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ENHANCING GROWTH AND YIELD OF DIRECT SEEDED RICE THROUGH INTEGRATED NUTRIENT MANAGEMENT UNDER DERA ISMAIL KHAN CONDITIONS

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ABSTRACT

The research study was conducted on farmer's field in village Dhakki, Dera Ismail Khan (KPK) during Kharif season, 2011 to determine the effect of integrated nutrient management on the growth and yield of direct seeded rice. Treatments were assigned randomly using RCBD having three replications. IR-6 was used as test variety. The net plot size was 2.5 x 5(12.5m^2) with10 rows. Treatments were T_1 = wheat straw @ 5 t ha^{-1} alone, T_2 = wheat straw @ 5 t ha^{-1} + P_2O_5 @ 30 Kg ha^{-1} , T_3 = wheat straw @ 5 t ha^{-1} + P_2O_5 @ 60 Kg ha^{-1} and T_4 = P_2O_5 @ 90 Kg ha^{-1} alone. Effect of wheat residues/straw and different phosphorus levels showed significant variations for plant height (cm), productive tillers m^{-2}, number of grains panicle^{-1}, panicle length (cm),1000 grain weight (g) and that the treatment T_2 (wheat straw @ 5 t ha^{-1} + P_2O_5 @ 30 Kg ha^{-1}) performed the best and gave the maximum paddy yield of 7.35 t ha^{-1}. It was concluded that selection of suitable cultivars, timely planting and accurate use of phosphorus with organic fertilizers, rates of fertilizer can be reduced by 50% thus sustaining the agricultural productivity and reducing environmental degradation.

Key-words: Aerobic Culture, Phosphorus , Wheat Residues, Growth and Paddy yield.

INTRODUCTION

Rice (*Oryza sativa* L.) is the second largest staple food crop after wheat and is a leading cash crop in irrigated agriculture in Pakistan. Rice is one of the most important cereal crops of the world in terms of food, area and production (Niamatullah *et al*. 2010). It occupies a significant position in formulation of agricultural policies and is the largest foreign exchange earner after cotton but Pakistan is still far behind than other rice producing countries and therefore low paddy yields are serious threats to the sustainability of farmer's livelihood. Pakistan is basically an agricultural country but agriculture in this country suffers from low production due to low yield per unit area (Awan *et al*. 2011). 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 6.7% of value added in agriculture and 1.6% in GDP (Annon, 2009-10). Pakistan ranks 4th country in the world for rice export but the average rice yield per hectare is only 2500 kg ha^{-1} which is too low as compared with many rice growing countries of the world. Per acre average yield at farmers level is also very low as compared to Egypt (8.4 t ha^{-1}) and U.S.A. (6.6 t ha^{-1}). It is grown in 111 countries ranging from the flood plains of Bangladesh to the Himalayan foothills of Nepal and from the rain forests of Indonesia to the desert plains of Australia (IRRI, 1995).

Food security can only be achieved by increasing yield of crops. Major problem in obtaining high crop yield in field crops is the unavailability of nutrients in balanced quantity. Deficiency of phosphorus is of serious concern for agricultural productivity on more than 90% of Pakistani soils. In addition high pH and carbonate contents in the soil may limit its utilization by plants. Application of phosphorus with additional use of wheat crop residues would be a promising strategy for enhancing P use efficiency and productivity of cropping system. Wheat crop residues are a good organic source of nutrients. Now, agriculture has been transformed to mechanized farming. Therefore, most of the wheat growers harvest the wheat crop with the combine harvester before planting rice crop. But instead of incorporating wheat residue/maintain/improve straw into the soil to its fertility status, people generally burn it. There is a need of the time to mould the people to get advantage of this rich source of nutrients. Ghosh and Singh (1998) reported that adequate nutrition, timely planting and proper plant protection are essential for improving the growth variables responsible for high paddy yield. An ample supply of available phosphorus may stimulate growth, result in early maturity and when used in conjunction with other plant nutrients, phosphorus fertilizers greatly increase crop yield and growers net income.

Since phosphatic fertilizes prices are increasing continuously there is a need to assess the contribution of P coming from crop residues and therefore the present research project was initiated to determine the effect of integrated nutrient management on the growth and yield of direct seeded rice for higher paddy yield under the agro-climatic conditions of D.I.Khan.

MATERIALS AND METHODS

The research work was carried out on farmer's field in village Dhakki, Dera Ismail Khan (KPK) during the year, 2011 to determine the effect of integrated nutrient management on the growth and yield of direct seeded rice. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. The net plot size was 2.5 x 5m (12.5m^{-2}) with 10 rows. IR-6 was used as test variety of rice crop. After chopping and mixing the wheat residues, the seedbed was prepared. A recommended dose of 120 N kg ha^{-1} as Urea and 70 kg K_2O ha^{-1} as SOP were applied at the time of final land preparation. Half of the N and full dose of K was applied at the time of sowing and remaining half of N was applied at panicle emergence stage. The treatments included in the experiment were T_1 = wheat straw @ 5 t ha^{-1} alone, T_2 = wheat straw @ 5 t ha^{-1} + P_2O_5 @ 30 Kg ha^{-1} , T_3 = wheat straw @ 5 t ha^{-1} + P_2O_5 @ 60 Kg ha^{-1} and T_4 = P_2O_5 @ 90 Kg ha^{-1} alone. All the agronomic operations except those under study were kept normal and uniform for all the treatments. Irrigation was applied whenever required and the water level on the soil surface was maintained to a depth of 5cm from seeding till maturity. Last irrigation was applied one week before harvesting. There were three replicate to each treatment.

The soil of the experimental field was silty clay with a pH of 8.3 and organic matter content of <1% (Table 1). Data were recorded on final plant height (cm), productive tillers m^{-2}, panicle length (cm), number of grains panicle^{-1}, 1000-grain weight (g), and paddy yield (t ha^{-1}).The 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).

Table I. Soil analysis report of experimental area.

Symbol	Unit	Symbol	Unit
PH	8.3	P	6.7 mg/kg
EC	0.980 dS/m	K	232 mg/kg
Ca + Mg	7.42 meq/L	Zn	1.236 mg/kg
HCO3	0.87 meq/L	Sand	16.4%
Cl	1.25 meq/L	Silt	42.0%
OM	0.78%	Clay	41.6%
N	0.028%	Textural class	Silty clay

RESULTS AND DISCUSSION

The ability of wheat crop residues in conjunction with various levels of phosphorus produced tallest plants and that the plot with the use of wheat straw @ 5 t ha^{-1} with P_2O_5 as DAP @ 60 Kg ha^{-1} resulted in more plant height (126.40 cm) as compared to other treatments. The lowest plant stature (116.40 cm) was recorded in the treatment where wheat straw @ 5 t ha^{-1} was applied alone. These results are in line with the observations of Byous *et al.* (2004) who found that plant nutrients remain in the wheat straw (approximately 35% N, 30% P, 85% K and 40-50% S) much of this can be recycled for subsequent crop growth after its decomposition.

Tillering capacity of a plant depends on the genotype and environment. The application of phosphorus in combination with wheat crop residues had significant effect on number of tillers m^{-2}. The treatment of wheat straw @ 5 t ha^{-1} with P_2O_5 as DAP @ 30 Kg ha^{-1} produced more tillers m^{-2} (359.33). The minimum number of tillers m^{-2} (314.67) was produced in the treatment of wheat straw @ 5 t ha^{-1} alone. These results are in consonance with the findings of Swarup and Yaduvanshi, (2000) who reported that tillers increased with the use of phosphorus fertilizers in combination with wheat crop residues.

Phosphorus application alone or in combination with wheat crop residues significantly affected panicle length. Maximum panicle length (28.13 cm) was attained when wheat straw @ 5 t ha^{-1} with P_2O_5 as DAP @ 30 Kg ha^{-1} was applied. Minimum panicle length (24.03 cm) was recorded in the treatment where wheat straw @ 5 t ha^{-1} alone was used. The present results are in agreement with Tanaki *et al.* (2002) who studied the growth and yield of rice with organic farming in comparison with inorganic fertilizers (conventional farming) found that the growth and yield of rice increased with continuous organic farming.

The data showed that soil application of phosphorus (P_2O_5) in combination with wheat residues for producing the number of paddy grains panicle^{-1} was significant. The treatment of wheat straw @ 5 t ha^{-1} with P_2O_5 as DAP @

30 Kg ha^{-1} gave the maximum number of paddy grains $panicle^{-1}$ (123.23) whereas minimum number of paddy grains $panicle^{-1}$ (104.60) was recorded in the plot where P_2O_5 as DAP @ 90 Kg ha^{-1} was applied alone. Balamurali *et al.* (2006) claimed that yield attribute (number of grains $panicle^{-1}$) increased due to the efficacy of organic and inorganic fertilizers which ultimately enhanced paddy yield.

The use of organic materials with inorganic fertilizers was found beneficial for 1000 grain weight of paddy. It was obvious that maximum weight of 1000 paddy grains (24.92 g) was recorded in T_2 (wheat straw @ 5 t ha^{-1} with P_2O_5 as DAP @ 30 Kg ha^{-1}) whereas the minimum 1000 weight of paddy grains (19.91 g) was found in T_4 when P_2O_5 as DAP @ 90 Kg ha^{-1} was applied alone. However, wheat straw application @ 5 t ha^{-1} alone was statistically at par to that of wheat residues application @ 5 t ha^{-1} with P_2O_5 as DAP @ 60 Kg ha^{-1} regarding 1000-grain weight. The present findings are in conformity with those of Sarwar (2005) who reported that the grain yield and yield components (plant height, number of fertile tillers and 1000 grain weight) of rice and wheat increased significantly with the application of chemical fertilizers in combination with different organic materials but compost proved the most superior in this regard.

Crop productivity is the rate at which a crop accumulates organic matter due to the rate of photosynthesis and conversion of light energy into chemical energy by green plants (Reddy, 2004). The most important parameter and ultimate task of farming is paddy yield which was affected significantly with various levels of phosphorus and wheat crop residues. It can be observed from data that the application of wheat straw @ 5 t ha^{-1} with P_2O_5 as DAP @ 30 Kg ha^{-1} produced maximum paddy yield of (7.35 t ha^{-1}) while the use of wheat straw @ 5 t ha^{-1} alone produced lowest paddy yield of (4.16 t ha^{-1}). The use of wheat straw @5 t $ha^{-1}$with small quantity of phosphorus fertilizer produced the highest grain yield due to maximum number of tillers m^{-2}, panicle length (cm), grains $panicle^{-1}$ and 1000 seed weight (gm). Similar results were reported by Sarwar (2005) who recorded that the grain yield of rice and wheat increased significantly with the application of chemical fertilizers in combination with different organic materials. Eagle *et al.* (2000) who also reported that crop residues increased the organic carbon and nutrient contents; decreased soil bulk density and increased the crop yields.

Table 2. Effect of Integrated Nutrient Management on the growth and yield of Direct Seeded 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	116.40 c	314.67 b	24.03 c	108.57 c	20.20 b	4.16 c
T_2	121.97 b	359.33 a	28.13 a	123.23 a	24.92 a	7.35 a
T_3	126.40 a	346.33 a	26.30 b	118.37 b	21.80 b	5.29 b
T_4	121.67 b	321.33 b	24.63 bc	104.60 d	19.91 b	5.05 bc
LSD	1.6936	13.290	1.8092	1.3097	2.7600	1.0540

T_1 = wheat straw @ 5 t ha^{-1} alone; T_2= wheat straw @ 5 t ha^{-1} + P_2O_5 @ 30 Kg ha^{-1}
T_3= wheat straw @ 5 t ha^{-1} + P_2O_5 @ 60 Kg ha^{-1}
T_4 = P_2O_5 @ 90 Kg ha^{-1} alone; LSD = Least Significant Difference

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