

# Relative Pesticide Residue in Chilli (*Capsicum annum* L.) Plant Parts at Different Growth Stages

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**Abstract:** Study was conducted to evaluate the presence of crop protective agents in chilli crop at different growth stages and at different plant parts. From the study it is found that presence of Organophosphorous, synthetic pyrethroids and strobilurin molecules were found in the samples of chilli plant parts in all the growing stages when analysed with GC MS/MS. The concentration of the molecules are in descending order of Triazophos > Permethrin total > Deltamethrin > Ethion > Cypermethrin total > Chlorpyrifos ethyl > Trifloxystrobin in chilli shoot. Molecules of Triazophos and Ethion were found in the roots of chilli. Pesticide residues of triazophos, ethion and trifloxystrobin were found in chilli fruits and the residue concentration in the chilli fruits were higher than the EU MRL. From the residue data of green chilli fruit samples, consumption is hazardous to humans and not recommended as the TMRI (Theoretical maximum residue concentration) residue level (0.2264 mg/person/day) crossed the MPI (maximum permissible Intake) in triazophos (0.06 mg/person/day), considering average daily consumption of green chilli is 50g per person per day.

**Keywords:** Pesticide residues, Chilli growth stages, TMRI, MPI

## 1. Introduction

Application of crop protective agents on crops is necessary to protect the crop from the damage of pests and diseases. Crop protective agents once applied on the crop, depending on the nature of the chemical molecule moves with in the plant from the place of application (source) to the other parts with in the crop. Depending on the molecular movement crop protective agents are called as systemic and non-systemic. It is estimated that of the total amount of pesticides applied for weed and pest control, only a very small part (<0.1%) actually reaches the sites of action (Pimental 1995).

These benefits of CPAs are balanced by an increased risk of phytotoxicity, since treated seeds are often exposed to significantly higher chemical concentrations than those occur in foliar treatments applied to established plants. To know the translocation of the pesticides and accumulation of the residues at different growth stages this study was initiated.

## 2. Materials and Methods

Location of the experiment field was Koonavarm village of East Godavari district of Andhra Pradesh state. In this study different crop protective agents accumulation among the plant parts were analysed. Plant samples were collected at different growth stages of the crop i.e. vegetative stage (21 days after planting), flowering stage (51 days after planting) and fruiting stage (81 days after planting). For the study Chilli crop was selected as the crop is pesticide intensive. Plant samples were collected from three different blocks from the experimental field.

After collecting, the plants samples were segregated as shoot (Plant part above soil except fruits), roots (Plant part below soil) and fruits (fruits including immature ones). From each block 10 plants were collected. All the plant parts were dried in shade and stored in refrigerator @ 4 °C before analysing the pesticide residues.

Residual estimation: All the plant samples were grinded and extracted the pesticide residues from the sample. The extracted solution is fed into Gas chromatography MS/MS and analysed for residues present in the sample.

Modified QuEChERS method of EURL-FV (European Union Reference Laboratory for Fruits and Vegetables) was followed for extraction of residue. All the pesticide residues found in the fruits were compared with the EU MRL standards (APEDA – EU MRL).

## 3. Results and Discussion

From this study the obtained data was tabulated and statistical tools like standard deviation and mean values were obtained and presented.

### **Vegetative stage:**

All the residues detected in the samples were presented in the table 1 and Fig 1. From the analysis results the concentration of residues were very high in shoots as the Crop protective agents were applied on the shoots directly. Pesticide residues observed were in the decreasing order of Triazophos > Permethrin total > Deltamethrin > Ethion > Cypermethrin total > Chlorpyrifos ethyl > Trifloxystrobin in the shoots of chilli and residues of Triazophos > Ethion was found in the roots of chilli crop during vegetative stage.

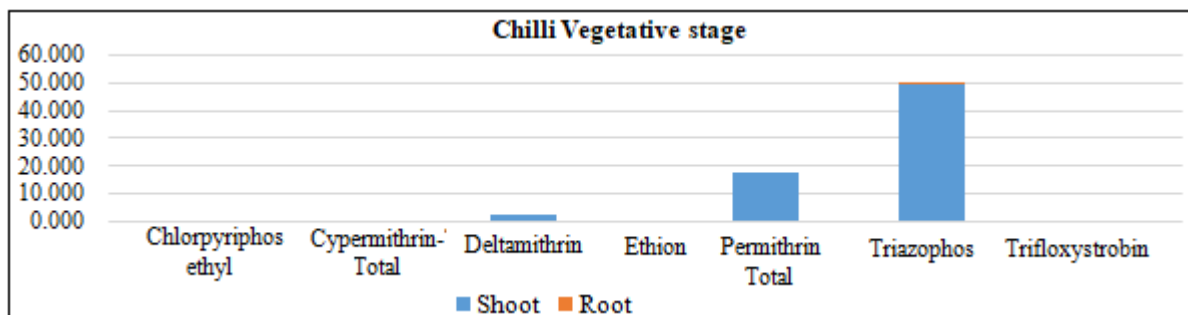
Lower residual level in the roots are because the smaller quantity translocated with in the plant depending on the chemical and the amount absorbed by the roots from the available pesticide in the soil. Logan 1974, reported similarly that pesticide molecule in the soil moves along

with the water and it may be absorbed by the roots may be one of the reason the residues in roots apart from the translocation of the molecule with in the plant from shoot to root.

**Table 1:** Pesticide residues in vegetative stage of chilli crop

	Chlorpyriphos ethyl	Cypermithrin-Total	Deltamithrin	Ethion	Permithrin Total	Triazophos	Trifloxystrobin
Shoot							
Mean (mg/Kg)	0.045	0.160	2.820	0.233	18.205	49.970	0.03
Standard Deviation	0.007	0.000	0.085	0.074	6.696	1.499	0
Root							
Mean (mg/Kg)	BLQ	BLQ	BLQ	0.013	BLQ	0.020	BLQ
Standard Deviation				0.006		0.000	

BLQ: Below the Limit of Quantification (0.01)



**Figure 1:** Pesticide residues within the shoots and roots of chilli during vegetative stage.

**Flowering stage:**

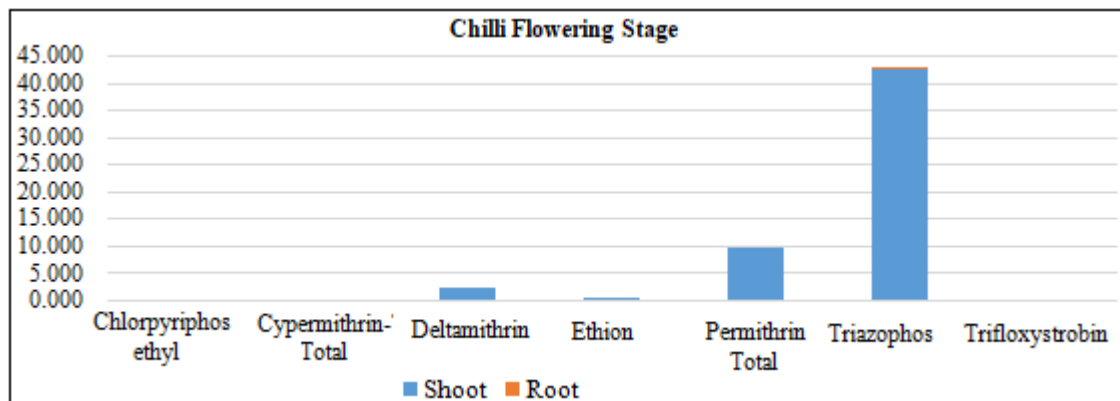
All the residues detected in the samples were presented in the Table 2 and Fig2. From the analysis results the concentration of residues were very high in shoots as the Crop protective agents were applied on the shoots directly. Pesticide residues observed were in the decreasing order of Triazophos > Permithrin total > Deltamithrin > Ethion >

Cypermithrin total > Chloripyriphos ethyl in the shoots of chilli and residues of Triazophos >Ethion was found in the roots of chilli crop during flowering stage. Pesticide residues were observed in the flowering stage were similar to the trend observed in residual concentration of vegetative stage in chilli.

**Table 2:** Pesticide residues in flowering stage of chilli crop

	Chlorpyriphos ethyl	Cypermithrin-Total	Deltamithrin	Ethion	Permithrin Total	Triazophos	Trifloxystrobin
Shoot							
Mean (mg/Kg)	0.050	0.140	2.343	0.250	9.670	42.620	BLQ
Standard Deviation	0.035	0.036	0.570	0.030	4.155	8.189	
Root							
Mean (mg/Kg)	BLQ	BLQ	BLQ	0.020	BLQ	0.067	BLQ
Standard Deviation				0		0.040	

BLQ: Below the Limit of Quantification (0.01)



**Figure 2:** Pesticide residues with in the shoots and roots of chilli during flowering stage

**Fruiting stage:**

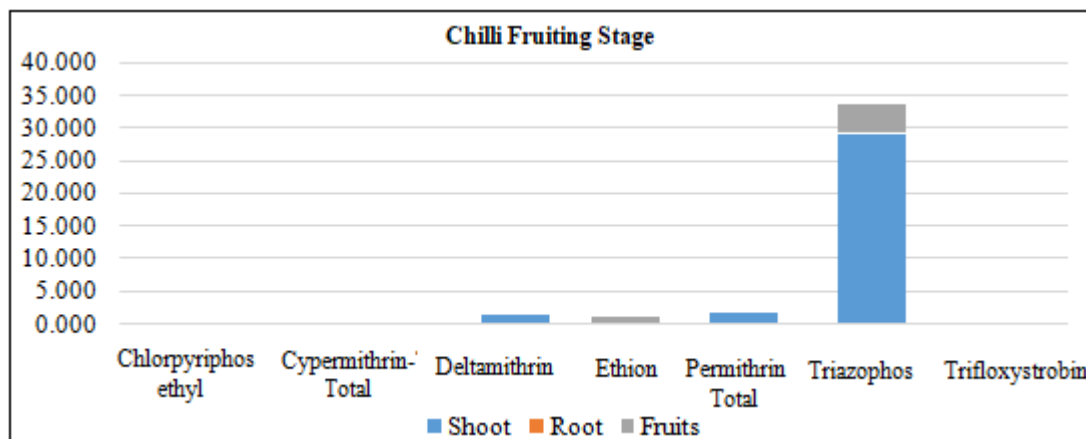
All the residues detected in the samples were presented in the Table 3 and Fig 3. From the analysis results the concentration of residues were very high in shoots as the Crop protective agents were applied on the shoots directly. Pesticide residues observed were in the decreasing order of Triazophos > Permethrin total > Deltamethrin > Ethion > Cypermethrin total > Chlorpyriphos ethyl > Trifloxystrobin in the shoots of chilli and residue of Ethion was found in the roots of chilli crop during fruiting stage.

Pesticide residues found in the fruits of chilli (Green chilli) were in the order of Triazophos> Ethion> Trifloxystrobin. All the three molecules detected in the green chilli fruits were above the EU MRL levels. Similarly organochlorine, organophosphorous and synthetic pyrethroid residue were observed by Singh et al., 2006; and Jabir et al., 2014 in vegetables.

**Table 3:** Pesticide residues in fruiting stage of chilli crop

	Chlorpyriphos ethyl	Cypermithrin-Total	Deltamithrin	Ethion	Permethrin Total	Triazophos	Trifloxystrobin
Shoots							
Mean (mg/Kg)	0.025	0.120	1.545	0.190	1.825	29.163	0.02
Standard Deviation	0.007	0.071	0.389	0.092	1.223	7.395	0
Roots							
Mean (mg/Kg)	BLQ	BLQ	BLQ	0.060	BLQ	BLQ	BLQ
Standard Deviation				0			
Fruits							
Mean (mg/Kg)	BLQ	BLQ	BLQ	0.673	BLQ	4.527	0.135
Standard Deviation				0.214		0.325	0.021
EU MRL				0.01		0.01	0.02

BLQ: Below the Limit of Quantification (0.01)



**Figure 3:** Pesticide residues within the shoots and roots of chilli during fruiting stage.

**Human Consumption:**

From the residue data in the fruit samples (Table 4) of green chilli consumption is not recommended as the TMRI (Theoretical maximum residue concentration) residue level (0.2264 mg/person/day) crossed the MPI (maximum permissible Intake) in triazophos (0.06 mg/person/day), considering average daily consumption of green chilli is 50g

per person per day. Total vegetable consumption per Indian adult is 400 gm (Narsingarao 2013). Though the MPI of Trifloxystrobin and Ethion were higher than the TMRC of Trifloxystrobin and Ethion respectively because of triazophos concentration consumption is hazardous to humans. Similar observation was found by Ock et al., 2003 during the study on finding the risks of food intake in Korea.

**Table 4:** Pesticide residues in green chilli crop in relation to human consumption

	Pesticide residue (mg/kg)	Standard Deviation	TMRC (mg/ person/ day)	MPI (mg/ person/ day)	ADI (mg/kg bw)
Triazophos	4.527	± 0.325	0.2264	0.06	0.001
Trifloxystrobin	0.135	± 0.021	0.0068	6	0.1
Ethion	0.673	± 0.214	0.0337	0.12	0.002

TMRC (Theoretical maximum residue concentration in mg/person /day) = Residue x Average daily consumption (150g)

MPI (Maximum Permissible Intake in mg/person/day) = ADI x Average body weight (60 Kg)

ADI (Acceptable Daily Intake) mg/kg bw by PPDB

**4. Conclusion**

From the study it is concluded that presence of Organochlorine, organophosphorous and synthetic pyrethroids were present in all the growing stages of chilli crop (vegetative, flowering and fruiting stages) and the presence of residues in the shoot (Above soil) part is very high compared to roots (Below soil). The residual

concentration is in the decreasing order of Triazophos > Permethrin total > Deltamethrin > Ethion > Cypermethrin total > Chlorpyrifos ethyl > Trifloxystrobin in shoot and in root Triazophos> Ethion followed by trifloxystrobin.

Residual concentration in green chilli fruits are higher than EU MRL for Triazophos>Ethion> Trifloxystrobin and remaining crop protective agents concentrations were below BLQ. Consuming these green chillies are hazardous to human health as the TMRC values are above MPI values when consumed at 50 gm/person/day.

## 5. Acknowledgement

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