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Impact of Post Biomethanated Distillery Spentwash on Seed Germination and Seedling Growth of Dryland Crops

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A laboratory experiment was conducted to study the effect of different concentrations (Control, 1, 2, 3, 4, 5, 10, 15 and 20%) of distillery spentwash on seed germination, root length, shoot length and vigour index in some dry land crops *viz*., Maize (Super 900M), Sunflower (Hybrid 3322), Redgram (local), White sorghum (APK 1), Red sorghum (local), Cumbu (COCu 9) and Groundnut (VRI 2). The distillery spentwash did not show any inhibitory effect on seed germination at low concentration. The spentwash at a higher concentration reduced the seed germination. But up to 10% concentration the distillery spentwash markedly improved the seed germination and seedling growth in all crops. Thus, the distillery spentwash can be used safely after proper dilution as substitute for chemical fertilizer to the crop plants.

Key words: Spentwash, dry land crops, germination, vigour index

In recent years, use of industrial effluents for irrigation after treatment is a favourable approach because effluents contain nutrients, which are useful for growth of crops. Distilleries are one of the most important agro based industries in India, produce ethanol from molasses. They generate large volume of foul smelling coloured waste water known as spentwash. The distillery spentwash contains organic and inorganic nutrients and have been reported to have a beneficial effect on crop yields (Joshi *et al*., 1996; Ramana *et al*., 2002). Further it serves as an additional source of fertilizer for agricultural use. Based on this background, a laboratory experiment was conducted to find out the effect of different concentrations of distillery spentwash on seed germination in dry land crops.

Materials and Methods

The distillery spentwash used in the present study was collected from the Salem Cooperative Sugar Mills Ltd., Mohanur, Namakkal District. The various physico-chemical properties of distillery spentwash were analysed using standard methods of APHA (1989). The post biomethanated distillery spentwash was used in this study and it was neutral in pH (7.07) and saline (EC 38 dSm^{-1}) in nature, dark brown in colour and contained appreciable amounts of plant nutrients (Table 1).

The germination test was conducted using roll towel method using Whatman No.1 filter paper. Seeds of Maize (Super 900M), Sunflower (Hybrid 3322), Redgram (local), White sorghum (APK 1), Red sorghum (local), Cumbu (COCu 9) and Groundnut (VRI 2) were procured from Namakkal District. For the germination test, 25 seeds of each species were placed in the filter paper. The rolls were dipped in the spentwash at different concentration (Control 1, 2, 3, 4, 5, 10, 15 and 20%). The dilution of the effluent was made with distilled water. The control was maintained in each case with distilled water. The experiment was conducted in completely randomized design with four replications and kept in the laboratory at 28 ± 2^{0}C and 90 ± 3% Relative Humidity (RH) in the presence of light. Emergence of radicle was taken as a criterion for germination. After 10 days the seeds lithat germinated were counted and expressed in percentage (ISTA, 1999). The seedlings growth was observed by measuring root length and shoot length.

Results and Discussion

The important physical, chemical and biological characteristics of the distillery spentwash is presented in Table 1. The effect of distillery spentwash on seed germination is given in Table 2 and Fig 1. The germination percentage of all the crops studied were increased gradually up to 5% concentration of distillery spentwash. At lower concentrations (1, 2, 3, 4 and 5), the distillery spentwash did not inhibit seed germination. In general the germination percentage decreased with increase in concentration (10,15 and 20%) of the distillery spentwash. Significant difference was also observed in germination percentage in all the crops. In most of the crops the germination percentage was increased up to 5 per cent concentration of spentwash. Except in maize, the germination percentage was reduced at higher concentration of spentwash. Among the dilutions, control recorded the least values (78%), while the 5 per cent recorded

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Table 1. Characteristics of biomethanated distillery spentwash

S. No.	Characters	Biomethanated spentwash*
1.	Colour	Dark brown
2.	Odour	Unpleasant burnt sugar
3.	pH	7.1
4.	EC (dSm^{-1})	38
5.	Total dissolved solids	50000
6.	Total suspended solids	3300
7.	Total solids	53300
8.	Biological oxygen demand	12800
9.	Chemical oxygen demand	35000
10.	Carbon ($g\ L^{-1}$)	24
11.	Nitrogen	420
12.	Phosphorus	40
13.	Potassium	9097
14.	Sodium	357
15.	Calcium	4600
16.	Magnesium	1752
17.	Chloride	13471
18.	Bicarbonates	195
19.	Sulphate	947
20.	Oil and grease	19.6
21.	Total sugars (%)	3.49
22.	Reducing sugars (%)	1.77
23.	Total phenols	84
24.	Zinc	7.20
25.	Iron	78
26.	Manganese	5.3
27.	Copper	5.5
29.	Bacteria (x 10^6 CFU ml^{-1} of effluent)	12
30.	Fungi (x 10^4 CFU ml^{-1} of effluent)	19
31.	Actinomycetes (x 10^3 CFU ml^{-1} of effluent)	Nil

* Mean of triplicate samples; (Values are in mg L^{-1} unless otherwise stated)

the highest percentage of germination (93%). Among the crops, maize (97%). sunflower (97%) and redgram (97%) recorded the highest values followed by red sorghum (95%), white sorghum (91%), cumbu (89%) and groundnut (85%). Irrespective of crops 5 per cent dilutions recorded the highest values. Similar results have been reported by Ramana *et al*. (2002) and Hari *et al*. (1994). The reason for obtaining maximum germination up to 10% of distillery spentwash may

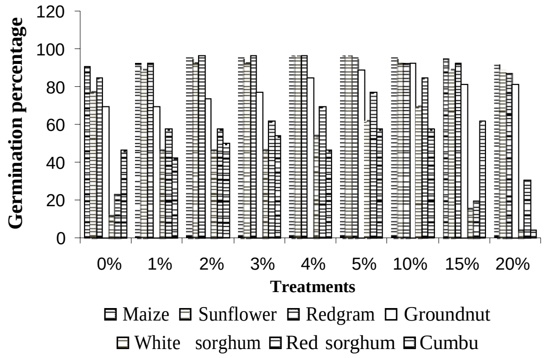

Fig 1. Effect of different concentrations of spentwash on germination percentage of crop seeds

be due to the presence of optimum level of major nutrients which act as a growth activator. In addition, the distillery spentwash contains growth promoting substances like IAA and GA (Murugaragavan, 2002). The inhibition of seed germination at higher concentration is due to excessive quantities of inorganic salts (Table 1), high osmatic pressure in higher concentration and consequently its higher EC value of the distillery spentwash. Our results are consistent with findings of the earlier workers

Table 2. Effect of different concentrations of spentwash on germination percentage of crop seeds

Dilutions of spentwash	Germination percentage Crop (C)							
(T)	Maize (Super 900M)	Sunflower (Hybrid 3322)	Redgram (Local)	White sorghum (APK 1)	Red sorghum (Local)	Cumbu (COCu 9)	Groundnut (VRI 2)	Mean
Control	91	77	85	72	79	75	70	**78**
1%	93	89	93	76	81	77	70	**82**
2%	97	93	97	82	85	79	74	**86**
3%	97	93	97	84	85	83	77	**88**
4%	97	97	97	87	89	86	82	**91**
5%	97	97	97	91	95	89	85	**93**
10%	97	93	93	82	90	89	83	**89**
15%	95	89	93	80	87	85	81	**87**
20%	94	89	87	78	85	80	79	**84**
Mean	95	90	93	81	86	83	78	**86**
	T	C	T x C					
SEd	**1.00**	**0.88**	**2.65**					
CD (0.05)	**1.97**	**1.74**	**5.22**					

(Neelam and Sahai, 1988, Pandey and Sony, 1994) who also observed a decrease in seed germination with increase in the concentration of the spentwash.

Regarding the results of seedling growth of different crops treated with different concentrations of distillery spentwash have been shown in Table 3, 4 and Fig 2, 3. The root and shoot lengths of crops were found increased when seeds were treated with up to 5 per cent spentwash. At higher concentration of spentwash (>5%), the significant reduction in root

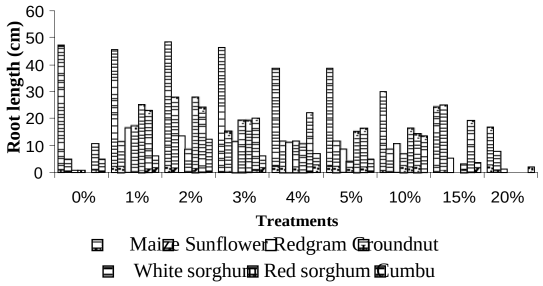

Fig 2. Effect of different concentrations of spentwash on root length of crop seeds

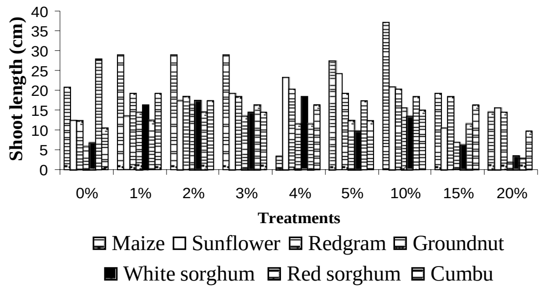

Fig 3. Effect of different concentrations of spentwash on shoot length of crop seeds

and shoot lengths as observed. Within the dilutions, 5 per cent spentwash produced the longest roots (25.4 cm), while control produced the shortest roots (13.5 cm). Among the crops maize (48.3 cm) recorded the highest values while the lowest value was with groundnut (13.5 cm). In the interaction effect irrespective of crops, 5 per cent spentwash recorded the highest values (Table 3).

Control recorded the least values of shoot length (12.2 cm), while the highest value was with 5 per cent dilution (23.4 cm). Among the crops maize recorded the highest values (37.2 cm) in 5 per cent spentwash, while white sorghum recorded the lowest values (16.4 cm) followed by red sorghum, groundnut, redgram, sunflower and cumbu (Table 4). Similar increase with definite concentration / dilution, on root length and shoot length in crops like sorghum, maize, cotton, black gram *etc*., had been reported by Lakshmanan and Gopal (1996). The root length and shoot length also decreased

Table 3. Effect of different concentrations of spentwash on root length of crop seeds

Dilutions of spentwash (T)	Root length (cm) Crop (C)							
	Maize (Super 900M)	Sunflower (Hybrid 3322)	Redgram (Local)	White sorghum (APK 1)	Red sorghum (Local)	Cumbu (COCu 9)	Groundnut (VRI 2)	Mean
Control	16.9	8.7	8.2	9.8	15.1	14.5	8.2	**13.5**
1%	38.6	11.6	9.8	11.6	17.5	16.4	9.8	**16.5**
2%	45.8	13.8	11.6	12.8	19.3	20.3	10.6	**19.2**
3%	46.3	15.4	12.8	14.1	21.8	22.2	11.3	**20.6**
4%	47.3	25.1	13.5	17.4	25.1	23.2	12.5	**23.4**
5%	48.3	28.0	16.4	19.3	28.0	24.1	13.5	**25.4**
10%	38.6	25.4	13.8	16.9	22.8	21.8	12.1	**21.6**
15%	29.9	22.8	12.0	14.7	19.9	19.7	10.5	**17.7**
20%	24.1	19.1	10.7	13.2	17.2	17.5	9.2	**14.8**
Mean	37.3	18.9	12.1	14.4	20.7	20.0	10.9	**19.2**
	T	C	T x C					
SEd	**0.25**	**0.22**	**0.67**					
CD (0.05)	**0.50**	**0.44**	**1.32**					

with increasing concentration of spentwash (15 and 20%). This could be due to the accumulation of salts of the spentwash at higher level in higher concentrations. Chaudhary *et al*. (1987) and (Malla and Mohanty, 2005) also expressed that effluents at higher concentration contain higher organic, inorganic and toxic elements that enter into the seed during imbibition and disturbed the germination process. However at lesser concentrations (higher dilutions) the osmotic pressure of spentwash decreased and the water availability to the germinating seed increased and favoured better germination and seedling quality characters. From the study it is suggested that the distillery spentwash contains an excess of various forms of cations and anions which are injurious to plant growth along with plant growth promoters. The concentration of these salts should be reduced to safer level by diluting the spentwash which can be used for irrigation purposes as liquid fertilizer.

Table 4. Effect of different concentrations of spentwash on shoot length of crop seeds

Dilutions of spentwash (T)	Shoot length (cm) Crop (C)							
	Maize (Super 900M)	Sunflower (Hybrid 3322)	Redgram (Local)	White sorghum (APK 1)	Red sorghum (Local)	Cumbu (COCu 9)	Groundnut (VRI 2)	Mean
Control	14.5	12.5	12.5	8.8	7.8	12.5	10.6	**12.2**
1%	24.5	15.4	16.5	12.2	13.5	16.2	14.5	**15.3**
2%	27.5	17.4	17.2	13.5	14.8	17.2	15.0	**17.4**
3%	29.0	19.3	18.3	14.8	16.4	17.4	16.4	**18.8**
4%	31.0	23.2	19.3	15.4	17.3	18.3	17.4	**20.3**
5%	37.2	24.1	20.3	16.4	18.3	28.0	19.3	**23.4**
10%	29.0	23.0	19.0	15.2	15.2	24.2	15.4	**20.2**
15%	20.7	19.5	18.0	13.8	13.3	20.4	14.9	**17.0**
20%	19.3	13.5	14.8	11.6	11.8	14.5	12.8	**14.3**
Mean	**25.9**	**18.7**	**17.3**	**13.5**	**14.3**	**18.7**	**15.1**	**17.7**
	T	C	T x C					
SEd	**0.22**	**0.19**	**0.58**					
CD (0.05)	**0.43**	**0.38**	**1.14**					

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