International Journal of Agriculture Sciences
ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 15, Issue 7, 2023, pp.-12473-12475.
Available online at https://bioinfopublication.org/pages/jouarchive.php?id=BPJ0000217

Research Article

APPLICATION OF ORGANIC AND INORGANIC FERTILIZER IN SUGARCANE FOR MAINTENANCE OF SOIL HEALTH AND SUGARCANE PRODUCTIVITY

GHODKE S.K.*, NIMBALKAR R.U., NALAWADE S.V. AND BHILARE R.L.
Central Sugarcane Research Station, Padegaon, 415521, Phaltan, Mahatma Phule Krishi Vidyapeeth, Rahuri, 413722, M.S., India
*Corresponding Author: Email - ghodkesk18@gmail.com

Received: June 04, 2023; Revised: July 26, 2023; Accepted: July 28, 2023; Published: July 30, 2023

Abstract: Attempt was made on "Effect of integrated application of organic and inorganic fertilizer on sugarcane productivity and soil health" at Central Sugarcane Research Station Padegaon, Phaltan, Satara, Maharashtra during 2014-15 to 2016-17 to develop nutrient management strategy for sustaining soil health and sugarcane production during Suru season. The treatment receiving RDF as per soil test along with 20 t ha^{-1} FYM recorded significantly the highest canes yield, CCS yield and number of milleable cane (157.06 t ha^{-1}, 21.57 t ha^{-1} and 89.92 '000 ha^{-1}, respectively). The quality parameters were found non-significant. The soil pH was slightly reduced in all the integrated nutrient management treatments and the soil EC was increased in all the treatments over the initial. Soil organic carbon content was increased in all the integrated nutrient management treatments over the initial status. The treatment receiving RDF as per soil test along with 20 t ha^{-1} FYM was recorded significantly the highest organic carbon (0.77 %), available nitrogen (283.41 kg ha^{-1}) phosphorus (26.32 kg ha^{-1}) and potassium (303.94 kg ha^{-1}). The application of RDF as per soil test along with 20 t ha^{-1} FYM recorded significantly the highest gross monetary returns (Rs.3,53,390 ha^{-1}), and followed by RDF as per soil test along with 10 t ha^{-1} FYM + biofertilizers (Rs.3,44,393 ha^{-1}). The highest benefit-cost ratio was reported in treatment having only RDF as per soil test (2.59). The application of recommended dose of fertilizers as per soil test along with 20 t ha^{-1} FYM for sugarcane and its two successive ratoon were found beneficial in terms of yield and soil health.

Keywords: *Sugarcane, Organic, Inorganic, soil health, Productivity and Economics*

Citation: Ghodke S.K., *et al*., (2023) Application of Organic and Inorganic Fertilizer in Sugarcane for Maintenance of Soil Health and Sugarcane Productivity. International Journal of Agriculture Sciences, ISSN: 0975-3710 & E-ISSN: 0975-9107, Volume 15, Issue 7, pp.- 12473-12475.

Academic Editor / Reviewer: Dr Anil Kumar, Dr R.M.Garkar

Introduction

Sugarcane (*Saccharum officinarum* Linne.) is an important commercial crop of the country. The sugarcane is a long duration crop and it demands large amount of nutrient for their production. Therefore, nutrient status of soil is decline and ultimately it affect the sugarcane production.

Application of fertilizer enhances crop growth and yield but excessive use of chemical fertilizer may lead to stagnation or decline in productivity for emerging deficiency of other nutrients and can degrade biophysical conditions [1,2]. The increasing cost of fertilizer also prevents their use by resource-poor farmers. Integrated use of fertilizer and manures may help minimizing the cost of chemical fertilizer, improves soil productivity and crop growth [3].

Integrated nutrient management not only increases the productivity of one crop but also have some residual effect on succeeding crop. Bokhtiar, *et al.,* (2008) [4] stated that only one-fifth to one half of the nutrients supplied by animal manure were used by the first crop following the application. The remainder was retained as humus subject to very slow decomposition, only 2.4% of nutrient elements were released annually. Some studies reported that farmyard manures applied in the crop field was not fully utilized by one crop, as it was needed decomposition. Its slow decomposition may benefit the following ratoon crops.

The available information about residual effects of combined use of organic and inorganic fertilizer on productivity of ratoon crops of sugarcane under field condition is limited [5]. In the present study, an attempt has been made to study the direct effects of organic and inorganic fertilizers on growth, yield, and juice quality of plant crop and their residual effects on succeeding ratoon crops of sugarcane. With this background, the present investigation was undertaken on "Impact of integrated application of organic and inorganic in improving soil health and sugarcane productivity" during 2014-15 to 2016-17.

Materials and Methods

The field experiment was conducted on "Impact of integrated application of organic and inorganic in improving soil health and sugarcane productivity" at Central Sugarcane Research Station Padegaon, Phaltan, Satara, Maharashtra during 2014-15 to 2016-17 for to develop nutrient management strategy for sustaining soil health and sugarcane production during Suru season. It consist of total nine treatments, 50% RDF, 100% RDF, RDF as per soil test, FYM @ 20 t ha^{-1} + 50 % RDF, FYM @ 20 t ha^{-1} + 100 % RDF, FYM @ 20 t ha^{-1} + RDF as per soil test, FYM @ 10 t ha^{-1} + BF (*Acetobacter* + PSB) + 50 % RDF, FYM @ 10 t ha^{-1} + BF (*Acetobacter* + PSB) + 100 % RDF, FYM @ 10 t ha^{-1} + BF (*Acetobacter* + PSB) + RDF as per soil test in randomized block design with three replications for one plant cane and its successive two ratoons. The recommended trash management practices were followed in ratoon crops.

The soil of the experimental site was medium black. Planting of sugarcane (CoM-0265) was done during first week of January at 120 cm row spacing. The intra row spacing of 15 cm was maintained. The recommended fertilizer dose of 250 kg N/ha, 115 kg P_2O_5/ha and 115 kg K_2O/ha were applied to sugarcane. Nitrogen was applied in 4 splits at planting (10%), tillering (40%), grand growth stage (10 %) and earthing up (40 %).

Phosphorus and Potassium were applied in 2 splits at planting (50 %) and earthing up (50 %) for plant cane and in ratoons 50% NPK was applied at 4 to 5 days after ratooning on one side of row and 50% NPK at 35 days after ratooning on other side of row with the help of crow bar. All the recommended plant protection measures were undertaken during the course of investigation. Data were recorded at harvest for yield and quality characters. The juice analysis was done by sampling five canes from each plot at harvest.

Table-1 Effect of different treatments on yield and quality parameters of sugarcane (Pooled)

Treatment	Cane yield (t ha^{-1})	CCS yield (t ha^{-1})	ACW (kg)	NMC	Brix°0	Sucrose (%)	CCS (%)	Purity (%)
T_1	110.44	15.08	1.41	71.94	18.95	18.17	13.58	95.60
T_2	121.51	16.62	1.56	76.63	19.36	18.03	13.63	95.93
T_3	127.79	17.75	1.58	80.47	19.67	18.84	13.84	95.71
T_4	135.09	18.52	1.63	82.82	19.48	18.16	13.70	94.38
T_5	150.61	20.69	1.72	87.91	19.17	18.52	13.65	93.89
T_6	157.06	21.57	1.78	89.92	19.77	18.78	13.64	94.78
T_7	135.01	18.60	1.66	81.7	19.40	17.97	13.75	95.89
T_8	145.69	20.28	1.69	86.98	19.33	18.05	13.84	96.25
T_9	153.06	21.56	1.76	88.15	19.19	18.43	14.03	95.73
SE$\pm$	7.19	1.03	0.09	2.13	0.34	0.37	0.13	1.42
CD at 5%	21.56	2.96	0.26	6.21	NS	NS	NS	NS

Table-2 Effect of different treatments on soil chemical properties at harvest (Pooled)

Treatment	Soil pH (1:2.5)	Soil EC (dS^{-1})	Organic Carbon (%)	Available nitrogen (kg ha^{-1})	Available phosphorus (kg ha^{-1})	Available potassium (kg ha^{-1})
T_1	7.55	0.46	0.66	207.58	19.32	241.99
T_2	7.48	0.48	0.69	221.93	20.90	260.08
T_3	7.54	0.54	0.71	233.48	21.50	250.98
T_4	7.38	0.61	0.74	241.53	23.21	282.56
T_5	7.43	0.68	0.74	263.50	23.45	303.94
T_6	7.37	0.66	0.77	283.41	26.32	298.18
T_7	7.34	0.67	0.73	237.56	22.26	271.80
T_8	7.41	0.65	0.74	261.94	23.67	286.11
T_9	7.40	0.70	0.75	278.50	24.43	274.04
SE$\pm$	0.03	0.03	0.03	3.53	0.49	4.32
CD at 5%	0.09	0.07	0.09	10.58	1.48	12.94

Results and Discussion

Yield and quality parameters

The data in respect of yield and yield contributing parameters of one plant cane and two ratoons are presented in [Table-1] revealed that the treatment T_6 receiving RDF as per soil test along with 20 t ha^{-1} FYM recorded significantly the highest canes yield, CCS yield and number of milleable cane (157.06 t ha^{-1}, 21.57 t ha^{-1} and 89.92 '000 ha^{-1}, respectively) and it was found at par with treatments T_9, T_5 and T_8. However, the treatment T_6 receiving RDF as per soil test along with 20 t ha^{-1} FYM recorded significantly the highest average cane weight (1.78 kg ha^{-1}) and it was found at par with all the treatments except T_1.

The results were conformity with to Sridevi, *et al.,* (2016) [6], Su, *et al.,* (2021) [7] and Tripathi, *et al.,* (2010) [8]. The different treatments quality parameters viz, Brix (%), Sucrose (%), Purity (%) and CCS (%) were found non-significant. The results were similar to Bokhtiar, *et al.,* (2008) [9], Liu, *et al.,* (2023) [10] and Nazirkar and Kamathe (2012) [11].

Soil chemical properties

The soil chemical properties have been analyzed from pre and post harvest soils of sugarcane and presented in [Table-2]. The soil pH was slightly reduced in all the integrated nutrient management treatments. The lowest soil pH (7.34) was recorded in treatment of T_7 receiving 50 % RDF along with 10 t ha^{-1} FYM + biofertilizers and the highest value was observed in treatment T_1 receiving 50 % RDF (7.55). The soil EC was increased in all the treatments over the initial. Significantly the lowest EC was noted in the treatment T_1 receiving 50 % RDF and it was found highest in treatment T_9. Similar findings were reported by Miah, (1994) [12] and Wu, *et al.,* (2023) [13].

Soil organic carbon content was reduced in the treatment T_1; however, it was increased in all the integrated nutrient management treatments over the initial status. The treatments T_6 receiving RDF as per soil test along with 20 t ha^{-1} FYM was recorded significantly the higher organic carbon (0.77 %) and it was found at par with all the treatments except treatment T_1.

The lowest organic carbon concentration was recorded in the treatment T_1. The treatment T_6 receiving RDF as per soil test along with 20 t FYM recorded significantly the higher soil available N, P and K (283.41, 26.32 and 303.94 kg ha^{-1} respectively). However, the lowest soil nutrient status of soil available N, P and K was found in the treatment T_1. These results are in confirmatory with results of Kshirsagar, (2008) [14], Liu, *et al.,* (2021) [15] and Paul, *et al.,* (2005) [16].

Economics

The data pertaining to gross returns, net returns and benefit-cost ratio as affected by different treatments are presented in [Table-3]. It is revealed that, the application of RDF as per soil test along with 20 t ha^{-1} FYM (T_6) recorded significantly the higher per hectare gross monetary returns (Rs.3,53,390 ha^{-1}), and followed by T_9 receiving RDF as per soil test along with 10 t ha^{-1} FYM + biofertilizers (Rs.3,44,393 ha^{-1}) and lowest in the treatment T_1 (Rs.2,48,496 ha^{-1}). The highest net returns (Rs.2,09,865 ha^{-1}) was observed in treatment T_9 having application of RDF as per soil test along with 10 t ha^{-1} FYM + biofertilizer (Acetobacter + PSB). The highest benefit-cost ratio was reported in the treatment T_3 receiving only RDF as per soil test (2.59) and it was found lowest in the treatment T_4 (1.52). These results are also in accordance with the findings of Islam, *et al.,* (1998) [17], Nascimento, *et al.,* (2021) [18], Singh and Singh (2002) [19], Timmareddy, (2001) [20] and Kshirsagar (2008) [21].

Table-3 Economics of different treatments (Pooled)

Treatment	Gross return	Cost of cultivation	Net return	B:C ratio
T_1	248496	92588	146879	2.35
T_2	273388	98517	166845	2.44
T_3	287527	98479	181637	2.59
T_4	321877	173804	164676	1.52
T_5	338868	179733	177328	1.55
T_6	353390	179695	192889	1.63
T_7	305874	134608	174846	1.94
T_8	327806	140537	193928	2.00
T_9	344393	140499	209865	2.12
SE$\pm$	19253	--	19253	--
CD at 5%	57719	--	57719	--

Conclusion

Application of recommended dose of fertilizers as per soil test along with 20 t ha^{-1} FYM for sugarcane and its two successive ratoon were found beneficial in terms of yield and soil health.

Application of research: Use of integrated nutrient management makes help in increasing cane and CCS yield of sugarcane with maintenance of soil fertility. Reduced application of chemical fertilizer with increasing nutrient use efficiency. Increasing farmer production with maintenance of soil fertility.

Research Category: Integrated nutrient Management in Sugarcane

Abbreviations: CCS- Commercial Cane Sugar, ACW- Average Cane Weight
NMC- Number of Millable Cane, PSB- Phoshate Solubilizing bacteria
RDF- Recommended dose of fertilizer, FYM- Farm Yard Manure

Acknowledgement / Funding: Authors are thankful to Central Sugarcane Research Station, Padegaon, 415521, Phaltan, Mahatma Phule Krishi Vidyapeeth, Rahuri, 413722, M.S., India

**Principal Investigator or Chairperson of research: Dr S.K. Ghodke
University: Mahatma Phule Krishi Vidyapeeth, Rahuri, 413722, M.S., India
Research project name or number: Research station study

Author Contributions: All authors equally contributed

Author statement: All authors read, reviewed, agreed and approved the final manuscript. Note-All authors agreed that- Written informed consent was obtained from all participants prior to publish / enrolment

Study area / Sample Collection: Central Sugarcane Research Station, Padegaon, 415521, Phaltan

Cultivar / Variety / Breed name: Sugarcane

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

References

[1] Chung W.J., Chang S.W., Chaudhary D.K., Shin J.D., Kim H., Karmegam N., Govarthanan M., Chandrasekaran M., Ravindran B. (2021) *Chemosphere*, 283, 131129.
[2] Wu Q.H., Li S., Huang Z.X. and Wang Q. (2020) *Archives of Agronomy and Soil Science*, 67, 727-738.
[3] Bhattacharyya P. and Chakraborty G. (2005) *Indian Journal of Fertilizers*, 1(9), 111-123.
[4] Bokhtiar S. M. and Sakurai K. (2007) *Journal of Plant Nutrition*, 30, 135-147.
[5] Singh P.P., Saini S.K. and Kumar K. (1995) *Indian J. Sug. Tech*.,10, 24-27.
[6] Sridevi B.A., Chandrashekar C.P. and Patil S.B. (2016) *Imperial Journal of Interdisciplinary Research*, 2(9), 970-979.
[7] Su M., Meng L.Z., Zhao L., Tang Y.K. and Qiu J.J. (2021) *Geoderma*, 404, 15311
[8] Tripathi A.O., Shingane U.S. and Thakare L.S. (2010) *Agril. Update*, 5(3), 397-399.
[9] Bokhtiar S.M., Paul G.C. and Alam K.M. (2008) *Journal of Plant Nutrition*, 31, 1832-1843.
[10] Liu H., Li D., Huang Y., Lin Q., Huang L., Cheng S., Sun S., Zhu Z. (2023) *Applied Soil Ecology*, 188, 104920.
[11] Nazirkar R.B. and Kamathe N.D. (2012) *An Asian Journal of Soil Science*, 7 (1), 89-92.
[12] Miah M.M.U. (1994) *Soil Fertilizer Management (SFFP) and Department of Agriculture Extension (DAE).*
[13] Wu Q., Zhou W., Lu Y., Li S., Shen D., Ling Q., Chen S. and Ao J. (2023) *Sugar Tech.*, (25), 552-561.
[14] Kshirsagar K.G. (2008) *Indian J. Agri. Econ*., 63(3), 396-405.
[15] Liu Z., Shang H.G., Han F., Zhang M.R., Li Q. and Zhou W.Z. (2021) *Applied Soil Ecology*, 168, 104117.
[16] Paul G.C., Rahman M.H. and Rahman A.B.M.M. (2005) *Sugar Tech.*, (7(2&3), 20-23.
[17] Islam M.J., Majid M.A., Paul G.C., Bokhtiar S.M. and Hossain A. (1998) *Proceedings of the National Workshop on Integrated Nutrient Management for Crop Production and Soil Fertility, held on 24-25 March* 1998, 159-166.
[18] Nascimento J.M.D., Netto J.A.F.V., Valadares R.V., Mendes G.D.O. and Costa M.D. (2021) *Soil Biology & Biochemistry*, 156, 1-9.
[19] Singh T. and Singh P. N. (2002) *Indian J. Sugarcane Technol*., 17 (1 & 2), 53-55.
[20] Timmareddy K.S. (2001) *M. Sc. (Agri.) Thesis, Univ. Agric. Sci., Dharwad, Karnataka, India.*
[21] Kshirsagar K.G. (2008) *Gokhale Institute of Politics and Economics Pune*, 124-136.