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Effect of Dairy Factory Effluent on Available Macronutrients in Soils of Pearlmillet and Greengram Crops

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ABSTRACT

A pot culture experiment was conducted during *rabi,* 2009 at S.V.Agricultural college, Tirupati (Andhra Pradesh) to characterize Dairy factory effluent (DFE) with respect to macronutrients and also to study the effect of Dairy factory effluent on available macronutrients in greengram and pearlmillet crops. The available N, P, K and S increased with increase in levels of Dairy factory effluent application from DFE_0 to $DFE_{3.0}$ irrespective of the crops studied. The soils of pearlmillet crop recorded higher available P and S whereas the soils of greengram crop registered higher available N and K. The interaction effect between crops and levels of Dairy factory effluent on available N and P was significant at 50 days and 25 days, respectively. Further, the interaction on available S was found to be significant at 50 days only while the interaction effect on available K was significant at all stages of crop growth.

Key words : Available N,P,K and S of soil, Dairy factory effluent, Greengram, Pearlmillet.

Dairy plant units are increasing day by day due to more urbanization, industrialization and fascination of people for dairy products. In the preparation of various dairy products and cleaning of the equipment lot of waste water is generated which is known as Dairy factory effluent (DFE). The Dairy factory effluent contains organic matter, moderate levels of N, P, K, S, micronutrients, microbial load and enzymes activity. According to Bertsch (2000), the Dairy factory effluent contains low contaminant levels of heavy metals and organic residues. Dairy factory effluent application doesn't adversely effect the soil and water (Cameron *et al.,* 2002) and long-term application of Dairy factory effluent to land enhances soil fertility, microbial load and biochemical attributes of soil (Sparling *et al.,* 2001). Proper dilution and systematic application of Dairy factory effluent would not cause any harm to soil and in some cases nutrients which are exhausted by plants will be recycled back to soil. However, such information on Indian soils, in general, and on soils of Andhra Pradesh, in particular, is lacking. Hence, the present investigation was undertaken to study the effect of different levels of Dairy factory effluent on availability of macronutrients in pearlmillet and greengram crops.

MATERIAL AND METHODS

A pot culture experiment was carried out at S.V. Agricultural college, Tirupati, Andhra Pradesh during *rabi*, 2009. The experiment was conducted in a complete randomized block design with factorial concept, comprising of five levels of Dairy factory effluent and two crops with three replications. The five levels of Dairy factory effluent were DFE_0 (soil alone), $DFE_{1.0}$ (soil + 1,00,000 L ha^{-1}), $DFE_{1.5}$ (Soil + 1,50,000 L ha^{-1}), $DFE_{3.0}$ (soil + 3,00,000 L ha^{-1}) and $DFE_{4.5}$ (soil + 4,50,000 L ha^{-1}). The two crops were greengram (LGG - 460) and pearlmillet (PBS - 1). All the levels of Dairy factory effluent are envisaged in the study were applied to a pot containing 40 Kg soil, one month before sowing of the crop. FYM @ 5 t ha^{-1} was applied uniformly to all the pots to enhance mineralization of Dairy factory effluent. The Dairy factory effluent required for the experiment was collected from Dairy plant, College of Dairy Technology, S.V. Veterinary university, Tirupati, Chittoor district, Andhra Pradesh. Soil Samples were collected initially (before application of Dairy factory effluent), 25 days, 50 days and at harvest.

The experimental soil was sandy clay loam (Typic Haplustalfs) in texture, neutral in reaction (7.40), non-saline (0.61 dSm^{-1}), low in available N (225 kg ha^{-1}) and P (8.64 kg ha^{-1}) and medium in available K (204 kg ha^{-1}) and S (10.62 kg ha^{-1}). All the soil samples were analyzed for available nitrogen, phosphorus, potassium and sulphur as per the standard procedures. Available N was determined by alkaline permanganate method (Subbiah and Asija, 1956). The available P was extracted with 0.5M $NaHCO_3$ extractant and was determined by

using ascorbic acid as reducing agent (Watanabe and Olsen, 1965) and the available K in the soils was extracted by employing neutral normal ammonium acetate and determined by aspirating the extract into the flame photometer (Jackson, 1973). The available S was determined turbidimetrically using 0.15% $CaCl_2$ extractant (Cottenie *et al.,* 1979).

RESULTS AND DISCUSSION

Characterization of Dairy factory effluent

The pH of Dairy factory effluent was slightly alkaline (7.80) with soluble salt concentration (EC) of 9.28 dSm^{-1}. Further, the Dairy factory effluent contained appreciable amount of N (41.30 mg L^{-1}), P (15.17 mg L^{-1}), K (16.50 mg L^{-1}) and S (0.02 mg L^{-1}).

Available nitrogen

Available N increased with increase in Dairy factory effluent application from DFE_0 to $DFE_{3.0}$ (Table 1) at 25 days, 50 days and at harvest. The higher value was reported with the treatment $DFE_{3.0}$ at all stages of crop growth. This may be due to mineralization of organic materials as well as nutrients present in the effluent were responsible for increased availability of nutrients. These results were in accordance with the findings of Chidankumar and Chandraju (2008). The soils collected from greengram crop recorded higher available N than soils collected from pearlmillet at 25 days and at harvest. It may be due to fixation of more nitrogen by leguminous crops like greengram. The interaction effect between crops and levels of Dairy factory effluent on available N was significant at 25 days and 50 days of crop growth. The highest available N was recorded in greengram crop treated with $DFE_{3.0}$ at 25 days.

Available phosphorus

Available P in soil significantly increased with increase in the levels of Dairy factory effluent application from DFE_0 to $DFE_{3.0}$ (Table 2) at all stages of crop growth. The highest value was recorded with $DFE_{3.0}$ at all stages of crop growth. This may be due to the presence of organic matter in the effluent which reduced the phosphorus fixing capacity of soil and increased the availability of phosphorus resulting in phosphorus storage in soil. These results were in conformity with the findings of Degens *et al.*(2000). The soils of pearlmillet crop recorded higher available P than the soils of greengram crop. The interaction effect between crops and levels of Dairy factory effluent was significant at 25 days of crop growth. The highest available P was recorded in pearlmillet crop with $DFE_{3.0}$. Presence of higher amount of inorganic nutrients in Dairy factory effluent resulted in higher available P.

Available potassium

Available K in soil significantly increased with increase in the levels of Dairy factory effluent application (Table 3). The higher available K in soil was recorded with $DFE_{3.0}$ irrespective of crops. Presence of high amount of potassium in waste water has increased K availability. Similar results were reported by Arienzo *et al*.(2009). The soils of greengram crop recorded higher available K than the soils of pearlmillet crop at all stages of crop growth. The interaction between crops and levels of Dairy factory effluent was significant at all stages of crop growth. Greengram crop treated with $DFE_{3.0}$ recorded the highest available K. The higher available K might be due to enhanced mineralization process as a result of increased microbial activity. These results were in accordance with the findings of Jadhav and Savant (1975**).**

Available sulphur

Available S in soil increased with increase in the levels of Dairy factory effluent application from DFE_0 to $DFE_{3.0}$ (Table 4). The higher available S was noticed in the treatment $DFE_{3.0}$ at all stages of crop growth. pearlmillet crop recorded significantly higher available S than greengram crop at all stages of crop growth. Mineralization of organic materials as well as nutrients present in effluent were responsible for increased availability of sulphur. The interaction effect between crops and levels of Dairy factory effluent was significant at 50 days. The highest available S in soil was recorded in pearlmillet crop treated with $DFE_{3.0}$.

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Table 1. Available nitrogen content (kg ha^{-1}) of soil at different stages of crop growth.

Treatments	Growth Stages								
	25 DAS			50 DAS			At Harvest		
	Pearlmillet	Greengram	Mean	Pearlmillet	Greengram	Mean	Pearlmillet	Greengram	Mean
DFE_0	233	249	241	252	257	255	243	254	248
$DFE_{1.0}$	256	264	260	309	282	296	288	300	294
$DFE_{1.5}$	293	299	296	326	303	315	311	323	317
$DFE_{3.0}$	314	329	321	353	352	352	325	332	328
$DFE_{4.5}$	280	289	284	316	304	310	312	313	313
Mean	275	286		311	300		296	304	
	SEm±	CD (P=0.05)		SEm±	CD (P=0.05)		SEm±	CD (P=0.05)	
Crops	0.7354	2.169		1.029	3.036		0.939	2.770	
Treatments	1.1628	3.430		1.627	4.801		1.484	4.379	
Interaction	1.6444	4.851		2.301	6.790		2.099	NS	

Table 2. Available phosphorus content (kg ha^{-1}) of soil at different stages of crop growth.

Treatments	Growth Stages								
	25 DAS			50 DAS			At Harvest		
	Pearlmillet	Greengram	Mean	Pearlmillet	Greengram	Mean	Pearlmillet	Greengram	Mean
DFE_0	9.37	9.27	9.32	10.18	10.16	10.17	11.37	10.83	11.10
$DFE_{1.0}$	10.10	9.84	9.97	11.10	11.04	11.07	12.00	11.76	11.88
$DFE_{1.5}$	10.67	10.18	10.40	11.44	11.23	11.33	12.50	12.13	12.31
$DFE_{3.0}$	11.70	10.99	11.35	12.49	12.27	12.38	13.40	13.12	13.26
$DFE_{4.5}$	10.52	10.07	10.30	11.70	11.47	11.58	12.30	12.05	12.18
Mean	10.46	10.07		11.38	11.23		12.31	11.98	
		SEm±	CD (P=0.05)		SEm±	CD (P=0.05)		SEm±	CD (P=0.05)
Crops		0.0160	0.04		0.0236	0.06		0.0617	0.18
Treatments		0.0253	0.07		0.0372	0.10		0.0976	0.28
Interaction		0.0358	0.10		0.0527	NS		0.1381	NS

Table 3. Available potassium content (kg ha^{-1}) of soil at different stages of crop growth.

Treatments	Growth Stages								
	25 DAS			50 DAS			At Harvest		
	Pearlmillet	Greengram	Mean	Pearlmillet	Greengram	Mean	Pearlmillet	Greengram	Mean
DFE_0	202	200	201	208	206	207	204	203	203
$DFE_{1.0}$	210	215	212	216	212	214	212	214	213
$DFE_{1.5}$	212	221	216	224	225	219	216	223	219
$DFE_{3.0}$	229	233	231	235	239	237	231	236	233
$DFE_{4.5}$	211	219	215	217	223	220	210	216	213
Mean	212	217		218	221		214	218	
		SEm±	CD (P=0.05)		SEm±	CD (P=0.05)		SEm±	CD (P=0.05)
Crops		0.5164	1.5234		0.5963	1.7591		0.5963	1.7591
Treatments		0.8165	2.4087		0.9428	2.7813		0.9428	2.7813
Interaction		1.1547	3.4064		1.333	3.9334		1.3333	3.9334

Table 4. Available sulphur content (kg ha^{-1}) of soil at different stages of crop growth.

Treatments	Growth Stages								
	25 DAS			50 DAS			At Harvest		
	Pearlmillet	Greengram	Mean	Pearlmillet	Greengram	Mean	Pearlmillet	Greengram	Mean
DFE_0	9.57	8.91	9.24	10.16	9.16	9.66	11.15	10.25	10.70
$DFE_{1.0}$	11.52	10.75	11.13	13.75	12.38	13.06	14.55	13.56	14.06
$DFE_{1.5}$	13.75	12.92	13.34	15.25	14.55	14.90	18.35	16.87	17.61
$DFE_{3.0}$	16.31	15.69	16.00	18.27	17.30	17.78	20.07	19.21	19.64
$DFE_{4.5}$	14.65	13.55	14.10	15.54	15.59	15.56	18.84	17.36	18.10
Mean	13.16	12.36		14.59	13.79		16.59	15.45	
		SEm±	CD (P=0.05)		SEm±	CD (P=0.05)		SEm±	CD (P=0.05)
Crops		0.0560	0.1652		0.0355	0.1046		0.0923	0.2724
Treatments		0.0886	0.2613		0.0561	0.1654		0.1460	0.4307
Interaction		0.1252	NS		0.0793	0.2339		0.2065	NS

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