

# YIELD and NUTRIENT UPTAKE of RAINFED PEARL MILLET (*PENNICETUM GLAUCUM*) as INFLUENCED by POST BIOMETHANATED SPENT WASH –A SUGARCANE DISTILLERY EFFLUENT

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**Abstract**--Field trials were conducted on forty four farmer fields of three Tehsils of Ahmednagar District Maharashtra, to study the effect of post biomethanated spent wash application during kharif with pearl millet as test crop. Application of liquid post biomethanated effluent @ 75,000 liters per hectare prior to sowing of crops increased the grain and straw yield of rain fed pearl millet by 10 and 4 per cent respectively. The soil available N,P,and k was increased by 52,2.83 and 3.77 per cent over untreated plots respectively .The N, P and K uptake was increased by application of post biomethanated spent wash.

**Keywords**-- Nutrient uptake, pearl millet, Post biomethanated spent wash , yield

## I. INTRODUCTION

Pearl millet (*Pennisetum glaucum*) is a major cereal crop and poor mans food mostly grown in Northern part of Western Maharashtra. There are over 319 distilleries in India, with installed capacity of 3.25 billion liters of alcohol [9]. The waste liquid produced after alcohol distillation is known as distillery effluent / spent wash. This spent wash is being used to produce methane gas to supplement its energy needs. The effluent left after the methane generation is known as post biomethanated spent wash. Disposal of post biomethanated spent wash is a great problem, and can be resolved by it's one time application for crop production as it is a rich source of nutrients, however it contain high amounts of soluble salts, which may affect soil properties with frequent and in high doses of application.The investigation was undertaken to study the effect of application post biomethanated spent wash before sowing on grain and straw yield and nutrient uptake of Pearl Millet and on soil chemical properties in three Tahsils viz. Rahuri, Kopargaon and Newasa of Ahmednagar District of Maharashtra.

## II. MATERIAL AND METHODS

The studies on one time land application of post biomethanated spent wash @ 75,000 lit ha<sup>-1</sup> as a liquid manure on farmers field in the jurisdiction of Kopargaon Sahakari Sakhar Karkhana Ltd., Kolpewadi, Tal. Kopartaon,

(KSSK), Somaiya Organo Chemicals Ltd, Sakarwadi, Tal. Kopargaon, (SOC), Dr. Bapurao Bapuji Tanpure Sahakari Sakhar Karkhana Ltd., Shrishivajinagar, Tal. Rahuri (BBT) and Shri. Dnyaneshwar Sahakari Sakhar Karkhana Ltd., Dnyaneshwarnagar, Bhende, Tal. Newasa, District Ahmednagar (DSSK) of Maharashtra. The total rainfall received during kharif 2006 was 480.5 mm in 34 rainy days. The average annual maximum and minimum temperatures were 32.4 °C and 18.76 °C respectively. Agro climatically, this region falls under the Scarcity Zone with very low rainfall and high rate of evaporation. The soils were of the order Entisol and Inceptisol with predominant great groups of Ustorthents and Haplusterts comprising of fine loams mixed, Isohypertermic family of Typic Ustorthents and Typic Haplusterts. The soils were alkaline in reaction (Mean pH 8.37) contain low amount of soluble salts (Ec 0.36),low available nitrogen, moderate in available phosphorus and very high in available potassium. The liquid post bio-methanated spent wash @ 75,000 liters per hectare was applied uniformly on the farmers fields in May 2006 before sowing of pearl millet uniformly with the help of butterfly spray tankers. Forty four farmer fields from 25 villages were selected. At each individual farm, one plot (40 R) was treated and other plot was kept untreated. After twenty days of application, regular cultivation practices were followed before sowing of crop.

The initial and post harvest soil samples from 44 treated and untreated fields were analyzed for their chemical properties. The post biomethanated spent wash used for one time controlled land application was analyzed for its chemical properties (Table 1). The Pearl Millet was sown in the second fortnight of June 2006 and harvested at maturity between 25-30th October 2006. The standard package of practices viz. Variety, spacing, weed control etc. followed were uniform for treated and untreated plots at each individual farm. The grain and straw yield from treated and untreated plots were recorded. Plant and grain samples were collected for nutrient concentration and uptake. The yield of grain and straw was recorded at each site at farmers field.

### III. RESULT AND DISCUSSION

The initial and after harvest soil analysis data was collected and reported and presented in Table 3. The data presented in Table 1 indicated that post bio-methanated spent wash under study is nearly neutral in reaction (pH 7.51). The electrical conductivity was very high (EC 45.13  $\text{dSm}^{-1}$ ) indicate presence of high concentration of dissolved salts. The BOD (6,208 ppm) and COD (27,318 ppm) values indicated the high content of soluble organic matter. The post biomethanated spent wash contained 0.15 per cent nitrogen, 0.025 per cent phosphorus and 0.99 per cent of potassium. Among the cations, potassium (0.99 %) was dominant and it was followed by calcium (0.30%), magnesium (0.28 %) and sodium (0.24 %). Among the anions presents sulphate was dominant (0.62 %) followed by chlorine (0.57 %)

TABLE 1. CHARACTERIZATION of POST BIOMETHANATED SPENT WASH

Sr. No.	Parameters	1	2	3	4	Mean
1	pH	7.20	7.22	7.92	7.71	7.51
2	EC ( $\text{dSm}^{-1}$ )	44.43	44.60	44.52	47.00	45.13
3	COD (ppm)	6400	6100	6000	6333	6208
4	BOD (ppm)	27,400	27,400	27,530	27,063	27,348
5	N (%)	0.15	0.15	0.16	0.14	0.15
6	P <sub>2</sub> O <sub>5</sub> (%)	0.026	0.025	0.026	0.023	0.025
7	K <sub>2</sub> O (%)	0.99	0.97	1.00	0.99	0.99
8	Cl (ppm)	5862	5690	5860	5473	5721
9	Na (ppm)	2420	2360	2520	2507	2452
10	SO <sub>4</sub> (ppm)	6247	6090	6133	6493	6241
11	Ca (ppm)	3006	3027	3067	3180	3070
12	Mg (ppm)	2800	2880	2827	2920	2857

Initial soil chemical properties indicated that the soils are alkaline in reaction, low in salt content, low to medium in available nitrogen, medium in available phosphorus and high in available potassium.

TABLE 2. INITIAL CHEMICAL PROPERTIES OF SOILS

Distillery	No. of samples	Soil properties (Initial)					
		pH	Ec ( $\text{dSm}^{-1}$ )	N	P	K	Ex. Na ( $\text{cmol}(\text{p}^+) \text{kg}^{-1}$ )
KSSK	16	8.35	0.42	162	15.9	392	3.7
SOC	23	8.58	0.42	175	18.2	438	8.6
BBT	17	8.44	0.37	160	14.5	506	7.1
DSSK	21	8.11	0.21	120	11.7	232	2.5
mean	77	8.37	0.36	154	15.1	392	5.5

#### A. EFFECT of POST BIOMETHANATED SPENT WASH on YIELD and UPTAKE of PEARL MILLET

1) *Grain yield*: The average grain yield of Pearl Millet of treated and untreated plots was 25.06  $\text{q ha}^{-1}$  and 22.76  $\text{q ha}^{-1}$ ,

respectively. The results indicated that application of PBSW resulted in higher grain yield by 10.10 per cent over untreated plots (Table 3). Increased in grain yield might be due to application of post biomethanated spent wash which was a rich source of various nutrient elements and improved microbial population. This might have influenced on release of native nutrients in soil and helped to maintain the soil fertility. Several scientists have reported the beneficial effect of post biomethanated spent wash on crops.

2) *Straw yield*: The straw yield presented in Table 3 revealed that there was increased in yield of treated plots (50.94  $\text{q ha}^{-1}$ ) by 4 per cent over untreated plots (48.78  $\text{q ha}^{-1}$ ).

TABLE 3. EFFECT OF POST BIOMETHANATED SPENT WASH on YIELD

Distillery	Mean of samples	Yield			
		Untreated soil		Treated soil	
		Grain	Straw	Grain	Straw
$\text{kg ha}^{-1}$					
KSSK	5	22.81	48.75	25.14	50.72
SOC	10	22.74	48.56	24.96	50.78
BBT	10	22.96	49.10	25.10	51.0
DSSK	19	22.54	48.70	25.05	51.27
mean	44	22.76	48.78	25.06	50.94

3) *Nutrient uptake*: The total uptake of N, P and K was increased by application of post biomethanated spent wash (Table 4).

TABLE 4. EFFECT OF POST BIOMETHANATED SPENT WASH ON NUTRIENT UPTAKE

Distillery	Available Nutrients ( $\text{kg ha}^{-1}$ )					
	Untreated			Treated		
	N	P	K	N	P	K
KSSK	50.04	10.48	91.23	55.82	11.15	95.97
SOC	49.56	10.11	90.69	55.40	11.45	96.04
BBT	49.58	10.42	91.27	55.37	11.11	95.58
DSSK	48.84	10.28	90.22	55.70	11.43	96.42
Mean	49.48	10.32	90.85	55.57	11.29	96.00

1) *Total Nitrogen*: Total uptake of nitrogen by Pearl Millet was increased in treated plots (55.57  $\text{kg ha}^{-1}$  in treated plots and 49.48  $\text{kg ha}^{-1}$  in untreated plots), which is attributed to nitrogen content and organic load which might have improved the available nitrogen status in soil.

2) *Total Phosphorus*: The application of PBSW increased the total phosphorus uptake from 10.32  $\text{kg ha}^{-1}$  in untreated to 11.29  $\text{kg ha}^{-1}$  in treated plots.

3) *Total Potassium*: The total potassium uptake by pearl millet increased due to application of PBSW @ 75,000  $\text{L ha}^{-1}$ . The total potassium uptake in treated plots increased by 6 per cent over untreated plots (96.00  $\text{kg ha}^{-1}$  of treated plots and 90.85  $\text{kg ha}^{-1}$  untreated plots).

#### B. CHEMICAL PROPERTIES of SOIL at HARVEST OF CROP

1) *Soil reaction ( pH )* :At harvest, pH value of untreated plots was 8.39 which was reduced to 8.29. Application of post bio-methanated spent wash reduced the pH in treated plots over untreated plots. The slight decrease in pH may be due to low pH of post bio-methanated spent wash.

2) *Electrical conductivity*: Application of post bio-methanated spent wash significantly increased the mean EC value of treated plot (0.39 dSm<sup>-1</sup>) over untreated plot (0.37dSm<sup>-1</sup>). The increased EC might be due to very high salt load (EC 45.13 dSm<sup>-1</sup>) of the post bio-methanated spent wash.

3) *Major nutrients*: The available major nutrient status of soil was considerably influenced in treated plots over untreated plots (Table 5).

1) *Available nitrogen*: At harvest, available nitrogen content of treated plots was increased over untreated plots. The mean nitrogen content of untreated plots was 140.4 kg ha<sup>-1</sup> and for treated plots was 145.70 kg ha<sup>-1</sup>. There was marginal increase in nitrogen content at harvest was observed.

2) *Available phosphorus*: At harvest, mean available phosphorus for untreated plots was 14.1 kg ha<sup>-1</sup> and for treated plots was 14.4 kg ha<sup>-1</sup> indicating slight increase in available P in soil, which may be due to P content (0.025 per cent) in post bio-methanated spent wash.

TABLE 5. EFFECT of POST BIOMETHANATED SPENT WASH on SOIL CHEMICAL PROPERTIES at HARVEST of PEARL MILLET

Treated						
Sr.No. of factory	pH (1:2.5)	Ec (dSm <sup>-1</sup> ) (1:2.5)	N	P	K	Ex.Na (cmol(p <sup>+</sup> ) kg <sup>-1</sup> )
			(kg ha <sup>-1</sup> )			
1	8.35	0.41	149	14.0	669	7.50
2	8.27	0.44	152	15.0	572	3.66
3	8.50	0.44	167	17.6	631	8.64
4	8.04	0.27	114	11.1	417	2.57
Mean	8.29	0.39	146	14.4	572	5.59

Untreated						
Sr.No. of factory	pH (1:2.5)	Ec (dSm <sup>-1</sup> ) (1:2.5)	N	P	K	Ex.Na (cmol(p <sup>+</sup> ) kg <sup>-1</sup> )
			(kg ha <sup>-1</sup> )			
1	8.46	0.38	147	13.9	492	7.12
2	8.37	0.44	144	14.4	369	3.66
3	8.59	0.44	161	17.1	422	8.64
4	8.13	0.23	108	10.8	220	2.52
mean	8.39	0.37	140	14.1	376	5.49

3) *Available potassium*: The application of post bio-methanated spent wash resulted in increase in available potassium content in treated plots (572.50 kg ha<sup>-1</sup>) over untreated plots (375.9 kg ha<sup>-1</sup>). The increase in available K at harvest might be due to application of PBSW (0.99 % K).

C. EFFECT of POST BIOMETHANATED SPENT WASH on CHEMICAL PROPERTIES of PIEZOMETER WATER

The application of post bio-methanated spent wash @ 75000 liters / ha resulted in slightly increase in COD (8.33 %),BOD (5.76 %),EC(7.47 %) while decrease in pH values by 1.2 %. Considerable increase in cations and anions were noticed .The decreasing trend of cations are K>Mg>Ca>Na and anions was SO<sub>4</sub> >CO<sub>3</sub> >HCO<sub>3</sub> > Cl > NO<sub>3</sub> .The Sodium Absorption Ratio and Residual Sodium Carbonate was increased by 0.37 and 0.40 respectively.

TABLE 6. CHEMICAL PROPERTIES OF PIEZOMETER WATER DURING KHARIF SEASON

Parameters	Dr. BBT (Mean of 5 samples)		KOP.SSK (Mean of 8 samples)		SOC (Mean of 10 samples)		Dny.SSK (Mean of 5 samples)	
	UT	T	UT	T	UT	T	UT	T
COD (ppm)	78.4	82.4	62.0	69.3	78.8	85.0	69.2	77.0
BOC (ppm)	26.0	24.0	20.8	31.4	26.4	21.4	23.8	25.8
pH	8.30	8.20	8.80	8.67	8.15	8.06	8.04	7.94
EC (dSm <sup>-1</sup> )	0.99	1.07	1.07	1.15	1.06	1.13	1.15	1.26
Cations (meqL <sup>-1</sup> )								
a) Ca <sup>2+</sup>	8.70	8.93	9.59	9.81	5.63	5.88	3.0	3.3
b) Mg <sup>2+</sup>	4.56	4.75	6.24	6.44	3.20	3.40	4.06	4.3
c) Na <sup>+</sup>	3.85	3.95	3.30	3.36	3.31	3.36	1.29	1.36
d) K <sup>+</sup>	0.07	0.08	0.07	0.08	0.07	0.08	0.02	0.03
Anions (meqL <sup>-1</sup> )								
a) CO <sub>3</sub> <sup>2-</sup>	1.21	1.26	1.31	1.36	1.11	1.15	0.24	0.31
b) HCO <sub>3</sub> <sup>-</sup>	5.24	5.31	5.40	5.45	4.56	4.62	2.93	3.05
c) Cl <sup>-</sup>	1.74	1.79	7.08	7.13	1.26	1.30	0.82	0.87
d) SO <sub>4</sub> <sup>2-</sup>	0.29	0.32	0.36	0.38	0.36	0.40	0.17	0.20
e) NO <sub>3</sub> <sup>-</sup>	5.08	5.12	5.45	5.49	5.06	5.11	3.61	3.68
SAR	1.07	1.51	0.86	1.21	1.15	1.60	0.49	0.70
RSC	-6.8	-3.10	-9.12	-9.45	-3.06	-4.49	-3.96	-4.32

IV. CONCLUSIONS

It is therefore concluded that post biomethanated spent wash could be a good source of organic material and can be useful for improving the soil chemical properties ,yield and nutrient uptake of Pear Millet. It could also be utilized as a good source of plant nutrients and rich source of potassic fertilizers as the potassium may be present in the form of potassium chloride (KCl) or potassium sulphate (K<sub>2</sub>SO<sub>4</sub>).The application of post biomethanated spent wash @ 75000 lit./ha have increased the concentration of,cations ,anions, and COD,BOD,SAR and RSC were within safe limits.



Fig.1.Method of spraying liquid manure on field.

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