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# Residual behaviour of profenofos on some field-grown vegetables and its removal using various washing solutions and household processing

M.A. Radwan *, M.M. Abu-Elamayem, M.H. Shiboob, A. Abdel-Aal

*Pesticide Chemistry Department, Residues Analysis Laboratory, Faculty of Agriculture, University of Alexandria, Aflatoon st. El-Shatby, Alexandria, Egypt*

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**Abstract**

Profenofos (Selecron 72% EC), was sprayed on field-grown pepper and eggplant at the recommended rate of 1.28 kg a,i/ha. Fruit samples were collected at 1 h to 14 days after application and analysed to determine the content and dissipation rate of profenofos. The effect of different washing solutions and some household processing on the removal of such residues from treated vegetables were also investigated. Profenofos residues were quantified by using gas chromatography. The results showed that the consumable safety time were found to be 10 days on sweet pepper and 14 days on hot pepper and eggplant fruits. The initial disappearance of profenofos appeared to follow first order kinetics with different rates of reaction of 0.38, 0.40 and 0.35 $day^{-1}$ for hot pepper, sweet pepper and eggplant, respectively. The corresponding half-lives ($t_{1/2}$) were 1.84, 1.74 and 1.96 days. Also, the results indicated that tap water, potassium permenganate and acetic acid solution gave high percent removal of profenofos residues from hot and sweet pepper fruits, while no detectable residues was found in eggplant fruit after washing with soap and acetic acid solutions. In general, all tested washing solutions gave higher percent removal of profenofos residues from eggplant fruit than the two other pepper fruits. Blanching and frying of pepper and eggplant fruits resulted in great reduction to almost completely removed (~100%) of the deposited profenofos. In addition, pickling process removed 92.58 and 95.61% from hot pepper fruit after one week and after two weeks, respectively.


*Keywords:* Residues; Profenofos; Eggplant; Green pepper; Washing solutions; Household processing

## 1. Introduction

Green pepper and eggplant are considered as major vegetable crops which grow on a large scale in Egypt, but these crops are attacked by many insects which require frequent use of insecticides. The use of insecticides for combating insect pests in agricultural production has no doubt enhanced food production and quality of the product, but their indiscriminate use has led to undesirable side effects on environment quality and human health. Consequently, analysis of residual quantities of insecticides in raw agricultural crops and in processed food is in forefront among preventive measures of public health safety. Profenofos is an organophosphorus insecticide widely used to control various insect pests on vegetable crops in Egypt. There are numerous studies in the literature that have examined profenofos behaviour in fresh and processed edible crops such as potatoes (Habiba et al., 1992; El-Tantawy et al., 1992 and Soliman, 2001), tomatoes (Ramadan, 1991; El-Nabarawy et al., 1992 and Ismail et al., 1993) as well as to find more efficient washing reagents for removing its residues

* Corresponding author. Tel.: +20 3590 5029; fax: +20 3590 2766.
*E-mail address:* mohamedradwan5@hotmail.com (M.A. Radwan).

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from potatoes to reduce health hazards (Zohair, 2001). However, there is a lack of published data in Egypt for the fate of this insecticide on field-grown green pepper and eggplant fruits and in the processed products. Therefore, the present work was designed to study the persistence of profenofos in green pepper (hot and sweet) and eggplant fruits. Emphasis on the safety periods for this insecticide in the tested vegetables was considered. Also, this study aimed to throw light on the influence of different washing solutions and some household processing on the removal of such residues from field-treated vegetables.

## 2. Materials and methods

### 2.1. Insecticide and chemical reagents

Profenofos; (*O*-(4-bromo-2-chlorophenyl)-*O*-ethyl-*S*-propyl phosphorothioate), with acute oral $LD_{50}$ of 400 mg/kg for rats, 99% technical grade sample was provided by Ciba Geigy Ltd. (Swizerland), which was used for GLC standardization in the present study. Formulated product (Selecron 72% EC) was employed in the field experiment. All chemicals (acetic acid, sodium chloride, sodium hydroxide and potassium permenganate) used were obtained from E. Merck Company (Germany). In addition, local soap (Rabso) was obtained from the market.

### 2.2. Field experiment and sampling

Field experiments were conducted during the summer in the Abees area, Alexandria Governorate, Egypt. Plots consisting of 10 rows separated by a three row belt of green pepper (*Capsicum annuum* L.) sweet var. California Wonder, hot pepper var. Long Red Cayonne and eggplant (*Solanum melongena* L.) var. Balady were allocated to randomized blocks with three replicates. The plants were sprayed with profenofos once at the recommended rate of 750 ml/feddan (feddan = 0.42 hectare), 2 days before the first harvesting. Spraying was carried out using a knapsack-sprayer (Cp-3) provided with one nozzle delivering 200 l water/feddan, which has proved to be sufficient to give good coverage on the treated plants. Untreated control plots were included for each treatment. The maximum and minimum temperatures during the crops season were 30 °C and 22 °C, respectively, with average relative humidity of 63%. Average sunshine hours recorded were 10.23. There was no rainfall during the period of study. All agricultural management practices were made as usually practiced in commercial production of pepper or eggplant. Fruit samples were randomly collected (500 g were sampled per replicate). Fruit samples were taken at intervals of 0 (1 h), 1, 3, 5, 7, 10 and 14 days after profenofos application. The collected representative samples were placed in plastic bags and frozen at −18 °C until insecticide residue analysis.

### 2.3. Extraction and clean-up

Samples of 50 g from hot pepper, sweet pepper and eggplant were extracted with acetone (150 ml) for 3 min followed by partitioning using dichloromethane (Bowman, 1980). The resulting extracts were evaporated to near dryness using a rotary evaporator at 35 °C. The concentrate was taken in 1 ml *n*-hexane for clean-up. The extracts were cleaned-up on a column contained 10 g activated silica gel 60 (70–230 mesh) and 1 g activated charcoal. The insecticide was eluted from the column with 100 ml of a solvent mixture, 20% acetone in *n*-hexane (Bowman and Leuck, 1971). The eluate was concentrated and then analysed by gas–liquid chromatography (GLC).

To examine the efficacy of extraction and clean up, three samples from each fruit type were spiked with known concentration (2 mg/kg) of the pure insecticide standard solution. Extraction and clean-up were performed as described earlier and recoveries were 73.10–94.35%. Results were corrected according to the average of recovery.

### 2.4. Residue determination

Determination of profenofos residues was performed using a Shimadzu 4-CM (PFE) GC. FPD with an analytical glass column (2 m × 3 mm i.d) packed with 4% SE-30 + 6% OV-210 on 80/100 Chromosorb W. The operating temperatures (°C) were maintained as follows: Column 220 isothermal, injector 270, detector 270 and gas flow rates (ml/min) were: nitrogen 40, hydrogen 80 and air 100; the limits of detection of standard profenofos under these conditions was 2.8 ng. Identification of insecticide residue was accomplished by retention time ($t_R$) and compared with known standard at the same conditions. The quantities were calculated on peak height basis. Using these conditions, the retention time of profenofos was 11 min.

### 2.5. Removal of profenofos residues from treated vegetables

Removal tests were carried out on the 10th and 7th day treated pepper and eggplant fruits, respectively, to imitate the normal time of consuming vegetable fruits under Egyptian conditions, where it is impossible that the producer send the vegetable crops to the market before this time. The procedure was accomplished either by different washing solutions or by home processing to evaluate their effectiveness on removing such residues. The fruit samples were divided into two parts. The first