Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2017; 6(6): 110-112
Received: 21-09-2017
Accepted: 22-10-2017

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Substitution of nitrogen requirement of rice (*Oryza sativa*) through organic and inorganic sources of nutrients in irrigated sub tropical foot Hills of Jammu

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Abstract
An experiment entitled "Studies on direct and residual effects of organic and inorganic sources of nutrients in rice-wheat cropping system" was conducted at research farm, FOA, Main Campus Chatha of SKUAST-Jammu during *kharif* season of 2006-07 and 2007-08. The soil of experiment site was sandy loam in texture with slightly alkaline in reaction (pH-8.1), medium in organic carbon (0.55 percent), low in available nitrogen and medium in available phosphorus and potassium. The field trial of Rice variety PC-19 was laid out in RBD. The treatments consisted of control, 100 percent N through vermicompost and farmyard manure and inorganic fertilizer (NPK) and in combination with 25 -50 percent N through vermicompost and farmyard manure.). Application of 100 inorganic fertilizer (NPK) brought about significant improvement in yield attributes and yield of rice (number of panicles m^{-2}, length of panicles, grain weight panicle^{-1}, number of grains panicle^{-1} and 1000-grain weight over the application of organic sources of nutrients and their combination with inorganic fertilizer during 1st year. Application of organic sources of N through vermicompost in the ratio of 75:25 (T8) increased the grain and straw yield significantly as against the rest of the organic sources and their combinations. Where as during 2nd year combination of vermicompost and inorganic fertilizer (75: 25) found to produce significant influence on yield attributes, yield of rice.

Keywords: Rice; FYM; Vermicompost; Inorganic fertilizer

Introduction
Rice occupies 11 percent of world agricultural land. Asia dominates the world in rice production as it accounts for about 90 percent of world's rice area and 92 percent of production. Asia being the most populated region of the world the major proportion of rice produced is consumed within the continent. Rice is the most important crop of India and it occupies 23.3 percent of gross cropped area of the country (Joshi and Tripathi.2006) [10]. Rice contributes 43 percent of total food grain production and 46 percent of total cereal production. It continues to play vital role in the national food grain supply. Among the rice growing countries in the world, India has the largest area under rice crop (about 45 million ha.) and ranks second in production next to China. (Anonymous 2007) [1]. Rice has a unique position in Indian economy and its industry has an extremely rich legacy. In Jammu and Kashmir it also plays a significant role in livelihood of people. Although area under rice is very small of about 0.27 m ha. Rice productivity in the state is high of about 2.2 t ha^{-1} compared to national average productivity 1.9 t ha^{-1} (Gupta *et al*.2009) [7].

To sustain high yield, the soil must contain adequate supply of nutrients. Most of the soils in India have been exhausted due to continuous crop production and use of high nutrient demanding crop varieties. The importance of chemical fertilizer in agriculture production can't be over emphasized but excess and imbalanced use showed reduction in soil fertility status and yield by 38 percent of rice crop (Singh, 2006) [14]. More recently, attention is being focused on the global environmental problems; utilization of organic wastes, FYM, compost, vermicompost and poultry manures as the most effective measure for the purpose. Organic materials are the safer sources of plant nutrient without any detrimental effect to crops and soil. Cowdung, farm yard manure, poultry manure and also green manure are excellent sources of organic matter as well as primary plant nutrients (Pieters, 2004) [12]. These causes have led to renewed interest in use of renewable sources (organic) and prompted the scientist to find out an alternative on sustained basis by optimizing all possible combinations of organic and inorganic sources of nutrients for crop production.

Materials and Methods

The present investigation entitled, substitution of nitrogen requirement of rice (*Oryza sativa*) through organic and inorganic sources of nutrients in rice-wheat system. The field experiment was conducted at research farm of division of Agronomy, Sher-e-Kashmir University of Agricultural Sciences and Technology of Jammu at main campus Chatha, during the year 2006-07 and 2007-08. The soil of the experiment field was sandy-loam in texture, slightly alkaline in reaction (pH-8.1), medium in organic carbon (0.55 percent), low in available nitrogen and medium in available phosphorus and potassium. Jammu is located at latitude of 32^0-$40^/$ N and longitude of 74^0-$58^/$ E with an altitude of 332 m above mean sea level. The climate of the experimental site is sub-tropical in nature and endowed with hot and dry early summer followed by hot and humid monsoon and cold winter. The mean annual rainfall varies from 1050-1115 mm of which 70 percent is received from south-west monsoon (June-September). The maximum and minimum temperature during the crop growing season ranged from 13.9 to 42.9 ^{0}C and 2.8 to 27.1 ^{0}C, respectively in year 2006-07 and maximum and minimum temperature ranged from 16.6 to 40.8 ^{0}C and 1.7 to 28.7 ^{0}C, respectively in crop season 2007-08. The mean weekly relative humidity ranged from 35 to 82 percent and 42 to 86.50 percent in the year 2006-07 and 2007-08, respectively. The total weekly rainfall ranged between 0 to 113.2 mm in 2006-07 and 0 to 242 mm during 2007-08.

Rice variety PC-19 seed sown @ 40 kg ha^{-1} in nursery and transplanted at three leaf stage, The experiment was laid out in RBD for raising rice crop with 8 treatments comprised of organic and inorganic sources of nutrients applied singly and in combination at different levels. The treatments were randomized and replicated thrice. In rice treatments consisted of T_1- control (without chemical fertilizers and organics), T_2- 100 percent N through farmyard manure, T_3- 100 percent N through vermicompost, T_4 -100% recommended dose of fertilizer (RDF), T_5 - 50% RDF +50% N through FYM, T_6 - 75% RDF +25% N through FYM, T_7 -50% RDF +50% N through Vermicompost and T_8 -75% RDF +25% N through vermicompost. The soil samples of the experimental material were analyzed by adopting standard laboratory procedure as described by (Jackson, 1967) and Olsen *et al*. (1954).Nitrogen was applied at the rate of 120 kg ha-1 through different organic sources along with two additional treatments which were recommended doses of NPK through chemical fertilizer (120 kg N: 60 kg P_2O_5:60 kg K_2O) and without control. The organic sources farm yard manure and vermicompost and inorganic source was urea. Phosphorus and potassium were applied through diammonium phosphate and muriate of potash, respectively. The half of the recommended dose of nitrogen and full dose of phosphorus and potassium were applied as basal at the time of transplanting and rest 50 percent was top dressed in two equal splits (coinciding maximum tillering and panicle initiation stage) at the time one month after transplanting of rice. The total amounts of organics were applied 15 days before transplanting of rice var. PC-19.

Results and Discussion

Yield attributing characters

Number of tillers and panicles m^{-2}

Tillering is an important trait for grain production and is thereby an important aspect of rice growth improvement. Production of tillers in rice plant was also influenced by different fertilizer combination at all the growth stages. The data regarding effective number of tiller m^{-2} and number of panicle m^{-2} are shown in table1. Perusal of data showed significant variation in these parameters among the different nutrient sources, application of treatment T_4 {N, P and K (inorganic fertilizer)} at recommended dose resulted in significant increase in number of tillers m^{-2} compared to those recorded in the remaining treatments followed by T_8 (75% RDF +25% N through vermicompost) and T_6 (75% RDF +25% N through FYM). Remaining treatments produced significantly less number of tillers m^{-2} and number of panicle m^{-2} except control. On the other hand, the trend during 2007-08 was little different. T_7 recorded significantly higher number of tillers and panicle m^{-2} compared to those recorded in the remaining treatments followed by T_5 where it behaved similarly with T_4.These results are also in conformity with the findings of (Sharma,2001) [13].

Number of filled grains per panicle

The data pertaining to grains panicle-1 as affected by different treatments are shown in table1. An analysis of data clearly revealed significant variation due to different treatments in both the years of experiment. All the treatments were significantly superior over T_1 (Control) during both years. During 2006-07, T_4 (N, P and K at recommended dose) recorded significantly higher number of grains $panicle^{-1}$ compared to all the remaining treatments followed by T_8 which showed its superiority over T_7, T_5, T_3 ,T_2 and T_1. On the contrary, during 2007-08, T_7 showed its superiority over all the remaining treatments followed by T_5 which proved significantly superior to T_4, T_8, T_6, T_2 and T_1.

1000 - Grains weight

A perusal of data revealed that during 1st year, T_4 showed its superiority by recording significantly highest test weight compared to all the remaining treatments. Treatment T_8 and T_6 also proved their superiority over all the remaining treatments except T_3 where the differences were of the similar magnitude. On the contrary, during 2007-08, T_7 showed its superiority over all the remaining treatments. Whereas, all other treatments behaved similarly and did not show significant variation except T_1 (control). (Hossain *et al*.2000) [8]

Grain and straw yield of rice

The grain and straw yield of rice (q ha^{-1}) as influenced by different treatments is presented in Table 2. During 1st year of experiment, T_4 (NPK at recommended dose) produced significantly highest grain yield compared to all the remaining treatments. The 2nd highest grain yield was produced when T_8 was applied followed by T_6, where the differences were of the similar magnitude. Similarly, T_8 and T_6 proved their superiority over T_7, T_5, T_3, T_2 and T_1. T_2 (100% N through FYM) produced the lowest grain yield except T_1 (control). On the other hand, during 2007-08, T_7 recorded significantly highest grain yield over the remaining treatments followed by T_5 which was statistically at par with T_4 which also behaved similarly and statistically at par with T_8.The grain yield of rice further declined in the treatment T_6 and T_3 where the differences were also of the similar order followed by T_2.

In the case of straw yield, during the 1st year, T_4 and T_8 out yielded all the remaining treatments. Similarly, T_4 and T_8 proved their superiority over T_6, T_7, T_5, T_3, T_2 and T_1 while the differences between former two treatments were not up to the mark. However, during 2007-08, maximum straw yield was recorded in plot T_7 which was statistically at par with T_4,

T_8, T_6, T_5 and was significantly higher than all the remaining treatments.

Harvest Index

Scanning of data pertaining to harvest index (Table 2) showed significant variation on HI due to various treatments in both the tears of field trial. It is obvious from the data that incorporation of chemical fertilizer (T_4) produced significantly improvement in HI over the rest of the treatments. Whereas during the 2nd year T_7 and T_5 produced significantly highest HI and were at par with each other followed by T_4 however, all other treatments did not show any consistent trend due to different treatments applied but lowest harvest index was obtained in control.

Table 1: Effect of various treatments on yield attributes of rice in rice-wheat cropping system

Treatments	Number of tillers m^{-2}		Number of panicles m^{-2}		Number of grains $panicle^{-1}$		1000-grain weight(g)	
	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
Direct effects of organic and inorganic sources								
T_1	199.33	204.33	140.33	150.66	70.47	70.75	18.63	18.86
T_2	271.11	305.48	206.00	230.66	85.84	91.85	20.76	22.08
T_3	294.11	312.48	222.33	236.66	91.51	95.18	21.06	22.84
T_4	314.69	319.33	238.33	240.33	98.41	98.18	23.11	23.01
T_5	291.33	321.05	218.66	235.66	88.83	100.86	20.75	23.09
T_6	306.58	309.41	228.00	229.33	93.38	97.03	21.66	21.88
T_7	296.75	326.49	223.66	242.00	90.41	104.10	20.96	24.24
T_8	310.63	315.41	233.00	231.66	94.08	98.85	22.06	22.34
C.D. ($p=0.05$)	3.93	4.63	4.67	4.78	2.44	2.24	0.68	1.05

Table: 2 Effect of various treatments on Grain yield (q ha^{-1}), Straw yield (q ha^{-1}) and Harvest Index (%) of rice in rice-wheat cropping system

TREATMENTS	Grain yield (q ha^{-1})		Straw yield (q ha^{-1})		Harvest Index (%)	
	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
Direct effects of organic and inorganic sources						
T_1	21.84	21.52	39.17	38.46	35.79	35.88
T_2	29.46	35.32	48.36	53.95	37.86	39.66
T_3	34.47	38.86	55.85	58.14	38.17	40.06
T_4	42.44	42.42	62.38	62.74	40.48	40.24
T_5	35.58	43.50	56.12	62.31	38.79	41.11
T_6	39.00	40.04	59.81	60.31	39.47	39.90
T_7	36.97	45.47	57.71	63.75	39.05	41.63
T_8	40.55	41.92	62.08	62.31	39.51	40.22
C.D. ($p=0.05$)	1.79	1.57	2.38	2.40	1.22	0.75

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