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Seed imbibed effect of sugarcane industrial effluent on germination percentage and seedling growth of millets (*Pennisetum typhoides* cv. ICTP-8203 and *Sorghum vulgare* cv. CSH-14)

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SUMMARY

The effect of various concentration of sugarcane industrial effluent on seed germination and seedling growth of *Pennisetum typhoides* cv. ICTP-8203 and *Sorghum vulgare* cv. CSH-14 is presented.The results shows that there is significant increase and decrease in the lower and higher concentration of effluent.In the present findings lower doses of the effluent show promontory effects where as higher doses show inhibitory effects on seed germination and seedling growth.

Key words : Sugarcane industrial effluent ,Germination, Seedling growth, *Pennisetum typhoides*, *Sorghum vulgare*

Western U.P. is considered as "Bowl of sugar" and here sugarcane crop is known as "Cash crop".Largest number of sugar mills are established in this region.One hand, this bring prosperity among farmers and on other hand, this creates drastic change in chemical and physical nature of air soil and water. The physico-chemical characteristics of sugar mill effluent,denoted the high magnitude of pollution load (Arindam kumar 1996) and suggested the study of toxic effect of effluent on the biological system. Hari *et al.* (1994) studied the combined effect of waste of distillery and sugar mill on seed germination, seedling growth and biomass of Okra *Abelmoschus esculentus* (L). Goel and Kulkarni (1994) studied the effect of sugar factory waste on germination of gram seed (*Cicer arietinum* L.) Kumar Rajesh (1995) noted the effct of sugar mill effluent on seed germination and sedling growth of *Cicer arietinum* cv.NP 58. To understand the effect of sugar mill effluent, seeds of *Pennisetum typhoides* cv.ICTP-8203 and *Sorghum vulgare* cv.CSH-14 were treated with different concentrations (from 10% to 100%) of sugarcane industrial effluent and such treatment was studied on seed germination and sedling growth.

MATERIALS AND METHODS

The seeds of uniform size, shape, colour and weight of *Pennisetum typhoides* cv.ICTP-8203 and *Sorghum vulgare* cv. CSH-14 as far as possible were selected, surface sterilized with 0.1% $HgCl_2$ solution, thoroughly washed with distilled water and kept in solutions of different concentrations (from 10% to 100%) of sugarcane industrial effluent separately for imbibition period. Seeds simultaneously kept in distilled water constituted the control. After requisite imbition they were transferred to petridishes having distilled water moistened filter paper and kept for germination and subsequent seedling growth at 25± 3^0C in dark.

Germination was assessed by radicle emergence (2-3 mm) and the per cent germination in each case was recorded. For dose response relationhips, seedling growth was studied at a particular day (*i.e.* 5th day) of germination by dissecting the seedling into various parts and subjecting to measurement of their length, fresh weight and dry weight.

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RESULTS AND DISCUSSION

Table 1 and Fig. (1) and (1a), (1b) and (1c), shows that lower doses of effluent show promotion in germination while higher dose show inhibition in *Pennisetum typhoides* cv.ICTP-8203. Doses from 10% to 50% show promotory effects on seedling growth. Dose 20% show maximum promotion, because in this dose, length of radicle and coleoptile is 530% and 268 %, fresh wt. of radicle, coleoptile and rasidual cotyledon is 170%, 157% and 66% and dry wt. of radicle, coleoptile and rasidual cotyledon is 166%, 300% and 65% of control respectively. On the other hand doses from 60% to 100% show inhibitory effects. Dose 60% show maximum inhibition, because in this dose, length of radicle and coleoptile is 166% and 63%, fresh wt. of radicle, coleoptile and rasidual cotyledon is 135%, 61% and 93 % and dry wt. of radicle, coleoptile and rasidual cotyledon is 50%, 57% and 117% of control

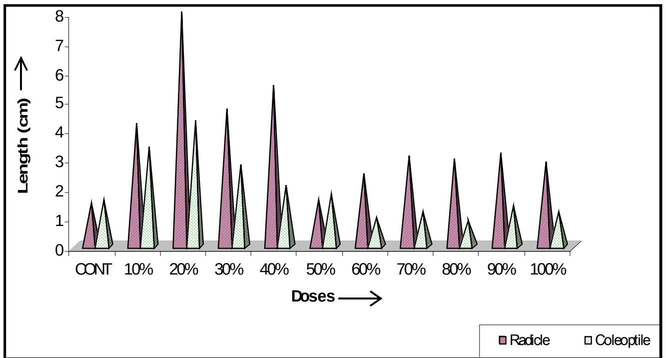

Fig. 1 (a): **Seed imbibed effect of sugarcane industrial effluent on length of radicle and coleoptile of *Pennisetum typhoides* cv. ICTP-8203**

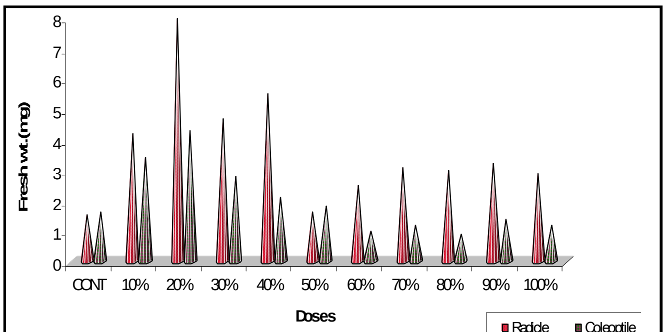

Fig. 1 (b): **Seed imbibed effect of sugarcane industrial effluent on fresh wt. of radicle and coleoptile of Pennisetum typhoides cv. ICTP-8203**

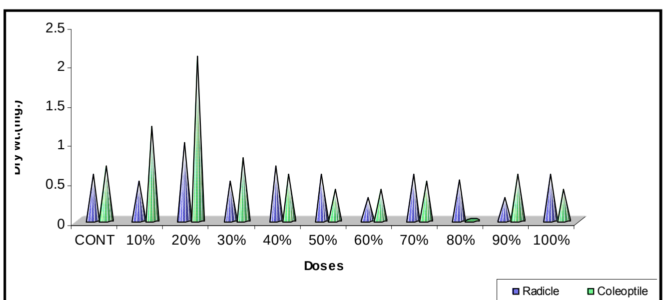

Fig. 1 (c): **Seed imbibed effect of sugarcane industrial effluent on dry wt.of radicle and coleoptile of Pennisetum typhoides cv. ICTP-8203**

respectively.

Effect of different doses of effluent on *Sorghum vulgare* cv.CSH-14 are mentioned in Table 2 and Fig. (1) and (2a), (2b) and (2c),which shows that higher dose of effluent show inhibition in germination. All doses show variable effects on seedling growth. Dose 90% show maximum inhibition and dose 30% show maximum promotion. In dose 30%, length of radicle and coleoptile is 155% and 133%, fresh wt. of radicle, coleoptile and

Table 1 : Seed imbibed effect of different concentrations of sugarcane industrial effluent on seed germination and seedling growth of *Pennisetum typhoides* cv. ICTP-8203

	Effluent concentrations %										
Doses →	Control	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Germination % →	90	100	100	100	80	80	80	70	80	100	70
Seedling parts ↓	Length (cm) ± S.D										
Radicle	1.5±0.67	***** 4.2±1.54	***** 8.0±1.95	***** 4.7±1.72	***** 5.5±1.92	1.6±0.60	* 2.5±0.42	***** 3.1±1.66	***** 3.0±1.04	***** 3.2±1.56	** 2.87±0.9
Coleoptile	1.6±0.62	***** 3.4±0.67	***** 4.3±0.77	***** 2.8±0.93	* 2.1±0.84	1.8±0.87	*** 1.0±0.53	* 1.2±0.70	**** 0.9±0.45	1.4±0.60	* 1.2±0.67
	Fresh wt. (mg) ± S.D										
Radicle	2.0±0.44	**** 2.8±0.89	***** 3.4±0.85	***** 4.8±1.62	***** 4.5±0.93	1.6±0.45	2.7±0.60	***** 4.1±1.93	2.0±1.41	***** 3.5±1.29	* 2.8±0.55
Coleoptile	11.1±5.46	14.0±8.09	**17.5±8.57	12.0±5.86	13.7±6.94	*16.2±10.2	* 6.8±1.86	10.0±7.50	*6.8±5.81	***19.0±9.94	8.5±6.00
Residual cotyledon	15.0±7.07	* 11.0±6.58	** 10.0±5.77	** 10.0±5.77	13.0±7.88	12.0±8.56	14.0±6.99	*** 9.0±4.59	*** 9.0±4.59	14.0±8.09	**** 8.0±4.83
	Dry wt.(mg) ± S.D										
Radicle	0.6±0.30	0.5±0.29	**1.0±0.47	0.5±0.30	0.7±0.37	0.6±0.41	**0.3±0.22	0.6±0.343	0.52±0.31	****0.3±0.16	0.6±0.41
Coleoptile	0.7±0.45	** 1.2±0.50	***** 2.1±0.73	0.8±0.37	0.6±0.36	** 0.4±0.32	** 0.4±0.30	* 0.5±0.254	** 0.4±0.27	0.6±0.29	0.4±0.26
Residual cotyledon	4.6±0.96	***** 2.5±0.97	***** 3.0±0.94	4.0±8.16	***** 3.0±1.24	4.6±1.26	*** 5.4±0.69	*** 3.5±1.08	* 4.0±1.15	5.0±0.81	4.5±1.50

N.B. *, **, ***, **** and ***** indicate significance of values at P= 0.10, 0.05, 0.025, 0.01, 0.005, respectively

Table 2 : Seed imbibed effect of different concentrations of sugarcane industrial effluent on seedling growth of *Sorghum vulgare* cv.CSH-14

Doses →	Control	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
					Effluent concentrations %						
Germination %→	100	100	100	100	100	90	70	80	100	70	90
Seedling parts ↓					Length (cm) ± S.D						
Radicle	4.5±1.97	4.7±1.00	***** 7.7±1.71	***** 7.0±1.96	4.1±1.58	3.8±1.16	*** 2.4±0.76	**** 2.2±0.65	* 5.5±2.00	**** 1.3±0.41	5.5±3.70
Coleoptile	4.5±2.32	4.0±2.83	** 6.2±1.82	** 6.0±1.49	*** 2.7±1.45	* 3.1±1.61	***** 1.6±0.86	**** 1.8±1.70	5.2±1.78	**** 1.8±0.76	4.2±1.30
					Fresh wt. (mg) ± S.D						
Radicle	17.7±9.40	16.2±12.10	** 31.0±17.9	** 26.0±9.60	** 11.2±8.16	13.0±10.04	**** 6.3±4.60	12.4±3.60	** 32.0±12.20	**** 5.6±2.16	***** 20.6±17.8
Coleoptile	46.0±15.00	48.8±31.70	***** 72.0±17.5	**** 67.0±18.20	* 34.5±22.8	42.2±22.70	*** 27.4±15.40	***** 21.3±18.70	***** 58.0±16.90	*** 27.1±17.90	46.6±34.6
Residual cotyledon	41.0±11.00	36.0±12.60	41.0±11.0	43.0±8.23	39.0±11.97	40.0±9.42	*35.0±10.80	*34.0±11.70	45.0±11.70	36.0±12.60	41.0±8.75
					Dry wt.(mg) ± S.D						
Radicle	1.9±0.82	1.1±0.73	2.0±0.98	** 2.9±1.50	** 1.4±0.58	** 1.2±0.95	***** 0.6±0.35	** 1.0±0.23	2.3±0.97	****** 0.8±0. 64	2.5±1.50
Coleoptile	4.2±1.60	3.0±1.00	** 5.6±1.90	** 5.7±1.60	***** 2.6±0.54	*** 2.4±0.92	***** 1.4±0.65	***** 1.5±2.20	* 5.6±2.60	***** 1.3±0.14	3.8±1.50
Residual cotyledon	25.0±8.40	24.0±8.40	**** 16.0±6.90	* 19.8±8.40	23.0±8.20	23.0±8.20	25.0±8.40	25.0±9.70	** 17.8±10.50	24.0±8.40	* 21.0±7.30

N.B. *, **, ***, **** and ***** indicate significance at P=0.10, 0.05, 0.025, 0.01, 0.005, respectively

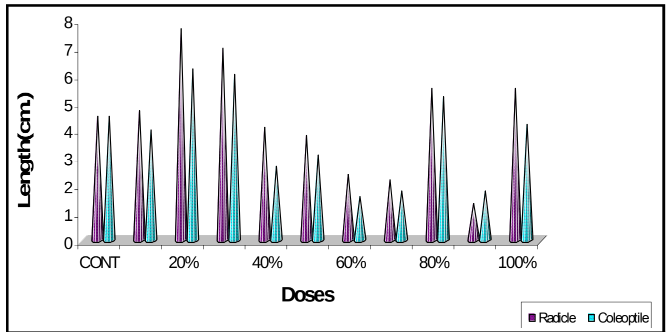

Fig . 2(a): Seed imbibed effect of sugarcane industrial effluent on length of radicle and coleoptile of *Sorghum vulgare* cv. CSH-14

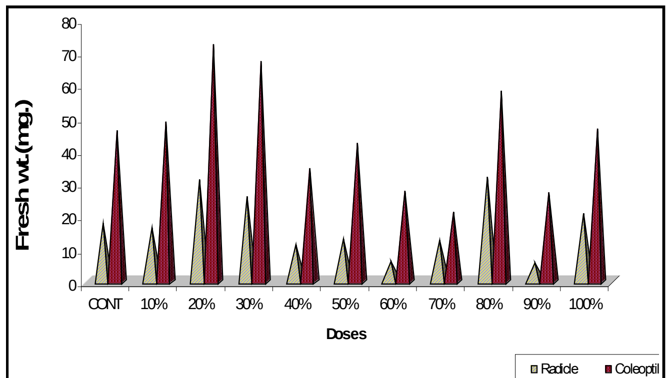

Fig. 2(b): Seed imbibed effect of sugarcane industrial effluent on fresh wt. of radicle and coleoptile of *Sorghum* vulgare cv.CSH-14

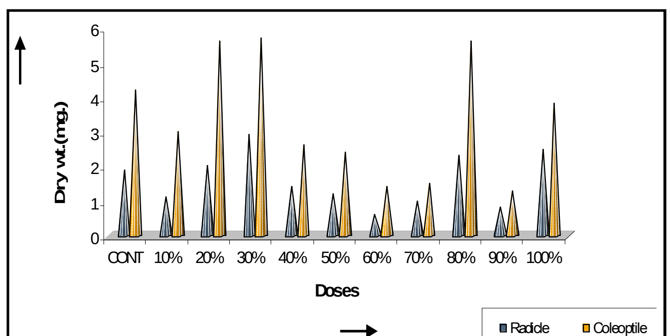

Fig. 2(c): Seed imbibed effect of sugarcane industrial effluent on fresh wt. of radicle and coleoptile of *Sorghum* vulgare cv.CSH-14

rasidual cotyledon is 146%, 145% and 104% and dry wt. of radicle, coleoptile and rasidual cotyledon is 152%, 135% and 73% of control, respectively. On the other hand in dose 90%, length of radicle and coleoptile is 28% and 40%, fresh wt. of radicle, coleoptile and rasidual cotyledon is 31%, 58% and 87% and dry wt. of radicle, coleoptile and rasidual cotyledon is 42%, 30% and 96% of control,

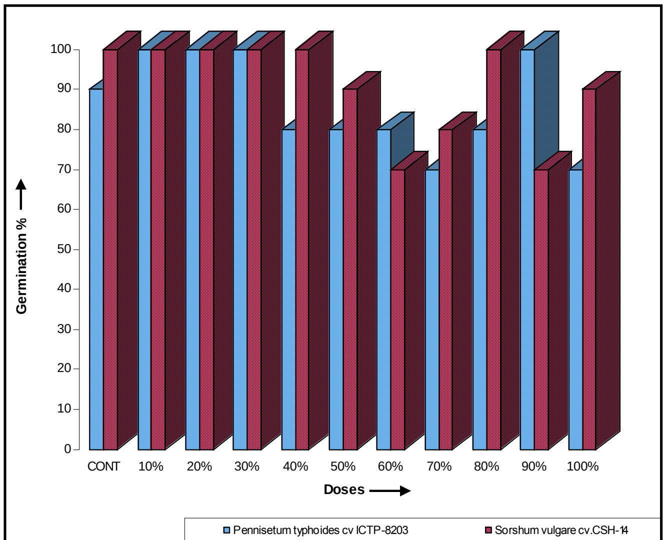

Fig. 1 : Seed imbibed effect of sugarcane industrial effluent on germination % of *Pennisetum typhoides* cv. ICTP-8203 and *Sorghum vulgare* cv. CSH-14

respectively.

Results shows that higher doses of the effluent show inhibitory effects on seed germination and seedling growth. Similar findings were studied by several workers. Hari *et al*. (1994) reported that Germination was completely inhibited in 100% effluent. Nath *et al*., 2006 also supported that The seed germination and seedling growth were significantly reduced with increase in concentration of the effluent. According to Patil *et al.,* 2001 The higher concentration elicited deleterious effects on the germination.

Higher doses of sugarcane industrial effluent show inhibition of seed germination due to osmotic inhibition of water absorption which inhibiting the functions of essential enzymes such as α-amylase and protease (Jerome and Ferguson, 1972, Mayer *et al.*, 1982).High osmotic pressure caused due to high salt concentration in the effluent might be the other factor for germination (Waisel,1958, Bumbla *et al*., 1968).When dry and dormant seeds were treated with effluent, the normal metabolism of seeds is disturbed on account of physical and chemical (different organic and inorganic salts) constituents of the effluent.The anions and cations absorbed by the seeds might be injurious to germination. Rajanan and Oblisami (1979) reported that the inhibition in germination may be as a result of high concentration of elements in the effluent The supply of excessive amount of nutrients by the effluent causes temporary saline conditions near the surface whereas excess of salts get accumulated and such activities affect germination and further growth(Shinde and Trivedy, 1987). Israelsen and Hansen (1962) reported that excess amount of Ca^{++} may also affect germination. Lower doses show promotory response on seedling growth. Why? Increasing response of seedling growth might be due to the presence of mineral nutrient along with Ca^{++} and Mg^{++} to favourable concentration in the effluent. The diluted form of effluent showed more favourable results. It may be due to decreased concentration of total dissolved solids. Corresponding observation were also recorded by Goutam and Bishnoi (1992) when treated with dairy effluent. Higher doses show inhibitory response on seedling growth. Why? Kumar (1999) reported that sugar mill effluent has induced chromosomal aberrations during mitosis and meiosis which may cause imbalance in gene action governing germination. The same findings were also reported in earlier work in analysis of other industrial effluent. It may be thus concluded that effluent had dose dependent inhibitory effects on seed germination and seedling growth.

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