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REGULAR ARTICLE

EFFECT OF BRIQUETTING AND CARBONISATION PLANT EFFLUENT ON SEED GERMINATION OF FIVE VARIETIES OF GROUNDNUT (*ARACHIS HYPOGAEA* L.)

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SUMMARY

The study deals with pollution by Briquetting and Carbonization plant effluent and its effect on five varieties of groundnut to evaluate its irrigation potential. The effluent is brownish black in colour. It contains higher amount of total nitrogen, metallic and non-metallic ions, sulphates, sodium, chloride, calcium and magnesium. The impact of various concentrations (10, 25, 50, 75 and 100 per cent) of this effluent on the seedling growth of five varieties of groundnut (*Arachis hypogaea* L.) was studied under laboratory conditions. Germination percentage, seedling growth, fresh weight and dry weight of groundnut seedlings exhibited a gradual increase upto 10 per cent and decrease at higher concentrations. The variety VRI-4 showed the better growth performance than the other varieties studied under effluent treatment.

Keywords: Water pollution. Industrial effluent. Germination studies. Varietal screening.

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1. Introduction

The use of industrial effluent for irrigation of crop plants is one of the highly beneficial prepositions of waste disposal. As the release of waste water is larger in amount from industries, it could fulfill the needs of irrigation crops. Each type of industrial effluent has a specific character and it may contain the nutrients that enhance the growth of crop plants. The use of this waste water for irrigation prevents the environmental hazard but also serves as additional potential source of fertilizer for agriculture use. To recycle nutrients through land application of dairy waste effluent requires the use of crops capable of utilization these nutrients [1]. Industrial effluents rich in organic matter and plant nutrients are finding agricultural use as cheaper way of disposal [2].

2. Materials and Methods

Materials

The effluent samples from briquetting and carbonization plant of Neyveli Lignite Corporation Limited, Neyveli, TN, India were collected in plastic containers from the point of disposal. The effluent was brought to laboratory for the physico chemical analysis and it was stored in walk in cooler in the plant physiology laboratory.

Seed Materials

The seeds of five varieties of groundnut TMV-10, JL-24, VRI-2, ALR-2 and VRI-4 were obtained from Regional Research Station, Virudhachalam, TN, India. The seeds with uniform size, colour and weight were selected for experimental purpose.

Analysis of the Briquetting and Carbonization Plant Effluent

The effluent samples of the Briquetting and Carbonisation factory were analysed for its various physico-chemical properties with the help of CARD, Neyveli Lignite Corporation, Neyveli, as per the methods mentioned in American Public Health Association [3]. The different concentration of the effluent (10, 25, 50, 75 and 100 per cent) was prepared by using tap water and they were used for the germination experiments.

Seed Germination – I

The seeds of five varieties of groundnut TMV-10, JL-24, VRI-2, ALR-2 and VRI-4 of uniform size, colour and weight were surface sterilized with 0.1 per cent mercuric chloride (HgCl2) solution and washed 5-6 times with distilled water. Twelve seeds of groundnut for each treatment were placed equispacially in sterilized Petri dishes, lined with filter paper soaked with different concentrations of the effluent. The seedlings raised in distilled water were designated as control. These Petri dishes were irrigated with different concentrations of the effluent uniformly. Each treatment was replicated five times. The number of seeds germinated in each treatment was counted on the 10th day and the total germination percentage was calculated. The emergence of radicle was taken as criteria for germination. The seedlings from each treatment were randomly selected for the measurement of root length and shoot length. The tolerant variety was selected based upon the above-mentioned characters.

The seedlings were separated into radicle, plumule, cotyledons and leaves. They were kept in a hot air oven at 80^{o}C for 24 hours. After that the dry weight were recorded, by using a single pan electrical balance.

3. Results and Discussion

The physico-chemical properties of B and C effluent are presented in Table-1. The effluent is brownish black in colour. It contains 506.5 mg/l of total solids, 408.5 mg/l of dissolved solids and 98 mg/l of suspended solids. The PH value is 8.53. The effluent contains 41.44 mg/l total nitrogen. The metallic and nonmetallic ions are present followed by Na, chlorides, Ca and Mg.

Table-1. Physico- Chemical Properties of Lignite industrial effluent

Sl. No	Parameters	Values
1	PH	7.4
2	EC	36.6
3	Temperature	32.8
4	Total solids	3.128
5	TSS (mg/l)	1.892
6	BOD	2.108
7	COD	2.252
8	Phosphate	32.5
9	Nitrate	48.6
10	Fluoride	165.8
11	Sulphur	1.18
12	Sodium	965
13	Potassium	1.122
14	Aluminum	635
15	Ammonia	718

A varietal screening test was conducted to find out the tolerant variety for effluent irrigation at germination level. The germination percentage of groundnut cultivars as affected by different concentrations of Band C effluent is furnished in Table-2. The germination percentage of all groundnut cultivars is found to be maximum at 10% (98, 100, 66, 68 and 99; for ALR-2, VRI-4, JL-24, VRI-2 and TMV-10 respectively). Germination percentage of all the cultivars of groundnut decreased gradually with progressive increase in effluent concentration. The minimum percentage of germination was recorded at 100% in all cultivars of groundnut (74, 87, 33, 44 and 75 for ALR-2, VRI-4, JL-24, VRI-2 and TMV-10 respectively).

TABLE 2. Effect of Briquetting and Carbonisation plant effluent on germination percentage of five verities of groundnut (10th day) seeding

Name of varieties	C	10%	25%	50%	75%	100%
ALR-2	97 ± 1.23	98 ± 1.39	91 ± 1.11	80 ± 1.37	83 ± 1.19	74 ± 1.38
VRI-4	99 ± 1.14	100 ± 1.37	98 ± 1.27	95 ± 1.29	91 ± 1.67	87 ± 1.24
JL-24	64 ± 1.25	66 ± 1.47	58 ± 1.62	50 ± 1.68	41 ± 1.27	33 ± 1.46
VRI-2	66 ± 1.63	68 ± 1.63	58 ± 1.47	54 ± 1.46	50 ± 1.36	44 ± 1.49
TMV-10	98 ± 1.14	99 ± 1.44	96 ± 1.84	91 ± 1.15	83 ± 1.19	75 ± 1.16

± Standard deviation

TABLE 3. Effect of Briquetting and Carbonization plant effluent on Root length of five varieties of groundnut (10th day) seedlings (cm /plant)

Name of the verities	C	10%	25%	50%	75%	100%
ALR-2	7.10±0.026	7.82±0.034	6.97±0.042	6.20±0.126	5.74±0.007	5.36±0.014
VRI-4	7.92±0.014	8.40±0.860	7.48±0.740	7.12±0.680	6.78±0.168	6.12±0.024
JL-24	5.92±0.004	6.10±0.020	5.24±0.037	5.02±0.059	4.83±0.048	3.27±0.124
VRI-2	6.20±0.132	6.98±0.260	6.13±0.380	5.87±0.417	5.31±0.586	4.98±0.864
TMV-10	7.19±0.012	8.01±0.038	7.11±0.162	6.94±0.010	6.29±0.010	5.89±0.014

± Standard deviation

TABLE 4. Effect of Briquetting and Carbonisation Plant Effluent on shoot length of five varieties of groundnut (10th day) seeding (g/plant)

Name of the verities	C	10%	25%	50%	75%	100%
ALR-2	13.01±1.803	14.87±1.824	13.10±0.984	12.17±0.798	11.19±0.686	10.29±0.532
VRI-4	14.90±1.432	15.40±1.674	14.10±1.526	13.24±10.72	12.92±0.962	11.27±0.864
JL-24	11.24±0.784	13.20±0.864	11.12±0.678	10.78±0.564	9.90±0.324	8.10±0.120
VRI-2	12.78±0.864	14.20±0.984	12.78±1.260	11.87±0.869	10.26±0.764	9.86±0.650
TMV-10	13.84±1.864	15.10±1.364	13.64±0.984	12.86±0.863	11.84±0.764	10.98±0.589

± Standard deviation

TABLE 5. Effect of Briquetting and Carbonisation Plant Effluent on dry weight of five varieties of groundnut (10th day) seeding (g/plant)

Name of the verities	C	10%	25%	50%	75%	100%
ALR-2	0.3280±0.054	0.5967±0.069	0.4980±0.036	0.4049±0.017	0.3987±0.027	0.3420±0.022
VRI-4	0.3766±0.063	0.8512±0.078	0.6652±0.060	0.5305±0.068	0.4682±0.069	0.4532±0.004
JL-24	0.2862±0.004	0.2990±0.009	0.1178±0.078	0.1092±0.004	0.0840±0.048	0.0700±0.006
VRI-2	0.3080±0.014	0.4869±0.050	0.3986±0.012	0.3201±0.024	0.2990±0.018	0.2010±0.024
TMV-10	0.3586±0.029	0.6876±0.047	0.5990±0.028	0.5865±0.032	0.4982±0.005	0.4032±0.047

± Standard deviation

Germination percentage increased gradually at low concentration of the effluent treatment. This is due to the stimulation of physiologically inactive seeds. The high concentration of solids in the effluents seems to be responsible for the inhibition for the germination, since the osmotic relationship of the seeds and water reduces the amount of observed water and retarded seed germination. The inhibition of germination at high concentration may be due to the presence of various cations and anions [4]. The root length of groundnut cultivars showed a decreasing trend with increase in effluent concentration (Table 3). Among the cultivars studied, VRI-4 exhibited maximum root length at 10% (8.40) and minimum length of root was observed at 100% effluent concentration (3.27) of JL-24 cultivars. The shoot length of groundnut variety as affected by different concentration of B and C plant effluent is represented in Table-4. The shoot length was found to be maximum at 10% effluent concentration (15.40 cm) of VRI-4 variety and minimum shoot length was observed at 10% (8.10cm) of JL-24 variety. There was gradual decline in shoot length with the increase in effluent concentration. Root length, shoot length, dry weight of groundnut seedling also gradually increased in 10% concentration. The same trend was observed earlier in *Phaseolus radiata* [5], *Oryza sativa* [6, 7] and *Cajanus cajan* [8] treated with various industrial effluents. The increase in seedling growth at lower concentration in comparison to the control may be due to enhanced plant nutrients present in the effluent. The germinating seeds in high concentration of effluent treatment would get less amount of oxygen which might have restricted energy supplies and retarded growth and development [9-11].

The dry weight of groundnut seedling of different concentration of B&C plant treatment are presented in Table-5.The maximum dry weight of seedlings occurred at 10% effluent concentration in VRI-4 variety (0.8512 g).The minimum dry weight was observed in 100% effluent concentration (0.0700) of JL-24 variety. The seedling dry weight was found to increase at lower concentration of 10% and decreases gradually at higher concentration to 100%. Similar type of varietal screening test were carried out with seven varieties of finger millet [12], corn and rice [13], three varieties of maize [14] and five varieties of rice [15] with effect of different types of effluents.

Among the all varieties studied, the variety VRI-4 showed the higher percentage of germination, seedling growth and dry weight of seedling while JL-24 showed the lower performance under different concentration of B&C plant effluent. The observed difference in tolerant capacity may be due their difference in their ability to the elements and it might be a genetic factor [12]. From the above preliminary study (i.e.) variety screening test it is found that the variety VRI-4 performed better in germination, seedling growth and dry matter production when compared to all the varieties taken up for the study. VRI-4 proved to be tolerant variety for B&C effluent irrigation then the other varieties studied. The order of tolerance was VRI-4> TMV-10> ALR-2> VRI-2> JL-24.

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