Dissipation of flubendiamide in/on Brinjal (Solanum melongena) fruits

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Received: 20 July 2010 / Accepted: 27 January 2011 / Published online: 1 March 2011
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Abstract A field experiment was conducted at Anand Agricultural University, Anand during Sept–Dec, 2009 to study the rate of degradation of flubendiamide in/on brinjal fruits following foliar application of Fame 480 SC at 90 (standard dose) and 180 (double dose) g a.i. ha\(^{-1}\). The residues estimated using HPLC revealed persistence of flubendiamide in/on brinjal till 3rd and 7th day after the last spray at standard and double dose, respectively. The residues of flubendiamide were reported as parent compound, and no desiodo metabolite was detected. The initial deposits of 0.17 and 0.42 μg g\(^{-1}\) in/on brinjal fruits reached below determination level of 0.05 μg g\(^{-1}\) on the 5th and 10th day at standard and double dose, respectively. The half life of flubendiamide on brinjal fruits ranged from 2.68 to 2.55 days. Soil samples analyzed on the 15th day after the last spray revealed residues at below determination level (0.05 μg g\(^{-1}\)) at either dose of application.

Keywords Flubendiamide and desiodo · Brinjal · Soil · Recovery · Dissipation

Introduction

Brinjal (Solanum melongena), also known as eggplant, belongs to the family Solanaceae and genus Solanum. It bears a fruit commonly used as a vegetable which is available throughout the year at cheaper rate. Brinjal fruit and shoot borer, Leucinodes orbonalis Guenée (Lepidoptera: Pyralidae), is the major insect pest of brinjal, throughout Asia. Larvae bore into shoots during the vegetative growth stage and later in flowers and fruits, rendering fruit unfit for human consumption. The crop loss caused by this pest is enormous and varies from 37% to 63% in different parts of India (Dhankar 1988). Due to poor natural enemy complex, concealed nature of the pest and result of successive cropping, this pest remains active throughout the year. The production of brinjal or eggplant is now seriously affected in many parts of the Indian sub-continent by the high cost and low efficacy of insecticide needed to ensure production of a viable crop (http://www.nri.org/research/chemicalecology-projects-brinjal.htm).

Of late several new molecules have been developed as pesticides, which can be degraded easily in the environment and are less harmful for human beings. Flubendiamide 1,2-benzenedicarboxamide,
N\textsuperscript{2}-[1,1-dimethyl-2-(methylsulfonyl)ethyl]-3-iodo-
N\textsuperscript{1}-[2-methyl-4-[1,2,2,2-tetrafluoro-1-(trifluoro-
methyl)ethyl][phenyl]-(9Cl) is one of those. It is the
representative of a class of chemicals, benzenedicarboxamides or phthalic and diamides.
Its structure consists of three parts: (1) a heptafluoroisopropyl group in the anilide moiety,
(2) a sulfonylalkyl group in the aliphatic amide moiety and (3) an iodine atom at the three-
position of the phthalic acid moiety (Tonishi et al. 2005). In contrast to most other commercially
available pesticides which act on nervous system, flubendiamide act by disrupting proper muscle
function by acting on ryanodine receptors (intracellular Ca\textsuperscript{2+} channels). This receptor is
specialized for the rapid and massive release of Ca\textsuperscript{2+} from intracellular stores, which is an
essential step in the muscle contraction. The pesticide disrupts the calcium balance in the
muscles of the insects by acting on the ryanodine receptor, affecting the muscle contraction
(Ebbinghaus-Kintscher et al. 2007). It is effective against most of the lepidopterous pests such as,
armyworms, bollworms, corn borers, cutworms, diamond back moths, fruitworms and loopers;
therefore, the pesticide is registered by EPA for use on corn, cotton, tobacco, pome and stone
fruit, tree nut crops, grapes and vegetable crops (including cucurbit vegetables, fruiting vegetables
and okra) (USEPA 2008). Flubendiamide is registered since 2007 India on cotton and rice.

As the information regarding persistence and dissipation of flubendiamide in/on brinjal is lack-
ing, the present study was carried out to investigate the persistence and dissipation kinetics of
flubendiamide residues in brinjal.

Material and methods

Sampling

A field experiment was conducted at the Main Vegetable Research Centre, Anand Agricultural
University, Anand during Sept to Dec 2009. The experiment was conducted in a randomized block
design using three replicates for each treatment. Three sprays of flubendiamide (Fame 480 SC)
were applied at 90 and 180 g a.i. ha\textsuperscript{-1} at an interval of 1 week on brinjal plants using Knapsack
sprayer. The first spray was made at the initiation of fruiting whereas the last spray at fruiting stage.
Water was sprayed in the control plot. Brinjal fruits were drawn at 0 (1 h), 1, 3, 5, 7, 10 and
15 days after the last spray. Soil samples were analysed on 15th day from the last spray.

Extraction and cleanup

Flubendiamide and its desiodo metabolite residues were extracted from brinjal and soil as per
the method of Fenoll et al. (2009). All the chemicals used in extraction and cleanup were either
analytical or pesticide grade. The solvents used were first distilled and checked for any unwanted
impurity prior to use. Acetonitrile and water used in analysis were of HPLC grade.

Fresh and healthy 500 g of brinjal fruits from each replication were drawn and immediately
chopped and homogenized. From this, a representative subsample of 10 g was transferred to
50-ml capacity polypropylene tube followed by addition of 10 ml of acetonitrile. In case of soil,
10 g of sub-soil and 20 ml of acetonitrile/water (1:1, v/v) were used. The polypropylene tubes of
brinjal fruit and soil were subjected to sonication for 15 min. This was followed by salting out
by addition of 2 g NaCl, shaking for 1 min and centrifugation at 3,000 rpm for 10 min. Known
amount of supernatant was drawn, evaporated to dryness in turbovap under nitrogen and final vol-
ume was made up to 3 ml with acetonitrile/water (6:4,v/v).

Flubendiamide and its desiodo metabolite were determined on Shimadzu LC-20AT HPLC
equipped with photodiode array detector and RP-18 e column (100 × 4.6 mm i.d). The mobile
phase used was acetonitrile/water (60:40, v/v) at low pressure gradient with a flow of 1.2 ml min\textsuperscript{-1}.
At this setting with 254 nm wavelength (Gopal and Mishra 2008; Sahoo et al. 2009), the retention
time for desiodo and flubendiamide was 7.5 and 10 min, respectively. The residues were calculated
by comparing the peak areas of the samples with that of matching standards run under same HPLC