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YIELD AND NPK REMOVAL BY WHEAT AS INFLUENCED BY FERTILIZER AND MANURE APPLICATIONS

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A field experiment was initiated during 'Rabi' 1983 at the NARC experimental farms, Islamabad, to monitor the impact of different cropping and fertility systems on soil properties and soil productivity on long term basis. This report considers first year results of wheat (*Triticum aestivum* L. Cv. Pak-81). Treatments included: (1) Fertilizer NP @ 120-60-0 kg ha^{-1} (2) Manure @ 20 t ha^{-1} (3) Fertilizer NP @ 120-60-0 kg ha^{-1} + Manure @ 20 t ha^{-1} (4) Control - No fertilizer or manure. All treatments significantly ($P<0.01$) affected the grain and straw yields of wheat but did not affect the grain:straw ratios. Grain yield affects of the various treatments were in the order of control = manure < NP < NP + manure. Removal of NPK by wheat grain and straw is discussed together with the implication of a significant fertilizer + manure interaction.

INTRODUCTION

The beneficial effects from addition of organic matter to soil in Pakistan has been well established (Azad and Yousaf, 1982). Crop production has also been enhanced from the application of N and P to Pakistani soils (Chaudhary, 1983). Many federal and provincial institutes, universites and agencies are involved in conducting fertilizer trials. Little is known however, about the long term effects of fertilizer, manure and frequency of application under different cropping systems (AARI, 1983; Anonymous, 1983 and Azad & Yousaf, 1282). The National Agricultural Research Centre at Islamabad initiated during Rabi 1983 a long term field trial to monitor the influence of manure and commercial NP fertilizers under different cropping patterns as reflected in crop productivity and changes in soil properties. The initial crop in each cropping pattern con-

sisted of wheat. The present report discusses the effect of some of the fertilizer and manure treatments on wheat yield and NPK removal by wheat.

MATERIALS AND METHODS

A long term cropping pattern and soil fertility study was initiated during Rabi season 1983 at NARC experimental farms, Islamabad. Characterization of the experimenfal site is presented in Table 1.

Table 1. *Soil characterization of the experimental site :*

1.	Mechanical Composition				Ca^{++}	me l^{-1}	6.25
	Sand	%	41.24		Mg^{++}	,,	9.45
	Silt	%	28.90				
	Clay	%	29.86	5.	CEC	me 100 g^{-1} soil	20.50
	Textural class	—	Clay loam	6.	Exchangeable cations:		
2.	pH paste	—	7.84		Na^{+}	me/100 g soil	1.13
3.	ECe	mmhos cm^{-1}	0.66		K^{+}	,,	0.20
4.	Soluble ions in saturation extract				$Ca^{++}+Mg^{++}$		19.37
					ESP	,,	5.51
	CO'_3	me l^{-1}	1.80	7.	Organic matter	%	0.62
	HCO'_3	,,	1.62	8.	$CaCO_3$	%	0.95
	Cl'	,,	1.30	9.	Total-N	%	0.07
	SO''_4	,,	1.66				
	$Na+$	,,	0.50				
	$K+$	,,	0.68	10.	$NaHCO_3$-P	ppm	6.00

Textural analysis was done according to USDA (Day, 1965). Various chemical analyses were carried out according to the standard procedures described in USDA handbook No. 60 (Richards, 1954). The original plan involved three variables viz, cropping system, frequency of fertilization and individual and combined application of organic manure and chemical fertilizers arranged physically according to randomized complete block split – split plot design with 4 replications. The three cropping patterns during the first year of the study consisted of wheat. The four fertilizer and manure treatments presented in Table 2 replicated 36 times were applied to all (144) plots of the whole experiment for initializing fertility management systems.

Table 2. *Ferttlizer and manure treatments used in the long term cropping system study* :

	Treaiment	Dose, kg ha^{-1}	Materials
1.	Control	—	—
2.	N P	120-60-0	Urea and single super phosphate
3.	Manure	20,000	Farmyard manure
4:	NP+Manure	120-60-0+20,000	Urea, single super phosphate and farmyard manure.

Wheat grain and straw yields were calculated from harvested areas of three 1 m^2 and threshed from 17x5 m^2 plot size. Wheat grain and straw yield together with grain: straw ratio were calculated on the basis of air dry weight. Data were statistically analysed and LSD was used for meau separation (Steal and Torrie, 1960,

Composite grain and straw samples prepared from ground material from 36 plots under each of four treatments were analysed in triplicate for NPK. The product of NPK concentrations in grain and straw with respective yields was used to calculate NPK uptake/removal by wheat plants. No estimate was made of the nutrients present below soil surface portions of the wheat plants.

RESULTS AND DISCUSSIONS

Wheat Grain and Straw Yield :

While manure did not increase either grain or straw yield, both the application of NP with and without manure resulted in highly significant yield increases (Table 3). Indeed, there was a positive response following the application of NP fertilizer with manure over the NP alone. No significant effect on grain: straw ratio was noted (Table 3).

Application of manure @ 20 t ha^{-1} did not increase the yields significantly over control. Application of NP with and without manure significantly ($P<0.01$) increased the grain yield by about 14% and 31%, respectively, over control. The synergistic effects of NP and manure applied together resulted in 15% and 28% higher grain yield over NP and manur applied singly. Individual and combined application of NP and manure resulted in 25% and 35% higher straw yield than control, respectively.

Table 3. *Effect of manure & NP fertilizer treatments on wheat grain and straw yield (Averages of 36 replicates)*

Treatment	Dose, kg ha^{-1}	Grain yield 000, kg ha^{-1}	Straw yield	Grain:Straw ratio
Control	—	3.37 a	6.97 a	0.49
NP	120-60-0	3.83 b	8.74 b	0.44
Manure	20,000	3.44 a	7.44 a	0.47
NP + Manure	120-60-0 + 20,000	4.41 c	9.40 b	0.48
Significance		**	**	NS
L.S.D.	0.01	0.31	0.68	0.04
	0.05	0.23	0.51	0.03

REMOVAL OF NPK

The plant nutrient data for wheat grain and straw are presented in Table 4. The application of fertilizer increased grain N from 2.03 % (control) to 2.38% and 2.31%, respectively, under NP and NP + Manure treatments though no change in straw nitrogen percentage was observed. However, the differences in total nitrogen removed were more marked (Table 5). The highest grain N uptake of 101.87 kg ha^{-1} was recorded in the NP + Mrnute treatment which exceedrd the control by 49 percent

No appreciable effect on P concentration in wheat grain and straw was observed.

Table 4. *Effect of manure and applied fertilizer on NPK concentrations in wheat straw and grain*

Treatment	Dose, kg/ha	Grain				Straw		
		N	P	K	%	N	P	PK
Control	—	2.03	0.18	0.51		0.025	0.02	0.81
NPK	120-60.0	2.38	0.18	0.48		0.025	0.02	0.89
Manure	20,000	1.93	0.15	0.43		0.025	0.01	1.05
NPK + Manure	120-60-0 + 20,000	2.31	0.19	0.48		0.025	0.01	1.24

Iudividual and combined applications of NP and manure produced more

pronouncsd effect of K concentration and uptake by straw than grain. The application of manure increased K from 0.82 % (Control) to 1.05 % and 1.24 % under manure and NP + Manure application, respectively. Treatment differen ces were more visible on K uptake (Table 5). The uptake of K by straw was the highest, 11.56 kg ha^{-1} under NP + Manure treatment which was about 106 % higher than control.

The resutts show that although soil was originally low in organic matter (0.062%), mere application of manure did not significantly increase wheat grain or straw yield. However, the positive interaction of manure in the presence of applied NP fertilizar on both grain and straw yield. However, the positive interaction of manure in the presence of applied NP fertilizer on both grain and straw yield suggests a favourable effect of manure may have been due to soil tilth rather than fertility per se.

Table 5. *Effect of different treatments on the uptake of NPK by wheat grain and straw.*

Treatment	Dose	Contents in Grain			Contents in Straw			Total removal by Grain-Straw		
		N	P	K	N	P	K	N	P	K
		kg ha^{-1}								
Control	—	68.41	6.07	17.19	1.74	1.39	56.46	70.15	7.46	73.65
NPK	120-60-0	91.15	6.89	18.38	2.19	1.75	77.79	93.34	8.64	96.17
Manure	20,000	66.39	5.16	14.79	1.86	0.74	78.12	68.25	5.90	92.91
NPK + Manure	120-60-0 + 20,000	101.87	8.38	21.17	2.35	0.94	116.56	104.22	9.32	137.73

No appreciable change in P uptake by wheat was observed, rather increased K uptake by wheat straw. This phenomenon suggests that K should be included in future trial for various crops in the study other than N and P.

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