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Nitrogen phosphorus and potassium uptake by grain and straw of wheat as influenced by long term inorganic and integrated nutrient management under rice: Wheat cropping system

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Abstract
Experiments were conducted during *kharif 2019-20* and 2020-21 at Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya Raipur (C.G.). The soil of experimental field was clayey (*Vertisols*) in texture, locally known as "*Kanhar*" which was low, medium and high in available N, P_2O_5 and K_2O, respectively. Experiment with both the crops *i.e.* rice and wheat was laid out in randomized block design with four replications having ten treatments. The treatments for both the crops were T_1: control, T_2: 50% RDF, T_3: 100% RDF, T_4: 150% RDF, T_5: 100% RDF+$ZnSO_4$ ($ZnSO_4$ Applied only *kharif*)., T_6: 100% NP, T_7: 100% N, and T_8: 100% RDF+FYM (FYM applied only *kharif*), T_9: 50% RDF+BGA (BGA applied only kharif), T_9: 50% RDF+GM (GM Applied only *kharif*). The application of T_4: 150% RDF produced the highest growth yield and yield attributing parameters which was statistically similar to the treatments of T_3:100% RDF, T_5:100% RDF + $ZnSO_4$, T_6: 100% N and P_2O_5 and T_8: 100%+FYM, at all stages of crop growth. The lowest growth and yield attributing parameters were observed under control where no nutrient was applied during both the years and on mean basis.

Keywords: Phosphorus, potassium, influenced, integrated, cropping

Introduction
Long term Fertilizer experiments are the best tool to assess the influence the continuous application of fertilizers, organic manures used alone or combined on sustainability and soil fertility. To achieve the higher yield of wheat, inorganic fertilizers were used with little or no addition of organic manure. Even though the inorganic fertilizers were resulted in higher crop yield, over reliance on them associated with declined soil properties and degraded soils by especially organic matter, soil biota and in turn decreased yield in subsequent period. This have also caused environmental hazards such as ground and surface water pollution by nitrate leaching that may deteriorate human and animal health (Pimentel, 1996). Majority of small and marginal farmers do not have financial resources to purchase sufficient fertilizers to replace soil nutrients removed through crop harvests. As a result, soil fertility has declined, and yields of staple food crops are typically low (Sanchez *et al.*, 1997).
So to reduce the amount of chemical fertilizers applied the field without resulting in its deficiency will be the main challenge in fertilizer management in the field. One of the possible options to reduce their use could be recycling of locally available organic wastes, *viz*. crop residue, green manure and farmyard manure (FYM), which can be a valuable and inexpensive source of plant nutrients. Positive effects of organic wastes on soil structure, aggregate stability and water-holding capacity have been well documented (Odlare *et al.*, 2008 and Wells *et al.*, 2000).

Materials and Methods
Experiment was conducted during *kharif Season* of 2019 and 2020 at Instructional cum Research Farm, Indira Gandhi Krishi Vishwavidyalaya Raipur (C.G.). The soil of experimental field was clayey (*Vertisols*) in texture, locally known as "*Kanhar*" which was low, medium and high in available N, P_2O_5 and K_2O, respectively. Experiment with both the crops *i.e.* rice and wheat was laid out in randomized block design with four replications having ten treatments. The treatments for both the crops were T_1: control, T_2: 50% RDF,

T_3: 100% RDF, T_4: 150% RDF, T_5: 100% RDF+$ZnSO_4$ ($ZnSO_4$ Applied only kharif)., T_6: 100% NP, T_7: 100% N, and T_8: 100% RDF+FYM (FYM applied only kharif), T_9: 50% RDF+BGA (BGA applied only kharif), T_9: 50% RDF+GM (GM Applied only kharif).

Result and Discussion

Uptake and total uptake of nitrogen in grain and straw in wheat

The concentration and uptake nitrogen by grain and straw and total uptake was significantly influenced long term inorganic and integrated nutrient management practices of wheat in Table 1.

The findings indicated that the highest value of nitrogen uptake and total uptake of N in grain and straw was the highest under the treatment of T_4: 150% RDF, but it was statistically at par to the treatment of T_8: 100% RDF + FYM during both the years and on mean basis. The lowest nitrogen concentration was observed under T_1: control.

Table 1: N uptake by grain and straw of wheat as influenced by long term inorganic and integrated nutrient management practices in rice -wheat cropping system

Treatment	N Uptake (kg ha^{-1})								
	Grain			Straw			Total		
	2019-20	2020-21	Mean	2019-20	2020-21	Mean	2019-20	2020-21	Mean
T_1: Control	17.65	16.85	17.25	5.07	4.64	4.86	22.72	21.49	22.11
T_2: -50% RDF	33.22	33.55	33.39	12.17	13.10	12.64	45.39	46.65	46.03
T_3: 100% RDF	45.42	47.57	46.50	21.28	22.75	22.02	66.7	70.32	68.52
T_4: 150% RDF	56.32	58.93	57.63	26.46	28.67	27.57	82.78	87.6	85.2
T_5: 100% RDF + $ZnSO_4$	44.52	45.28	44.90	20.39	21.90	21.15	64.91	67.18	66.05
T_6: 100% N and P_2O_5	44.16	44.83	44.50	19.86	21.01	20.44	64.02	65.84	64.94
T_7: 100% N	23.95	23.00	23.48	9.02	8.40	8.71	32.97	31.4	32.19
T_8: 100% RDF + FYM	55.40	57.91	56.66	24.82	27.61	26.22	80.22	85.52	82.88
T_9: 50% RDF + BGA	32.49	32.90	32.70	11.37	12.57	11.97	43.86	45.47	44.67
T_{10}: 50% RDF + GM	38.89	38.45	38.67	17.70	16.62	17.16	56.59	55.07	55.83
S.Em ±	1.67	1.70	1.69	0.74	0.79	0.77	2.41	2.49	2.46
LSD (P=0.05)	4.84	4.95	4.90	2.17	2.30	2.24	7.01	7.25	7.14

Uptake and total uptake of phosphorus in grain and straw in wheat

The data pertaining on phosphorus uptake and total uptake by wheat grain and straw as influenced long term inorganic and integrated nutrient management practices during both the years and on mean basis are presented in Table 2. The findings indicated that the Phosphorus uptake and total uptake in grain and straw was the highest under the treatment of T_4: 150% RDF, but it was statistically at par to the treatments of T_8: 100% RDF + FYM during both the years and on mean basis. The lowest phosphorus concentration was observed under T_1: control.

Table 2: P uptake by grain and straw of wheat as influenced long term inorganic and integrated nutrient management practices in rice -wheat cropping system

Treatment	P Uptake (kg ha^{-1})								
	Grain			Straw			Total		
	2019-20	2020-21	Mean	2019-20	2020-21	Mean	2019-20	2020-21	Mean
T_1: Control	3.43	3.05	3.24	0.94	0.79	0.87	4.37	3.84	4.11
T_2: -50% RDF	6.60	6.85	6.73	2.11	2.28	2.20	8.71by	9.13	8.93
T_3: 100% RDF	9.38	10.00	9.69	3.76	4.23	4.00	13.14	14.23	13.69
T_4: 150% RDF	11.40	12.22	11.81	4.70	5.21	4.96	16.1	17.43	16.77
T_5: 100% RDF + $ZnSO_4$	9.02	9.35	9.19	3.46	3.86	3.66	12.48	13.21	12.85
T_6: 100% N and P_2O_5	9.01	9.32	9.17	3.25	3.58	3.42	12.26	12.9	12.59
T_7: 100% N	4.69	4.21	4.45	1.65	1.50	1.58	6.34	5.71	6.03
T_8: 100% RDF + FYM	11.29	12.08	11.69	4.40	5.00	4.70	15.69	17.08	16.39
T_9: 50% RDF + BGA	6.45	6.71	6.58	1.98	2.20	2.09	8.43	8.91	8.67
T_{10}: 50% RDF + GM	8.09	7.53	7.81	3.13	2.87	3.00	11.22	10.4	10.81
S.Em ±	0.34	0.35	0.35	0.13	0.14	0.14	0.47	0.49	0.49
LSD (P=0.05)	0.99	1.02	1.01	0.38	0.41	0.40	1.37	1.43	1.41

Uptake and total uptake of potassium in grain and straw in wheat

The data on potash uptake and total uptake by wheat grain and straw as influenced long term inorganic and integrated nutrient management practices during both the years and on mean basis are presented in Table 3.The findings revealed that the highest value of potassium uptake and total uptake of K in grain and straw was the highest under the treatment of T_4: 150% RDF, but it was statistically at par to the treatments of T_8: 100% RDF + FYM during both the years and on mean basis. The lowest potassium concentration was observed under T_1: control

Table 3: K uptake by grain and straw of wheat as influenced by long term inorganic and integrated nutrient management practices in rice -wheat cropping system

Treatment	K Uptake (kg ha^{-1})								
	Grain			Straw			Total		
	2019-20	2020-21	Mean	2019-20	2020-21	Mean	2019-20	2020-21	Mean
T_1: Control	4.45	3.79	4.12	25.58	23.65	24.62	30.03	27.44	28.74
T_2: 50% RDF	10.69	10.95	10.82	53.82	57.23	55.53	64.51	68.18	66.35
T_3: 100% RDF	16.99	18.79	17.89	80.75	85.80	83.28	97.74	104.59	101.17
T_4: 150% RDF	21.77	23.35	22.56	99.23	104.12	101.68	121	127.47	124.24
T_5: 100% RDF + $ZnSO_4$	16.59	17.82	17.21	78.49	83.72	81.11	95.08	101.54	98.32
T_6: 100% N and P_2O_5	16.56	17.47	17.02	75.83	79.10	77.47	92.39	96.57	94.49
T_7: 100% N	6.53	5.51	6.02	41.74	39.79	40.77	48.27	45.3	46.79
T_8: 100% RDF + FYM	20.86	22.74	21.80	92.88	100.72	96.80	113.74	123.46	118.6
T_9: 50% RDF +BGA	10.46	10.74	10.60	48.84	52.98	50.91	59.3	63.72	61.51
T_{10}: 50% RDF + GM	13.57	12.73	13.15	71.39	68.19	69.79	84.96	80.92	82.94
S.Em ±	0.61	0.64	0.63	2.90	3.03	2.97	3.51	3.67	3.6
LSD (P=0.05)	1.77	1.89	1.83	8.41	8.78	8.60	10.18	10.67	10.43

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