## FINAL REPORT

# PERSISTENCE OF DIAZINON AND SELECRON ON CALLALOO UNDER NATURAL FIELD CONDITIONS IN JAMAICA, AND DURING POST-HARVEST STORAGE AND PROCESSING.


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# PERSISTENCE OF DIAZINON AND SELECRON ON CALLALOO UNDER NATURAL FIELD CONDITIONS IN JAMAICA, AND DURING POST-HARVEST STORAGE AND PROCESSING.

## Introduction

Callaloo (*Amaranthus viridis* L.) is an annual herb grown in Jamaica as a leaf vegetable initially on small holdings and backyard gardens as a source of iron in the Jamaican diet, but over the last two decades has grown into a very important export crop (Clarke-Harris *et al.* 1998[1]). Several Lepidopteran and Coleopteran insects feed on the leaves of the plant and have attained major pest status on the crop. In order to limit economic losses associated with these pest species, many farmers rely primarily on chemical control and often use a variety of insecticides - either in rotation or as cocktail mixtures - in an effort to suppress populations of the pests.

In many instances, pesticides are applied above the recommended rate and the crop is usually harvested at a fixed time after spraying for consumption. The reentry period stated by the manufacturer may or may not be adhered to and, with a paucity of data on the persistence of the various insecticides being used on the crop under typical Jamaican conditions, the risk to persons consuming the crop cannot be assessed. The present study was therefore designed, as part of an ongoing effort, to determine the persistence of Diazinon and Selecron (profenofos) on callaloo plants under typical Jamaican field conditions, as well as the impact of procedures done during preparation and cooking on the persistence of the residues of these insecticides that may be on the crop at the time of harvest.

## Project Goal and Objectives

Goal: To determine the persistence of Diazinon and Selecron on callaloo under a typical Jamaican field condition.

Objectives:

1. Determine the levels of Diazinon and Selecron residues on callaloo at different time-periods after treatment.

[1] Clarke-Harris, Dionne, Fleischer, Shelby and Fender, Andrea. 1998. Identification Guide: Major pests of callaloo. 16 pp.

2. Determine the levels of Diazinon and Selecron residues on callaloo at harvest and at different stages during post harvest, processing and cooking.

3. Generate half-lives for the insecticides under the specific field condition using appropriate regression models.

**Methodology**

Three callaloo plots (4 x 4 metres) were established in the Botany Gardens in the Department of Life Sciences, The University of the West Indies, Mona. Three weeks after establishment of the plots, they were treated with Diazinon and Selecron (a.i. profenofos) at a rate of 0.07 ml per plant using a 15L Cooper Pegler® air compression sprayer. Two sets of three leaves were randomly selected from each plot 1 hour, and 1, 2, 3 and 7 days after treatment. The samples were stored in labeled plastic bags at 0-5°C for residue extraction and analysis at a later date. The quantity of rainfall was recorded during the period of sampling.

Callaloo plants (approximately 200 grammes) were randomly selected and harvested 24 hours after treatment. The harvest plants were mixed and divided into eight equal portions. Two portions of the sample were randomly selected for one of the following processes: Determination of the residues at harvest, after storage on a table top for a 12-hour period, after rinsing with salt water or after preparation for consumption by steaming. Samples put through these processes were stored in labeled plastic bags at 0-5°C for residue extraction and analysis at a later date. The residual salt water used for washing and liquid generated during the steaming process were also collected and stored in labeled flasks at 0-5°C for residue extraction and analysis.

**Residue extraction and analysis**

About 20-30g of the callaloo samples were cut in small pieces and placed in a commercial 2-speed blender containing the extraction solvent (Methylene chloride, DCM or hexane) and blended for two minutes at high speed. The sample was filtered (Whatman filter paper #2) and the filtrate dried with about 50g of anhydrous sodium sulphate. The dried liquid was decanted into a 250 mL round bottom flask and concentrated to about 2 mL using a rotorary evaporator.

The 2 mL of evaporated sample extract was transferred to a 20 cm activated florisil column and eluted with 50 mL of Hexane, 50 mL of 15% DCM/Hexane (v/v) and 150 mL of 60% DCM/Hexane (v/v). Each of the 3 fractions was separately rotaevaporated (after adding 5 mL of iso-octane – Optima grade) to 1.0 mL. 1 uL of the extract was analysed by an Agilent 6890

fitted with a HP 5MS column (0.25mm x 0.25 um x 30m). A calibration curve was prepared in the range of 0 – 10 mg/L for Diazinon and 0 -100 mg for Selecron. Detection limit of instrument is less than 10 ug/L.

## Results and Discussion

The concentrations of the residues of the active ingredients of Diazinon and Selecron recovered from callaloo plants at different times after treatment are presented in Table 1. Since the initial concentrations of the active ingredients of the insecticides were different, the data was transformed to percent of initial (Day 0) recovery to allow for a more meaningful comparison (Figure 1).

The insecticides were lost from the treated plants at a similar rate with 57.0±0.8%and 50.0±2.14% of Diazinon and Selecron, respectively, being lost from the plants within 24 hours after treatment (Figure 1). Ninety percent of the residues were lost two days after treatment. No Diazinon residue and only 1.7% of the Selecron residue were detected on the callaloo seven days after treatment. With the majority of the residues being lost prior to a total of 9 mm of rainfall between days two and seven, rainfall was not a major factor in the fate of the pesticides on the callaloo.

**Table 1:** Concentrations of the active ingredients of Diazinon and Selecron on callalloo plants different days after treatment.

| Time after treatment (days) | Rainfall (mm) | Pesticide concentration (µg/kg) | |
|---|---|---|---|
| | | Diazinon | Selecron |
| 0 | - | 6.54±0.03 | 47.0±1.50 |
| 1 | 0 | 2.81±0.04 | 23.5±0.40 |
| 2 | 0 | 0.64±0.01 | 4.57±0.15 |
| 3 | 2.8 | 0.62±0.00 | 3.46±0.10 |
| 7 | 6.2 | nd | 0.80±0.01 |

nd = not detected

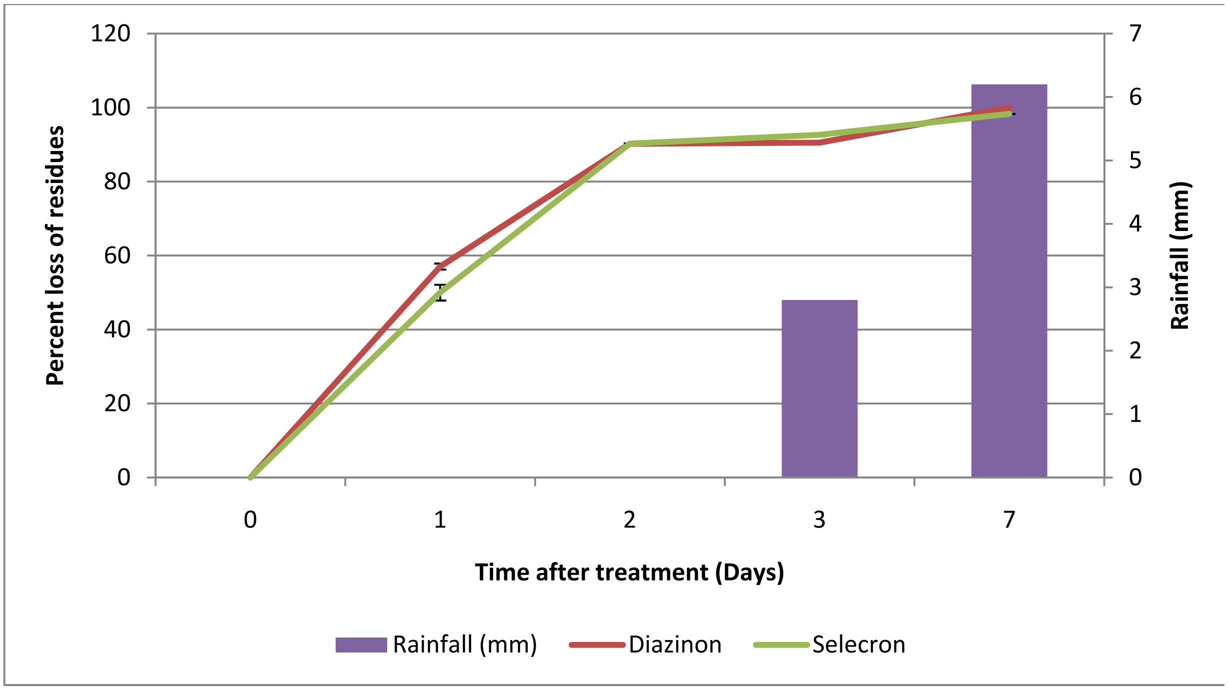


**Figure 1:** Percent loss of the active ingredients of Diazinon and Selecron during a 7-day period from callalloo plants treated with the insecticides.

There is no significant difference (P = 0.446) in the rate of loss of the active ingredients of Diazinon and Selecron from treated callaloo. Under the prevailing field condition at the time, the estimated half-lives of the insecticides were 0.85 and 0.91 days for Diazinon and Selecron, respectively (Table 2). This suggests relatively low persistence of the insecticides under Jamaican field conditions.

**Table 2:** Half-life of Diazinon and Selecron on callalloo plants cultivated in Mona during February 2012.

| Insecticides | Half-Life (Days) | Confidence Intervals (95%) | Slope |
|---|---|---|---|
| Diazinon | 0.85 | 0.33 – 1.18 | 2.88 ± 0.398 |
| Selecron | 0.91 | 0.44 – 1.47 | 2.85 ± 0.365 |

The concentrations of Diazinon and Selecron on treated callaloo at the time of harvest, after storage for 24 hours, and after washing and cooking are presented in Table 3. There was no significant difference (P = 0.893) in the persistence of the residues of both insecticides under

**Table 3:** Concentrations of the active ingredients of Diazinon and Selecron on callalloo at harvest and after exposure to different postharvest processes.

| Sample description | Pesticide Residues (μg/kg) | |
|---|---|---|
| | Diazinon | Selecron |
| Freshly harvested callaloo | 2.10±0.12 | 15.6±0.40 |
| Uncooked callaloo stored in refrigerator for 24 hours | 1.35±0.08 | 9.17±0.03 |
| Uncooked callaloo stored on shelf for 24 hours | 0.66±0.00 | 4.42±0.02 |
| | | |
| Callaloo washed with salt water | 0.834±0.01 | 7.48±0.02 |
| Salt water washing from callaloo | 0.001 ± 0.001 | 0.004±0.001 |
| Cooked callaloo | 0.131±0.01 | 1.11±0.06 |
| Liquid obtained from cooked callaloo | nd | nd |

nd = not detected

different storage conditions and processing activities (Figure 2). Twenty-four hour storage on a shelf resulted in 69-72% of the insecticide residues being lost compared to 35-41% when stored in the refrigerator.

Washing the callaloo in salt water, a practice usually done in Jamaica, resulted in the removal of 52.0±1.92% of Selecron residues being lost compared to 60.1±3.60% of the Diazinon residues. Cooking resulted in 93-94% of the residues of both insecticides being lost. No residues of either insecticide were detected in liquid obtained from the cooked callaloo. It should be noted that no assessment was done for the presence of degradation products, of the insecticides, in the cooked callaloo.

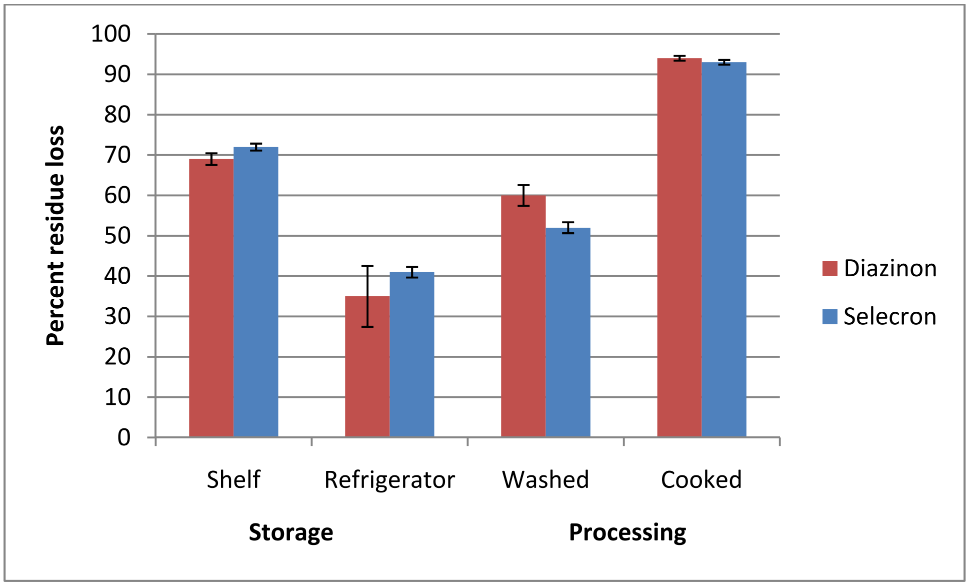


**Figure 2:** Percent loss of the active ingredients of Diazinon and Selecron from callaloo treated with the insecticides during storage and processing of the callaloo.

## Conclusions

- The half-life of Diazinon on callaloo under the prevailing field conditions at the time of the experiment was 0.85 days (C.I. 95%; 0.33 – 1.18 days).
- The half-life of Selecron on callaloo under the prevailing field conditions at the time of the experiment was 0.91 days (C.I. 95%; 0.44 – 1.47 days).
- Storage of harvested callaloo in the refrigerator resulted in a 35.3 ± 7.53% of Diazinon residue being lost over a 24-hour period compared to a loss of 68.6 ± 1.46 % of the residue when the callaloo was stored on an open shelf.
- Storage of harvested callaloo in the refrigerator resulted in a 39.9 ± 1.32% of Selecron residue being lost over a 24-hour period compared to a 70.8±0.86% loss of the insecticide residue when stored on an open shelf.
- Washing with salt-water reduced Diazinon and Selecron residues on the treated callaloo by 60.1 ± 2.57% and 52.0 ± 1.36%, respectively.
- Cooking reduced Diazinon and Selecron residues on the treated callaloo by 93.7 ± 0.60% and 92.9 ± 0.57%, respectively.