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EVALUATING THE YIELD AND PROTEIN CONTENT OF FODDER GRASS UNDER PAPER MILL EFFLUENT IRRIGATION AND SOLID WASTES AMENDMENT

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ABSTRACT

Using alternative water resources such as treated industrial effluent is considered very important to produce crops and green forage due to irrigation water shortage, especially in arid and semiarid regions. The objectives were to investigate the effects of irrigation with treated effluent of paper mill and amendment of paper mill solid wastes on Cumbu Napier fodder yield and quality. Results indicate increase in grass biomass yield under I_2T_4 (Effluent irrigation coupled with Fly ash 10 t ha^{-1}+ Bio sludge 6 t ha^{-1} + 75% NPK over I_1T_1(100% NPK) was 44.7 percent during II cutting and 52.6 percent in III cutting and the protein content also improved considerably. Treated effluent use in irrigation of Cumbu Napier fodder and application of solid wastes are considered as useful alternative disposal method of wastewater without the risk of accumulation of toxic elements in the soil and the maintenance of the environment.

KEY WORDS : Effluent, Fodder, Flyash, Biosludge

INTRODUCTION

Reducing agricultural water use and maintaining or improving economic productivity of the agricultural sector is the major challenge in arid and semiarid regions. Irrigated agriculture is the major consumer of fresh water supplies in many parts of the world, particularly in relatively arid and semiarid regions like India. The demand on scarce water resources in these countries is increasing with time for both agriculture and non-agriculture purposes.

Over recent years, severe shortages in food supplies for livestock have been experienced in, due to shortages of water for irrigation. Many projects to produce forages have been established during the last two decades to cover some green and dry forage needs in these countries. However, scarcity of adequate fresh water supplies might pose challenges for sustainability of the field projects especially with utilizing ground water for irrigation, which is consumed in large amounts as these countries are characterized with very high rates of evapotranspiration and soils of low capacity to retain water.

The objectives of this study were to evaluate Cumbu Napier grass for green fodder production utilizing treated effluent and solid wastes of paper mill.

MATERIALS AND METHODS

The field experiment was laid out at Pappampalayam village in Erode. Fodder grass Cumbu Napier, variety CO_3 was selected as the test crop. Cumbu Napier CO_3, an interspecific hybrid between *P. glaucum x P. purpureum* was released by Tamil Nadu Agricultural University for general.

The field experiment was laid out in split plot design with three replications with the following treatments.

1. Main plot treatments – Irrigation sources

I_1 - Well water irrigation

I_2 - Treated effluent irrigation

2. Subplot treatments –Solid wastes

T_1 - Control (100% NPK)
T_2 - Biosludge 12 + ha^{-1} + 75% NPK
T_3 - Limesludge 10 t ha^{-1} + Biosludge 6 t ha^{-1} + 75% NPK
T_4 - Flyash 10 t ha^{-1} + Biosludge 6 t ha^{-1} + 75% NPK
T_5 - Vermiculite 5 t ha^{-1} + 75% NPK

The field was ploughed well and opened into ridges and furrows of 75 x 60 cm apart and irrigation channels were formed. Plots of required size (18 m^2) were formed manually.

Recommended dose of NPK fertilizers at 50:50:40 kg ha^{-1}(N as Urea, P as Single Super Phosphate and K as Murate of Potash) were applied as basal dressing as per the treatment details. After each harvest, Nitrogen is applied at the rate of 100 kg ha^{-1}. Solid wastes as per treatment details were applied before planting. Rooted slips of CO_3 Cumbu Napier grass were obtained from the Department of Forage Crops at TNAU and planted at the rate of one slip per hill at a spacing of 75 x 60 cm. The field was irrigated immediately after planting and second irrigation was given on 3rd day. Subsequent irrigations were given regularly as per treatment schedule and requirement. The net plots were harvested and treatment wise yield was recorded (fresh weight) by cutting stalks close to the ground level.

The plants in net plot area of each plot were cut close to the ground level and the fresh weight was recorded and expressed as kg/plot. The protein content was estimated by Lowry's method.

RESULTS AND DISCUSSION

In the first harvest, well water irrigation (I_1) recorded significantly higher yield of 171.3 kg/plot than effluent irrigation (I_2) of 93.1 kg/plot. In the second harvest, effluent irrigation (I_2) and well water irrigation performed equally good and there was no significant difference between them. But at the third harvest, the highest mean yield of 132.3 kg/ plot was observed under effluent irrigation (I_2).

In the third harvest, the interactions between irrigation sources and solid waste treatments revealed that, the biomass yield ranged from 97 kg / plot (I_1T_4) to 148.0 kg/plot (I_2T_4). The highest biomass yield was recorded in the treatment T_4 which received 10 t ha^{-1} of fly ash + 6 t ha^{-1} of Bio sludge t 75% NPK under both irrigations I_1T_4 (135.3 kg/plot) and I_2T_4 (148.0 kg/plot).

The yield of Cumbu Napier was higher under effluent irrigation in the II and III cutting. The yield increase over well water irrigation during the II cutting was 7.35 percent and it increased to 10.35 percent during III cutting This proved that growing Cumbu Napier grass under treated paper mill effluent for enhanced fodder production to support dairy units is a viable option which needs a positive consideration. But, well water irrigation performed significantly well during the I harvest. The decrease

Biomass yield of Cumbu Napier grass as influenced by effluent irrigation and solid wastes application during three cuttings

Treatments	Biomass Yield (kg/plot)					
	I cut		II cut		III cut	
I_1 T_1	146.3		108.7		97.0	
T_2	182.7		130.0		126.0	
T_3	175.6		126.0		121.7	
T_4	188.7		132.3		135.3	
T_5	163.3		122.0		119.3	
Mean	171.3		123.8		119.9	
I_2 T_1	80.7		116.0		116.3	
T_2	97.3		151.0		139.0	
T_3	95.7		119.0		137.7	
T_4	109.3		157.3		148.0	
T_5	82.7		121.0		120.3	
Mean	93.1		132.9		132.3	
	SEd	CD(0.05)	SEd	CD(0.05)	SEd	CD(0.05)
I	0.37	1.61	0.49	2.13	0.52	2.22
T	2.45	5.19	2.08	4.41	2.02	4.28
I x T	3.12	6.71	2.68	5.87	2.61	5.75

in yield during the I harvest, under effluent irrigation, might be due to the initial shock in the establishment of the slips, since slips of Cumbu Napier grass procured from TNAU are normally cultivated under fresh water. Use of the treated paper mill effluent could have delayed the rooting and initial establishment of the slips.

The treatment that received Fly ash 10 t ha^{-1} + Bio sludge 6 t ha^{-1} + 75% NPK (T_4) recorded the highest yield irrespective of the irrigation sources. This might be due to increased available nutrient content which could have led to greater utilization of nutrients by the crops resulting in higher yields. The same was corroborated by the findings of Sathish Kumar (2002).

The increase in biomass yield under I_2T_4 over I_1T_1(100% NPK) was 44.71 percent during II cutting and 52.57 percent in III cutting. It is evident that by opting for the incorporation of bio sludge and fly ash which are the solid by products of paper industry, an enhanced productivity of fodder grass could be ensured at the same time achieving a saving of 25% towards the cost of fertilizer input.

The next best combination for increasing the biomass yield was I_2T_2 (effluent irrigation and bio sludge 12 t ha^{-1} + 75% NPK) which contributed to 38.91 percent increase in yield than under 100% NPK under well water irrigation in the II cutting and 43.29 percent increased biomass in the III cutting.

The above treatment was followed by I_2T_3 (Lime sludge 10 t ha^{-1} + Bio sludge 6 t ha^{-1} + 75% NPK under effluent irrigation which recorded 41.95 percent higher yield than I_1T_1 followed by I_2T_5 (vermiculite 5 t ha^{-1}+ 75% NPK under effluent irrigation) contributing 24.02 percent increased yield than I_1T_1.

The treatment receiving Fly ash 10 t ha^{-1} + Bio sludge 6 t ha^{-1} + 75% NPK (T_4) increased significantly the plant nutrient content of the fodder grass irrespective of the irrigation sources. The nutrient content increased, due to the increased nutrient status of soil by the addition of solid wastes together with effluent irrigation. The findings are in line with those of Swarup and Ghosh (1979) and Reddy *et al.* (1981). This indicated that soil incorporation of the solid by products of the paper industry resulted in enhanced quality of the fodder which would ultimately improve the health of the dairy and draught animals and milk production too.

CONCLUSION

The above study assures that the fodder grass Cumbu Napier can be cultivated successfully using paper mill effluent as the alternate irrigation source and paper mill solid wastes (Fly ash 10 t ha^{-1} + Bio sludge 6 t ha^{-1}) as the amendments. The application of solid waste amendments together with the effluent irrigation has increased the yield of green forage of the CN hybrid grass. This increase due to

Plant protein content of Cumbu Napier grass as influenced by effluent irrigation and solid wastes application during three cuttings

Protein content (%)	Treatments					
	III cut		II cut		I cut	
8.06	7.94		8.00		**I_1 T_1**	
8.31	8.19		8.13		T_2	
8.36	8.38		8.31		T_3	
8.44	8.50		8.56		T_4	
8.25	8.25		8.19		T_5	
8.28	8.25		8.24		Mean	
8.13	8.19		8.19		**I_2 T_1**	
8.19	8.25		8.13		T_2	
8.31	8.31		8.38		T_3	
8.50	8.56		8.50		T_4	
8.19	8.25		8.19		T_5	
8.26	**8.31**		**8.28**		**Mean**	
	SEd	CD(0.05)	SEd	CD(0.05)	SEd	CD(0.05)
I	NS	NS	NS	NS	NS	NS
T	0.03	0.12	0.13	0.28	0.13	0.28
I x T	NS	NS	NS	NS	NS	NS

the decomposition of organic fertilizers is accompanied by the release of appreciable amounts of CO_2 that dissolve in water to form the carbonic acid which was responsible for releasing appreciable amounts of nutrients from the soil to the plants, which could contribute to higher yields (Bharadwaj and Omanwar, 1994; Sebastian *et al.,* 2009). The application of organic amendments such as vermicompost, FYM, pressmud, ETP sludge etc. in the drained field increased the height of Cumbu Napier grass, the content of crude proteins and the total yield of green forage compared to the control field without drainage (Balusamy *et al.,* 2019). It could be concluded that there is a vast potential for the use of the treated effluent coupled with the solid by products like bio sludge, fly ash and press mud in an eco-friendly way for the production of Cumbu Napier fodder grass of enhanced nutrient content. The cost of cultivation too would be reduced with the reduction in the cost of fertilizers by more than 25 percent.

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