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LIGHT CONTROL OF PERIODICITY OF BLEEDING FROM ROOTS OF *VICIA FABA*

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Key Word Index—*Vicia faba*; Leguminosae; light control of bleeding sap; sugars; amino acids.

Abstract—The light control of the periodicity of bleeding sap was investigated, and it appears that the metabolic activity of the roots controls the exudation. Nitrite, nitrate, fructose, glucose and sucrose, various amino acids and some other unidentified compounds, were detected in the bleeding sap.

INTRODUCTION

EXUDATION of bleeding sap from cut stumps of herbaceous plants shows a diurnal periodicity, which has been described for a number of plants including sunflower,[1] tomato[2] and field pea.[3] Considerable evidence supports the view that exudation from root systems is related to the synthetic activities of the root and, in a legume, the root nodules. Correlations between illumination of plant tops and activity of nitrogen fixation in nodules have been shown by many workers, and the role of photosynthate translocated from the plant tops has been implicated.[4–7] The present work demonstrates the effect of light in controlling the timing of the periodicity.

RESULTS

Data were collected during 36 hr periods from 2 sets of plants. In November, the diurnal pattern of bleeding had its maximum at about 12.00—4 hr after the beginning of the light period and 2 hr before the temperature maximum. In March, a similar result was obtained. In October, the lights were turned on at 03.00 to prevent the glasshouse from freezing. This had the effect of keeping the temperature minima and maxima at about the same times of day as in the earlier experiments, but altered the time of maximum bleeding to 06.30—3·5 hr after the beginning of the light period.

Analysis of the November samples indicated that exudation of amino acids was maximum near the bleeding maximum. Mean amino weight per plant per hr decreased to 0·2 μg at 22.00 hr and was maximum at 28 μg at 14.00 hr.

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The following compounds were identified in sap by TLC: nitrate, nitrite, fructose, glucose and sucrose. In addition, aspartic and glutamic acids and their amides, accounted for 80–90% of the sap amino acid content, and the following amino acids were also present in trace amounts: cysteine, serine, threonine, dihydroxyphenylalanine, alanine, valine, methionine, tyrosine, phenylalanine, isoleucine, leucine, glycine, arginine, lysine and γ-aminobutyric acid. Unidentified organic acids were also present, and dansylation indicated the possible presence of some small peptides.

DISCUSSION

The effect of light in controlling the timing of the periodicity of bleeding is demonstrated. Light has a well documented effect on the metabolism of roots and root nodules since, through photosynthesis, it provides the carbohydrates from which xylem sap amino acids are synthesised.[8] Thus, root metabolism may be reduced at night due to lack of carbohydrate supply from the shoot. Certainly the amino acid concentration of sap is reduced at night.[2] Whilst it appears that the metabolic activity of roots controls the exudation of bleeding sap, the mechanism of the control is obscure.

EXPERIMENTAL

Seeds of *Vicia faba* var. Triple White, were sown in pots in garden soil and grown to three leaves in a glasshouse with a 14-hr day provided by supplementary lighting. Temperatures were measured using a thermohydrograph.

Shoots were excised below the first leaf and sap allowed to collect for one hr in tubes made of 'parafilm', sealed to the stump with white Vaseline. A group of 20–30 plants were decapitated at each sample time. Volumes were measured with a microsyringe. Total amino acids were determined by aspiration of samples through the external standard line of a Technicon Autoanalyser, using alanine as a standard. Concentrations were calculated as μg alanine.

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