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A Note on the Anatomical Changes Induced by High Salinity Water in Roots of Vetiver (*Vetiveria zizanioides* Nash)*

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Abstract: Vetiver (*Vetiveria zizanioides* Nash), a hedge-forming grass with high tolerance to salinity, was grown from root divisions in pots containing sandy soil, at the Faculty of Agriculture, University of Khartoum, Sudan. Four levels of Red Sea water mixed with fresh water were used in the following ratios of sea water to fresh water: 0:1 (EC, 0.4 dSm^{-1}) as a control, 1:20 (EC, 3.1 dSm^{-1}), 1:10 (EC, 5.5 dSm^{-1}) and 1:5 (EC, 9.3 dSm^{-1}). Depending on the level of salinity suberization was induced to varying degrees in the stele including that of the pericycle, protoxylem elements, and phloem. This may have contributed to the death of plants under the highest level of sea water.

Key words: Vetiver roots; salinity water; anatomical changes

Salinity induces physiological, morphological and anatomical modifications in plants (Gadallah and Ramadan 1997). Anatomical modifications in roots, caused by high salinity, affect some physiological functions such as root hydraulic resistance (Navarro *et al*. 2007). Shannon *et al*. (1994) suggested that salt stress results in increased suberization and diameter of roots. These modifications were reported to have adaptive advantages for prolonged survival in saline or dry soils (Neumann 1995).

Vetiver (*Vetiveria zizanioides* Nash) is a hedge-forming perennial grass that rarely seeds and is propagated by root divisions or slips. It has important uses, including control of soil erosion, and was reported to have high salinity tolerance (Truong and Baker 1998).
The objective of the present study was to investigate the anatomical modifications of vetiver roots grown under different dilutions of Red Sea water.

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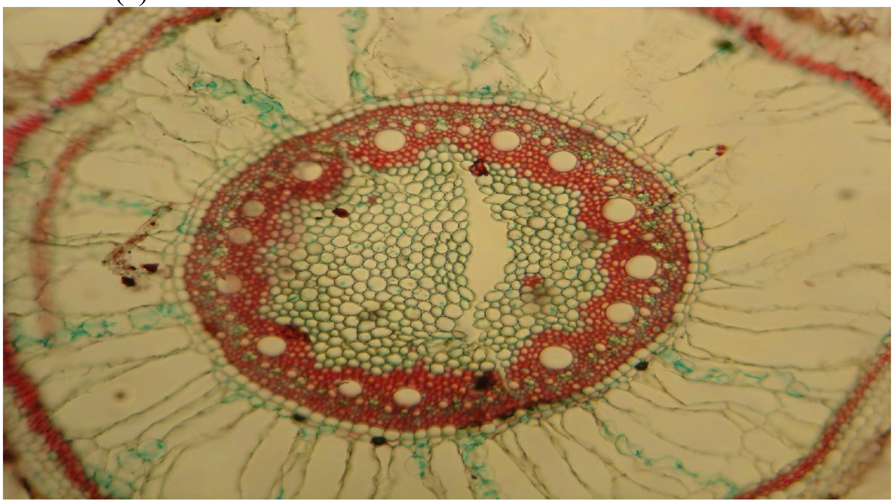
A pot experiment was conducted in the Faculty of Agriculture, University of Khartoum, Shambat, Sudan, using sandy soil and different dilutions of the Red Sea water; namely, sea water : fresh water 0:1 (EC, 0.4 dSm^{-1}) as a control, 1:20 (EC, 3.1 dSm^{-1}), 1:10 (EC, 5.5 dSm^{-1}) and 1:5 (EC, 9.3 dSm^{-1}). The treatments were designated S1 to S4, respectively. Vetiver root divisions were planted in pots arranged in a completely randomized design and irrigated with fresh water during the first three weeks of establishment; irrigation treatments were started thereafter. Root samples were taken for anatomical studies after three months of growth

The results showed that aboveground parts of plants irrigated with the highest proportion of seawater (S4) withered and died after two months of growth. The growth of plants under other dilution treatments was adversely affected to varying degrees compared to the control. The roots had a peculiar anatomy in which cortical cells under all treatments were destroyed leaving only cell walls connecting the hypodermis and endodermis (Plate 1). This would not affect water movement across the root since it takes place through the apoplast. A hypodermis of parechymatous cells followed 2-3 layers of heavily suberized cells and a prominent endodermis- all closely packed – were always present under all treatments. Salinity seemed to have induced extensive suberization of varying degrees in the stele. Suberization in response to salinity has been reported by Shannon *et al*. (1994) and Navarro *et al*. (2007). The pericycle was suberized under all treatments except the fresh water treatment (S1).

Under all treatments, metaxylem elements were surrounded by sheaths of sclerenchymatous cells (Plate 1). There was complete suberization of the phloem and protoxylem elements under the highest proportion of sea water (S4) and to a lesser degree under the S3 treatment. The complete suberization of the pericycle and phloem may have contributed to the death of plants under the highest proportion of seawater.

(a)



(b)

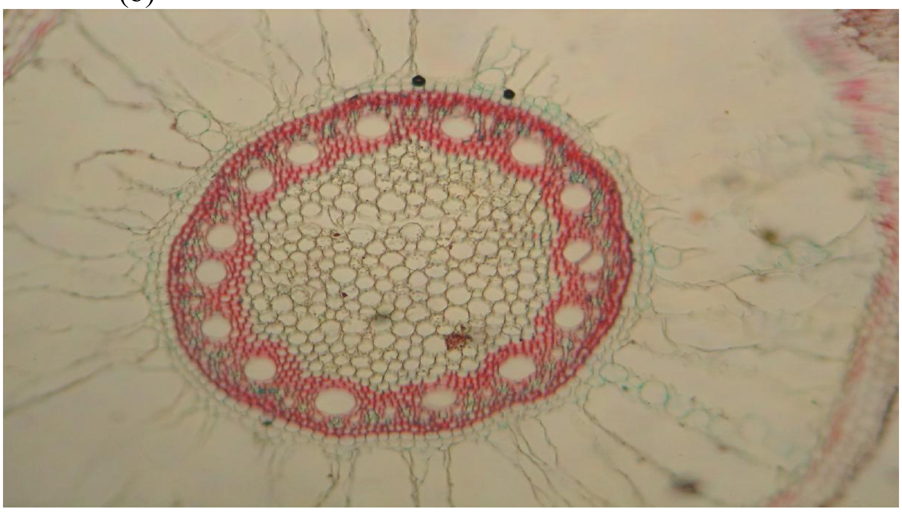
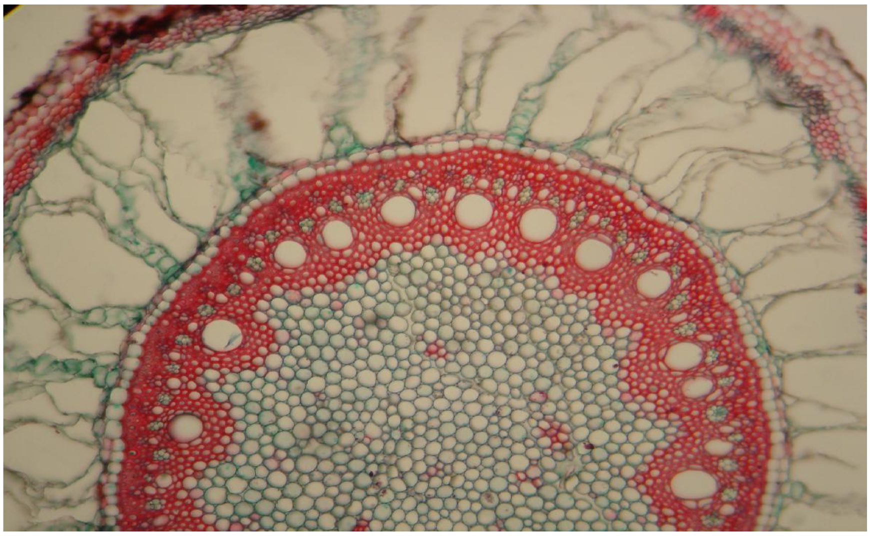


Plate 1. Cross-section of vetiver roots irrigated with (a) fresh water only (S1), and (b) 1:20 seawater: fresh water (S2), (c) 1:10 seawater: Fresh water (S3) and (d) 1:5 seawater: fresh water (S4). (Magnification X40)

(c)



(d)

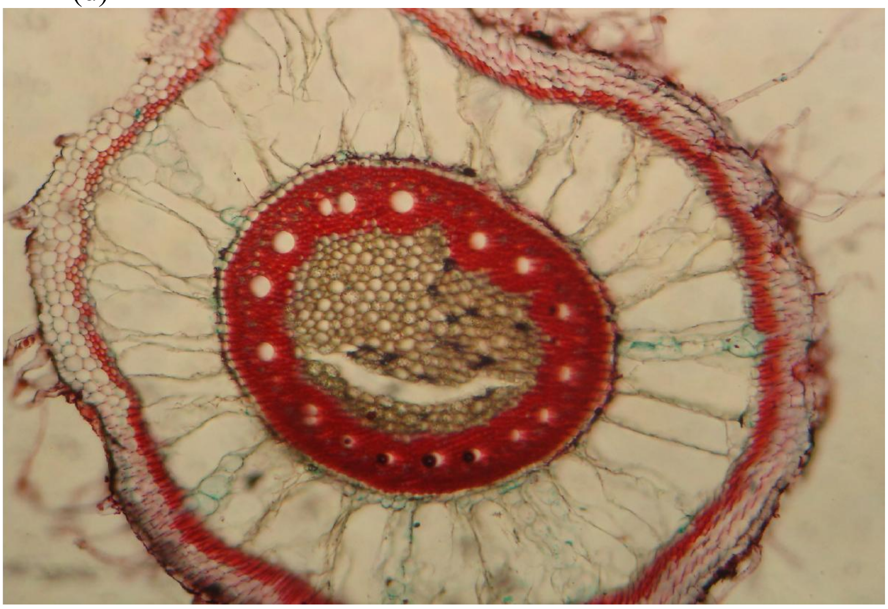


Plate 1. Contn.

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التغيرات التشريحية التى يحدثها الماء عالى الملوحة فى جذور نبات الفيتيفار (*Vetiveria zizanioides* Nash)*

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موجز البحث: زرع نبات الفيتيفار (*Vetiveria zizanioides* Nash)، الذى يكون أسيجة، وذلك باستخدام قطع من الجذور فى تجربة أصص تحتوى على الرمل بكلية الزراعة، جامعة الخرطوم. استخدمت ثلاثة مستويات من ماء البحر الأحمر مخلوطاً بالماء العذب، وكانت نسب ماء البحر للماء العذب على النحو التالى: 1:0 (EC, 0.4 dSm^{-1}) وقد استخدم كشاهد، و 20:1 (EC, 3.1 dSm^{-1})، و 10:1 (EC, 5.5 dSm^{-1})، و5:1 (EC, 9.3 dSm^{-1}). واعتماداً على مستوى الملوحة، أحدث الماء المخلوط سبرنة بدرجات متفاوتة فى العمود الوعائى وشمل ذلك الدائرة المحيطة وعناصر الخشب الأولى واللحاء. وربما قد ساهم ذلك فى موت النباتات تحت المستوى الأعلى من ماء البحر.

*جزء من أطروحة ماجستير للكاتب الأول، معهد دراسات التصحر واستزراع الصحراء، جامعة الخرطوم، السودان