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Effect of Cow Urine Enriched Agricultural Waste on Growth, Yield and Uptake by Wheat

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A B S T R A C T

Total twelve treatments were tested to study "Effect of cow urine enriched agricultural waste on growth, yield and uptake by wheat" during rabi 2017-18 in randomized block design with three replications with wheat variety GW 451. The growth and yield parameters of wheat viz., plant height at harvest (84.3 cm), number of tillers per meter row length (102), number of ear head per meter row length (94), grain per ear head (41.2), 1000 grain weight (48.2 g), grain yield (4813 kg ha-1) and straw yield (6498 kg ha-1) were recorded significantly higher with application of 100% RDN through chemical fertilizes (T5). The highest gross and realization of 121288.5 ₹ ha-1 and 93196.5 ₹ ha-1 was accrued under the treatment T5 (100% RDN by chemical fertilizers) with the Benefit : Cost Ratio of 4.3. The maximum NUE (22.5 kg ha-1) was noted under treatment T5 and the minimum NUE (16.4 kg ha-1) was noted under treatment T3. The maximum bacterial population was noted under T12 whereas; fungal population was higher in T5. Significantly the higher values of available N (141.7 kg ha-1), P2O5 (32.7 kg ha-1) and K2O (203.1 kg ha-1) content in soil after harvest of crop were recorded with the treatment T12. In case of organic carbon, treatment T3 recorded the highest value of organic carbon (0.27 %). Uptake of N, P and K was found maximum in treatment T5 (100% RDN by chemical fertilizers) compare to rest of treatments.

Introduction

The great Green Revolution in India could be possible due to adoption of improved scientific technologies in high yielding varieties of wheat. The area under wheat has seen remarkable growth over last decades. It is estimated that the area under wheat crop in Gujarat is around 1.02 million hectare and production of 2.94 million tonnes (MOAFW, 2018). Gujarat state shares nearly 3.4 per cent of area, 3.2 per cent of production of India with 2875 kg ha^{-1} productivity. Wheat is highly responsive to added inputs particularly, chemical fertiliser. The yield of wheat increases with the increase in fertiliser dose. But addition of excessive fertilisers has deteriorated the soil health and farmers in many areas are shifting from chemical to organic crop production. Wheat is no exception; organic wheat cultivation is gaining momentum. The major challenge for

organic farming is low nutrient content in the organic manures to be added to supplement nutrients. Cow urine (CU) is good source of plant nutrients especially nitrogen, besides it contains sulphur, phosphorus, potassium, manganese, iron, silicon, chlorine, several enzyme and hormones etc.

Castor is the major non edible oilseed crop of North Gujarat, which is typically as wheat belt also. Castor shell, dehulled seed coat waste, contains about 1.9 % nitrogen, 0.3 % phosphorus and 4.5 % potassium. Because of skewed C/N ratio, castor husks performed badly when used as organic source alone (Lima *et al.*, 2008). Hence, it is imperative to reduce the rate of mineralization of the CC and to improve the C/N ratio of the castor shell. This study had been framed with objective to evaluate combinations of CC and castor shell in order to ascertain a proportion of those by-products to harness best use of chemical fertilisers along with CU enriched organics in a sustainable way.

Materials and Methods

The field experiment was conducted during *rabi*, 2017-18 at Castor Mustard Research Station, SD Agricultural University, Sardarkrushinagar (District Banaskantha) Gujarat India is located at 72^{o} 19' East longitude and 24^{o}19' North latitude at 154.52 meters above the mean sea level. This region falls under North Gujarat Agro-Climatic Zone (AES-IV) of Gujarat. The enriched organic is used in the present study were made by thoroughly sprinkling of CU until saturation in three independent and separate heaps of organics 35 days before sowing of wheat. Each heap was turned weekly and moisture of the heaps was kept at around 30 percent. The pH, EC, moisture content (%), Total Organic Carbon (TOC), N, P, K, S and ash contents in enriched organics after enrichment which is used in the present study are given in Table 1.

Initial and after harvest random soil samples (0-15cm) were collected and processed from the different spots. All physico-chemical parameters and nutrient content of soil were analyzed by standard methods. The field experiment with wheat crop (GW-451) comprised of 12 treatments designed in randomized block design with three replications. The RDF: 60 kg N–60 kg P_2O_5 ha^{-1} were applied in all plots (except control) uniformly as basal and 60 kg N applied at 35 DAS as recommended dose. The top dressing with 60 kg N ha^{-1} was given at 35 DAS using required quantity of enriched CSC, VC, CC (applied in furrows).The soil of were neutral in soil reaction (pH 7.4), normal in salt concentration (EC 0.15 dSm^{-1}), loamy sand in texture, low in organic carbon (0.19 %) and available nitrogen (106 kg ha^{-1}) medium in available phosphorus (29 kg ha^{-1}) and potash content (156 kg ha^{-1}). The statistical analysis of the data collected for different parameters were carried out following the procedure of as described by Panse and Sukhatme (1967).

Results and Discussion

Effect on yield and yield attributes

An application of 100 % RDN through chemical fertilizers (T_5) recorded significantly maximum number tillers per meter row length (102.8), plant height (84.3 cm),number of ear head per meter row length (94.6) and it was remained *at par* with the treatment T_6 (75% RDN by chemical fertilizers + 25% N by T_2), T_7 (75% RDN by chemical fertilizers + 25% N by T_3), T_8 (75% RDN by chemical fertilizers + 25% N by T_4), T_9 (50% RDN by chemical fertilizers + 50% N by T_2), T_{10} (50% RDN by chemical fertilizers + 50% N by T_3)and T_{11} (50% RDN by chemical fertilizers + 50% N by T_4) (Table 2).Increased number of tillers per meter row length might to be due to increased levels of nitrogen resulted in produced more tillers from the main stem and

reduction of mortality of tillers. These results are confirmatory to Liaqat *et al.,* (2003). The increase in plant height might be due to slowly releasing of nutrients in root zone area from enriched organics during the entire crop growth period, which resulted in better plant growth. The present findings are in close agreement with those reported by Subbaiah and Mittra (1997) and Das *et al.,* (2001). The increase in number of ear head due to increase in available nutrients (rapid mineralization), particularly nitrogen, might be attributed to enhancement of protoplasm content of the plant and acceleration of metabolic processes. Similar finding were also reported by Sharma and Bali (1998) and Brar *et al.,* (2000).

Data pertaining to number of grain per ear head and 1000 grain weight as influenced by application of various treatments indicated that application of 100 per cent RDN through chemical fertilizer (T_5) recorded significantly maximum number of grain per ear head (41.2) and 1000 grain weight (48.2 g), it was remained *at par* with the treatment T_6 (75% RDN by chemical fertilizers + 25% N by T_2), T_7 (75% RDN by chemical fertilizers + 25% N by T_3), T_8 (75% RDN by chemical fertilizers + 25% N by T_4), T_9 (50% RDN by chemical fertilizers + 50% N by T_2), T_{10} (50% RDN by chemical fertilizers + 50% N by T_3)and T_{11} (50% RDN by chemical fertilizers + 50% N by T_4). The number of grain per ear head increased might be due to nitrogen promoted the initiation of spikelets that resulted in more grain per ear head. Nitrogen fertilizer applied in optimum dose decreases the chance of grains to deteriorate in the spikes which resulted in lower grain yield (Seiling *et al.,* 2005). The increase in 1000 grain weight might be ascribed to supply of nitrogen at higher levels increase photosynthetic activities and translocation of photosynthates, which might have promoted the growth, better partitioning of photosynthates in yield attributes and eventually produced large size more grain of higher weight. These results are similar to those reported by Patel and Upadhyay (1993).

It was found that application of 100 per cent RDN through chemical fertilizer (T_5) recorded significantly maximum grain yield (4813 kg ha^{-1}) and maximum straw yield (6498 kg ha^{-1}) which was remained *at par* with the treatmentT_6 (75% RDN by chemical fertilizers + 25% N by T_2), T_7 (75% RDN by chemical fertilizers + 25% N by T_3), T_8 (75% RDN by chemical fertilizers + 25% N by T_4), T_9 (50% RDN by chemical fertilizers + 50% N by T_2), T_{10} (50% RDN by chemical fertilizers + 50% N by T_3) and T_{11} (50% RDN by chemical fertilizers + 50% N by T_4). Higher nutrient availability and subsequent higher production of photosynthates that led to higher yield and biomass production which reflected in higher effective tillers per plant that ultimately resulted in higher grain yield. Positive results of higher rates of nitrogen application on grain and straw yields were also reported by Pandey *et al.,* (1997); and Singh *et al.,* (2003).

A perusal of data on gross return as influenced by difference treatments revealed that the highest gross and net realization of 121288.5 ₹ $ha^{-1}$and 93196.5 ₹ ha^{-1}, respectively were accrued under the treatment T_5 (100% RDN by chemical fertilizers) with the Benefit: Cost Ratio of 4.3. This could be attributed to higher grain and straw yield received in these treatments which is reflected from total biomass production of the same treatment.

Effect on soil parameters

Data revealed that various treatments did not show significant effect on the soil pH and EC after harvest of the crop (Table 3). However, application of CU enriched VC (T_3) recorded significantly higher value of organic carbon

(OC) content in soil after harvest of wheat crops (0.27%) and it was remained *at par* with treatment T_2 (CU enriched CSC), T_7 (75% RDN by chemical fertilizers + 25% N by T_3), T_9 (50% RDN + 50% N by T_2) and T_{12} (1/3 N by T_2 + 1/3 N by T_3+1/3 N by T_4) might be due to treatment has stimulated the growth and activity of microorganisms and also better root growth, resulting in higher production of biomass, crop stubbles and residue. Under the present study, significantly the highest available soil N (141.7 kg ha^{-1}) and available phosphorus (32.7 kg ha^{-1}) after harvest of the wheat crop was found under application of 1/3 N by T_2 + 1/3 N by T_3 + 1/3 N by T_4 (T_{12}) which might be due to as addition of organics materials in soil *viz*, CSC, VC and castor cake enriched with CU which increased microorganisms in soil and released organic acids in after decomposition which increased nutrients availability in soil after harvest of crop, hence available result higher under this treatment. However, the application of different treatments did not show significant effect on the available potassium in soil after harvest of the wheat crop.

Effect on Nitrogen Use Efficiency (NUE)

The data presented in Table 4 indicated that NUE (kg ha^{-1}) influences under various treatments. The maximum NUE (22.5 kg ha^{-1}) was noted under treatment T_5 and the minimum NUE (16.4 kg ha^{-1}) was noted under treatment T_3.

Effect on microbial count

Data presented in Table 5 indicated that microbial population in soil after harvest of wheat crop influences under various treatments. Bacterial population observed higher in treatment T_{12} (1/3 N by T_2 + 1/3 N by T_3+1/3 N by T_4) and fungal population found higher in treatment T_5 (100% RDN by chemical fertilizers), whereas minimum population of bacteria and fungi respectively observed in treatment T_1 (Absolute control) and treatment T_3 (CU enriched VC), which might be due to as addition of organics materials in soil *viz*, CSC, VC and CC enriched with CU which increased microorganisms in soil after harvest of crop.

Effect on uptake of nutrients

The significantly maximum uptake of N in grain (96.0 kg ha^{-1}) and straw (46.9 $kgha^{-1}$) recorded with an application of 100 % N through chemical fertilizer (T_5) and it was remained *at par* with treatments T_6 (75% N by RDN + 25% N by T_2) and T_9 (50% N by RDN + 50% N by T_2) (Table 6). The increased uptake of the nutrients was due to added supply of nutrient and well developed root system resulting in better absorption of water and nutrient. There was an increased about 96.0 and 46.9 per cent nitrogen uptake, by grain and straw, respectively under T_5 treatment over control. Similar findings were also observed in rice crop by Singh *et al.*, (2018).

Table.1 Physico-chemical and nutrients content in organics after enrichment

Organics	pH (1:10 w/v)	EC (1:10 w/v)	Moisture content (%)	Major nutrients (%)					Ash content (%)
				TOC	N	P	K	S	
Castor Shell Compost (CSC)	8.3	3.87	36	61.6	2.8	0.99	2.6	0.8	25.3
Vermicompost (VC)	7.3	3.15	29	28.0	2.1	0.76	0.8	0.5	47.8
Castor cake (CC)	6.9	1.38	38	86.4	5.0	2.10	1.1	0.2	55.5

Table.2 Effect of CU enriched organics on number of tillers per meter row length, plant height (cm), number of ear head per meter row length, number of grain per ear head, 1000 grain weight, grain and straw yield of wheat

Treatments	No. of tillers per meter row length	Plant height at harvest (cm)	No. of ear head per meter row length	No. of grain per ear head	1000 grain weight (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Total Biomass (kg/ha)	Gross realization (₹ ha^{-1})	Cost of cultivation (₹ ha^{-1})	Net realization (₹ ha^{-1})	BCR
T_1 :Absolute control	82.86	46.4	75.66	25.3	40.2	2127	2852	4979	47857	23495	24362	2.0
T_2 : CU enriched CSC	87.32	57.5	80.12	33.2	43.4	4120	5546	9666	92700	35032	57668	2.6
T_3 : CU enriched VC	86.89	50.2	79.69	32.6	43.2	4089	5505	9594	92002	69273	22729	1.3
T_4 : CU enriched CC	88.68	69.9	81.48	35.1	43.7	4149	5556	9705	93352	42889	50463	2.1
T_5 : 100% RDN by chemical fertilizers	102.76	84.3	94.56	41.2	48.2	4813	6498	11311	121288	28092	93196	4.3
T_6 : 75% RDN by chemical fertilizers +25% N by T_2	97.53	79.3	90.33	39.4	47.6	4453	5967	10420	112126	30545	81581	3.7
T_7 : 75% RDN by chemical fertilizers + 25% N by T_3	95.03	78.7	87.83	39.1	47.5	4431	5938	10369	111573	39161	72412	2.8
T_8 : 75% RDN by chemical fertilizers + 25% N by T_4	91.66	76.0	84.46	38.8	47.4	4410	5910	10320	111045	28323	82722	3.9
T_9 : 50% RDN by chemical fertilizers + 50% N by T_2	97.93	80.3	90.73	40.3	47.8	4484	6054	10538	112998	32979	80019	3.4
T_{10} : 50% RDN by chemical fertilizers + 50% N by T_3	89.82	75.8	82.62	38.4	47.3	4280	5736	10016	107772	50211	57561	2.1
T_{11} : 50% RDN by chemical fertilizers + 50% N by T_4	88.99	75.7	81.79	37.6	45.7	4252	5698	9950	107066	28535	78531	3.8
T_{12} : 1/3 N by T_2 + 1/3 N by T_3+1/3 N by T_4	85.27	47.0	78.07	31.5	42.3	4120	5439	9559	103578	46290	57288	2.2
S.Em. ±	4.18	2.94	4.18	1.28	1.07	225.01	275.90					
C.D. at 5 %	14.27	8.65	12.85	3.77	3.14	658.10	809.20					
C.V. %	7.93	7.47	8.61	6.18	4.10	9.40	8.60					

Price Grain: 22.5 ₹ kg^{-1}; Straw: 2.0 ₹ kg^{-1}

Table.3 Effect of CU enriched organics on pH and EC of soil after harvest of wheat

Treatments	pH	EC (dSm^{-1})	OC (%)	Available nitrogen ($kg\ ha^{-1}$)	Available P_2O_5 ($kg\ ha^{-1}$)	Available potash ($kg\ ha^{-1}$)
Initial	7.4	0.15	0.19	105.6	29.2	156.0
T_1 :Absolute control	7.6	0.19	0.192	107.7	20.4	149.6
T_2 : CU enriched CSC	7.4	0.26	0.261	137.7	31.3	194.4
T_3 : CU enriched VC	7.5	0.13	0.274	139.4	31.9	195.2
T_4 : CU enriched CC	7.4	0.12	0.238	129.0	30.2	190.9
T_5 : 100% RDN by chemical fertilizers	7.5	0.14	0.227	113.3	24.3	153.6
T_6 : 75% RDN by chemical fertilizers +25% N by T_2	7.4	0.13	0.236	119.6	27.4	171.0
T_7 : 75% RDN by chemical fertilizers + 25% N by T_3	7.4	0.13	0.240	120.3	28.0	176.3
T_8 : 75% RDN by chemical fertilizers + 25% N by T_4	7.3	0.13	0.224	123.8	28.8	177.2
T_9 : 50% RDN by chemical fertilizers + 50% N by T_2	7.3	0.14	0.248	115.0	26.9	163.1
T_{10} : 50% RDN by chemical fertilizers + 50% N by T_3	7.4	0.13	0.254	123.6	29.4	181.1
T_{11} : 50% RDN by chemical fertilizers + 50% N by T_4	7.4	0.12	0.235	128.6	29.6	185.4
T_{12} : 1/3 N by T_2 + 1/3 N by T_3+1/3 N by T_4	7.2	0.12	0.243	141.7	32.7	203.1
S.Em. ±	0.19	0.004	0.007	3.71	1.04	9.40
C.D. at 5 %	NS	NS	0.025	10.89	3.07	NS
C.V. %	3.24	5.65	5.62	5.15	6.4	9.13

Table.4 Effect of CU enriched organics on nitrogen use efficiency after harvest of wheat

Treatments	NUE ($kg\ ha^{-1}$)
T_2 : CU enriched CSC	16.6
T_3 : CU enriched VC	16.4
T_4 : CU enriched CC	16.9
T_5 : 100% RDN by chemical fertilizers	22.4
T_6 : 75% RDN by chemical fertilizers +25% N by T_2	19.4
T_7 : 75% RDN by chemical fertilizers + 25% N by T_3	19.2
T_8 : 75% RDN by chemical fertilizers + 25% N by T_4	19.0
T_9 : 50% RDN by chemical fertilizers + 50% N by T_2	19.6
T_{10} : 50% RDN by chemical fertilizers + 50% N by T_3	17.9
T_{11} : 50% RDN by chemical fertilizers + 50% N by T_4	17.7
T_{12} : 1/3 N by T_2 + 1/3 N by T_3+1/3 N by T_4	16.6

Table.5 Effect of CU enriched organics on microbial population in soil after harvest of wheat

Treatments	Microbial population (cfu gm^{-1})	
	Bacteria	Fungi
T_1 :Absolute control	$1.45x10^7$	$1.19 x10^5$
T_2 : CU enriched CSC	$2.70 x10^7$	$4.90 x10^5$
T_3 : CU enriched VC	$2.87 x10^7$	$7.15 x10^5$
T_4 : CU enriched CC	$1.92 x10^7$	$7.80 x10^5$
T_5 : 100% RDN by chemical fertilizers	$2.76 x10^7$	$8.85 x10^5$
T_6 : 75% RDN by chemical fertilizers +25% N by T_2	$3.84 x10^7$	$4.80 x10^5$
T_7 : 75% RDN by chemical fertilizers + 25% N by T_3	$4.49 x10^7$	$2.09 x10^5$
T_8 : 75% RDN by chemical fertilizers + 25% N by T_4	$2.82x10^7$	$6.40 x10^5$
T_9 : 50% RDN by chemical fertilizers + 50% N by T_2	$4.67 x10^7$	$4.90 x10^5$
T_{10} : 50% RDN by chemical fertilizers + 50% N by T_3	$3.65 x10^7$	$2.95 x10^5$
T_{11} : 50% RDN by chemical fertilizers + 50% N by T_4	$4.17 x10^7$	$5.31 x10^5$
T_{12} : 1/3 N by T_2 + 1/3 N by T_3+1/3 N by T_4	$5.99 x10^7$	$3.19 x10^5$

Table.6 Effect of CU enriched organics on nitrogen, phosphorous and potassium uptake by grain and straw

Treatments	N uptake (kg ha^{-1})		P uptake (kg ha^{-1})		K uptake (kg ha^{-1})	
	Grain	Straw	Grain	Straw	Grain	Straw
T_1 :Absolute control	35.8	16.5	6.9	5.0	5.1	19.1
T_2 : CU enriched CSC	71.7	34.9	15.4	10.0	11.3	41.2
T_3 : CU enriched VC	70.5	34.3	15.0	9.9	11.1	40.4
T_4 : CU enriched CC	73.3	35.3	15.7	10.1	11.7	41.7
T_5 : 100% RDN by chemical fertilizers	96.0	46.9	20.3	12.4	14.6	52.1
T_6 : 75% RDN by chemical fertilizers +25% N by T_2	81.6	40.6	17.7	11.2	13.2	46.1
T_7 : 75% RDN by chemical fertilizers + 25% N by T_3	80.1	38.8	17.5	11.0	13.0	45.6
T_8 : 75% RDN by chemical fertilizers + 25% N by T_4	79.1	38.4	17.3	10.9	12.8	45.1
T_9 : 50% RDN by chemical fertilizers + 50% N by T_2	83.8	40.9	18.4	11.4	13.5	46.9
T_{10} : 50% RDN by chemical fertilizers + 50% N by T_3	75.9	36.8	16.5	10.6	12.3	43.7
T_{11} : 50% RDN by chemical fertilizers + 50% N by T_4	75.1	36.4	16.2	10.3	12.1	42.7
T_{12} : 1/3 N by T_2 + 1/3 N by T_3+1/3 N by T_4	70.4	33.6	15.0	9.7	10.6	39.4
S.Em. ±	4.82	2.30	1.11	0.58	0.81	2.15
C.D. at 5 %	14.15	6.76	3.26	1.72	2.37	6.32
C.V. %	11.23	11.09	12.07	9.97	11.92	8.89

The results on P uptake by grain and straw revealed that significantly maximum uptake of P in grain (20.3 kg ha^{-1}) and straw (12.4 kg ha^{-1}) recorded with an application of 100 % N through chemical fertilizer (T_5) and which was remained *at par* with treatments T_6 (75% N by RDN + 25% N by T_2), T_7 (75% RDN + 25% by T_3), T_8 (75% RDN by chemical fertilizers + 25% N by T4) and T_9 (50% N by RDN + 50% N by T_2) . This could be due to increased uptake of P by grain and straw when applied 100% RDN

(120 kg ha^{-1}) through chemical fertilizers recorded maximum P content in grain and straw.

Potassium uptake by grain and straw (14.6 and 52.1 kg ha^{-1}) was recorded significantly the highest with application of 100% RDN by chemical fertilizers (T_5) which was remained *at par* with treatments T_6 (75% RDN by chemical fertilizers + 25% N by T_2), T_7 (75% RDN by chemical fertilizers + 25% N by T_3), T_8 (75% RDN by chemical fertilizers + 25% N by T_4), T_9 (50% RDN by chemical fertilizers + 50% N by T_2), T_{10} (50% RDN by chemical fertilizers + 50% N by T_3) and T_{11} (50% RDN by chemical fertilizers + 50% N by T_4) and K uptake by straw remained *at par* with T_6 (75% RDN by chemical fertilizers + 25% N by T_2) and T_9 (50% RDN by chemical fertilizers + 50% N by T_2).

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