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EFFECT OF PRIMARY BIOMETHANATED SPENTWASH ON CHEMICAL PROPERTIES AND YIELD OF FODDER MAIZE

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SUMMARY

The experiment on effect of primary biomethanated spentwash on physico-chemical properties of sodic vertisols and yield of fodder maize 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) and combination of FYM+RDF, FYM+50% GR and FYM+RDF+100 per cent GR+RDF on soil properties, nutrient uptake, growth 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) 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 fodder maize crop were significantly higher in PBSW treatment applied @ 500 m^3/ha, however, uptake and yield of fodder maize were significantly higher in 400 and 500 m^3/ha treatments (495.30 and 517.31 q/ha green yield, respectively) followed by FYM+RDF+ 50 per cent GR and FYM+RDF+100 per cent GR.

Key words : Post biomethanated spent wash, bulk density, hydraulic conductivity

Among salt affected soils, sodic soils have prominent place. Excess exchangeable sodium and high pH characteristics of sodic soils are responsible for deterioration in soil physico-chemical characteristics resulting in poor air and water movement in soil, which ultimately adversely affects growth, yield and chemical composition and nutrient uptake by plants. The potential of maize as an excellent forage crop is well known, particularly in arid and semi-arid regions of the world. It is a multipurpose cereal crop grown for grain, stover and green fodder. With its wide ability to adapt to diverse agro-ecological conditions, it has unique position in the world forage crops (Singh 2015).

Primary biomethanated spentwash contains nitrogen (1,200-1,500 mg/l) phosphorus (40-70 mg/l) potassium (800-13,000 mg/l) and iron (50-150 mg/l). 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 semi-arid region. It occurs in region where evapotranspiration greatly exceeds precipitation and the soils that are increasingly brought under intensive irrigation show more waterlogging problem in canal command areas. Sodic soils due to high ESP possess poor physical properties. The high exchangeable sodium content of the soil leads to dispersion of fine clay particles resulting in low permeability, crusting and hardening of soil surface upon drying. As a result, the aeration, soil water movement and root growth are 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 unfavourable 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

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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

Field experiment was conducted on a sodic calcareous soil belonging to Pather soil series of isohyperthermic family of Vertic Haplustepts.

Treatment details of experiment

Treatment No.	Treatment details
T_1	Absolute control
T_2	FYM 5 mg/ha+RDF (AST)
T_3	FYM 5 mg/ha+50% of GR+RDF (AST)
T_4	FYM 5 mg/ha+100% of GR+RDF (AST)
T_5	100 m^3/ha of PBSW
T_6	200 m^3/ha of PBSW
T_7	300 m^3/ha of PBSW
T_8	400 m^3/ha of PBSW
T_9	500 m^3/ha of PBSW

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

Application of primary biomethanated spentwash (PBSW), FYM and gypsum was done 20 days before sowing (due to some reasons the experiment was repeated so 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 1 which indicated that pH of soil decreased with increasing level of PBSW. The decrease in value of pH was 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) and T_4 (8.67). On the 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 of 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 to 500 m^3/ha) 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 per cent GR treatment only and superior over all other treatments tested. The reduction in pH due to FYM+100 per cent GR+RDF treatment at

TABLE 1

Effect of primary biomethanated spentwash on pH, electrical conductivity and organic carbon content of soil at sowing and after harvest of fodder maize

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

harvest in sodic soil was statistically equivalent with lower doses of PBSW (100 and 200 m^3/ha).

Similar results of decrease in pH value were also reported by Kaushik *et al.* (2005). At harvest, increase in EC was from 0.55 dS/m (T_1) to 1.46 dS/m (T_9) treatment T_9 (1.46 dS/m) was at par with treatments T_8 and T_7 (1.38 and 1.31 dS/m, respectively). While treatment T_4 (1.245 dS/m) was at par with treatment T_3, T_5 and T_6 (1.23, 1.27 and 1.28 dS/m respectively). Treatment T_1 (0.55 dS/m) differed significantly with T_2 (0.62 dS/m) due to high amount of soluble salts by Hati *et al.* (2003), Kaushik *et al.* (2005). Organic carbon in treatment T_9 (6.5 g/kg) was at par with treatment T_8 and T_7 (6.3 and 6.2 g/kg, respectively). On the other hand, in treatment T_4 (5.7 g/kg) was at par with treatments T_3, T_5 and T_6 (5.5, 5.9 and 6.0 g/kg, respectively). T_2 and control differed from each other. Similar study was also reported Hati *et al.* (2003).

The availability of N increasing from T1 to T9 (Table 2). The treatment T_9 (22301 kg/ha) was at par with T_8 (219.89 kg/ha), and were significantly superior over all the other treatments tested. At harvest for available P, more or less same trend was observed, (Table 2) however, treatment T_9 (7.86 kg/ha) was at par with T_8 (7.75 kg/ha). The treatment T_4 (6.61 kg/ha) was at par with all other treatments except T_8 and T_9. The treatments FYM+RDF, FYM+Gypsum 50 per cent and FYM+100 per cent gypsum were at par with 100, 200 and 300 m^3/ha PBSW and control. The experiment conducted by Kaushik *et al.* (2005) 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 (2009), Chandel *et al.* (2011) and Deshpande *et al.* (2012).

At harvest, more or less same trend was observed, however, treatment T_9 (485 kg/ha) was at par with T_8 (478 kg/ha). The treatment T_4 (375 kg/ha) was at par with treatments T_3 and T_5 (356 and 408 kg/ha, respectively). On the other hand, treatment T_2 (332 kg/ha) was at par with control (314 kg/ha). The experiment conducted by Kaushik *et al.* (2005) reported significant increase in soil available K due to application of PME on sodic soil, which increased mineralizable K by soil microbes. Same results were obtained by Gore (2009).

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

The fresh yield of green fodder maize was mainly due to improvement of sodic soil as indicated by reduction in ESP in PBSW treatments. As the dose of PBSW increased, 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 contained more amount of organic load, major and minor nutrients with growth promoting enzymes (Gore, 2009). The increased doses of PBSW also increased EC of soil; however, it was in safe limit, which did not affect maize

TABLE 2

Effect of primary biomethanated spentwash on available nutrient at sowing and after harvest of fodder maize

Treatments	Available nutrients (kg/ha)					
	N		P		K	
	At sowing	At Harvest	At sowing	At Harvest	At sowing	At Harvest
T_1: Control	157.86^{d}	152.18^{d}	8.35^{f}	6.46^{c}	365.86^{g}	313.63^{f}
T_2: FYM 5 mg/ha+RDF (AST)	172.42^{cd}	165.58^{cd}	8.54^{ef}	6.48^{c}	418.13^{f}	375.03^{cd}
T_3: FYM 5 mg/ha+50% of GR+RDF (AST)	174.56^{c}	166.64^{cd}	8.73^{e}	6.50^{c}	433.06^{ef}	356.03^{de}
T_4: FYM 5 mg/ha+100% of GR+RDF (AST)	178.74^{c}	172.46^{bc}	9.02^{d}	6.61^{bc}	436.0^{e}	332.31^{ef}
T_5: 100 m^3/ha of PBSW	216.38^{b}	185.88^{bc}	9.30^{d}	6.87^{bc}	459.2^{d}	408.17^{bc}
T_6: 200 m^3/ha of PBSW	229.39^{b}	199.54^{ab}	9.32^{d}	6.91^{bc}	477.8^{c}	430.20^{b}
T_7: 300 m^3/ha of PBSW	256.10^{a}	203.66^{ab}	11.11^{c}	7.03^{b}	503^{b}	442.33^{b}
T_8: 400 m^3/ha of PBSW	264.46^{a}	219.89^{a}	11.87^{b}	7.75^{a}	518.66^{ab}	478.04^{a}
T_9: 500 m^3/ha of PBSW	268.64^{a}	223.01^{a}	13.20^{a}	7.86^{a}	533.86^{a}	484.56^{a}
S. E±	5.21	10.14	0.10	0.16	5.66	13.33
C. D. (P=0.05%)	15.63	30.44	0.30	0.5	17	40
C. V. (%)	5.05	11.22	5.09	12.44	5.47	10.23

TABLE 3
Effect of application of primary biomethanated spentwash on fresh green fodder yield of maize

Treatment	Fresh green fodder yield (q/ha)
T_1: Control	280.95[e]
T_2: FYM 5 mg/ha+RDF (AST)	337.82[d]
T_3: FYM 5 mg/ha+50% of GR+RDF (AST)	398.01[c]
T_4: FYM 5 mg/ha+100% of GR+RDF (AST)	417.56[bc]
T_5: 100 m^3/ha of PBSW	421.86[bc]
T_6: 200 m^3/ha of PBSW	439.86[b]
T_7: 300 m^3/ha of PBSW	444.81[b]
T_8: 400 m^3/ha of PBSW	495.30[a]
T_9: 500 m^3/ha of PBSW	517.31[a]
S. E±	12.52
C. D. (P=0.05)	37.55
C. V. (%)	5.20

yield. Deshpande *et al.* (2012) also observed increase in yield of sunflower due to application of increased doses of PBSW upto 180 m^3 ha^{-1} in sodic soil.

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 stages of soil sampling. The pH was reduced from 8.90 to 8.54 from control (T_1) to 500 m^3/ha (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 increase in EC was observed in treatment of 500 m^3/ha 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 increase in EC of both the stages of 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 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 PBSW followed by 400 m^3/ha PBSW and FYM+Gypsum+RDF.

The significant increase in green yield of fodder maize was noticed due to application of PBSW (500 m^3/ha) followed by integrated use of FYM, gypsum and RDF. The maximum green yield (517 q/ha) was recorded in treatment of 500 m^3/ha PBSW, which was at par with 400 m^3/ha PBSW) treatment. The available soil nitrogen, phosphorus and potassium content after harvest of fodder maize was highest in 500 m^3/ha 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.

It can be concluded form the study that the use of PBSW @ 500 m^3/ha was beneficial in amelioration of sodic soil and more effective than the use of 5 mg/ha FYM+Gypsum @ 50 per cent gypsum and 5 mg/ha FYM+Gypsum @ 100 per cent gypsum requirement+RDF or only FYM @ 5 mg/ha+RDF. The PBSW @ 500 m^3/ha along with 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.

REFERENCCES

Chandel, A. C., C. R. Palwe and H. P. Pardeshi. 2011 : Effect of levels of post biomethanated spent wash (PBSW) on biometric observations and yield at harvest of soybean. *An Asian J. Soil Sci.* **6** : 66-68.

Deshpande, A. N., B. Kamble, R. B. Shinde and S. B. Gore. 2012 : Effect of primary treated biomethanated spentwash on soil properties and yield of sunflower (*Helianthus annuus* L.) on sodic soil. *Comm. Soil Sci. & Pl. Analysis.* **43** : 730-743.

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.

Hati, K. M., A. K. Biswas, K. K. Bandopadhyay, and A. K. Mishra. 2003 : Effect of post-methanation effluent on soil physical properties under a soybean-wheat system in a Vertisol. *J. Pl. Nutr. Soil. Sci.,* **166** : 345-347.

Kaushik, A., R. Nisha, K. Jagjeeta, and C. P. Kaushik, 2005 : Impact of long term and short term irrigation to sodic soil with distillery effluent in combination with bio amendments. *Bioresource Tech.* **96** : 1860-66.

Singh, N., S. K. Sharma, Rohtas Kumar, Rajpaul, and Satyender Singh. 2015 : Effect of sodicity and nitrogen levels on dry matter yield, protein and nutrient uptake in maize. *Forage Res.,* **40** : 237-242.