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Original Research Article

Impact of Treated Paperboard Mill Effluent Irrigation on Yield and Quality of Chillies

S. Ponmani[1], C. Udayasoorian[2]

[1]Dryland Agricultural Research Station, Tamil Nadu Agricultural University, Chettinad-630 102, India
[2]Department of Environmental Sciences, Tamil Nadu Agricultural University, Coimbatore-641 003, India

Corresponding Author: S. Ponmani

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ABSTRACT

A study has been conducted to use the treated paperboard mill effluent and well water with the combination of amendments *viz.*, Biomanure (BM), Vermicompost (VC), Farmyard manure (FYM) and Fly ash (FA) for cultivating vegetable crop chillies to assess their impact on yield and fruit quality. The treatment combination of biomanure @ 5 t ha^{-1} + vermicompost @ 3.5 t ha^{-1} + fly ash @ 5 t ha^{-1} + 100 % NPK performed better than rest of the treatments. Application of FA, BM and VC along with effluent irrigation had increased the yield of chillies *viz.*, fruit length, fruit width and fruit weight. The yield increased was recorded 20.90 per cent over control (100 % NPK alone). The quality parameters *viz.*, ascorbic acid, capsaicin and oleoresin in chillies were higher under effluent irrigation and amendments addition.

Key words: Treated paperboard mill effluent, solid wastes, chillies, quality parameters

INTRODUCTION

During the past few decades, Indian industries have registered a quantum jump, which has contributed to high economic growth but simultaneously it has also given rise to severe environmental pollution. Huge quantity of solid wastes and effluents generated from different industries are being dumped into the environment, causing hazards in the long run. Pulp and paper industry is one of the largest consumers of plant and water resources, which releases significant amount of effluents in nearby areas. Application of effluent on land as irrigation water, source of plant nutrients offers a promising alternative.[(1)] This effective management of wastes brings economic benefits and protects fragile ecosystem from degradation. However, effluents of some industries have useful characteristics and have the potential to improve crop productivity. [(2)] The effluent irrigated soils over the years, without any deterioration on crop quality. [(3,4)]

The present consumption of vegetable per capita per day in India is 135 g against the requirement of 285 g per day. It indicates the necessesity to raise the production of vegetables which can be achieved by linking more land under

vegetable cultivation and increasing productivity of the vegetables as well. Chillies (*Capsium annum L.*) are cultivated in all the states and union territories of the country. The area under cultivation is estimated to be around 8 lakh hectares. The total production stands at around 84 lakh metric tonnes. Generally, vegetable crops are sensitive to soil pollution and they are the best indicators of hazardous chemicals. Hence an attempt has been made in the present study to evaluate the yield and quality of chillies under treated paperboard mill effluent irrigation.

MATERIALS AND METHODS

Field trial

The experiment was carried out at Indian Tobacco company, paperboards and speciality papers division (ITC-PSPD) Unit: Kovai, Thekkampatti village, Mettupalayam , Coimbatore District of Tamil Nadu during 2007-2008. Chillies variety CO 4 was used in this study. The experiment consisted of 2 factors *viz.*, irrigation (I_1 – well water, I_2- treated paperboard mill effluent), treatments (T_1- T_8). i. e. the recommended dose of NPK alone (T_1), the other treatments had recommended dose of NPK (30: 60: 30 kg ha^{-1}) along with solid wastes *viz.*, FYM @ 12.5 t ha^{-1} (T_2), Fly ash @ 5 t ha^{-1} (T_3), Biomanure @ 5 t ha^{-1} (T_4), Vermicompost @ 3.5 t ha^{-1} (T_5), Biomanure 5 t ha^{-1} + Fly ash @ 5 t ha^{-1} (T_6), Vermicompost @ 3.5 t ha^{-1}+ Fly ash @ 5 t ha^{-1} (T_7), Biomanure @ 5 t ha^{-1} + Vermicompost @ 3.5 t ha^{-1} + Fly ash @ 5 t ha^{-1} (T_8).

The growth attributes, plant height was measured from the ground level to the tip of the main stem and number of branches were counted and expressed in numbers at the interval of 30, 60 and 90 DAT (Days After Transplanting). The yield attributes *viz.*, fruit weight, fruit length and fruit girth was recorded. The capsaicin content and ascorbic acid content of fruit s w ere estimated adopting the procedure given by. [5]

Statistical Analysis

Two way analysis of variance (ANOVA) was applied to determined any significant ($P<0.05$) difference among the irrigation observed in field trial. [6] The treatment differences that are not significant were noted as Non Significant (NS).

RESULTS AND DISCUSSION

Plant biometric observation

The treated paperboard mill effluent irrigation along with solid waste application *viz.*, BM, VC, FA recorded taller plants and more number of branches than well water irrigation in chillies at all the three stages of growth *viz.*, 30 (36.0 cm), 60 (42.4 cm), 90 (67.4 cm) DAT (Table.1) . In the present study, the inorganic nitrogen and other essential plant nutrients contributed from vermicompost, biomanure and fly ash might have helped in the promotion of the growth characters of chillies. The same phenomenon of maximum plant height was observed in vermicompost amended treatment by [7,8] also reported maximum plant height and the highest number of branches were recorded in vegetable cowpea when grown on biocompost amended soil with paper mill effluent irrigation.

Yield

The fruit yield was more under VC + BM + FA + 100 % NPK (T_8) with effluent irrigation than well water irrigation (Fig.1). This could be due to favorable influence on yield attributing characters *viz.*, fruit weight (10.92 gm), fruit length (11 cm) and fruit girth (5.3 cm) under effluent irrigation (Table.2). Similar results were also expressed by [9] who had reported that application of vermicompost was increased the fruit yield in chillies, might be due to increased number of fruit, fruit weight, fruit length and fruit girth. In general, growth attributes are directly correlated to the yield of vegetable crops.

Addition of these organic manures enhances the growth attributes like number of leaves and number of branches and it leads to increased photosynthesis to crops. This will facilitate increased yield in crops.

Table 1. Effect of treated paperboard mill effluent irrigation and solid waste on plant height (cm)

Treatments	Chillies								
	45 DAT			90 DAT			At harvest		
	I_1	I_2	Mean	I_1	I_2	Mean	I_1	I_2	Mean
T_1	24.4	27.0	25.7	31.4	32.5	31.9	45.7	51.0	48.4
T_2	26.5	32.0	29.3	33.5	43.0	38.3	51.5	53.7	52.6
T_3	23.1	28.5	25.8	30.6	35.0	32.8	45.2	52.6	48.9
T_4	27.0	30.5	28.8	33.7	39.5	36.6	52.3	56.0	54.2
T_5	31.3	33.7	32.5	37.4	43.1	40.3	55.1	59.3	57.2
T_6	26.8	31.5	29.2	34.0	40.4	37.2	56.0	57.1	56.6
T_7	32.0	34.0	33.0	37.0	44.1	40.6	61.0	62.5	61.8
T_8	34.5	37.4	36.0	39.1	45.6	42.4	65.5	69.2	67.4
Mean	28.2	31.8		34.6	41.0		54.0	57.7	
	SEd	CD(0.05)		SEd	CD(0.05)		SEd	CD(0.05)	
I	0.63	1.28		0.79	1.61		1.17	2.40	
T	1.26	2.57		1.58	3.23		2.35	4.80	
IT	1.78	NS		2.24	NS		3.33	NS	

I_1 - Well water; I_2 -Treated effluent, T_1 – 100 % NPK, T_2 - FYM + 100 % NPK, T_3 - FA + 100 % NPK, T_4 - BM+ 100 % NPK, T_5 – VC+ 100 % NPK, T_6 - BM + FA + 100 % NPK, T_7 - VC+ FA+ 100 % NPK, T_8 - BM+ VC+FA + 100 % NPK
(FYM – Farmyard manure ; FA – Fly ash ; BM– Biomanure ; VC– Vermicompost ; DAT- Days After Transplanting)

Table 2. Effect of treated paperboard mill effluent irrigation and solid waste on fruit length and girth (cm) of chillies

Treatments	Length			Girth		
	I_1	I_2	Mean	I_1	I_2	Mean
T_1	8.2	9.1	8.7	4.4	4.2	4.3
T_2	8.7	9.8	9.2	4.3	5.1	4.7
T_3	8.3	9.3	8.8	4.8	3.9	4.6
T_4	9.9	10.2	10.1	4.2	5.1	4.7
T_5	9.5	10.7	10.1	4.6	5.6	5.1
T_6	10.2	9.6	9.9	4.1	5.4	4.8
T_7	9.8	10.4	10.1	4.8	5.7	5.2
T_8	10.7	11.3	11.0	4.8	5.8	5.3
Mean	9.4	10.1		4.5	5.1	
	SEd	CD(0.05)		SEd	CD(0.05)	
I	0.11	0.23		0.06	0.11	
T	0.23	0.47		0.11	0.23	
IT	0.32	0.66		0.16	0.32	

I_1 - Well water; I_2 -Treated effluent, T_1 – 100 % NPK, T_2 - FYM + 100 % NPK, T_3 - FA + 100 % NPK, T_4 - BM+ 100 % NPK, T_5 – VC+ 100 % NPK, T_6 - BM + FA + 100 % NPK, T_7 - VC+ FA+ 100 % NPK, T_8 - BM+ VC+FA + 100 % NPK
(FYM – Farmyard manure ; FA – Fly ash ; BM– Biomanure ; VC– Vermicompost ; DAT- Days After Transplanting)

Quality parameters

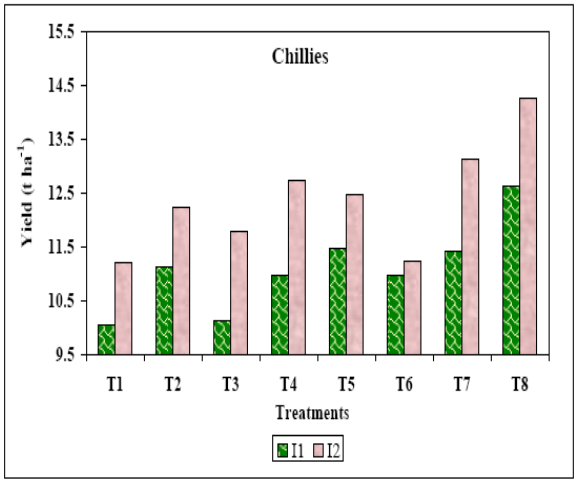
The quality parameters of chillies *viz.*, ascorbic acid, capsaicin and oleoresin contents were higher in paperboard mill effluent irrigation when compared to well water irrigation (Table.3) Among the treatment combination, the treatment receiving VC + BM + FA+ 100 % NPK recorded highest value compared to other treatments. This might be due to combined use of treated effluent along with amendments, which might have provided enough nutrients with better physical and microbial environment and thus improving the soil fertility and ultimately resulted in improved quality parameters. Similar results were also reported in tomato, [10] radish and onion, [11] bhendi [12,13] when grown in organic amended soil with paper mill effluent irrigation.

Table 3. Effect of treated paperboard mill effluent irrigation and solid wastes on ascorbic acid, capsaicin and oleoresin content (mg 100 g^{-1}) of chillies

Treatments	Ascorbic acid			Capsaicin			Oleoresin		
	I_1	I_2	Mean	I_1	I_2	Mean	I_1	I_2	Mean
T_1	20.67	23.69	22.18	0.45	0.53	0.49	11.32	11.78	11.55
T_2	27.67	31.00	29.34	0.49	0.62	0.56	12.47	12.66	12.57
T_3	20.00	24.67	22.34	0.47	0.56	0.52	11.83	11.99	11.91
T_4	26.33	38.34	32.34	0.47	0.64	0.56	13.25	13.46	13.36
T_5	34.67	45.32	40.00	0.54	0.72	0.63	13.98	14.20	14.09
T_6	28.00	33.65	30.83	0.51	0.76	0.64	13.37	13.71	13.54
T_7	44.60	59.33	51.97	0.54	0.73	0.64	13.73	14.66	14.19
T_8	51.32	65.21	58.27	0.60	0.80	0.70	14.95	15.52	15.23
Mean	31.66	40.15		0.51	0.67		13.11	13.50	
	SEd	CD(0.05)		SEd	CD(0.05)		SEd	CD(0.05)	
I	0.34	0.68		0.01	0.03		0.04	0.08	
T	0.67	1.37		0.02	0.05		0.07	0.15	
IT	0.95	1.94		0.03	0.07		0.10	0.21	

I_1 - Well water; I_2 -Treated effluent, T_1 – 100 % NPK, T_2 - FYM + 100 % NPK, T_3 - FA + 100 % NPK, T_4 - BM+ 100 % NPK, T_5 – VC+ 100 % NPK, T_6 - BM + FA + 100 % NPK, T_7 - VC+ FA+ 100 % NPK, T_8 - BM+ VC+FA + 100 % NPK
(FYM – Farmyard manure ; FA – Fly ash ; BM– Biomanure ; VC– Vermicompost ; DAT- Days After Transplanting)

Fig.1. Effect treated paperboard mill effluent irrigation and solid waste on yield of chillies



T_1 – 100 % NPK T_2 - FYM + 100 % NPK T_3 - FA + 100 % NPK
T_4 - BM+ 100 % NPK T_5 – VC+ 100 % NPK T_6 - BM + FA + 100 % NPK
T_7 - VC+ FA+ 100 % NPK T_8 - BM+ VC+FA + 100 % NPK
FYM – Farmyard manure FA – Fly ash BM– Biomanure
VC– Vermicompost I_1- Well water I_2- Treated paperboard mill effluent

CONCLUSION

Yield and quality of chillies under effluent irrigation and solid waste application was evaluated. Solid waste incorporation coupled with effluent irrigation for chillies revealed that effluent irrigation increased the yield by 20.90 %. This suggests that growing chillies under treated paper mill effluent is a viable option for vegetable production.

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