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Short Communication

Electrolytic leakage as a tool to assess seedling health in pine

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Electrolytic leakage in infected Blue pine (*Pinus wallichiana*) needles was monitored by measuring conductivity change in pine needles affected by Lophodermium needle blight disease. Electrolytic leakage in infected Blue pine needles varied significantly between severity categories. Highest electrolytic leakage of 345.33 µmoh/cm was noticed in pine needles having > 81% disease severity in comparison to unaffected check (181.33 µmoh/cm) indicating a positive relationship between disease severity and electrolytic leakage. The evaluation of electrolyte leakage appears to be rapid and accurate method for assessing the hardwood seedling health and physiological status.

Key words: Electrolytic leakage, blue pine, needle blight.

INTRODUCTION

The assessment of seedling health is an essential component of any reforestation or afforestation programme. The use of low quality seedlings may often result in decline in plant growth and establishment (Sampson et al., 1996). Therefore, it is imperative to identify the quality stocks showing vigorous growth attribute. Healthy vigorous seedlings grow at increasingly faster rates than the seedlings of low vigour (Burdett and Brand, 1990) and the plants raised from high quality saplings require less maintenance as well as exhibit more resistance to insects and diseases. Seedling vigour is associated with physiological activity of healthy tissue (Sampson et al., 1996).

Therefore, there is need for efficient practical methods to monitor the changes in physiological status of seedlings due to diseases. Electrolyte leakage determines the loss of electrolyte due to some interference in plant physiology and has successfully been employed in phyllosphere of sorghum for assessing the extent of disease infection (Balasubramanian, 1973) and for hardiness determine in conifers (Colombo et al., 1995; Bigras, 1997). Conifers are hardwood plants which often express disease symptoms very late rendering the disease management difficult. Therefore, the assessment of electrolyte leakage may help in providing some preliminary idea about pathpogenic interference even though the pathogen is latent. In the present communication, an attempt has been made to explore the possibility of using electrolyte leakage as a tool to assess disease through establishing a relationship between

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Table 1. Electrolytic leakage of Blue pine needles exhibiting blight severity of different categories.

Needle blight severity categories	Electrolytic leakage (µmoh/cm)
Needles without any infection	181.33 (13.46)
Needles with < 20% disease	226.67 (15.05)
Needles with 21 – 40% disease	253.00 (15.90)
Needles with 41 - 60% disease	286.00 (16.91)
Needles with 61 - 80% disease	302.00 (17.37)
Needles with > 81% disease	345.33 (18.58)
CD (P = 0.05)	0.32

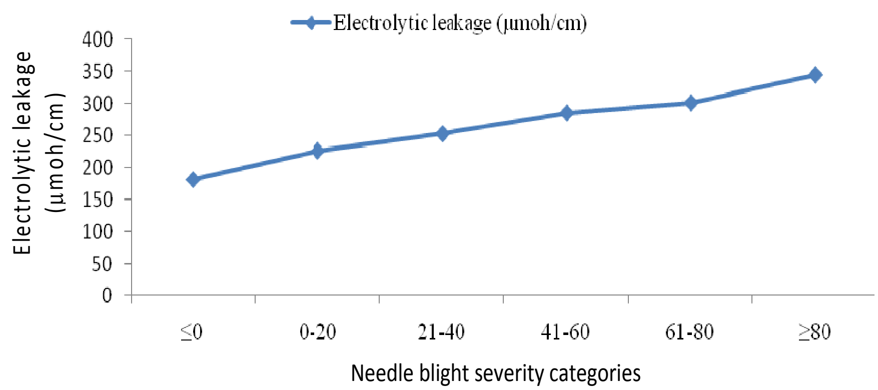

Figure 1. Effect of needle blight disease severity on electrolytic leakage.

needlecast disease severity and electrolyte loss.

MATERIALS AND METHODS

The infected Blue pine (*Pinus wallichiana*) needles bearing needlecast symptoms of varying intensity category were collected from Forest Nursery, SKUAST-K, Shalimar, Srinagar (J&K) during September-October, 2010. Six of 10 year old Blue pine plants were randomly selected and tagged for scoring of the diseased needles under natural epiphytotic conditions. Scoring was done as per the 0-4 point scale given by Skilling and Nicholls (1974) wherein 0 = needles/whorls showing no disease symptoms, 1 = needles/whorls affected with 1 - 25% infection; 2 = needles/whorls affected with 26 - 50% infection; 3 = needles/whorls affected with 51 - 75% infection, and 4 = needles/whorls affected with 76 - 100% infection. The percent disease intensity was calculated as per the formula:

$$\text{Percent disease intensity} = \frac{\sum (n \times v)}{N \times 4} \times 100$$

Where, Σ = Summation; n = number of diseased needles/whorls in each category, v = numerical value of each category; N = number of needles/whorls examined, and 4 = maximum grade value. The loss of electrolytes due to disease was estimated by measuring the conductivity of leachates from the diseased pine needles as per Wheeler and Hanchey (1968). The infected needles were thoroughly washed with tap water, rinsed three times with distilled water and finally washed with deionized water. The needle sample (1 g each) was blotted dry and suspended in sterile double distilled water in 10 ml water. The suspended material was incubated at 25 ± 1°C for 24 h. The conductivity of bathing solution was measured with the help of a conductivity bridge having platinum electrodes PICO pH meter (Labindia Ltd.). The temperature of bathing solution during conductivity measurement was maintained at 25 ± 1°C. The results were expressed as specific conductivity (µmoh/cm) of the leachetes.

RESULTS AND DISCUSSION

Electrolytic leakage in infected Blue pine needles was monitored by measuring the changes in the conductivity of needles affected by varied needle blight disease intensities. All the severity classes significantly varied in their electrolytic leakages (µmoh/cm). The highest electrolytic leakage of 345.33 µmoh/cm was noticed in pine needles having > 81% disease severity in comparison to control (181.33 µmoh/cm) (Table 1 and Figure 1). The electrolytic leakage in plants has previously been studied with respect to stress tolerance (McKay and White, 1997), cold hardiness (Burr et al., 1990) and dormancy status (Wilson and Jacobs, 2004), all of which are interrelated and depict cell damage due to loss of cell membrane integrity. The present study is first of its kind in conifer needles as well as with respect to forest diseases.

Grossnickle (2005) studied electrolytic leakages in conifer roots for determining the physiological stress. Further, they suggested that root electrolytic leakage procedures could forecast overall seedling performance over a range of root damages and reported that root electrolytes are species-specific. The loss of electrolytic leakage observed in disease affected needles in the present study may be attributed to the membrane damage due to necrosis and higher absorption of electrolytes by diseased plants. Our findings are in corroboration with Campos et al. (2003) who reported that electrolytic leakage in plant membranes is often associated with increases in permeability and loss of integrity. Wheeler and Hanchey (1968) reported electrolytic leakage as a result of downy mildew disease in sorghum caused by *Sclerospora sorghi.* Pellizzari et al. (1976) have reported that electrolytic leakage from infected leaf tissues represents an early pathogenic event occurring during the hypersensitive response (HR) to viruses, bacteria or fungi. Water and electrolyte losses may explain the formation of necrotic local lesions, characteristic of HR, by assuming that they represent an early step of necrogenesis due to membrane damage, leading ultimately to cell death (Pellizzari et al., 1976; Goodman, 1972). The stock health quality tests that measure the functional integrity of seedlings may help to forecast their survival capability and growth under optimal conditions (Grossnickle and Folk, 1993).

The correlation between needle blight severity and electrolytic leakage was highly significant (P = 0.01) and positively correlated (r = 0.98). Also, the multiple regression analysis revealed that the unit change in disease severity exerted influence on electrolytic leakage upto the extent of 1.63 units in positive direction. The regression equation of $Y_{\text{Electrolytic leakage (µmoh/cm)}} = 197 + 1.63_{\text{Needle blight severity category}}$ and $R^2 = 95.5$ revealed that only 4.5% variation is due to other reasons than that of needle caste disease. Perusal of literature reveled that knowledge about electrolytic leakage due to needle blight disease is lacking and it signifies its importance of studies.

Conflict of Interest

The authors have not declared any conflict of interest.

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