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Effect of Organic and Inorganic Manures on Growth and Yield of Rice Variety "Basmati–2000"

MUHAMMAD USMAN, EHSAN ULLAH, EJAZ AHMAD WARRIACH, MUHAMMAD FAROOQ AND AMIR LIAQAT
Department of Agronomy, University of Agriculture, Faisalabad–38040, Pakistan

ABSTRACT

A filed trial to determine the effect of organic and inorganic sources of nutrients on growth and yield of rice variety Basmat–2000, comprising of 11 different treatments using randomized complete block design with four replications was conducted at Post–Graduate Agricultural Research Station, University of Agriculture, Faisalabad. Application of NPK @ 50–37.5–30 Kg ha^{-1} along with poultry manure @ 20t ha^{-1} showed significantly maximum leaf area index (2.98), plant height at maturity (130.31 cm), grain yield (3.82 t ha^{-1}) and harvest index (46.46%). This treatment also produced maximum number of tillers per hill, number of grains per panicle, 1000–grain weight and straw yield which was at per with T_6, where NPK @ 50–37.5–30 kg ha^{-1} along with FYM @ 20 t ha^{-1} was applied.

Key Words: Organic; Inorganic; Manures; Rice basmati

INTRODUCTION

Chemical fertilizers are crucial input for improving fertility of soil and have become an integral part of modern crop production technology. There is no complete substitute of chemical fertilizers in our conditions because soils of Pakistan are generally low in organic matter due to less rainfall and high temperature. High cost and non–availability of fertilizers at the time of sowing and their adulteration poses great problem. Most of the farmers are using nitrogen alone and do not bother about the application of other macro and micro nutrients which are equally essential for improving crop productivity and quality. Indiscriminate use of chemical fertilizers is also creating environmental problem.

Rice is the staple food of large population of the world. It provides the primary food for more than two billion people and hundreds of million of people in Africa and Latin America. Due to low fertility status of Pakistani soils, average yields of are 2012 kg ha^{-1} against high yield potentials of new varieties (Anonymous, 2003). Balanced fertilization and availability of macro and micro nutrients is essential to explore the genetic yield potential of such an important crop. Earlier studies reveal that judicious and proper use of fertilizers can markedly increase the yield and improve the quality of rice (Place *et al*., 1970). According to Mahapatra (1971) proper fertilization can bring a breakthrough in rice production. Use of farm yard manures with chemical fertilizers increase the solubility of SSP from 32 to 40% and delays P fixation (Sharif, 1985). Machado *et al*. (1986) reported that organic fertilizers were essential for rice and particularly effective in combination with NPK increasing fertilizer use–efficiency. Present studies were, therefore, undertaken to evaluate the effect of various organic sources of nutrients alone and in combination with synthetic fertilizers.

MATERIALS AND METHODS

The studies pertaining to the effect of organic and inorganic sources of nutrients on the agronomic traits of fine rice were conducted at the Post–Graduate Agricultural Research Station, University of Agriculture, Faisalabad. The experiment was laid out in a randomized complete block design with four replications. The treatments were 0–0–0 Kg NPK ha^{-1} (T_1), 100–75–0 Kg NPK ha^{-1} (T_2), 100–75–60 Kg NPK ha^{-1} (T_3), FYM 20 t ha^{-1} (T_4), Poultry manure @ 20 t ha^{-1} (T_5), 50–37.5–30 Kg NPK ha^{-1} + FYM @ 20 t ha^{-1} (T_6), 50–375–30 Kg NPK ha^{-1} + PM @ 20 t ha^{-1} (T_7), 100–75–60 Kg NPK ha^{-1} + FYM @ 10 t ha^{-1} (T_8), 100–75–60 Kg NPK ha^{-1} + PM @ 10 t ha^{-1} (T_9), 50–37.5–30 Kg NPK ha^{-1} + FYM @ 10 t ha^{-1} (T_{10}) and 50–37.5–30 Kg NPK ha^{-1} + PM @ t ha^{-1} (T_{11}).

Two seedlings per hill were transplanted during 3rd weak of July in the Pattern of 20 x 20 cm hills. Rice cv. Basmati 2000 was used as a medium of trial. Manures were added as per treatments, FYM and PM was added 10 days before transplanting. Growth parameters like leaf area index, plant height and yield parameters like number of tillers per hill, number of grains per panicle, 1000–grain weight, paddy yield and BCR were recorded by following standard procedures. The data were analyzed statistically by using Fisher's analysis of variance technique at 5% probability level (Steel & Torrie, 1980).

RESULTS AND DISCUSSION

Leaf area index. The data regarding leaf area index is presented in Table I. Data reveals that poultry manure @ 20 t ha^{-1} in combination with chemical fertilizers @ 50–37.5–30 Kg NPK ha^{-1}, produced maximum leaf area index (2.8), which was followed by results against application of FYM @ 20 t ha^{-1} in combination with 50–37.5–30 Kg NPK ha^{-1} giving 2.88 leaf area index. Inorganic sources of nutrients @

100–75–60 Kg NPK ha^{-1} and 100–75–0 Kg NPK ha^{-1} produced 2.58 and 2.52 leaf area indices. Similarly, organic manures alone gave very poor values of leaf area index as compared to that of inorganic manures. Maximum leaf area index in response to poultry manure @ 20 t ha^{-1} along with 50–37.5–30 Kg NPK ha^{-1} than all other treatments might be due to high decomposition rate of PM as compared to FYM (Salim *et al*., 1986). It might also be due to better physiological growth of plants, as organic matter by ameliorating the micro nutrients deficiencies and by increasing the cation exchange capacity of soil, improved nutrients availability and enhanced growth. These results are in line with the findings of Singh and Ram (1976).

Plant height. Plant height is not a yield component especially in grain crops but it indicates the influence of various nutrients on plant metabolism. It was found that application of mineral fertilizers increased the plant height significantly over organic sources when applied separately. But significantly maximum plant height (130.31 cm) was obtained in plots where poultry manure @ 20 t ha^{-1} was applied in combination to mineral fertilizer @ 50–37.5–30 Kg NPK ha^{-1}. These results were followed by the application of same amount of mineral fertilizers along with FYM @ 20 t ha^{-1} (Table I). Inorganic sources of nutrients when applied separately (T_3) showed 127.13 cm average plant height. Significantly lowest plant height was recorded for control.The increase in plant height in response to combined application of organic and inorganic manures is might be due to enhanced availability of macro nutrients as well as micro nutrients. These results are supported by the findings of Gunaseena and Ahmad (1961) who reported that the use of organic manures in combination with mineral fertilizers maximized the plant growth and yield.

Number of tillers per hill. Number of tillers per plant or per unit area is the most important component of yield. More the number of tillers, especially fertile tillers, the more will be the yield. In present study combined use of organic manures @ 20 t ha^{-1} FYM or poultry manure and mineral fertilizers @ 50–37.5–30 Kg NPK ha^{-1}, produced maximum number of tillers per hill (11.90) than all other treatments. (Table I) the maximum tillering in above mentioned treatments might be attributed to the more availability of nitrogen, that played a vital role in cell division. Besides this tillering also depends largely upon soil physical conditions that were improved by the addition of organic matter. These results are in accordance to the findings of Rajput *et al.* (1988), Bhuiya and Akhand (1983) and Goplswamy and Vidhyasekaram (1987).

Number of grains per panicle. The data pertaining to the number of grains per panicle against various combination of organic and inorganic sources of nutrients reveal that organic manures (20 t ha^{-1} PM) along with chemical fertilizers @ 50–37.5–30 Kg NPK ha^{-1}, produced maximum number of grains per panicle (95.63). These results were statistically at par with that of treatment T_6 in which FYM @ 20 t ha^{-1} (organic source) applied along with same amount of chemical fertilizers giving 95.58 number of grains per panicle. Significantly lowest number of grains per panicle i.e. 76.83 was obtained from control treatment. More number of grains per panicle in treatments T_7 and T_6 might be due to better utilization of phosphorus in the presence of organic manures, as phosphorus being a part of DNA played a vital role in the building of genetic ports of plants. These results are supported by the findings of Ceausu *et al*. (1986) who reported that P uptake from labelled mono calcium phosphate (relatively less available to plants) was significantly increased by addition of organic manures. These results are also in accordance to that of Jilani (1988).

1000–grain weight (g). Organic manures (FYM and Poultry Manure) in combination with Chemical fertilizers influenced the 1000–grain weight significantly over control. Maximum 1000–grain weight (19.02 g) was recorded for the treatment in which poultry manure @ 20 t ha^{-1} was applied along with chemical fertilizers @ 50–37.5–30 Kg NPK ha^{-1}. This was followed by treatment T_6 (FYM @ 20 t ha^{-1} + 50–37.5–30 Kg NPK ha^{-1}) giving 18.94 g 1000–grain weight. Chemical fertilizers applied alone in the form NPK

Table I. Effect of organic and inorganic manures on growth and yield of rice variety Basmati-2000

Treatments	Leaf area index	Plant Height (cm)	No. of grain per hill	No. of grain per panicle	1000-grain weight (g)	Paddy yield (t ha^{-1})	Benefit cost ratio
T_1= 0-0-0 Kg NPK ha^{-1}	1.81 k	105.70 c	7.03 e	76.83 h	16.56 g	1.41 c	1.12
T_2= 100-75-0Kg NPK ha^{-1}	2.52 I	121.81 gh	11.58 ab	86.95 d	17.67 de	2.56 e	1.54
T_3 = 100-75-60 Kg NPK ha^{-1}	2.58 d	127.13 c	11.05 b	90.70 b	18.76 b	3.16 cd	1.70
T_4 = Farm Yard Manure 20 tha^{-1}	1.56 j	121.10 h	8.68 d	82.32 g	17.11 f	2.01 h	1.45
T_5 = Poultry Manure 20 tha^{-1}	1.71 c	123.50 f	11.32 ab	84.09 f	17.52 c	2.41 f	1.69
T_6 = 50-37.5-30 Kg NPK ha^{-1} + FYM @ 20 tha^{-1}	2.88 b	128.80 b	11.90 a	95.58 a	18.94 ab	3.45 b	2.00
T_7 = 50-37.5-30 Kg NPK ha^{-1} + P.M @ 20 tha^{-1}	2.98 a	130.31 a	11.90 a	95.63 a	19.02 a	3.82 a	2.16
T_8 = 100-75-60 Kg NPK ha^{-1} + FYM @ 20 tha^{-1}	2.31 f	126.33 cd	11.53 ab	90.12 b	17.85 d	3.1 d	1.63
T_9 = 100-75-60 Kg NPK ha^{-1} + P.M @ 20 tha^{-1}	2.78 c	125.91 d	11.34 ab	88.38 c	17.24 f	3.22 c	1.68
T_{10} = 50-37.5-30 Kg NPK ha^{-1} + FYM @ 10 tha^{-1}	2.00 h	122.60 fg	10.11 c	86.16 e	17.61 e	2.13 g	1.83
T_{11} = 50-37.5-30 Kg NPK ha^{-1} + P.M @ 10 tha^{-1}	2.20 g	124.74 c	10.91 b	90.22 b	18.15 c	2.11 d	1.83

LSD = 0.05; Any two mean not sharing a letter in common differ significantly at 0.05

@ 100–75–60 Kg ha^{-1} produced relatively less 1000–grain weight (18.76 g) than that of above said treatments. The reasons for higher 1000–grain weight against combined application of organic and inorganic manures might be due to higher solubility of phosphorus and slow release of nitrogen. Significantly minimum 1000–grain weight was produced by control treatment. All the other treatments showed moderate results. These results are also in line to the findings of Mondal *et al*. (1990).

Paddy yield (t ha^{-1}). The results presented in Table I, showed pronounced increase in paddy yield by the application of different fertilizer combinations. Among the organic fertilizers applied separately, poultry manure @ 20 t ha^{-1} showed better results against the same amount of Farm Yard Manure giving 2.4 t ha–1 and 2–01 t ha^{-1} paddy yield, respectively. In case of mineral fertilizers, NPK @ 100–75–60 Kg ha^{-1} (T_3) produced maximum yield of 3.16 t ha^{-1} over the plots fertilized @ 100–75–0 Kg NPK ha^{-1} (T_2) which gave 2.56 t ha^{-1} paddy yield. Significantly lowest grain yield was obtained from the plots where no manure was added (T_1).

On overall basis significantly maximum paddy yield of 3.82 t ha^{-1} was produced by combined application of organic manures (Poultry manure @ 20 t ha^{-1}) along with chemical fertilizers @ 50–37.5–30 Kg NPK ha^{-1} (T_7). These results were followed by that of farm yard manure @ 20 t ha^{-1} applied in combination with the same amount of mineral fertilizers, giving 3.45 t ha^{-1} paddy yield.

Yield is attributed to different yield components. In this study yield contributing parameters like number of tillers per hill, number of grains per panicle and 1000–grain weight were significantly increased by combined effect of organic and inorganic sources of nutrients. This might be due to decrease in number of abortive kernels per panicle as a result of integrated use of nutrients (Jilani, 1988). Organic manures, as discussed earlier, increased the fertilizer use efficiency and improved the physical and chemical properties of soil hence making better utilization of nutrients might also be a reason towards increased yield Mondal *et al*. (1990), Sharma and Mitra (1990), Salim *et al*. (1997) and Rashid *et al*. (1999) also reported similar findings.

Benefit cost ratio. According to data presented in Table I, the highest value of benefit cost ratio was observed in case of combined application of organic manure in form of poultry manure @ 20 t ha^{-1} (T_7). These results were followed by that of treatment T_6 in which organic manure in the form of FYM @ 20 t ha^{-1} was applied along with same amount of mineral fertilizers giving 2.00 value of benefit cost ratio.

Among organic sources of nutrients applied separately, Poultry manure @ 20 t ha^{-1} gave higher BCR value of 1.69 than that of FYM @ 20 t ha^{-1}, giving 1.45 BCR value. In case of chemical fertilizers, the plots that were fertilized with 100–75–60 kg NPK ha^{-1} (T_3) gave 1.70 value of BCR than that of treatment T_2 in which chemical fertilizers were applied @ 100–75–0 Kg NPK ha^{-1}, giving 1.54 value of BCR. Significantly minimum value for benefit cost ratio (1.12) was recorded in control.

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