

Effect of Stem Infused Chemicals on Kernel Yield, Levels of Enzymes and Chlorophyll content in Maize (ZEA MAYS L) varieties

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Key Words

Stem infused chemicals, Kinetin, thiourea, n-Propyl gallate, L-Histidine, n-Ethyle maleimide.

Media Summary

Stem infusion of kinetin, thiourea, n-propyl gallate, L-histidine significantly increases kernel yield in tropical maize (*Zea mays* L.) varieties while NEM significantly decreases them.

Abstract

The yield for tropical maize is lower than the temperate maize and it has been suggested that poor transport and partitioning of total dry matter to grain are the major constraints. Grain filling is a function of position of the ear leaf, photosynthesis rate, plant growth regulator level and rate of assimilate transport. Structural complexity of leaf and kernel tissue can limit the development of grain. Infusion of chemicals through stem can be used as a tool to ascertain their role during seed formation. The chemicals used for this study were kinetin(kin), thiourea(thio), n-propyl gallate (n-PG), L-histidine (L-hist) and n-ethyl maleimide (NEM) injected through internode below the ear at 3 days after pollination (DAP) and 10 DAP. Stem infusion of kinetin, thiourea, n-propyl gallate, L-histidine significantly increased kernel weight, number of kernels and yield of apical, middle ear and basal ear position kernels in all four varieties of maize viz Prabhat, Navjot, Malan and Surya while NEM significantly decreased them. The result suggests accumulation of sucrose in field grown ear cob and kernel pedicel due to symplastic/apoplastic or both restrictions as evident by NEM application. Kinetin and biomodulators like thiourea, n-propyl gallate, L-histidine partially overcome such restrictions of assimilate transport leading to an increase in growth and development of seeds in kernels. Levels of total lipoxygenase, alpha- amylase and protease differed among the ear positions. The chlorophyll content of leaves was also affected by the infusion of these chemicals.

Introduction

The yield of tropical maize (*Zea mays* L.) is lower than temperate maize and it has been suggested that poor transport and partitioning of total dry matter to grain are the most important constraints (Goldsworthy 1974). Grain filling is a function of position of the topmost ear, leaf photosynthesis rate, plant growth regulators level and rate of assimilate transport from source to sink (Gifford and Evans 1981). All of these functions depend on various biochemical factors that have a direct bearing of grain function per se. Determination of such factors limiting grain development are difficult to ascertain due to structure complexity of leaf and kernel tissue which are involved in assimilate partitioning and transport. Infusion through stem (Boyle et al 1991), especially during early embryogenesis (upto 10 DAP) is a method used to ascertain role of chemicals in maize and seed formation (Zhang 1999). The effect of stem injected kinetin, thiourea, n-propyl gallate, L-histidine and N-ethyl maleimide were seen in four Indian maize varieties at 3 and 10 days after pollination on kernel number, weight, chlorophyll content and activities of enzymes viz lipoxygenase(Lox), alpha amylase and protease.

Materials and Methods

Zea mays L. cultivators Malan, Surya (maturity 80 d), Navjot maturity 90 d) and Prabhat (maturity 105 d) were grown under standard rain fed agronomical conditions. Stem injection (modification of Boyle et al 199) solutions of kinetin, thiourea, n-propyl gallate, L-histidine and NEM were injected in the stem through internode below the ear at 3 DAP and 10 DAP during 0800 - 1200 hours. Control group received water only. Plants were allowed to grow without any further treatment. Ears were harvested at maturity and data were collected on kernel weight number and average kernel yield per ear. The chlorophyll content was estimated from the ear leaf (Moran and Perath 1980). Enzymes Lox (Hans Peter 1974), alpha amylase (Wrint & Hans Peter 1974) and protease (Wrint 1974) were estimated from kernels at three positions (basal, middle, and tip) on the ear at 10 DAP.

Results and Discussion

The aborted ovaries of apical portion in mature cob were filled with grains in injected plants by kinetin, thiourea, n-propyl gallate (n-PG), L-histidine. Stem injection of chemicals except NEM significantly increased apical kernel number and weight in all varieties. The effect of chemicals being in the order of kinetin > thiourea > n-propyl gallate (n-PG) > L-histidine. NEM reduced the number of kernels in all varieties indicating that it restricts sucrose transport from source to sink. It is known that anatomically all ovaries are similar after fertilization for some time (Spollen et al 1986). Similarly, there are no significant differences between apical and middle seeds on the ear regarding concentration of abscisic acid. IAA and gibberellins Zhang et al 1999). The "aborting ovaries" perhaps have reduced sink strength (capacity to accumulate the photosynthate transport from leaves) as compare to setting ovaries and as a result they accumulate less sucrose (Spollen et al 1986). In terms of phytohormones it has been reported that cytokinin concentration was lower and ethylene production was higher in aborting seeds than developing middle ear (Zhang et al 1999). The result suggests accumulation of sucrose in field grown ear cob and kernel pedicel due to symplastic or both restrictions as evident by NEM application. Kinetin and biomodulators like thiourea, n-propyl gallate, L-histidine partially overcome such restrictions of assimilate transport leading to an increase in growth and development of seeds.

Distribution of enzymic level of total lipoxygenase (lox), alpha amylase and protease differed among ear positions. Lox activities was higher in basal than apical kernels while alpha amylase was significantly higher in apical than mid ear and minimum being in basal kernels. Total protease activity did not differ among three ear positions.

Kinetin, thiourea, n-Propyl gallate and L-Histidine, increases the chlorophyll content of leaf while NEM decreases the same.

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