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Short Note

Effect of Biomethanated Distillery Spentwash on Quality and Nutrient parameters of Maize Grown on Entisol

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A field Experiment was carried out during 2009 in the farmer's field at Sathyamangalam, Erode with the objective to assess the effect of liquid distillery effluent as irrigation water on grain quality (reducing sugars, protein and starch) and nutrient uptake (N, P, K Ca, Mg, Zn, Cu, Fe and Mn) of maize. Treatments consisted of 50, 100 and 150 kilo l per ha of the biomethanated distillery spentwash along with recommended dose of fertilizers with and without potassium. Results of the field experiment revealed that the application of biomethanated distillery spentwash @ 100 kilo l per ha with recommended dose of NPK or NP (without K) significantly increased the grain protein content and nutrient uptake of maize over recommended dose of fertilizers.

Key words: Distillery Spentwash, Entisol, Maize, Nutrient uptake.

Spentwash is a liquid waste, rich in organic loads and nutrients are being discharged from the molasses based distillery industry to the tune of 14 - 15 l for every l of alcohol production. Everyday, 60 kilo l of effluent is discharged from the factory. Its safe disposal is a matter to be concerned. Most of these effluents are either discharged in rivers causing the problem of water pollution or flooded on waste lands before evaporation causing air pollution. In India, about 40 billion l of spentwash is being discharged annually from 319 distilleries (Kanimozhi and Vasudevan, 2010). Utilization of industrial effluent after proper treatment in agriculture has raised the hope of recycling the effluent in constructive way (Hedge and Patil, 1983). The raw spentwash contained high biochemical oxygen demand (BOD), Chemical oxygen demand (COD) and solids, which is again subjected to biomethanation process in order to get the effluent with 80 per cent BOD reduction *viz.,* the Biomethanated Distillery Spentwash (BDS). The concept of one time land application and fertigation of BDS is very recently advocated, as unlike other industrial wastes, it does not contain any hazardous material that is detrimental to soil health and plant growth (Manickam, 1996). It contains considerable amount of N and P, rich in K, Ca, Mg and traces of Zn, Cu, Fe and Mn (Mohamed Haroon and Subash Chandra Bose, 2004). Therefore, its addition to agricultural lands may help to build the soil fertility (Joshi and Singh, 2010). Effluent discharging from each distillery unit will be unique and different, hence, there is a need to work out different strategies and approaches to find a solution for productive use in agriculture. Hence, the present investigation was undertaken to optimize the concentration of distillery effluent as irrigation water in conjunction with inorganic fertilizers for maize crop.

Materials and Methods

A field experiment was conducted during 2009 (August to December) at Aalathu kombai (11° 27' to 11° 47'N latitude and 76° 51' to 77° 28' E longitude with 600 m above mean sea level), Erode district, Tamil Nadu where a distillery with spentwash generation capacity of 60 kilo litre per day from molasses is operating since 1996. The location comes under the soil series of Irugur with the subgroup of *Typic Ustorthent* under the soil order Entisol. The annual precipitation is around 700 mm and minimum temperature ranged from 18 to 25°C and the maximum from 28°C to 36°C. The soil is sandy loam, low in organic carbon (0.38%) and available N (104 kg/ha), medium in available P (19 kg/ha) and available K (224 kg/ha). Different doses of BDS along with inorganic fertilizers using maize hybrid COH (M) 5 as test crop was tried. The experiment was laid out in randomized block design with three replications. The treatments consist of T_1 – RD (recommended dose) of NPK, T_2 - BDS @ 50 kilo l ha^{-1} + RD of NP, T_3 - BDS @ 50 kilo l ha^{-1} + RD of NPK, T_4 - BDS @ 100 kilo l ha^{-1} + RD of NP, T_5 - BDS @ 100 kilo l ha^{-1} + RD of NPK, T_6 - BDS @ kilo l ha^{-1} + RD of NP, T_7 - BDS @ 150 kilo l ha^{-1} + RD of NPK. Spentwash was applied as per the treatment and incorporated into the soil at 30 days before sowing in order to reduce the BOD and COD. The

experimental plots were irrigated immediately after sowing. Recommended dose of nitrogen was

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applied (150 kg/ha) as urea, phosphorus (75 kg/ ha) as single super phosphate and potassium (75 kg/ha) as muriate of potash as per the treatment. Fifty per cent of N and full doses of phosphorus and potassium were applied as basal and the remaining half dose of N was top-dressed at 30 days after sowing (DAS).

Protein content in grain was estimated by adopting the procedure given by Alikhan and Young (1973). The reducing sugar content of maize grain was determined by Anthrone reagent method by Somogyi (1952). Starch content was estimated as described by Dreywood (1946). The maize cob and stover samples collected from the field at the time of harvest were dried in hot air oven at 65^{o}C to calculate the moisture percentage. The oven dried

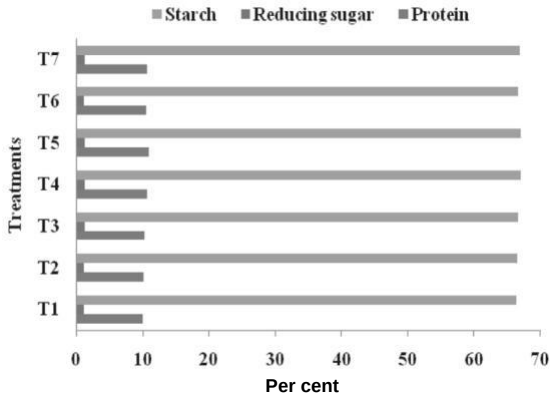

Fig. 1. Impact of different doses of BDS with fertilizer nutrition on changes in biochemical properties of maize. Treatment details as given in materials and methods.

cob and stover samples were powdered in Wiley mill and analyzed for N, P, K, Ca and Mg contents by following standard procedures. The corresponding nutrient uptake was computed based on the yield of cob and stover and total biomass on oven dry weight basis. The data were analyzed statistically and the treatment means were compared using LSD at 5 % probability (Panse and Sukhatme, 1985).

Results and Discussion

Influence of BDS on the biochemical properties of maize

The protein content of maize was significantly influenced by the application of BDS but reducing sugar and starch contents of maize were not significantly influenced. The protein content varied from 10.05 to 10.91 per cent and among the treatments, BDS @ 100 kilo l ha^{-1} + RD of NPK recorded the highest grain protein content (10.91 %) which was on par with BDS @ 100 kilo l ha^{-1} + RD of NP (10.74 %) and the lowest was recorded by RDF (10.05 %) (Fig. 1). The reason might be that the beneficial effect of substitution levels of nitrogen through distillery effluents in maize. Higher protein content could be due to more uptake of nitrogen by crop. This is in line with the findings of Sukanya and Meli (2005). However nitrogen substitution levels showed no significant effect on starch and reducing sugar contents. The present results are in accordance with the findings of Suganya (2008).

Influence of BDS on the macronutrients uptake of maize

The nutrient uptake of the maize crop was significantly increased due to application of distillery effluent. Application of BDS @ 100 kilo l ha^{-1} + RD of NPK registered the highest N, P, K, Ca and Mg uptake of 166, 41.4, 216, 76.8, 51.4 kg ha^{-1} respectively and the lowest was recorded by RDF (Table 1). The increased nutrients uptake due to more absorption of nutrients by the crop, supplied through nutrient rich distillery spentwash. These results corroborates with the findings of Kalaiselvi (2008). Effluent has a rich source of organics, which may be beneficial to micro flora besides acting as slow nutrient releaser. The increased uptake of N, P and K in the present study is in conformity with the findings of Hati *et al*. (2007).

Influence of BDS on micronutrients uptake of maize

Similarly to macronutrients uptake, micronutrients uptake of the maize crop was also significantly

Table 1. Impact of BDS with inorganic chemical fertilizers on nutrients uptake of maize

	Macronutrients uptake (kg ha^{-1})					Micronutrients uptake (g ha^{-1})			
Treatments	N	P	K	Ca	Mg	Zn	Cu	Fe	Mn
T_1 - RDF	128	34.8	138	54.8	31.6	214	193	2235	126
T_2 - BDS @ 50 KL ha^{-1} + NP	135	36.1	144	59.5	38.0	242	251	2586	144
T_3 - BDS @ 50 KL ha^{-1} + NPK	141	36.8	165	61.2	41.8	253	282	2615	162
T_4 - BDS @ 100 KL ha^{-1} + NP	158	40.1	195	70.4	49.5	313	407	2801	317
T_5 - BDS @ 100 KL ha^{-1} + NPK	166	41.4	216	76.8	51.4	328	434	2934	378
T_6 - BDS @ 150 KL ha^{-1} + NP	148	38.2	172	63.4	43.7	261	315	2677	215
T_7 - BDS @ 150 KL ha^{-1} + NPK	151	38.9	188	66.8	45.6	293	356	2736	276
SEd	1.53	0.36	1.84	0.67	0.45	3.09	3.64	30.13	2.55
CD (0.05)	4.34	1.12	5.27	2.07	1.32	9.52	11.2	92.9	7.9

RDF - Recommended Dose of NPK; BDS: Biomethanated Distillery Spentwash; DAP-Days After Planting

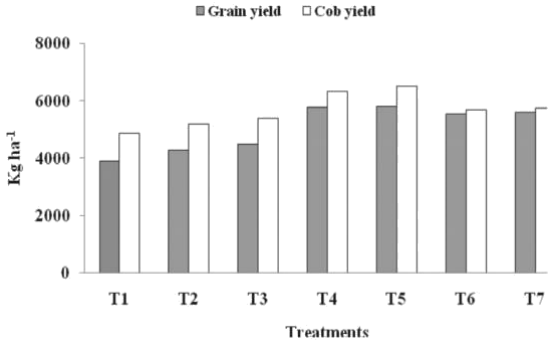

Fig. 2. Impact of BDS application with reommended dose of fertilizers on grain and cob yield of maize. Treatment details as given in materials and methods.

increased due to application of distillery spentwash. Application of BDS @ 100 kilo l ha^{-1} ha^{-1} + RD of NPK registered the highest micronutrient uptake of 328, 434, 2934 and 378 g ha^{-1} of Zn, Cu, Fe and Mn respectively and the lowest was recorded by RDF (Table 1). This is in line with findings of Kavitha *et al.* (2008). There was a direct relationship between nutrients uptake and yield. BDS @ 100 kilo l ha^{-1} + RD of NPK registered the highest grain and cob yield of 5815 kg ha^{-1} and 6543 kg ha^{-1} respectively which was on par with BDS @ 100 kilo l ha^{-1} + RD of NP of 5759 kg ha^{-1} and 6327 kg ha^{-1} respectively and the lowest grain (3917 kg ha^{-1}) and cob yield (4864 kg ha^{-1}) were recorded by RDF (Fig. 2). The distillery effluent is essentially a plant extract and contains high level of plant nutrients which are made available to the plant, thus resulting in better growth, development and yield of the crop. This is close agreement with the findings of Taradevibhukia *et al.* (2009). Addition of spentwash to supply nitrogen resulted in significantly higher growth parameters compared to chemical fertilization and this increase was significant throughout the phonological stages of crop growth. The reason was due to the increased nutrient supply and also their availability coupled with good physical properties exhibited by the application of spentwash (Madhumitadas *et al.,* 2010).

Conclusion

From the present investigation, it could be concluded that the application of BDS @ 100 kilo l ha^{-1} with recommended dose of NPK or BDS @ 100 kilo l ha^{-1} or with recommended dose of NP was found optimum for getting higher grain yield of maize hybrid COH (M) 5 under irrigated condition.

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