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Evaluation the expression of some insecticidal protein coding genes during seeds storage

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Abstract

Seed considers the basic and crucial input for agricultural production. The most injurious insects which causes a great damage for *Vicia faba* seeds and *Triticum durum* grains is *Callosobuchus maculatus* F. and *Rhyzopertha dominica*. The present work was designed to evaluate the efficacy of three protectants (deltamethrin as synthetic insecticide; *Beauveria bassiana* as bioinsecticide and phosphate fertilizer) on these storage pests. This study focused on some defense-related genes as resistant factors under storage conditions. Plants developed different defense mechanisms to reduce insect attack, such as the induction of defensive proteins towards a range of economically important insect pests. Amongst the genes encoding insecticidal proteins are those that encode lectins protein. Quantification the expression of *lectin* gene, and two cell wall-remodeling genes (pectin and pectin-esterase) at the transcriptional level in *Vicia faba* and *pectin-methyl-esterase inhibitor* gene in wheat plant were examined. The result obtained showed that the imported *V. faba* cultivar and the *T. durum* Beni-Suef5 cultivar was the most susceptible to infestation by *C. maculatus* and *R. dominica* respectively, while Noubaria1 and Suhag5 cultivars appeared to be more resistant. The mortality percentage of *C. maculatus* and *R. dominica* was increased with increasing the concentrations of the tested materials and the residual activity of LC_{95} in *V. faba* and *T. durum* cultivars treated with deltamethrin or *B. bassiana* indicating high residual effect till three months, while a sharp decline in the efficiency of the fertilizer was recorded at 8^{th} week.

Considerable variations in protein banding patterns were observed in both *V. faba* and *T. durum* treated with LC_{95} deltamethrin or with *B. bassiana* in which some bands are disappeared and new are appeared. SCoTs analyses showed alteration in *Vicia faba* and *T. durum* genomes and decreasing in the Genomic Template Stability (GTS) index in response to treatments with LC_{95} of deltamethrin and LC_{95} *B. bassiana* after storage periods were recorded. The expression of three defense related genes (*Vf_Lectin, Vf_Pectin* and *Vf_ Pectin-esterase*) were investigated in *Vicia faba* and only one gene (*Td_Pectin-methyl-esterase* inhibitor) was investigated in *T. durum* cultivars. The upregulation of *Vf_Lectin* genes was recorded in both *Vicia faba* cultivars after deltamethrin treatments while its expression downregulated with the bio-insecticide,

compared with control. The expression level of *Vf_Pectin* gene in response to deltamethrin and *B. bassiana* was upregulated in both *Vicia faba* cultivars, but the highest expression level recorded in imported cultivar by 44-fold in response to *B. bassiana*. The expression level of *Vf_ Pectin-esterase* gene was up-regulation in all samples, except in the cultivar Noubaria1 treated with LC_{95} deltamethrin was downregulated. *Td_Pectin-methyl-esterase Inhibitor* (*PMEI*) gene was upregulated in both *T. durum* cultivars (Suhag5 and Beni-Suef5) in response to LC_{95} of deltamethrin or to LC_{95} of *B. bassiana* and the expression level in response to *B. bassiana* has exhibited highest level by 12-fold for Beni-Suef5 compared to non-treated grains.

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List of abbreviations

Abbreviation	Complete name
ABM	Abamectin
ALA	Amino-levulinic acid
AP-PCR	The arbitrarily primed polymerase chain reaction
APX	Ascorbate peroxidase
αAl-I	Amylase inhibitors
C: I	Chloroform isoamyl
CAT	Catalase
CpTI	Cowpea encoding trypsin inhibitor
CV	Cultivar
DEPC	Diethylpyrocarbonate
DNA	Deoxyribonucleic acid
dsRNA	Double-stranded- Ribonucleic acid
EDTA	Ethylene-diamine-tera-acetic acid
FAO	Food and agriculture organization of the United Nations
F1	First generation
g/ ha	gram per hectare
GR	Glutathione reductase
GTS	Genomic template stability
IPs	Insect pests
IRAP	Inter-retrotransposon amplified polymorphism
ISSR	Inter simple sequence repeat
KD	Kilodalton
mg/kg	milligram per kilogram
ml/L	Milliliter per liter
mM	Millimole
µM	Micrometer
mRNA	messenger ribonucleic acid
NPs	Nanoparticles
PAE	Pectin acetyl-esterase
PE	Pectin-esterase
PIs	protease inhibitors

Abbreviation	Complete name
PME	Pectin methyl esterase
PMEI	Pectin methyl-esterase inhibitor
ppm	Parts per million
qRT-PCR	Quantitative Reverse Transcription PCR
RAPD	Random amplified polymorphic DNA
REMAP	Retrotransposon-microsatellite amplified polymorphism
RNA	Ribonucleic acid
RNAi	RNA interference
RIPs	Ribosome-inactivating proteins
ROS	Reactive oxygen species
SAPs	Stress-associated proteins
(SCoT) marker	Start codon targeted
SDS	Sodium dodecyl sulphate
SOD	Superoxide dismutase
TE	Tris-EDTA buffer
TXM	Thiamethoxam
U	Unit
WAKs	Wall-associated kinases
WHO	World Health Organization