Indian Journal of Entomology 84(2): 262-267 (2022) DoI No.: 10.55446/IJE.2021.106

PESTICIDES USE PATTERN IN OKRA

S M Chavan*, P K Modi[1] and P D Verma[2]

Agriculture Experimental Station, Navsari Agricultural University,
Paria 396145, Dist. Valsad, Gujarat, India
[1]Fruit Research Station, Navsari Agricultural University, Gandevi 396360, Gujarat, India
[2]Krishi Vigyan Kendra, Navsari Agricultural University, Dediapada 394650,
Dist. Narmada, Gujarat, India
*Email: sachinento@gmail.com (corresponding author)

ABSTRACT

A survey on the pesticide usage pattern in okra conducted among 100 farmers in Tapi District of Gujarat during 2017-18, revealed a clear trend in greater use of newer molecules followed by organophosphorous insecticides. Changing trend in awareness among farmers on the use of stick for mixing, and of measuring cup, and not reusing the pesticide containers for household purpose was observed. However, farmer's knowledge on recommended pesticide, dosage, safe harvest interval, label claim, personnel protection as well as spraying, proper disposal of pesticide container was lacking, but their knowledge was fair enough on time of application and storage, proper mixing and measuring of pesticides. To produce pesticide residue free okra fruit, it is essential to educate the farmers about proper preharvest interval, use of recommended pesticides, increased awareness about restricted and banned ones, and health hazards caused by misuse of pesticides.

Key words: Okra, insect pests, disease, farmers, field survey, insecticides, fungicides, storage, measuring, mixing, pesticide use pattern, Tapi, South Gujarat

Vegetables play a major role in Indian agriculture producing higher returns per unit area and time. Okra (*Abelmoschus esculentus* L.) is an important vegetable crop grown throughout the year in India, but its productivity is low due to yield losses caused by insect pests, diseases and nematodes. The crop is attacked by more than 72 insect pests and infestation is observed from seedling to harvest stage. The yield losses caused by sucking pests amount to 32.06 to 56.0% by leafhopper *Amrasca biguttula biguttula* (Ishida) (Singh et al., 1994), 94.0% by whitefly *Bemisia tabaci* (Gennadius) (Sastry and Singh, 1974), 54.04% by aphids *Aphis gossypii* (Glover) Chaudhary and Dadheech (1989) and 17.46 to 48% by two spotted spider mite *Tetranychus urticae* (Koch) (Kumaran et al., 2007). The avoidable yield loss caused by *Earias* spp. due to fruit damage was 36 to 90% (Misra et al., 2002). To avoid these losses, farmers resort to haphazard use of pesticides. In addition to high-yielding crop varieties and fertilizers, pesticides help the Indian farmers in achieving a substantial increase in agricultural productivity (Birthal et al., 2000).

Farmers cannot tolerate any loss to the vegetables either by insects or diseases and hence resort to chemical control. Pesticide use has increased rapidly over the last two decades @12%/ year (Thacker et al., 2005). About 13% of total pesticides used in agriculture are consumed by vegetable crops which cover only 3% of total cropped area. The widespread use of pesticides results in toxic residues (Kumari et al., 2002; Kumari 2008; Srivastava et al., 2011; Wang et al., 2011). Indiscriminate, improper, use of restricted pesticides on vegetables and negligence in following proper waiting periods make marketed vegetables very often contaminated with pesticides (Lakshminarayana and Menon, 1975). Many farm gate vegetable samples showed presence of insecticide residues (Singh et al., 1999). Literature reveals that vegetables with residues of pesticides above their respective maximum residue limit (MRL) may pose health hazards to consumers (Elliion et al., 2000; Mukherjee and Gopal, 2003). Contamination of vegetable crops is sometimes more than the prescribed tolerance limits. Jeyanthi and Kombairaju (2005) studied the pesticide use in important vegetable crops, viz. chillies, cauliflower, brinjal and okra. Average pesticide usage has been estimated at 5.13, 2.77, 4.64 and 3.71 kg a.i./ ha on chillies, cauliflower, brinjal and okra crops, respectively. Godfred et al. (2013) conducted a survey to assess the knowledge of pesticides handling by crop farmers along River Oyansia in Ghana. Survey on pesticide usage

pattern in okra was also carried out by Anil Kumar et al. (2017) in three villages of Karimnagar district of Telangana. This study is on a survey on pesticide usage pattern in okra crop conducted in Tapi district of Gujarat state where okra contributes 44.4% of total area grown under vegetable with total production of 1,33,552 mt (40.42% of total vegetable production).

MATERIALS AND METHODS

Survey was conducted to understand pesticide usage pattern of okra growers of Tapi district of South Gujarat. For the selection of area and respondents, multistage random sampling technique and universe method was adopted. At the first stage of sampling, Tapi district was selected among the seven districts of the South Gujarat purposively based on its' higher area coverage under okra (44.4%). Out of 7 blocks of Tapi district, three blocks (viz., Dolvan, Valod and Vyara) were selected at the second stage of sampling. In the selected blocks a relatively homogenous field cultivated with vegetable crops was selected. The farmers who have been growing okra were selected as respondents through total enumeration. Thus, total 100 farmers were considered as respondents, who were not pre-informed to avoid biased responses and to gain actual insight of the farming practices. The data was collected by personal interview method by using local language (Gujarati) for getting their exact response and simple % method was used for analysis of data statistically to reach meaningful conclusions. The questionnaire was designed in the form of closed questions in either a multiple-choice format or questions with yes/ no as answers. The objectives and scope of the study were explained to farmers for their fair cooperation. Based on the objectives, a questionnaire format consisting of general information about farmer was prepared and data was collected by interviewing the farmers individually using it.

RESULTS AND DISCUSSION

Overall pesticides usage profile in okra growing Tapi district revealed that the use of acetamiprid 20SP was maximum (52%) followed by thiamethoxam 25WG (25%), profenophos 50EC (22%); cartap hydrochloride 50WP (22%), bifenthrin 10EC (17%), monocrotophos 36SL (16%) (Table 1); insecticides like chlorpyrifos 50%+ cypermethrin 5EC (13%), deltamethrin1%+ triazophos 35EC (11%), dimethoate 30EC (8%), emamectin benzoate 5SG (5%), propargite (5%); chlorantraniliprole 18.5SC (4%), imidacloprid 17.8SL (4%), carbofuran 3G (3%), thiamethoxam 12.6%+ lambda cyhalothrin 9.5ZC (2%), cypermethrin 25EC (2%), lamda cyhalothrin 5EC (1%), buprofezin 25EC (1%), chlorpyriphos 20EC (1%), flonicamid 50WG (1%), imidacloprid 30.5SC (1%) for management of sucking pests and borer complex followed next. Likewise, fungicides usage revealed that the use of hexaconazole 5% SC was maximum (39%) followed by sulphur 80WP (14%) (Table 1); other fungicides like carbendazim 12% + mancozeb 63%WP (4%), carbendazim 50WP (2%), copper oxychloride 50WSP (1%), tebuconazole (1%), tebuconazole 10WP + sulphur 65WG (1%), mancozeb 75WP (1%), propineb 70WP (1%), kasugamycin 5 + copper oxychloride 50 (1%), thiophenate methyl 70WP (1%) for management of damping off, powdery mildew, leaf spot and wilt diseases followed next.

Only seven insecticides (acetamiprid 20SP, imidacloprid 17.8SL, thiamethoxam 25WG, carbofuran 3G, chlorantraniliprole 18.5SC, emamectin benzoate 5SG, lamdacyhalothrin 5EC and cypermethrin 25EC) with label claim recommended by Central Insecticide Board and Registration Committee (CIB & RC) were found to be used. In case of fungicides only sulphur 80WP was used. Other insecticides and fungicides not registered for its use in okra were also in use (Table 1). Most of the hazardous insecticides recommended for cotton were found to be used. These observations corroborate with those of Meenambigai et al. (2017) in Tamil Nadu. The use of monocrotophos (16%) was noticed, although its use has been restricted in vegetable in India from 5th October, 2005. The study showed a clear declining trend in the use of synthetic pyrethroids and greater use of newer molecules followed by organophosphates. These results agree with those of Meenambigai et al. (2017). Eighty five % respondents mainly collect information from agricultural input retailers, while 7% and 3% of respondents from university scientist/extension officer/other agricultural field functionaries and experienced farmer/big farmer, respectively (Table 2). This observations corresponds to those of Meenambigai et al. (2017) and Anilkumar et al. (2017)**.** About one third (71%) and 20% respondents decide to spray on regular basis (own decision) and as per the presence of pest, respectively. Thirty one % tribal okra growers select/ purchase pesticides as per the cost (preference given to chief pesticide), whereas one third (69%) select/ purchase pesticides as per the efficiency of management of pest/ pathogen.

Ninety %, 8% and 2% of the respondents preferred to apply pesticides at evening, morning and afternoon time,

Table 1. Pesticides used by farmers for management of pest and diseases in okra

S. No.	Pesticide	Used against	No. of Respon-dents uses	CIB&RC recommended crop
1.	Acetamiprid 20SP	Sucking pests	52	okra, cotton, cabbage, chilly, rice
2.	Imidacloprid 17.8SL	Sucking pests	4	cotton, paddy, chilli, sugarcane, mango, sunflower, okra, citrus, groundnut, tomato, grapes
3.	Imidacloprid 30.5SC	Sucking pests	1	cotton, paddy
4.	Thiomethaxam 25WG	Sucking pests	25	paddy, cotton, okra, mango, wheat, mustard, tomato, brinjal, tea, potato, citrus
5.	Flonicamid 50WG	Sucking pests	1	rice, cotton
6.	Chlorpyriphos 20EC	Sucking Pests, SFB	1	paddy, beans, gram, sugarcane, cotton, groundnut, mustard, brinjal, cabbage, onion, apple, ber, citrus, tobacco
7.	Profenophos 50EC	SFB, GC	22	cotton, soybean
8.	#Monocrotophos 36SL	SFB, GC	16	paddy, maize, blackgram, greengram, pea, redgram, sugarcane, cotton, citrus, mango, coconut, coffee, cardamom
9.	Dimethoate 30EC	Sucking, SFB	8	bajra, maize, sorghum, casot, mustard, safflower, onion, potato, apricot, banana, citrus, fig, mango, rose
10.	Chlorantraniliprole 18.5SC	SFB, GC	4	rice, cabbage, cotton, sugarcane, tomato, chilli, brinjal, pigeonpea, soybean, bengalgram, black gram, bittergourd, okra
11.	Emamectin Benzoate 5SG	SFB, GC	5	cotton, okra, cabbage, hilli, brinjal, pigeonpea, chickpea, grapes, tea
12.	Cartap Hydrochloride 50WP	FB, GC	22	paddy
13.	Chlorpyrifos 50%+ Cypermethrin 5% EC	Sucking, SFB, GC	13	cotton, paddy
14.	Deltamethrin1% + Triazophos 35%EC	Sucking, SFB, GC	11	cotton, brinjal
15.	Thiamethoxam 12.6%+ Lambdacyhalothrin 9.5%ZC	Sucking, SFB, GC	2	cotton, maize, groundnut, soybean, chilli, tea, tomato
16.	Propargite 57SC	Red mite	5	tea, chilli, apple, brinjal,
17.	Buprofezin 25EC	Sucking pests	1	cotton, chilli, mango, grapes, paddy
18.	Carbofuran 3G	Sucking pests & nematodes	3	barley, bajara, sorghum, jute, groundnut, french bean, potato, tomato, apple, citrus, maize, paddy, mustard, soybean, sugarcane, okra, chilli, cabbage, wheat, brinjal, banana, peach, mandarins, french bean, pea, tea
19.	Cypermethrin 25EC	SFB	2	cotton, okra, brinjal
20.	Bifenthrin 10EC	SFB, Sucking pests	17	cotton, paddy, sugarcane
21.	Lamdacyhalothrin 5EC	SFB	1	cotton, paddy, brinjal, tomato, chilli, pigeonpea, onion, okra, chickpea, groundnut, mango
22.	Carbendazim 12% + Mancozeb 63%WP	LS, PM	4	groundnut, paddy, potato, tea, grape, mango, chilli, maize, apple
23.	Carbendazim 50WP	Damping off, wilt, LS, PM	2	paddy, wheat, barley, tapioca, cotton, jute, groundnut, sugarbeet, peas, cluster beans, cucurbits, brinjal, apples, grapes, walnut, ber, rose, chillies, moong, cowpea, tobbaco
24.	Copper Oxychloride 50WSP	Wilt, LS, PM	1	citrus, chilli, betel, banana, coffee, tobacco, tomato, grapes, coconut, cardamom
25.	Hexaconazole 5SC	LS, PM	39	paddy, mango, grapes.
26.	Tebuconazole 10%WP+ Sulphur 65%WG	PM, LS	1	chilli, soybean
27.	Tebuconazole 25.9SC	PM, LS	1	chilli, groundnut, paddy, onion, soybean, black gram
28.	Sulphur 80WP	PM, LS	14	apple, grape, groundnut, cowpea, moong, black gram, pea, sorghum, chilli, okra, mango, citrus, tea
29.	Mancozeb 75WP	LS	1	wheat, maize, paddy, sorghum, potato, tomato, chilli, cauliflower, groundnut, grapes, guava, banana, apple, cumin
30.	Propineb 70WP	LS	1	apple, pomogranate, potato, chilli, tomato, grape, paddy, cotton
31.	Kasugamycin 5 + Copper Oxychloride 50	LS, PM	1	grape, paddy
32.	Thiophenate methyl 70 WP	PM	1	papaya, apple, tomato, bottle gourds, grapes

SFB- Shoot and fruit borer, GC- Green caterpillar, LS-Leaf Spot, PM-Powdery mildew, SFB-Shoot and fruit borer
Insecticide under restricted use

Table 2. Knowledge level of okra growing farmers on pesticide usage pattern

Pesticide use pattern	Respondents (%)	Pesticide use pattern	Respondents (%)
Source of knowledge		Spraying intervals before commencement of picking	
Agro chemical input retailer	85	2-3 days	0
Scientist/Extension officer/Other functionaries	7	4-6 days	4
Experienced farmer /big farmer	3	Weekly	41
Own experience	5	Depending upon the pest/disease	55
Decision of Time of pesticide application		Spraying intervals after commencement of picking	
Presence of pest/just before pest occurrence period	20	2-3 days	30
Agro chemical dealer recommendation	6	4-6 days	61
Colleague farmer recommendation	3	Weekly	4
Spray on regular basis (Own decision)	71	Depending upon the pest/disease	3
Factors Affecting choice of pesticide		Time interval between last spraying and harvesting	
Cost of the product	31	1-2 days	40
Efficiency of pest/pathogen control	69	3-4 days	53
Time of the day when application usually takes place		4-6 days weekly	7
Morning	8	Protective measure adopted by respondents	
Afternoon	2	No precautions	76
Evening	90	Low precautions	21
Frequency of application of pesticide		Partial precautions	3
4 to 6 times	0	Complete precautions	0
7 to 10 times	0	Method of disposal of the empty pesticide container	
> 10 times	100	Throw away	50
Method of application		Burning/burying in pits	50
Spraying	100	Keeping at home for other uses/ give to others	0
Spraying & Dibbling	7	Selling them to peddlers	0
Spraying & Drenching	15	Consumption of okra by the respondents	
Place of storage of pesticides		Regular (Once in a week)	20
With fertilizers and farm equipment at farm site	45	Sometimes (Once in month)	50
With fertilizers and farm equipment outside the house	50	Never	30
Stored inside the house	5		

respectively. All the respondents applied pesticides mainly through spraying whereas 7% followed dibbling and 15% also applied by drenching. All the respondents apply the pesticide more than ten times. Further, respondents preferred to apply pesticides in the following days' interval- 2-3 days (0%), 4-6 days (4%), weekly (41%) and depending upon the pest/ disease infestation/ infection (55%) before commencement of picking. Whereas, after commencement of picking, 30%, 60%, 4% and 3% respondents preferred at 2-3 days, 4-6 days, 7 days interval and depending upon the pest/ disease infestation/ infection, respectively. Forty % of the respondents followed the waiting period of 1-2 days. Maximum (53%) the respondents follow 3-4 days of waiting period while, 40% and 7% follow the waiting period of 1-2 and 4-6 days, respectively. About 45% of the farmers store pesticides with fertilizers and farm equipment at the farm site, away from the house. Fifty % respondents store the pesticides with fertilizers and farm equipment outside the house. It was found that majority of the respondents (76%) have not followed the protective measures during spraying. About 21% of the respondents were noticed to follow less than required precautions and only 3% followed partial precautions. Half of the respondents (50%) dispose the empty pesticide container/ packing material by throwing away at roadside, along the borders of the field etc. (Table 2). Half of the respondents (50%) dispose by burning or buried in the soil which is line with the findings of Gurava Reddy et al. (2011).

Eighty-nine % respondents were found to be male who carried out the spraying operations, while 11% were female; about 88% measured chemical by pesticide container cap and remaining add it approximately; and 80% respondents carried out spraying operation by themselves, and 20% depended on labour (Table 3). All the respondents mixed the chemical by using stick and avoiding bare hands; majority of the farmers followed safe methods while storing or mixing or spraying which may be due to awareness on the effect on health and majority of the farmers measuring by pesticide

Table 3. General awareness of farmers on pesticides and their use

S. No.	Particulars/comments	Frequency		%	
		Yes	No		
1.	Are you mixing different pesticide formulations for spraying	85	15	85	15
2.	Whether you take retail invoice after purchasing of pesticide?	61	44	61	44
3.	Whether you have any idea about proper disposal of pesticide container/packing material?	05	95	05	95
4.	Whether you rinse the empty container//packing material?	0	100	0	100
5.	Whether you have any knowledge on pesticide environmental effect?	89	11	89	11
6.	Are you aware about recommended pesticides against different pests	55	45	55	45
7.	Are you aware about the pesticide classification based on toxicity	12	88	12	88
8.	Are you aware that monocrotophos is restricted for use on vegetables?	2	98	2	98
9.	Are you aware that for each pesticide, pre-harvest interval is recommended	4	96	4	96
10.	Are you aware that pesticide residues are found in vegetables	18	82	18	82
11.	Are you aware that food exports are rejected due to pesticide residues	4	96	4	96
12.	Do you think high pesticide dose gives higher yields	78	22	78	22
13.	Do you think that okra cultivation is not possible without use of chemicals	80	20	80	20
14.	How do you measure the chemical	1	2		
	1. Pesticide container measuring cap 2. Approximately	88	12		
15.	How do you mix the chemical	1	2		
	1. Bare hands 2. Stick	0	100		
16.	Which spray appliances you are using for spray	1	2		
	1. Knapsac sprayer 2. Motorized sprayer	100	0		
17.	Mostly who carried the spraying operation?	1	2		
	1. Male 2. Female	89	11		
18.	Who sprays the crop	1	2		
	1. Your self 2. Skilled worker	80	20		

container cap was due to their habituated to its usage. Present finding confirms the findings of Anilkumar et al. (2017). About 85% of respondents followed mixing of different pesticides formulations, rather than applying single pesticide at a time, basically to save time, labour, money and to combat two or more pests with a single spray, whereas 15% sprayed the pesticide with mixing which indicate their knowledge in using pesticides. These findings are in line with Anilkumar et al. (2017). Sixty-one % respondents asked for retail invoice from agri input retailer. Ninety-five % and 89% were aware about proper disposal of pesticide and their effect on the environment, respectively. Only 12% respondents have knowledge about pesticide classification based on toxicity. Ninety-five %, 96%, 82% and 96% respondents were found unaware about restricted use of monocrotophos, waiting period, pesticide residues in vegetables and rejection of exported material due to pesticides residues, respectively. About 82% respondents opined that more pesticide dose gives higher yields. All the okra growers (100%) preferred the knapsack sprayer for spraying. Remarkable observation was that about 30% okra growers never consume the okra grown by themselves, whereas 50% do consume it sometimes i.e. once in month. Only 20% farmers consumed okra regularly i.e once in week (Table 3). This fact emerged due to indiscriminate and injudicious application of pesticides carried by farmers.

REFERENCES

Anil Kumar B K, Ragini A, Padmasri K, Jeevan Rao, Shashibhushan V. 2017. Survey on pesticide usage pattern in bhendi (*Abelmoschus esculentus* L.). Bulletin of Environment, Pharmacology and Life Sciences 6(1): 182-188.

Birthal P S, Sharma O P, Kumar S, Dhandapani A.2000. Pesticide use in rainfed cotton: frequency, intensity and determinants. Agricultural Economic Research Review 13(2): 107-122.

Chaudhary H R, Dadheech L N.1989. Incidence of insects attacking okra and the avoidable losses caused by them. Annals of Arid Zone 28 (3): 305-307.

Elliion, J, Sauve F, Selwyn J. 2000. Multi residues method for determination of residues of 251 pesticides in fruits and vegetables by gas liquid chromatography and liquid chromatography with fluorescence detector. Journal of AOAC International 83: 698-713.

Godfred D, Akoto O. 2013. Dietary intake of organophosphorus pesticide residues through vegetables from Kumasi, Ghana. Food and Chemical Toxicology 46: 3703-3706.

Gurava Reddy, Satish J, Chandra Sekhara M. 2011. Awareness of chilli farmers on safe use of pesticides: A Case of Crop Life India (CLI) project farmers from Guntur district of Andhra Pradesh. International Journal of Applied Biology and Pharmaceutical Technology 2: 128-132.

Jeyanthi H, Kombairaju S. 2005. Pesticide use in vegetable crops: frequency, intensity and determinant factors. Agricultural Economics Research Review 18: 209-221.

Kumaran N, Douressamy S, Ramaraju K, Kuttalam S.2007. Estimation of damage and yield loss due to *Tetranychus urticae* Koch (Acari:Tetranychidae) on okra under artificial infestation. Journal of Acarology 17: 4-6.

Kumari B. 2008. Effects of household processing on reduction of pesticide residues in vegetables. ARPN Journal of Agricultural and Biological Science 3(4): 46-50.

Kumari B, Madan V K, Kumar R, Kathpal T S. 2002. Monitoring of seasonal vegetables for pesticide residues. Environmental Monitoring and Assessment 74: 263- 270.

Lakshminarayana V, Menon P K. 1975. Screening of Hyderabad market samples of food stuffs for organochlorine residues. Indian Journal of Plant Protection 3: 4-19.

Meenambigai C, Bhuvaneswari K, Mohan Kumar K, Sangavi R. 2017. Pesticides usage pattern of okra, *Abelmoschus esculentus* (L) Moench in Tamil Nadu. Journal of Entomology and Zoology Studies 5(6): 1760-1765.

Misra H P, Dash D D, Mahapatra D. 2002. Efficacy of some insecticides against okra fruit borer, *Earias spp.* and leafroller, *Syleptaderogata* Fab. Annals of Plant Protection Science 10(1): 51-54.

MukherjeeI, Gopal V. 2013. Pesticide residues in vegetables in and around Delhi. Environmental Monitoring and Assessment 86(3): 265-271.

Sastry K S M, Singh S J. 1974. Effect of yellow vein mosaic virus infection on growth and yield of okra crop. Indian Phytopathology 27(3): 294-297.

Singh G, Brar K S. 1994. Effect of date of sowing on the incidence of *Amrasca biguttula biguttula* (Ishida) and *Earias* spp. on okra. Indian Journal of Ecology 21(2): 140-144.

Singh,B, Gupta A, Bhatnagar A, Parihar N S. 1999. Monitoring of pesticide residues in farm gate samples of chilli. Pesticide Research Journal 11(2): 207-209.

Srivastava A K, Purushottam T, Srivastava M K, Lohani M, Srivastava LP.2011. Monitoring of pesticide residues in market basket samples of vegetable from Lucknow city, India. Environmental Monitoring and Assessment 176: 465-472.

Thacker N P, Bassin J K, Nitnaware V, Vaidya P, Das S K, Biswas M. 2005. Proceeding of the national seminar on pesticide residues and their risk assessment. pp. 65-77.

Wang H S, Sthiannopkao S, Du J. Chen Z J, Kim K W, Mohamed Y M S, Hashim J H,Wong C K, Wong M H. 2011. Daily intake and human riskassessment of organochlorine pesticides (OCPs) based on Cambodian market basket data. Journal of Hazardous Materials 192 (3): 1441-1449.

(Manuscript Received: March, 2021; Revised: August, 2021;
Accepted: September, 2021; Online Published: November, 2021)
Online published www.entosocindia.org (Ref. No. e21097)