Chilling and the germination and early growth of sorghum and cotton seedlings

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Many crops of tropical and subtropical origin, such as corn, cotton, soybean, rice, sorghum and tomato, suffer chilling injury when subjected to non-freezing temperatures below about 10-15^{0}C. This situation arises when these species are grown as summer crops in temperate environments and occurs most commonly in the spring and early summer when there is a greater probability of experiencing low soil and air temperatures.

Chilling causes a number of reversible changes in the physical state of membranes, resulting in reduced permeability and in the structure and function of enzyme proteins. If chilling is sustained, these primary events lead sequentially to a serit of secondary lesions and, ultimately, to irreversible injury of the plant tissue (1 Some of these effects have been studied during the germination and early growth of sorghum *(Sorghum bicolor)* and cotton *(Cossypium hirsutum)* when exposed to chilling stress under controlled conditions of light and temperature.

Seeds of both species are injured and fail to germinate at temperatures much below 8-10?C, conditions which are commonly experienced in soil during spring in district where these crops are grown. Arrhenius plots of respiration and germination rates show a decrease in Qlo's of these reactions below about 12?C, indicating a marked reduction in rates below this 'critical' temperature. The rate of elongation of th mesocytol is also negligible below 10?C. The resulting combination of slow germination and delayed emergence at low temperatures predisposes seedlings to attack by fungal and other soil-borne pathogens (2).

Chilling young cotton seedlings at 5?C in the light also reduces the hydraulic con ductivity of the roots, causing the leaf water potential to fall. Because stomata also close very slowly at this temperature, the loss of water through transpiration causes further dehydration and wilting of leaves. If chilling is prolonged, the de hydration, coupled with photo-oxidation of chlorophyll, can cause the death of exposed leaves (3).

Chlorosis of early-formed leaves of cotton and soybean, when exposed to chilling in the light, is due to the failure to accumulate chlorophyll under conditions of slow chlorophyll synthesis and rapid photo-oxidation of newly-formed pigment.

The damage to the roots, leaves and photosynthetic capacity of seedlings of cotton and sorghum, as a result of chilling, causes a significant reduction (70%) in their relative growth rates 6 days after exposure to only 24 h chilling in the light at 8$^?$C. Chilling injury suffered by crops in the seedling stage can also influence later development and ultimately cause a reduction in final yield.

Little can be done to reduce deleterious consequences of chilling stress except by breeding for increased chilling tolerance within the range of variation present in most chilling-sensitive crops. A rapid screening technique, based on the rate of chlorophyll synthesis in etiolated leaf tissue, is being developed to assist in this regard.

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3. McWilliam, J.R., Kramer, P.J. and Musser, R.L. 1982. Aust. J. Plant Physiol. (In press).