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Biomethanated distillery spentwash application and its impact on soil health, growth and yield of Elephant foot yam

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ABSTRACT

Agrobased industries are contributing socio-economic development of the country, distillery industries are using sugarcane molasses as a raw material for alcohol production. Every litre of alcohol production ten to fifteen litres of waste water generated named as spentwash. The disposal of spentwash is a seroious issue and looking for recycling option to enhance soil health.r Distillery Spentwashis important organic liquid manure contain high amount of nutrients like nitrogen, phosphorus, potassium, calcium and sulfur and also it contains high amount of micronutrients such as iron, zinc, copper, manganese, boron and molybdenum. Field experiment was conducted to study the efficiency of Biomethanated distillery spentwash, on improving the yield and quality of Yam at Research and Development farm of Bannari Amman Sugars Ltd., Modur, Sathyamangalamtaluk, Erode district. Distillery Spentwashwas applied in a field with the treatments from 10 to 60 KL/ha and soil samples are collected at initial, vegetative and harvesting stage of Elephant foot yam. The application of spent wash as manure was improved soil health and resulted in increasedroot and shoot length quality and yield of Elephant foot Yam. There was enhanced available N andK status of soil with the application of spent wash, particularly for K.The increase in yield and quality parameters was observed at harvest stage of Elephant foot Yam.Application of Biomethanated Distillery Spentwashat 50 KL/ha recorded higher yield of 38.20 t /ha. Elephant foot yam quality parameters like Carbohydrate, Vitamin C, Beta carotene were significantly increased when compared to control field.

Introduction

Elephant foot yam (*Amorphophallus paeonii folius* Dennst. Nicolson) is a tropical tuber crop associated with the family Arecaceae and widely consumed as vegetable (Rahman, 2020). A famine food crop in the pacific Islands which has acquiring popularity as a cash crop among the farming community of our country. It has high production potential, increased biological efficiency, good culinory properties, and medicinal utility and therapeutic values. It is grown commercially as annual crop, generally with one to few broad heavily dissected leaves with long petiole and rhizomatous stem called corm Theyare used as staple food and wealthy in starch content. After boiling, baking, and frying, the corm is eaten like a vegetable In some states like northern and eastern states use cultivars like wild and local mainly in pickle making. Elephant foot yam has high dry matter production capacity per unit area comparing with most of the othe rvegetables. The yam offers a range of health benefits and is sought after by Ayurvedic doctors. It treats abdominal pain, dysentery and spleen enlargement. Perhaps due to its numerous benefits, it has a rich cultural association in India. The assortment for business development in our nation is "Gajendra", which is a

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neighborhood determination from Kovvur, West Godavari region of Andhra Pradesh. It has high yielding potential with enthusiastic developing propensity. The corms are smooth, hemispherical and discouraged in the middle, 20-25 cm distance across and generally dull-yellowish earthy colored tone at collect. The corms are likewise liberated from corrosiveness, produce less or no cormels and have better nature of tissue.

In cultivation of different crops, spent wash have been utilized (where applied) as manure provides successful results. Continued increase was also observed in case of nutrientstatus availability of soil, uptakeof nutrientby crops and germination. It has also improved nutrient availability and uptake without having any negative post-harvest effects on soil texture, chemistry, or biology. The positive effect of spent wash on crop production is well recorded (Rajagopal *et al.,* 2014; Pugazh *et al.,* 2016) reported that total chlorophyll content, crop growth rate (CGR), total dry matter, and nutrient uptake all rose when distillery effluent was added (N, P and K). It was discovered that a one-time controlled application of diluted spentwash improved soil fertility and agricultural yields (Chandraju *et al.,* 2013; Chopra *et al.,* 2013; Bhardwaj *et al.,* 2019; Ruhela *et al.,* 2020). The availability of nutrients in distillery effluents, as well as the prospect of substituting them for inorganic fertiliser in agriculture, holds a lot of promise (Joshi and Singh, 2010).

Material and Methods

Study Location

This study was investigated to monitor the effect of distillery spentwash on soil health, growth, yield of Elephant foot Yam atBannari Amman Sugars unit, Modhur near Sathyamangalam in Erode district of Tamil Nadu. The experimental setup was conducted in Randomised Block Design (RBD) with three replications. Treatment details areT_1: Control (Recommended dose of NPK), T_2: Biomethanateddistillery spent wash @ 60 KL/ha, T_3: Biomethanateddistillery spent wash @ 50 KL/ha, T_4: Biomethanateddistillery spent wash @ 40 KL/ha, T_5: Biomethanateddistillery spent wash @ 30 KL/ha. T_6: Biomethanateddistillery spent wash @ 20 KL/ha and T_7: Biomethanateddistillery spent wash @ 10 KL/ha

Sample collection:

The soil was loamy in texture and soil samples were periodically collected (initial stage, vegetative stage and harvesting stage) and analysed for physic-chemical properties as per the standard procedure (American Public Health Association, 2012). Biometric observations and ield data's were recorded at harvest stage.

Results and Discussion

Effect of BDS application on pH

The pH of the soil (Figure1) shows slightly increased with increasing dose of BDS application except control but this shows no significant change in the pH of soil (Fig 1). The highest pH recorded are 8.05 at Initial stage of crop, 8.09 at vegetative stage and 7.45 at harvesting stage in T_2 (Biomethanateddistillery spent wash @ 60 KL/ha). There was increase in soil pH due to the application of spentwash. The spentwash reacts with the soil minerals during decomposition and dissolving large amounts of Ca, Al and Fe, Soil pH incresed subsequently due to precipitation of Ca and Mg. The new compounds formed during precipitation resulted in increase of soil pH. Addition of base materials like calcium from spentwash also has increased the pH (Baskaran *et al.,* 2010).

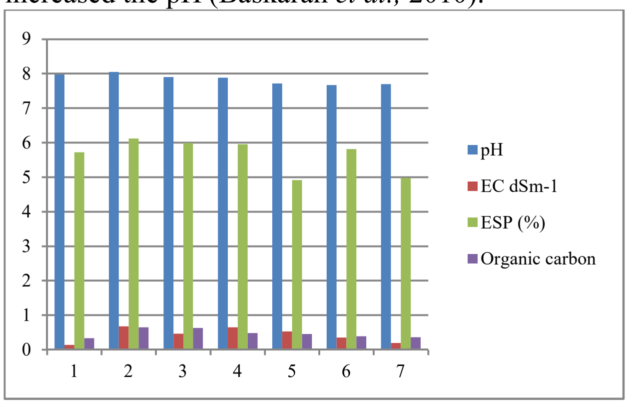

Figure 1: Effect of BDS application on physicochemical charecteristics of soil.
(Note: T1=1, T2=2, T3=3, T4=4, T5=5,T6=6 and T7=7)

Effect of BDS application on EC

The EC of the soil was significantly higher than the control at all stages of observation. The highest EC of the soil was recorded 0.68 dS m^{-1} at Initial stage of crop, 0.60dS m^{-1} at vegetative stage of crop and 0.53 dS m^{-1} at harvesting stage of cropin T_2. In the control group, the lowest EC was 0.14 dS m^{-1}. (Figure 1). PBSW contains higher amounts of soluble salts (34.90- 38.06 dS m-1). Increase in EC of soil due to increase in PBSW. Kamble and Deshpande, 2014 reported that the EC of soil increased markedly due to accumulation of salts from spentwash

Effect of BDS application on Exchangeable Sodium Percentage (ESP) of soil

There was no much variation observed for ESP which indicated that through the content of exchangeable cations like Ca, K and Mg were also present at higher level in the BDS, thereby the ESP was not appreciably increased by the application of spentwash. The ESP of the soils under study showed that it was within the critical limit of less than 15%. Soils having ESP > 15% will lead to alkali soil which is a problem soil wherein crop growth will be affected by the unfavourable physical properties of soil. Similarly when the sil possess high EC (>4 dSm^{-1}) leads to saline soil ultimately affects crop growth by diosmosis and other unfavourable effects. Kamble and Deshpande (2014) reported the increase in ESP due to repeated application of distillery effluent and it was maintained below 15. The ESP of soil was gradually increased at the end of experiment as compare to initial values. The greater ESP of soil was observed in wheat harvest 2010-11 *i.e.* at the end of experiment as compare to soybean harvest 2009-10. This was due to continuous application of spentwash.

Effect of BDS application on Organic Carbon

With the exception of the control (T1), the carbon (organic) content of the soil increased significantly as the dose of BDS was increased. When compared to the control group, the organic carbon level was considerably greater (0.65%) (0.33 %).The organic carbon content increased over different stages of crop in all the treatments (Fig 1).The spentwash treatment greatly enhanced the soil organic carbon con The spentwash used in the study was rich in organic carbon which might have enriched the Organic Carbon. The improvement in Organic Carbon due to the application of spentwash was reported by Kalaiselvi and Mahimairaja (2011). Kumar and Chopra (2012), reported increase in soil organic carbon with increase in spentwash application. Addition of organic matter through effluent and better crop growth with concomitant increase in root biomass could be the probable reasons for the improvement in organic carbon content in spentwash applied soil. .

Effect of BDS application on Available Nitrogen and Potassium content of soil

T2 had the highest N and K concentrations at the starting stage of the crop, with 135 kg per hectare and 169 kg per ha, respectively. The highest concentration of N and K (158 kg/ ha and 209 kg/ ha) were observed at vegetative stage in T_2 and 117 kg per ha and 139 kg per ha were observed in harvest stages in T_2 (Figure 2).There was enhanced available N andK status of soil with the application of spent wash, particularly for K. The increased N and K availability in soil could be due to the additional N and K support provided by the spent wash, and the other reason for the significant increase in the available N and K status of the soil could be due to increased microbial activity caused by the addition of organic matter via BDS, which in turn could have increased sufficient release of native sources of these nutrients. Because the spent wash includes adequate N and K, it is considered a nutrient source and is used to raise crops in proportion to the fertilizer's amount of these nutrients. BDS contained just a little amount of nitrogen and its application greatly improved the soil's available nitrogen status as the spentwash contains plant based proteinaceous substances the ammonification of organic N followed by nitrification of NH_4 might have occurred and increased the mineral N content of soil (Chandraju *et al.,* 2010). A remarkable increase in the availability of N, P and K content of both in the treated and raw spentwash was also reported by Moazzam *et al*. (2012).

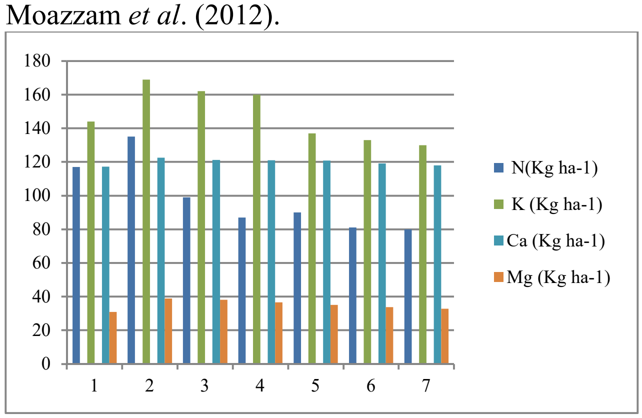

Figure 2: Effect of BDS application on physicochemical charecteristics of soil
(Note: T1=1, T2=2, T3=3, T4=4, T5=5, T6=6 and T7=7)

Figure 3. Field view and Yield of Elephant foot Yam

Table 1. Effect of Biomethanated distillery spentwash application on growth parameters of Elephant foot yam

Treatments	Plant height (cm)	Petiole length (cm)	Culm girth (cm)	No.of leaflets (no's)
T1	43.20	43.50	12.10	253.20
T2	62.53	52.70	15.20	311.10
T3	63.30	53.90	15.60	343.20
T4	59.17	49.20	14.60	288.90
T5	57.80	47.30	14.30	283.50
T6	55.30	46.20	13.40	275.20
T7	50.10	45.30	13.20	235.30

Effect of BDS application on exchangable calcium and magnesium

Distillery spentwash significantly improved the amount of exchangeable Ca and Mg in the sample. The highest Exchangeable Ca and mg concentration at initial stage of crop were 122.47kg/ ha and 38.97 kg /ha recorded in T_2.The highest concentration of Ca and Mg (122.70 kg/ ha and 37.95kg/ ha) were observed at vegetative stagein T_2 and 119.87 kg $ha^{-1}$and 35.79 kg/ha were observed in harvest stages in T_2(Figure 2). At all stages, the lowest concentration was recorded in control soil (T_1) that received no spentwash. The Exchangeable Ca content grew dramatically as the rate of spentwash application increased. also noticed increased Ca and Mg content in the soil, which might be attributed to Ca and Mg addition through effluent addition or both.

(due to the application of biomethanated distillery spentwash. Therefore, spentwash must be applied judiciously according to crop requirements. The application of spentwash increased the CEC, K, Ca, and Mg content of the soil, which might be due to addition of K, Ca and Mg either through the effluent addition or the solubilising effect of distillery effluent on the unavailable native forms. The addition of Ca, Mg and S through effluents in soil increased the availability of Ca, Mg and S in soil ultimately reflected the uptake of these nutrients. The results are similar to the findings of Chandraju *et al.* (2010).

Effect of BDS application on growth, yield and quality parametres

It is obvious from Table 1 that plant height, cum girth, length of petiole and number of leaflets showed maximum in T3 treatment when compare to other treatments. The treatments T3 and T2 showed slight variation in culmgirth and petiol length. The maximum growth period, which included synchronised height physiological activity with maximum nutrient intake, may have benefited in increasing plant height 150 days after planting. Increased culmgirth as a result of increased photosynthatis being diverted from the source (leaves) to the sink (corm), which is a common occurrence in practically all root and tuber crops

Application of BDS @ 50 KL/ ha recorded higher yield of 36.23 t per ha,BDS@ 10 t per ha(35.81 t/ha) and BDS @ 60 KL /ha recorded the yield of

35.03 t/ha (Table 2, Figure 3) BDS application at 50 KL/ha gave significant difference on yield and other yield characters such as corm diameter and yield. The increasing in yield may be due to increase in nutrient uptake. Analysis of drymatter, beta carotene, starch, calcium oxalate showed maximum in T3 treatment when compared to other treatments. The quality parameters like Carbohydrate, Vitamin C and Beta carotene were analysed and BDS @ 50 KL/ ha recorded maximum of 453 µg/100g of Beta Carotene, Carbohydrate 10.7% and 1.35 mg /100g of Vitamin (Table 2). Elephant foot yam quality parameters like Carbohydrate, Vitamin C, Beta carotene were significantly increased when compared to control field.Based on the findings of this study, it can be concluded that the effect of Biomethanated Distilley Spent wash had a significant impact on Elephant foot Yam growth and yield.

Table 2. Effect of Biomethanated distillery spentwash application on yield and quality parameters of Elephant foot yam

Treatments	Corm Diameter	Corm Yield (ha)	Dry matter (%)	Starch (%)	Calcium Oxalate (%)	Vitamin (IU)	B- Carotene (µg/100g)
T1	11.50	24.40	26.90	15.20	0.0209	138.30	381.20
T2	14.20	32.60	31.40	16.25	0.0208	146.40	422.90
T3	14.80	38.20	32.60	17.60	0.0312	148.70	453.70
T4	13.20	33.20	29.70	16.50	0.0216	142.30	371.80
T5	12.30	33.00	27.40	16.20	0.0217	140.50	403.90
T6	12.10	29.70	27.20	15.80	0.0213	140.10	399,40
T7	12.00	27.60	27.00	15.60	0.0200	140.20	377.50

Conclusion

Application of BDS @50KL /ha has recorded higher yield and also brought tremendous changes in quality parameters like carbohydrate and vitamin C and beta carotene.Hence BDS can be used as a nutrient source for the cultivation of Elephant foot Yam.f

Acknowledgement

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Conflict of interest

The authors declare that they have no conflict of interest.

References

American Public Health Association (APHA).(2012). “Standard Methods for the Examination of Water and Waste water”. Ed. Clesceri, A.D., Rice, L.S. and Greenberg, A.E., American water works association, Washington, 1368.

Baskaran, L., Ganesh, K. S., Chidambaram, A. L. A., & Sundaramoorthy, P. (2009). Amelioration of sugar mill effluent polluted soil and its effect of green gram (Vigna radiata L.). *Botany Research International*, *2*(2), 131-135.

Bhardwaj, S., Ruhela, M., Bhutiani, R., Ahamad, F., & Bhardwaj, R. (2019). Distellery spent wash (DSW) treatment methodogies and challenges with special reference to incineration: An overview. *Environment Conservation Journal*, *20*(3), 135-144.

Chopra, A. K., Srivastava, S., Kumar, V., & Pathak, C. (2013). Agro-potentiality of distillery effluent on soil and agronomical characteristics of Abelmoschus esculentus L.(okra). *Environmental Monitoring and Assessment*, *185*(8), 6635-6644.

Joshi, H. C., & Singh, G. (2010). Use of distillery effluent in agriculture. *Water: a Human Right or a Commodity?*, 20.

Kamble, B. M., & Deshpande, A. N. (2014). Impact of post biomethanated spentwash on soil properties, nutrient uptake and yield of soybean â€“wheat cropping sequence. *Journal of Applied and Natural Science*, *6*(2), 552-569.

Kalaiselvi, P., & Mahimairaja, S. (2011). Effect of distillery spentwash on yield attributes and quality of groundnut crop. *Middle East Journal of Scientific Research*, *7*(2), 189-193.

Kumar, V., & Chopra, A. K. (2012). Fertigation effect of distillery effluent on agronomical practices of *Trigonella foenum-graecum* L. (Fenugreek). *Environmental Monitoring and Assessment*, *184*(3), 1207-1219.

Khan, M. A., Shaukat, S. S., Shahzad, A., & Arif, H. (2012). Growth and yield responses of pearl millet (Pennisetum glaucum [L.] R. Br.) irrigated with treated effluent from waste stabilization ponds. *Pakistan Journal of Botany*, *44*(3), 905-910.

Nedunchezhiyan, M., Jata, S. K., Mukherjee, A., & Misra, R. S. (2011). Impact of Growth Regulators on Cormel Production and Dormancy Breaking in Elephant Foot Yam [Amorphophallus paeoniifolius (Dennst.) Nicolson]. *Journal of Root Crops*, *37*(1), 24-28.

Pugazh, G., Thiyagu, R., & Sivarajan, P. (2016). Physico-chemical characterization of raw and diluted effluent from distillery industry. *International Research Journal of Engineering and Technology*, *3*(4), 2055-2059.

Vadivel, R., Minhas, P. S., Singh, Y., DVK, N. R., & Nirmale, A. (2014). Significance of vinasses waste management in agriculture and environmental quality-Review. *African Journal of Agricultural Research*, *9*(38), 2862-2873.

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