International Research Journal of Environment Sciences E-ISSN 2319–1414
Vol. **5(4),** 50-53, April **(2016)** *Int. Res. J. Environment Sci.*

Soil Properties and Yield of Fodder Maize Influenced by Primary Biomethanated Spentwash

Sunil Jawale[1], Santosh Patil[2*], Sunil Joshi[2] and Deepak Patil[2]
[1]Department of Soil Science and Agriculture Chemistry, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India
[2]BAIF Development Research Foundation, Uruli Kanchan, Pune 412 202, Maharashtra, India
santosh86patil@gmail.com

Available online at: www.isca.in, www.isca.me
Received 22nd January 2016, revised 8th February 2016, accepted 2nd March 2016

Abstract

The experiment on soil properties and yield of fodder maize influenced by primary biomethanated spentwash was carried at Post Graduate Farm, MPKV, Rahuri during 2011-12. The effect of varying doses of primary biomethanated spentwash (100, 200, 300, 400, and 500 m^3 ha^{-1}) and combination of FYM + RDF, FYM + 50 % GR and FYM + RDF + 100 % GR + RDF on soil properties and yield of fodder maize was studied. The experimental soil was Vertic Haplustepts with alkaline (pH 8.90), calcareous ($CaCO_3$ 10.50 %), clay in texture, high in exchangeable sodium (10.60 cmol (p^+) kg^{-1}) and ESP (25.20) with low in available nitrogen and phosphorus and high in available potassium. The available N, P and K after harvest of crop were significantly higher in PBSW treatment applied @ 500 m^3 ha^{-1}, however, uptake and yield were significantly higher in 400 m^3 ha^{-1} and 500 m^3 ha^{-1} treatments (495.30, 517.31 q ha^{-1} green yield respectively) followed by FYM + RDF + @ 50 % GR and FYM + RDF + 100 % GR.

Keywords: Post Biomethanated Spent Wash, Bulk Density and Hydraulic Conductivity.

Introduction

Primary biomethanated spent wash contain nitrogen (1,200-1,500 mgL^{-1}) phosphorus (40-70 mgL^{-1}) potassium (800-13,000 mgL^{-1}) and iron (50-150 mgL^{-1}). These nutrients can be utilized for crop production. Spentwash can be utilized effectively after dilution 50-75 times for crop production. Land degradation due to salinity and sodicity is a serious problem faced in arid and semiarid region. It occurs in region where evapo-transpiration is greatly exceeds precipitation and the soils that are increasingly brought under intensive irrigation show more water logging problem in canal command areas. Dispersion of fine clay particles resulting into low permeability, crusting and hardening of soil surface upon drying recorded due to high exchangeable sodium content of the soil. As a result, the aeration, soil water movement and root growth is hampered. Besides the high sodium content is often toxic to many plants, which exhibits poor growth and yield. The soils have poor aggregate stability, low organic matter content, toxic concentration of CO_3^{2-} and HCO_3^-, poor microbial activity due to unfavorable pH and reduced availability of N, K, Zn and Fe and affect the productivity of soil. The primary biomethanated spentwash contains considerable amount of soluble calcium which may prove to be beneficial for reclamation of sodic soil. However, since primary biomethanated spentwash also contains sodium, it becomes immense necessary to investigate the impact of primary biomethanated spentwash application on the saturation of soil exchange complex with calcium and sodium and the consequent effect of amelioration on soil sodicity.

Materials and Methods

The experiment was conducted on a sodic calcareous soil belonging to Pather soil series of

Table-1
Treatment details of experiment

Treatments No.	Treatment details
T_1	Absolute Control
T_2	FYM 5 Mg ha^{-1} + RDF (AST)
T_3	FYM 5 Mg ha^{-1} + 50 % of GR + RDF (AST)
T_4	FYM 5 Mg ha^{-1} + 100 % of GR + RDF (AST)
T_5	100 m^3 ha^{-1} of PBSW
T_6	200 m^3 ha^{-1} of PBSW
T_7	300 m^3 ha^{-1} of PBSW
T_8	400 m^3 ha^{-1} of PBSW
T_9	500 m^3 ha^{-1} of PBSW

Note: RDF- recommended dose of fertilizer, GR- Gypsum requirement, AST- As per soil test, PBSW- Primary biomethanated spentwash.

isohyperthermic family of Vertic Haplustepts Application of primary biomethanated spentwash (PBSW), FYM and gypsum was done 20 days before sowing (Due to some reasons the experiment was repeated so the all the treatments increasing the PBSW, FYM, Gypsum and fertilizers added on 21/02/2011 were applied as shown in Table-1.

Results and Discussion

The soil pH is presented in table which indicated that pH of soil decreased with increasing level of PBSW. The decrease in value of pH at sowing from treatment T_1 (8.90) to T_9 (8.59).

At harvest pH of soil in treatment T_9 (8.54) was at par with treatment T_8 (8.57), T_7 (8.60), T_6 (8.62), T_5 (8.64), T_4 (8.67). On other hand treatment T_4 (8.67) was at par with treatment T_5 and T_6 (8.64 and 8.62 respectively) and also with treatments T_2 and T_3 (8.78 and 8.76, respectively). The reduction in pH of sodic soil was due to the application PBSW which attributed to release of organic acids on microbial decomposition of organic matter content presented in PBSW. It was clear from the study that, the higher doses of PBSW (100 $m^3 ha^{-1}$ to 500 m^3 ha^{-1}) reduced pH significantly in sodic soil. The reduction in soil pH was in the proportion to the increased doses of PBSW and it was at par with FYM + 100 % GR treatment only and superior over all other treatments tested. The reduction in pH due to FYM + 100 % GR + RDF treatment at harvest in sodic soil was statistically equivalent with low doses of PBSW (100 and 200 m^3 ha^{-1}).

Table-2
Effect of primary biomethanated spentwash on chemical properties of soil

Treatments	pH (1:2.5)		EC(dSm^{-1}) (1:2.5)		Organic carbon (g kg^{-1})	
	At sowing	At Harvest	At sowing	At Harvest	At sowing	At Harvest
T_1: Control	8.90	8.88	0.52	0.55	3.7	3.5
T_2: FYM 5 Mg ha^{-1} + RDF (AST)	8.81	8.78	0.60	0.62	4.4	4.2
T_3: FYM 5 Mg ha^{-1} + 50% of GR + RDF (AST)	8.78	8.76	1.19	1.23	5.7	5.5
T_4: FYM 5 Mg ha^{-1} + 100 % of GR + RDF (AST)	8.70	8.67	1.21	1.24	5.9	5.7
T_5:100 m^3 ha^{-1} of BSW	8.67	8.64	1.23	1.27	6.1	5.9
T_6:200 m^3 ha^{-1} of PBSW	8.65	8.62	1.26	1.28	6.3	6.0
T_7:300 m^3 ha^{-1} of PBSW	8.62	8.60	1.29	1.31	6.4	6.2
T_8:400 m^3 ha^{-1} of PBSW	8.61	8.57	1.36	1.38	6.6	6.3
T_9:500 m^3 ha^{-1} of PBSW	8.59	8.54	1.44	1.46	6.8	6.5
S.E. ±	0.033	0.05	0.033	0.033	2.3	1.6
CD (0.05%)	0.10	0.15	0.10	0.10	7.0	4.8
CV %	2.82	1.05	15.30	6.16	6.54	8.39

Table-3
Soil nutrients influenced by primary biomethanated spentwash

Treatments	Available nutrients (kg ha^{-1})					
	N		P		K	
	At sowing	At Harvest	At sowing	At Harvest	At sowing	At Harvest
T_1 : Control	157.86	152.18	8.35	6.46	365.86	313.63
T_2: FYM 5 Mg ha^{-1} + RDF (AST)	172.42	165.58	8.54	6.48	418.13	375.03
T_3: FYM 5 Mg ha^{-1} + 50 % of GR + RDF (AST)	174.56	166.64	8.73	6.50	433.06	356.03
T_4: FYM 5 Mg ha^{-1} + 100 % of GR + RDF (AST)	178.74	172.46	9.02	6.61	436.00	332.31
T_5: 100 m^3 ha^{-1} of PBSW	216.38	185.88	9.30	6.87	459.20	408.17
T_6: 200 m^3 ha^{-1} of PBSW	229.39	199.54	9.32	6.91	477.80	430.20
T_7: 300 m^3 ha^{-1} of PBSW	256.10	203.66	11.11	7.03	503.00	442.33
T_8: 400 m^3 ha^{-1} of PBSW	264.46	219.89	11.87	7.75	518.66	478.04
T_9: 500 m^3 ha^{-1} of PBSW	268.64	223.01	13.20	7.86	533.86	484.56
S.E. ±	5.21	10.14	0.10	0.16	5.66	13.33
CD (0.05%)	15.63	30.44	0.30	0.5	17	40
CV %	5.05	11.22	5.09	12.44	5.47	10.23

Similar results of decreased in pH value were also reported by Kaushik *et al.* (2005)[1]. At harvest, increase in EC was from 0.55 dSm^{-1} (T_1) to 1.46 dSm^{-1} (T_9) treatment T_9 (1.46 dSm^{-1}) was at par with treatment T_8 and T_7 (1.38 and 1.31 dSm^{-1} respectively). While, treatment T_4 (1.245 dSm^{-1}) was at par with treatment T_3, T_5 and T_6 (1.23, 1.27 and 1.28 dSm^{-1} respectively), treatment T_1 (0.55 dSm^{-1}) differs significantly with T_2 (0.62 dSm^{-1}) due to high amount of soluble salts by Pathak *et al.* (1999)[2], Hati *et al.*[3], Kaushik *et al.* (2005)[1]. Organic carbon in treatment T_9 (6.5 g kg^{-1}) was at par with treatment T_8 and T_7 (6.3 and 6.2 g kg^{-1} respectively). On other hand in treatment T_4 (5.7 g kg^{-1}) was at par with treatment T_3, T_5 and T_6 (5.5, 5.9 and 6.0 g kg^{-1} respectively) T_2 and control differs with each other. Similar study also reported by Pathak *et al.*[2], Hati *et al.* [3].

At harvest for available N, more or less same trend was observed, however, treatment T_9 (7.86 kg ha^{-1}) was at par with T_8 (7.75 kg ha^{-1}). The treatment T_4 (6.61 kg ha^{-1}) was at par with all other treatments except T_8 and T_9. The treatments FYM + RDF, FYM + Gypsum 50 % and FYM + 100 % Gypsum, were at par with 100, 200 and 300 m^3 ha^{-1} PBSW and control. The experiment conducted by Kaushik *et al.*[1] reported significant increase in soil available P due to application of PME on sodic soil, which increase minerlizable P by soil microbes. Same results were obtained by Gore[4].

At harvest, more or less same trend was observed, however, treatment T_9 (485 kg ha^{-1}) was at par with T_8 (478 kg ha^{-1}). On other hand treatment T_2 (332 kg ha^{-1}) was at par with control (314 kg ha^{-1}). The experiment conducted by Kaushik *et al.*[1] reported significant increase in soil available K due to application of PME on sodic soil, which increase minerlizable K by soil microbes. Same results were obtained by Gore[4].

The significantly highest fresh green yield was obtained under the treatment T_9 (517 q ha^{-1}), however, it was at par with treatment T_8 (495 q ha^{-1}), both are significantly superior over all other treatments tested.

Table-4
Fodder yield of maize influenced by primary biomethanated spentwash

Treatment	Fresh green fodder yield (q ha^{-1})
T_1: Control	280.95
T_2: FYM 5 Mg ha^{-1} + RDF (AST)	337.82
T_3: FYM 5 Mg ha^{-1} + 50 % of GR + RDF (AST)	398.01
T_4: FYM 5 Mg ha^{-1} + 100 % of GR + RDF (AST)	417.56
T_5: 100 m^3 ha^{-1} of PBSW	421.86
T_6: 200 m^3 ha^{-1} of PBSW	439.86
T_7: 300 m^3 ha^{-1} of PBSW	444.81
T_8: 400 m^3 ha^{-1} of PBSW	495.30
T_9: 500 m^3 ha^{-1} of PBSW	517.31
S.E. ±	12.52
CD (0.05%)	37.55
CV %	5.20

The fresh yield of green fodder maize was mainly due to improvement of sodic soil as indicated by reduction in ESP in PBSW treatments. There was reduction in ESP. this reduction in ESP was more in PBSW treatments of higher doses, which resulted in higher fresh weight yield of green fodder maize. The higher doses of PBSW also helped in improvement of soil fertility as it contain more amount of organic load, major and minor nutrients with growth promoting enzymes by Gore[4]. The increased doses of PBSW also increased EC of soil; however, it was in safe limit, which did not affect maize yield. It was observed that there was significant reduction in pH of soil after addition of PBSW and gypsum, however, significant increase in organic carbon, cation exchange capacity and EC was observed in both the stage of soil sampling. The pH was reduced from 8.90 to 8.54 from control (T_1) to 500 m^3 ha^{-1} (T_9) of PBSW treatment in soil respectively; this reduction was significantly superior over control, FYM + RDF and FYM + Gypsum + RDF treatments. The significant highest increased in EC was observed in treatment of 500 m^3 ha^{-1} PBSW than all other treatments in both the stages of soil sampling, however, this increase was more at harvest stage than at sowing stage and it was below the tolerable limits. The increased in EC of both the stages soil sampling in FYM + Gypsum + RDF treatment was statistically superior over control. The available soil nitrogen, phosphorus and potassium content after harvest of fodder maize was highest in 500 m^3 ha^{-1} PBSW treatment than all other treatments tested, however significantly superior N, P and K uptake by fodder maize was found in (500 m^3 ha^{-1} PBSW) followed by 400 m^3 ha^{-1} PBSW and FYM + Gypsum + RDF.

The significant increased in green yield of fodder maize was noticed due to application of PBSW (500 m^3 ha^{-1}) and followed by integrated use of FYM, Gypsum and RDF. The maximum green yield (517 q ha^{-1}) was recorded in treatment of (500 m^3 ha^{-1} PBSW), which was at par with (400 m^3 ha^{-1} PBSW) treatment. The available soil nitrogen, phosphorus and potassium content after harvest of fodder maize was highest in 500 m^3 ha^{-1} treatment than all other treatments tested. The significantly superior N, P and K uptake by fodder maize was found in PBSW treatments at higher doses, followed by FYM + Gypsum + RDF and FYM + RDF.

Conclusion

It can be concluded form the study that the use of PBSW @ 500 m^3 ha^{-1} was beneficial in amelioration of sodic soil and more effective than the use of 5 Mg ha^{-1} FYM + Gypsum @ 50 % gypsum and 5 Mg ha^{-1} FYM + Gypsum @ 100 % gypsum requirement + RDF or only FYM @ 5 Mg ha^{-1} + RDF. 9The PBSW @ 500 m^3 ha^{-1} alongwith slight supplements of chemical fertilizers may help in improving sodic soils as well as can achieve sustainability in yield of fodder maize. However, it needs further studies for confirmation under provision of suitable drainage in future.

References

1. Gore S.B. (2009). Effect of post biomethanated spentwash on soil biological properties on yield of sunflower on sodic soil. Submitted M.Sc. (Agri.) Thesis in M.P.K.V., Rahuri.
2. Hati K.M., Biswas A.K., Bandopadhyay K.K. and Mishra A.K. (2003). Effect of post methanation effluent on soil physical properties under a soybean-wheat system in a Vertisol. *J. Pl. Nutr. Soil. Sci.,* 166 (3), 345-347
3. Kaushik A., Nisha R., Jagjeeta K. and Kaushik C. P. (2005). Impact of long term and short term irrigation to sodic soil with distillery effluent in combination with bio amendments. *Bio resource Tech.*, 96(17), 1860-66.
4. Pathak H., Joshi H.C., Chaudhari R., Kalra N. and Dwivedi M.K. (1999). Soil amendment with distillery effluent for wheat and rice cultivation. *Water Air and Soil Pollut.* 113, 133-140.