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Quality analysis and effect of reused water on some biological characteristics of *Phaseolus vulgaris* and *Pisum sativum*

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Abstract: Seeds of *Phaseolus vulgaris* L. and *Pisum sativum* were planted in separated pots, then these pots divided into two groups, each group divided into four subgroups. Four different wastewater were used to irrigate the treatments. The results showed the effects induced by irrigated wastewater on *P. vulgaris* L. and *P. sativum.* The degree of water salinity induced increasing SOD, protein content and the area of xylem elements, but reduced chlorophyll-α in *P. vulgaris*. The CAT, protein and chlorophyll-α were increased in in *P. sativum* as a result to salinity which also reduces the area of xylem elements.

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Introduction

Phaseolus vulgaris L. is a legume species with a wide distribution, therefore it can be grown in a high range of environmental conditions except those of extremes (Singh, 1999). Also, *Pisum sativum* is an edible leguminous seed that need a particular soil feature i.e. clay with slight acidity (Vural et al., 2000; Mani, 2015). In this species, salinity is more effective on germination of the bean (Ghezal et al., 2016). In Iraq, especially in past years, the regression of fresh water and increased the area with saline soil (Al-Adily, 2014) has been led to use other unusual water resources for irrigation (Al-Maamori and Al-Adily, 2018). Many works done regarding the effects of using wastewater for irrigation (Khurana and Singh, 2012; Nwaokobia et al., 2018). Since both *P. vulgaris* and *P. sativum* are sensitive to salinity (Maas and Hoffman, 1977; De Pascales et al., 1997; Munns and Tester, 2008), therefore, this work aimed to study the effects of different reused water for the irrigation of *P. vulgaris* and *P. sativum* as alternative for fresh water.

Materials and Methods

The seeds of *P. vulgaris* and *P. sativum* were planted in pots each with 1 kg soil, then seed pots of each species were divided into four subgroups each with three replicates. They were irrigated with four different wastewaters (Table 1). These wastewaters were collected from four different puncture water within Babylon Governorate, Iraq. Standard methods were used to measure of the water characteristics (APHA, 2005). In addition, the standers methods of soil labs were used to measure the important features of the used soil in the palnted pots (ICARDA, 2001). The measure characteristics are shown in Table 1.

The biochemical measurement of the plants with ages of 45 day were chlorophyll-α (Yash, 1998), proline content (Bates, 1973), SOD (Marklund and Marklund, 1974), total protein (Bradford, 1976) and catalase content (Aeibi, 1984). The method to study the anatomical variations was based on Jahanson (1940).

Results and Discussions

The biochemical results of *P. vulgaris* L. and *P. sativum* showed their different strategies to adapt with water quality (Tables 1, 2). The high salinity of type 3 water (EC=3320 μs/cm) reduce chlorophyll-α and CAT in *P. vulgaris*, which may be due to concentration of chloride because bean is sensitive to salinity ions (Bouzid and Rahmoune, 2012; Anna et

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Table 1. Some characters of four types of wastewater used in irrigated of *Phaseolus vulgaris* and *Pisum sativum*.

Parameters	Wastewater			
	1	2	3	4
pH	8.6	8.1	8.5	8.3
E.C (μs/cm)	1438	950	3320	3210
TDS (mg/l)	1030	698	2340	1450
Salinity (mg/l)	1240	786	2930	1740
Total Hardness (mg/l)	700	840	1480	920
Calcium (mg/l)	280.56	336.67	593.18	368.74
Magnesium (mg/l)	102.34	122.81	216.38	134.51
Chloride (mg/l)	349.89	409.76	779.76	499.85
Alkalinity (mg/l)	140	240	400	320
Sulphate (mg/l)	67.65	122.55	153.92	241.18
Organic matter (%)	0.07	0.16	0.12	0.28

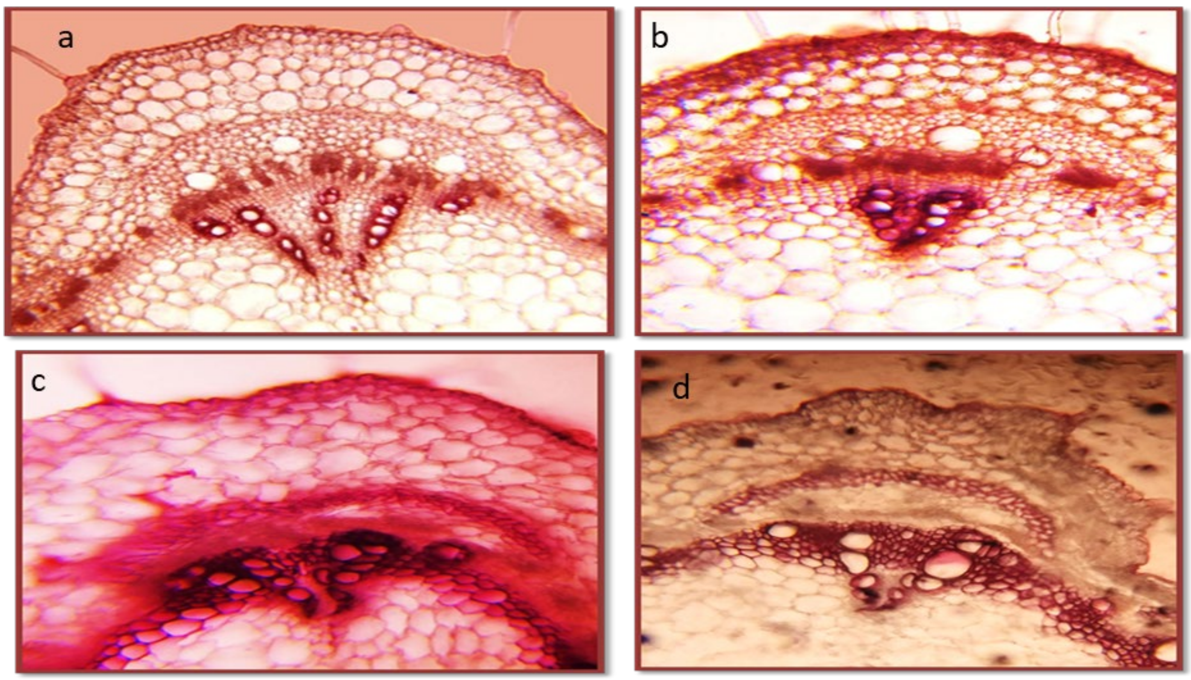

Figure 1. Anatomical variation of stem of *Phaseolus vulgaris* induced by different wastewater sources (20X).

al., 2015) causing defect in amount of gas exchange and the producig chlorophyll-α (Kauymakanova and Stoeva, 2008). Whereas, *P. sativum* do not showed an increase in chlorophyll-α content with increase salinity of irrigated water and high concentration recorded in group 4 containing high concentration of organic matter (0.28%). Pisum was able to tolerant salinity by increasing proline formation and protein content which was in a positive relationship with CAT. This results are in agreement with other studies done on pisum on other type of soil and under different weather conditions (Mani, 2015; Artega et al., 2020). The results also give a good indicator to prove ability of pisum agriculture in Iraq.

Histological sections of the stem in the studied species (Figs. 1 and 2) revealed that thickness of epidermal cells was higher in group 2 which irrigated with wastewater containing lower concentrations of total ions and salinity, while the high levels of salinity induced increasing of the epidermal layer numbers and no increase found in group 3, so in this group showed an increasing in area of xylem elements and the higher increase was in group 4. Bean is adapted to salinity in many different adaptation, some were

Table 2. Physiological responses of *Phaseolus vulgaris* and *Pisum sativum* to type of irrigated waste water.

Species	Wastewater	CAT (U/ml)	SOD (U/ml)	protein (mg/ g.D.W)	proline (µmole / g.D.W)	Chlorophyll content (SPAD)
P. vulgaris	1	22.24	4.477	23.74	16.85	25.4
	2	15.09	2.947	24.79	20.48	22.9
	3	11.32	3.91	27.8	22.22	12.4
	4	30.48	3.343	26.96	23.15	29.5
P. sativum	1	13.81	2.493	24.4	48.63	17.3
	2	16.02	1.45	27.8	47.82	21.7
	3	18.11	1.813	27.96	59.55	23.4
	4	15.07	2.55	24	60.79	29.3

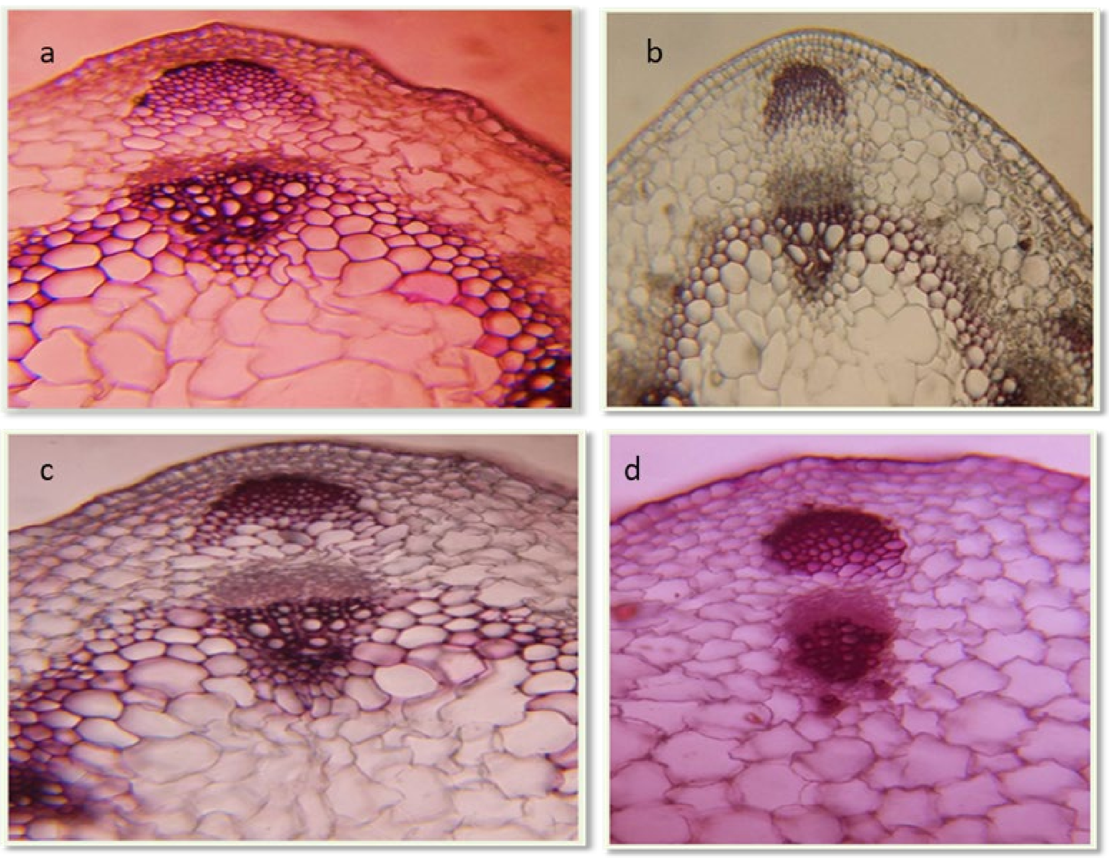

Figure 2. Anatomical variation of stem of *Pisum sativum* induced by different wastewater sources (20X).

biochemically or phonologically (Al-Hassan et al., 2016) and in this study anatomical adaptations, including decrease the layers of collenchyma tissue was observed. In contrast, in pisum, there was no significant variations in the area of epidermis, while organic matter may be induced the producing of the parenchyma tissue and the width of vascular bands (as seen in group 4) and the number of the xylem elements but it reduced the diameter of xylem vessel. Plants can tolerant elevated concentrations of salinity ions by increasing the fibers of xylem (Al-Adily et al., 2018). Salinity causes some plants to change the anatomy of vascular system according to degree of EC of water or soil (Tietjen et al., 2017; Qaderi et al., 2019).

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