EFFECTS OF WATER STRESS AND PARTIAL SOIL-DRYING ON SENESCENCE OF SUNFLOWER PLANTS

by

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SUMMARY

The present thesis aimed to investigate the symptoms of leaf senescence in response to plant shoot water stress and explore the possibility of the involvement of a non-hydraulic root signal in the senescence response of mature leaves of sunflower.

The effect of plant leaf water status on mature leaf senescence of sunflower was evaluated from changes in the leaf water potential and soluble protein, total free amino acid and chlorophyll contents, and chlorophyll a/b ratio, following a regime of a single water stress cycle (15 days) and resumption of adequate water supply. The fall in leaf water potential accelerated the rate of loss of leaf soluble protein content compared to that occurring in non-stressed senescing leaves. In corresponding to the breakdown of soluble protein there was an accumulation of free amino acid,s including a presumed proline S accumulation. This phenomenon is different from that which occurred in attached naturally senescing leaves, in which the total amino acid content was found to decrease in company with the fall in leaf soluble protein content.

The rate of loss of chlorophyll content was also accelerated by water stress. Chlorophyll degradation in response to water stress, however, was slower than the protein response. A similar pattern of response to that in total chlorophyll content was also achieved in the chlorophyll a/b ratio.

Upon re-watering, there was a recovery in the protein content to the level found in control leaves coupled with a rapid disappearance of the total free amino acid accumulated. Total chlorophyll content and chlorophyll a/b ratio, on the other hand, did not recover to the control levels after watering was resumed. However, there was a change in the rate of decline of both total chlorophyll content and chlorophyll a/b ratio to the normal senescence rate, subsequent to the recovery in leaf water potential.

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To examine the possibility of an effect of a root-sourced signal on leaf senescence, plants were grown with the root system divided equally between two containers. One half of the root system was exposed to drying soil by withholding water from this half of the soil, whereas the other half of the soil was well-watered to maintain the leaf water status. Metabolic changes in mature leaves of these plants following six weeks of the partially soil-drying imposition were determined in comparison to those in well-watered plants. The loss of leaf soluble protein content showed a significant response to the effect of treatment from week 4 of exposing the plant to soil-drying in part of the root system. However, there was no significant response in leaf total chlorophyll, free amino acid and proline contents, but a slight response, when summed across time and leaf position, in chlorophyll a/b ratio compared to that in the control leaf.

To investigate whether this increase in the leaf protein loss rate in response to soil-drying could be attributed to reductions in nutrient supply or undetectable changes in leaf water status as a result of the loss of half the nutrient or water gathering capacity, the half of the root system in drying soil was excised after four weeks of exposure to drying soil. This treatment was followed by an increase in leaf protein content, indicating relief from the effects of roots growing in dry soil.

The results are interpreted to demonstrate an effect of a non-hydraulic root signal on senescence of the leaves. The alleviation of the leaf soluble protein loss rate by the excision of the root system in drying soil also indicates that this signal originates in roots in dry soil and acts to promote protein loss.

STATEMENT

I hereby declare that the thesis here presented contains no material which has been accepted for the award of any other degree or diploma in any University and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

I give consent to this copy of my thesis, when deposited in the University Library, being available for loan and photocopying.

(Sathaporn Wongareonwanakij)

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