

## RESEARCH ARTICLE

# Study of physical parameters and productivity of wheat irrigated with sewage water under IAA application

■ RAM KUMAR SAGAR<sup>1\*</sup>, CHANDRA SHEKHAR KUMAR<sup>1</sup>, ALKA SINGH<sup>2</sup> AND J.N. MAURYA<sup>1</sup>

<sup>1\*</sup>Department of Plant Science, M.J.P. Rohilkhand University, BAREILLY (U.P.) INDIA

Email: shekhar\_shiv@yahoo.co.in, dr.mauryajn@gmail.com

<sup>2</sup>Department of Botany, Bareilly College, BAREILLY (U.P.) INDIA

Email: alka1singh@yahoo.com

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## ABSTRACT

A field experiment was conducted to use the two concentrations of sewage water (50% and 100%) treated with 10 ppm and 20 ppm Indole Acetic Acid (IAA) (Auxin) concentrations for irrigating wheat (*Triticum aestivum* L.) variety PBW-343. Results showed that the application of 10ppm and 20 ppm IAA with both the sewage water (SW) concentrations stimulated the physical parameters such as plant height, number of tillers and leaf area as compared to sewage water alone and control (tap water). Parameters of productivity/yield such as number of ear/plant, grain yield, straw yield, grains/head, 1000 grain weight and harvest index induced in sewage water with IAA compared to sewage water alone (50 and 100%) and control. 20 ppm concentration of IAA resulted an increment in all these parameters compared to 10 ppm IAA. The high nutrients and organic matter contents of sewage water make it an excellent fertilizer which enhanced the crop productivity.

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\*Corresponding author :  
sagar15rk@gmail.com

## INTRODUCTION

Rapid growth of urban population results in generation of huge quantities of sewage water perennially. In India only 30 per cent of the sewage water (SW) is treated before it's discharged. Thus, untreated sewage water finds its way into water system such as rivers, lakes, ground water and coastal waters, causing serious water pollution (GOI, 2002). Sewage and industrial waste water is commonly used for irrigating agricultural fields in developing countries including India (Pandey *et al.*, 2008; Nath *et al.*, 2009).

Application of sewage water to cropland and forested lands is an attractive option for disposal because it can improve physical properties and nutrient contents of soils (Kiziloglu *et al.*, 2007). Sewage water irrigation not only provides water, N and P but also organic matter to the soils (Siebe, 1998).

Thus, its use would help in water conservation, recycling nutrients (N., P and K.) in sewage water, reducing direct fertilizer inputs and minimising pollution leads to receiving water bodies (Vasudevan *et al.*, 2010; Thapliyal *et al.*, 2009). Continuous use of sewage water leads to the enrichment of soil with essential macro and micro-nutrients (Kanan *et al.*, 2005).

Auxin *i.e.* Indole Acetic Acid (IAA) can manipulate a variety of growth and development phenomena in various crops. IAA has been found to increase the plant height, number of tillers, number of leaves per plant, fruit size with consequent enhancement in seed yield in groundnut (Lee, 1990), cotton (Kapgata *et al.*, 1989), cowpea (Khalil and Mandurah, 1989) and rice (Kaur and Singh, 1987). It also increases the flowering, fruit set, and the total dry matter of crops (Gurdev and Saxena, 1991). The study also quantified the impact of sewage water irrigation with IAA in wheat crop.

## MATERIALS AND METHODS

Wheat (*Triticum aestivum* L. cv. PBW 343) was obtained from the National seed corporation, New Delhi. Before use seeds were surface sterilized with 30 per cent sodium hypochlorite for 10 min, thoroughly washed with distilled water and placed on moist filter paper for germination. After 24 h seeds were sown in the field (0.5 cm depth) and irrigated with sewage water collected from Sanjay Nagar channel (SN Channel), Bareilly, U.P., India. Sewage water (SW) was analysed for its physical and chemical parameters (Table A) as per APHA (1998). 50 and 100 per cent concentrations of sewage water (SW) was used alongwith exogenous application of 10 and 20 ppm IAA after 25, 50, 75 and 100 days of sowing. All the treatments were conducted in triplicates and tap water was used as control. At 30, 60 and 90 days, plant height (cm), number of tillers, leaf area (cm<sup>2</sup>) and leaf area index were measured. Ears/plant, grains/head, grain yield (g/m<sup>2</sup>), straw yield (g/m<sup>2</sup>), 1000grains weight (g) and harvest index were measured at harvesting stage after irrigation with SW alone and in combination with IAA.

Table A : Characteristics of SN channel (sewage water) of Bareilly city, U.P. India	
Parameters	Sewage water
pH	8.42
EC (µs/cm)	879.0
Odour	Sewage like
Temperature	27°C
B.O.D.	80.0 mg/l
C.O.D.	440.0 mg/l
Chloride	112.0 mg/l
SO <sub>4</sub>	57.0 mg/l
PO <sub>4</sub>	12.0 mg/l
N	28.5 mg/l
P	53.2 mg/l
K	20.8 mg/l
Ca	95 mg/l
Zn	21.668 mg/l
Cu	0.315 mg/l
Pb	0.917 mg/l
Cr	ND
Fe	19.084 mg/l

### Statistical analysis :

Data were summarized as mean of replicates ± S.D. treatments were compared by two way analysis of variance (ANOVA) and the significance of mean difference within and

in between the treatments was done by Duncan's multiple range test (DMRT).

## RESULTS AND DISCUSSION

Effect of SW with and without IAA showed differential response on growth parameters of wheat at 30, 60 and 90 days of irrigation. Significant ( $p < 0.001$ ) increase in plant height, number of tillers, leaf area and leaf area index were observed at 90 days as compared to 60 and 30 days for the all respective treatments (Table 1 and 2). Growth parameters stimulated significantly ( $p < 0.001$ ) in 100% SW followed by 50% SW alone or in combination with IAA compared to control (Tap water). James (1971) in his experiments concluded that pH= 7-9 is fit for irrigation and the concentrations of N, P, K and many macro and micronutrients of SW supported the growth of wheat crops compared to tap water. Our findings of increase in growth parameters of wheat irrigated with SW compared to control were also suggested by Lone and Rizwan (1997). Marginal increase in plant height and leaf area index was accounted in 100% SW+20 ppm IAA compared to 100% SW+10 ppm IAA. Similar finding was also evident in 50% SW+20 ppm IAA at 30, 60 and 90 days of irrigation. IAA has been found to increase the plant height, number of leaves per plant, fruit size with consequent enhancement in seed yield in groundnut (Lee, 1990), cowpea (Khalil and Mandurah, 1989) and rice (Kaur and Singh, 1987). Application of IAA also had stimulatory effect on plant height over control in soybean (Sarkar *et al.*, 2002). IAA induced higher number of branches/plant was also reported by Chhipa and Lal (1988).

Several parameters of productivity were also examined in wheat irrigated with SW alone and in combination with IAA (Table 3). Gradual increase in ears/plant, grains/head, grain yield, straw yield, 1000 grains weight and harvest index were accounted in wheat irrigated with SW compared to control at harvesting stage. Similar findings were also reported by Day *et al.* (1979) who observed that irrigation with SW produced taller plants, more heads/unit area, heavier seeds, and higher grain yield than wheat grown under tap water. They attributed this increase to the N, P, K and other nutrient elements contained in SW.

Noticeably, application of IAA also stimulated the productivity parameters as compared to SW alone. Saha *et al.* (1996) reported that 300, 600 and 900 ppm IAA applied at the beginning of the tillering stage in wheat increased ear, spikelet and grain length. It has been also reported by several authors that application of IAA resulted in increase in flowering, the total dry matter of crops (Gurdev and Saxena, 1991), increase dry matter accumulation (Hore *et al.*, 1988) and enhance total yield (Maske *et al.*, 1998). Slight increase in productivity parameters was evident significantly ( $p < 0.001$ ) in 100% SW compared to 50% SW. 20 ppm IAA with SW

**Table 1 : Effect of SN channel sewage water irrigation with and without auxin (IAA) on growth parameters of wheat at three different days**

Parameters	Treatments	Day 30	Day 60	Day 90
Plant height cm	T <sub>0</sub>	22.41±1.27	56.37±0.71 <sup>a</sup>	91.07±0.12 <sup>ab</sup>
	T <sub>1</sub>	29.60 ±0.40 ***	57.07±0.21 <sup>a</sup>	96.10±2.34 <sup>ab***</sup>
	T <sub>2</sub>	29.73±0.25***	57.60±0.79 <sup>a</sup>	96.67±0.47 <sup>ab***</sup>
	T <sub>3</sub>	30.17±0.51***	60.00±0.20 <sup>a***</sup>	99.80±0.20 <sup>ab***</sup>
	T <sub>4</sub>	31.03±0.38***	60.87±0.15 <sup>a***</sup>	100.77±0.75 <sup>ab***</sup>
	T <sub>5</sub>	32.03±0.15***	61.20±0.36 <sup>a***</sup>	101.47±0.58 <sup>ab***</sup>
	T <sub>6</sub>	32.37±0.23***	62.00±0.20 <sup>a***</sup>	101.93±0.70 <sup>ab***</sup>
No. of tillers	T <sub>0</sub>	2.00±0.00	4.00±0.00 <sup>a</sup>	4.67±0.58 <sup>a</sup>
	T <sub>1</sub>	3.00±0.00*	6.67±0.58 <sup>a***</sup>	7.00±0.00 <sup>a***</sup>
	T <sub>2</sub>	3.67±0.00*	7.00±0.00 <sup>a***</sup>	7.33±0.58 <sup>***</sup>
	T <sub>3</sub>	3.67±0.58***	7.33±0.58 <sup>a***</sup>	8.00±1.00 <sup>a***</sup>
	T <sub>4</sub>	4.00±0.58***	7.67±0.58 <sup>a***</sup>	8.33±0.58 <sup>a***</sup>
	T <sub>5</sub>	4.33±0.00***	7.67±0.58 <sup>a***</sup>	8.67±0.58 <sup>ab***</sup>
	T <sub>6</sub>	4.33±0.58***	8.33±0.58 <sup>a***</sup>	9.00±0.00 <sup>a***</sup>

Values are means of replicates ± S.D., T<sub>0</sub>: Control, T<sub>1</sub>: 50% SW, T<sub>2</sub>: 100% SW, T<sub>3</sub>: 50% SW+10 ppm IAA, T<sub>4</sub>: 50% SW+20 ppm IAA, T<sub>5</sub>: 100%SW+10 ppm, IAA and T<sub>6</sub>: 100% SW+20 ppm IAA. Between treatments: \*p<0.05, \*\*p<0.01, \*\*\*p<0.001- as compared to T<sub>0</sub> Between days: <sup>a/b</sup>p<0.05 or <sup>a/b</sup>p<0.01 or <sup>a/b</sup>p<0.001- as compared to day 30 day 60.

**Table 2 : Effect of SN channel sewage water irrigation with and without auxin (IAA) on growth parameters of wheat at three different days**

Parameters	Treatments	Day 30	Day 60	Day 90
Leaf area (cm <sup>2</sup> )	T <sub>0</sub>	4.53±0.51	34.40±0.06 <sup>a</sup>	44.61±0.24 <sup>ab</sup>
	T <sub>1</sub>	6.33 ±0.01 ***	41.00±0.11 <sup>a***</sup>	45.45±0.09 <sup>ab*</sup>
	T <sub>2</sub>	6.34±0.01***	44.80±1.37 <sup>a***</sup>	46.61±0.06 <sup>ab***</sup>
	T <sub>3</sub>	6.39±0.01***	45.58±0.12 <sup>a***</sup>	52.33±0.40 <sup>ab***</sup>
	T <sub>4</sub>	6.44±0.01***	45.98±0.60 <sup>a***</sup>	53.09±0.36 <sup>ab***</sup>
	T <sub>5</sub>	6.55±0.00***	46.13±0.43 <sup>a***</sup>	53.29±0.48 <sup>ab***</sup>
	T <sub>6</sub>	6.55±0.05***	47.09±0.65 <sup>a***</sup>	54.24±0.63 <sup>ab***</sup>
Leaf area index	T <sub>0</sub>	0.45±0.05	3.44±0.01 <sup>a</sup>	4.46±0.02 <sup>ab</sup>
	T <sub>1</sub>	0.63±0.00***	4.10±0.01 <sup>a***</sup>	4.55±0.01 <sup>ab*</sup>
	T <sub>2</sub>	0.63±0.00***	4.48 ±0.14 <sup>a***</sup>	4.66±0.01 <sup>ab***</sup>
	T <sub>3</sub>	0.64±0.00***	4.56±0.01 <sup>a***</sup>	5.23±0.04 <sup>ab***</sup>
	T <sub>4</sub>	0.65±0.01***	4.60±0.06 <sup>a***</sup>	5.31±0.04 <sup>ab***</sup>
	T <sub>5</sub>	0.65±0.00***	4.61±0.04 <sup>a***</sup>	5.33±0.05 <sup>ab***</sup>
	T <sub>6</sub>	0.66±0.01***	4.71±0.06 <sup>a***</sup>	5.42±0.06 <sup>ab***</sup>

Values are means of replicates ± S.D., T<sub>0</sub>: Control, T<sub>1</sub>: 50% SW, T<sub>2</sub>: 100% SW, T<sub>3</sub>: 50% SW+10 ppm IAA, T<sub>4</sub>: 50% SW+20 ppm IAA, T<sub>5</sub>: 100%SW+10 ppm, IAA and T<sub>6</sub>: 100% SW+20 ppm IAA. Between treatments: \*p<0.05, \*\*p<0.01, \*\*\*p<0.001- as compared to T<sub>0</sub> Between days: <sup>a/b</sup>p<0.05 or <sup>a/b</sup>p<0.01 or <sup>a/b</sup>p<0.001- as compared to day 30 day 60.

**Table 3: Effect of SN channel sewage water irrigation with and without auxin (IAA) on productivity of wheat at harvesting stage**

Treatments	Ears/ plant	Grains/ head	Grain yield (g/m <sup>2</sup> )	Straw yield (g/m <sup>2</sup> )	1000 grains wt. (g)	Harvest index
T <sub>0</sub>	51.00±1.00	39.00±1.00	340.49±0.58	710.10±0.30	36.39±1.10	32.41±0.04
T <sub>1</sub>	56.00 ±1.00 ***	43.67 ±0.58 ***	504.65 ±1.64 ***	960.72±1.20***	41.74±0.54***	34.43 ±0.10 ***
T <sub>2</sub>	56.33±0.58***	44.33±0.58***	513.53±0.41***	964.63±0.89***	42.32±0.40***	34.69±0.08***
T <sub>3</sub>	62.33±2.08***	44.33±0.058***	521.66±0.88***	964.31±0.57***	42.69±0.39***	35.10±0.03***
T <sub>4</sub>	64.67±0.58***	44.67±0.58***	535.52±2.17***	970.29±0.73***	42.95±0.25***	35.56±0.10***
T <sub>5</sub>	65.00±1.00***	44.67±0.58***	598.28±1.97***	974.85±0.46***	43.37±0.34***	38.03±0.07***
T <sub>6</sub>	65.33±0.58***	44.67±0.58***	601.54±2.02***	975.79±0.67***	44.16±0.10	38.13±0.07***
ANOVA F (4,20 DF)	80.24***	29.93***	9569.14***	52041.35***	68.74***	2340.75***

Values are means of replicates ± S.D., T<sub>0</sub>: Control, T<sub>1</sub>: 50% SW, T<sub>2</sub>: 100% SW, T<sub>3</sub>: 50% SW+10 ppm IAA, T<sub>4</sub>: 50% SW+20 ppm IAA, T<sub>5</sub>: 100%SW+10 ppm, IAA and T<sub>6</sub>: 100% SW+20 ppm IAA.\*\*\*p<0.001- as compared to T<sub>0</sub>

resulted an increase in the productivity parameters of wheat compared to 10 ppm IAA with SW of SN channel at harvesting stage. However, the growth regulators had highly significant effect on the number of pods/plant. It is interesting to note that the lower concentrations (100 ppm) of IAA increased the number of pods better than the higher concentrations (200 ppm) as reported by Sarkar *et al.*(2002). Our results also supported with the findings of Reena *et al.*(1999) who reported that 100 ppm IAA increased the seed yield in rice, sesame and soybean respectively.

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