RESPONSE OF POTATO TO PACLOBUTRAZOL AND MANIPULATION OF REPRODUCTIVE GROWTH UNDER TROPICAL CONDITIONS

by

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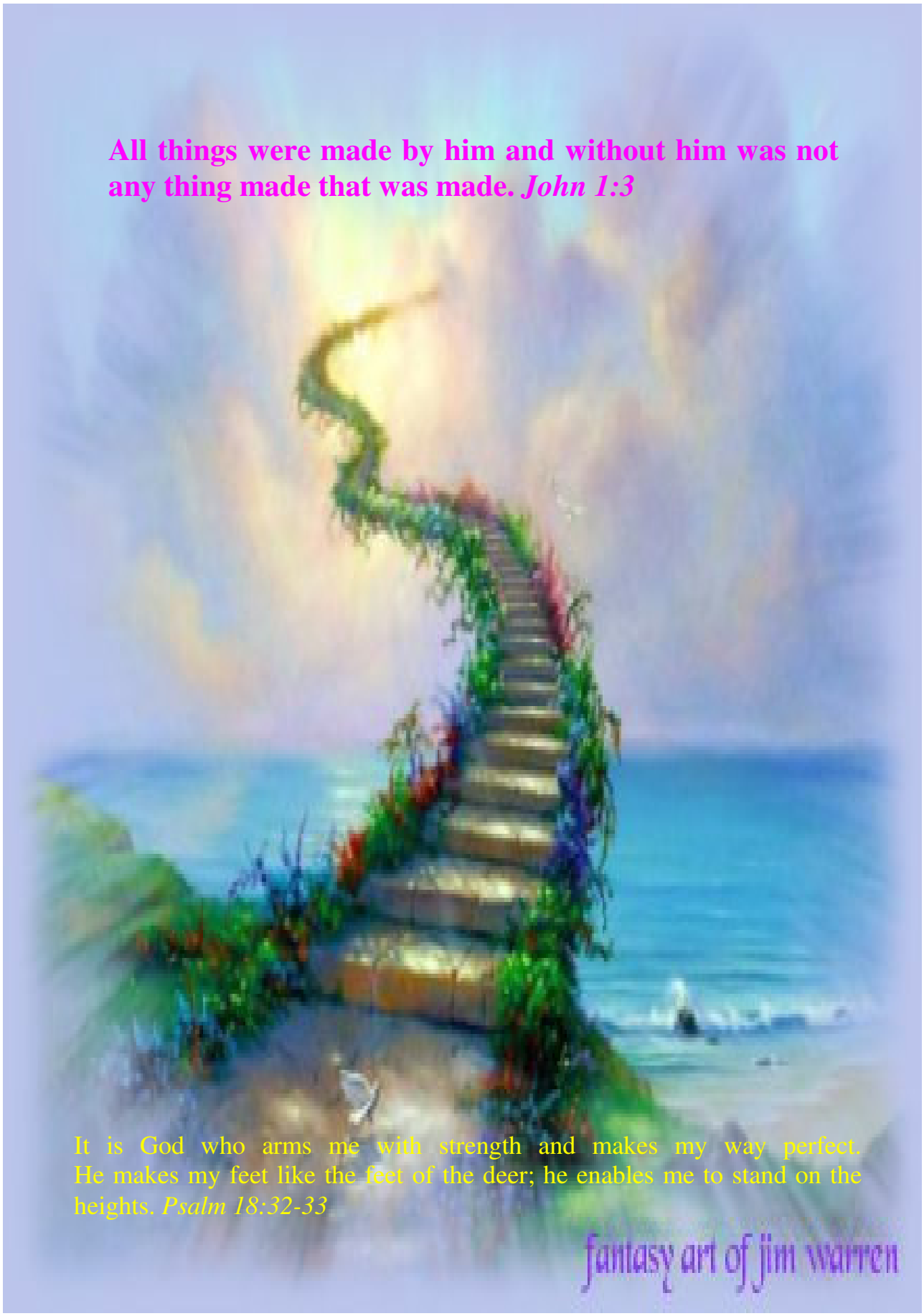
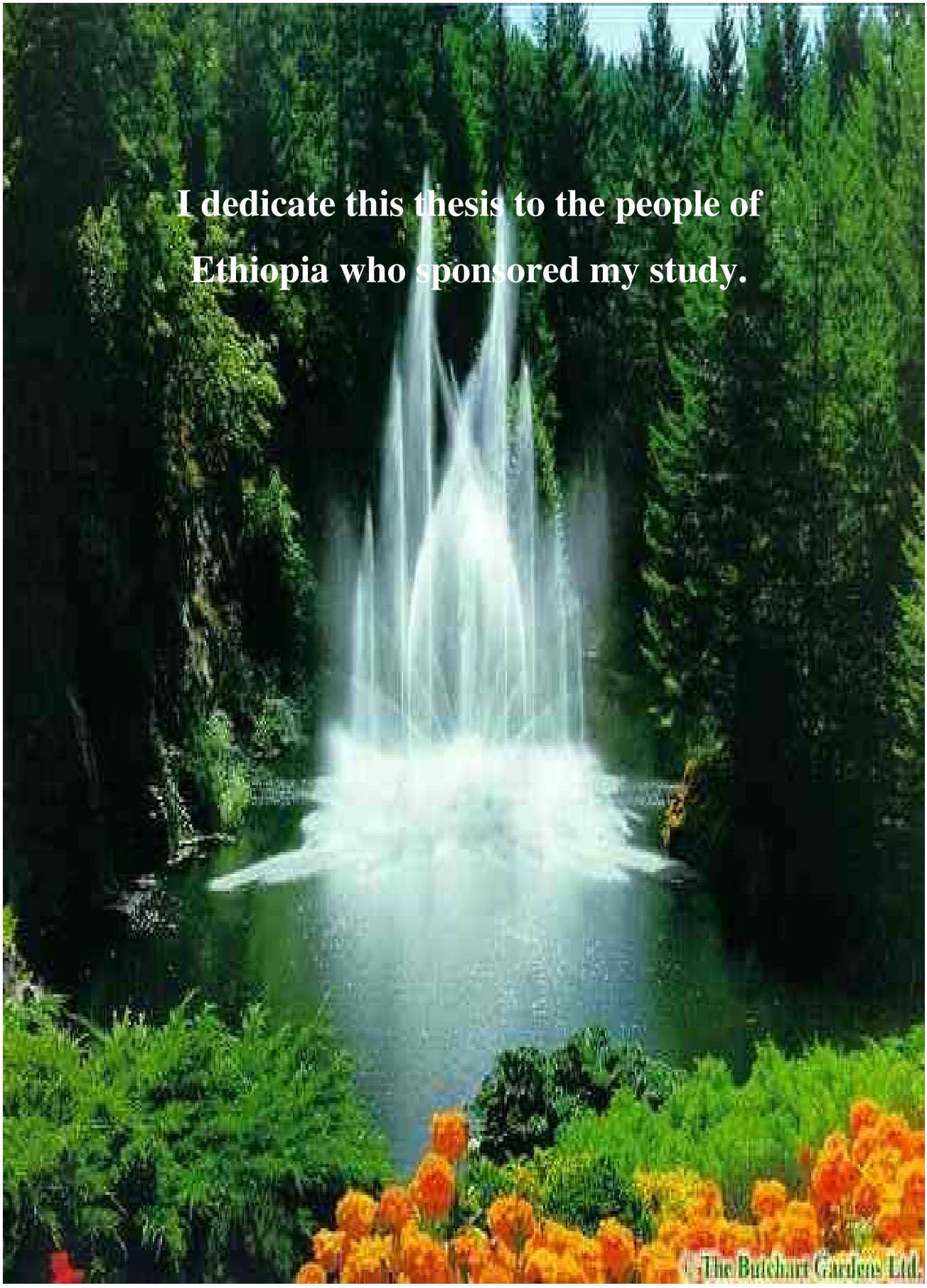

All things were made by him and without him was not any thing made that was made. *John 1:3*
It is God who arms me with strength and makes my way perfect. He makes my feet like the feet of the deer; he enables me to stand on the heights. *Psalm 18:32-33*
fantasy art of jim warren


I dedicate this thesis to the people of
Ethiopia who sponsored my study.
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RESPONSE OF POTATO TO PACLOBUTRAZOL AND MANIPULATION OF REPRODUCTIVE GROWTH UNDER TROPICAL CONDITIONS

BY

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ABSTRACT

High temperature limit successful potato cultivation in the lowlands of tropical regions. One effect of high temperature may be an increase in gibberellin activity that is inhibitory to tuberization. Paclobutrazol blocks gibberellin biosynthesis and reduces its level in the plant. The effect of paclobutrazol on potato was examined under non-inductive conditions in a greenhouse and under field conditions in the hot tropical lowlands of eastern Ethiopia. Paclobutrazol was applied as a foliar spray or soil drench at rates equivalent to 0, 2, 3, and 4 kg a. i. per ha.

Paclobutrazol increased chlorophyll *a* and *b* content, and photosynthetic efficiency, enhanced early tuber initiation, delayed physiological maturity, and increased tuber fresh mass, dry matter content, specific gravity and crude protein content. It reduced the number of tubers per plant and extended the tuber dormancy period. Paclobutrazol reduced shoot growth, and plant height, and increased the partitioning of assimilates to the tubers while reducing assimilate supply to the leaves, stems, roots and stolons. Stomatal conductance and the rate of transpiration were reduced. In addition, paclobutrazol treatment increased tuber N, Ca and Fe content while reducing P, K and Mg content. Growth analyses indicated that paclobutrazol decreased leaf area index, crop growth rate, and total biomass production. It increased

specific leaf weight, tuber growth rate, net assimilation rate, and partitioning coefficient (harvest index). Microscopic observations showed that leaves of treated plants developed thicker epicuticular wax layers. The epidermal, palisade and spongy mesophyll cells were larger. It increased the thickness of the cortex and the size of vascular bundles and pith cells of the stem. It also increased the width of the cortex and favoured the formation of more secondary xylem vessels, resulting in thicker roots. Deposition of starch grains in the stem pith cells, and cortical cells of the stem and root, were stimulated in response to paclobutrazol treatment. In most instances the method of application did not affect the efficiency of paclobutrazol.

The effect of cultivar and reproductive growth on growth, photosynthetic efficiency, water relations, dry matter production, tuber yield and quality of potato was also the subject of investigation. Non-flowering, flowering and fruiting plants of cultivars Al-624, Al-436, CIP-388453-3(A) and CIP-388453-3(B) were evaluated under field conditions of a sub-humid tropical highland of eastern Ethiopia. Cultivars exhibited differences with respect to leaf stomatal conductance, rate of transpiration, net photosynthesis, biomass production and allocation, tuber yield, tuber size distribution, specific gravity, dry matter content and nutrient composition. Fruiting plants had higher leaf stomatal conductance, and higher rates of transpiration and photosynthesis rates. The leaf area index, tuber growth rate, and partitioning coefficient (harvest index) of the fruiting plants were reduced, but crop growth rates and net assimilation rates were higher. Without affecting total dry matter production, fruit development reduced the amount partitioned to the leaves, stems, roots, and tubers. Fruit development reduced total and marketable tuber mass and tuber numbers.

The effect of MCPA and paclobutrazol were studied under greenhouse and field conditions. Single foliar sprays were applied during the early and full bud development stages at rates of 0, 250, 500, and 750 g a.i. ha^{-1}. Both MCPA and paclobutrazol greatly reduced the number of flowers and completely inhibited berry set. MCPA did not affect the number, yield, dry matter content and specific gravity of tubers. Without affecting the number of tubers, paclobutrazol increased tuber yield, dry matter content and specific gravity.

Keywords: Anatomical modification, assimilate partitioning, Ethiopia, growth analysis, high temperature, non-inductive, paclobutrazol, potato genotypes, photosynthetic rate, *Solanum tuberosum* L, specific gravity, tropical lowland, tuber quality, tuber yield

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