# EVALUATION OF TRANSLOCATION OF [$^{14}$C]RADIOLABELED PLANT PROTECTION PRODUCT IN TOMATO

Author: Samuel Freedlander[1], Shaila Rao[2], Kalumbu Malekani[1], and Seunghun Kang[1]
[1]Smithers Viscient, Wareham, Massachusetts, USA
[2]Gowan Company, Yuma, Arizona, USA

## INTRODUCTION & OBJECTIVES

Once applied to a plant, residues of plant protection products have the potential to move to other plant tissues via phloem and xylem. This translocation can affect pollinating insects and consumers of the plant tissues.

The objective of this study was to evaluate the translocation of a plant protection product through phloem and xylem to various tomato tissues (flower, leave, stem, and root) when applied to leaves and soil. The study was designed to simulate a field application of [$^{14}$C]active ingredient (a.i.) to tomato plants, which were selected for their continuous flowering and vegetative growth to allow comparable assessment at multiple intervals.

## MATERIALS AND METHODS

Tomato plants used were a common commercial variety at the BBCH 51 stage. Plants were applied with a formulation of [$^{14}$C] radiolabeled a.i. and processed as outlined in the table below.

| Group | Replicates | Application Rate | Application Method | Tissues Harvested | Analysis |
|---|---|---|---|---|---|
| Group II: | Three 13.2 L buckets | 0.50 kg a.i/ha | Foliar Application | Leaves, stems, flowers at 1, 2, 4, 6, 8 WAP[1]. Roots at 8 WAP. | Combustion & autoradiography for TRR[2]. Tissues ≥ 10 µg/kg extracted, HPLC-RAM[3] for distribution |
| Group III: | | | Soil Drench | | |

[1]weeks after application, [2]total radioactive residues, [3]high performance liquid chromatography with radiochemical detection

**Table 1. Sample Processing**




**Figure 1. Application for Group II (left) and Group III (right)**

## RESULTS AND DISCUSSION

Combustion analysis indicated the TRR in all tissue types from the soil drench group was higher than in corresponding tissues from the foliar application group.

| Group | Tissue | 1 WAP (µg/kg) | 2 WAP (µg/kg) | 4 WAP (µg/kg) | 6 WAP (µg/kg) | 8 WAP (µg/kg) |
|---|---|---|---|---|---|---|
| Group II: Foliar Application | Leaves | 7.2 | 11.1 | 5.6 | 14.1 | 12.8 |
| | Stems | 2.1 | 6.0 | 1.9 | 4.9 | 4.6 |
| | Flowers | 6.9 | 5.1 | 4.7 | 5.5 | 2.1 |
| | Roots | - | - | - | - | 4.6 |
| Group III: Soil Drench | Leaves | 27.5 | 32.1 | 39.3 | 34.9 | 45.6 |
| | Stems | 10.1 | 13.3 | 14.5 | 9.0 | 15.9 |
| | Flowers | 12.9 | 26.3 | 18.7 | 8.7 | 7.8 |
| | Roots | - | - | - | - | 563.2 |

"-" = not applicable

**Table 2. Results of Combustion Analysis for Total Radioactive Residues**

HPLC-RAM analysis indicated the majority of radioactive residues observed in all tissue types from both groups was not the active ingredient, but rather other polar and non-polar metabolites.

| Group | Tissue | 1 WAP a.i. (µg/kg) | 2 WAP a.i. (µg/kg) | 4 WAP a.i. (µg/kg) | 6 WAP a.i. (µg/kg) | 8 WAP a.i. (µg/kg) |
|---|---|---|---|---|---|---|
| Group II: Foliar Application | Leaves | - | 4 | - | 1 | 1 |
| | Stems | - | - | - | - | - |
| | Flowers | - | - | - | - | - |
| | Roots | - | - | - | - | - |
| Group III: Soil Drench | Leaves | 1 | 1 | 1 | 1 | ND |
| | Stems | - | 1 | ND | - | ND |
| | Flowers | 3 | ND | ND | - | - |
| | Roots | - | - | - | - | 27 |

"-" = not applicable, "ND" = not detected

**Table 3. Results of HPLC-RAM Analysis for Active Ingredient**

## ACKNOWLEDGEMENTS

We wish to acknowledge the contributions and support of our colleagues at Smithers Viscient.

## RESULTS & DISCUSSION (CONTINUED)

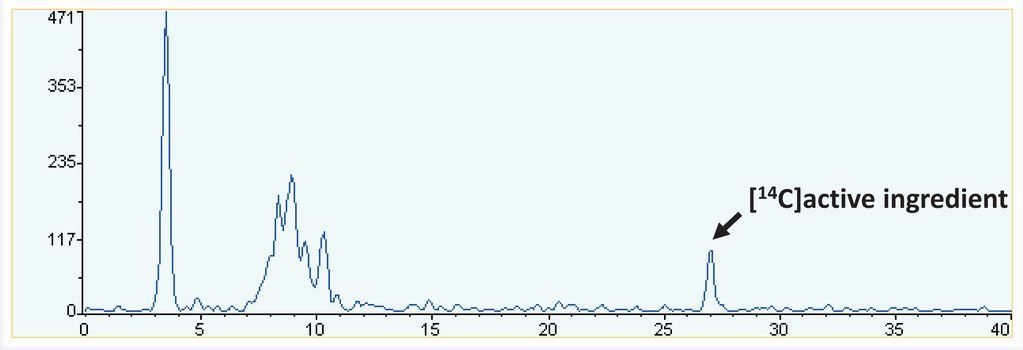



**Figure 2. HPLC-RAM chromatogram of tomato leaf extract from Group III (Soil Drench) at 1 WAP**

Autoradiography analysis supported combustion analysis results that TRR in all tissue types from the soil drench group was higher than in corresponding tissues from the foliar application group.

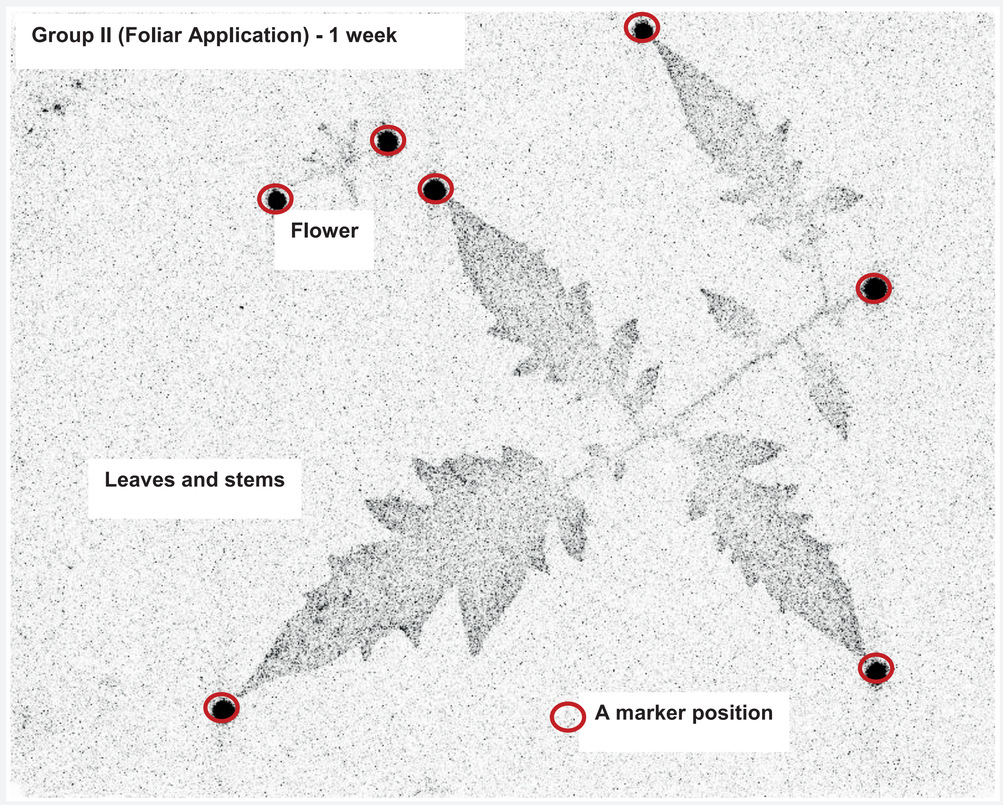



**Figure 3. Autoradiograph of tomato leaf from Group II (Foliar Application) at 1 WAP**

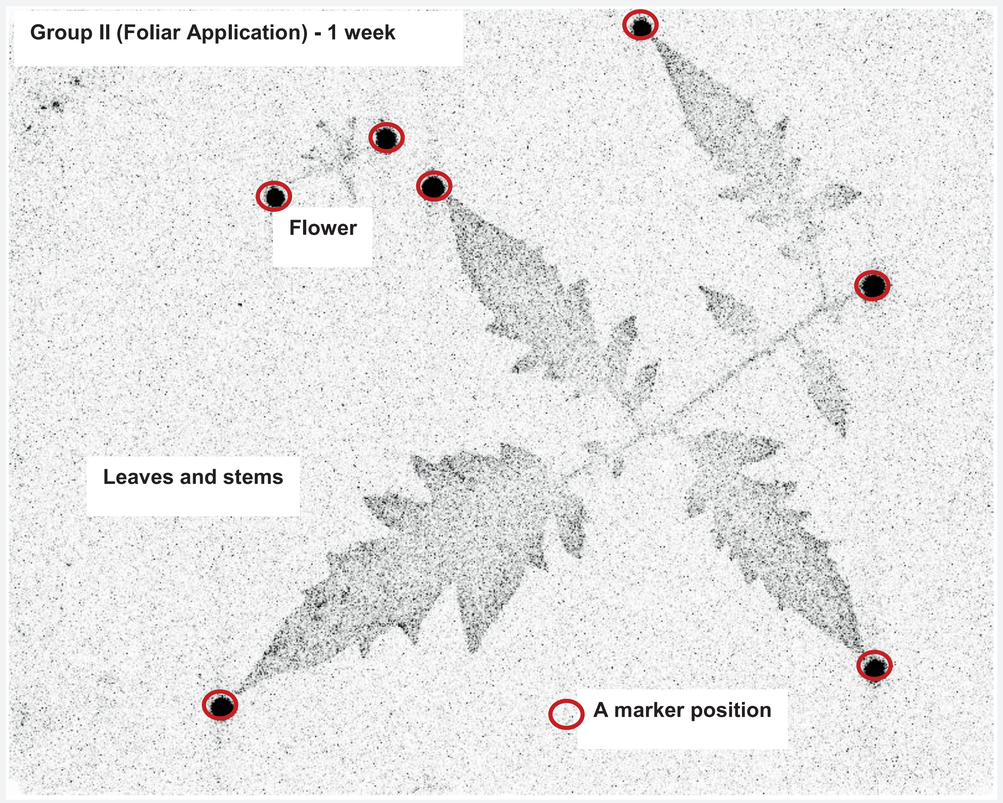



**Figure 4. Autoradiograph of tomato leaf from Group III (Soil Drench) at 1 WAP**

## CONCLUSIONS

- Residues are translocated by both basipetal movement (downward from leaf application) via phloem and by acropetal movement (upward from both leaf and root application) via xylem.
- Acropetal translocation via xylem results in more accumulation at a faster rate.
- Foliar application of certain plant protection products may result in reduced translocation to flowers, which may reduce exposure to pollinating insects.
- The majority of translocated residues may be metabolites with different toxicological effects.
- Autoradiography may be an efficient qualitative assessment method for translocation of radioactive residues in plant tissues.
- It is possible to efficiently evaluate translocation during a conventional plant metabolism study. This can provide valuable information to better assess the potential effects of plant protection products on pollinating insects.

www.smithersviscient.com info@smithersviscient.com

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