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RESEARCH ARTICLE

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Yield and nutrient uptake under wheat-pearl millet-green gram cropping system as influenced by industrial sludges and soil conditioners

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ABSTRACT

A field experiment was conducted during 2002-03 at Agronomy Instructional Farm, Sardarkrushinagar to study the effect of industrial sludges and soil conditioners on seed yield and nutrient uptake of N, P and K under wheat-pearl millet-green gram cropping system. Application of ETP sludge @ 20 t ha^{-1} to wheat crop resulted in significantly higher grain yield of wheat,pearl millet and green gram crops raised in sequence than control. GS20, ACS20, GS20, ACS10, FA10, FA20, VC10 and FYM10 treatments. Different sludges and soil conditioners enhanced uptake of N, P and K by grain as well as straw and followed the order of ETP sludge> private farm manure> FYM> vermicompost >fly ash > coir pith >control> ammonium chloride sludge > glycerin sludge in case of wheat crop (first crop in sequence); whereas ETP sludge > private farm manure> farm yard manure > vermicompost > fly ash > coir pith> ammonium chloride sludge > glycerin sludge > control in case of bajra and green gram crop (second and third crop in sequence)

KEY WORDS : Industrial sludge, Soil conditioner, Nutrient, Uptake and yield

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INTRODUCTION

Rapid expansion of industrialization, colossal amount of solid wastes are given out everyday and disposed off safely to save the environment. Industrial wastes are relatively more hazardous to the environment. However, it is not always true that all industrial wastes are pollutants. There are some industrial wastes containing manurial as well as ameliorative elements in appreciable quantities. This would solve the twin problem of disposal and also substitute some quantities of fertilizers.

Recycling of organic waste through vermicompost and ordinary composting (FYM) helps to minimize environment pollution and also improve their manurial value for agriculture. These soil conditioners supply both macro and micronutrients and improve physical, chemical and biological properties of the soils. These manures very often leave substantial residual fertility effect on succeeding crop.

Thus, there is a great potential and large scope for eco-friendly management of industrial wastes and soil conditioners. Keeping this in view, present investigation pertaining to use of some industrial solid wastes and soil conditioners on productivity under wheat-pearl millet-green gram cropping system was carried out.

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MATERIALS AND METHODS

The field experiments were conducted at the Agronomy Instructional Farm, C. P. College of Agriculture, S.D. Agricultural University, Sardarkrushinagar during winter (*Rabi*), hot weather (summer) and rainy (*Kharif*) seasons during 2002-03. The soil was loamy sand with 7.52 pH, low in organic carbon (0.23 %) and available nitrogen (167 kg ha^{-1}) and medium in available P_2O_5 (46 kg ha^{-1}) and available K_2O (180 kg ha^{-1}). Each industrial sludge and soil conditioner comprised of two levels (10 and 20 t ha^{-1}.) treatments including absolute control. The experiment consisted of seventeen treatments *viz.*, FYM10: FYM 10 t ha^{-1}, FYM20: FYM 20 t ha^{-1}, PFM10: Private firm manure 10 t ha^{-1}, PFM20: Private firm manure 20 t ha^{-1}, CP10: Coir pith @ 10 t ha^{-1}, CP20: Coir pith @ 20 t ha^{-1}, VC10: Vermicompost @ 10 t ha^{-1}, VC20: Vermicompost @ 20 t ha^{-1} ,ETP10: ETP sludge @ 10 t ha^{-1} , ETP20: ETP sludge @ 20 t ha^{-1} ,FA10: Fly ash @ 10 t ha^{-1} , FA20: Fly ash @ 20 t ha^{-1}, ACS10: Ammonium chloride sludge @ 10 t ha^{-1}, ACS20: Ammonium chloride

@ 20 t ha^{-1} and GS10: Glycerin sludge @ 10 t ha^{-1} and GS20: Glycerin sludge @ 20 t ha^{-1} including one absolute control .The treatments were applied to wheat crop during *Rabi* season. After randomization of treatments and formation of basins, the sludges and soil conditioners *viz.*, FYM, private farm manure, coir pith, vermicompost, fly ash, ammonium chloride sludge and glycerin sludge were applied and thoroughly incorporated in 15 cm topsoil layer. Recommended fertilizer dose to wheat, pearl millet and green gram was applied as 120-60-00; 100-50-00 and 20-40-00 kg N, P_2O_5 and K_2O, ha^{-1}, respectively. The experiment was laid out in randomized block design and replicated four times. The site of experiment was same for all the three crops. Rainfall during crop period was 736.50 mm during 2002-03

RESULTS AND DISCUSSION

The findings of the present study have been discussed in the following sub heads :

Wheat-pearl millet-green gram yield:

An application of ETP sludge @ 20 t ha^{-1} resulted in higher grain (4264, 5404 and 1404 kg ha^{-1}) and stover (6014, 9146 and 2403 kg ha^{-1}) yields of wheat, pearl millet and green gram, respectively (Table 1, 2 and 3). The increase in grain yield of wheat, pearl millet and green gram was 31.7, 31.5 and 47.1 % by ETP sludge @ 20 t/ha over control treatment. However, with respect to grain yield, its performance was at par with that obtained by FYM10, VC20, ETP10, FA10, VC10 and FA20 in case of wheat crop; VC20, FYM20, ETP10, CP20, PFM20 and FYM10 in case of pearl millet crop and VC20, FYM20, CP20, FA20, PFM20 and FYM10 in case of green gram crop. Application of ammonium chloride sludge @ 20 t ha^{-1}, GS10 and GS20 recorded significantly lower grain and stover yields of wheat than control. The adverse effect of different soil conditioners on plant growth and yield was reported by Rajpur *et al.* (2002) in wheat. But in case of pearl millet and green gram the grain and stover yield were improved over control, indicated that the harmful effect of ammonium chloride and glycerin sludge in soil were nullify in second (pearl millet) and third (green gram) crop grown in succession after wheat crop.

Micro-nutrient uptake:

The application of ETP sludge @ 20 t ha^{-1} gave significantly higher nitrogen uptake over GS20, ACS20, ACS10, GS10, Control, FYM20, FA10, FA20, CP10, PFM20 and PFM20 treatments by wheat crop (table-1). However, the lowest nitrogen uptake was recorded by GS20, which was significantly lower than control treatment. Similar trend was also observed with respect to phosphorus and potassium uptake by grain and stover of

Table 1 : Effect of sludges and soil conditioners on yield and N, P, K uptake in wheat crop

Treatments	Yield (kgha^{-1})		Uptake (kg ha^{-1})					
			Nitrogen		Phosphorus		Potassium	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
Control	3236	4889	63.66	39.59	11.45	10.45	8.66	50.96
FYM10	4069	6014	99.10	54.66	15.64	20.29	14.12	80.40
FYM20	3542	5417	86.61	46.00	15.01	18.87	12.25	68.35
PFM10	3542	5472	96.60	59.05	14.03	19.72	12.73	81.45
PFM20	3139	5181	92.00	62.36	13.37	19.40	15.57	96.24
CP10	3417	5250	90.37	55.21	11.60	16.00	11.39	61.41
CP20	3806	5586	100.88	57.50	13.04	17.83	13.63	60.03
VC10	3858	5744	96.35	55.00	15.62	20.86	13.41	74.84
VC20	4061	5994	102.11	59.21	16.16	20.46	14.53	71.31
FA10	3861	5792	89.17	57.03	13.03	15.86	13.25	67.72
FA20	3847	5611	89.43	51.83	15.89	15.23	13.30	66.16
ETP10	3922	5792	103.04	54.69	14.29	20.17	13.71	69.64
ETP20	4264	6014	112.34	63.16	15.78	18.08	15.12	75.16
ACS10	3392	5125	66.99	43.40	14.66	20.60	11.76	51.03
ACS20	2322	3803	47.22	32.93	11.18	15.77	7.02	38.00
GS10	2708	4167	63.72	35.68	9.91	14.40	9.17	42.21
GS20	1908	3042	45.50	27.70	6.92	10.18	6.41	34.91
S.E. ±	150	278	5.51	3.60	0.89	1.07	0.86	4.53
C.D. (P=0.05)	427	791	15.68	10.25	2.53	3.05	2.43	12.89
C. V. %	8.66	10.63	12.97	14.32	13.29	12.39	14.11	14.14

Table 2 : Effect of sludges and soil conditioners on yield and N,P,K uptake in pearl millet crop

Treatments	Yield (kgha^{-1})		Uptake (kg ha^{-1})					
			Nitrogen		Phosphorus		Potassium	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
Control	4108	7201	83.89	87.38	16.05	26.70	13.80	108.33
FYM10	4819	8347	106.03	102.47	21.81	37.29	28.82	183.72
FYM20	5097	8788	128.41	107.11	25.20	39.39	30.58	209.55
PFM10	4560	7868	113.34	114.41	22.27	35.97	23.73	193.80
PFM20	4875	8215	131.32	148.71	22.76	39.45	31.50	207.35
CP10	4351	7632	107.50	108.34	17.94	31.38	17.58	145.64
CP20	4889	8132	104.85	114.64	20.41	33.74	20.26	173.20
VC10	4343	8118	95.97	104.13	18.00	36.71	19.47	170.62
VC20	5353	8535	139.74	111.68	23.80	38.65	24.68	199.85
FA10	4201	7938	86.60	99.99	13.74	32.21	16.12	165.98
FA20	4657	8257	104.35	103.90	17.71	33.65	20.00	180.48
ETP10	5096	8708	113.92	117.53	22.16	37.05	20.45	186.52
ETP20	5404	9146	121.38	125.71	24.99	39.15	23.21	195.67
ACS10	4229	7500	89.15	95.53	20.49	37.44	14.92	122.79
ACS20	4589	7972	97.30	100.96	24.79	41.62	15.30	132.24
GS10	4507	7826	97.22	98.70	19.44	33.27	16.49	143.97
GS20	4599	8208	111.23	111.18	19.19	34.95	18.07	159.48
S.E. ±	211	354	8.04	7.37	1.45	2.28	1.67	11.19
C.D. (P=0.05)	601	1007	22.88	20.98	4.13	6.49	4.74	31.84
C. V. %	9.01	8.71	14.92	13.53	14.06	12.74	15.97	13.21

Table 3 : Effect of sludges and soil conditioners on yield and N,P,K uptake in green gram crop

Treatments	Yield (kgha^{-1})		Uptake (kg ha^{-1})					
			Nitrogen		Phosphorus		Potassium	
	Grain	Straw	Grain	Straw	Grain	Straw	Grain	Straw
Control	954	1583	36.89	31.62	3.60	4.75	9.51	9.55
FYM10	1193	2286	49.74	49.34	5.74	8.30	12.24	17.57
FYM20	1334	2408	57.14	54.20	6.47	10.21	14.11	20.64
PFM10	1092	1794	46.63	46.95	5.40	8.87	11.31	13.93
PFM20	1204	2072	55.97	50.31	6.31	10.07	13.61	17.62
CP10	1074	1875	44.20	47.39	4.52	5.37	12.39	13.04
CP20	1274	2144	57.83	52.95	5.79	7.17	15.65	16.57
VC10	1041	2278	41.88	46.03	4.98	10.13	10.43	17.53
VC20	1404	2353	59.46	54.28	7.83	9.66	15.04	19.21
FA10	1111	2058	44.93	42.86	4.42	6.50	11.38	15.07
FA20	1253	2125	52.92	44.77	5.01	7.38	13.17	16.11
ETP10	1310	2311	55.25	50.93	6.27	8.14	13.73	17.67
ETP20	1404	2403	62.08	54.36	6.60	8.87	15.24	23.63
ACS10	1045	1903	44.14	40.15	5.84	7.14	12.29	12.03
ACS20	1104	2156	50.47	47.18	5.88	9.92	12.54	13.29
GS10	1102	2006	45.82	45.66	4.80	7.19	12.58	13.78
GS20	1129	2128	52.71	47.71	4.68	7.19	14.24	15.13
S.E. ±	81	123	3.61	3.33	0.55	0.57	1.03	1.12
C.D. (P=0.05)	232	350	10.27	9.48	1.56	1.61	2.94	3.17
C. V. %	13.82	11.64	14.30	14.04	19.82	14.05	16.03	13.92

wheat crop. Treatment VC20 recorded significantly higher nitrogen uptake by grain and stover of pearl millet crop, which was statistically at par with PFM20, FYM20 and ETP20 treatments. The lowest uptake was noticed with

GS10 treatment. However, maximum phosphorus uptake of pearl millet crop was recorded by grain and stover with application of FYM @ 20 t ha^{-1} (Table 2). The lowest phosphorus removal by pearl millet grain and straw was recorded with control. Application of ETP sludge @ 20 t ha^{-1} (62.08 and 54.36 kg ha^{-1} by grain and stover, respectively) resulted in significantly higher uptake of nitrogen over control, VC10, CP10, FA10, ACS10, GS10, FYM10 and PFM10. The lowest uptake of nitrogen recorded with control treatment. Application of vermicompost @ 20 t ha^{-1} registered significantly higher removal of P by grain and with FYM20 by straw in green gram crop. However, application of coir pith @ 20 t/ha and FYM @ 20 t ha^{-1} recorded significantly higher potassium uptake by grain and stover of green gram, respectively (Table 3).

The significant increase in N, P and K uptake under different sludges and soil conditioners might be due to the supply of these nutrients by sludges and soil conditioners as well as by creating fabvourable physical environment of the soil. The beneficial effect of sludge was also reported by Kumavat *et al.* (2003). Similarly positive role of vermicompost on N, P and K uptake was reported by Kademani *et al.* (2003) and Singaravel *et al*. (2000) with use of FYM and coir pith.

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