ANONGNUT BHONWONG: DEFENSIVE ROLE OF TOMATO

POLYPHENOL OXIDASES AGAINST COTTON BOLLWORM \textit{[Heliothis armigera} (Hübner)] AND BEET ARMYWORM \textit{[Spodoptera exigua} (Hübner)].

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POLYPHENOL OXIDASE/ TOMATO/ \textit{Lycopersicon esculentum} Mill./ COTTON BOLLWORM/ \textit{Heliothis armigera} (Hübner)/ BEE ARMYWORM/ \textit{Spodoptera exigua} (Hübner)/ DEFENSIVE ROLE/ INSECT RESISTANCE

Tomato (\textit{Lycopersicon esculentum} Mill.) is an economically important vegetable crop with numerous health-beneficial compounds. Tomato polyphenol oxidases (PPOs) catalyze the oxidation of phenolics to quinones and have implicated in insect resistance. This defensive role, however, has not conclusively proven in tomato. The objectives of this study were 1) to select transgenic tomato plants with modified PPO activity levels suitable for use as a platform for defensive role against insect evaluation, 2) to examine PPO expression under normal condition and in response to insect infestation and 3) to evaluate the defensive role of PPO against cotton bollworm \textit{[Heliothis armigera} (Hübner)] and beet armyworm \textit{[Spodoptera exigua} (Hübner)]. The foliage consumption, larval growth rate, mortality percentage, pupal weight and larval life-span of cotton bollworms and beet armyworms feeding on foliar and fruits of transgenic tomato overexpressing PPO (OP) and underexpressing PPO (UP) were evaluated in comparison with those feeding on
nontransformed (NT) plants.

Selection of transgenic tomato using PPO activity assay, the most accurate and precise method, allowed efficient obtainment of UP19-3 plants with 1.2-30.5 fold lower foliar PPO activity levels than NT, OP18 plants with .6-25.3 fold higher foliar PPO activity than NT, and OP28 plants with 1.6-11.4 fold higher foliar PPO activity than NT. The foliar PPO activity levels of all genotypes appeared to increase as tomato plants aged. In 4-week-old fruits, it was found that OP18 had 3.4 and 29.8 fold higher PPO activity than those of NT and UP, respectively whereas UP19-3 had the lowest PPO activity (8.7 fold lower than NT). Differential PPO expression patterns were observed in fruits of various tomato genotypes. In UP only the epidermis showed PPO expression. This epidermal expression was also observed in NT. In addition, PPO was also detectable in pericarp, placenta, embryo, and seed coat of this genotype. Similarly, OP fruits expressed PPO in all of these tissues, but at higher levels than NT, especially in seed coat and embryo. When node 4 leaflets of all tomato genotypes were infested by beet armyworm, their PPO activity levels were locally induced by .7-21.3 fold. No systemic induction was observed at node 6 leaves.

Evaluation of cotton bollworm resistance in foliar of UP, NT and OP plants showed that more foliage was consumed in node 8 leaves of UP than NT and OP. And simple growth rates of cotton bollworms feeding on node 8 leaves of UP plants were upto 3.0 and 2.9 times higher than on NT and OP leaves, respectively. Moreover, percent mortality was the highest in larvae feeding on node 8 leaves of OP plants. In addition, PPO activity levels were found to be negatively correlated with simple growth rate of cotton bollworm and leaf area consumed, substantiating the defensive role of PPO against this insect. Similar results were obtained when these plants
were evaluated for beet armyworm resistance. Simple growth rates of beet armyworms feeding on both nodes 4 and 8 leaves of UP plants were up to 2.4 and 3.8 times higher than on NT and OP leaves, respectively. And more UP foliage was usually consumed than others. The beet armyworm resistance evaluation in fruits found significantly higher percent weight loss due to larval consumption in UP19-4 compared to other genotypes. However, no significant difference in simple and relative growth rates was found among tomato genotypes with varied PPO activity levels.

These results indicate that tomato PPO provides a crucial role in resistance to both cotton bollworm and beet armyworm. The resistance may be contributed by constitutive PPO and/or PPO induced in response to cotton bollworm and beet armyworm infestation Therefore, breeding of tomato to increase PPO activity levels may increase resistance to insect pests and minimize the usage of toxic pesticides