# Electric Capacity as a Measure of the Intact Root System Size in the Soil

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## ABSTRACT

When alternate electric current is put into the soil where a plant is growing and the second electrode is linked to the basal part of the plant and electric capacity measured then its size is positively related to the root system size (RSS). The measuring current frequency is 1 kHz (Chloupek, 1977; Dalton, 1995).
Comparable is only RSS:

- Of plants of the same species – RSS of different species are not comparable.
- When measured in the same time.
- In the same substrate (soil, hydroponics etc.).
- When the same instrument preset on measurement of parallel capacity is used.
- When the aerial part of the measured plants is dry.

The relation between RSS and its electric capacity is obvious from:

- The significant correlation between the electric capacity of the root system and its weight, volume and surface - not only in our experiments.
- Higher yield of varieties with greater RSS in dry environment (barley and wheat).
- The reaction of plants on drought which was similar as the reaction on small RSS (lower content of starch and higher content of nitrogen substances in barley and wheat grain).
  However the measurement cannot evaluate distribution of the RSS in soil profile.

KEYWORDS: Root system size (RSS), electric capacity, barley, wheat

## MATERIAL AND METHODS

The measurement was used in evaluation of barley varieties (not published yet). In 2005, 2006, 2007 and 2008, respectively, 10, 22, 20 and 22 varieties of two-row spring barley were evaluated at two locations (only one in 2007) for their root system size by its electric capacity (Fig. 1). The RSS were compared with the yield and quality of the varieties in official variety trials at 19, 7, 17 and 19 stations, respectively. All of the varieties were tested under two treatments: with and without fungicide application.

Figure 1. The device (LCR METER ELC 131D) for measurement of electric capacity in the field.

## RESULTS

The RSS of the barley was measured during elongation, heading and grain filling. It was influenced by the location of the experiments (48-88%), by the variety (3-16%) and between 2-8% of the total variation was unexplained.

Varieties with a greater RSS had a significantly higher yield in the dry year of 2007, which was characterized by a yield decrease of 18% for the four standard varieties in comparison to the other three years, at all 20 stations for both treatments ($r=0.480$ and 0.470, respectively, $P<0.05$ for both).

The difference in yield was particularly apparent when the RSS was greater in the first term, perhaps due to the relatively smaller RSS in this year. Varieties with below average RSS yielded significantly less than those with average and above average RSS. Similar relationships between RSS and yield in the relatively normal years (2005, 2006 and 2008) were found at only the four driest stations ($r=0.793$, $P<0.05$), with only a similar tendency at the highest altitude stations ($r=0.370$) and at all stations ($r=0.336$). No negative correlation was found between RSS and the corresponding yields.

Varieties with greater RSS in 2005 and 2006 had more stable yields (correlation with adaptability $r=-0.817$ and -0.448, respectively, $P<0.05$ for both); but lacked significant correlations in other years. Sixteen malting varieties with greater RSS had significantly higher contents of starch, sugar extracts and malt extracts ($r=0.635$, 0.610 and 0.503, respectively, $P<0.01$ and 0.05 for the last two) and higher yields of protein and starch ($r = 0.506$ and 0.833, respectively, $P < 0.05$ and 0.01) in 2007. It can be concluded that a small RSS was related to a lower grain yield and lower malt quality in dry environments, even if the genetic background of the varieties was very different (Chloupek, Dostal, Streda, 2009).

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