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Water status of a plant body and its ohmic resistances

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The electrical resistivity of a plant body was determined using (i) a four probe resistivity bridge and (ii) a two probe a.c. conductivity bridge. Measurements were taken by inserting Pt electrode either into the stem or leaf petiole. Measurements by d.c. method had been found to result in polarization. The plant body resistivity was of the order of $10^4 - 10^5$ om.cm. The i - E curves obtained for plant leaves and stems were linear. Resistance measured varied predictably with uptake and loss of water and correlated positively with measurements of leaf water potential (LWP) and also leaf electric potential (LEP). In this paper, correlation between electrical resistance, LWP and LEP are presented.

Key words: Leaf water potential, leaf electric potential, ohmic resistance of leaf

METHODS AND MATERIALS

Leaf electric potential

Detached mango leaves were fixed to Pt wire electrodes through petiole and the leaves were kept half dipped in distilled water and in solutions of different concentrations of NaCl (0.05 to 1.5 M). Potentials were monitored with respect to saturated calomel electrode (S.C.E) over a period of 2 h. The pH of the external media was also monitored.

Leaf water potential

Leaf discs were obtained from both immersed and exposed parts of the leaves. Their water potentials were measured using HR - 33T Dew point microvoltmeter.

Resistance measurements

2-probe AC method: Two platinum pins of 0.5 mm dia and 2.5 cm length were inserted 10 cm apart into the stem of a croton plant. The resistance in between was monitored morning to evening using a conductivity bridge operating at 1000 cps.

4-probe DC method: Four Pt pins (0.5 mm dia × 2.5 cm long) were inserted into the stems of a potted croton and also a hibiscus plant. DC obtained from batteries, 5-50 μA was passed through the outer electrodes. Corresponding potentials developed between the two inner electrodes were monitored using a Digital voltmeter.

Similarly, resistance measurements were made on different plant leaves (guava, ashoka, spinach, mango, red gram and pothos). The four probes used were of Pt pins of dia 0.25 mm. The interelectrode distance was 1.5 mm.

TABLE–I: Leaf water potentials at different liquid media

Liquid media	Leaf water potential (bars)		
	Control	Immersed region	Exposed region
Dist. water	−20.9	−21.5	−21.9
0.05 M, NaCl	−21.0	−21.0	−23.0
0.2 M, NaCl	−18.5	−20.3	−22.5
1.0 M, NaCl	−20.0	−35.0	−23.0
1.5 M, NaCl	−17.0	−33.0	−21.0

Pure DC used was obtained from dry cells. Current passed was in the range 5-20 μA.

RESULTS AND DISCUSSION

Distilled water and 0.05 M NaCl solution have not affected the LWP much (Fig. 1). This may be due to endosmosis. The values obtained were very close to that of control (Table I). However, the LEP continued to increase over the experimental period of 2 h (Fig. 2). At concentrations of 0.2 to 1.5M, the LWP deviated from the control (Table I) to more negative values (Fig. 1). This may be due to exosmosis. The LEP decreased after an initial increase (Fig. 2). The pH of the external liquid media decreased from 5.8 to 5.6 and 7.5 to 6.0 for 0.05M and 1.5M NaCl solutions respectively. This decrease could be attributed to the excretion of electrolytes from the leaves [1]. The resistance of the croton plant measured by 2 probes increased from $2.6 \times 10^4 \Omega$ to $3.1 \times 10^4 \Omega$ during the course of the day. This reflects the gradual water loss due to transpiration which results in high solute concentration and high osmotic pressure. The latter undergoes rhythmic changes being low in the morning, high at 1-2 p.m. and low during night [2]. The concentration of the sap solute does not fluctuate greatly, over short periods [3]. Hence, it may be the water movement which alters the solute concentration. This in turn may be responsible for the variations in resistance, LWP and LEP. The i-E curves obtained by the 4-probe method in all the cases were linear. It is reported that plasmolysis is accompanied by lowering of specific resistance [4].

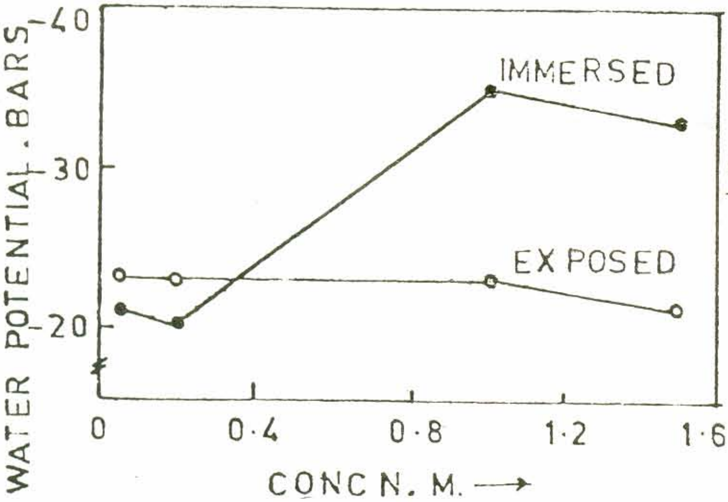

Fig. 1: Monthly variation in total microbial count

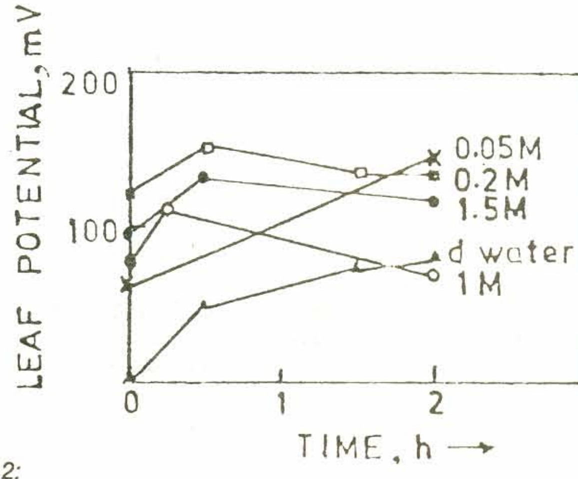

Fig. 2:

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