

ABSTRACT

Comparative Evaluation of the response of pigeon pea and cowpea to drought and waterlogging

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A series of pot experiments were carried out under greenhouse conditions to compare the physiological and morphological responses of pigeon pea and cowpea to increased levels of moisture stress resulting from inadequate or excessive water supply.

In pigeon pea moisture stress increased the stomatal resistance (Γ_s) of the upper leaf surfaces, but had no effect on Γ_s of the lower surfaces, whereas in cowpea moisture stress increased the Γ_s of both leaf surfaces in a similar manner. This difference in stomatal response resulted in a much greater relative decrease in total stomatal conductance in cowpea which was reflected in reduced water loss and higher values of leaf water potential (Ψ_L) and leaf relative water content (LRWC) in cowpea as compared to pigeon pea.

Leaf area development, dry matter accumulation and growth rates were adversely affected by increasing the levels of moisture stress in both crops. Root:shoot ratio was increased in both crops in response to moisture stress with the increase in pigeon pea being greater.

Water use efficiency (WUE) was also increased by increasing the levels of moisture stress in both crops particularly in the early stages of growth although in cowpea a trend of increasing WUE was also observed in the pod filling stages.

The exposure of cowpea cultivars to waterlogging resulted in rapid stomatal closure, increased LRWC and a sufficiently high Ψ_L to maintain leaf turgor, but reduced photosynthetic rates. Genotypic variability in stomatal response to waterlogging among the cowpea cultivars was also observed, but all growth indices were adversely affected by waterlogging treatments.

The differences between cowpea cultivars A-1809 (tolerant) IT-83S-898 (intermediate) and UCR-A-31 (susceptible) with respect to water status, leaf area

development, dry matter accumulation and growth rates in response to waterlogging were related to the greater degree of root damage in the susceptible cultivar and to the greater development of lysigenous cavities in the stem base and primary roots of the tolerant cultivar.

Waterlogging of pigeon pea cultivars for 1 to 4 days severely affected all cultivars and resulted in wilting, chlorosis, senescence, reduced leaf area, root damage and marked reduction of dry matter accumulation.

It is concluded that, pigeon pea is better adapted to drought conditions than cowpea because of its ability to maintain leaf turgor at very low Ψ_L and the greater increase in root:shoot ratio in the former. In contrast the physiological, morphological and anatomical changes in cowpea enable some cultivars to tolerate moderate levels of waterlogging, whereas the pigeon pea cultivars tested were extremely sensitive and unable to tolerate waterlogging in excess of one day.

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