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Efficient utilization of sewage water for improving the forage yield and quality of bajra-napier hybrid grass

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Abstract : Field experiments were conducted at Agricultural College and Research Institute, Madurai to compare the effect of sewage effluent on yield and quality of Bajra Napier hybrid grass with two irrigation sources *viz.*, ordinary water (I_1) and sewage effluent (I_2) as main plots and four N levels *viz.*, 0, 50, 75 and 100 kg N ha^{-1} as sub plot treatment in a split plot design with three replications. BN 2 grass was grown as a test crop. Among the different levels of N, application of 100 kg N ha^{-1} recorded the highest green fodder (303 t ha^{-1}), dry matter (61 t ha^{-1}) and crude protein (5.26 t ha^{-1}) yield. Sewage effluent irrigation increased the green fodder, dry fodder and crude protein yield. The interaction effect between sewage effluent irrigation and N showed that 100 kg N ha^{-1} with sewage effluent irrigation recorded the highest green fodder yield of 357 t ha^{-1}, dry matter yield of 72 t ha^{-1} and crude protein yield of 6.37 t ha^{-1}. Sewage water irrigation showed increased total K, Ca, Fe, Mn and Zn content in BN 2 grass. The oxalic acid content was within the safe limit at all the levels of N tried (2.04-2.08%) and with sewage effluent irrigation (2.14-2.61%). A decrease in crude fibre content was observed due to the increased addition of N at both the source of irrigation because of involvement of N in protein synthesis and consequent reduction in carbohydrate, ultimately leading to better digestibility of the grass. *(Key words : Bajra Napier hybrid grass, Sewage Effluent, Drymatter, Crude protein, Crudefibre, Oxalic acid)*

Waste water (cattle shed wash, domestic wash, sewage effluents etc...), pose problems of safe disposal. Soil disposal of such water is cost effective and offers vast scope for recycling of nutrients and water. The loading rates and life of a disposal are determined in part, by the efficiency of the crop in taking up these nutrients. These waste waters were found to contain heavy loads of microorganisms, organic matter and plant nutrients. Successful recycling could be better achieved only when the subsequent plant growth is frequently removed and utilized. Thus, forage production on such lands is considered economical. The fodder quality characters were altered to a great extent by waste water irrigation and N fertilization. Hence, the present investigation was carried out to study the effect of sewage effluent for improving the forage yield and quality of bajra-napier hybrid grass.

Materials and Methods

Field experiments were conducted at Agricultural College and Research Institute, Madurai during 1992-93 to study the effect of sewage effluent on yield and quality of bajra-napier hybrid grass with two irrigation sources *viz.*, ordinary water (I_1) and sewage effluent (I_2) as main plots and four N levels *viz,* 0, 50, 75 and 100 kg N/ha as subplot treatments in a split plot design with three replications. Basal dressing of 50kg P_2O_5 /ha and 50 kg K_2O/ha were applied as super phosphate and muriate of potash along with Nitrogen as urea. BN 2 grass was grown a test crop. Nitrogen was top dressed after each cut (once in 45 days) through urea as per the N levels. In an year eight cuttings were taken and the green fodder yield was recorded and expressed in t/ha.

The plant samples collected for the estimation of dry matter percentage and other quality parameters were air dried and then dried in the oven at 70°C and ground in a willy mill using 1mm screen. The crude protein was estimated by microkjeldahl method (Humphries, 1956 and Piper 1966), P by vanadomolybdophosphoric yellow colour method (Jackson, 1973), K by using flame photometer (Jackson, 1973), Ca and Mg by versenate titration method (Jackson, 1973), micronutrients *viz.*, Fe, Cu, Mn and Zn by using Atomic Absorption Spectrophotometer (AAS) (Lindsay and Norwell, 1978).

Results and Discussion

Effect of N levels and irrigation sources on green fodder, drymatter and crude protein yield

Among the different levels of N, application of 100 kg N/ha recorded the highest green fodder (303 t/ha), dry matter (61 t/ha) and crude protein (5.26 t/ha) yield (Table 1 and Table 2). Sewage water irrigation increased the green fodder, dry

Table 1. Effect of Nitrogen levels and irrigation sources on green fodder and dry matter yield of BN 2 forage grass.

(Average for two years)
(Mean of three replications)

N levels (kg ha^{-1})	Green fodder yield (t/ha/yr)			Dry matter yield (t/ha/yr)		
	I_1	I_2	Mean	I_1	I_2	Mean
0	173.2	241.3	207.2	35.0	45.2	40.1
50	191.6	268.8	230.2	39.5	52.4	45.9
75	232.2	281.4	256.8	47.6	55.8	51.7
100	246.5	357.8	303.1	49.4	72.31	60.9
Mean	210.3	287.3	-	42.9	56.41	-
	SE_d	CD (5%)		SE_d	CD (5%)	
I	0.685	2.948		0.276	1.850	
N	1.477	3.219		0.715	1.557	
I at N	1.935	4.731		0.918	2.175	
N at I	2.089	4.556		1.011	2.203	

Table 2. Effect of Nitrogen levels and irrigation sources on crude protein yield and crude fibre content of BN2 forage grass.

(Average for two years)
(Mean of three replications)

N levels (kg ha^{-1})	Crude protein yield (t/ha/yr)			Crude fibre content (%)		
	I_1	I_2	Mean	I_1	I_2	Mean
0	7.95	7.92	7.94	30.6	32.2	31.4
50	8.31	7.96	8.14	29.5	31.0	30.3
75	8.37	8.61	8.49	28.8	30.5	29.7
100	8.62	8.85	8.73	27.4	29.5	28.5
Mean	8.31	8.34	-	29.1	30.8	-
	SEd	CD (5%)		SEd	CD (5%)	
I	0.054	NS		0.326	NS	
N	0.083	0.179		0.818	1.783	
I at N	0.115	0.304		1.054	NS	
N at I	0.117	0.254		1.157	NS	

Table 3. Effect of Nitrogen levels and irrigation sources on total P, K, Ca and Mg content of BN 2 forage grass.

N levels (kg ha^{-1})	Total P (%)			Total K (%)			Total Ca (%)			Total Mg (%)		
	I_1	I_2	Mean	I_1	I_2	Mean	I_1	I_2	Mean	I_1	I_2	Mean
0	0.295	0.300	0.298	4.55	5.11	4.83	0.160	0.178	0.169	0.560	0.520	0.540
50	0.300	0.270	0.285	4.56	5.38	4.97	0.170	0.198	0.184	0.500	0.470	0.485
75	0.290	0.250	0.270	4.53	5.08	4.81	0.188	0.236	0.212	0.500	0.500	0.500
100	0.310	0.260	0.285	4.80	5.81	5.31	0.184	0.238	0.211	0.510	0.430	0.470
Mean	0.299	0.270	-	4.61	5.35	-	0.176	0.213	-	0.520	0.480	-
	SE_d	CD (5%)		SE_d	CD (5%)		SE_d	CD (5%)		SE_d	CD (5%)	
I	0.002	0.009		0.038	0.163		0.002	0.010		0.022	NS	
N	0.007	0.016		0.060	0.132		0.004	0.008		0.023	0.049	
I at N	0.009	0.021		0.083	0.218		0.005	0.014		0.035	NS	
N at I	0.011	0.023		0.086	0.186		0.005	0.012		0.032	NS	

matter and crude protein yield. The interaction effect between sewage water irrigation and N showed that 100 kg N/ha with sewage water irrigation recorded the highest green fodder yield of 357 t/ha, dry matter yield of 72 t/ha and crude protein yield of 6.4 t/ha. This is in accordance with the findings of Andreev and Grislis (1990), Singh *et al.* (1991) and Gladis (1995). Positive response of green fodder yield to N application was reported in pearl millet and sorghum by Katoria *et al.* (1981). Tripathi *et al.* (1984) reported that increased dose of N significantly increased the forage yields in *Pennisetum pedicellatum* and the highest dry matter yield (92.2 q/ha) was obtained at 90 kg N/ha. Waste waters and sewage contained most nutrients essential for crop growth and hence increased the fodder yield (Singh and Mishra, 1987). *Medicago sativa* irrigated with sewage water gave average dry matter yield of 8.78

Table 4. Effect of Nitrogen levels and irrigation sources on total Fe, Cu, Mn and Zn content of BN 2 forage grass.

N levels (kg ha^{-1})	Total Fe (ppm)			Total Cu (ppm)			Total Mn (ppm)			Total Zn (ppm)		
	I_1	I_2	Mean	I_1	I_2	Mean	I_1	I_2	Mean	I_1	I_2	Mean
0	324	310	317	15.3	20.1	17.7	17.0	15.1	16.1	31.3	37.6	34.5
50	314	340	327	15.6	20.8	18.2	18.0	16.5	17.3	32.3	46.8	39.6
75	318	471	395	17.6	18.8	18.2	19.1	16.8	17.9	37.8	58.1	48.0
100	374	387	381	19.4	19.6	19.5	19.6	17.3	18.5	43.8	59.3	51.6
Mean	263	377	-	16.98	19.83	-	18.4	16.4	-	36.3	50.5	
	SE_d	CD(5%)		SE_d	CD(5%)		SE_d	CD(5%)		SE_d	CD(5%)	
I	2.88	12.37		0.955	NS		0.400	1.722		0.549	2.360	
N	4.15	9.03		0.455	0.991		0.418	0.910		0.918	2.000	
I at N	5.84	15.73		1.106	4.161		0.649	NS		1.251	3.237	
N at I	5.86	12.78		0.643	1.401		0.590	NS		1.298	2.829	

Table 5. Effect of Nitrogen levels and irrigation sources on oxalic acid content of BN 2 forage grass.

N levels (kg ha^{-1})	Oxalic acid content (%)		
	I_1	I_2	Mean
0	2.041	2.144	2.093
50	2.156	2.299	2.228
75	2.384	2.428	2.406
100	2.486	2.610	2.548
Mean	2.267	2.370	-
	SE_d	CD(5%)	
I	0.042	NS	
N	0.063	0.137	
I at N	0.088	NS	
N at I	0.089	NS	

t/ha (Andreev and Grislis, 1990). A study by Singh *et al*., (1991) also indicated that the sewage water increased the drymatter yield of berseem. Vitkovaskii (1981) observed the increased crude protein content in napier grass with the application of N upto 360 kg N/ha/yr. *Medicago sativa* irrigated with sewage water and canal water gave crude protein yields of 1.77 and 1.44 t/ha respectively. (Andreev and Grislis, 1990).

Effect of N levels and irrigation sources on crudefibre content

The crude fibre value is an indirect indication of digestibility of the forage. It is a known fact that higher the crude fibre lower will be the digestibility and vice-versa. A decrease in crude fibre content was observed due to addition of N at both the sources of irrigation (Table 2)

The application of N favourably reduced the crude fibre content of fodder through increased succulence, a factor much related to feed intake. This is in close agreement with the findings of Govindaswamy and Manickam (1988), Mani and Kothandaraman (1981). Similar observation was made by Gladis (1995) who reported that the crude fibre content of fodder sorghum was altered to a great extent by waste water irrigation and highest value was observed with domestic wash.

Effect of N levels and irrigation sources on mineral constituents

The total P content in the forage grass was not much varied due to sewage water irrigation whereas it significantly increased the total K, Ca, Fe, Mn and Zn content in BN2 grass (Table 3 and 4). The increased dose of N resulted in the increased K content in the forage grass thus a synergestic effect of added N on the total K content was established. Gladis, 1995 and Kelling *et al.*,1977 reported the highest P in fodder irrigated with domestic wash.

Increased dose of N resulted in increase in Ca content of the grass exhibiting a positive influence on the digestibility. This is mainly because of decreased crude fibre content due to addition of N at both the sources of irrigation which in turn through increased succulence, a factor much related to feed intake influence on the digestibility. Sewage effluent irrigation showed a marked increase in Ca content over ordinary water irrigation. Similar results were also reported by Fresquez *et al.*, (1990) and Mani (1979).

In the sewage water irrigated fodder, Fe (310-471 ppm), Zn(37.6-59.3 ppm) and Cu (18.8-20.8 ppm) content were the highest where as the Mn (15.1-17.3 ppm) content was the lowest. Singh *et al.* (1991) observed higher concentrations of Cu, Fe and Mn in berseem irrigated with sewage water. These variations were attributed to the minerals carried in the water, the alterations in soil physico-chemical properties and the associated alterations in their availability in soil.

Effect of N levels and irrigation sources on oxalic acid concentration

The presence of oxalic acid in hybrids of Napier grass occupies a significant position in the evaluation of this grass for its feeding value. Synthesis of oxalic acid will be promoted in the plant if the cation-anion balance is disturbed due to heavy applications of N fertilizers in order to bring an equilibrium. Hence, proper management of fertilizers is of utmost importance to minimize the accumulation. A level of below 3 percent in forage plants is believed to be the safe limit, above which symptoms of oxalate toxicity will be exhibited. (Desraj and Mudgal, 1968). In the present study the oxalic acid content in the BN2 grass was within the safe limit (Table 5) at all the levels of N tried (2.04-2.48%) and with sewage effluent irrigation (2.14-2.61%).

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Research Notes

Effect of pesticides spray on resultant seed quality in bhendi

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The seed crops of vegetables are subject to the same insect problem as edible vegetables. The control of pests begins with crop growth and ends at seed harvest. Several plant protection chemicals applied to the seed crop, either alone or in combination, affect the biological events of seed during the course of its development and maturation and ultimately affecting the quality of the seed produced. In bhendi, fruit borer (*Earias vitella*) is a serious pest and also in other malvaceous crops causing severe damage to the tune of 80 per cent (Srinivasan and Gowder, 1960) and hence efforts were taken to control the serious pest and its effect on resultant seed quality.

A field experiment was conducted in two seasons *viz.* June – July and February – March with the following pesticides spray *viz.* Endosulfan – 0.05% (P1), Monocrotophos – 0.05 % (P2), Fenvalerate – 0.02 % (P3), Chlorpyriphos – 0.05 % (P4), Carboryl – 0.1 % (P5), Neem Oil 250 ml / acre (P6), Pesticides rotation (P7) (Dimethoate 0.03 % + P1 + P2+P4+P6) and Control (P0).

They were sprayed separately at 10 days interval starting from first flowering until pods turned brown colour. The graded resultant seeds were subjected to accelerated ageing test (Woodstock and Feeley, 1965). After 7 days of ageing, the seeds were subjected to the following seed quality, attributes *viz.*, germination (Anon, 1985), seedling measurements, drymatter production, and vigour index (Abdul – Baki and Anderson, 1973).

The resultant seed from monocrotophos, endosulfan and neem oil recorded high germination (70.5, 67.5 and 65 %, respectively), lengthier roots (9.63, 9.00 and 8.75 cm, respectively) and shoot (13.88, 13.88 and 12.13 cm, respectively), greater drymatter production (282, 268 and 246 mg, respectively) and vigour index (1571, 1515 and 1340, respectively) compared to control which registered only low germination (44 %), poor root (5.88 cm) and shoot (8.75 cm), low