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Effects of Treated Effluent of Oil and Gas Industry on The Anatomical Structures of Some Vegetable Crops

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Abstract

The present investigation has been carried out on the anatomical features of Trigonella foenum-graecum L., Lycopersicon esculentum Mill., Solanum melongena L. and Ruphanus sativa.L. subjected to irrigation of Control, dilute effluent (DE) and concentrated effluent (CE) of the treated (oil and gas) industrial effluent in order to identify the anatomical response of the plant to the treatment. Tap water was used as a control. The stems and the roots were manually cross-sectioned stained with safranin and then mounted in a drop of glycerin jelly on glass slides. A cover slip was placed over them and observations were made. Analysis resulted that dilute concentration of the effluent did not show abnormality while the higher concentration (CE) of the effluent showed abnormalities in the root such as abnormal vascular development, cellular degradation and anomalous cambial activity, ruptured epidermis, while damaged cortical, hypodermal and epidermal cells were observed in the stem and root of the plant. However damaged was more pronounced in root than the stem. This shows that higher concentration of the oil and gas industrial treated effluent induced anatomical abnormalities in selected plants, while the diluted effluent was safe for the plant growth.

Keywords: Treated oil and gas industrial effluent, Anatomy, Irrigation, Abnormality

I. INTRODUCTION

Recent years have been the era of industrial development. For the development of any country, the development of industries with minimal environmental pollution is highly desirable. On the other hand, Industry is the segment of economy concern with production of goods. It began in its present form during the 1800s, aided by technological advances and it has continued to develop to this day. So, Industry in the second sense became a key sector of production all over the world. Abu Dhabi is a great industrial port of U.A.E., having many oil and gas as well as petrochemical industries. The options of industrial effluent reuse in agriculture provide ways to combat fresh water crisis without degrading environmental quality. The reuse of industrial effluent is being applied in several water starved countries. In general, any industry has both positive and negative environmental impacts. The planners and the environmentalists need to document these impacts to maximise positive and minimise negative impacts. Reusing and recycling materials are often an essential part of everyday life.

The benefit to use treated industrial effluents in agriculture is the alternative for water scarcity in the developing country for irrigation. It's also meet to provided important minerals and act as fertilizer which are necessary for healthy growth and development of plants for obtained good yield. However, it's also equally harmful for plants, and soil by deteriorate soil quality to use it without check its bad properties. Even via food chain it is enough capable to cause human health hazards.

The direct use of concentrated effluent may have toxic effect on plants anatomical characters. Ghimire and Bajracharya (1996) assessed the toxic effect of effluents on seed germination and seedling growth of vegetables. Industrial effluent may affect the internal structure of plant organs as suggested by Uaboi et al. (2009). Effluents of certain industries contain heavy metals. Certain heavy metals are useful for the plant growth at trace level. Others have adverse effect on growth and development of plants (Collins, 1981). Peralta et al. show the effect of heavy metal on seed germination and plant growth of Alfalfa plant (2000). The present study mansion an evaluation of treated industrial effluent application in some agricultural crops and its effects in their anatomy.

I. METHODS AND MATERIAL

- Treated industrial effluent from oil and Gas Company was collected.
- Pot mix soil, seeds and pots are purchased from authorized nursery at Abu Dhabi.
- Pot culture was set up with 10 seeds in each pot and treatment using different concentration of treated Oil and Gas effluent.
- Anatomy of root and stem was performed by manual cross section methods.
- Section stained with safranin and mounted in a drop of glycerine gelly on glass slides.
- After placing a cover slip, sections were observed under Axioscope, Zeiss, Germany.
- Results were analyzed on the basis of different types of structural damage.

II. RESULTS AND DISCUSSION

The outermost layer of the root is affected more as root is the foremost organ to be in direct contact with the effluent. In the present study, the cells of cortex were normal when treated with dilute concentration of the effluent but Certain cortical parenchyma cells become brownish and exhibit degeneration and some become enlarge in size by the effect of effluent. (Fig. 2a A, B) Also, the present study showed no negative effect on the growth and development of vascular bundles at lower concentration. However, when the plants treated with higher concentration of effluent the walls of many endodermis cells became thicker due to the deposition of suberin. (Fig.4 A, B) At the higher concentration of effluent more deposition of tannin and ectopic lignification was also observed in stealer region (Fig.1A, C). The reason for the abnormality in the plant may be due to the higher amount of pollutant present in the concentrated treated effluent. The physicochemical studies of an effluent also support these studies. The other reason may be due to the combined effect of different metals and organic molecules in the effluent. Irrigation of *Cenchrus celaris* with paper board industry effluent caused damage in the cortical layers of root (Vijaykumar and Udayasooriyan, 2007). Omosun *et al.*, 2008 was also reported that the cortical cells of the roots and stems of *Amaranthus hybridus* in 2-3% crude oil treated soil were flattened tangentially and smaller in size compared to that grown in control which had round polygonal cells that appeared larger. In present study cortical cells became abnormally larger in size (Fig.2a B). Further, cambium activity was also affected by the treatment of effluent which shows the abnormal and anomalous cambium activity (Fig. 2b). In comparison to control layers of xylem and phloem were decreasing in the treated plant, as well as they were more decreasing with CE treatment, than DE. Abnormal stealer development is also found (Fig-1). The effect of textile wastewater decreased the size of xylem vessels and phloem cells (Mahmood *et al.*, 2005). Stem is less affected than root, so very less abnormalities are reported (Fig-3a & 3b). They are represented by damage epidermis layers, if the plant stems were in direct contact with effluents. In some of the stem anomalous cambium activities are found. (Fig. 4 D).

III. CONCLUSION

The present pot study shows that the effect of Dilute concentration (DE) of suggested effluent did not show any abnormality in the anatomy of the plant. However, as the concentration of treated oil and gas industrial effluent was increased concentrated effluent (CE) various anatomical abnormalities such as ectopic lignification, abnormal cellular division and large cortical cells, cell death in epidermis, hypodermis and cortex was increased. Stem is less affected than root, so very less abnormalities are reported in stem. They are represented by damage epidermis layers, when the plant stems were in direct contact with effluents. In some of the stem anomalous cambium activities are found which lead to eccentric and stunted growth of plants.

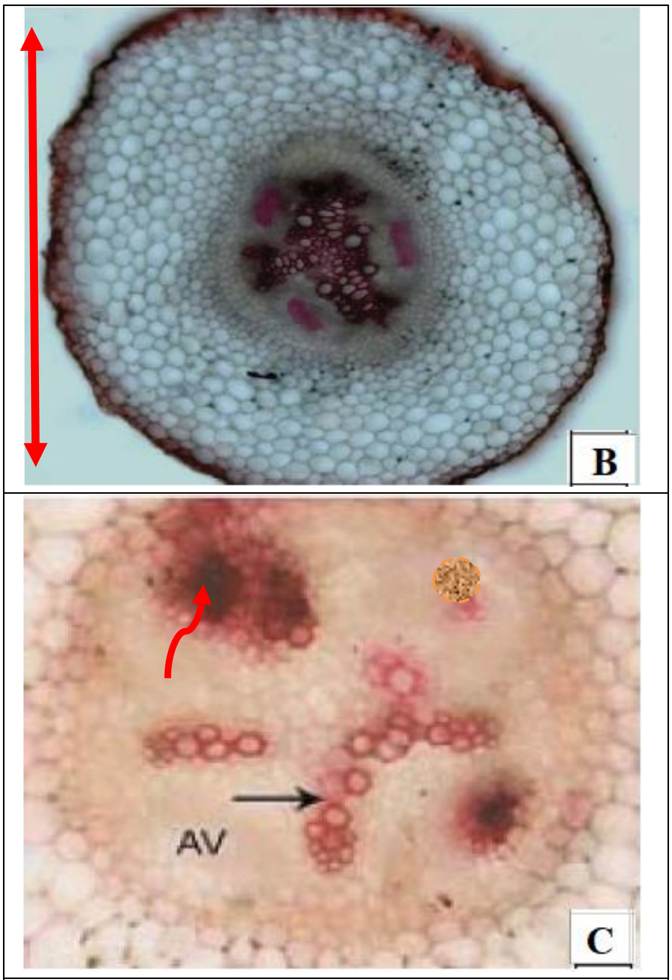
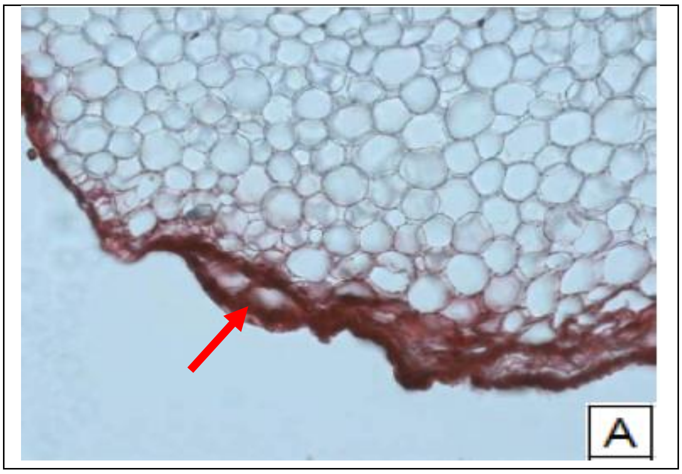


Fig. 1: Abnormal young root anatomy
A - Abnormal Protoxylem development, B - Damage epidermis and hypodermis lead to cells death, epidermis cells turn brown in colour, C - Ectopic lignifications and abnormal vessels development, *Lycopersicon esculentum* (young stem)
B - *Solanum melongena, C- Raphanus sativus*



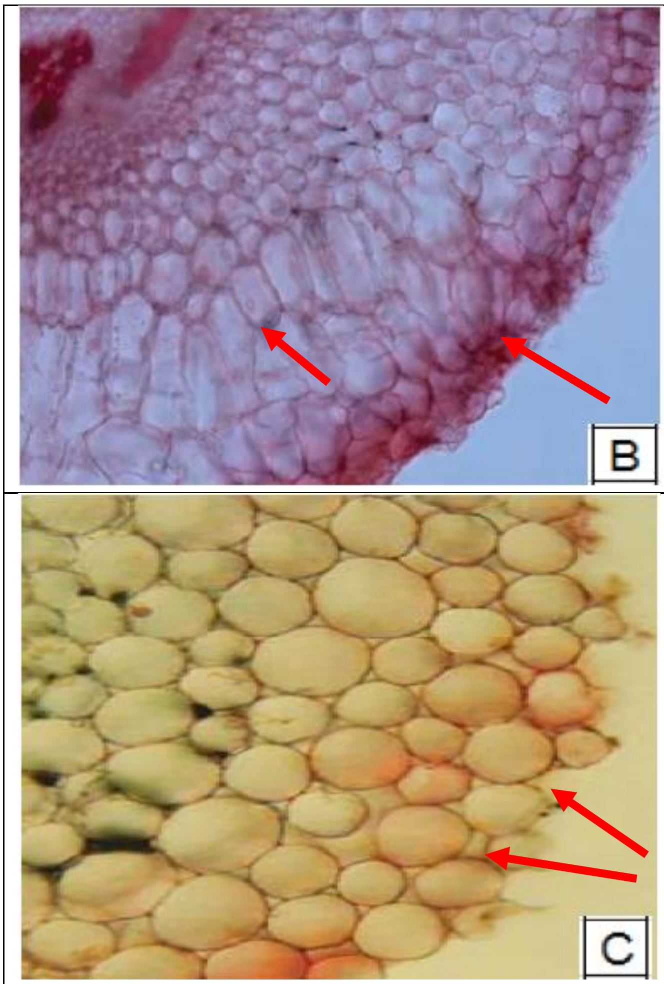


Fig. 2a Abnormal old root anatomy
A - Damage epidermis and cortical cells
B - Cortical cells enlargement
C - Destroyed epidermis
A - *Lycopersicon esculentum*
B - Raphanus sativus
C - *Trigonella foenum graecum*

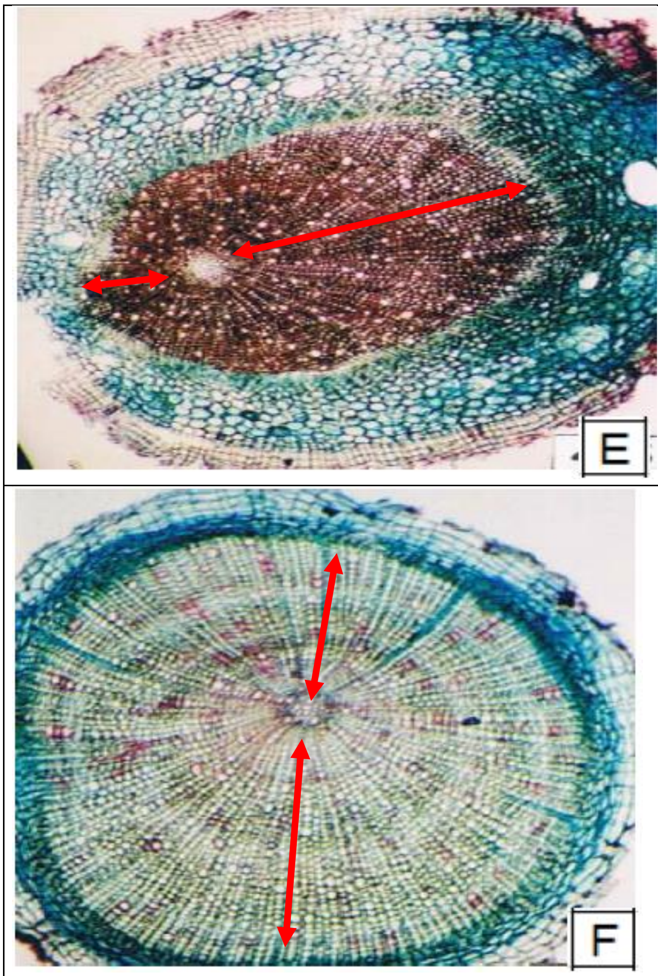
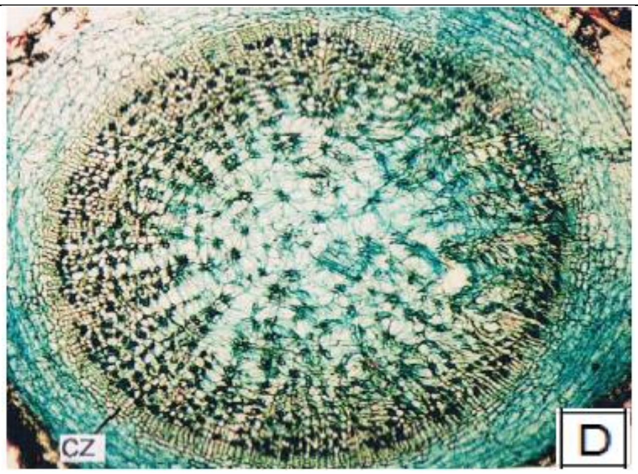
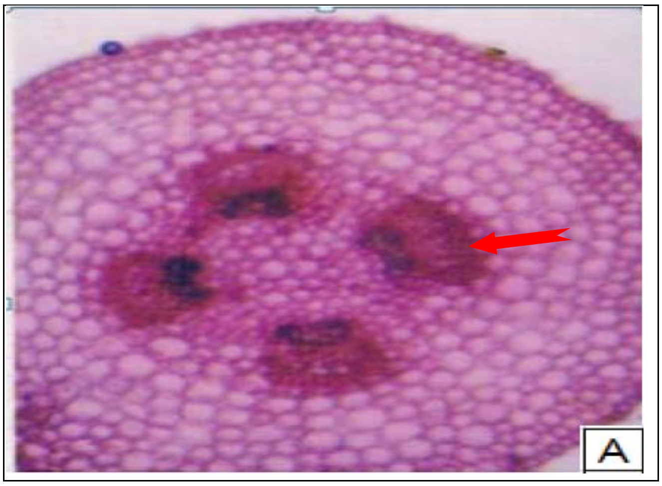


Fig. 2b Abnormal root anatomy – anomalous cambial activity
D - abnormal cambial activity, *Raphanus sativus*
E - abnormal cambial activity - eccentric growth, *Lycopersicon esculentum*
F - abnormal cambial activity - eccentric growth, *Lycopersicon esculentum*





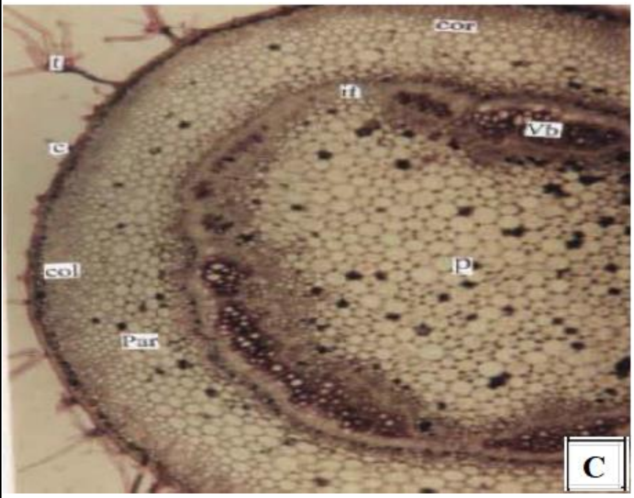
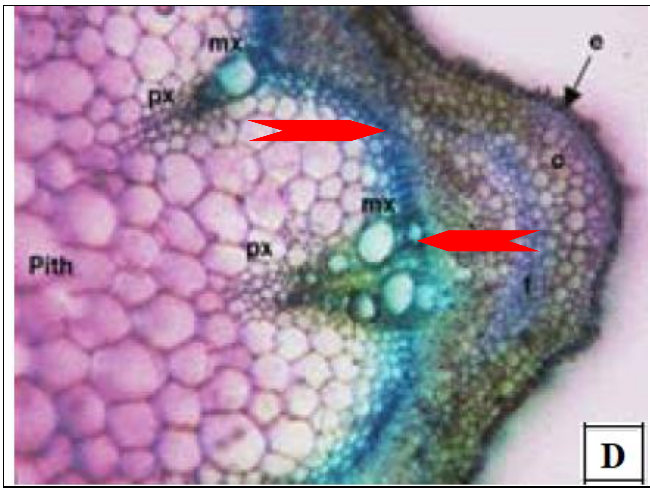
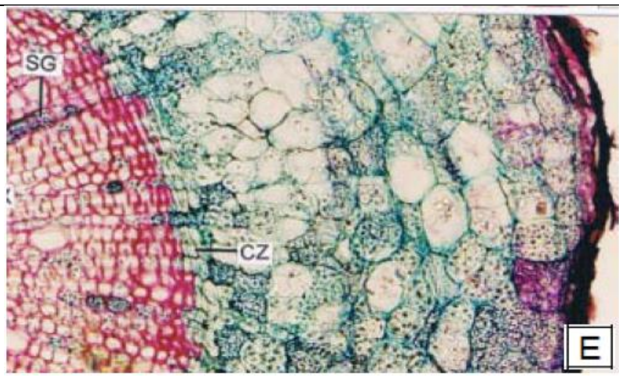


Fig. 3a: Normal young and old Stem Anatomy
A - Tetrarch Provascular bundles, *Trigonella foenum graecum* (young stem)
B - Hexarch Provascular bundles, *Raphanus sativus* (young stem)
C - Development of vascular cambium *Solanum melongena* (old stem)





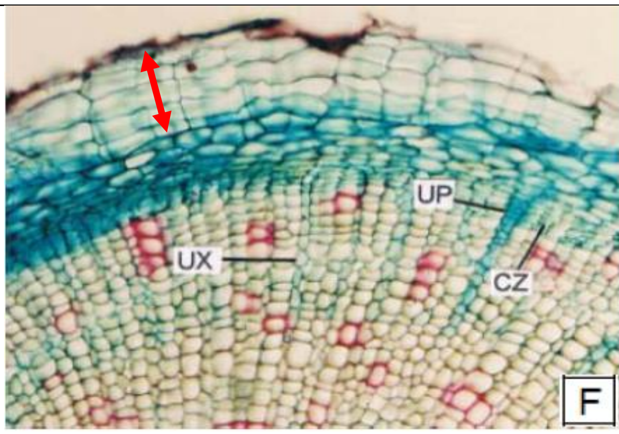
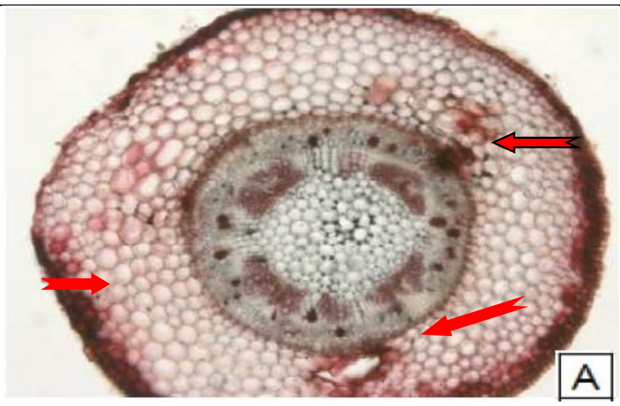


Fig. 3b: Normal young and old Stem Anatomy
D - Development of vascular cambium, *Lycopersicon esculentum* (young stem)
E - Cortical cells fill up with starch grains, *Solanum melongena old stem*
F - Cork cells, *Raphanus sativus*



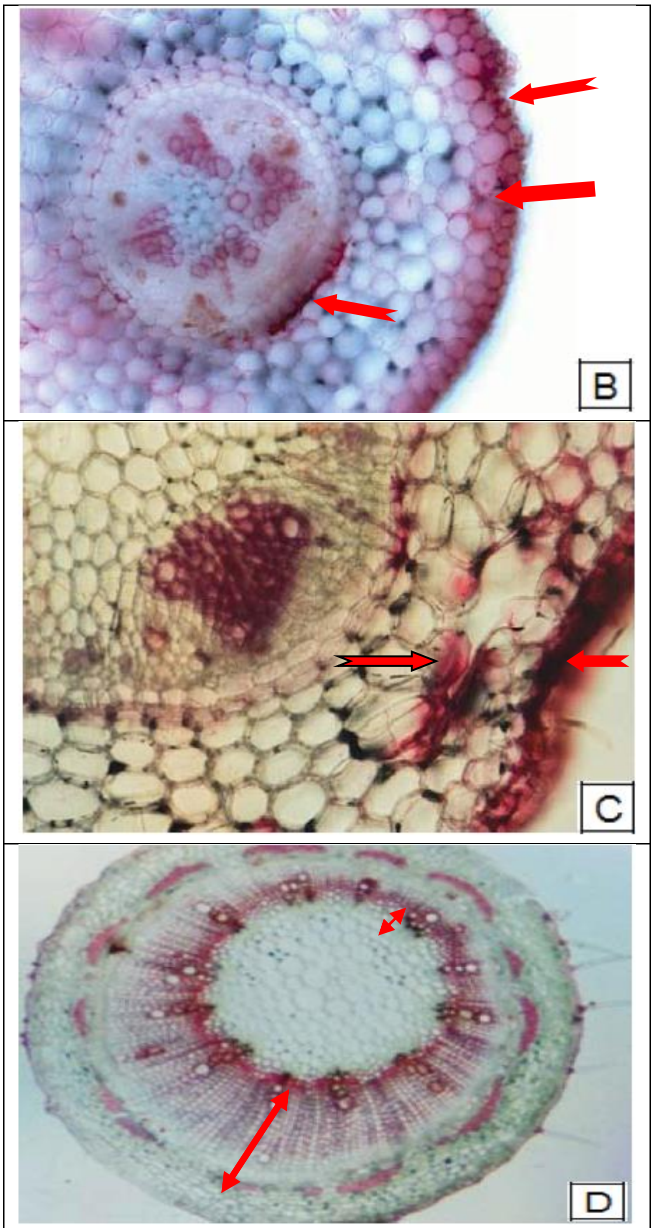


Fig. 4: Abnormal stem anatomy
A - *Trigonella foenum graucum* (abnormal epidermis, some cortical tissues and endodermis);Cell death occur in epidermal, hypodermal and some of the cortical cells , B – *Lycopersicon esculentum* (effluents affected outer layers); C – *Solanum melongena* young stem ,damage epidermis, cortex and endodermis, D - *Solanum melongena* old stemAnomalous cambium activity reflects into eccentric growth.

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