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# Dissipation of Novaluron in Chilli and Brinjal

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**Abstract:** This research reports on the dissipation of novaluron [(±)-1-[3-chloro-4-(1, 1, 2-trifluoro-2-trifluoromethoxyethoxy)phenyl]-3-(2,6-difluorobenzoyl)urea] in chilli and brinjal. Dissipation and the corresponding parameters were calculated from the data obtained by analyses of the residual parent compound. Novaluron was rapidly dissipated in chilli and brinjal following first order reaction kinetics at all rates of application with half-lives of 1.80-1.95 days (for chilli) and 1.80-2.08 days (for brinjal) and the residue was found to be below detectable limit on 10th day samples. The study revealed that novaluron will not pose any residual toxicity problem.

**Key words:** Novaluron, dissipation, chilli, brinjal

## INTRODUCTION

Novaluron (Fig. 1) is an insecticide falling into the class of diflubenzoylureas. Novaluron is a new pesticide molecule belonging to the group of insecticides termed Insect Growth Regulators (IGR). Although the compound mainly acts by ingestion, but it still possess some contact activity. IGR are comparatively safer to beneficial insects and environment and are compatible for use in an integrated pest management system.

This IGR acts by inhibiting chitin synthesis, thereby causing abortive moulting and abnormal endocuticular deposition (Tomlin, 1997). Novaluron effects only at the larval stages while the adults are seldom damaged. Also the non-target species i.e., predators and parasites are almost never affected. Hence this compound is coming up as an eco-friendly or green pest-controlling agent.

Several bioefficacy trials have been conducted on this compound. Su *et al*. (2003) has found out that novaluron efficiently controls Lepidopterans, Coleopterans and Homopterans by both ingestion and contact activity. Ishaaya *et al*. (1998) have concluded that this novel benzoylphenylurea is also

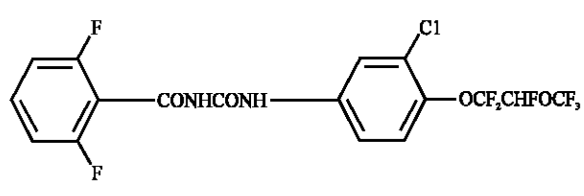


Fig. 1: Chemical structure of novaluron

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capable of regulating the population of beet armyworm (*Spodoptera exigua*) and greenhouse whitefly (*Trialeurodes vaporariorum*). *Plutella xylostella*, a major pest of cabbage, American ballworm (*H. armigera*) a larvae attacking cotton crops and brinjal shoot and fruit borer (*Leucinodes orbonalis*) are other insects which can be monitored using novaluron (Murthy and Ram, 2002).

Thus several reports are available regarding the detailed studies on bioefficacy of novaluron. But report on the residue and dissipation pattern of novaluron in vegetable crops are lacking. Therefore, the objective of this study was to evaluate the dissipation pattern of novaluron in chilli and brinjal.

## MATERIALS AND METHODS

A three seasons (1st season, July 2002; 2nd season, January 2003; 3rd season, July 2003), field experiment on chilli and brinjal was conducted at Bidhan Chandra Krishi Viswavidyalaya agricultural experimental farm, Jaguli, Nadia, West Bengal, India. Novaluron (Rimon 10 EC) was applied thrice 28, 35 and 42 days after transplantation for chilli and 30, 37 and 45 days after transplantation for brinjal as high volume spray (400 L $ha^{-1}$) by a knapsack sprayer. The application rate was 37.5 g a.i. $ha^{-1}$ (recommended application rate, i.e., $T_1$) and 75.0 g a.i. $ha^{-1}$ (twice the recommended application rate, i.e., $T_2$). Also an untreated control ($T_3$) was simultaneously maintained. Each treatment including control was replicated thrice in a Randomized Block Design (RBD).

The chilli and brinjal samples (50 g) were extracted with 100 mL of acetonitrile: water (65:35) using a mixer and filtered through a Buchner funnel after washing using 100 mL of the extracting solvent. The acetonitrile was evaporated by a rotary vacuum evaporator at 40°C.

The concentrated extract was transferred to a separating funnel with distilled water (100 mL). Clean up was carried out by liquid-liquid partitioning with dichloromethane. The dichloromethane fraction was concentrated under vacuum followed by partitioning with hexane: acetonitrile (1:2), the hexane fractions being discarded. The concentrated acetonitrile fraction was further cleaned up by column chromatography using activated silica gel in between two layers of sodium sulphate. Hexane: acetone (8:2) was used to elute novaluron from the column. The organic fraction was evaporated to dryness, rinsed with HPLC grade methanol and filtered (0.2 µm) for HPLC analysis.

High Performance Liquid Chromatograph (HPLC 1050 Hewlett Packard equipped with UV detector and Chemito 5000 Data Processor) was used for final determination of novaluron residues. Shandon Hypersil 250×4.6 mm ODS 5 µm ($RPC_{18}$) column was used for the chromatographic separation of novaluron. The mobile phase consisted of methanol/water 80/20 (v/v) and the flow-rate was 1 mL $min^{-1}$. The entire system was allowed to stabilize for 15 to 20 min. The UV detector was operated at 254 nm. Aliquots of 20 µL of standard or test portion extract were injected. The retention time, sensitivity and limit of detection were 3.6 min, 0.01 and 0.01 µg $g^{-1}$, respectively. The average recovery of novaluron in chilli and brinjal spiked at 0.1-1.0 ppm were 92.0-94.1%, respectively.

## RESULTS AND DISCUSSION

Data regarding the initial deposits, percent dissipation, half-life values and regression equations of novaluron residues in chilli and brinjal following application at the rate 37.5 g a.i. $h^{-1}$ a ($T_1$) and 75.0 g a.i. $ha^{-1}$ ($T_2$) have been presented in Table 1 and 2.

The initial deposit of novaluron in chilli after two hours of spraying ranged between 0.073-0.077 and 0.148-0.152 mg $kg^{-1}$ irrespective of the seasons for the treatments $T_1$ and $T_2$, respectively. The loss of residues over a period of time showed a steady dissipation from 64.28-86.15% within 5 days. The residue level fell below detectable limit on the 7th day for $T_1$ and 10th day for $T_2$ (Table 1).

Table 1: Residue and dissipation of novaluron in chilli

| Application rate | Season | Period after application | Mean±SD | Dissipation (%) | Regression equation | $R^2$ | Half life ($t_{1/2}$) days |
|---|---|---|---|---|---|---|---|
| Recommended application rate | 1st | 0 | 0.075±0.0046 | | y = 1.9153 - 0.1668x | 0.98 | 1.80 |
| | | 1 | 0.058±0.0036 | 22.69 | | | |
| | | 3 | 0.030±0.0040 | 59.38 | | | |
| | | 5 | 0.011±0.0026 | 85.33 | | | |
| | | 7 | BDL* | | | | |
| | 2nd | 0 | 0.073±0.0040 | | y = 1.8892 - 0.1541x | 0.98 | 1.95 |
| | | 1 | 0.055±0.0036 | 24.45 | | | |
| | | 3 | 0.031±0.0044 | 57.59 | | | |
| | | 5 | 0.012±0.0010 | 83.92 | | | |
| | | 7 | BDL | | | | |
| | 3rd | 0 | 0.077±0.0026 | | y = 1.9297 - 0.1676x | 0.97 | 1.80 |
| | | 1 | 0.059±0.0036 | 23.87 | | | |
| | | 3 | 0.032±0.0052 | 58.36 | | | |
| | | 5 | 0.011±0.0010 | 86.15 | | | |
| | | 7 | BDL. | | | | |
| Twice the Recommended application rate | 1st | 0 | 0.148±0.0118 | | y = 2.2615 - 0.1542x | 0.90 | 1.95 |
| | | 1 | 0.124±0.0062 | 16.36 | | | |
| | | 3 | 0.076±0.0046 | 48.42 | | | |
| | | 5 | 0.050±0.0053 | 66.49 | | | |
| | | 7 | 0.010±0.0010 | 93.28 | | | |
| | | 10 | BDL | | | | |
| | 2nd | 0 | 0.152±0.0061 | | y = 2.2751 - 0.1560x | 0.90 | 1.93 |
| | | 1 | 0.126±0.0089 | 17.23 | | | |
| | | 3 | 0.079±0.0044 | 48.15 | | | |
| | | 5 | 0.050±0.0053 | 67.39 | | | |
| | | 7 | 0.010±0.0017 | 94.11 | | | |
| | | 10 | BDL | | | | |
| | 3rd | 0 | 0.150±0.0060 | | y = 2.2712 - 0.1548x | 0.89 | 1.94 |
| | | 1 | 0.125±0.0052 | 16.58 | | | |
| | | 3 | 0.076±0.0044 | 49.35 | | | |
| | | 5 | 0.053±0.0062 | 64.28 | | | |
| | | 7 | 0.010±0.0020 | 93.66 | | | |
| | | 10 | BDL | | | | |

*BDL = Below Detectable limit

The initial deposit of novaluron in brinjal after two hour of spraying varied between 0.075-0.078 and 0.149-0.156 mg $kg^{-1}$, irrespective of the seasons for the treatments $T_1$ and $T_2$, respectively. The loss of residues over a period of time showed a steady dissipation from 65.55-85.66% within 5 days. The residue level goes to below detectable limit on the 7th day for $T_1$ and 10th day for $T_2$ (Table 2).

The dissipation of novaluron residue followed first order reaction kinetics in both the application rates as a straight line was obtained in each case when log values of the residue was plotted against different time intervals. From this study it appears that the rate of dissipation is independent of initial deposit and the half-life ($t_{1/2}$) of novaluron varied between 1.80-1.95 days (for chilli) and 1.80-2.08 days (for brinjal) irrespective of the seasons and application rate.

For the untreated control, no residues of novaluron were detected irrespective of the seasons. The half-lives of novaluron in chilli were found short and would be of no concern for contamination both in the food chain and in the environment.

The MRL value of novaluron has not yet been established. There is no recommended MRL value of novaluron in chilli or brinjal by WHO/FAO/JMPR/GOI. But MRL value of novaluron for tomato has been fixed in the range of 0.02-0.5 mg $kg^{-1}$ and PHI within 1-7 days in Brazil, Peru, Argentina and Chile. As no residue was detected after 10th day, it might be stated that novaluron may not pose any residual toxicity problem.

Table 2: Residue and dissipation of novaluron in brinjal

| Application rate | Season | Period after application | Mean±SD | Dissipation (%) | Regression equation | $R^2$ | Half life ($t_{1/2}$) days |
|---|---|---|---|---|---|---|---|
| Recommended application rate | 1st | 0 | 0.077±0.0053 | | y = 1.9324 - 0.1666x | 0.97 | 1.81 |
| | | 1 | 0.059±0.0036 | 23.51 | | | |
| | | 3 | 0.034±0.0092 | 55.28 | | | |
| | | 5 | 0.011±0.0026 | 85.39 | | | |
| | | 7 | BDL* | | | | |
| | 2nd | 0 | 0.078±0.0046 | | y = 1.9253 - 0.1668x | 0.97 | 1.80 |
| | | 1 | 0.058 ±0.0030 | 25.56 | | | |
| | | 3 | 0.032±0.0036 | 59.12 | | | |
| | | 5 | 0.011±0.0007 | 85.66 | | | |
| | | 7 | BDL | | | | |
| | 3rd | 0 | 0.075±0.0049 | | y = 1.9207 - 0.1647x | 0.97 | 1.83 |
| | | 1 | 0.058±0.0029 | 22.11 | | | |
| | | 3 | 0.033±0.0042 | 56.42 | | | |
| | | 5 | 0.011 ±0.0007 | 85.19 | | | |
| | | 7 | BDL | | | | |
| Twice the recommended application rate | 1st | 0 | 0.156±0.0070 | | y = 2.2651 - 0.1460x | 0.90 | 2.06 |
| | | 1 | 0.127±0.0079 | 18.38 | | | |
| | | 3 | 0.078±0.0079 | 50.22 | | | |
| | | 5 | 0.054±0.0046 | 65.69 | | | |
| | | 7 | 0.012±0.0010 | 92.36 | | | |
| | | 10 | BDL | | | | |
| | 2nd | 0 | 0.149±0.0060 | | y = 2.2480 - 0.1444x | 0.91 | 2.08 |
| | | 1 | 0.124±0.0044 | 16.57 | | | |
| | | 3 | 0.076±0.0044 | 48.87 | | | |
| | | 5 | 0.051±0.0036 | 65.55 | | | |
| | | 7 | 0.012 ±0.0010 | 92.19 | | | |
| | | 10 | BDL | | | | |
| | 3rd | 0 | 0.153±0.0046 | | y = 2.2659 - 0.1518x | 0.91 | 1.98 |
| | | 1 | 0.125±0.0052 | 18.19 | | | |
| | | 3 | 0.077±0.0035 | 49.32 | | | |
| | | 5 | 0.049±0.0036 | 68.29 | | | |
| | | 7 | 0.011±0.0026 | 92.56 | | | |
| | | 10 | BDL | | | | |

*BDL = Below Detectable Limit

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