International Journal of Agricultural Sciences
Volume **10** | Issue 1| January, 2014 | 70-74

RESEARCH PAPER

Effect of paddy straw and paper mill effluent on growth attributes and yield of wheat

SUSHIL KUMAR SHARMA* AND SHAYAM DAS
Krishi Vigyan Kendra, Samoda-Ganwada, PATAN (GUJARAT) INDIA
(Email : sushil4sharma@gmail.com)

Abstract : A field experiment was conducted on the field of progressive farmer at Nalhera village district Saharanpur, Uttar Pradesh from *Rabi* 2006-07 and 2007-08 to study the effect of paddy straw and paper mill effluent on growth and yield attributes of wheat rhizosphere. The experiment was carried out in RBD with 12 treatments and three replications. In the study different levels of NPK were mixed with various proportions of diluted paper mill effluent and fixed amount of 5 ton paddy straw. During the study of growth and yield attributes it was obsereved that application of 100 % recommended NPK + 5 ton paddy straw recorded 10.0 and 10.3 no. of tillers in 2006-07 and 2007-08 which were at par with 150% NPK and 100% NPK treatments. Differences among treatments for effective numbers of tillers per square meter were highly significant in both the years. The minimum no. of tilleres was obsereved in the application of 75% recommended dose of NPK+100% PME. The highest plant hight was recorded with application of 150% recommended dose of NPK was75.6 and 75.0 cm in both the year application of chemical fertilizers and with paddy straw give significantly higher plant height. The result revealed that maximum average plant dry weight and length of ears were observed that application of 150 % recommended NPK was 21.39, 21.94 g 9.30 and 10.20 cm per plant in both the years, respectively. The data on grains per ear envisage the differences in treatment highly significant during both the crop seasons. The result show that NPK alone 150% and 100% application with paddy straw were significantly different in all the growth attributes *viz*., plant height, plant dry weight, no. of tillers, ear length etc. compared with application of paper mill effluent in irrigation.

Key Words : Paddy straw, Paper mill effluent, Growth attributes, Yield attributes

View Point Article : Sharma, Sushil Kumar and Das, Shayam (2014). Effect of paddy straw and paper mill effluent on growth attributes and yield of wheat. *Internat. J. agric. Sci.*, **10** (1): 70-74.

Article History : Received : 20.01.2013**; Revised :** 14.09.2013**; Accepted :** 10.10.2013

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the world's most widely cultivated food crop. It is consumed in various forms by large population all over the world. The production of wheat was 85.93 mt in India from 29.25 million ha area during 2010-11 (Agricultural statistics at a glance, 2011). Crop residues form considerable part of the dry matter after harvest of grain crops. The crop residues played a key role in improving and maintaining soil productivity in the area, where mechanical harvesting is practiced. The appreciable quantity of residue that left over in the field under such conditions is generally burnt *in situ* by farmers resulting into the loss of vegetable organic matter and nutrients particularly nitrogen and sulphur. The incorporation of crop residue is supposed to improve physical, chemical and biological properties. Therefore, to accelerate the decomposition of crop residues, certain organic and inorganic supplements like FYM, rock phosphate, urea as starter dose, gypsum etc. are applied along with crop residues.

Practically major portion of effluents emanating from various pulp and paper industries in our country is being discharged into various rivers. The land application of waste water is a preferred alternative for its disposal since; soil is believed to have a capacity for receiving and decomposing waste and pollutants. The heavy metals like mercury, calcium and lead are present in pulp and paper mill effluent as reported by Achari *et al.* (1999) and which pose serious hazard to

*** Author for correspondence**

aquatic as well as soil flora and fauna Lignin and cellulose, two of the most abundant organic compounds present in pulp and paper mill effluents are most difficult for biodegradation. The exposure of seeds of rice to paper mill effluent retarded the growth of rice seedlings. The adverse effect was more pronounced where a higher concentration (value) of effluent was used reported by Mishra and Behera (1991). Inhibitions of seed germination at higher concentration of effluent may be due to high level of dissolved solids which enriched the salinity and increased conductivity of absorbed solute by seed before germination.

Singh (1992) reported that an increase in plant height from CRI to milk stage, after which a slight decrease in height was recorded. The leaf chlorophyll content of wheat decreased with increasing concentration of paper mill effluent (Chaturvedi *et al.*, 1995). Diluted paper mill effluent increased the plant height, shoot and root biomass, grain yield of wheat while undiluted effluent caused inhibition in plant growth resulting in sharp decline of yield observed by Singh *et al.* (2002). Therefore, in order to evaluate the effect of integrated use of paddy straw, paper mill effluent and N, P, K the present investigation was undertaken at Nalhera, Saharanpur in 2006-07 and 2007-08, respectively.

MATERIAL AND METHODS

The experiment was conducted during 2006-07 and 2007-08 at progressive farmers' field at Nalhera Gurjar, Distt Saharanpur. The experiment was laid out in randomized block design with 12 treatments and three replications. Wheat variety PBW 343 was used in the experiment and was sown using a seed rate of 100 kg/ha. The details of treatment combinations are given in Table A. In the study different levels of recommended doses of NPK fertilizers were mixed with various dilutions of paper mill effluent (PME) and fixed amount of 5 ton paddy (PS) straw. The PME and PS were analysed for their composition following the standard methods of analysis. The composition of PME and PS is given in the Table B and Table C, respectively. For analysis of nitrogen in effluent, about 50 ml effluent was taken in distillation flask. 20 ml of boric acid solution with mixed indicator was taken in 150 ml conical flask and was put beneath the condenser. 10 ml of NaOH (10 M) was added in distillation flask. The flask was stopped and ammonia was distilled in to boric acid solution till the distillate was about 30-35 ml. The distillate was titrated with 0.02 N H_2SO_4 until the colour changed to pink. Simultaneously a blank sample was also run with same procedure except effluent. The content of N (mg/l) was calculated using the following formula:

Table A : Details of treatment combinations

T_1	100% N.P.K.
T_2	100% N.P.K. + 5 ton PS
T_3	100% N.P.K. + 100% PME
T_4	100% N.P.K. + 5 ton PS + 50% PME
T_5	100% N.P.K. + 5 ton PS + 75% PME
T_6	100% N.P.K. + 5 ton PS + 100% PME
T_7	75% N.P.K. + 5 ton PS
T_8	75% N.P.K. + 100% PME
T_9	75% N.P.K. + 5 ton PS + 50% PME
T_{10}	75% N.P.K. + 5 ton PS + 75% PME
T_{11}	75% N.P.K. + 5 ton PS + 100% PME
T_{12}	150% N.P.K.

where

PS = Paddy straw

PME = Paper mill effluent

Table B : Properties of paper mill effluent of star paper mill Saharanpur

Sr. No.	Characters	Value
1.	pH	7.68
2.	Ec	0.97 dsm^{-1}
3.	Carbonate	28.7 (mg/L)
4.	Bicarbonates	334.6 (mg/L)
5.	Organic carbon	1.53%
6.	Nitrogen	20.0 (mg/L)
7.	Phosphorus	21.4 (mg/L)
8.	Potassium	135.4 (mg/L)

Table C : Chemical composition of paddy straw

Property	Value
Carbon%	45.9
Nitrogen%	0.68
Phosphorus%	0.08
Potassium%	1.91
Lignin%	8.72
Cellulose%	2.41
C:N ratio	67.5

$$\mathbf{NH_3 - N\ (mgl^{-1}) = \frac{(A - B) \times 280}{ML\ sample}}$$

where,

A = Volume of H_2SO_4 used for sample (ml)

B = Volume of H_2SO_4 used for blank (ml).

Phosphorus was determined by ascorbic acid method (Murphy and Riley, 1962). 10 ml effluent sample was pipetted in 50 mL volumetric flask. Then 10 ml of reagent B was added. The volume was made upto 50 ml. A series of standard solutions of 0, 2, 4, 6, 8 and 10 ppm P were prepared. The blue colour was developed within 30 minutes. Then transmittance of the colour was measured at 660 nm wave length. Standard curve was prepared by plotting the per cent transmittance (T) against concentration of P in standard solutions and P concentration of the effluent corresponding

to its per cent T value was read from the graph.

$$P\ (mg\ L^{-1}) = \frac{\text{Quantity of P in sample (mg)}}{\text{Volume of sample (mL)}} \times 1000$$

Potassium concentration in sample was also determined by flame photometric method exactly in the same manner as sodium except that the working standard solutions of much lower concentrations *i.e.* 0, 2, 4, 6, 8, 10 and 20 mg KL^{-1} were prepared from stock solution of 100 mg KL^{-1}, which was prepared by dissolving 0.1908 g of dried KCl (AR grade) salt in distilled water, the volume was made up to one litre.

For analysis of carbonates and bicarbonates in effluent, 5 ml effluent was taken into a 100 ml conical flask and about 20 mL of distilled water was added. Then 2 drops of phenolphthalein indicator were added and it was titrated against 0.01 N H_2SO_4. The volume of acid consumed was recorded as 'A'. Two drops of methyl orange indicator were added to colourless contents in the conical flask (left after titration), which gave yellow colour. The titration was performed against 0.01 N H_2SO_4 till the yellow colour change to red. The volume of acid consumed was recorded as 'B'.

Carbonates (me L^{-1}) = 4 A

where,

A = Volume of 0.01 $\underline{N}$ H_2SO_4 consumed in first titration

Bicarbonates (meL^{1}) = 2 (B-A)

where,

B = Volume of 0.01 $\underline{N}$ H_2SO_4 consumed in second titration.

The growth and yield attributes data collected in fields under this investigation were as follows :

At maturity, the plant height from the soil surface to the apex of plant was measured in centimeter in each treatments and replication for 2006-07 and 2007-08.

Number of effective tillers per plant were counted by counting spikes per plant in each treatment and replication for both years of 2006-07 and 2007-08, respectively.

After harvesting in both years one plant taken of each treatment and replication and oven dried and was taken weight in g per plant.

The length of ear was measured after detaching them from plant after harvesting, with scale in centimeter.

The spikes were threshed and cleaned for counting number of grains per spike.

The weight of grains was recorded by taking their weight on balance with digital display.

For thousand grain weight, 100 grains were counted and weighed, and recorded weight was multiplied by 10 *i.e.*

1000 grain weight (g) = Weight of 100 grains (g) x 10

The results of this investigation with the addition of treatments were described in the Results and Discussion section of the manuscript.

RESULTS AND DISCUSSION

The plant growth parameters *viz*., effective number of tillers, plant heights and plant dry weight were observed and the data pertaining to the effect of treatments are presented in Table 1.

From Table 1, it was observed that highest number of tillers was observed in T_{12} treatment (150% NPK) 11.00 in 2006-07 and 11.3 in 2007-08 followed by T_1 (100% NPK), 10.5 and 10.7 in 2006-07 and 2007-08, respectively. The

Table 1 : Effect of different treatments on growth attributes (effective no. of tillers, plant height and plant dry weight) at maturity

Treatments	Growth attributes					
	No. of tillers/m^2		Plant height(cm)		Plant dry wt. (g)	
	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
T_1 = 100% NPK	10.5	10.7	74.8	73.1	20.37	20.85
T_2 = 100% NPK + 5 Ton PS	10.0	10.3	74.0	72.0	20.84	21.44
T_3 = 100% NPK + 100% PME	8.4	8.7	72.0	71.0	18.39	18.96
T_4 = 100% NPK + 5 Ton PS + 50% PME	9.5	9.8	72.0	69.5	19.42	19.94
T_5 = 100% NPK + 5 Ton PS + 75% PME	9.0	9.3	71.6	70.5	19.10	19.65
T_6 = 100% NPK + 5 Ton PS + 100% PME	8.5	8.7	70.5	68.8	18.70	19.55
T_7 = 75% NPK + 5 Ton PS	7.8	7.9	68.5	67.2	17.64	18.54
T_8 = 75% NPK + 100% PME	6.5	6.8	62.0	60.2	16.14	16.58
T_9 = 75% NPK + 5 Ton PS + 50% PME	7.3	7.5	67.5	65.6	17.06	18.21
T_{10} = 75% NPK + 5 Ton PS + 75% PME	7.1	7.4	64.2	63.8	16.57	17.07
T_{11} = 75% NPK + 5 Ton PS + 100% PME	6.9	7.3	63.0	62.0	15.40	17.52
T_{12} = 150% NPK	11.0	11.3	75.6	75.0	21.39	21.94
F Value	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
C.D. (P=0.01)	0.727	0.475	0.667	2.531	3.869	3.259
CV	3.701	2.343	0.416	1.612	9.127	7.380

results showed that T_2 (100% NPK + 5 Ton PS) also gave similar results, this treatment was 10.0 and 10.3 no. of tillers per square meter for 2006-07 and 2007-08, respectively. The data show the differences among treatments for effective numbers of tillers per square meter were highly significant during both years. The minimum number of tillers was recorded in treatment T_8 6.5 and 6.8 per square meter, followed by T_{11} (75% NPK + 5 Ton PS + 100% PME) 6.9 and 7.3 per square meter, respectively.

The plant height in different treatments was recorded in both years highly significant. The data revealed that treatment T_{12} (150% NPK) significantly had highest plant height in both years, being 75.6 and 75.0 cm, respectively. The significant plant height in treatment T_1 (100% NPK) was followed with 74.8and 73.1 cm, during 2006-07 and 2007-08, respectively. The minimum length of plant was observed in T_8 (75% NPK + 100% PME) 62.0 and 60.2 cm, followed by T_{11} (75% NPK + 5 Ton PS + 100% PME) with 63.0 and 62.0 cm during both years. The application of only chemical fertilizers and paddy straw *i.e.* T_{12}, T_1, T_2 gave significantly higher plant height as compared to application of 100% PME *i.e.* T_8, T_{11}. The only T_3 (100% NPK + 100% PME) recorded significantly higher plant height 72.0 and 71.0 cm, for 2006-07 and 2007-08, respectively.

Average plant dry weight per plant recorded in different treatments during experiment are shown in Table 1. From table it is revealed that the maximum average dry weight plant $^{-1}$ 21.39 g and 21.94 plant^{-1} in T_{12} (150%NPK) in both the years followed by T_2 (100% NPK+5 ton PS) 20.84 and 21.44 g plant^{1} and T_1 (100%NPK) 20.37 and 20.85 g. The maximum plant dry weight per plant was observed in T_8 (75 % NPK + 100 % PME) 16.14 and 16.58g plant^{-1} in 2006-07 and 2007-08, respectively. It was also observed that treatments T_{12},T_1,T_2,T_3,T_4,T_5,T_6 and T_7 recorded at par and significantly differed from T_8,T_9,T_{10} and T_{11} in both the years. Maskina *et al.* (1987) also noted increase in plant height, numbers of tillers per unit area when they incorporated rice residue in plots over residue burning. Removal beneficial effect of residue incorporation on plant height, numbers of tillers of rice and wheat were also recorded by Meelu *et al.* (1994). However, the decrease in plant height, number of tiller per square meter and plant dry weight in present investigation recorded to decrease as concentration of paper mill effluent increased in all treatments. Singh (1992) recorded the decrease in plant height when effluent concentration increased. The maximum and minimum height after harvesting was recorded at 25 per cent and 100 per cent effluent concentration. Mishra and Sahoo (1989) also stated that 44% reduction in shoot weight of rice in 100% paper mill waste treated soil. While, Singh *et al.* (2002) reported that diluted paper mill effluent increased chlorophyll content, plant height shoot and root biomass, while undiluted effluent caused inhabitation in plant growth.

The yield attributing characters were observed and the results pertaining to effect of treatments are presented in Table 2.

The maximum length of ears was achieved in T_{12} (150% NPK) being 9.30 and 10.20 cm in 2006-07 and 2007-08, respectively. However it was also found that T_1 (100% NPK) and T_2 (100% NPK + 5 Ton paddy straw was significantly at par with T_8 (75% NPK + 100% PME), T_{11} (75% NPK + 5 ton PS + 100% PME) and T_{10} (75% NPK + 5 Ton PS + 75% PME) in both crop season. The data revealed that irrigation with paper mill effluent affected the ear length in both years

Table 2 : Effect of different treatments on yield attributing (ear length, grain/ear, grain weight /ear and thousand grain weight) parameters

Treatments	Yield attributing parameters							
	Ear length (cm)		Grain /Ear		Grain wt./Ear		Thousand grain wt.	
	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08	2006-07	2007-08
T_1 = 100% NPK	9.09	9.80	42	45	1.71	1.81	51.2	53.4
T_2 = 100% NPK + 5 Ton PS	8.90	9.40	41	43	1.65	1.71	48.4	48.5
T_3 = 100% NPK + 100% PME	7.60	8.30	33	34	1.31	1.41	35.0	35.4
T_4 = 100% NPK + 5 Ton PS + 50% PME	8.59	8.06	39	40	1.58	1.67	40.8	44.0
T_5 = 100% NPK + 5 Ton PS + 75% PME	8.20	8.59	38	38	1.42	1.51	43.60	41.3
T_6 = 100% NPK + 5 Ton PS + 100% PME	8.00	8.30	34	35	1.40	1.50	37.2	37.5
T_7 = 75% NPK + 5 Ton PS	7.20	7.60	35	32	1.21	1.41	33.3	33.8
T_8 = 75% NPK + 100% PME	6.19	6.40	26	25	0.80	0.91	21.7	20.0
T_9 = 75% NPK + 5 Ton PS + 50% PME	7.00	7.30	30	30	1.11	1.21	30.9	31.2
T_{10} = 75% NPK + 5 Ton PS + 75% PME	6.86	7.00	28	28	0.92	1.11	28.4	29.0
T_{11} = 75% NPK + 5 Ton PS + 100% PME	6.50	6.90	27	27	0.81	0.84	25.6	22.0
T_{12} = 150% NPK	9.30	10.20	44	46	1.78	1.81	55.6	56.2
F Value	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.	Sig.
C.D. (P=0.01)	0.37	0.44	0.5177	1.201	0.387	0.325	0.72	0.85
CV	2.09	2.35	6.473	1.481	12.863	10.025	0.84	0.98

with treatments *viz*., T_8, T_{11}, T_{10}, T_3 etc. while using paddy straw with paper mill effluent increased the length of ear in T_4, T_5. The minimum length of ear was recorded with T_8 6.19 and 6.40 cm followed T_{11} 6.50 and 6.90 cm for both years, respectively. The effect of treatments showed highly significant results.

The data for grains ear^{-1} envisage that the differences in treatments were highly significant during both crop seasons. Significantly highest grains/ear were obtained under the treatment T_{12} (150% NPK) followed by T_1 and T_2 was 44 and 46, 42 and 45 and 41 and 43 during both crop seasons of year 2006-07 and 2007-08, respectively. The minimum grains were observed in treatment T_8 (26 and 25) for 2006-07 and 2007-2008, respectively. The results showed that once again 150% NPK and 100% NPK application and with paddy straw produced high grains per ear compared to application of paper mill effluent in irrigation.

Effect of treatments on grains weight per ear in wheat

The grain weight/ear was significantly highest under T_{12} (1.78 and 1.91 g) followed by T_1 (1.71 and 1.81 g) for the year 2006-07, respectively for year 2007-08. The minimum grain weight/ear was recorded in T_8 and T_{11}.

Effect on different treatments on thousand grain weight:

It is clear from Table 5 that the variation among the treatments for thousand grain weight was significant during both crop season of 2006-07 and 2007-08. Significantly highest under T_{12} (150% NPK) during both the years with 55.6 and 56.2 gm. The next best performance in order of preference were T_1, T_2, T_5 and T_4 during 2006-07 and T_1, T_2, T_5 and T_4 during 2007-08. Significantly lowest thousand grain weight was recorded under the treatment T_8 where 100% paper mill effluent (PME) with 75% NPK was applied during both years. The result presented below showed that all the yield attributing parameters *viz*., ear length, grain/ear ,grain wt,/ear and thousand grain wt were observed highest in the treatment number T_{12} followed by T_1 and T_2. As the concentration of paper mill effluent increases all the parameters were observed to decrease. The treatment contains only crop residue with fertilizer showed better results over the treatments include paper mill effluent and its increased concentration. Alam *et al.* (1994) reported that the incorporation of rice residue @ 5.0 t ha^{1} along with recommended dose of NPK had increased the number of spikes per unit area, number of grains per spike, test weight. Beneficial effects of residue incorporation on yield attributing characteristics was also reported by Meelu *et al.* (1994). Singh and Singh (2005) in a pot experiment with five effluent levels *viz*., 0, 25. 50, 75 and 100% with four replications on maize reported concentration of paper mill increase biomass content decreases.

Conclusion:

Based on the results obtained during investigation it may be concluded that the addition of crop residues had positive effects on plant growth attributes (*i.e*. number of tillers, plant height and plant dry weight), yield attributes (*viz*., ear length, grains per ear, grain weight per ear and thousand grain weight) when it was used with recommended doses of fertilizers and diluted doses of paper mill effluent. But when the fertilizers doses decreased and concentration of paper mill effluent increased it had adverse effect plant growth and yield attributes.

REFERENCES

Achari, Matli Srinivas; Dhakshinamoorthy, M. and Arunachalam, G. (1999). Studies on the influence of paper mill effluents on the yield, availability and uptake of nutrients in rice. *J. Indian Soc. Soil Sci.,* **47** (2) : 276-280.

Alam, M.P., Singh, R.S. and Prasad, E. (1994). Integrated nutrient management in rice-wheat cropping system. *J. Res. Birsa Agric. Univ.,* **6**(2) : 165-166.

Chaturvedi, C. Zaidi, P.H. and Agarwal, S.R. (1995). Effect of industrial effluent and ageing on the chlorpphyll content of wheat plants. *J. Rec. Adv. Sci.,* **10** (1/2) : 65-69.

Maskina, M.S., Singh, Y. and Singh, B. (1987). Wheat straw management for rice on coarse textured soil. *Internat. Rice Res. Newsl.,* **12**(2): 40.

Meelu, O.P., Singh, B. and Singh, Y. (1994). Effect of green manure and crop residue recycling on N economy, organic matter and physical properties of rice-wheat system in India, 7-8 May, 1994, CCS HAU, *Regional Res. Station,* Karnal, 91-76.

Mishra, K. and Sahoo, S. (1989). Agro-potentiality of paper waste water. In : *Soil pollution and soil organism.* Ed. P.C. Mishra, Ashish Publishing House, New Delhi, INDIA.

Mishra, R.N. and Behera, P.K. (1991). The effect of paper industry effluent on growth pigment, carbohydrate and protein of rice seedlings. *Environ. Pollution*, **72** (2):159-168.

Singh, A.P. and Singh, Room (2005). Effect of paper mill effluent on soil properties and performance haracteristics and effects of some industrial effluent on wheat crop. Thesis, G. B. Pant University of Agriculture and Technology, Pantnagar, Nainital, U.P.

Singh, Anoop, Agrawal, S.B., Rai, J.P.N., Singh, Pratibha, Singh, A. and Singh, P. (2002). Assessment of the pulp and paper mill effluent on growth, yield and nutrient quality of wheat (*Triticum aestivum* L.). *J. Environ. Biol.,* **23**(3) : 283-288.

Singh, B.K. (1992). Characteristics and effects of some industrial effluent on wheat crop. Thesis, G.B. Pant University of Agriculture and Technology, Pantnagar, UTTARAKHAND (INDIA).