Open access Journal International Journal of Emerging Trends in Science and Technology
Impact Factor: 2.838 DOI: http://dx.doi.org/10.18535/ijetst/v3i03.18

Irrigational Impact of Distillery Spentwash on the Growth and Yield of Graminacious Forages –Anjan Grass (Cenchrus Ciliaris), Setaria Grass (Setaria Anceps), Para Grass (Brachiaria Mutica) and Rhodes Grass (Chloris Gayana)

Authors
Bhuvan.P[1], S.Chandraju[2]
[1]Department of Studies in Sugar Technology, Sir M. Vishweshwaraya Postgraduate Centre, University of Mysore, Tubinakere, Mandya-571402, Karnataka, India
Email: *bhuvan.p83@gmail.com*
[2]Department of Studies in Sugar Technology, Sir M. Vishweshwaraya Postgraduate Centre, University of Mysore, Tubinakere, Mandya-571402, Karnataka, India

ABSTRACT
Studies were conducted to study the growth and yield of graminacious forages; Anjan Grass, Setaria Grass, Para Grass, and Rhodes grass irrigated with distillery spentwash of different concentration. The spentwash in the ratio of 1:1, 1:2, and 1:3 was used and analysed for their plant nutrients such as Nitrogen, Phosphorous, Potassium and other physical and chemical characteristics. Experimental soil was tested for its chemical and physical parameters. Anjan Grass, Setaria Grass, Para Grass and Rhodes Grass rooted slips(3inch) were sowed in different pots and irrigated with raw water(RW) along with spentwash in the ratio of 1:1, 1:2, and 1:3. The studies of the growth and yield were studied. It was found that the growth and yield was very good in 1:3 spentwash irrigation compared to 1:1 spentwash, 1:2 spentwash and raw water irrigation for all the plants. Hence, Spentwash can be expediently used as a medium for irrigation in specific dilution without harming the atmosphere, water and soil.

Keywords-*Distillery spentwash, Anjan grass, Setaria Grass, Para grass, Rhodes grass, Growth, Yield*

INTRODUCTION

1.1 ANJAN GRASS-C.Ciliaris and C.Setigerus are most commonly used for forage production. C.ciliaris is a native of tropical and subtropical Africa, India and Indonesia. It is widely distributed in hotter and drier parts of India and is found in open bush and grassland in its natural habitat. It is widely distributed in the plains of Rajasthan, Gujarat, Punjab and western UP extending upto foot hills of Jammu upto an altitude of 400m. It is polymorphic, perennial and warm season bunch grass with extensive native range in the form of various ecotypes and cyto types. It is highly drought tolerant and well adapted to arid and semi-arid areas and thrives well in light textured soils.

1.2 SETARIA GRASS- It is also called as Golden Timothy. The grass grows well at 20-25ºC. It is more cold tolerant than most of tropical and subtropical grasses. It is usually too coarse to be of much value as preferred feed. It is very palatable at young but becomes less palatable at maturity. This is a tufted perennial, 45–180cm tall with the lower culm nodes compressed. Basal leaf-sheaths are often nearly flabellate in arrangement. False spike are dense with orange bristles and sub-acute spikelets, 2-3mm long. The leaf blades are glabrous flat, 30-40cm long, 6-10mm wide, linear and lanceolate. Inflorescence is terminal, compressed panicle about 15cm long, appearing as a dense cylindrical.

1.3 PARA GRASS- It is also known as Buffalo grass. The crop responds well to sewage irrigation. It is a coarse, trailing perennial that spreads by surface runners which root profusely at the nodes with flowering stems 1 to 2 m high. The culms are erect, leafy, hollow, succulent and glabrous with hairy nodes. The leaf blades are dark green in colour, 25 to 30 cm long and 1 to 2 cm broad. The grass prefers hot and humid climate of the tropics and subtropics with high annual rainfall ranging between 1000 and 1500 mm. It can withstand short term flooding and water logging but cannot be grown in dry land, in arid and semi-arid regions. It is sensitive to cold. The grass grows in moist. It thrives best on highly fertile clay loam to clayey textured soils with high moisture retention capacity. It can be grown even on sandy soils with good irrigation facility. It tolerates slightly acid to alkaline soils. It is highly tolerant to saline or sodic soil conditions. So it is an excellent grass in soil reclamation. It grows well on field bunds, banks of streams and canals, lowlands and soils too wet for normal farm crops. It is a nutritious high yielding and palatable forage grass. The grass appears to be free of any toxic effect.

1.4 RHODES GRASS- Itis native to Africa but it can be found throughout the tropical and subtropical world as a naturalized species. It is also cultivated in some areas as a palatable graze for animals. It is tolerant of moderately saline and alkaline soils and irrigation. It is difficult to establish and have it persist on heavy-cracking clay soils. It does not tolerate drought or flooding well and is best adapted to areas where annual rainfall exceeds 600mm. It is only moderately tolerant of frost and it is a valuable pasture grass for livestock. It is a perennial grass which can reach one half to nearly three meters in height and spreads via stolons.

In sugar industry Molasses is the chief source of raw material for the manufacture of rectified spirit. Nearly 10-12 litres of spentwash are discharged for every litre of rectified spirit produced. The discharge of spentwash into open field or water bodies result in environmental, soil and water pollution. The spentwash is rich in organic carbon and plant nutrients. Since it is from plant source extract it contains negligible heavy metals and other toxic substances (Eyini et al, 1990). Meanwhile it is rich in plant essential nutrients it can be used in agriculture so the problem of disposal becomes easy along with the utilisation of nutrients by plants. It also helps to utilise spentwash in a proper method to avoid adverse effects on the environment. So diluted spentwash can be used for irrigation purpose without adversely affecting soil fertility, growth and yield. The diluted spentwash irrigation improves the physical and chemical properties of the soil and further increases soil micro flora. Twelve pre-sowing irrigations with the diluted spentwash had no adverse effect on the germination of maize but improved the growth and yield (Singh Y. and Raj Bahadur, 1998). Diluted spentwash increases the growth of shoot length, leaf number per plant, leaf area and chlorophyll content of peas. Increased concentration of spentwash causes decreased seed germination, seedling growth and chlorophyll content in Sunflowers (Helianthus annuus) and the spentwash should be safely used for irrigation purpose at lower concentration. The spentwash contained an excess of various forms of cations and anions, which are injurious to plant growth and these constituents should be reduced to the beneficial level by diluting spentwash, which can be used as a substitute for chemical fertilizer. The spentwash could be used as a complement to mineral fertilizer to sugarcane. The spentwash contains N, P, K, Ca, Mg and S and thus valued as a fertilizer when applied to soil through irrigation with water. The application of diluted spentwash increased the uptake of Zinc(Zn), Copper(Cu), Iron(Fe) and Manganese(Mn) in maize and wheat as compared to control and the highest total uptake of these were found at lower dilution levels than at higher dilution levels.

Mineralization of organic material as well as nutrients present in the spentwash was responsible for increased availability of plant nutrients. Diluted spentwash increases the uptake of nutrients, height, growth and yield of leaves vegetables, nutrients of cabbage and mint leaf, nutrients of top vegetable,

pulses, condiments, root vegetables in untreated and spentwash treated soil, yields of top vegetables (creepers), yields of tuber/root medicinal plants, yields of leafy medicinal plants nutrients of creeper medicinal plants, yields of leafy medicinal plants in normal and spentwash treated soil, nutrients of ginger and turmeric in normal and spentwash treated soil, nutrients of tubers/ roots medicinal plants.

Studies on growth and yield of Mustard, Castor, Cotton, Groundnut, Zinnia, Vinca, Sesame and Jatropha seeds has been conducted earlier. (Chandraju.S et al). However, no information is available on the growth and yield of Anjan grass, Setaria Grass, Para grass and Rhodes grass rooted slips irrigated by distillery spentwash. Therefore, the present investigation was carried out to study the influence of different proportions of spentwash on the growth and yield of Anjan grass, Setaria Grass, Para grass, Rhodes grass.

MATERIALS AND METHODS

Physio-chemical parameters and amount of Nitrogen(N), Potassium(K), Phosphorous(P) and Sulphur(S) present in the primary treated diluted spentwash (1:1, 1:2, 1:3SW) were analysed by standard methods (Table-2 and 3). The PTSW was used for irrigation with a dilution of 1:1, 1:2 and 1:3. A composite soil sample collected prior and later to spentwash irrigation was air-dried, powdered and analysed for physio-chemical properties (Table-1 and Table-4). Graminacious forage plants selected for the present investigation were Anjan grass, Setaria Grass, Para grass and Rhodes grass. The rooted slips(3inch) were sowed in different pots[25.5cm(h), 45.5cm(dia)] and irrigated by applying 0.75 to 1 lit/pot depends upon the climatic condition) with raw water(RW), 1:1SW, 1:2SW and 1:3SW at the dosage of once a week and rest of the period with raw water as required. Trials were conducted, growth and yield was recorded (Table-5 and 6).

Table:1 Characteristics of experimental soil

Parameters	Values
Coarse sand[c]	8.99
Fine sand[c]	41.06
Slit[c]	25.87
Clay[c]	21.80
pH (1:2soln)	8.32
Electrical conductivit[a]	562
Organic carbon[c]	0.98
Available Nitrogen[b]	392
Available Phosphorous[b]	239
Available Potassium[b]	99
Exchangeable Calcium[b]	163
Exchangeable Magnesium[b]	251
Exchangeable Sodium[b]	119
Available Sulphur[b]	296
DTPA Iron[b]	201
DTPA Manganese[b]	210
DTPA Copper[b]	9
DTPA Zinc[b]	62

Units: a-µS, b-mg/L, c-%

Table: 2 Chemical characteristics of distillery Spentwash

Chemical parameters	PTSW	1:1 PTSW	1:2 PTSW	1:3 PTSW
pH	7.52	7.60	7.66	7.70
Electrical conductivity[a]	28600	19900	8650	5290
Total solids[b]	46300	31090	22380	15890
Total dissolved solids[b]	36250	16930	11565	6420
Total suspended solids[b]	10360	6031	5119	1930
Settleablesolids[b]	9690	4260	3390	2840
COD[b]	40820	19190	9998	3010
BOD[b]	15880	6960	4285	2620
Carbonate[b]	Nil	Nil	Nil	Nil
Bicarbonate[b]	12800	7030	3320	1120
Total Phosphorous[b]	39.20	23.39	16.20	9.97
Total Potassium[b]	7200	4590	2990	1860
Calcium [b]	920	602	391	203
Magnesium[b]	1552.68	892.19	201.3	101.6
Sulphur[b]	75.2	35.6	18.9	9.9
Sodium[b]	502	296	218	172
Chlorides[b]	6122	3829	3212	2868

Iron[b]	7.9	6.2	3.4	2.3
Manganese[b]	1020	829	442	201
Zinc[b]	1.5	0.98	0.59	0.51
Copper[b]	0.272	0.201	0.092	0.056
Cadmium[b]	0.005	0.003	0.002	0.001
Lead[b]	0.15	0.09	0.07	0.014
Chromium[b]	0.05	0.021	0.01	0.007
Nickel[b]	0.08	0.049	0.03	0.011
AmmonicalNitrogen[b]	744.7	332.42	274.4	155.09
Carbohydrates[c]	21.64	11.32	7.93	5.92

Units: a-µS, b-mg/L, c-%, PTSW-Primary treated distillery Spentwash

Table:3 Amount of N, P, K and S (Nutrients) in distillery Spentwash

Chemical parameters	PTSW	1:1 PTSW	1:2 PTSW	1:3 PTSW
AmmonicalNitrogen[b]	744.7	332.42	274.4	155.9
Total Phosphorous[b]	39.20	23.39	16.20	9.97
Total Potassium[b]	7200	4590	2990	1860
Sulphur[b]	75.2	35.6	18.9	9.9

Units: b-mg/L, PTSW-Primary treated distillery spentwash

Table:4 Characteristics of experimental soil(After harvest)

Parameters	Values
Coarse sand[c]	9.03
Fine sand[c]	41.53
Slit[c]	26.02
Clay[c]	22.46
pH (1:2 soln)	8.19
Electrical conductivity[a]	601
Organic carbon[c]	1.51
Available Nitrogen[b]	449
Available Phosphorous[b]	263
Available Potassium[b]	114
Exchangeable Calcium[b]	166
Exchangeable Magnesium[b]	250
Exchangeable Sodium[b]	120
Available Sulphur[b]	298
DTPA Iron[b]	211
DTPA Manganese[b]	214
DTPA Copper[b]	10
DTPA Zinc[b]	62

Units:a-µS, b-mg/L, c-%

Table:5 Growth of graminacious forages at different irrigations(ft)

Name of the plant	RW 30^{TH}, 60^{TH}, 90^{TH} (Day)	1:1PTSW 30^{TH}, 60^{TH}, 90^{TH} (Day)	1:2PTSW 30^{TH}, 60^{TH}, 90^{TH} (Day)	1:3PTSW 30^{TH}, 60^{TH}, 90^{TH} (Day)
Anjan Grass	1.5,2.8, 3.5	0.9,2.1, 3.1	1.7,2.8, 4.1	2.2,3.8, 5.2
Setaria Grass	1.0,2.2, 3.1	0.8,1.6, 2.7	1.1,2.3, 3.6	1.4,2.7, 3.9
Para Grass	4.8,7.2, 10.2	3.3,6.8, 9.6	5.0,7.5, 10.2	5.9,8.0, 11.1
Rhodes Grass	2.9,4.1, 5.2	2.1,3.9, 4.5	2.8,4.0, 5.3	3.3,4.4, 6.1

Table: 6 Average yield of graminacious forages

Name of the plant	Average Weight(Kg)			
	RW	1:1PTSW	1:2 PTSW	1:3 PTSW
Anjan Grass	0.408	0.446	0.578	0.903
Setaria Grass	1.254	1.364	1.512	1.618
Para Grass	0.950	1.224	1.368	1.754
Rhodes Grass	0.414	0.440	0.511	0.603

RESULTS AND DISCUSSION

Characteristics of experimental soils such as pH, electrical conductivity, the amount of organic carbon, available nitrogen(N), phosphorous(p), Potassium (K), sulphur(S), exchangeable calcium (Ca), Magnesium(Mg), Sodium(Na), DTPA iron (Fe), manganese(Mn), copper(Cu) and zinc(Zn) were analysed and tabulated(Table-1). It was found that the soil composition is fit for the cultivation of plants, because it fulfils all the requirements for the growth of plants. Chemical composition of PTSW, 1:1,1:2 and 1:3SW such as pH, electrical conductivity, total solids (TS), total dissolved solids (TDS), total suspended solids(TSS), settelable solids(SS), chemical oxygen demand(COD), biological oxygen demand(BOD), carbonates, bicarbonates, total phosphorous(P), total potassium (K), ammonical nitrogen (N), calcium(Ca)

magnesium (Mg), sulphur (S), Sodium(Na), chlorides (Cl), iron(Fe), Manganese (Mn), zinc (Zn), copper(Cu), cadmium(Cd), lead(Pb), chromium (Cr) and nickel (Ni), were analysed and tabulated (Manivasakam N,1987; Piper,1996) (Table-2). Amount of N, P, K and S contents are presented in Table-3. In all the cases, maximum growth was observed in 1:3SW compared to RW, 1:1SW and 1:2SW irrigation. Growth rate was very poor in 1:1SW irrigation compared to RW, 1:2SW and 1:3SW irrigations and yield was 100% in 1:3SW, 50% in 1:1SW, 85% in 1:2SW and 90% in RW irrigations.

CONCLUSION

The study found that the growth and yield was good (100%) in 1:3 SW irrigation, while very poor in 1:1 SW (50%), moderate in 1:2SW(85%) and 90% in RW irrigation. In 1:3SW dilution the plants are able to absorb maximum nutrients both from the soil and spentwash resulting in good yield. This concludes that 1:3SW dilution can be used for cultivation of forage crops than other dilutions and raw water.

ACKNOWLEDGEMENT

The authors are thankful to the NSL sugars., Koppa, Karnataka, for providing spentwash and ZARS, UAS(B), V.C.Farm, Mandya for providing graminacious forages root slips and lab for soil and spentwash analysis.

REFERENCES

1. Josh H.C., Kalra.N.Chaudari.A. &Deb.D.L. (1994).Environmental issues related with distillery effluent utilization in agriculture in India, Asia Pac J Environ. Develop, 1,92-103.
2. Lindsay.W.L.,&Norvel.W.A. (1978). Development of D.T.P. A soil test for Zn, Fe, Mn, and Cu, Soil Sci.Soci.A.M.J, 42,421-428.
3. Pathak.H.,Joshi.H.C., Chaudhari.A., Chaudhary. R. , Kalra.N. & Dwevedi. M.K.(1998) Disttilery effluent as soil amendment for wheat and rice. J. Indian Soc. Soil Sci., 46,155-157.
4. Ramadura.R.,Gerard.E.J.(1994). Distillery effluent and downstream products, SISSTA, Sugar Journal 20, 129-131.
5. Singh.Y.,RajBahadur.(1998). Effect of application of distillery effluent on maize crop and soil properties. Indian J. Agri Science 68, 70-74.
6. Pandey.K.C. ,&Roy.A.K. (2011). Forage Crops Varieties. Indian Grassland and Fodder Research Institute, Jhansi.
7. Narayan. T.R, Dabadgho.P.M.(1972). Forage crops of India, ICAR, New Delhi.
8. Whyte.R.O.(1964). Grassland and fodder resources of India, ICAR, New Delhi.
9. Sun & Ray, Indian Feed Stuffs, ICAR, New Delhi.
10. Chatterjii.B.N. Das.P.K(1989). Forage crop production, Principles and practices, Oxford and IBH Publication, New Delhi.
11. Chandraju.S., Basavaraju. H.C., & Chidankumar. C.S. (2008). Investigation of impact of irrigation of distillery spentwash on the nutrients of cabbage and mint leaf. Indian sugar 39,19-28.
12. Chandraju.S., Basavaraju. H.C., & Chidankumar. C.S.(2008). Investigation of impact of irrigation of distillery spentwash on the nutrients of the pulses. Asian J. Chem., 20(8), 6342-6348.
13. Chidankumar.C.S. & Chandraju.S.(2009). Impact of distillery spentwash irrigation on yield of some condiments: An investigation, Sugartech. 11(3), 303 -306.
14. Devarajan.L, Rajanan.G. , Ramanathan.G. & Oblisami.G. (1994). Performance of field crops under distillery effluent irrigations, Kisan World 21, 48-50.
15. Eyini M, Jayakumar M. Pannirselvam S.(1990). Distillery effluent induced changes in apiculture waxes deposits of Eichorniacrassipes. Indian Journal of Economy, 20:1 – 4.