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Direct and residual effects of industrial sludges and soil conditioners on growth, yield attributes and yield of wheat-pearl millet- green gram sequence

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ABSTRACT

A field experiment was conducted during 2002-03 at Sardarkrushinagar, to study the direct and residual effects of industrial sludges and soil conditioners on growth and yield attributes as well as yield of wheat-pearl millet-green gram cropping sequence. Initial plant population, plant height, number of total and effective tillers per plant of wheat varied significantly with the application of ETP sludge @ 20 t/ha over control with ACS10, ACS20, GS10 and GS 20 treatments. Yield attributes (length of spike, no. of grain per spike, test weight) in wheat were not influenced by industrial sludges and soil conditioners. Though ETP20, FYM10, VC20, ETP10, FA10, VC10, FA20 being at par, resulted in significantly higher grain yield of wheat than the control and the rest of the treatments tried. However, the residual effect of sludges and soil conditioners on growth and yield attributes of pearl millet and green gram crops were not significantly influenced except plant height in pearl millet crop. Maximum residual effect was recorded by ETP20 treatment followed by VC20, FYM20, CP20, PFM20 and FYM10, which proved its superiority over control and rest of the treatments with respect to grain yield of pearl millet and green gram crops.

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Key words : Industrial sludge, Soil conditioner, Growth attributes, Yields attributes, Yield

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 under taken.

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}), 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}). The experiment consisted of seventeen treatments *viz.*, con: Absolute control, 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 sludge @ 20 t ha^{-1} and GS10: Glycerin sludge @ 10 t ha^{-1} and GS20: Glycerin sludge @ 20 t ha^{-1}. The treatments were applied to wheat crop during *Rabi* season. After randomization of treatments

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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 fertilizers 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, 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 results obtained from the present investigation are presented in Table 1, 2 and 3.

Direct effect:

Application of glycerin sludge @ 10 and 20t ha^{-1} (GS10 and 20) as well as ammonium chloride sludge@ 20 t ha^{-1} (ACS 20) significantly lower down the germination of wheat seeds as compared to other sludges and soil conditioners. Application of ETP sludge @ 20 t ha^{-1} had significantly increased plant height, number of total and effective tillers per plant, length of spike, number of grain per spike and test weight closely followed by FYM10, VC20, ETP10, FA10 and VC10 treatments. Improvement in growth and yield attributes due to incorporation of ETP sludge and vermicompost was owing to improvement in growth supporting physicochemical attributes of materials. The improvement in growth attributes with the use of different organic and inorganic materials were also reported by Jat and Ahlawat (2004).

Incorporation of ETP sludge @ 20 t ha (ETP20), FYM10, VC20, ETP10, FA10, Vc10, FA20 and CP20 resulted in significantly higher grain (4264 kg ha^{-1}) and biological (6014 kg ha^{-1}) yields of wheat than control (Table 1). The grain yield of wheat due to incorporation of glycerin sludge @ 10 t ha^{-1} and 20 t ha^{-1} and NH_4Cl sludge @ 20 t ha^{-1} had adverse effect on the grain yield of wheat over control. This might be due to their higher electrical conductivity, pH and Na content, which resulted in significant reduction in seed germination. The adverse effect of sludge was also reported by Rajpur *et al*. (2002) on wheat crop.

Residual effect:

Mean data revealed that growth and yield attributes of summer pearl millet and *Kharif* green gram were not

Table 1: Effect of sludges and soil conditioners on growth, yield attributes as well as yield of wheat

Treatments	Growth attributing characters				Yield attributing characters			Yield (kg ha^{-1})	
	Initial plant population (metre row length)	Plant height (cm)	Total tillers per plant	Effective tillers per plant	Length of spike (cm)	No. of grains per spike	Test weight (g)	Grain	Straw
Control	56.88	75.95	3.10	2.41	8.23	45.43	46.69	3236	4889
FYM10	58.69	82.20	3.55	2.88	8.87	48.29	49.73	4069	6014
FYM20	57.44	78.50	3.37	2.60	8.62	47.19	47.13	3542	5417
PFM10	58.00	78.75	3.02	2.69	8.89	46.81	47.14	3542	5472
PFM20	55.94	74.60	3.22	2.32	8.69	45.46	46.70	3139	5181
CP10	57.13	77.80	3.34	2.62	8.76	46.06	47.30	3417	5250
CP20	58.31	78.85	3.20	2.78	8.82	46.14	48.44	3806	5586
VC10	58.56	80.50	3.31	2.95	8.74	47.09	48.37	3858	5744
VC20	59.69	81.05	3.98	3.26	8.91	49.48	47.85	4061	5994
FA10	59.31	80.80	3.55	2.72	8.75	49.14	49.42	3861	5792
FA20	58.38	79.00	3.08	2.77	8.92	46.08	49.10	3847	5611
ETP10	59.38	80.95	3.78	2.77	8.47	47.71	49.23	3922	5792
ETP20	60.38	82.50	3.96	2.89	8.93	49.98	50.69	4264	6014
ACS10	57.13	77.05	3.10	2.49	8.86	45.69	46.69	3392	5125
ACS20	28.69	67.25	2.93	2.37	8.51	41.93	46.90	2322	3803
GS10	31.88	69.05	2.67	2.44	8.33	45.43	46.90	2708	4167
GS20	26.63	55.80	2.50	2.30	8.24	45.56	46.68	1908	3042
S.E. ±	0.86	3.11	0.10	0.12	0.22	1.67	1.03	150	278
C.D. (P=0.05)	2.46	8.85	0.29	0.35	NS	NS	NS	427	791
C. V. %	3.25	8.13	6.27	9.31	4.99	7.17	4.29	8.66	10.63

Table 2 : Effect of sludges and soil conditioners on growth, yield attributes as well as yield of pearl millet

Treatments	Growth attributing characters			Yield attributing characters			Yield (kg ha^{-1})	
	Initial plant population (one metre row length)	Plant height (cm)	Total tillers per plant	Effective tillers per plant	Length of ear head (cm)	Test weight (g)	Grain	Straw
Control	12.75	150.03	7.38	5.08	22.10	8.68	4108	7201
FYM10	13.25	157.00	7.83	5.55	22.63	8.87	4819	8347
FYM20	13.00	165.58	8.17	5.83	23.03	9.05	5097	8788
PFM10	13.75	154.35	7.85	5.11	22.40	8.74	4560	7868
PFM20	12.75	157.25	8.31	5.99	22.78	8.98	4875	8215
CP10	14.00	153.98	7.42	5.24	22.15	8.89	4351	7632
CP20	14.50	162.70	7.53	5.94	22.88	9.00	4889	8132
VC10	13.25	152.50	7.41	5.46	22.38	9.08	4343	8118
VC20	15.50	167.15	7.60	5.98	23.80	9.24	5353	8535
FA10	13.00	150.20	7.45	5.39	22.25	8.69	4201	7938
FA20	13.75	156.60	7.71	5.72	22.48	8.99	4657	8257
ETP10	14.00	165.45	7.78	5.51	23.35	8.96	5096	8708
ETP20	14.25	175.08	8.12	5.94	24.35	9.06	5404	9146
ACS10	12.75	152.45	7.37	5.15	22.38	9.16	4229	7500
ACS20	13.50	156.15	7.71	5.39	22.65	8.99	4589	7972
GS10	13.50	154.35	7.56	5.15	22.40	8.84	4507	7826
GS20	13.75	156.15	7.48	5.19	22.78	9.48	4599	8208
S.E. ±	0.56	3.69	0.23	0.25	0.56	0.26	211	354
C. D. (P=0.05)	NS	10.49	NS	NS	NS	NS	601	1007
C. V. %	8.21	4.67	5.98	8.92	4.95	5.86	9.01	8.71

NS=Non-significant

Table 3: Effect of sludges and soil conditioners on growth, yield attributes as well as yield of green gram

Treatments	Growth yield attributing characters				Yield attributing characters				Yield (Kg ha^{-1})	
	Initial plant population (one metre row length)	Plant height (cm)	Total no. of branches plan^{-1}	Effective No. of branches plan^{-1}	No. of pods plant^{-1}	Length of pod (cm)	No. of seeds pod^{-1}	Test weight (g)	Grain	Straw
Control	13.00	61.25	6.28	2.96	9.43	8.15	10.08	39.90	954	1583
FYM10	13.75	61.75	6.78	3.14	11.29	8.57	11.63	41.62	1193	2286
FYM20	14.50	64.70	7.19	3.43	11.42	8.78	12.38	42.86	1334	2408
PFM10	13.00	69.80	7.11	3.20	9.89	8.45	10.75	40.80	1092	1794
PFM20	13.50	66.20	6.68	3.30	11.47	8.58	11.50	41.68	1204	2072
CP10	13.25	69.70	6.92	3.13	10.81	8.39	10.38	40.06	1074	1875
CP20	14.00	68.40	6.86	3.25	10.88	8.68	11.75	41.81	1274	2144
VC10	13.75	68.05	6.32	3.05	9.71	8.38	10.38	40.64	1041	2278
VC20	15.00	61.05	6.98	3.23	11.40	8.80	12.13	42.65	1404	2353
FA10	13.00	64.70	6.44	3.12	9.46	8.35	10.31	40.14	1111	2058
FA20	13.75	65.35	7.08	3.31	11.02	8.55	11.13	41.61	1253	2125
ETP10	14.25	61.30	7.09	3.28	11.16	8.78	12.06	42.79	1310	2311
ETP20	14.75	68.80	7.25	3.83	11.99	8.83	12.81	43.36	1404	2403
ACS10	13.00	62.40	6.37	2.96	9.53	8.38	10.31	40.57	1045	1903
ACS20	13.25	66.00	6.84	3.10	9.85	8.48	10.81	40.86	1104	2156
GS10	13.75	61.60	7.15	3.15	9.76	8.44	10.75	40.52	1102	2006
GS20	13.50	68.85	7.41	3.21	10.48	8.48	11.63	41.26	1129	2128
S.E. ±	0.61	2.44	0.26	0.15	0.66	0.17	0.62	1.25	81	123
C.D. (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	232	350
C. V. %	8.85	7.48	7.48	9.31	12.50	4.07	10.99	6.03	13.82	11.64

NS=Non-significant

benefited through different sludges and soil conditioners applied to previous wheat crop, except plant height of bajra crop. However, incorporation of ETP20, FYM20, CP10, CP20, VC20 have very good residual effect over control.

Significant increase in grain as well as straw yields of succeeding pearl millet and green gram crops grown in sequence with application of ETP20, VC20, FYM20, ETP20, CP20, PFM20 and FYM10 were recorded over control and rest of the treatments (Table 2 and 3). The results obtained are in confirmity with those of Grewal *et al*. (2000). Improvement was mainly owing to the fact that organic manure (soil conditioners) would help in conversion of unavailable nutrients to available form through increased microbial activity and enabled the crop to remove plant nutrients in higher quantity resulting in better growth and more dry matter accumulation.

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