



Impact of Resource Based Organic Farming on Soil Fertility in Sugarcane Fields under South Gujarat Climatic Conditions

R. R. SISODIYA ^{a*}, K. G. PATEL ^a, P. K. DUBEY ^b,
V. J. Zinzala ^a, A. R. Kaswala ^b, Narendra Singh ^c
and J. B. Vasave ^d

^a Department of Soil Science and Agricultural Chemistry, NMCA, NAU, NAVSARI, India.

^b Department of NRM, ACH, NAU, NAVSARI, India.

^c Department of Soil Science, NAU, NAVSARI, India.

^d Polytechnic in Agriculture, NAU, Vyara, India.

Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

This study investigated the effect of resource based organic farming on soil fertility in sugarcane fields of south Gujarat. It has measured, organic C, Bulk density, N, P, K₂O considering two factors include: Spacing and compost levels. The investigation was conducted during the years 2019–20 and 2020–21 at Organic Farm, Aspee College of Horticulture, Navsari Agricultural University,

*Corresponding author: E-mail: rvtsisodiya2021@gmail.com;

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Navsari (Gujarat). The soil of the experimental field was clayey in texture, with electrical conductivity within the safe limit (0.46 and 0.47 dS/m). The soil was medium in organic carbon (0.67 and 0.74 %) and slightly alkaline in reaction (pH 7.70 and 7.65). Medium in available nitrogen (248.30 kg/ha and 226.40 kg/ha) and P₂O₅ (45.20 and 35.70 kg/ha), high in available K₂O (416.40 and 429.10 kg/ha), DTPA-extractable Fe (17.00 and 18.20 mg/kg), Mn (15.20 and 16.80 mg/kg), Cu (2.62 and 2.67 mg/kg), and DTPA-extractable Zn (1.60 and 1.48 mg/kg) during both years, respectively. The treatments, viz., (Factor A Spacing, S₁:90 cm; S₂:120 cm x 60 cm paired row with green manuring). (Factor B Manure levels, M₁: NADEP @ 100 % RDN; M₂: NADEP @ 75 % RDN; M₃: NADEP @ 50 % RDN; and M₄: NADEP @ 25 % RDN + Sugarcane trash @10 t/ha + jeevamrut @ 2000 l/ha., were applied to the sugarcane crop and replicated three times in factorial randomized block design. The soil physico-chemical properties enumerated with treatment M₁: NADEP @ 100 % RDN its enhanced soil fertility, increasing organic carbon significantly during both the experimental years and nitrogen during second year of experiment. Organic farming positively impacts soil health. The Soil Properties reported enhanced soil fertility with organic treatments and reduced depletion of nutrients.

Keywords: Soil fertility; organic; clayey; sugarcane crop.

1. INTRODUCTION

In India, post-independence agriculture has witnessed several undesirable consequences in the want to produce more and more to feed hungry population. Often these are called as ill-effects of green revolution. Few examples of these are, indiscriminate use of natural resources, imbalanced fertilization with no or little emphasis on organics, over emphasis on use of synthetic chemicals etc. The continuous application of chemical fertilizers deteriorates the physical, chemical and biological property of soil in turn resulting low yield of sugarcane (Bremner, 1965). The frequent and excessive use of chemical fertilizers has created various problems like widespread deficiency of secondary and micronutrients, decline in crop productivity and increasing environmental pollution (Ghodke et al., 2023). In due course, these became parts of conventional practice of farming (Horrigan et al., 2002), reduction in bio-diversity (Lupwayi et al., 2001; Oehl et al., 2004) and soil erosion (Reganold et al., 1987) are some of the most important negative impacts of conventional farming, which are paid much attention these days due to environmental and public health concerns (Horrigan et al., 2002; Clark, 1998). The long-term sustainability of conventional crop production practices has become questionable due to these negative impacts (Afsharnia et al., 2021). Thus, to sustain the production system in long run "devoid of unsustainable components of conventional farming" scope of integrated farming in general and organic farming in particular has received utter attention.

Sugarcane (*Saccharum Hy. sp.*) is one of the most important crops in both tropical and

subtropical region of the world and a major export product of many developing countries. Sugarcane cultivation in India dates back to the Vedic period. The earliest mention of sugarcane cultivation is found in Indian writings of the period 1400 to 1000 B.C. It is a principal raw material for sugar industry as world's 75% sugar comes from sugarcane (Anon., 2013). It is the main source of sugar, jaggery (gur) and brown sugar (khandsari). Crushed by-products of sugarcane industry like bagasse and molasses also have important uses. Molasses is used in distilleries for the manufacturing of citric acid, ethyl, alcohol etc. Press mud is generally used for soil amendment (Afsharnia et al., 2020). The upper green part of sugarcane is also used as a fodder for cattle feeding. Owing to its versatile utility and vast capability to meet the demands of human population, it is rightly called as 'Wonder cane'.

Sugarcane (*Saccharum Hy. sp.*) belongs to the family *poaceae* (Gramineae) and tropical sugarcane originated from Oceania (New Guinea) while Indian cane (*Saccharum spontaneum* L.) originated from North Eastern India. The word *Saccharum* is derived from the Sanskrit word "sharkara" and it indicates its Indian origin. Brazil led the world in sugarcane production. India is the second largest producer of sugar in the world with over 5 mha of sugarcane growing area. In India, sugarcane is grown in 50.98 lakh hectare with total production 430.50 Million tones with the productivity of 84.44tons per hectare and the average sugar recovery of 10.23%. Considering area, Uttar Pradesh, Maharashtra, Karnataka, Tamil Nadu, Bihar, Andhra Pradesh and Gujarat are the major sugarcane growing states (Afsharnia et al.,

2018). Gujarat produces only 3.72 per cent sugarcane from 4.65 per cent area of India. Sugarcane area, production, productivity and sugar recovery, in Gujarat was 2.23 lakh hectare, 17.44 million tones, 78.31 t/ha and 11.09 %, respectively (Anon., 2023). Surat, Navsari, Valsad, Bharuch, Tapi, Narmada, Bhavnagar, Rajkot, Junagadh and Jamnagar are the important sugarcane producing districts.

The manuscript entitled “Impact of resource based organic farming on soil fertility in sugarcane fields under south Gujarat climatic conditions” is very much important from the part of the research community on sugarcane and its associated industries. It also very much important to sustain soil fertility with natural resources in long duration crop like sugarcane. This article highlighted various aspects of the soil physio chemical properties and soil fertility after cultivation of an important industrial crop like sugarcane.

2. MATERIALS AND METHODS

2.1 Experimental Site

The experiment was conducted at Organic Farm, Navsari Agricultural University, Navsari, Gujarat. The farm was converted in to organic during 2005, since then organic management practices were adopted to raise the crops. This place is situated at 20°57' N latitude, 72°54' E longitude and has an altitude of about 10 m above the mean sea level and is located 12 km away in the

east from the great historical place ‘Dandi’ on the Arabian seashore.

2.2 Experimental Details

The experiment was carried out in a factorial randomized block design comprising of 8 treatments, combinations with thrice in replication (Table 1). Sugarcane variety used for experiments was CoN:7072 sown with two different spacing treatments like S₁: 90 cm and S₂: 120 cm x 60 cm paired row (with green manuring) and four different manuring levels treatments like M₁:NADEP @ 100% RDN, M₂:NADEP @ 75 % RDN, M₃:NADEP @ 50 % RDN and M₄:NADEP @ 25 % RDN+ Sugarcane trash @10 t/ha + jeevamrut @ 2000 l/ha. The NADEP compost is used as a organic manures equivalent to nitrogen requirement of sugarcane (RDN). Sugarcane trash and jeevamrut (500 lit/ha) at first four irrigation as per treatment. The physico-chemical properties of soil recorded before (initial) and after harvest of sugarcane during both the years for each plot. Soil samples will be collected before and after experiment. About 1.5 kg of representative soil sample will be collected from each plot at 0–22.5 cm depth. The soil samples will be air dried in shade. After air drying, the soil will be ground with wooden mortar and pestle and passed through 2.0 mm sieve. These processed soil samples will be stored in cloth bags for detailed analysis. The soil samples will be analyzed for different parameters by adopting standard procedures (Table 2).

Table 1. Treatments details

Treatments	
Factor I: Spacing	
S ₁ : 90 cm	
S ₂ : 120 cm x 60 cm paired row (with green manuring)	
Factor II: Manure levels	
M ₁ :NADEP @ 100 % RDN	
M ₂ :NADEP @ 75 % RDN	
M ₃ :NADEP @ 50 % RDN	
M ₄ :NADEP @ 25 % RDN+ Sugarcane trash @10 t/ha + jeevamrut @ 2000 l/ha.	

Table 2. Soil and water analysis methods

Properties	Methods	References
Bulk density	Core	Black (1965)
Organic carbon	Walkley and Black titration	Jackson (1973)
Available N	Alkaline potassium permanganate	Subbiah and Asia (1956)
Available P ₂ O ₅	Olsen (Extraction with 0.5M NaHCO ₃ at pH 8.5)	Jackson (1973)
Available K ₂ O	Flamephotometric (Extraction with 1 N NH ₄ OAc at pH 7.0)	Jackson (1973)

3. RESULTS AND DISCUSSION

3.1 Bulk Density of Soil

The result regarding soil bulk density (g/cc) at harvest of sugarcane as affected by different treatments is presented in Table 3. The result revealed that soil bulk density (g/cc) at harvest of sugarcane was not affected significantly by the treatments of spacing, compost as well as year and their interactions.

3.2 Soil Organic Carbon (%)

Result regarding treatment effect on soil organic C is presented in Table 4. The result revealed spacing treatment did not affect soil organic C significantly during both the individual years. However, numerically higher soil organic C content after harvest of sugarcane (0.73 and 0.79 %) was found with treatment S₂ (120 cm x 60 cm paired row with green manuring) during the year 2019-20 and 2020-21, respectively. Effect of compost treatment on soil organic C content after harvest of sugarcane was significant. Treatment M₁ (NADEP compost @ 100 % RDN) recorded significantly higher soil organic C content after harvest of sugarcane during the year 2019-20 (0.75 %) and 2020-21(0.82 %). Minimum soil organic C content after harvest of sugarcane was recorded in treatment M₃. Decrease in pH in manure plots was attributed to increase in partial pressure of CO₂ and organic acids due to organic matter decomposition. Slight increase in soil organic C content and available nutrient status was observed in ratoon crop than plant crop is due to residual and cumulative effects of added organic manures in ratoon crop. Same result was also reported by Lakshmi et al. (2011), Ghosh et al. (2012) and Aswal et al. (2012).

Interaction effect of SxM on soil organic C content after harvest of sugarcane was non-significant during the year 2019-20 and 2020-21.

3.3 Available N(kg/ha)

The result pertaining to soil available N (kg/ha) status after harvest of sugarcane is presented in Table 5. The result revealed that the content of available N in soil in the year 2019-20 was not differed significantly but it was differed significantly in the year 2020-21 due to spacing treatments. In the year 2020-21, spacing treatment S₂(120 cm x 60 cm paired row with green manuring) recorded significantly higher

available N content in soil (251.2 kg/ha) as compared to treatment S₁ (90 cm), recorded available N content 241.6 kg/ha in soil after harvest of sugarcane. Similarly, the content of available N in soil in the year 2019-20 was not differed significantly but it was differed significantly in the year 2020-21 due to compost treatments. In the year 2020-21, treatment M₁ (NADEP compost @ 100% RDN) recorded significantly higher content of available N (266.9 kg/ha) after harvest of sugarcane. However, this treatment was remained at par with treatment M₂(application of NADEP compost @ 75 % RDN). Comparatively lowest content of available N in soil was recorded in treatment M₄(application of NADEP compost @ 25 % RDN+ Sugarcane trash @ 10 t/ha + jeevamrut @ 2000 l/ha). The higher amount of available N in soil is may be due to the favorable soil conditions under addition of organic matter might have helped in mineralization of soil N leading to buildup of higher available N. The similar results were founded by other researchers (Marinari, 2006), Randhe et al. (2009), Zhao et al. (2016). Aswal et al. (2012), Saini et al. (2020). During both the years, interaction effect of SxM on available N content in soil after harvest of sugarcane was non-significant.

3.4 Available Phosphorus (kg/ha)

Result regarding effect of spacing on soil available P₂O₅status after harvest of sugarcane is given in Table 6. Result indicated that the content available P₂O₅in soil after harvest of sugarcane was not affected significantly by spacing treatments during both the individual years. The content available P₂O₅in soil after harvest of sugarcane was affected significantly by compost treatments during the year 2020-21. In the year 2020-21, treatment M₁ (NADEP compost @ 100% RDN) recorded significantly the highest content of available P₂O₅(47.5 kg/ha) after harvest of sugarcane. Significantly the lowest content of available P₂O₅(39.0 kg/ha) after harvest of sugarcane was recorded in treatment M₄. However, this treatment was remained at par with the treatment M₃during the year 2020-21. During both the years, interaction effect of SxM on available P₂O₅ content in soil after harvest of sugarcane was non-significant.

3.5 Available K₂O (kg/ha)

The result regarding available K₂O content in soil after harvest of sugarcane is presented in Table 7. The result showed that effect of different

treatments *i. e.* spacing, compost and their interactions on available K₂O content in soil after harvest of sugarcane were not significant during both the individual years. Application of NADEP compost @ 100 % RDN (M₁) found numerically higher soil available potassium (436.4 and 443.3 kg/ha respectively) status after harvest of sugarcane while lower soil available potassium (414.3 and 419.1 kg/ha respectively) status was noted with application of NADEP compost @ 25 % RDN+ Sugarcane trash @ 10 t/ha + jeevamrut @ 2000 l/ha (M₄) during the year 2019-20, 2020-21. The soils that had received organic

amendments consistently showed significantly higher amounts of available N, P and K. This is primarily due to the mineralization and release of these elements contained in the organics (FYM, PS, GM) on their decomposition reported by Ghosh et al. (2012) similar findings also reported by Saini et al. (2020), Ghodke et al. (2023). perusal of data revealed that the interaction effects of different treatments on soil available potassium (kg/ha) status after harvest of sugarcane were found to be non-significant during both the individual as displayed in Table 7.

Table 3. Effect of different treatments on bulk density of soil after harvest of sugarcane

Treatments	Bulk density (g/cc)	
	2019-20	2020-21
Factor I: Spacing		
S ₁ -90 cm	1.38	1.36
S ₂ -120 cm x 60 cm with GM	1.37	1.36
S Em±	0.01	0.01
CD at 5%	NS	NS
Factor II: Compost levels		
M ₁ -Com. @ 100 % RDN	1.36	1.34
M ₂ -Com. @ 75 % RDN	1.37	1.35
M ₃ -Com. @ 50 % RDN	1.39	1.38
M ₄ -Com. @ 25 % RDN+ ST @ 10t/ha + JM @ 2000 l/ha)	1.37	1.37
S Em±	0.01	0.01
CD at 5%	NS	NS
CV (%)	2.47	2.49
SXM		
S Em±	0.02	0.02
CD at 5%	NS	NS
Initial	1.41	

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

Table 4. Effect of different treatments on soil organic C content after harvest of sugarcane

Treatments	Soil organic C (%)	
	2019-20	2020-21
Factor I: Spacing		
S ₁ -90 cm	0.71	0.77
S ₂ -120 cm x 60 cm with GM	0.73	0.79
S Em±	0.01	0.01
CD at 5%	NS	NS
Factor II: Compost levels		
M ₁ -Com. @ 100 % RDN	0.75	0.82
M ₂ -Com. @ 75 % RDN	0.71	0.78
M ₃ -Com. @ 50 % RDN	0.70	0.75
M ₄ -Com. @ 25 % RDN+ ST @ 10t/ha + JM @ 2000 l/ha)	0.70	0.77
S Em±	0.01	0.01
CD at 5%	0.03	0.03
CV (%)	3.69	3.59
SXM		
S Em±	0.02	0.02
CD at 5%	NS	NS
Initial	0.67	

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

Table 5. Effect of different treatments on available N content in soil after harvest of sugarcane

Treatments	Available N (kg/ha)	
	2019-20	2020-21
Factor I: Spacing		
S ₁ -90 cm	223.6	241.6
S ₂ -120 cm x 60 cm with GM	224.4	251.2
S Em±	2.3	3.1
CD at 5%	NS	9.4
Factor II: Compost levels		
M ₁ -Com. @ 100 % RDN	230.2	266.9
M ₂ -Com. @ 75 % RDN	224.5	255.4
M ₃ -Com. @ 50 % RDN	221.6	232.7
M ₄ -Com. @ 25 % RDN+ ST @ 10t/ha + JM @ 2000 l/ha)	219.8	230.6
S Em±	3.2	4.4
CD at 5%	NS	13.3
CV (%)	3.5	4.4
SXM		
S Em±	4.6	6.2
CD at 5%	NS	NS
Initial	248	

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

Table 6. Effect of different treatments on available P₂O₅ content in soil after harvest of sugarcane

Treatments	Available P ₂ O ₅ (kg/ha)	
	2019-20	2020-21
Factor I: Spacing		
S ₁ -90 cm	34.5	41.5
S ₂ -120 cm x 60 cm with GM	34.7	43.4
S Em±	0.7	0.6
CD at 5%	NS	NS
Factor II: Compost levels		
M ₁ -Com. @ 100 % RDN	36.8	47.5
M ₂ -Com. @ 75 % RDN	35.3	42.8
M ₃ -Com. @ 50 % RDN	33.9	40.4
M ₄ -Com. @ 25 % RDN+ ST @ 10t/ha + JM @ 2000 l/ha)	32.4	39.0
S Em±	1.0	0.9
CD at 5%	NS	2.7
CV (%)	7.3	5.2
SXM		
S Em±	1.5	1.3
CD at 5%	NS	NS
Initial	45	

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

Table 7. Effect of different treatments on available K₂O content in soil after harvest of sugarcane

Treatments	Available K ₂ O (kg/ha)	
	2019-20	2020-21
Factor I: Spacing		
S ₁ -90 cm	422.9	431.7
S ₂ -120 cm x 60 cm with GM	426.5	431.0
S Em±	6.9	4.3

CD at 5%	NS	NS
Factor II: Compost levels		
M ₁ -Com. @ 100 % RDN	436.4	443.3
M ₂ -Com. @ 75 % RDN	430.2	433.5
M ₃ -Com. @ 50 % RDN	417.8	429.5
M ₄ -Com. @ 25 % RDN+ ST @ 10t/ha + JM @ 2000 l/ha)	414.3	419.1
S Em±	9.8	6.1
CD at 5%	NS	NS
CV (%)	5.7	3.5
SXM		
S Em±	13.9	8.6
CD at 5%	NS	NS
Initial	416	

GM: Green Manuring, Com.: NADEP Compost, ST: Sugarcane Trash, JM: Jivamrut

4. CONCLUSION

It can be concluded that the soil physico-chemical properties enumerated with treatment M₁: NADEP @ 100 % RDN its enhanced soil fertility, increasing organic carbon significantly during both the experimental years and nitrogen during second year of experiment. Organic farming positively impacts soil health. The Soil Properties reported enhanced soil fertility with organic treatments and reduced depletion of nutrients. Soil organic carbon improvement might be helpful for nutrient availability as well as biological properties of soil and improvement microbial activity. The sustainable agriculture productivity as well as maintenance of soil fertility available organic resource-based treatment positive impact was noticeable.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declares that no generative AI technologies such as Large Language Models (Chat GPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

- Afsharnia, F., A. Marzban, and A. Abdeshahi. "Sugarcane transportation process modeling by time series approach." (2018): 117-126.
- Afsharnia, F., Marzban, A., Asoodar, M. and Abdeshahi, A., 2021. Preventive maintenance optimization of sugarcane harvester machine based on FT-Bayesian network reliability. *International Journal of Quality & Reliability Management*, 38(3), pp.722-750.
- Afsharnia, F., Marzban, A., Asoodar, M.A. and Abdeshahi, A., 2020. Availability modeling of sugarcane harvesting system by using Markov chain. *Journal of Biosystems Engineering*, 45, pp.145-154.
- Anonymous, (2013). Indian Sugar Industry, *Annual Research report-2013*.
- Anonymous, (2023). Commodity Profile for Sugar , March, 2023.<http://agricoop.gov.in/sites/default/files/SugarNew29.pdf>.
- Aswal, J., Negi, D. S. and Shah, B. (2012). Impact of organic manure and bio-agents/ botanicals on major crops in Uttarakhand hills. *Journal of Eco-Friendly Agriculture*, 7 (1): 35-37.
- Bairwa R., Jha, C. K., Thakur S. K. and Kumar V. (2022). Soil health, cane productivity and juice quality improvement through sugarcane trash management in plant-ratoon system grown in calcareous soil. *Biological Forum – An International Journal*.14(2): 1091-1094.
- Banerjee, K., Puste, A. M., Gunri, S.K., Jana, K. and Barman, M. (2018). Effect of integrated nutrient management on growth, yield, quality and soil health of spring planted sugarcane (*Saccharum officinarum*) in West Bengal. *Indian Journal of Agronomy*, 63 (4): 41- 47.
- Black C. A. (1965). Methods of Soil Analysis: Part-1 Physical and mineralogical properties. *American society of Agronomy*, Madison, Wisconsin, USA.
- Bremner, J. M. (1965). Total Nitrogen In: C. A. Black (ed.) Methods of soil analysis. Part 2: Chemical and microbial properties. Number 9 in series Agronomy. *American*

- Society of Agronomy, Inc. Publisher, Madison, USA. pp.1049-1178.
- Clark, M. S., Horwath, W. R., Shennan, C. and Scow, K. M. (1998). Changes in soil chemical properties resulting from organic and low-input farming practices. *Agronomy Journal*, 90:662–671.
- Ghodke S. K., Nimbalkar R. U., Nalawade S. V. and Bhilare R. L. (2023). Application of organic and inorganic fertilizer in sugarcane for maintenance of soil health and sugarcane productivity. *International Journal of Agriculture Sciences*, 15: 12473-12475.
- Ghosh S, Brian W, Subrata G, Nimai S and Biswapati M. (2012). Organic amendments influence soil quality and carbon sequestration in the Indo-Gangetic plains of India. *Agriculture Ecosystems and Environment*, 156:134– 141.
- Horrigan, L., Lawrence, R. S. and Walker, P. (2002). How sustainable agriculture can address the environmental and human health harms of industrial agriculture. *Environmental Health Perspectives*, 110: 445–456.
- Jackson, M.L. (1973). Soil Chemical Analysis. Prentice hall of India Pvt. Ltd., New Delhi.
- Kumari S, Swaroop N, Thomas T, Mohanta SR, Thomas A. (2025). Soil Test Crop Response Concerning Soil Properties and Yield Attributes of Mustard (*Brassica juncea* L.) var. Krishna. *J. Sci. Res. Rep.*, 30 (7): 687-94.
- Lakshmi, C. S., Rama, T., Rani, T., Usha.; R, and Naidu, N. V. (2011). Effect of organic manures on soil fertility and productivity of sugarcane in north coastal zone of Andhra Pradesh. *Indian Journal of Agricultural Research*, 45(4): 307 – 313.
- Lupwayi, N. Z., Monreal, M. A., Clayton, G. W., Grant, C. A., Johnston, A. M. and Rice, W. A. (2001). Soil microbial biomass and diversity respond to tillage and sulphur fertilizers. *Canadian Journal of Soil Science*. 81: 577-589.
- Marinari, S., Mancinelli, R., Campiglia, E. and Grego, S. (2006). Chemical and biological indicators of soil quality in organic and conventional farming systems in Central Italy. *Biological Indices*. 6: 701-711.
- Oehl, F., Sieverding, E., Mäder, P., Dubois, D., Ineichen, K., Boller, T. and Wiemken, A. (2004). Impact of long-term conventional and organic farming on the diversity of arbuscular mycorrhizal fungi. *Oecologia*, 138: 574–583.
- Randhe, M. V., Jadhoo, S. D. and Mane, S. S. (2009). Effect of organic and inorganic fertilization on yield and quality of wheat. *Green Farming*, 2(1): 924 -927.
- Reganold, J. P., Elliott, L. F., & Unger, Y. L. (1987). Long-term effects of organic and conventional farming on soil erosion. *Nature*, 330(6146), 370-372.
- Saini, P., Kumar, P., Hooda, V. S., Akshith and Kumari S. (2020). Effect of different organic and inorganic sources of nutrients on growth, yield, residual nutrient status and physiology of blackgram. *International Journal of Chemical Studies*, 8(3):2559-2563.
- Subbiah, B. V. and Asija, G. L. (1956). A rapid procedure for the estimation of available nitrogen in soil. *Current Science*, 25: 259-260.
- Zhao, X., Gao, X., Zhang, S. and Wu, P. (2016). The effect of long-term fertiliser applications on soil organic carbon and hydraulic properties of a loess soil in China. *Land Degradation & Development*. 27: 60-67.

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