# Effect of textile waste water on morphophysiology and yield on two varieties of peanut (*Arachis hypogaea* L.)

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An experiment was conducted to evaluate the use of textile waste water on morphophysiology and yield of two varieties of peanut, TMV-10, and JL-24. Textile waste water application increased germination, chlorophyll a, b and total chlorophyll content, growth parameters, yield and yield contributing characters. Physico-chemical characteristics of textile waste water met the irrigation quality requirements and were within the permissible limits.

**Key words:** textile waste water, peanut, morphophysiology, germination, chlorophyll content, physioco-chemical.

## Introduction

There has been a strong global awakening during the last few decades regarding the proper management of existing natural resources. Among them, irrigation water is one which becoming costlier due to increasing demand of human population. Simultaneously the demand for food is also increasing, which has brought more and more land under cultivation and focused the attention on fertilizer and irrigation water. With these certain limitations, one has to turn to non-conventional recourses to meet the irrigation water demand. Among others, one of the most important irrigation as well as nutrient resources is industrial waste water, which consists of about 95% water and the reset as organic and inorganic nutrients. Since, its disposal is a big problem in urban areas, applying the textile waste water to agricultural field instead of disposing off in lakes and rivers can make crops grow better due to presence of various nutrients like N, P, Ca, Mg etc. (Kannan *et al*., 2005 and Khan *et al*., 2003). There can be both beneficial and damaging effects of irrigation with waste water on various crops including vegetables (Ramana *et al*., 2002). The

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need is to assess waste water quality and plant species requirements before using treated waste water for crops production (Jothimani *et al*. 2002).

## Materials and methods

An experiment was conducted in industrial area, Pasupathy Palayam, Karur District, Tamil Nadu, India. Textile waste water were collected from common effluent treatment plants and the impact of textile waste water on morphophysiology and yield of two varieties of peanut TMV-10 and JL-24 were evaluated. Seeds of both the varieties were soaked in 5 hours in different concentrations of the textile waste water at 25%, 50%, 75% and 100%. After soaking, the seeds were sown in the effluent irrigated field. Seeds were irrigated thrice a week at respective waste water concentrations. The water and soil were analysed for various physico-chemical characters (APHA 1985). Plant sampling was done 45 days after sowing to asses the effect of textile waste water in terms of growth parameters such as root and shoot length, leaf number, leaf area index, fresh and dry weight of the plants. Chlorophyll a, b and total chlorophyll were calculated by Mac Kinney, (1941). Leaf number, leaf area index and ratio were calculated (Watson, 1958). Total plant dry weight was recorded by drying the plants at 80º C till constant weight. Yield component were determined at development of pod and number of the pods. Data were analysed and standard deviation (S.D) was calculated (Gomez & Gomez 1984).

## Results and discussion

The irrigation water analyses showed that the pH of textile waste water is (8.01 to 8.09) which slightly alkaline in nature. Textile waste water showed low BOD, high in chloride content and contained more essential plant nutrients like N, P, K and Ca (Table 1). The soil analysis showed minor difference in pH of the soil taken before sowing and after harvest (Table 2). There were only marginal decreases in nitrogen and phosphorus content of effluent irrigated soil while potassium content was almost unchanged. In the case of tap water irrigated soil, greater decrease in N, P and K was observed after harvest. Application of textile waste water resulted in increase in organic carbon.

The mean of percentage germination was influenced by different effluent concentrations. Increased percentage of textile waste water in irrigation water decreased the percentage germination of peanuts in both varieties (JL-24 and TMV-10). The highest percentage germination was observed in 50% effluent concentration, 95% germination in TMV-10 and 92% in JL-24. The lowest percentage germination of 38% and 42% were recorded in 100 % effluent concentrations (Fig. 1).

**Table 1.** Physico – chemical characteristics of textile waste water.

| Characteristics ($mg/l^{-1)}$) | Textile waste water |
|---|---|
| Colour | Dark Brown |
| Odour | Unpleasant |
| pH | 8.1-8.9 |
| Eclectic conductivity d $Smol^{-1}$ | 6.2 |
| Total Suspended solids | 250.300 |
| Total Dissolved solids | 1600.3956 |
| As $Co_3$ | 1500 |
| BOD | 42 |
| COD | 146 |
| Bicarbonate | 1500 |
| Chloride | 526 |
| Sulphate | Present |
| Calcium | 580 |
| Magnesium | 140.25 |
| Sodium | 45.69 |
| Potassium | 28.2 |

(Values in $mg/l^{-1}$ unit except pH and E.C)

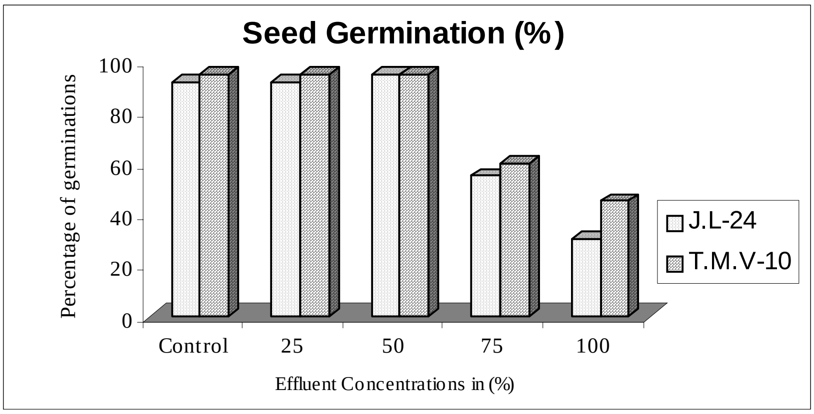


**Fig. 1.** Percentage seed germination of two peanut varieties grown in soil with different effluent concentrations.

In general, all the growth and yield characteristics of both crops were increased with textile waste water irrigation, as is evident from increased leaf area ratio, leaf area index, root and shoot length and dry weight accumulation (Table 4 and 5). Textile waste water application resulted to increase in the plant dry weight in TMV-10 which was slightly high in 50% (8.69 $mg/g^{-1}$ d.wt), JL-24 was (8.01 $mg/g^{-1}$ d.wt) in 50 days old treated peanut. Greening of plants was enhanced by textile waste water application and thus chlorophyll content of TMV-10 as 0.78 $mg/g^{-1}$ f.wt in 100 % treatment, JL-24 was slightly low in chlorophyll-a in 0.69 $mg/g^{-1}$ f.wt in same concentration. Total chlorophyll content was gradually increased with increasing the effluent concentration in both the varieties. Among the two varieties TMV-10 responded well than JL-24. Chlorophyll a which significantly increased of 50% effluent treatment in TMV-10 and JL- 24 was increased of 25% treatment but Chl. b was slightly lower than that compared to chlorophyll a. Total chlorophyll content increased considerable in the treatment, however TMV-10 was significantly increased in 75% treatment than JL-24 which was significantly in 50% effluent treatment (Table 3).

**Table 2.** Physico- chemical properties of experimental soil (Mean ±SE).

| Parameters | Control soil (Tap water irrigated ) | | Effluent irrigated soil | |
|---|---|---|---|---|
| | Before sowing | After 50 days | Before sowing | After 50 days |
| pH | 7.62±0.05 (**100.00**) | 7.85±0.12 (**103.01**) | 7.65±0.10 (**100.00**) | 7.92±0.30 (**103.52**) |
| Phosphorus kg $ha^{-1}$ | 12.30±2.21 (**100.00**) | 11.10±1.76 (**90.24**) | 12.58±1.95 (**100.00**) | 13.45±1.12 (**106.91**) |
| Nitrogen kg $ha^{-1}$ | 119.23±2.48 (**100.00**) | 117.25±2.85 (**98.33**) | 121.29±1.79 (**100.00**) | 118.145±2.10 (**97.40**) |
| Potassium kg $ha^{-1}$ | 58.21±1.97 (**100.00**) | 55.07±2.38 (**94.60**) | 57.56±1.87 (**100.00**) | 55.98±1.56 (**97.25**) |
| Organic matter (%) | 0.39 ±0.02 (**100.00**) | 0.29±0.06 (**74.35**) | 0.35±0.01 (**100.00**) | 1.29±0.10 (**328.57**) |

Values in parenthesis indicate over control

The textile waste water application enhanced the root and shoot length in partially diluted effluent in both varieties. However, TMV-10 response well than JL-24. Maximum root and shoot length was observed in 75% in both the varieties. But root and shoot length was significantly increased in 50% (19.55 and 27.4 cm) effluent concentration, JL-24 was significantly increased at 50% (15.03 cm) in root and shoot (Table 4).

**Table 3.** Chlorophyll content (mg/g f.w$^{-1}$) in 50 days old peanut varieties (*Arachis hypogaea* L) grown in control and treated soils (Mean ±SE).

| Parameters mg/g$^{-1}$ f.wt | Varieties | Control | Effluent Concentrations (%) | | | |
|---|---|---|---|---|---|---|
| | | | 25% | 50% | 75% | 100% |
| Chlorophyll a | JL24 | 0.45±0.02 (100.00) | 0.57±0.02* (126.66) | 0.61±0.1 (135.55) | 0.67±0.03 (148.88) | 0.69±0.02 (153.33) |
| | TMV10 | 0.49±0.01 (100.00) | 0.62. ±0.01 (126.53) | 0.69±0.03** (140.81) | 0.75±0.0.2 (153.06) | 0.78±0.01 (159.18) |
| Chlorophyll b | JL24 | 0.16±0.02 (100.00) | 0.19±0.01 (118.75) | 0.26±0.03 (162.5) | 0.31±0.01* (193.75) | 0.34±0.002 (212.5) |
| | TMV10 | 0.20±0.01 (100.00) | 0.26±0.002 (130.00) | 0.33±0.02* (165.00) | 0.39±0.1 (195.00) | 0.42±0.01 (210.00) |
| Total chlorophyll | JL24 | 0.61±0.2 (100.00) | 0.76±0.1 (124.59) | 0.87±0.02** (142.62) | 0.92±0.2 (150.81) | 0.96±0.03 (157.37) |
| | TMV10 | 0.69±0.02 (100.00) | 0.88±0.01 (127.82) | 1.02±0.02 (147.82) | 1.14±0.2** (165.21) | 1.20±0.1 (173.91) |

The leaf area index and leaf area ratio was observed in 50 days old treated peanut. Above parameters are increased gradually in increasing the effluent concentrations upto 100% (Table 5). Maximum leaf area index observed in TMV-10 (0.45 cm$^2$ plant$^{-1}$) grown in 100% effluent water and in JL-24 (0.37 cm$^2$ plant $^{-1}$) grown in 75% effluent water. Leaf area ratio was high in TMV-10 as 100% (0.30 (cm$^2$ plant $^{-1}$) and JL -24 was 0.27 in 75% treatment. Fresh and dry weight also increased in 50% treated effluent in both the varieties, however TMV-10 was slightly increased than JL-24 in all the treatment concentrations.

**Table 4.** Root and shoot length in 50 days old control and treated peanut varieties (*Arachis hypogaea* L).

| Parameters | Varieties | Effluent concentrations in (%) | | | | |
|---|---|---|---|---|---|---|
| | | Control | 25% | 50% | 75% | 100% |
| Shoot Length (cm) | TMV-10 | 21.4 ±0.3577 (100.00) | 25.4 ±0.6996 (118.69) | 27.4** ±0669 (128.03) | 31.8 ±0.9959 (148.59) | 28.4 ±0.4560 (132.77) |
| | JL24 | 17.6 ±0.4560 (100.00) | 19.4** ±0.4560 (110.22) | 22.0* ±0.7428 (125.00) | 23.4 ±0.6066 (132.95) | 19.4 ±0.8294 (110.22) |
| Root Length (cm) | TMV-10 | 12.36 ±0.2102 (100.00) | 16.48 ±0.2049 (133.35) | 19.55** ±0.1532 (158.16) | 17.75* ±0.1121 (143.65) | 14.11 ±0.2323 (114.16) |
| | JL-24 | 11.45 ±0.3081 (100.00) | 14.92 ±0.852 (129.58) | 15.03* ±0.0880 (131.25) | 13.86 ±0.2388 (117.32) | 12.44 ±0.1340 (117.32) |

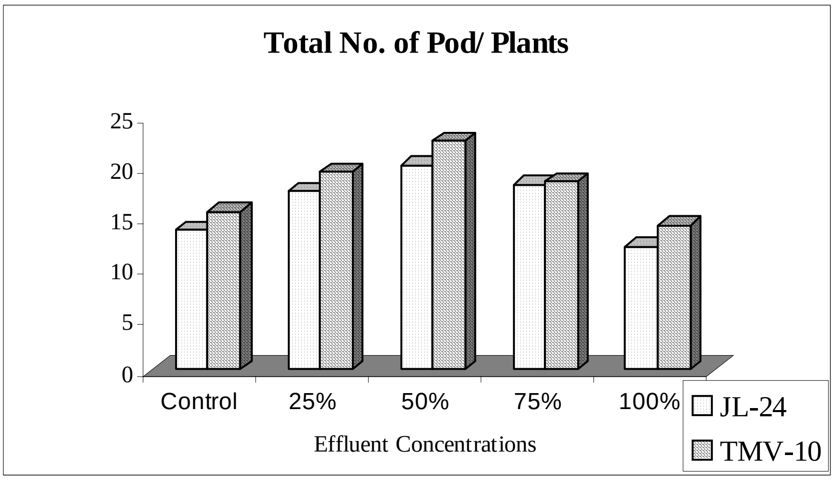


**Fig. 2.** No of pod yield in textile waste water treated control and treated peanut varieties (*Arachis hypogaea* L.).

Recording the yield characteristic (pod) (Fig. 2) was gradually increased upto 50% with increasing the effluent concentration, textile waste water proved beneficial and recorded an increase the pod number in 50% treatment in both varieties TMV-10 and JL-24.

Data on both varieties of peanut plants showed that textile waste water is beneficial for the growth and yield of the peanut plants. This may be attributed to the presence of several essential plant nutrients like N, P, K, Ca and Mg present in the textile waste water (Kannan *et al*. 2005). Nitrogen plays an important role and stimulates the growth of stem and leaves (Khan *et al*., 2003; Saravanamoorthy and Ranjitha Kumari, 2005). Thus increased nutrient concentration increases leaf number and leaf area by increasing cell size and number (Gardner *et al*., 1985 and Devlin and Witham, 1986). Thus, the higher plant mineral nutrient status, larger leaf number and leaf area higher concentrations of both chlorophyll a and b were recorded (Kannaiyan 2001). In this study, the increase in shoot and root dry weight were observed at 25% effluent treatment in textile effluent treatment could increase the yield of the plants at 25% and 50% treatments. However, the yield decreased in 100% concentration treatment.

The decrease in root and shoot biomass was less in JL-24 than TMV-10. Decreases in the growth and biomass of *Cicer arietinum* were decreased by distillery effluent that has been also reported by Srivastava and Sahai (1987). The chlorophyll a and chlorophyll b contents were significantly increased at 50% and 75% concentration in both the peanut varieties (Table 3).

Similar observation has been reported by Saravanamoorthy and Ranjitha Kumari (2005); Kannaiyan (2001) and Sahai *et al*. (1983) in *Arachis hypogaea* L. and *Phaselous radiatous* L. treated with distillery and textile industrial effluent. The pigment content was increased upto 50% effluent concentrations in both varieties (TMV-10 and JL-24). Chlorophyll b content was affected at higher concentrations as compared to chlorophyll a. It may therefore be suggested that textile waste water acts as a supplement to the soil fertility, humus content, organic matter and mobile compounds of nutrients. These finding are in agreement with earlier reports of Jothimani *et al*. (2002), Ramachandran (1994); Saravanamoorthy and Ranjitha Kumari, (2005); Swaminathan and Vaidheeswaran (1991) and Veer and Lata (1997).

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**Table 5** Effect of textile waste water on morphometric parameters in 50 days old control and treated peanut varieties (*Arachis hypogaea* L).

| Parameters | TMV-10 | | | | | JL-24 | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | **Control** | **25%** | **50%** | **75%** | **100%** | **Control** | **25%** | **50%** | **75%** | **100%** |
| Leaf area index ($cm^2/mg$) | 0.28 ±0.2145 | 0.33 ±0.1158 | 0.38 ±0.1356 | 0.43 ±0.2108 | 0.45 ±0.1245 | 0.25 ±0.1245 | 0.31 0.2578 | 0.35 ±0.1389 | 0.37 ±0.1276 | 0.34 ±0.1546 |
| Leaf area ratio ($cm^2/mg$) | 0.21 ±0.11238 | 0.24 ±0.1645 | 0.27 ±0.1269 | 0.29 0.1128 | 0.30 ±0.1145 | 0.17 ±0.1457 | 0.21 ±0.1245 | 0.24 ±0.1489 | 0.27 ±0.1212 | 0.25 0.1245 |
| Fresh weight mg/g-1 d.wt | 16.55 ±0.4513 | 17.70 ±0.2411 | 19.08 ±0.1050 | 15.08 ±0.343 | 13.26 ±0.1619 | 16.34 ±0.2804 | 18.15 ±0.1975 | 18.81 ±0.2482 | 13.32 ±0.1571 | 11.34 ±0.3200 |
| Dry weight mg/g-1 d.wt | 7.73 ±0.1058 | 7.90 ±0.2074 | 8.69 ±0.1814 | 6.51 ±0.3962 | 5.88 ±0.1703 | 6.38 ±0.2081 | 7.15 ±0.2702 | 8.01 ±0.1374 | 6.35 ±0.3026 | 4.88 ±0.1 |
| Moisture content (%) | 9.45 ±0.2665 | 9.37 ±0.2571 | 10.44 ±0.3174 | 7.81 ±0.1517 | 7.71 ±0.1708 | 9.73 ±0.1228 | 9.79 ±0.2271 | 8.77 ±0.1824 | 7.14 ±0.1167 | 6.73 ±0.1708 |