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Growth and biomass production in potato grown in the hot tropics as influenced by paclobutrazol

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Abstract

Two similar field trials were carried out during 2003 in a hot tropical region of eastern Ethiopia to investigate the effect of leaf and soil applied paclobutrazol on the growth, dry matter production and assimilate partitioning in potato. A month after planting paclobutrazol was applied as a foliar spray or soil drench at rates of 0, 2, 3, and 4 kg a.i. paclobutrazol ha^{-1}. Plants were sampled during treatment application and subsequently 2, 4, 6 and 8 weeks after treatment application. The data was analyzed using standard growth analyses techniques. None of the growth parameters studied was affected by the method of paclobutrazol application. Paclobutrazol decreased leaf area index, crop growth rate, and total biomass production, and increased specific leaf weight, tuber growth rate, net assimilation rate, and partitioning coefficient of potato. At all harvesting stages, paclobutrazol reduced the partitioning of assimilate to the leaves, stems, and roots and stolons and increased allocation to the tubers. Although paclobutrazol decreased the total biomass production it improved tuber yield by partitioning more assimilates to the tubers. Paclobutrazol improved the productivity of potato under tropical conditions by redirecting assimilate allocation to the tubers.

Introduction

Potato prefers cool weather and the optimum temperature for foliage growth is 20–25 °C, for net photosynthesis 16–25 °C, and for tuberization 20 °C (Levy 1992). Although it is a remarkable adaptable crop its expansion has been restricted in some regions due to unfavorably high temperatures.

Leach et al. (1982) developed a carbon budget for potatoes indicating that plant growth rate is strongly related to net photosynthesis and dark respiration. At elevated temperatures foliage growth is promoted, rate of photosynthesis declines rapidly, assimilate partitioning to the tubers is reduced and dark respiration increases (Thornton et al. 1996). Tuber growth is completely inhibited at 29 °C (Levy 1992) above which point the carbohydrate consumed by respiration exceeds that produced by photosynthesis (Burton 1972).

The effects of high temperatures on the growth and development of potato believed to be mediated through the production of high levels of gibberellin-like compounds (Menzel 1981) that are known to delay or inhibit tuberization (Vreugdenhil and Struik 1989; Abdella et al. 1995). Hammes and Nel (1975) postulated that a balance between endogenous gibberellins (GA) and a tuber