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Effect of sewage water on seed germination and vigour index of different varieties of groundnut (*Arachis Hypogaea* L.)

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Abstract: *The study has been focused on the investigation on ground nut (Arachis hypogea) fields influenced by sewage water. Sewage water sampled in and around Mysore city and analyzed for physicochemical parameters. Different concentrations such as 1, 5, 10, 25, 50, 70 and 100% of sewage water on seed germination and vigour index of Arachis hypogea verities such as DH – 2 – 30, ICJS – 11, JL – 24, K – 134, TMV – 2 and VRI – 2 were studied. From the recorded observation it is concluded that the sewage water diluted to 25% concentration for irrigation of groundnut enhances germination percentage and vigour index in K – 134 variety which is more susceptible than other tested varieties.*

Key words: *Ground nut (Arachis hypogaea* L.*), Sewage water, Physico-chemical parameters, Seed germination, Vigour index*
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Introduction

Huge volume of sewage water is being produced in metropolitan cities due to ever increasing population. The water collected through sewerage system in outskirts of the city is discharged to agricultural lands without treatment which has both toxic and fertilizer values.

There is an increase in the use of sewage water for irrigation especially in the out skirts of the cities, particularly in the dry area where there is scarcity of natural water. There are several advantage and disadvantage in using this sewage water for irrigation purpose. Sewage water contains higher amounts of nutrients which increases crop yield substantially and reduce the need for fertilizer, and ultimately decreases overall cost of production. Continuous use of sewage waste water may lead to environmental problems such as soil sickness, soil and ground water contamination and phytotoxicity (Hicks and Hird, 2000). Sewage water adversly affects root crops such as radish during maturity stage and as a result the production decreases substantially (Bakhsh and Hassan, 2005). The city sewage water is mainly used for raising vegetables in the vicinity of the cities. Leafy vegetables like, cauliflower, cabbage, spanich *etc.*, grow quite well in the presence of sewage water (Bakhsh and Hassan, 2005). There is hardly any literature available on using sewage water for the irrigation of ground nut which is a major oil yielding crop. Hence in the present study an attempt has been made to know,

1. The physico-chemical properties of sewage water,
2. Effect of different concentrations of sewage water on the seed germination and seedling vigor of *Arachis hypogea*.

Materials and Methods

Water sampling: Sewage water sample of about one liter was randomly collected in polyethylene bottles from the point where the sewage water enters the field for irrigation of ground nut crop. Water samples were transported to laboratory and analysed for various physico-chemical parameters.

Physico-chemical properties of sewage water: The physico-chemical properties such as pH, electric conductivity, dissolved oxygen, biological oxygen demand, chemical oxygen demand, temperature, total dissolved solids, total suspended solids, free carbon dioxide, nitrogen, total alkalinity, carbonate, bicarbonates, calcium, magnesium, chloride, sulphate, hardness and various nutrients and heavy metals such as K^{+1}, P^{2+}, Fe^{2+}, Cu^{2+}, Zn^{2+}, Mn^{2+}, Ni^{2+} and Pb^{2+} were also analyzed (APHA, 2005).

Certified seeds of groundnut varieties such as DH-3-30, ICJS-11, JL-24, K-134, TMV-2 and VRI-2 were obtained form certified seed sellers Mysore for the experimental purpose.

Seed treatment with sewage water: Different varieties of groundnut seeds were surface sterilized with 0.2% $HgCl_2$ solution for two minutes and washed with running water for thirty min. The known and equal volume of 1, 5, 10, 25, 50, 75 and 100% concentration of sewage water was poured on to the petriplates containing twenty-five groundnut seeds placed equidistantly. Fresh water served as control.

Seed germination: After treating the seeds (400 Nos.) with sewage water the plates were kept for incubation at 21+1°C for nine days and percent seed germination was recorded. Radical was taken as criteria for germination, each treatment replicate for four times (ISTA, 1996).

Vigour index: Germinated seedlings were evaluated for vigour index (VI). The root and shoot length of germinated seedling were measured and vigour index was calculated using the formula given by Abdul Boki and Anderson (1973).

VI = (MRL + MSL)x PG

VI = Vigour index; MRL=Mean root length; MSL= Mean shoot length; PG = Percentage germination.

Results and Discussion

In the present study sewage water which is used for irrigation of groundnut fields was analyzed to know the physico-chemical properties of sewage water and its effect on seed germination and vigour index. The results of physico-chemical parameters are given in the Table 1. Several authors have studied the physico-chemical properties of sewage water with reference to irrigation. Where the similar studies made by (Devi, 1991; Garg, 1998). Although the sewage water is a source of many nutrients, it also includes a significant amount of heavy metals like Fe^{2+}, Cu^{2+}, Zn^{2+}, Mn^{2+}, Ni^{2+}, Pb^{2+} as shown in Table 1. Extensive use of this effluent for irrigation purpose may result in an upsurge of such metals in soils and various crops.

In the study it is observed that all six varieties showed response to sewage water treatment but there is slight difference. It is observed that there is significance increase in seed germination, 98% in DH-3-30, 96% in KJS-11, 92% in JL-24, 99% in K-34, 91% in TMV-2 and 95% in VRI-2 varieties (Table 2) and seed vigor 326.10% of DH-3-30, 321.10% of KJS-11, 342.71% of JL-24, 362.05% of K-34, 350.01% of TMV-2 and 351.22% of VRI-2 varieties at the concentration of 25% followed by 10,5 and 1% respectively (Table 3), which is correlated with the results of rice, wheat and cucumber (Pal and Bhattacharyya, 2003).

Table – 1: Physico-chemical properties of water

Parameters	Sewage water results	Sewage water standard	Fresh water
pH	8.3	5.5 -9.0	6 to 8.5
EC	15.97		400
DO	1.70		5
BOD	165	350	100
COD	348	350	250
Temperature °C	30		28
TDS	2140	2100	500
TSS	760	600	19
Free CO_2	2.10		1.21
Nitrogen	70.90	50.0	0.20
Total alklanity	480.00		300
Carbonates	362.18		20.78
Bicarbonates	1128.30		163.68
Calcium	249.52		75
Magnesium	106.64		50
Chloride	1002.00	1000	200
Sulphate	1087.00	1000	200
Hardness	890.00		300
Fe^{2+}	5.0	3.0	0.3
Cu^{2+}	6.0	3.0	1.5
Zn^{2+}	20.0	15.0	15.0
Mn^{2+}	3.0	2.0	0.5
Ni^{2+}	5.0	3.0	Nil
Pb^{2+}	2.0	1.0	0.1

All units are in mgl^{-1} except pH, EC = μScm^{-1}. Values are the means ± S.E of four replicates each and two consecutive seasons. Data were subjected to analysis of variance and compared for significance according to DMRT ($p < 0.05$)

Table - 2: Effect of different concentration of sewage water on seed germination percentage of different varieties of groundnut (*Arachis hypogaea* L.)

Groundnut varieties	Sewage water concentration (%)							
	Control	1	5	10	25	50	75	100
DH –3 – 30	85.00 ± 0.57^{b}	93.00 ± 0.56^{bc}	95.00 ± 0.17^{b}	96.00 ± 0.45^{b}	98.00 ± 0.50^{a}	72.00 ± 0.53^{b}	63.00 ± 0.18^{b}	47.00 ± 0.54^{b}
ICJS – 11	79.00 ± 0.39^{c}	91.00 ± 0.25^{d}	93.00 ± 0.34^{c}	95.00 ± 0.49^{bc}	96.00 ± 0.13^{b}	66.00 ± 0.46^{c}	59.00 ± 0.29^{c}	36.00 ± 0.52^{c}
JL – 24	56.00 ± 0.15^{f}	94.00 ± 0.42^{b}	95.00 ± 0.41^{b}	94.00 ± 0.21^{c}	92.00 ± 0.27^{c}	51.00 ± 0.35^{e}	48.00 ± 0.57^{e}	24.00 ± 0.23^{e}
K – 134	89.00 ± 0.32^{a}	96.00 ± 0.33^{a}	97.00 ± 0.14^{a}	98.00 ± 0.36^{a}	99.00 ± 0.19^{a}	74.00 ± 0.37^{a}	64.00 ± 0.38^{a}	49.00 ± 0.47^{a}
TMV – 2	66.00 ± 0.39^{e}	93.00 ± 0.40^{bc}	94.00 ± 0.20b^{c}	92.00 ± 0.31^{d}	91.00 ± 0.44^{d}	62.00 ± 0.28^{d}	53.00 ± 0.55^{d}	20.00 ± 0.30^{f}
VRI – 2	77.00 ± 0.24^{d}	92.00 ± 0.16^{cd}	95.00 ± 0.26^{b}	95.00 ± 0.43^{bc}	95.00 ± 0.22^{bc}	65.00 ± 0.48^{c}	57.00 ± 0.12^{c}	34.00 ± 0.51^{d}

Values are the means ± S.E of four replicates each and two consecutive seasons. Data were subjected to analysis of variance and compared for significance according to DMRT ($p < 0.05$)

Table - 3: Effect of different concentration of sewage water on vigour index of different varieties of groundnut (*Arachis hypogaea* L.)

Groundnut varieties	Sewage water concentration (%)							
	Control	1	5	10	25	50	75	100
DH – 3 – 30	310.32^{ab}	290.17^{b}	260.53^{a}	240.41^{ab}	326.10^{d}	203.01^{ab}	101.53^{c}	82.56^{b}
ICJS – 11	310.12^{ab}	291.18^{ab}	259.33^{b}	240.42^{ab}	321.10^{e}	202.38^{bc}	103.73^{b}	79.09^{c}
JL – 24	308.31^{b}	290.10^{ab}	258.24^{b}	238.47^{c}	342.71^{c}	200.71^{d}	99.01^{d}	76.30^{d}
K – 134	311.41^{a}	293.56^{a}	262.31^{a}	241.38^{a}	362.05^{a}	204.08^{a}	105.31^{a}	86.88^{a}
TMV – 2	308.57^{b}	292.23^{ab}	258.65^{b}	238.51^{bc}	350.01^{b}	200.53^{d}	102.84^{bc}	83.01^{b}
VRI – 2	309.61^{ab}	290.74^{ab}	261.61^{a}	239.36^{bc}	351.22^{b}	201.91^{cd}	99.71^{d}	71.76^{e}

Values are the means of four replicates each and two consecutive seasons. Data were subjected to analysis of variance and compared for significance according to DMRT ($p < 0.05$)

There was maximum reduction of seed germination 47% of DH-3-30, 36% of KJS-11, 24%of JL-24, 49% of K-34, 20% of TMV-2 (Table 2) and 34% of VRI-2 varieties and seed vigor 82.56% of DH-3-30, 79.09% of KJS-11, 76.30%of JL-24, 86.88% of K-34, 83.01% of TMV-2 and 71.76% of VRI-2 varieties at the concentration of 100% followed by 75, and 50% respectively (Table 3). Results were correlated with the results of *Cicer arietinum* (Raina and Raina, 2005; Rao and Nanda Kumar, 1983), *Vigna mungo* (Kannabiran and Harilal, 1998), *Phaseolus mungo* (Madhappan, 1993), *Sessamum indicum* (Neelam and Sahai, 1998), Green gram and Maize (Shanmugavel, 1993) and Groundnut (Sundaramoorthy and Lakshmi, 2000).

The above results attributed that higher concentration above tolerance level inhibit seed germination due to production of various enzymes (Agarwal *et al*., 1981; Shukla and Pandey, 1991) or prevention by enriching the salinity and conductivity of solute being absorbed by seed before germination (Neelam and Sahai, 1998) or some times the seeds undergo physiological stress due to high salinity (Rao and Nanda Kumar, 1983) or due to excess quantities of micronutrients, heavymetals and toxic chemicals (Dollar *et al*., 1972; Binu Kumari *et al.*, 2006; Indra and Sivaji, 2006). So it may be may suggested that when farmers use sewage water to irrigate the groundnut fields it is to be diluted and resistant varieties to be used (Sundaramoorthy, 2000) to avoid the loss in yield which is more susceptible.

Present work is intended on germination behavior of ground nut variety of seeds at different dilutions to find out the effect of sewage water.

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