

TEA STATISTICS

Pesticide residues in tea: Issues and concern

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Worldwide a considerable amount of agricultural produce is damaged by pests and diseases. Tea is not an exception in this regard. Being evergreen perennial, tea plantations of genetically diverse cultivars inter-planted with shade trees in Southeast Asia provide a relatively steady microclimate and food supply for insect and mite communities.^{1,2} More than one thousand species of arthropod pests are known to attack tea bushes all over the world, causing a yield loss ranging from 5% to 55%.^{3,5}

Tea is a crop that can well justify the expense of extensive insect control programme.⁶ Because of its particular agro-ecosystem and its perennial nature, this loss as a result of pest infestation is compounded in tea. Pest problem in tea has largely been controlled by the use of broad spectrum chemical pesticides that offer good control of pests, increased yield and high economic returns. According to an estimate, the average use pattern of chemical pesticides in tea was 11.5 kg ha⁻¹ in the Assam valley and Cachar, 16.75 kg ha⁻¹ in Dooars and Terai, and 7.35 kg ha⁻¹ in Darjeeling.⁷ Recently, Sannigrahi and Talukdar⁸ reported that the average pesticide use pattern in Dooars is 14.16 L kg⁻¹ ha⁻¹ yr⁻¹, of which synthetic pesticides constitute 85%. No doubt, means of chemical control is one of the best ways to minimise the loss due to insects, diseases and weeds, provided their application is done in right way synchronizing with the vulnerable stages of the pests. However, injudicious and continuous use of chemical pesticides have serious drawbacks like development of resistance to pesticides, pest resurgence, outbreak of secondary pests, harmful effects on human health and environments in addition to presence of undesirable residues.^{9,10}

Pesticides Resides in Tea

The Issues

- Pesticide residues in made tea produced by different countries are becoming a serious problem in view of the strict regulatory measures being adopted by EC, Germany, Japan and other developed countries.
- Many cases the residue data from field trials are not available. So in that case, the MRLs are generally

fixed at the limit of detection (very low) that often leads to rejection of consignment.

The Concern

- Presence of pesticide residues above the acceptable level act as a Non-Tariff barrier in the export of tea.
- It is mandatory for exporting countries to generate data for fixation of MRLs for different pesticides used in tea.

Pesticide residues are determined by MRLs, *i.e.* Maximum Residue Level and defined as the maximum concentration of pesticide residue (expressed as milligrams of residue per kilogram of food/animal feeding stuff) likely to occur in or on food and feeding stuffs after the use of pesticides according to Good Agricultural Practice (GAP). MRLs help in ensuring that residue levels do not pose undesirable risks for consumer health. They act as an indicator of the proper use of pesticides and ensure compliance with legal requirements for low residues on food. MRLs are considered as trading standards used to ensure that imported and exported food are safe to consume.

For a particular crop, the MRLs of pesticides are fixed based on the guidelines of national and international regulatory bodies. For tea, MRL of an approved chemical is generally fixed at a value determined from field trials where the bushes are treated with the pesticide and samples (made tea) are analysed to determine residue levels. Nationally, Central Insecticides Board (CIB) is the authority to regulate the usage of pesticides in the country. As per CIB, for a particular pesticide, bio-effectiveness data needs to be generated at minimum three locations and based on two seasons giving the details regarding the layout, methodology of field experiments including number of sprays, volume, stage of crop, *etc.* and observation on pests, population/damage, yield, *etc.* In addition, residue data needs to be generated for one season, four locations giving the details of spray, doses and estimation of residue on different time intervals, method of residue estimation recovery, *etc.* Data of a particular pesticide thus obtained from multi-locational trials are sent to Central Insecticides Board and Regis-

Table 1A: Insecticides – As approved by the CIB Registration Committee for use on “Tea crop” in India under the Insecticides Act, 1968 and their corresponding EU MRL

S. No.	Insecticide	Name of insect pest	Dosage g a.i ha ⁻¹	MRL (as on 20.05.2011) ppm	EU MRL (as on 26.03.2012) (mg kg ⁻¹)
1.	Azadirachtin 1% min EC	Thrips Red spider mites	4000–5000 (Formulation)	N.R.	0.01 (formulation not mentioned)
2.	Azadirachtin 5% EC	Caterpillar Pink mite Red spider mites Thrips	200 (Formulation) --do-- --do-- --do--	N.R.	0.01 (formulation not mentioned)
3.	Carbofuran 3% GR	Cockchafer grubs	0.3/ tree	N.F	0.05
4.	Chlorpyrifos 20% EC	Semi looper Scale insect Red slug caterpillar	150 150 150		0.1
5.	Deltamethrin 2.8% EC	Thrips Leaf roller Looper caterpillar	3–4 10 2.5–3.75	2.00	5.00
6.	Dicofol 18.5 % EC	Scarlet mite Purple mite Pink mite Red spider mite Yellow mite Jassid Thrips	230 230 230 230 230 230 230	5.00	20
7.	Dimethoate 30% EC	Mite	200	N.F	0.05
8.	Endosulfan 35% EC	Aphids, Caterpillars, Mealy bug, Scales and Thrips	288–350	5.00	30
9.	Ethion 50 % EC	Red spider mite Purple mite Yellow mite Thrips Scale insects	250 250 250 250 250		3.00
10.	Fenazaquin 10% EC	Red spider mite Pink mite Purple mite Scarlet mite	100 100 100 125	3.00	10
11.	Fenpropathrin 30% EC	Mites	50–60	2.00	2.00
12.	Fenpyroximate 5% EC	Red spider mite Pink mite Purple mite	15–30 15–30 15–30	0.02	0.1
13.	Flufenzin 20% SC	Pink mite Purple mite Red spider mite	80–100 80–100 100–120	0.05	0.05
14.	Flufenoxuron 10% DC	Lopper caterpillar Red spider mite	20–30 20–30	N. F.	0.05

Table 1A. *contd.*

S. No.	Insecticide	Name of insect pest	Dosage g a.i ha ⁻¹	MRL (as on 20.05.2011) ppm	EU MRL (as on 26.03.2012) (mg kg ⁻¹)
15.	Fluvalinate 25% EC	Flush worm	50–100	N. F.	15
		Red spider mite	125		
		Bunch caterpillar	125		
		Thrips	125		
16.	Hexythiazox 5.45% EC	Scarlet mite	15–25	0.01	4.0
		Red sider mite	15–25		
17.	Phosalone 35 %EC	Aphid	360	N. F.	0.1
		Mite	360		
		Thrips	360		
18.	Profenophos 50% EC	Red spider mite	400–500	N.F.	0.1
		Pink mite	400–500		
		Tea mosquito bugs	400–500		
		Lopper caterpillar	400–500		
		Thrips	400–500		
19.	Propargite 57% EC	Red spider mite	430–612	10	5.00
		Pink mite	430–612		
		Purple mite	430–612		
		Scarlet mite	430–612		
20.	Quinalphos 25% EC	Thrips	190	0.01	0.1
	Quinalphos 20% AF	Looper caterpillar	0.05%	0.01	0.1
21.	Spiromesifen 22.9% SC	Red spider mite	96	1.0	0.02
22.	Thiamethoxam 25% WG	Tea Mosquito bug	25	0.01	20
23.	Bifenthrin 8% SC	Red Spider mite	40	0.05	5.00
		Tea mosquito bug			

tration Committee (CIB&RC) for its label claim in tea. Only those pesticides that have label claim in tea for use in India are permitted for application in tea gardens. At present, 35 pesticides have label claim for use in tea as approved by CIB&RC. Among which there are 23 insecticides, 6 fungicides and 6 herbicides (Table 1).

Internationally, the Joint Meeting on Pesticide Residues (JMPR), is an expert group consisting of members from FAO, WHO and other relevant core assessment groups that recommends MRLs for pesticide residues in food and feed, based on scientific evaluations adopted by CODEX through Codex Committee on Pesticide Residues (CCPR) for use as international standards by the World Trade Organization (WTO) in international trade under the Sanitation and Phytosanitation (SPS) agreement in agricultural commodities. In addition, different panels and groups are there to review the effect of the pesticides in the human and environment. In this regard, the WHO core assessment group is responsible for reviewing toxicological and related data and for estimation of Acceptable Daily Intakes (ADIs) of the pesticides

for humans (where possible). MRLs can typically be less than a milligram (mg) of pesticide residue in a kilogram of food (1 mg kg⁻¹) up to 5 mg kg⁻¹ or more.

Harmonization of MRLs

MRL of a particular pesticide varies in different counties based on several factors like, the food habit of the region, differences in use patterns with reference to severity of pests, lack of harmonization in crop grouping, differences in the residue definition(s), differences in toxicological end-points, MRL calculations, consumer exposure calculations, etc.¹¹ In order to eliminate such differences, the CODEX MRLs have added advantages as it allows harmonization of MRLs to eliminate trade barriers. In addition, it is beneficial for the entire food value chain from growers, food processors, traders, retailers to crop protection product manufacturers *vis-a-vis* for governments to save resources. The generated data on pesticide residue might be used in several regions with higher predictability and less cost for industry.¹¹

The FAO-Intergovernmental Group (IGG) on Tea

Table 1B: Fungicides – As approved by the CIB Registration Committee for use on “Tea crop” in India under the Insecticides Act, 1968 and their corresponding EU MRL

S. No.	Fungicide	Disease controlled	Formulation dose ha ⁻¹	MRL (as on 20.05.2011) ppm	EU MRL (as on 26.03.2012) (mg kg ⁻¹)
1.	Bitertanol 25% WP	Blister blight	200 g	N.F.	0.1
2.	Copper oxychloride 50/77%/WP	Blister blight	350 g	N.F.	N.A.
3.	Hexaconazole 5%EC	Blister blight	200 ml	0.02	0.05
4.	Propiconazole 25%EC	Blister blight	125–250 ml	0.1	0.1
5.	Sulphur 80%WP	Red spider, Pink and Purple mites	1 kg	NR	N.A.
	Sulphur 40%WP	Pink and purple mites	2.0 L	– do –	N.A.
	Sulphur 52%SC	Red spider mite	2.0 L	– do –	N.A.
6.	Streptomycin sulphate 9% + Tetracyclin hydrochloride 1%SP	Blister blight	40 g + 350 – 420 g of Copper oxychloride 50% S.P. in 67 L of water per ha spray	N.F.	N.A.

recognized the urgent need for the harmonization of tea MRLs to reduce the cost of compliance by exporting countries in meeting the requirements of importing countries along with the concerns of consumers regarding food safety. The Group at its earlier sessions identified and agreed on the following key issues.¹²

- Strengthen cooperation between producers and importers to generate residue data required to address the difficulties arising from pesticide MRL regulatory changes in the importing countries;
- Support the efforts by producing countries for the generation of MRL data and collation for submission to Codex and expert consultations;
- Sustain global initiatives for pesticide management in tea in both producing and consuming countries and “harmonize” the approach to legislators on tea MRLs.

All these activities are coordinated by the Tea Board of India through the tea research institutes of the country and various associations of the tea industry to both national and international regulatory bodies.

MRL in made tea or Brew?

The issue of whether to fix MRL in made tea or in brew remains a question. Actually, the MRL is fixed on the commodity on sale. Since made tea is the commodity which is on sale, MRL is fixed on it. But it is the infusion, which we drink and not the made tea. Since tea is consumed as tea brew (infusion) and the amount of pesticide residue is very less in tea brew compared to its presence

in made tea (finished product, which is the traded form), it will be logical to fix the MRL in tea brew rather than in tea which is traded. Attempts have been made by the Tea Board of India involving other Govt. Departments/ Ministries along with tea research institutes/tea industry in different national and international forum to fix MRL in tea brew. In this direction, attempts have been made in the CCPR meetings to fix MRLs in tea brew internationally through scientific evidences and results to get full agreement on the establishment of MRLs on “tea brew”. Further, discussions were made at the CCPR Working Group on methods of Sampling, analytical method, processing studies and all other relevant information. However, for establishment of MRLs for tea brew, two important criteria are required to be followed:¹¹

1. Data requirements for submission to the JMPR for evaluation will not be changed.
2. Changes should be done in the CCPR MRL establishment procedure.

The FAO-IGG Working Group on MRL in tea brew has been addressing this issue for some time and would further strengthen to generate residue data on a continuous basis both in tea (*traded form*) and tea brew (*infusion*) and develop methodologies to calculate risk assessment realistically for the benefit of the tea consumers, producers and trade.

Present Status of Fixation of MRL in Tea Brew

The issue of fixation of MRLs based on tea brew was discussed at the 18th Session of the Intergovernmental Group (IGG) on Tea. Based on the recommendations, an

Table 1C: Herbicides – As approved by the CIB Registration Committee for use on “Tea crop” in India under the Insecticides Act, 1968 and their corresponding EU MRL

S. No.	Herbicide	Weeds controlled	Formulation a.i. per ha	MRL (as on 20.05.2011) ppm	EU MRL (as on 26.03.2012) (mg kg ⁻¹)
1.	Glyphosate 41% SL IPA salt	<i>Axonopus compressus</i> , <i>Cynodon dactylon</i> , <i>Imperata cylindrical</i> , <i>Polygonum perfoliatum</i> , <i>Paspalum scrobiculatum</i> , <i>Arundinella bengalensis</i>	0.820–1.23 kg	1.0	2.0 (irrespective of formulation)
2.	Glyphosate ammonium salt 5% SL	<i>Cynodon dactylon</i> , <i>Digitaria sanguinalis</i> , <i>Paspalum conjugatum</i> , <i>Ageratum conyzoides</i> , <i>Biden pilosa</i> , <i>Cyperus rotundus</i> , <i>Euphorbia spp</i> , <i>Imperata cylindrical</i> , <i>Boreria latifolia</i>	1.5 kg	N.A.	2.0 (irrespective of formulation)
3.	Glyphosate 71% SG	<i>Acalypha indica</i> , <i>Sida aculata</i> , <i>Ipomea digitaria</i> , <i>Digera arvensis</i> , <i>Digitaria sanguinalis</i> , <i>Paspalum conjugatum</i> , <i>Ageratum conyzoides</i> , <i>Cyperus rotundus</i>	2.13 kg	N.F.	2.0 (irrespective of formulation)
4.	Glufosinate ammonium 13.5% SL	<i>Panicum ripens</i> , <i>Borria hispida</i> , <i>Imperata cylindrica</i> , <i>Digitaria sanguinalis</i> , <i>Commelina benghalensis</i> , <i>Ageratum conyzoides</i> ♂	0.375–0.500 kg	0.001	0.1
5.	Oxyfluorfen 23.5% EC	<i>Digitaria imperata</i> , <i>Paspalum</i> , <i>Borria hispida</i>	150–250 kg	0.2	0.05
6.	Paraquat dichloride 24% SL	<i>Imperata cylindrica</i> , <i>Setaria sp.</i> , <i>Commelina benghalensis</i> , <i>Boerhaavia hispida</i> , etc.	0.2–1.0 kg	0.05	0.05

international ring test was carried out in 2009 with three pesticides, viz., Lambda-Cyhalothrin, Imidachloprid and Dimethoate. The ring test for black tea samples were arranged by Tea Research Association, Tocklai, India and Green tea samples by China. Results presented in 19th session of FAO-IGG on tea at Delhi (2010) showed that the transfer of residues of the pesticides followed water solubility of the compounds and called for additional ring tests. The Working Group of MRL based on Tea Brew hold two important deliberations since the 43rd CCPR meeting; first at Mombasa, Kenya on 18- 19 July 2011 (FAO- IGG, 2011) and in the full session of FAO IGG on Tea at Colombo, Sri Lanka on 30 Jan- 1st Feb 2012 (FAO- IGG, 2012).^{12,13} The Working group agreed on a plan of action towards meeting the strategy on achieving harmonization of Maximum Residue Levels (MRLs), identification of the priorities of compounds for MRL fixation, continuation for new data generation; position of country MRLs; position in regard to replacement of old and high polarity compounds by new and

safer chemicals and urgency to fix new MRLs for them. It was decided to progress further with its objectives towards establishing “processing factor” (Brew factor) and subsequently MRL based on tea brew; and in venture to take up once again with Codex.

The issue of fixation of MRLs in tea brew was further discussed in 44th CCPR meeting and two identical CRDs (10 and 29) were submitted to the CCPR 44, followed by a joint presentation before the CCPR 44 under agenda 12(b) and replying of queries. Now the issue has taken a shape with the decisions taken at the CCPR level. “The committee supported the current procedure of JMPR in the establishment of MRLs for pesticides in tea and encouraged countries to submit relevant data/information on brewing factors and standard methods to JMPR for consideration in estimation of MRLs for pesticides in Tea”.¹⁴ In view of the above, data generation for the risk analysis of compounds for the Codex to fix MRLs for tea brew is on progress.

Conclusion

Use of pesticides for pest management in tea is a 'necessary evil'. Therefore, the pesticide regulation in tea is formulated to ensure protection of consumers against the over exposure to pesticides that are hazardous to human health and environment. In India, the concentration of pesticides in food is regulated by two laws (1) the Food Safety and Standards Act, 2006 (erstwhile Prevention of Food Adulteration act 1954) and (2) the Insecticide Act, 1968. As per sec.21 of Food Safety & Standards Act, Pesticides residue, insecticides, common heavy metals, micro-biological and foreign matters counts should not be in excess of such tolerance limit and quantity stipulated by PFA. Residues of impurities considered to be of toxicological significance. Pesticides registered with Central Insecticide Board and having label claim for tea need be used. In addition, residue data generation for new pesticides that are effective against major pests and comparatively safe to environment is on progress for label claim under CIB before their actual use in tea plantations. The Registration Committee of Central Insecticide Board under the Insecticide Act 1968 ensures that pesticides allowed for use will not leave the residues on tea above fixed MRLs. It should also be in line with international standards prescribed by Codex, FAO, WHO, etc. to ensure that the export of tea from the country is in accordance with the international standard and safe for human consumptions. The Govt. of India, Ministry of Commerce & Industry, vide its order Ref. SO486 (E) dated 01.04.05 had issued the 'Tea Distribution and Export Control Order 2005' which has been facilitating to limit the undesirable substances in tea. This will not only help in producing quality teas for better acceptability by consumers but also improve the image of the country in competitive global market. It is expected that in near future Indian teas will more be in demand for their quality and safety.

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