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

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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.

INTRODUCTION

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 increased 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).
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 K₂O 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 kg ha⁻¹ year⁻¹. This may be due to the trifling (0.8 kg ha⁻¹ year⁻¹) use of K in Pakistan as compared to world average K use (15.1kg ha⁻¹ year⁻¹) (Ahmad and Rashid, 2003).

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 5m x 3m. 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 panting 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).

**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° 42’ N; longitude 73° 08’ 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).
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

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

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 bounds 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**


