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INTEGRATED POTASH NUTRIENT MANAGEMENT ENHANCES RICE PRODUCTIVITY UNDER PADDY SOIL

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ABSTRACT

The objective was to study the effect of soil incorporated potassium sulphate when applied alone and in combination with FYM on the growth and yield of fine rice “Super Basmati”. The experiment was conducted at Kala Shah Kaku during 2010 using RCBD with three replications. The treatments were control (T_1) where no K_2SO_4 and FYM was applied , soil application of K_2SO_4 @ 70Kg ha^{-1} (T_2), FYM application @ 5 t ha^{-1} (T_3), FYM application @ 5 t ha^{-1} + K_2O @ 20 Kg ha^{-1} (T_4), FYM application @ 5 t ha^{-1}+K_2O @ 40 Kg ha^{-1} (T_5). Paddy yield was significantly enhanced when K_2SO_4 was applied in combination with FYM. Maximum paddy yield (6.11 t ha^{-1}) was recorded in T_5 while, lowest paddy yield (4.15 t ha^{-1}) was found in control. The increase in yield with K_2SO_4 and FYM application (47.23%) compared to control was an outcome of positive correlation between grain yield and tillers m^{-2}, grains panicle^{-1} and thousand-grain weight which ultimately enhanced paddy yield.

Key words: Integrated potash, nutrient management, K_2SO_4, FYM, paddy yield

INTRODUCTION

Rice (*Oryza sativa* L.) is an important cereal food crop of the world as well as Pakistan. It provides the principle food for about half of the world population. Rice also occupies a significant position in agriculture economy of Pakistan and is the largest foreign exchange earner after cotton and fall next to wheat as a staple food for millions of people in Pakistan. Rural economy and the prosperity of rice belt largely depend on rice as a source of foreign exchange. Rice was planted on an area of over 2.67 million hectares with total production of 6.68 million tones and accounts for 17% of the total cereals produced annually. It accounts for 6.7% of value added in agriculture and 1.6% in GDP (Anon., 2009-10). Every year around 1/3rd of the total rice produce is exported and 2/3rd is consumed locally. Pakistan ranks 5th country in the world for rice export but the average rice yield per hectare is only 2500 kg ha^{-1} which is low compared with many rice growing countries of the world. Average yield at farmers field in Pakistan is very low almost the half to that of Egypt, Japan, U.S.A. and Korea. With the increase in the use of chemical fertilizers, increased cropping intensity, introduction of mechanical cultivation, burning of farm wastes and crop residues as fuel, the availability of farm yard manure (FYM) and other biological sources have fallen far short of the organic matter requirements for successful crop production. The situation may lead to further deterioration of physical condition of soils. Efforts are therefore, required to be made to bring into the cropping system the suitable FYM so that the soil condition may not only be maintained but also improved to sustain the crop productivity. Among various factors which can help increase the production per unit area, there is a dire need to use integrated potash fertilizer to enhance K-use efficiency and the productivity of rice.

Potassium is the 3rd major essential nutrient required for plant growth. The balanced and adequate use of integrated potash fertilizers has substantial effects on quality, ripening and grain yield. The indiscriminate use of K fertilizer can lower the yield and deteriorate the kernel quality.

Majority of Pakistani soils are calcareous in nature with pH value greater than 8.5 that affect K availability. The major fraction of potash fertilizer directly applied to soil gets fixed with clay fraction and becomes unavailable to crop plants. Further, the price of K fertilizers is getting higher day by day and becoming unaffordable to farmers (NFDC, 2005). The present study was, therefore, planned to determine the efficacy of soil incorporated potassium sulphate when applied alone and in combination with FYM for optimum economic returns from rice.

MATERIALS AND METHODS

The experiment was conducted at Rice Research Institute (PARC Rice unit area) Kala Shah Kaku, Lahore during the year 2010. The aim was to study the use of soil incorporated potassium sulphate when applied alone and in combination with FYM in order to evaluate the impacts on economic output and the yield of transplanted fine rice

"Super Basmati". The trial was laid out using Randomized Complete Block Design (RCBD) having three replications. The net plot size was 2.5 m x 5 m. The seed for raising seedlings was sown in 1st week of June and the seedlings were transplanted by trained manual laborers in the 1st week of July. Row to row and plant to plant distances were maintained at 20cm. All the agronomic operations except those under study were kept uniform for all the treatments. The treatments included in the experiment were control (No K_2SO_4 and FYM /T_1), soil application of K_2SO_4 @ 70 Kg ha^{-1} (T_2), FYM application @ 5 t ha^{-1} (T_3), FYM application @ 5 t ha^{-1}+K_2O @ 20 Kg ha^{-1} (T_4), FYM application @ 5 t ha^{-1}+K_2O @ 40 Kg ha^{-1} (T_5). All the phosphorus @ 90 Kg ha^{-1} applied as basal dose whereas N was applied in two split doses i.e half dose at land preparation and 2nd half at 1st irrigation. Ten plants from each plot were randomly selected to record the observations like plant height, grains $panicle^{-1}$, panicle length were differentiated and counted separately for further analysis. Data on plant height (cm), productive tillers m^{-2}, panicle length (cm), grains $panicle^{-1}$ (g), 1000 grain weight (g) and paddy yield (t ha^{-1}) were recorded.

The collected data were analyzed statistically by using STATISTIX software and the differences among the treatments' means were compared by the least significant differences (LSD) test at 5% probability level (Steel *et al*., 1997).

RESULTS AND DISCUSSION

Soil incorporated potassium sulphate when applied alone and in combination with FYM did not vary in affecting plant height (Table I). Plant height ranged 118.23-120.37.5 cm. These results corroborate the conclusion of Manzoor *et al*. (2008) who also recorded the non-significant effect of K application on plant height.

The data recorded for number of productive tillers m^{-2} indicated that tillers were affected significantly by both the soil incorporated potassium sulphate in combination with FYM application (Table I). It revealed that maximum number of productive tillers m^{-2} (421) were produced with the application of FYM @ 5 t ha^{-1} in combination with K_2O @ 40 Kg ha^{-1} and the least number of tillers m^{-2} (345.67) was experienced by control. The increase in number of tillers may be attributed to the availability of optimum nutrient and moisture availability especially at tillering stage. These findings are supported by Fageria *et al.* (2003) and Sarwar (2005) who revealed that the application of potassium sulphate alongwith FYM increased the tillering in rice.

Integrated potash nutrient application had non-significant affect on panicle length. However, maximum panicle length (26.34 cm) was attained when soil application of K_2SO_4 @ 70Kg ha^{-1} was applied, while minimum panicle length (24.63 cm) was recorded at FYM @ 5 t ha^{-1}.

Number of grains $panicle^{-1}$ was significantly affected by soil incorporated K_2SO_4 in combination with FYM. Maximum number of grains $panicle^{-1}$ (137.17) was produced from FYM @ 5 t ha^{-1}+K_2O @ 40 Kg ha^{-1}. Minimum number of grains $panicle^{-1}$ (85.27) was observed in control where no potassium sulphate and FYM was applied. Similar findings were also experienced by Balamurali *et al*. (2006) who reported that yield attribute (number of grains $panicle^{-1}$) increased due to the efficacy of FYM and inorganic fertilizer which ultimately improved the productivity of rice.

The data pertaining to 1000-grain weight (g) are presented in Table I. The data showed that the 1000-grain weight was significantly influenced by the integration of soil incorporated K_2SO_4 and FYM application. Among all the treatments, FYM @ 5 t ha^{-1} + K_2O @ 20 Kg ha^{-1} produced the maximum 1000-grain weight (21.60 g) followed by FYM @ 5 t ha^{-1} + K_2O @ 40 Kg ha^{-1}. Whereas the minimum 1000-grain weight (17.30 g) was recorded with control. However, FYM application @ 5 t ha^{-1} + K_2O @ 20 Kg ha^{-1} was statistically at par to that of FYM application @ 5 t ha^{-1} + K_2O @ 40 Kg ha^{-1} regarding 1000-grain weight. These results are in consistency to the conclusions of Sarwar (2005) and Bahmaniar *et al*. (2007) that significant differences for 1000-grain weight were found where potassium sulphate was applied in combination with FYM.

The treated plots had increasing effects on paddy yield than that of control. Among the treatments, FYM application @ 5 t ha^{-1} + K_2O @ 40 Kg ha^{-1} produced maximum paddy yield (6.11 t ha^{-1}) while, the lowest paddy yield (4.15 t ha^{-1}) was found in control. The enhancement in yield with potassium sulphate and organic fertilizer is credited to increase in number of tillers m^{-2}, grains $panicle^{-1}$ and thousand grain weight. These results are in conformity with those of Tiwari *et al.* (2001), and Singh *et al*. (2001) who claimed that the use of FYM will be more profitable to achieve the highest grain yield of rice. Zaka *et al*. (2003) also examined the similar findings regarding organic and inorganic fertilizers which significantly affected growth parameters and yield attributes that finally enhanced paddy yield.

Conclusion

The overall results of present investigations lead us to the conclusions that there is a significant impact of soil incorporated K_2SO_4 in combination with FYM on the yield and yield components of fine grain rice variety "Super

Basmati" under agro-ecological conditions of Kala Shah Kaku. The increase in paddy yield with the use of FYM in combination with K_2SO_4 is ascribed to the promoting effects on tillers m^{-2}, grains $panicle^{-1}$ and 1000-grain weight. It is recommended that FYM application @ 5 t ha^{-1} + K_2O @ 40 Kg ha^{-1} can increase paddy yield under paddy soil.

Table I. Effect of integrated potash nutrient application on rice.

Treatment	**Plant height (cm)**	**Tillers m^{-2}**	**Panicle length (cm)**	**Grains $panicle^{-1}$**	**1000-grain weight (g)**	**Paddy yield (t ha^{-1})**
T_1	119.90	345.67 c	24.81	85.27 c	17.30 b	4.15 d
T_2	120.37	402.00 ab	26.34	125.33 a	18.07 b	5.20 bc
T_3	118.23	366.33 c	24.63	101.83 b	18.40 ab	4.56 cd
T_4	118.27	396.00 b	25.43	102.47 b	21.60 a	5.45 ab
T_5	118.97	421.00 a	25.27	137.17 a	19.20 ab	6.11 a
LSD	NS	21.174	NS	15.156	3.2767	0.7713

T1 = Control (No K2SO4 and FYM) ; T2 = Soil application of K2SO4 @ 70Kg.ha-1; T3 = FYM application @ 5 t. ha-1; T4 = FYM application @ 5 t.ha-1+K2O @ 20 Kg.ha-1; T5 = FYM application @ 5 t.ha-1+K2O @ 40 Kg.ha-1; LSD = Least Significant Difference.
Same letters in each column are not significantly different according to DMR Test.

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