Original Research Article

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 fertilizers (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.

Keywords
Cow urine, Castor cake, Castor shell compost, vermicompost, wheat, Enrichment, uptake of nutrients

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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° 19' East longitude and 24°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$_2$O$_5$ 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$_3$) 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 (T5) 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 T6 (75% RDN by chemical fertilizers + 25% N by T2), T7 (75% RDN by chemical fertilizers + 25% N by T3), T8 (75% RDN by chemical fertilizers + 25% N by T4), T9 (50% RDN by chemical fertilizers + 50% N by T2), T10 (50% RDN by chemical fertilizers + 50% N by T3) and T11 (50% RDN by chemical fertilizers + 50% N by T4). 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 T5 (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 (T3) 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 T2 (CU enriched CSC), T7 (75% RDN by chemical fertilizers + 25% N by T3), T9 (50% RDN + 50% N by T2) and T12 (1/3 N by T2 + 1/3 N by T3+1/3 N by T4) 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 T2 + 1/3 N by T3 + 1/3 N by T4 (T12) 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 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 T5 and the minimum NUE (16.4 kg ha⁻¹) was noted under treatment T3.

**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 T12 (1/3 N by T2 + 1/3 N by T3+1/3 N by T4) and fungal population found higher in treatment T5 (100% RDN by chemical fertilizers), whereas minimum population of bacteria and fungi respectively observed in treatment T1 (Absolute control) and treatment T3 (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 kg ha⁻¹) recorded with an application of 100 % N through chemical fertilizer (T5) and it was remained at par with treatments T6 (75% N by RDN + 25% N by T2) and T9 (50% N by RDN + 50% N by T2) (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 T5 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 | 207 |
| C.D. at 5% | 14.27 | 8.65 | 12.85 | 3.77 | 3.14 | 658.10 | 809.20 | 207 |
| C.V. % | 7.93 | 7.47 | 8.61 | 6.18 | 4.10 | 9.40 | 8.60 | 207 |

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 P₂O₅ (kg ha⁻¹) | Available potash (kg ha⁻¹) |
|------------|-----|------------|--------|-----------------------------|------------------------|---------------------------|
| Initial    | 7.4 | 0.15       | 0.19   | 105.6                       | 29.2                   | 156.0                     |
| T₁: Absolute control | 7.6 | 0.19       | 0.192  | 107.7                       | 20.4                   | 149.6                     |
| T₂: CU enriched CSC | 7.4 | 0.26       | 0.261  | 137.7                       | 31.3                   | 194.4                     |
| T₃: CU enriched VC | 7.5 | 0.13       | 0.274  | 139.4                       | 31.9                   | 195.2                     |
| T₄: CU enriched CC | 7.4 | 0.12       | 0.238  | 129.0                       | 30.2                   | 190.9                     |
| T₅: 100% RDN by chemical fertilizers | 7.5 | 0.14       | 0.227  | 113.3                       | 24.3                   | 153.6                     |
| T₆: 75% RDN by chemical fertilizers +25% N by T₂ | 7.4 | 0.13       | 0.236  | 119.6                       | 27.4                   | 171.0                     |
| T₇: 75% RDN by chemical fertilizers + 25% N by T₃ | 7.4 | 0.13       | 0.240  | 120.3                       | 28.0                   | 176.3                     |
| T₈: 75% RDN by chemical fertilizers + 25% N by T₄ | 7.3 | 0.13       | 0.224  | 123.8                       | 28.8                   | 177.2                     |
| T₉: 50% RDN by chemical fertilizers + 50% N by T₂ | 7.3 | 0.14       | 0.248  | 115.0                       | 26.9                   | 163.1                     |
| T₁₀: 50% RDN by chemical fertilizers + 50% N by T₃ | 7.4 | 0.13       | 0.254  | 123.6                       | 29.4                   | 181.1                     |
| T₁₁: 50% RDN by chemical fertilizers + 50% N by T₄ | 7.4 | 0.12       | 0.235  | 128.6                       | 29.6                   | 185.4                     |
| T₁₂: 1/3 N by T₂ + 1/3 N by T₃+1/3 N by T₄ | 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) |
|------------|---------------|
| T₂: CU enriched CSC | 16.6         |
| T₃: CU enriched VC  | 16.4         |
| T₄: CU enriched CC | 16.9         |
| T₅: 100% RDN by chemical fertilizers | 22.4         |
| T₆: 75% RDN by chemical fertilizers +25% N by T₂ | 19.4         |
| T₇: 75% RDN by chemical fertilizers + 25% N by T₃ | 19.2         |
| T₈: 75% RDN by chemical fertilizers + 25% N by T₄ | 19.0         |
| T₉: 50% RDN by chemical fertilizers + 50% N by T₂ | 19.6         |
| T₁₀: 50% RDN by chemical fertilizers + 50% N by T₃ | 17.9         |
| T₁₁: 50% RDN by chemical fertilizers + 50% N by T₄ | 17.7         |
| T₁₂: 1/3 N by T₂ + 1/3 N by T₃+1/3 N by T₄ | 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 |
|-------------------------------------------------|---------------------------------|----------|-------|
| T₁: Absolute control                            |                                 | 1.45x10⁷ | 1.19x10⁵ |
| T₂: CU enriched CSC                             |                                 | 2.70x10⁷ | 4.90x10⁵ |
| T₃: CU enriched VC                              |                                 | 2.87x10⁷ | 7.15x10⁵ |
| T₄: CU enriched CC                              |                                 | 1.92x10⁷ | 7.80x10⁵ |
| T₅: 100% RDN by chemical fertilizers           |                                 | 2.76x10⁷ | 8.85x10⁵ |
| T₆: 75% RDN by chemical fertilizers +25% N by T₂|                                 | 3.84x10⁷ | 4.80x10⁵ |
| T₇: 75% RDN by chemical fertilizers + 25% N by T₃|                                 | 4.49x10⁷ | 2.09x10⁵ |
| T₈: 75% RDN by chemical fertilizers + 25% N by T₄|                                 | 2.82x10⁷ | 6.40x10⁵ |
| T₉: 50% RDN by chemical fertilizers + 50% N by T₄|                                 | 4.67x10⁷ | 4.90x10⁵ |
| T₁₀: 50% RDN by chemical fertilizers + 50% N by T₃|                                 | 3.65x10⁷ | 2.95x10⁵ |
| T₁₁: 50% RDN by chemical fertilizers + 50% N by T₄|                                 | 4.17x10⁷ | 5.31x10⁵ |
| T₁₂: 1/3 N by T₂ + 1/3 N by T₃+1/3 N by T₄     |                                 | 5.99x10⁷ | 3.19x10⁵ |

### 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 |
| T₁: Absolute control                            | 35.8  | 16.5  | 6.9   | 5.0   | 5.1   | 19.1  |
| T₂: CU enriched CSC                             | 71.7  | 34.9  | 15.4  | 10.0  | 11.3  | 41.2  |
| T₃: CU enriched VC                              | 70.5  | 34.3  | 15.0  | 9.9   | 11.1  | 40.4  |
| T₄: CU enriched CC                              | 73.3  | 35.3  | 15.7  | 10.1  | 11.7  | 41.7  |
| T₅: 100% RDN by chemical fertilizers           | 96.0  | 46.9  | 20.3  | 12.4  | 14.6  | 52.1  |
| T₆: 75% RDN by chemical fertilizers +25% N by T₂| 81.6  | 40.6  | 17.7  | 11.2  | 13.2  | 46.1  |
| T₇: 75% RDN by chemical fertilizers + 25% N by T₃| 80.1  | 38.8  | 17.5  | 11.0  | 13.0  | 45.6  |
| T₈: 75% RDN by chemical fertilizers + 25% N by T₄| 79.1  | 38.4  | 17.3  | 10.9  | 12.8  | 45.1  |
| T₉: 50% RDN by chemical fertilizers + 50% N by T₂| 83.8  | 40.9  | 18.4  | 11.4  | 13.5  | 46.9  |
| T₁₀: 50% RDN by chemical fertilizers + 50% N by T₃| 75.9  | 36.8  | 16.5  | 10.6  | 12.3  | 43.7  |
| T₁₁: 50% RDN by chemical fertilizers + 50% N by T₄| 75.1  | 36.4  | 16.2  | 10.3  | 12.1  | 42.7  |
| T₁₂: 1/3 N by T₂ + 1/3 N by T₃+1/3 N by T₄     | 70.4  | 33.6  | 15.0  | 9.7   | 10.6  | 39.4  |

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 (T₅) and which was remained at par with treatments T₆ (75% N by RDN + 25% N by T₂), T₇ (75% RDN + 25% by T₃), T₈ (75% RDN by chemical fertilizers + 25% N by T₄) and T₉ (50% N by RDN + 50% N by T₂). This could be due to increased uptake of P by grain and straw when applied 100% RDN.
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 (T6) which was remained at par with treatments T6 (75% RDN by chemical fertilizers + 25% N by T2), T7 (75% RDN by chemical fertilizers + 25% N by T3), T8 (75% RDN by chemical fertilizers + 25% N by T4), T9 (50% RDN by chemical fertilizers + 50% N by T2), T10 (50% RDN by chemical fertilizers + 50% N by T3) and T11 (50% RDN by chemical fertilizers + 50% N by T4) and K uptake by straw remained at par with T6 (75% RDN by chemical fertilizers + 25% N by T2) and T9 (50% RDN by chemical fertilizers + 50% N by T2).

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