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# An Assessment of Carbaryl Residues on Brinjal Crop in an Agricultural Field in Bikaner, Rajasthan (India)

Stephen Dhas and Meera Srivastava
Laboratory of Entomology, P.G. Department of Zoology, Govt. Dungar College,
Bikaner-334 001, Rajasthan, India

**Abstract:** *Solanum melongena* Linn. (brinjal) is the most common, popular and principal vegetable crop grown in many geographical parts in India. This staple vegetable crop is extensively damaged by the insects and farmers use large quantities of chemical insecticides, Carbaryl being one of them. The present study was undertaken to evaluate the persistence of Carbaryl on brinjal (fruit) and soil in an agricultural field in Bikaner (28ºN latitude and 73º18′E longitudes), Rajasthan, India. The residues in soil progressively declined up to 60 days but became non-detectable during the next sampling at 75th day. The dissipation of insecticide was faster during the first 8 days as compared to latter period, while, on fruits the initial deposit of 11.47 ppm from 0.2% carbaryl spray was dissipated to 9.93ppm within one day after treatment recording thereby a decrease in residue to about 13.40 percent. After 25th day residues were non-detectable representing 100% dissipation. It may be concluded from the observations of the present study that the residues of the pesticide Carbaryl in soil became non-detectable after 60 days of spraying; while, on crops it persisted upto 15 days.

**Key words:** Carbaryl, residues and *Solanum melongena*

## INTRODUCTION

Brinjal has been cultivated in the country for the last 4,000 years, although it is often thought of as a Mediterranean or mid-Eastern vegetable. Among the Solanaceous vegetables, brinjal *Solanum melongena* Linn. is one of the the most common, popular and principal vegetable crop grown in many geographical parts in India. The area under brinjal cultivation is estimated at 0.51 million ha. with total production of 8,200,000 Mt (FAO data, 2005, http://faostat.fao.org/). Brinjal is mainly cultivated on small family farms and it is a source of cash income for resource-poor farmers. This staple vegetable crop is extensively damaged by the insects and losses range from 50-70%. Farmers use large quantities of chemical insecticides singly or in combination to get blemish free fruits, which fetch premium prices in the market. This practice of indiscriminate use of insecticides leads to build up of pesticide residues in the produce, destruction of beneficial insects, pest resurgence, pesticide exposure to farm workers and environmental pollution.

## MATERIALS AND METHOD

The present study was undertaken to evaluate the persistence of Carbaryl on Brinjal crop (fruit) and soil in an agricultural field in Bikaner (28ºN latitude and 73º18′E longitudes), Rajasthan, India during 2007.

**Method to detect Carbaryl residues:**

**In soil:** For determination of Carbaryl residues in soil, soil samples were collected from the farm. These samples were air-dried, ground to pass through 2mm sieve and stored in glass bottles.

The soil samples were found to be fortified at 15.20µg $g^{-1}$ and 32.50 µg $g^{-1}$ soil. Sufficient amount of methanol was added to form slurry. The contents were thoroughly mixed and kept overnight at room temperature (35±5ºC) for drying. The soil (80g) was taken in a tubling jar along with fresh untreated soil (720g) and mixed thoroughly. This resulted in 15.20µg $g^{-1}$ concentration of carbaryl in soil. Similar procedure was followed for 32.50µg $g^{-1}$ treatment using 160g of treated and 640g of fresh untreated soil.

Triplicate samples of fortified soils after each treatment (25g) were taken in 50ml beakers and distilled water (8ml) was added to each beaker for maintaining the soil moisture at field capacity. The samples were air-dried, ground and mixed with 0.25 g of activated charcoal and 0.50g of florisil and packed in glass column (62×1.5cm ID) containing a 3 cm layer of Sodium sulphate over a cotton plug. The column was eluted with chloroform-diethyl ether (1:1) for a minimum period of 2hrs. The organic soluent fractions from the three extractions were pooled and evaporated to dryness at room temperature.

This single step extraction and clean-up technique removed most of the interfering co-extractives and eluent obtained was analyzed colorimetrically for carbaryl as follows:

The eluent so dried was dissolved in a known quantity of methanol (20ml) i. e. two 10 ml fractions of methanol and transferred distilled water (DW) and 5ml of 0.3 % Sodium Nitrate solution were added and then 5 ml of Sulphanilic acid were also added. The contents were mixed, left for 10 minutes and 10 ml of 16% Sodium

**Corresponding Author:** Meera Srivastava, Laboratory of Entomology, P.G. Department of Zoology, Govt. Dungar College, Bikaner-334 001, Rajasthan, India

hydroxide were added and then the absorbance was recorded on colorimeter at 520nm against a blank containing all the reagents except carbaryl.

**On brinjal fruits:** Carbaryl sprays were given with hand compressor sprayer at fruiting stage in brinjal (*Solanum melongena*). Fruit samples were collected at 0, 1, 3, 5 and 7 days after spray and samples were analysed for the insecticide residues.

Fifty (50g) brinjal fruit samples were extracted with 100ml mixture of isopropanol: hexane (1:2). The samples were re-extracted with 50ml of the solvent mixture and filtered. The filtrate was washed with water to remove isopropanol. For clean-up, 0.5g activated charcoal was added and shaken thoroughly. It was filtered through a bed of anhydrous sodium sulphate (3 cm layer). The column was eluted with chloroform-diethyl ether (1:1) for a minimum period of 2hr. The organic solvent fractions from the three extractions were pooled and evaporated to dryness at room temperature.

The single step extraction and clean up technique removed most of the interfering co-extractives and eluent obtained was analysed by employing the colorimetric method (Yuen, 1965).

## RESULTS

**Carbaryl residues in soil:** The carbaryl residues in soil obtained at different time intervals are given in Table 1. The initial deposits (residues recovered after 1hr of application) were 12.6 and 25.92 ppm in agroecosystem at low (17.24µg $g^{-1}$) and high (34.48 µg $g^{-1}$) levels of fortification respectively. The residues progressively declined up to 60 days but became non-detectable during the next sampling at 75$^{th}$ day. The dissipation of insecticide was faster during the first 8 days as compared to latter period.

**Carbaryl residues on brinjal fruits:** The initial deposit of 11.47 ppm from 0.2% carbaryl spray was dissipated to 9.93ppm within one day after treatment recording thereby a decrease in residue to about 13.40 percent (Table 2). When the treated fruits collected after 4 , 6 , 8, 10 and 15 days were analyzed, the residues observed were 6.09 ppm and thereby 46.88% loss, 5.14 ppm and thereby 55.25% loss, 3.93 ppm and thereby 65.73% loss, 1.87 ppm and thereby 83.74% loss and 0.95 ppm and thereby 91.69% loss respectively. After 25$^{th}$ day residues were non-detectable representing 100% dissipation.

## DISCUSSION

During the present study the field was treated with pesticide Carbaryl during Kharif season when the crop comprised of brinjal vegetable. The residues were assessed in soil and on the brinjal fruits.

**Residues in soil:** The initial deposits of Carbaryl were 12.60 and 25.92 ppm in soil after both first and second spray. The residues progressively declined beyond 60 days in both the levels but became non-detectable during the next sampling at 75$^{th}$ day. The dissipation of insecticides was faster during the first 8 days as compared to the latter period. The dissipation of residues at low level of fortification was, in general, significantly faster, than at high-level fortification. Similar results have also been reported by other workers (Lichtenstein *et al*., 1971 and Gajbhiya, 1989) for organo-chlorine pesticides. The pH of soil during the study was alkaline and ranged from 8.3-9.0, organic carbon content was 0.1-0.6%, EC was 0.21-0.25 mmohos $cm^{-1}$, CEC was 6.0 meq.100$g^{-1}$ and moisture content was 1.0-1.6 in $ft^{-1}$. Soil moisture content and temperature plays important role in rapid microbial degradation of pesticides. Besides the insecticides, were applied on the surfaces which are subjected to rapid loss by volatilization and photo-gradation. According to reports available, the organic matter in soil firmly adsorbs the insecticide molecules, rendering it non available to microbial degradation and other losses such as leaching, volatilization, etc. resulting in increased persistence of insecticides. Similar observations were made by Chapman *et al.* (1981). They observed that 74% of the initially applied (1 ppm) delta methrin remained in organic soil as compared to 52% in mineral soil after 8 weeks of treatment. The results are also in close conformity with the studies made by Biswas *et al.* (1991) and Ali *et al.* (1994).

Table 1: Carbaryl residues in soil at the agroecosystem studied

| Days after application | Residues in µg / g | |
|---|---|---|
| | 1$^{st}$ spray | 2$^{nd}$ spray |
| 0 | 12.6 | 25.92 |
| 4 | 9.6 | 19.24 |
| 8 | 6.24 | 12.86 |
| 16 | 5.04 | 10.26 |
| 30 | 3.2 | 6.52 |
| 45 | 0.56 | 1.4 |
| 60 | 0.12 | 0.4 |
| 75 | N.D * | N.D* |

* Non- detectable

Table 2: Carbaryl residues on brinjal fruits collected from the agroecosystem studied

| Days after treatment | Carbaryl residues (µg/g) | % Reduction |
|---|---|---|
| 0 | 11.47 | - |
| 1 | 9.93 | 13.4 |
| 4 | 6.09 | 46.88 |
| 6 | 5.14 | 55.25 |
| 8 | 3.93 | 65.73 |
| 10 | 1.87 | 83.74 |
| 15 | 0.95 | 91.69 |
| 25 | N.D* | 100 |

* Non- detectable

**Residues on Brinjal fruits:** The initial deposit of Carbaryl on brinjal fruits were of 11.47 ppm from 0.2 per cent Carbaryl spray and dissipated to 9.93 ppm within one day after treatment recording thereby a decrease in residue to about 13.40 per cent. Deshmukh *et al.* (1972) reported only 5.4 ppm of initial deposit, which might be due to the use of lower dosage (0.8 kg $ha^{-1}$). Kavadia and Shanker (1976) however, reported a less deposit (6.5 to

7.7 ppm) on tomato fruits from 0.25 per cent carbaryl application. This could be attributed to the fact that the insecticide was applied only once. When the treated fruits were collected after 10 days and analyzed, 1.87 ppm of residue was observed indicating thereby 83.74 per cent loss which further went down to 91.69 per cent after 15 days. The residue reached below tolerance level (FAO/WHO, 1972) after 6 days of application during the present study. The same waiting period was also reported by Kavadia and Shanker (1976). The fruits can, therefore, be considered as fit for human consumption after 6 days waiting period. The complete dissipation was recorded after 25 days of spray. Similar results have also been reported by Deshmukh and Singh (1975) while studying dissipation of Carbaryl and Malathion from okra fruits.

## CONCLUSION

It may be concluded from the observations of the present study that the residues of the pesticide Carbaryl in soil became non-detectable after 60 days of spraying; while, on crops it persisted upto 15 days. The study suggests that the persistence of residues in soil and on crops would undoubtedly result in deleterious effect not only on the health of human but also on other livestock animals sooner or later. Insecticides also might have targeted some non-pest insect species, thus, threatening the biodiversity. Therefore, safe alternate methods of pest management must be adopted.

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