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IMPACT OF WASTEWATER ON THE YIELD OF A PULSE CROP

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ABSTRACT

A pot experiment was conducted to study the effect of wastewater on *Lens culinaris* cv. DLP-15 with two different concentrations of wastewater i.e. 50% WW and 100% WW with different doses of phosphorus (P_0, P_{10}, P_{20} and P_{40} kg ha^{-1}) and N @ 20 kg ha^{-1} and K @ 30 k ha^{-1} was also applied basally. Significant increase was obtained in plant fresh weight, plant dry weight, nodules number $plant^{-1}$, seed yield $plant^{-1}$ and biomass $plant^{-1}$ with wastewater in comparison with ground water (GW) owing to higher nutrient contents present in it. Among the phosphorus doses P_{20} proved good while between the two concentrations of wastewater 100% proved more effective. Therefore, the two can be recommended safely for the cultivation of this pulse crop.

INTRODUCTION

Inorganic fertilizers are essential for the cultivation of crops, as without them, the plants cannot grow and develop up to their full potential. However, excessive use of inorganic fertilizers is an important source of pollution as their nutrients run off the land due to heavy rainfall or leached through the soil reaching to the ground water. On the other hand their long term presence in soil also leads to acidification. Large quantities of wastewater are being produced by exponentially increasing population, urbanization and industrialization thereby causing a serious threat to the environment. Therefore, use of wastewater in agriculture is gaining importance now a days because of its value as a potential irrigant and a nutrients donor as confirmed by the finding of Aziz *et al*. (1994, 1995), Pradhan *et al*. (2001), Akhtar *et al*. (2006). Thus this practice can make it possible to conserve the limited water resources and also to prevent pollution of water bodies. Keeping these points in mind, an attempt was made to use the wastewater collected from a city wastewater drain situated along the Aligarh-Mathura road, commonly in use for irrigation of various agricultural crops, for the cultivation of leguminous crop.

MATERIALS AND METHODS

A pot experiment was conducted during the rabi season of 2002-2003 in the net house of the Department of Botany, Aligarh Muslim University, Aligarh, to study the effect of city wastewater on lentil (*Lens culinaris*) cv. DLP-15. 10″ size earthen pots were filled with 5 kg soil containing soil and farmyard manure in 3:1 ratio. Seeds were sown @ of 10 seeds pot^{-1} and after germination, the seedlings were limited to maintain one plant pot^{-1}. Each pot has 3 replications. The crop was grown under two different concentrations of city wastewater, which was mixture of sewage and household water plus industrial effluents i.e. 50%WW and 100%WW and tap water which was used as ground water (GW), applied at alternate day @ 250 ml pot^{-1}. In addition to this crop was supplied with four levels of phosphorus i.e. P_0, P_{10}, P_{20} and P_{40} along with 20 kg N ha^{-1} and 30 kg K ha^{-1} applied basally one day before sowing to avoid seed injury. The source of nitrogen, phosphorus and potassium were supplied on the form of commercial grade urea, single super phosphate and muriate of potash respectively. The parameters observed were plant fresh weight, plant dry weight, nodule number plant^{-1}, seed yield plant^{-1} and biomass. Growth parameters were studied at pre-flowering, flowering and post-flowering stages, whereas biomass and seed yield was recorded at the time of harvest. Water samples were analysed for various characteristics, (APHA, 1989) and Ghosh *et al*. (1983) procedures were followed for soil analysis. The data was statistically analysed as described by Gomez and Gomez (1984).

RESULTS AND DISCUSSION

Wastewater proved beneficial, in comparison to groundwater for all the parameters including, the seed yield and biomass. Among the two concentrations of wastewater 100%WW proved superior to 50%WW and can be directly used without dilutions as it is generally utilized away from the source and already diluted by way of mixing with the domestic wastewater thrown into the same drain. This may be because of the presence of some essential nutrients present in wastewater like nitrogen, phosphorus and potassium in addition to calcium, magnesium, sulphur and chloride (Table 1). Similar views have also been expressed by Aziz *et al*. (1993), Khan *et al*. (2003) and Shah *et al*. (2005). Analysis of wastewater exhibited more electrical conductivity (EC), chemical oxygen demand (COD), biological oxygen demand (BOD). However, values of most of the parameters were within limits of CPCB (1995) or FAO (1994), except BOD, COD and Mg. The role of these nutrients is well established as nitrogen is involved in cell division, expansion (Gardner *et al*., 1985); phos-

Table 1

Physicochemical characteristics of 100% wastewater, 50% wastewater and groundwater and characteristics of soil before sowing in 1:5 (soil : water extract). All determination in mg l^{-1}or as specified.

	Water			Soil	
Determinations	GW	50% WW	100% WW	Determinations	
pH	8.0	7.6	7.0	Texture	Sandy loam
EC (µ mhos cm^{-1})	700	850	1050	CEC (meq 100g^{-1} soil)	3.72
TS	930	1423	2390	pH	7.52
TDS	580	830	1360	Organic carbon (%)	0.819
TSS	350	590	1030	NO_3-N (g kg^{-1} soil)	0.332
BOD	17.21	80.23	150.66	P (g kg^{-1} soil)	0.120
COD	45.63	181.54	372.24	K	15.00
NO_3^--N	0.85	3.52	7.79	Ca	31.9
NH_4^+	2.58	3.71	5.99	Mg	15.79
PO_4 -N	0.68	1.24	1.86	Na	14.11
7.96	12.46	20.14		CO_3	20.33
Ca	27.95	89.39	158.64	HCO_3	105.46
Mg	18.14	72.81	139.23	SO_4	17.32
Cl	65.26	108.26	125.46	Cl	28.79
CO_3	18.66	46.34	106.55		
HCO_3	66.21	186.26	361.42		
SO_4	40.00	52.00	75.00		
Na	14.78	23.26	38.41		

Table 2
Effect of GW, 50%WW and 100%WW on plant fresh weight, plant dry weight and nodule number on lentil (*Lens culinaris* L.) cv. DLP-15 with different levels of phosphorus.

Treatment	Plant fresh weight			Plant dry weight			Nodule number plant^{-1}		
	Pre Flowering	Flowering	Post Flowering	Pre Flowering	Flowering	Post Flowering	Pre Flowering	Flowering	Post Flowering
GW×P_0	1.084	3.055	6.879	0.257	0.722	1.623	6.54	12.16	5.33
GW×P_{10}	1.173	3.329	7.635	0.272	0.772	1.753	9.67	6.54	6.13
GW×P_{20}	1.309	3.695	8.598	0.295	0.859	1.980	10.73	9.67	6.83
GW×P_{40}	1.323	3.702	8.607	0.302	0.865	0.985	10.87	10.73	6.87
50%WW×P_0	1.152	3.189	7.308	0.265	0.748	1.701	8.73	10.87	5.87
50%WW×P_{10}	1.232	3.502	8.198	0.285	0.809	1.873	10.57	8.73	6.53
50%WW×P_{20}	1.407	3.964	9.335	0.309	0.933	2.105	11.53	10.57	7.87
50%WW×P_{40}	1.423	3.958	9.330	0.320	0.930	2.112	11.37	11.33	7.93
100%WW×P_0	1.158	3.299	7.498	0.268	0.758	1.736	9.27	11.37	6.07
100%WW×P_{10}	1.278	3.628	8.398	0.291	0.826	1.937	10.89	9.27	6.77
100%WW×P_{20}	1.453	4.064	9.635	0.318	0.953	2.197	11.57	10.89	8.56
100%WW×P_{40}	1.467	4.072	9.629	0.325	0.960	2.206	11.65	11.57	8.67
C.D. at 5%	0.020	0.023	0.026	ns	0.012	0.265	0.256	0.210	0.189

Table 3
Effect of GW, 50%WW and 100%WW on seed yield (g plant^{-1}) and biomass (g plant^{-1}) of lentil (*Lens culinaris* L.) cv. DLP-15 with different levels of phosphorus.

Treatment	Seed yield plant^{-1}	Biomass plant^{-1}
GW×P_0	1.600	5.047
GW×P_{10}	1.801	5.329
GW×P_{20}	2.035	5.761
GW×P_{40}	2.031	5.770
50%WW×P_0	1.708	5.180
50%WW×P_{10}	1.915	5.599
50%WW×P_{20}	2.245	6.170
50%WW×P_{40}	2.249	6.181
100%WW×P_0	1.744	5.228
100%WW×P_{10}	1.963	5.682
100%WW×P_{20}	2.307	6.208
100%WW×P_{40}	2.313	6.212
C.D. at 5%	0.039	0.026

phorus in energy transfer, nucleic acids, cell membrane, phosphoproteins (Hewitt, 1963) and nodulation (Andrew, 1977); potassium in photosynthesis, leaf area and cofactor of may enzymes (Mengel and Kirkby, 1996) and Mg in chlorophyll and middle lamella in addition to an essential element for various enzymatic reactions.

Among the various doses of phosphorus P_{20} proved optimum being at par with higher dose, P_{40} showing luxury consumption. As wastewater contained sufficient amount of phosphorus, which could have been utilized by the plants and therefore, additional fertilizer dose of phosphorus was saved (Table 2). It may be pointed out that the presence of additional amount of nutrients like P in the soil medium has increased the root proliferation and nodulation. Phosphorus has a role in stimulation of nodulation through its effect on rhizobia. It may also be noted that legumes show an evident preference to phosphorus fertilizer (Raju and Verma, 1984) in comparison with nitrogenous fertilizers, which is generally compensated through N_2 fixation. Yield is the final manifestation of morphological and physiological traits, which depends upon various environmental factors including water and nutrients. Therefore, in the present study, 11.69% higher yield was recorded under wastewater application (Table 3) due to the increase in morphological parameters because of wastewater and phosphorus application.

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