricultural research (2nd edn.). An Intern. Rice Res. Inst. A Wiley-Inter-Science Publication.
- Muhammad, D. Hussain, A. Sartaj and Bhatti, M.B. 1990. Locational differences in forage yield and quality of maize cultivars. *Pakistan J. Sci. Ind. Res.* 33(10): 454-456.
- Rehman, H. Bhatti, A.U. and Gurmani, A.H. 1982. Fertilizer experiment on cereal crops in Dera Ismail Khan District. *Soil Sci. Div. Agric. Res. Inst. Tarnab Peshawar, Pakistan.*
- Shahzad, M.A. Musa, M. Chaudhary, G.A. Nasim, M. and Gondal, M.A. 1992. Response of spring maize to NPK application under barani conditions. Paper presented in 5th Nat. Congr. of Soil Sciences held at NWFP Agric. Univ. Peshawar, Pakistan on Oct.23-25, 1992. p.4.(Abstr.)
- Sharma, S. and Das, N.R. 1982. Response of dwarf wheat to NPK and Ca. *Indian J. Plant Physiol.* 25: 364-370.
- Solankey, B. S. Shinde, D.A. and Rathore, R.S. 1993. Effect of split application of NPK on Sorghum in Vertic Ustochrept of Madhya Pradesh. *J. Potash Res.* 9(1):76-79.
- Umar, S. 2006. Alleviating adverse effects of water stress on yield of sorghum, mustard and groundnut by potassium application. *Pakistan J. Bot.* 38(5): 1373-1380.