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Variation in growth parameters of maize (*Zea mays* L.) at different growth stages due to onetime application of distillery spent wash r o reject

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Abstract
Spentwash is the waste water generated from distilleries causing many environmental problems. It is a good source of plant nutrients as it is originated from sugarcane and it can be utilized in agriculture as nutrient source. In this regard an experiment was conducted during *kharif* 2013 to know the effect of this distillery spentwash R O reject application on different growth parameters and yield of maize (*Zea mays* L.) crop. The experiment consisted of seven treatments laid out in Randomized Complete Block Design with three replications. At 30, 60, 90 and 120 days after sowing (DAS) the different growth parameters like plant height (19.43, 145.2, 166.7 and 178.4, respectively), number of leaves per plant (5.1, 11.2, 13.4 and 12.9, respectively) and leaf area (183.3, 571.3, 661.9 and 766.9 cm^2, respectively) and days to 50% flowering (53.3 days) were found to be higher in treatment receiving 150% N through distillery spentwash (DSW) R O reject. Significantly lower values of different growth parameters were recorded in treatment receiving RDF only. It is concluded that application of distillery spentwash (DSW) R O reject resulted in increased nutrient status of soil which intern increased higher growth parameters and yield of maize.

Keywords: Distillery, maize, plant height, R O reject, Spentwash

Introduction
Distilleries are the most important agro based industries and are major source of spentwash which is generated during production of alcohol from molasses. This distillery spentwash is the waste water and results in many environmental problems and disposal of this is main concern due to its large volume as well as due to its high BOD and COD. As it is a plant origin in nature it contains good amounts of nutrients, hence can be utilized in crop production. It can be applied directly to the land as irrigation water or can be blended with irrigation water in proper proportion.

In the present day intensive agriculture availability of organic manures is decreasing day by day. Therefore, the application of nutrients from different sources needs to be considered to keep the soil fertile and to make agriculture more sustainable. It is said that nutrient supplying capacity of soil declines steadily under intensive cropping system. On the other hand during recent years, sugar industries are producing large amount of waste products some of which are rich source of nutrients. So by keeping this in mind we made an effort to check the effect of application of distillery spentwash R O reject different growth parameters and yield of maize (*Zea mays* L.) crop.

Material and Methods
An experiment was conducted during *kharif* 2013 in the farmer's field and distillery spentwash R O reject was collected from J. P. Distilleries Pvt. Ltd. Heggadathihalli village, Kunigal taluk, Tumkur district, which is situated in the southern dry zone (Zone-6) of Karnataka (India). The soil of the experimental site was sandy clay loam in texture belong to the order *Alfisol*. The initial soil properties of the experimental site are represented in table 1.

Table 1: Initial soil properties of the experimental field

Soil Properties	Values	Soil Properties	Values
pH	6.48	Calcium (me/100g)	3.6
EC (dsm^{-1})	0.14	Magnesium (me/100g)	2.4
CEC [cmol (p^+) kg^{-1}]	8.9	Sulphur (ppm)	19.10
Organic carbon (%)	0.55	Iron (ppm)	21.28
Av. Nitrogen (kg ha^{-1})	248.37	Zinc (ppm)	0.38
Av. Phosphorus (kg h^1)	22.69	Manganese (ppm)	23.20
Av. Potassium (kg ha^{-1})	652.51	Copper (ppm)	0.60

Farm yard manure (7 t ha^{-1}) was applied three weeks before sowing of the maize crop. The experiment consisted of seven treatments laid out in Randomized Complete Block Design with three replications. Recommended dose of fertilizer: 100:50:25 kg N: P_2O_5: K_2O ha^{-1} was given. The spacing was maintained at 60 cm X 30 cm and NAH-1137 (HEMA) is a 120 days duration maize variety was used. The distillery spentwash R O reject was applied one month prior to sowing. The chemical analysis of distillery spentwash R O reject is mentioned in table 2. The characterization of distillery spentwash was also carried out by Murugaragavan and Mahimairaja (2010) [4], Ray *et al.* (2012) [9] and Radha and Srivastava (2012) [6]. The different growth parameters of maize crop like plant height, number of leaves per plant and leaf area (cm^2) at 30, 60, 90 and 120 days after sowing (DAS) and days to 50% flowering were recorded.

Table 2: Physico-chemical characteristics of distillery spentwash R O reject

Parameters	Values	Parameters	Values
Colour	Dark brown	Calcium (mg L^{-1})	1932
pH	7.29	Magnesium (mg L^{-1})	1202.4
EC (dsm^{-1})	44	Sulphur (mg L^{-1})	430.01
Organic carbon (%)	0.9	Iron (mg L^{-1})	48.66
Total suspended solids (mg L^{-1})	37100	Zinc (mg L^{-1})	5.12
Total dissolved solids (mg L^{-1})	48000	Manganese (mg L^{-1})	6.98
BOD (mg L^{-1})	53560	Copper (mg L^{-1})	4.5
COD (mg L^{-1})	87280	Boron (mg L^{-1})	26.4
Nitrogen (%)	0.18	Chlorides (mg L^{-1})	7139.1
Phosphorus (mg L^{-1})	450.2	Bicarbonates (mg L^{-1})	86.7
Potassium (mg L^{-1})	11887		

The experiment consisted of 7 treatments *viz.*, T_1: RDF only; T_2: RDF + FYM; T_3: 50% N through DSW R O Reject + 50% N through fertilizer; T_4: 75% N through DSW R O Reject + 25% N through fertilizer; T_5: 100% N through DSW R O Reject; T_6: 125% N through DSW R O Reject; and T_7: 150% N through DSW RO Reject.

Statistical analysis

The data collected were analyzed statistically following the procedure as described by Panse and Sukhatme (1967) [5]. The level of significance used in 'F' and't' test was *P=0.05*. Critical differences were calculated using the't' test wherever 'F' test was significant.

Results and Discussion

Effect of distillery spentwash R O reject application on different growth parameters of maize crop

Plant height (cm)

The data pertaining to plant height as influenced by one time application of distillery spentwash R O reject are presented in Table 3. At 30 DAS, the plant height did not show any significant difference due to the effect of one time application of distillery spentwash R O reject. Significantly higher plant height during 60, 90 and 120 DAS was observed in treatment T_7 (150% N through DSW R.O. reject) (145.2, 166.7 and 178.4 cm, respectively) compared to all the other treatments followed by T_2 (RDF + FYM) (141.6, 163.3 and 167.9 cm, respectively) and T_6 (125% N through DSW R.O. reject) (124.9, 159.5 and 170.8 cm, respectively). The treatments T_2 and T_6 were found to be on par with each other. Significantly lower plant height during 60, 90 and 120 DAS (117.5, 139.1 and 142.1 cm, respectively) was observed in the treatment receiving RDF only (T_1).

Table 3: Effect of one time application of distillery spentwash R O reject on plant height at different stages of maize.

Treatments	Plant height (cm)			
	30 DAS	60 DAS	90 DAS	120 DAS
T_1- RDF only	17.15	117.5	139.1	142.1
T_2- RDF + FYM	18.77	141.6	163.3	167.9
T_3-50% N through DSW R.O. reject + 50% N through fertilizer	18.57	129.7	157.6	155.6
T_4-75% N through DSW R.O. reject + 25% N through fertilizer	16.79	113.7	143.8	154.2
T_5-100% N through DSW R.O. reject	18.18	129.5	146.0	165.4
T_6-125% N through DSW R.O. reject	19.19	124.9	159.5	170.8
T_7-150% N through DSW R.O. reject	19.43	145.2	166.7	178.4
SEm±	0.79	6.53	1.31	2.64
CD at 5%	NS	20.11	4.03	8.14

Number of leaves per plant

The number of leaves per plant at 30 DAS did not show any significant difference due to the effect of one time application of distillery spentwash R O reject (Table 4). Significantly higher number of leaves per plant at 60, 90 and 120 DAS was observed in treatment receiving 150% N through distillery spentwash R.O. reject (T_7) (11.2, 13.4 and 12.9, respectively) followed by application of RDF + FYM (T_2) (10.7, 12.4 and 12.1, respectively) and application of 125% N through distillery spentwash R.O. reject (T_6) (9.7, 11.7 and 11.3, respectively). Significantly lower number of leaves at 60, 90 and 120 DAS (8.8, 9.9 and 10.3, respectively) was observed in the treatment receiving RDF only (T_1).

Table 4: Effect of one time application of distillery spentwash R O reject on number of leaves per plant at different stages of maize.

Treatments	Number of leaves per plant			
	30 DAS	60 DAS	90 DAS	120 DAS
T_1- RDF only	4.9	8.8	9.9	10.3
T_2- RDF + FYM	4.5	10.7	12.4	12.1
T_3-50% N through DSW R.O. reject + 50% N through fertilizer	5.1	10.2	11.6	11.4
T_4-75% N through DSW R.O. reject + 25% N through fertilizer	4.8	9.1	10.9	11.2
T_5-100% N through DSW R.O. reject	4.6	10.1	11.3	10.8
T_6-125% N through DSW R.O. reject	5.0	9.7	11.7	11.3
T_7-150% N through DSW R.O. reject	5.1	11.2	13.4	12.9
SEm±	0.18	0.39	0.31	0.29
CD at 5%	NS	1.22	0.95	0.92

Leaf area (cm^2)

The results related to leaf area of the plant due to application of distillery spentwash R O reject are presented in Table 5. At 30 DAS, the leaf area did not show any significant difference due to the effect of one time application of distillery spentwash R O reject. But significantly higher leaf area during 60, 90 and 120 DAS was recorded in treatment receiving 150% N through distillery spentwash R.O. reject (T_7) (571.3, 661.9 and 766.9 cm^2, respectively) compared to all the other treatments. The treatment T_7 was followed by treatment T_2 (RDF + FYM) (525.6, 652.1 and 749.4 cm^2, respectively) and T_6 (125% N through DSW R.O. reject) (451.7, 634.1 and 750.1 cm^2, respectively). The treatments T_3 (492.7, 603.9 and 724.9 cm^2, respectively), T_4 (482.9, 610.0 and 733.4 cm^2, respectively) and T_5 (476.9, 611.6 and 725.4 cm^2, respectively) were found to be on par with each other. Significantly lower Leaf area during 60, 90 and 120 DAS (423.9, 604.8 and 696.9 cm^2, respectively) was observed in the treatment receiving RDF only (T_1).

Days to 50% flowering

The number of days taken by maize crop to attain 50% flowering as influenced by one time application of distillery spentwash R O reject was recorded and the same has been presented in Table 5. Days to attain 50% flowering were found non-significant among the treatments. Higher number of days to attain 50% flowering was observed in treatment receiving 150% N through distillery spentwash R.O. reject (T_7) (53.33 days) and lower was in RDF only (T_1) (51.0 days).

Table 5: Effect of one time application of distillery spentwash R O reject on leaf area at different stages of maize and days to 50% flowering

Treatments	Leaf area (cm^2)				Days to 50% flowering
	30 DAS	60 DAS	90 DAS	120 DAS	
T_1- RDF only	140.8	423.9	604.8	696.9	51.0
T_2- RDF + FYM	159.2	525.6	652.1	749.4	51.3
T_3-50% N through DSW R.O. reject + 50% N through fertilizer	153.4	492.7	603.9	724.9	51.7
T_4-75% N through DSW R.O. reject + 25% N through fertilizer	125.5	482.9	610.0	733.4	52.3
T_5-100% N through DSW R.O. reject	151.5	476.9	611.6	725.4	52.7
T_6-125% N through DSW R.O. reject	202.6	451.7	634.1	750.1	52.7
T_7-150% N through DSW R.O. reject	183.3	571.3	661.9	766.9	53.3
SEm±	25.43	21.33	4.68	4.27	22.81
CD at 5%	NS	65.73	14.43	13.17	NS

Application of distillery spentwash R O reject to soil increased the growth attributes of maize *viz.*, plant height, number of leaves per plant and leaf area at 30, 60, 90 and 120 days after sowing (DAS) which was very well brought out when compared to control. This was due to the fact that crop nitrogen requirement was fully met both at early and later stages of crop. These findings are supported by findings of Sakthipriyadharshini (2008) [10].

At all the crop growth stages, one time application of distillery spentwash R O reject in treatment receiving 150% N through DSW R.O. reject (T_7) recorded the highest plant height, number of leaves per plant and leaf area at 30, 60, 90 and 120 days after sowing (DAS) over the control (RDF only) (T_1). This might be due to nitrogen substitution as well as addition of other nutrients by distillery spentwash R O reject to soil which has increased the availability of other nutrients and their uptake in addition to nitrogen. More number of leaves increased the photosynthetic efficiency during crop growth and produced more assimilates at all the stages of crop growth. These results are in accordance with the findings of Rath *et al.* (2010) [8] and Doddamani *et al.* (2011) [1]. But there was no significant influence of application of distillery spentwash R O reject on number of days to 50% flowering. Thus, the improvement in plant height, number of leaves per plant and leaf area resulted in higher total dry matter production.

Effect of distillery spentwash R O reject application on grain and stover yield of maize crop

There was significant increase in grain yield of maize due to the effect of distillery spentwash R O reject application (Fig. 1). Distillery spentwash R O reject application has resulted in higher grain yield mainly due to its nutritional effects, in addition to improvement in physical and chemical properties of the soil and organic carbon. The results indicated that treatment receiving 150% N through DSW R.O. reject (T_7) (46.6 q ha^{-1}) recorded significantly higher grain yield followed by 125% N through DSW R.O. reject (T_6) (44.8 q ha^{-1}) and lowest was recorded in RDF only (T_1) (31.8 q ha^{-1}). Similar results were also reported by Ramana *et al.* (2002)[7], Kundal *et al.* (2004) [2] and Monica (2007) [3].

There was significant increase in stover yield of maize due to distillery spentwash R O reject application (Fig. 1). Application of distillery spentwash R O reject was found more effective in increasing the stover yield. The reason for increased stover yield in distillery spentwash R O reject

applied plots might be due to higher soil available nitrogen in these plots. The effect of distillery spentwash R O reject application on the stover yield of maize followed the similar trend as that observed under grain yield. The results indicated that treatment receiving 150% N through DSW R.O. reject (T_7) (82.8 q ha^{-1}) recorded significantly higher stover yield followed by 125% N through DSW R.O. reject (T_6) (75.3 q ha^{-1}). Lowest stover yield was recorded in RDF only (T_1) (58.8 q ha^{-1}).

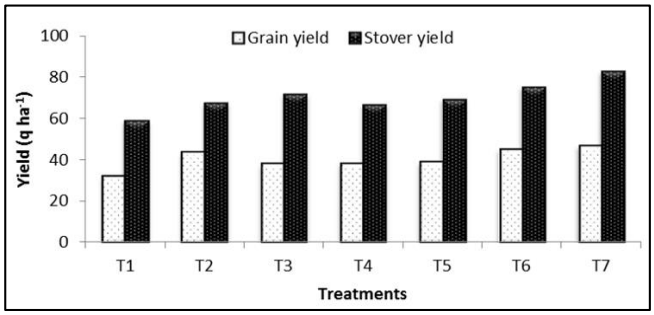

Fig 1: Effect of one time application of distillery spentwash R O reject on grain and stover yield of maize.

Addition of more nutrients through distillery spentwash R O reject resulted in the higher grain and stover yield of maize. Higher grain and stover yield in maize could be attributed to better uptake of essential nutrients and their translocation to economic parts. The increase in yield due to application of distillery spentwash was also reported by Suganya and Rajannan (2009) [11].

Conclusion

The different growth parameters of maize crop like plant height, number of leaves per plant and leaf area (cm^2) at 30, 60, 90 and 120 days after sowing (DAS) and days to 50% flowering were found to be increased due to application of distillery spentwash R.O. reject compared to control. Due to addition of nutrients from spentwash in soil and their subsequent uptake by crop resulted in the improved growth parameters with increase in quantity of spentwash applied which ultimately led to increased yield of maize. So, it is concluded that application or utilization of distillery spentwash R.O. reject in crop production serves as a nutrient source and also improves fertility status of the soil due to addition of organic matter and different nutrients.

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References

1. Doddamani MB, Gali SK, Patagar RG, Mukharib DS. Effect of long-term distillery spentwash application on crop growth, yield and soil potassium status in vertisols. National symposium on potassium nutrient in enhancing yield and quality of crops. Dharwad (India), 2011, 116-117.
2. Kundal MH, Biswas AK, Bandyopadhyay K, Misra AK. Effect of post-methanation effluent on soil physical properties under a soybean-wheat system in a Vertisol. Environmental Monitoring and Assessment. 2004; 19(3):166-174.
3. Monica CB. Environmental impact of post biomethanated distillery spentwash. M.Sc. Thesis, Tamil Nadu Agricultural University, Coimbatore, 2007.
4. Murugaragavan R, Mahimairaja S. Charaterization of distillery spentwash for its valuable nutrient substitute to dryland agriculture. Journal of Ecobiology. 2010; 24(2):169-174.
5. Panse VC, Sukhatme PV. Statistical method for agricultural workers. ICAR, New Delhi, 1967, 100-174.
6. Radha Jain, Srivastava S. Nutrient composition of spent wash and its impact on sugarcane growth and biochemical attributes. Physiology and Molecular Biology of Plants. 2012; 18(1):95-99.
7. Ramana S, Biswas AK, Kundu S, Saha JK, Yadava RBR. Effect of distillery effluent on seed germination in some vegetable crops. Bioresource Technology. 2002; 82:273-275.
8. Rath P, Pradhan G. Mishra MK. Effect of sugar factory distillery spent wash (dsw) on the growth pattern of sugarcane (*Saccharum officinarum*) crop. Journal of Phytochemistry. 2010; 2(5):33-39.
9. Ray SNC, Ranjan N, Kumari K, Sinha RC. Potential Use Of A Mix Of Fly Ash And Diluted Distillery Effluent In Agriculture: A Case Study On The Vegetative Growth And Photosynthetic Pigments Of The Ornamental Plant, *Calendula Officinalis*., International Journal of Engineering Research and Applications. 2012; 2(5):193-203.
10. Sakthipriyadharshini K. Studies on the impact of post methanated distillery spentwash on soil and ground water. M.Sc. Thesis, Tamil Nadu Agric. Univ., Coimbatore, 2008.
11. Suganya K, Rajannan G. Effect of one time post-sown and pre-sown application of distillery spentwash on the growth and yield of Maize crop. Botanical Research International. 2009; 2(4):288-294.