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A study on analysis of Carbofuran 3G residue in five important rabi vegetables of Assam, India

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Abstract
The pesticide refers to the chemicals like insecticides, fungicides, herbicides and nematicides. The pesticides are basically used in agriculture for control of insect-pests, diseases and weeds and as vector control agents in public health programme. Pesticides are toxic to human, animals and even to the environment and have both acute and chronic effect on health depending on the quantity of consumption and ways in which a person is exposed. An attempt was made to know the extent of use of Carbofuran 3G chemicals in vegetable cultivation by the farmers and to examine the extent of its residue on vegetables ready for consumption. The purity of the samples was confirmed by HPLC analysis. The result revealed that all the farmers under different groups had used higher dose of Carbofuran 3G in vegetable crop fields. All the vegetables under study were having a higher concentration of Carbofuran 3G residue than the Maximum Residue Level.

Keywords: Agricultural chemical, pesticides, toxic, Carbofuran 3g, maximum residue level

Introduction
The agricultural chemicals are used in agriculture to control insect-pests, diseases and weeds. Insect-pests and diseases damage more than one third of the potential food production. The percentage of crop losses in India varies from 10 to 30. In monetary terms, every year these losses amount to Rs. 2,90,000 million. If half of these losses can be reduced, a substantial quantity of food can be made available for human consumption [1].
Some pesticides persist in the environment for years long. Environmental contamination or occupational use can expose the general population to pesticides residues, including physical and biological degradation products present in the air, water, and food [2].
Pesticides are toxic to human, animals and even to the environment. Worldwide, pesticide use had resulted acute and chronic poisoning and it is hazardous to human health, from mild effects to death [3]. Out of the total poisoning cases, two thirds were suicide attempts, and the rest were due to occupational or accidental poisoning [4]. Continuous exposure to sub lethal quantities of pesticides for a prolonged period of time may result in chronic illnesses in humans [5]
The farmers in the state of Assam have been using some pesticides to save crop from pests and diseases. There are a few literatures on negative effect of pesticides in Assam; but the concentrations of the pesticides available in the vegetables used for consumptions are not quantified. Therefore, an attempt has been made to quantify the concentration of Carbofuran 3G pesticide residues available in five *rabi* vegetables namely; cabbage, cauliflower, potato, brinjal and tomato ready for consumption with the objectives to know the extent of use of Carbofuran 3G chemicals in vegetable cultivation and to examine the extent of agro-chemicals residue on vegetables ready for consumption.

Materials and Methods
There are six agro-climatic zones in the state of Assam. Out of these agro-climatic zones, two zones were selected for the study and one district from each agro-climatic zone was selected based on the area under vegetable cultivation. The district selected from the North Bank Plain zone was Darrang and from the Lower Brahmaputra Valley Zone Barpeta district was selected. From each district, two Agriculture Development Officer Circles wear selected. Five villages from each circle and 15 vegetable growing farmers from each village were selected. A total of 450 numbers of respondent farmers were selected for the study.

The farmers were categorized as group I, group II and group III based on the area under vegetable cultivation using the Cumulative Square Root frequency method [6]. The farmers' group I included the farmers having vegetable cultivation area less than 0.4 ha, group II included the farmers having vegetable growing area 0.4-0.8 ha and the group III included the farmers having more than 0.8 ha vegetable growing area. Simple graphical and tabular analysis was done.

To know the extent of use of Carbofuran 3G chemical in vegetable cultivation, simple graphical presentation was done. The laboratory analysis was carried out to examine the residual concentration of Carbofuran 3G present in five fresh vegetables (cabbage, cauliflower, potato, brinjal and tomato) ready for consumption. The fresh vegetable samples were collected from six different retail markets, considering three markets from each district. The collected vegetable samples were sent to the laboratory for testing of pesticide residues on the same day of collection. The vegetable samples were kept in deep freezing condition (at 120 ^{0}C) just after receiving at laboratory to maintain its property. The samples were collected during *rabi* season, 2018. The purity of the samples was confirmed by HPLC analysis.

Results and Discussion

Quantity (Dose) of Carbofuran 3G used (kg/ha) by the respondent farmers in cultivation of vegetables

Carbofuran is one of the most toxic carbamate pesticides. It is used to control insects in a wide variety of crops. It is a systemic insecticide. It is a toxic chemical both for birds and other vertebrates. Carbofuran 3G was a very popular insecticide in the study area. The farmers applied equal quantity of this chemical in all vegetable fields to protect the crop from cutworms and some other insects. The Quantity (dose) of Carbofuran 3G (kg/ha) used by the farmers in vegetable cultivation was presented in fig 1. From the figure, it was observed that the per hectare application of Carbofuran 3G in vegetable field was found more in group I and group II each calculating 33.75 kg per hectare against 30.00 kg per hectare for group III in Barpeta district with an average of 32.50 kg per hectare. The per hectare application of the chemical was calculated as 32.00 kg per hectare for group I and 30.00 kg per hectare for group II and group III in Darrang district with an average of 30.67 kg per hectare. The analyzed data made it clear that the farmers of all groups in both the districts applied Carbofuran 3G more than the recommended dose (19.0 kg/ha). It was advisable to the farmers that the application Carbofuran 3G killed most of the beneficial insects and some other organisms present in the soil. So, in lieu of application of Carbofuran 3G as basal dose in the field as a whole, it was better to apply in the basal part of the plant during plantation of seedlings. Such practice might save the beneficial insects and some other organisms present in the soil to a great extent.

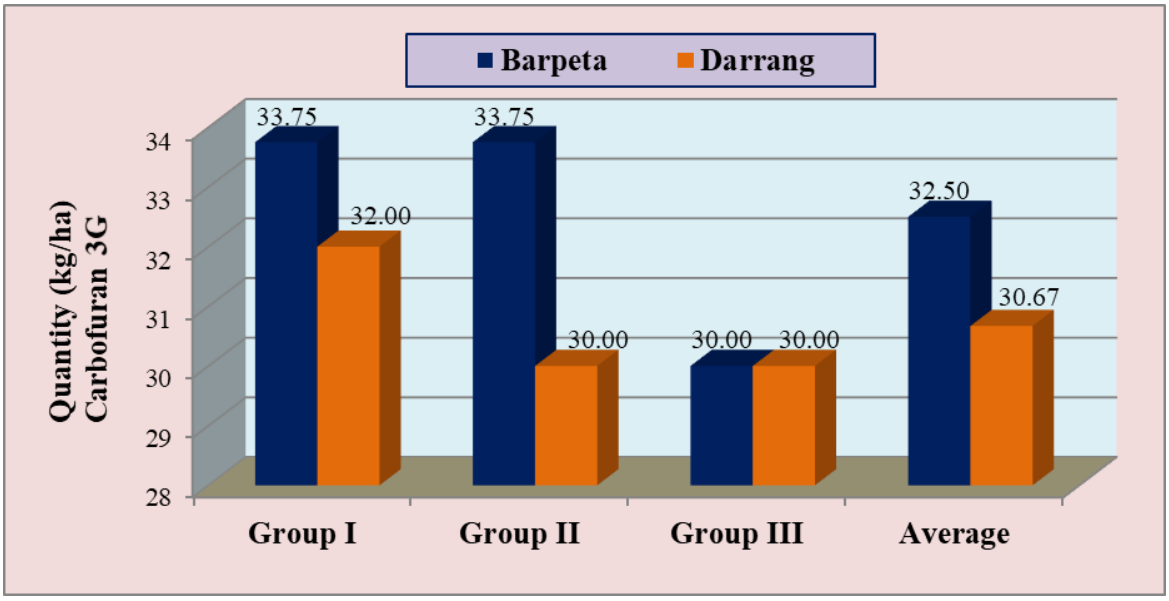

Fig 1: Dose (quantity) of Carbofuran 3G used (kg/ha) in vegetable fields

Concentration of Carbofuran 3G residue in vegetable samples ready for consumption in the study area

The concentration of Carbofuran 3G residue in vegetable samples ready for consumption in the study area had been presented in Table 1.

The average concentration of Carbofuran 3G residues present in the cabbage samples collected from different markets of Barpeta district was estimated at 2.71 ppm and that for Darrang district was estimated at 2.64 ppm. It meant that more concentration of Carbofuran 3G residue in cabbage was recorded for Barpeta district. Regarding the concentration of Carbofuran 3G residues in the samples of cabbage collected from different markets of Barpeta district revealed that the concentration of residue of the chemical was found the highest in the sample collected from Barpeta town market (3.77 ppm) and the lowest was recorded for the sample collected from Sarbhog market (2.07 ppm). In Darrang district, the samples collected from Dalgaon market showed the highest concentration (4.78 ppm) and the lowest was calculated for Kharupetia market (1.32 ppm).

The average concentration of Carbofuran 3G residues present in the cauliflower samples collected from different markets of Barpeta district was estimated at 2.35 ppm and that for Darrang district was estimated at 3.76 ppm. It suggested that there was more concentration of Carbofuran 3G residues in cauliflower at Darrang district than Barpeta district. Regarding the concentration of Carbofuran 3G residues in the samples of cauliflower collected from different markets of Darrang district revealed that the concentration of residue of the chemical was computed the highest in the sample

collected from Kharupetia market (7.13 ppm) and the lowest was estimated for Dalgaon market (2.04 ppm). For Barpeta district, the highest concentration was computed for Barpeta town market (2.69 ppm) and lowest was recorded for the sample collected from Howly market (2.17 ppm).

In case of potato, the concentration of Carbofuran 3G residues present in the samples collected from different markets of Barpeta district was estimated at 2.86 ppm and that for Darrang district was estimated at 4.70 ppm. It meant that more concentration of Carbofuran 3G residue in potato was recorded for Darrang district than Barpeta district. Market wise analysis revealed that the concentration of Carbofuran 3G residue was found the highest in the sample collected from Howly market (3.34 ppm) and the lowest was recorded for the sample collected from Sarbhog market (2.46 ppm) in Barpeta district. In case of Darrang district, the sample of potato collected from Dalgaon market showed the highest concentration (8.18 ppm) and the lowest was estimated for Mangaldai town market (2.91 ppm).

For brinjal, the concentration of Carbofuran 3G residues present in the samples collected from different markets of Barpeta district was estimated at 4.08 ppm and that for Darrang district was estimated at 2.82 ppm. It meant the higher concentration of Carbofuran 3G residues in brinjal was recorded in Barpeta district than Darrang district. Market wise analysis revealed that the concentration of Carbofuran 3G residue in the samples of brinjal collected from Howly market was found the highest (6.53 ppm) and lowest was recorded for the sample collected from Barpeta town market (2.84 ppm) in Barpeta district. In case of Darrang district, the sample of brinjal collected from Dalgaon market showed the highest concentration (3.37 ppm) and the lowest was estimated for Kharupeta market (2.18 ppm).

Similarly for tomato, the concentration of Carbofuran 3G residues present in the samples collected from different markets of Barpeta district was estimated at 2.18 ppm and that for Darrang district was estimated at 2.23 ppm. That is, the higher concentration of Carbofuran 3G residue in brinjal was recorded for Darrang district as compared to Barpeta district. The market wise analysis revealed that the concentration of Carbofuran 3G residues in the samples of tomato collected from Barpeta town market (2.38 ppm) recorded the highest and lowest was recorded for the sample collected from Howly market (1.99 ppm) in Barpeta district. In case of Darrang district, the sample of tomato collected from Kharupetia market showed the highest concentration (2.92 ppm) and the lowest was estimated for Dalgaon market (1.62 ppm).

From the above discussion, it was clear that average concentration of residue of the Carbofuran 3G was not uniform. It varied from market to market. The reason behind this might be that the farmers did not use the chemicals in a fixed quantity. Moreover, there might have prior Carbofuran 3G residue in the soil which added some amount of residue to the vegetables.

According to the Food Safety and Standard Authority of India (FSSAI), the Maximum Residue Level (MRL) for Carbofuran 3G permitted for consumption of cabbage was 0.1 ppm. Agnihotri [1] (1999) reported that the Maximum Residue Level (MRL) for Carbofuran 3G on vegetables was 0.2 ppm. Thus, it could be said that all the vegetables under study had a higher concentration of Carbofuran 3G residue than the Maximum Residue Level. Some other results of the studies carried out by different scientists also depicted similar inference.

Similar results were reported by different scientists. In a study on analysis of pesticide residue in selected vegetables of Prakasam district of Andhra Pradesh reported that 82.82% of the pesticides surveyed or contained residues above the MRL. One of the detected and most frequently found pesticide residues was Carbofuran [7]. In Kenya it was observed that Furadan was used extensively in farming causing residual environmental distribution and contamination and posing risks to small birds and mammals [8]. Similar result was monitored in six seasonal vegetable samples during 1996-97 [9].

Table 1: Concentration of Carbofuran 3G residue in vegetable samples ready for consumption in the study area

Districts	Markets	Concentration of Carbofuran 3G residue in different vegetable samples (ppm)				
		Cabbage	Cauliflower	Potato	Brinjal	Tomato
Barpeta	Howly	2.28	2.17	3.34	6.53	1.99
	Barpeta town	3.77	2.69	2.78	2.84	2.38
	Sarbhog	2.07	2.19	2.46	2.87	2.18
	District Average	2.71	2.35	2.86	4.08	2.18
Darrang	Dalgaon	4.78	2.04	8.18	3.37	1.62
	Kharupetia	1.32	7.13	3.72	2.18	2.92
	Mangaldai town	1.82	2.11	2.19	2.91	2.16
	District Average	2.64	3.76	4.70	2.82	2.23

Conclusion

Vegetables are the source of different minerals, nutrients vitamins and fiber which are very essential for a human being. To get a better harvest and to save the vegetable crops from infestation of different pests and diseases it is very important to apply pesticides. The study revealed that the farmers were using more quantities of Carbofuran 3G in their vegetable fields. It certainly protected the crops from the insect-pests or nematodes; but due to excessive application of the chemicals, the vegetables ready for consumption contained a higher concentration of Carbofuran 3G residue and it made the vegetables unfit for consumption. Thus, it was advisable to the vegetable growers to consult with the agricultural experts before application of chemicals in the field. To grow a healthy crop, they might also follow the integrated pest management practices. They should be made aware about the negative impact of pesticide residues. Thus, awareness and training Programmes on judicious use of pesticides should be provided to the vegetable growers. The government should establish some laboratory for testing pesticide residues so that purity of the vegetables could be known time to time.

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