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Ashoka N
Assistant Professor, Dept. of Agricultural Economics, College of Horticulture, Munirabad, Koppal, Karnataka, India

Ravi Kumar B
Assistant Professor, Dept. of Plant Pathology, College of Horticulture, Munirabad, Koppal, Karnataka, India

Gajanana Kustagi
Assistant Professor Dept. of Post Harvest Technology, College of Horticulture, Munirabad, Koppal, Karnataka, India

Ravi Y
Scientist (PSMAC), ICAR-NRC on Seed Spice, Ajmer, Rajasthan, India

Rajeshwari Nidagundi
Assistant Professor, Dept. of PSMAC, College of Horticulture, Munirabad, Koppal, Karnataka, India

Venkatesh Hosmani
Assistant Professor, Dept. of Agricultural Entomology, College of Horticulture, Munirabad, Koppal, Karnataka, India

Correspondence
Ashoka N
Assistant Professor, Dept. of Agricultural Economics, College of Horticulture, Munirabad, Koppal, Karnataka, India

Analysis of farmer's behavior for bio-pesticides in Hyderabad-Karnataka: A case in Ballari and Koppal districts

Ashoka N, Ravi Kumar B, Gajanana Kustagi, Ravi Y, Rajeshwari Nidagundi and Venkatesh Hosmani

Abstract
Repeated exposure to agro-chemical pesticides may increases the pesticide accumulation in food chain and adversely affect on human and environment. Hence, part of farming community shifting from chemical inputs to bio-inputs. In this regard, this study was conducted to know the extent of awareness, usage pattern, product differentiation, factors affecting and purchase pattern of bio-pesticides in Ballari and Koppal districts in Karnataka state. The data pertaining to this study was collected with the help of pre-tested questionnaire during the agricultural year 2018. The results of the study indicated that, the training programmes conducted by the Scientists of College of Horticulture, Munirabad provided the information on usage of bio-pesticides to farming community to the maximum extent (40.67%) followed by Agricultural Officers (18.26%). Many of the crop plants are prune to soil borne diseases and this factor made farmers to opt for bio-pesticides to maintain sustain soil health. Sixty for per cent of the respondents differentiate the product with the help of brand name and followed by symbol (25.83%). Majority of respondents (70.83%) opinioned that bio-pesticides are easily available as market network is well established. Majority of farmers purchase the bio-pesticides after sowing as many farmers are using bio-pesticides for perennial crops. The study also specified that, there is vast scope for the sellers to deliver the product at door steps of farmer's field as telemarketing is an emerging market.

Keywords: Bio-pesticides, farmers, market, purchase, sales and utilization

Introduction
Use of pesticide has surely added towards improving agricultural production, thus increasing agricultural income. However, haphazard utilization of artificial chemical pesticides has adversely affected human health and environment and has also enhanced development of pesticide resistance among pest species. Farmer's suicides in Karnataka are attributed to untreated mental illness. Depression arising from repeated exposure of agro-chemicals, pesticides may increase the risk for mood disorders and ultimately suicide (Purnanand, 2011) [1]. Recently, the World Health Organization's (WHO) estimate indicated that, 25 million cases of acute occupational pesticide poisoning in developing countries and 20,000 deaths world-wide each year (Ezhil Vendan, 2016) [2].

Therefore, there has been a rising demand for foodstuff and quality in recent decades, as reflected in the stiff safety rules on imports of products and severe set of laws on the amount of pesticide residues on farm products. Bio-pesticides are natural materials derived from animals, plants, and bacteria, as well as certainminerals, which are used for pest control (EPA. Bio-pesticides, 2017) [3]. Currently, bio-pesticides consist of a small share of the total crop safety market internationally, with a value of about $3 billion worldwide, accounting for just 5 per cent of the total crop protection market (Marrone, 2014; Olson, 2015) [4, 5]. Although bio-pesticide use at a global scale is increasing by almost 10 per cent every year (Kumar, 2016) [6], it appears that the global market must increase further in the future if these pesticides are to play a visible role in substituting for chemical pesticides and reducing the current over-reliance on them. Currently, there are fewer bio-pesticide active substances registered in the EU than in the US, India, Brazil, or China (Christos and Spyridon, 2018) [7]. However, bio-pesticides may represent about 4.2 per cent of the overall pesticides market in India (Das, 2014) [8]. Globally, bio-pesticides production is 4.5 per cent and in USA it is 6 per cent, whereas in India, it accounts only 3 per cent of the total chemical pesticides production. Presently, only 12 types of bio-pesticides including neem based and microbial based formulations are registered under the Insecticide Act, 1968 in India (EzhilVendan, 2016) [2].

Even though the potential demand for bio-pesticides is very high, the real demand from the farming community is very low.

There is lack of awareness among farmers about the benefits of this low cost product. There is also lack of proper marketing network, lack of awareness among marketing personnel and lack of promotional efforts in right direction etc. In this regard, this study was conducted dynamics of bio-pesticide usage in Hyderabad-Karnataka region in Northern Karnataka.

Methodology

To accomplish the objectives of the present study, Koppal and Ballari districts were selected because these districts represents most of the suitable climatic and geographical conditions thatare prevailing in the state and also enjoyed considerable part in production of agricultural and horticultural crops. In the next stage, list of two talukas from each district were selected *viz*., Koppal and Gangavati from Koppal district and Hosapete and Hagaribommanahalli from Ballari district usingbio-pesticides was prepared in consultation with the horticulture and agriculture officials in the districts. From the list of talukas, two villages from each taluka were randomly selected for the study. The primary data pertaining to the year 2018 were collected from 120 farmers' respondents (60 from each district) with the help of pre-tested questionnaire.

Analytical tools like tabular analysis and simple average were used indicating the characteristic like buying behavior, brand preference, sales strategy, marketing cost, constraints, etc.

Results and Discussion

The findings of the present study have been presented under following heads:

Sources of information for bio-pesticides availability

Sources of information pertaining to the bio-pesticides availability to the farmers are presented in Table 1. The result revealed that most of the farmers came to know about availability of suitable bio-pesticide from Scientists of College of Horticulture, Munirabad (40.67%) followed by Agriculture Officers (18.26%), Dealers /Retailers (17.43%), Company marketing officers (9.43%), Friends/ relatives/ Progressive farmers (8.30%), Advertisement (3.32%) and other sources of information which accounted to only 2.49 per cent. This result revealed that Scientists of College of Horticulture, Munirabad are the main sources of information (40.67%) as Scientists of this college have conducted many method and result demonstration training programme as a part of their extension activities in both the districts. Similar observations were made by Gururaj (2007) [9] with regard to cotton and cabbage in North Karnataka. In addition to this, scientists have delivered series of lecture during the farmer's meet along with literature distribution. The college is situated at border of the both district hence intervention of scientists is at maximum extent.

Factors affecting the use of bio-pesticides

Different factors influence for usage of bio-pesticides by the farmers is presented in Table 2. It is noticed from the table that sustaining the soil health by managing the soil borne pathogens was the most perceived factor (35.83%) followed by increased cost of chemical pesticides (18.33%), increasing the total returns (10.83%), to get better quality of produce (8.33%). Environmental concern (6.67%), reducing the cost of cultivation (5.83%), motivation from neighbor farmers (3.33%) and motivation by media (0.83%) were identified as other factors for use of bio-pesticides. Majority of the farmers were opting for soil borne bio-pesticides as many of the plant diseases are soil borne in nature. In addition to this, increasing cost of chemical pesticides and to maximize the total returns were other two important factors made farmers to use bio-pesticides.

Product differentiation of bio-pesticides

The degree of product differentiation of bio-pesticides by farmers among the various brands of bio-pesticides from different producers is given in Table 3. It is clear from the table that the 65.00 per cent of respondents differentiate the products from their brand names, 25.83 per cent from brand symbol, 4.17 per cent by colour of packaging, 3.33 per cent by shape of the packaging and 1.67 per cent from size of the packaging. Since majority (66.67%) of the farmers using bio-pesticides for fruit crops and fruit growers are aware of different brands of bio-pesticides available in the markets as they are literate and undergone different training programmes at different institutions. This result is in line with (Yeledhalli *et al*. 2011) [10] with respect to marketing of bio-fertilizers in North Karnataka.

Purchase pattern of bio-pesticides

It is noticed from the Table 4 that 70.83 per cent of farmers perceived that the bio-pesticides are easily available and 29.17 per cent perceived its availability is difficult. This is mainly because of well established marketing network of bio-pesticides, as many public and private firms are engaged in producing and marketing of bio-pesticides in these districts. With respect to certified/standardized quality of bio-pesticides 60.83 per cent of the respondents were aware of certified/standardized quality of bio-pesticides while purchasing and 39.17 per cent of the farmers were not aware of quality of bio-pesticides. Sufficient technical knowledge of the farmers on quality aspects is attributed the reason. Nearly 65 per cent of farmers purchase the bio-pesticides after the sowing as 66.67 per cent of the farmers using the bio-pesticides for perennial / fruit crops (Table 5). Almost 35 per cent of the respondents were purchasing bio-pesticides at the sowing time and 6.67 per cent during land preparation. This was because of their convenience at the time of purchasing other inputs, as 33.37 per cent of bio-pesticides were using for annual crops. About purchase behavior, 54.17 per cent of farmers purchased the intended product only, whereas 33.33 per cent respondents purchase with other inputs. This is because to control soil borne diseases organically. About 12.50 per cent farmers get the produce delivered at their door step through E-commerce (online shopping). College of Horticulture, Munirabad also supplies bio-pesticides to the farmers at their door steps as and when demanded by the farmers.

Utilization pattern of bio-pesticides in different cropping enterprises

Utilization pattern of bio-pesticides in study area is presented in Table 5. It is clear that bio-pesticides used more in Fruit crops (66.67%) followed by Vegetable crops (16.67%), Cereals (8.33%), Pulse crops (3.33%), Commercial crops (4.14%) and Oil seed crops (0.83%). The reasons attributed for more usage of bio-pesticides to fruit crops are they are perennial in nature and hence they more prone for soil borne pests and diseases. Hence, locally isolated bio-pesticide were more effective against soil borne pathogens especially in high value crops like fruit crops. Pomegranate is dominated fruit crops in the study area and farmers of these districts apply

bio-pesticides (*Trichoderma sp.* and *Pseudomonas sp.*) against bacterial blight and wilt with intention to produce organically. Farmers in the study area opinioned that College of Horticulture, Munirabad is producing locally isolated *Trichoderma* and *Pseudomonas* stains which are most effective against soil born diseases particularly in these regions.

Bio-pesticides application pattern

The method of application of bio-pesticides is vary from farmer to farmer and is shown in Table 6. It is evident from the table that seed treatment with jaggery solution is more (90.83%) as jaggery is cheaply available and effective and very few (5.38%) farmers are using bio-pesticides with sugar solution. With respect to soil application, 15 per cent of respondents applied directly to the soil and majority (85%) farmers used bio-pesticide after mixture with Farm Yard Manure / Cow dung / Compost. This is because bio-pesticides are living organism which multiplies well with organic matter. In liquid form, 18.33 per cent of farmers practiced seedling dip method especially for vegetable crops, because tender seedling can easily absorbs more bio-pesticides in liquid formulation and 35.83 per cent farmers using bio-pesticides through drip irrigation method. Majority of respondents are spraying the bio-pesticides over crop plants especially for perennial crops. This is because of their convenience and as per the recommendation of Scientists of College of Horticulture, Munirabad in various training programmes. Yeledhalli *et al.* (2011) [10] also reported similar observation in case of biofertilizers application in Karnataka.

Table 1: Sources of information of bio-pesticides availability N=60+60=120

Sl. No.	Particulars	Koppal District		Ballari District		Aggregate (Overall)	
		Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
1	Agriculture officers / KSDA / RSK	10	16.67	12	20.00	22	18.26
2	Scientists of College of Horticulture (COH), Munirabad	27	45.00	22	36.67	49	40.67
3	Company marketing officers	6	10.00	5	8.33	11	9.43
4	Dealers / Retailers	10	16.67	11	18.33	21	17.43
5	Advertisements	2	3.33	2	3.33	4	3.32
6	Friends / Relatives / Progressive farmers	4	6.67	6	10.00	10	8.3
7	Others (Specify)	1	1.67	2	3.33	3	2.49

Table 2: Reasons for using bio-pesticides or factors influencing N=60+60=120

Sl. No.	Particulars	Koppal District		Ballari District		Aggregate (Overall)	
		Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
1	Increasing cost of chemical pesticides	10	16.67	12	20.00	22	*18.33*
2	Sustained soil health / For managing soil borne pathogens	22	36.67	21	35.00	43	35.83
3	Reduced cost of cultivation	4	6.67	3	5.00	7	5.83
4	Better quality of produce	3	5.00	7	11.67	10	8.33
5	Increasing returns	6	10.00	7	11.67	13	10.83
6	Motivation from neighboring farmers	3	5.00	1	1.67	4	3.33
7	Environmental concern	4	6.67	4	6.67	8	6.67
8	Easy of operation	4	6.67	5	8.33	9	7.50
9	Motivation by media	1	1.67	0	0.00	1	0.83

Table 3: Product differentiation of bio-pesticides N=60+60=120

Sl. No.	Particulars	Koppal District		Ballari District		Aggregate (Overall)	
		Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
1	Brand name	38	63.33	40	66.67	78	65.00
2	Brand symbol	16	26.67	15	25.00	31	25.83
3	Colour of package	3	5.00	2	3.33	5	4.17
4	Shape of package	2	3.33	2	3.33	4	3.33
5	Size of package	1	1.67	1	1.67	2	1.67
6	Others (Specify)	0	0.00	0	0.00	0	0.00

Table 4: Purchase pattern of bio-pesticides N=60+60=120

Sl. No.	Particulars	Koppal District		Ballari District		Aggregate (Overall)	
		Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
1	Are bio-pesticides available easily						
	Yes	40	66.67	45	75.00	85	70.83
	No	20	33.33	15	25.00	35	29.17
2	Whether you purchase certified / standard bio-pesticides						
	Yes	35	58.33	38	63.33	73	60.83
	No	25	41.67	22	36.67	47	39.17
3	Purchase time of bio-pesticides						
	At the time of land preparation	3	5.00	5	8.33	8	6.67
	At the time of sowing	15	25.00	20	33.33	35	29.17
	After sowing	42	70.00	35	58.33	77	64.17
4	How you brought bio-pesticides						
	Buy intended product only	35	58.33	30	50.00	65	54.17
	Along with other inputs	20	33.33	20	33.33	40	33.33
	Door delivery	5	8.33	10	16.67	15	12.50

Table 5: Utilization patter of bio-pesticides N=60+60=120

Sl. No.	Particulars	Koppal District		Ballari District		Aggregate (Overall)	
		Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
1	Fruit crops	38	63.33	42	70.00	80	66.67
2	Vegetable crops	12	20.00	8	13.33	20	16.67
3	Cereals crop	5	8.33	5	8.33	10	8.33
4	Pulse crops	2	3.33	2	3.33	4	3.33
5	Oil seed crops	0	0.00	1	1.67	1	0.83
6	Commercial crops	3	5.00	2	3.33	5	4.17

Table 6: Bio-pesticides application pattern N=60+60=120

Sl. No.	Particulars	Koppal District		Ballari District		Aggregate (Overall)	
		Frequency	Per cent	Frequency	Per cent	Frequency	Per cent
1	**Seed Treatment**						
	With Jaggary solution	54	90.00	55	91.67	109	90.83
	With sugar solution	4	6.67	3	5.00	7	5.83
	With water	2	3.33	2	3.33	4	3.33
2	**Soil application**						
	Applied directly to the soil	10	16.67	8	13.33	18	15.00
	Mixed with FYM/cow dung/Compost	50	83.33	52	86.67	102	85.00
	Mixed with other pesticides	0	0.00	0	0.00	0	0.00
3	**Liquid form**						
	Seedling dip	10	16.67	12	20.00	22	18.33
	Fertigation method	18	30.00	25	41.67	43	35.83
	Aerial spray	32	53.33	23	38.33	55	45.83

Summary and Policy implication

In spite of increasing demand for chemical pesticides, the agricultural production in the study area is slowly shifting back to organic agriculture due to more human and soil health conscious. The extension activities of Scientist of College of Horticulture, Munirabad are the most preferred media of creating the awareness of bio-pesticides. The results indicated that, company marketing officers involved around only nine per cent for advertisements for promoting their products. Hence, it is recommended that company marketing officers should be very aggressive in the market to penetrate their products in the minds of customers. There is enough scope to promote the products from the dealers/ retailers as they are the primary source of information and consultant to the farming community through the training programmes.

The results indicated that meager amount of bio-pesticides are using for oilseed and commercial crops. Hence, extension programmes may drag attention on role of bio-pesticides on these crops for improving yield and managing soil borne diseases.

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