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Full Length Research Paper

Effect of Textile and Dye Effluent Irrigation on Germination and its Growth Parameters of Green Gram, Black Gram and Red Gram

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Abstract

The wastewater from a typical cotton textile industry is characterized by high value of BOD, COD, colour and pH. Because of the high BOD, the untreated textile wastewater can cause rapid depletion of dissolved oxygen if it is directly discharged into the surface water sources. The high colour renders the water unfit for use at the downstream of the disposal point. In view of the above adverse effects, the textile industry effluent is to be treated and discharged according to the standards prescribed under Central Water Act, 1974. The effluent from textile and dye factory was studied for its effect on germination and vigour index of the seedlings of pulse crops. The diluted textile and dye effluent with water in 1:3 ratio (T_2) did not have any adverse effect on the growth and vigour index of field crops. The highest numerical value for germination was recorded in T_1 (river water control) and the lowest value was recorded in T_5 (undiluted effluent) followed by T_2 (Effluent: River water-1:3) and T_3 (Effluent: River water 1:1), which were on par with each other. The growth parameters like germination per cent, root length, shoot length, dry matter production and vigour index showed a better performance as the concentration of the effluent decreased.

Key words*: TDS - Total Dissolved Solids, SAR- Sodium Absorption Ratio, BOD - Biological Oxygen Demand, COD –Chemical Oxygen Demand, CO5 - Coimbatore5, CO6 - Coimbatore6, CORG7 - Coimbatore Redgram7.*

INTRODUCTION

Discharge of textile and dye effluent damages the quality of soil and water bodies. In India, 82 per cent of textile industries are cotton and remaining 18 per cent are synthetic industries (Sheth et al., 2004). Accumulation of excessive salts makes the soils saline, while presences of excessive colour in effluent pollutes the water bodies and prevent the penetration of light, which in turn impedes with the photosynthetic activities of aquatic flora. The presence of hydrogen sulphide, ammonia and chloride in the textile and dye factory effluent was highly toxic to fish in water bodies (Ranganathan and Kurian, 1997). The effluent discharged from textile and dye industries, breweries, fertilizers, antibiotic factories and slaughter houses were hazardous to the flora and fauna of inland streams or other natural water resources (Thavamani, 2000 and Oblisami, 1991). The physico-chemical nature of the effluents varies and the colouring of wastewater is mainly due to the presence of dyes and the colouring agents (Banat et al., 1996). Verma et al. (1974) also reported that the discharge of effluent into the river increased the BOD and COD of the river water. The high colour renders the water unfit for use at the downstream of the disposal point. To objective of the study was impact of textile and dye effluent on germination percentage shoot length, root length and vigour index were recorded for green gram, black gram and red gram.

MATERIALS AND METHODS

The effluent from textile and dye factory was studied for its effect on germination and vigour index of the seedlings of cereals like paddy and maize crops. The germination percentage was recorded from the paper and tray methods of germination study. The trays and papers were irrigated with effluent at different concentrations. Observations on germination percentage shoot length, root length and vigour index were recorded

for cereal crops like paddy and maize.

Treatment details

T_1 - Control River water alone)
T_2 – Effluent (1 part): River water (3 parts)
T_3 - Effluent: River water (1 part:1 part)
T_4 - Effluent: River water (3parts:1 part)
T_5 - Undiluted effluent (Effluent alone)
Design : CRD- Complete Randomized block Design
Replication : Three

Experimental Crops

Green gram (CO6), Black gram (CO5) and Red gram (CORG7)

Germination percentage

Germination test was conducted with four replicates of hundred seeds each using paper and tray method in the germination chamber maintained at 25± 2^0 C and 96 ± 2 per cent Relative Humidity. The germination percentage was calculated based on the normal seedling count on different crops and it was expressed in percentage (ISTA, 1999). Ten seedlings used for root measurement were measured for shoot length from the collar region to the tip of the plumule and the mean value expressed as cm.

Root length

Ten normal seedlings were taken at random at the end of the germination test for measuring the root length. The portion from the collar region to the tip of root was measured and the mean value was recorded as root length in cm.

Vigour index

Vigour index value was computed using the following formula suggested by Abdul-Bakil and Anderson (1973) and expressed as whole number. Vigour index = Germination percentage x Total seedling length (cm).

Dry matter production

Ten normal seedlings per replication used for growth measurements were placed in a paper cover and dried under shade for 24 h and then transferred into a hot air oven maintained at 85± 1^0C for 24hr. The dried seedlings were cooled in a silica gel desiccator for 30 min. The mean dry weight of the seedling were estimated in electrically operated top pan balance and expressed as mg 10 seedling -1.

RESULTS AND DISCUSSIONS

Effect of textile and dye effluent irrigation on growth parameters of seeds

Germination studies

The effect of different dilutions of textile and dye effluent on germination, root length, shoot length, dry matter production and vigour index of seeds were evaluated with cereals like paddy and maize seedlings and the results are presented here under. The river water was used as control.

Green gram (CO6)

Dilution of textile and dye effluent had a significant effect on the growth characters of green gram seedlings (Table 3). In general, the green gram performed better in diluted effluents than under undiluted effluent. The germination percentage of seeds was the highest in T1 (control). The maximum root length was recorded in T1 (21.20 cm). But maximum shoot length was observed in T2 (22.51 cm). The maximum vigour index of 4162 was observed in T5 (2563). Somashekar et al., (1984) reported that effluent from textile and dye factory inhibited the germination and plant height of jowar, bajra and paddy even at 25 per cent concentration. The diluted textile and dye effluent with water in 1:3 ratio (T2) did not have any adverse effect on the growth and vigour index of field crops. Continuous use of paper and pulp industrial sludge over a period of 15 years to a sandy soil increased the soil EC, exchangeable Na, Ca, Mg and K, available P, K, Fe, Mn, Zn and Cu contents (Palaniswami and Sree Ramulu, 1994).

Black gram (CO5)

In general, the growth of black gram was better in diluted effluent than in undiluted effluent (Table 3). The highest and lowest germination percentages were observed in T_1 and T_5 respectively. The highest root length of 21.61 cm was recorded in T_2 followed by T_3 (20.12 cm), which were significantly different from rest of the treatments. The treatment T_1 registered highest shoot length of (23.21 cm), while the minimum shoot length was noticed in undiluted effluent (15.23 cm). The maximum vigour index was recorded in T_2 (4320). Among the pulses, black gram performed better under effluent than green gram and red gram. This finding is in line with the observations recorded by Swaminathan and

Table 1. Initial characteristics of treated textile and dye effluent and river water used for irrigation

Parameters	Treated textile and dye effluent	River water	Parameters	Treated textile and dye effluent	River water
pH	8.38	6.95	**Carbonates (mg L^{-1})**	21.0	-
Colour	Dull blue	Colourless	**SAR**	129	-
EC (dS m^{-1})	2.16	0.12	**Per cent sodium (%)**	88.3	-
TDS (mg L^{-1})	1376	80.0	**Iron (mg L^{-1})**	0.11	8.0
Nitrogen (mg L^{-1})	37.0	-	**Zinc (mg L^{-1})**	0.21	1.46
Phosphorous (mg L^{-1})	24.0	-	**Manganese (mg L^{-1})**	0.12	14.2
Potassium (mg L^{-1})	16.8	0.68	**Copper (mg L^{-1})**	0.08	-
Organic carbon (per cent)	0.60	-	**Chromium (mg L^{-1})**	22	-
Calcium (mg L^{-1})	28.0	11.50	**Cadmium (mg L^{-1})**	0.06	-
Magnesium (mg L^{-1})	20.0	8.20	**Nickel (mg L^{-1})**	0.12	-
Sulphates (mg L^{-1})	42.0	15.20	**Lead (mg L^{-1})**	1.42	-
Sodium (mg L^{-1})	150	6.50	**Bicarbonates (mg L^{-1})**	85.0	-
Chlorides (mg L^{-1})	120	25.0			

Table 2. Effect of effluent on germination growth characters on Green gram (CO6)

	Green gram (CO6)				
Treatments	**Germination (per cent)**	**Root length (cm)**	**Shoot length (cm)**	**Dry matter production (mg)**	**Vigour Index**
T_1	100	21.20	20.42	17.21	4162
T_2	96	19.40	22.51	16.42	4023
T_3	96	18.30	18.32	15.31	3516
T_4	95	21.10	20.21	17.43	3924
T_5	89	15.40	13.40	17.21	2563
SEd	0.78	3.50	3.24	3.63	29.58
CD (0.05)	1.73	NS	NS	NS	65.91

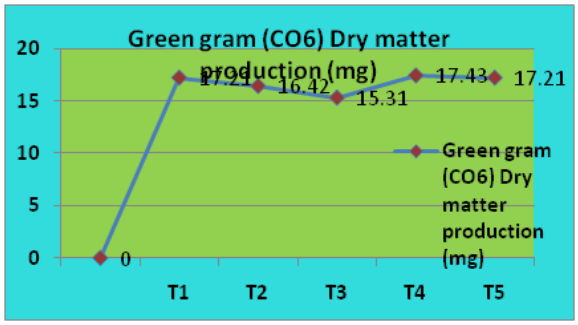

Figure 1. Effect of effluent on Dry matter production of Green gram (CO6)

T_1 - Control (River water), T_2 - Effluent: water (1:3), T_3 - Effluent: water (1:1), T_4 - Effluent: water (3:1), T_5 - Undiluted effluent

Table 3. Effect of effluent on germination growth characters on Black gram (CO5)

	Black gram (CO5)				
Treatments	**Germination (per cent)**	**Root length (cm)**	**Shoot length (cm)**	**Dry matter production (mg)**	**Vigour Index**
T_1	99	17.21	23.21	27.48	4001
T_2	98	21.61	22.48	22.32	4320
T_3	98	20.12	22.32	20.12	4159
T_4	96	18.26	21.18	21.21	3786
T_5	91	16.41	15.23	18.42	2870
SEd	0.79	0.15	0.17	0.13	31.06
CD (0.05)	1.76	0.33	0.38	0.25	69.21

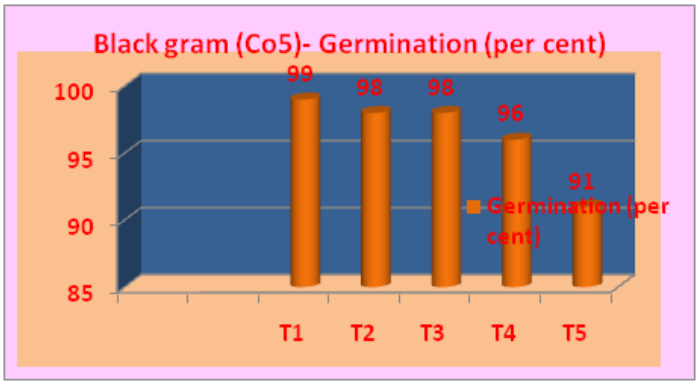

Figure 2. Effect of effluent on germination percentage of Balck gram (CO6)

Table 4. Effect of effluent on germination growth characters on Red gram (CORG7)

Red gram (CORG7)					
Treatments	**Germination (per cent)**	**Root length (cm)**	**Shoot length (cm)**	**Dry matter production (mg)**	**Vigour Index**
Treatments	96	19.12	12.12	21.50	2999
T_1	94	19.32	11.32	20.50	2880
T_2	93	21.41	11.28	19.28	3040
T_3	90	12.51	9.14	19.57	1949
T_4	84	9.28	7.61	16.25	1419
T_5	0.75	0.14	0.08	0.16	20.35
SEd	1.67	0.30	0.19	0.36	45.34

Vaidheeswaran (1991) who reported that the diluted dye effluent increased the germination and vigour index of groundnut.

Red gram (CORG7)

Growth characters of red gram were better in diluted effluent than undiluted effluent (Table 4). The highest germination per cent was observed in T_1 (96) (control) followed by T_2 (94). The dry matter production was higher in T_1 (21.50 mg) followed by T_2 (20.50 mg), while vigour index was higher in T_3 (3040) followed by T_1 (2999). This finding supported with textile and dye effluent contains organic and inorganic chemical species, which have adverse effects on different crops. The germination of kidney bean (*Phaseolus aureus*) and lady's finger (*Abelmoschus esculentus*) seeds were affected adversely when 75 and 100 per cent concentrations of the textile effluent were used as compared to control (water). Bengal gram (*Cicer arietinum*) seeds germination was adversely affected in even as low as 50 per cent textile effluent concentration. But unlike above said crops, 50 per cent diluted textile effluent increased the seed germination, total sugars, starch, reducing sugar, and chlorophyll than control (distilled water) of groundnut seedlings (Swaminathan and Vaidheeswarn, 1991). The biometric as well as biochemical attributes of soybean showed a decrease with increased concentration of the dye effluent (Vijayakumari 2003; Umamaheswari *et al.* 2003).

SUMMARY AND CONCLUSIONS

In this investigation, an attempt has been made to assess the effect of textile and dye effluent on germination of pulse crops like greengram, blackgram and redgram. This study concluded that, the germination per cent, root length, shoot length, dry matter production and vigour index of cereal crops like greengram, blackgram and redgram were higher in lower effluent concentrations (25 and 50 % effluent) but decreased with increasing concentration of effluent (75 and 100 % effluent).

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