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Pesticide usage practice by IPM and NON-IPM farmers in pigeon pea from Vijayapura district of Karnataka, India

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Abstract
The pesticide application in pigeon pea crop against pest and disease was varied in related to actual use and recommended, the quantity of pesticide used was almost double than the recommended by both IPM and non-IPM farmers. Among the IPM farmers, majority of the farmers (97%) reported that pesticides use was adequate, followed by quality of pesticide (62%) and awareness about labels (92%) and expiry date (57%) and farmers bought from registered company (87%). Similarly, in case of non-IPM farmers, 98 percent were opined the adequacy of pesticides use, quality of pesticides (47%), bought from registered company (68%) and awareness about labels (73%) and its expiry date (38%). About 47 percent of the farmers used knapsack sprayer and remaining 53 percent of the farmers used power sprayers. With regard to mixing of the pesticides with water, majority of the farmers (54%) mixed the chemicals with pouring water and 42 percent of farmers have used wooden stick for mixing. Most of the farmers (72.5%) applied chemicals across the wind direction.

Keywords: Pigeon pea, IPM and non-IPM farmers, Pesticide usage, Vijayapur

Introduction
Pigeon pea (*Cajanus cajan* (L.) Millsp.) is one of the most important legume crops of the tropics and subtropics of Asia and Africa. India is the world's major producer and consumer of pulses including pigeon pea. About 90 percent of the global pigeon pea area (4.9 m.ha.) is in India contributing to 93 percent of the global production [1].

Pigeon pea is highly sensitive to wide range of insect pests both in the fields (at various stages of crop growth) and storage. Most of the pests attack the crop at reproductive stage causing direct losses. Diseases, insect pests and viral diseases transmitted by insects are the major bottlenecks in realizing higher yields in pigeon pea [2]. It is most susceptible to a large number of diseases and insect pests which cause heavy losses. Fletcher [3] listed a total of 35 insects like *Helicoverpa armigera*, *Etiellazinckenella*, *Euchryspos cnejus*, *Odontotermes distans*, *Marucatestulalis* and *Gryllus bimaculatus*. Lal *et al.* [4] reported nearly 200 species of insects on pigeon pea, among these, 34 as serious pests for other crops as well. Of late, insects which have become serious includes Podbug, *Calvigrallagibbosa*, *C.scutellarius*, various species of leaf webbers, especially *Cydiacritica*, *Maruca vitrata* and glaerucid beetle. Polyphagous pests like cutworms (*Agrotis ipsilon* and *Ochropleura flammatra*) and hairy caterpillars (*Amsacta moorei*, *A. albistriga* and *Spilosoma obliqua*) have also become serious [5].

A pesticide includes such as insecticides, herbicides, fungicides, acaricides, molliscicides and nematicides, which are used on plants, soil and water to control pest and diseases. The pesticides used to prevent pre-harvest and post-harvest losses has assumed a great significance during the last two decades, was a phenomenal attempt to provide sufficient nutritive food for the ever growing world population.

India ranks 10th in pesticide consumption in the world with a consumption rate of 45,386 tonnes per annum [6]. Karnataka stands 7th position in total quantity of consumption of pesticide (1225 tonnes/annum), whereas the consumption value of pesticides in Vijayapura district is Rs. 400 million [6].

Every rupee spent on chemical pest control helps in saving crop output worth of Rs. 3. The average per hectare consumption of pesticides for cultivation of crops in India had increased from 0.03 kg in 1954-55 to 0.57 kg in 1996 [7]. So, this work is an endeavour to compare the yield between farmers actual use of pesticides over recommended dose.

Materials and Methods

The current study endeavored to evaluate the economics of pesticide use in pigeon pea. Pigeon pea is grown predominantly in Vijayapura district. The total area under pigeon pea crop in Vijayapura district is 1,83,550 hectare (as per 2014). Eventhough the crop is widespread in this district, the study on pesticide use against various pest and disease is lacking till date. Hence, we were selected Vijayapura district in Karnataka state for the study. Vijayapura district is located in Northern part of Karnataka and is situated between15^0 $20^{'}$ to 17^0 $28^{'}$ North latitude and 74^0 $54^{'}$ to 76^0 $28^{'}$ East longitude. It consists of five taluks viz., Vijayapura, Sindagi, Indi, Muddebihal and Basavana Bagewadi. The district is bound on the North by Sholapur district and on North West by Sangli district Maharashtra.

The study was chiefly based on the primary data collected from sample farmers through personal interview method (individiual contact). Multistage sampling technique was adopted to get a essential information from sample respondents. In the first stage, all five taluks were predominantly selected in the second stage, four villages based on highest area under pigeon pea were selected from each of the selected taluks. In third stage, six pigeon pea growing farmers out of which three are IPM and other three are non-IPM were randomly selected from each village for getting the required information on pigeon pea cultivation. Thus, the total sample size become 120. The sample farmers were interviewed individually using a pre-tested and structured schedules, which was specifically designed for the study.

Tabular analysis

The tabular analysis were used for determining general characteristics, pesticide usage, costs, returns and profits etc, from pigeon pea cultivation in the study area. The percentages and averages were worked out to draw meaningful interpretations.

Results

The pesticide application in pigeon pea crop against pest and disease was varied in related to actual use and recommended, the quantity of pesticide used was almost double than the recommended by both IPM and non-IPM farmers. The recommended quantity of pesticide requirement for pigeon pea production is presented in Table 1. for non-IPM farmers, which revealed that the recommended dose of Flubendimide (0.30 l/ha), Clorophyiphos (0.80 l/ha), Profenophos (0.80 l/ha), Rhynaxypyr (0.06 l/ha), Monocrotophas (0.60 l/ha), Diclorovas (0.80 l/ha), Dimithoate (0.68 l/ha) and Spinosad (0.06 l/ha) whereas the farmers actually used Flubendimide (0.67 l/ha), Clorophyiphos (1.85 l/ha), Profenophos (1.70 l/ha), Rhynaxypyr (0.40 l/ha), Monocrotophas (1.65 l/ha), Diclorovas (2.15 l/ha), Dimithoate (1.74 l/ha) and Spinosad (0.23 l/ha) extra cost incurred due to excess use of insecticides (Rs.770), (Rs.1050), (Rs.1350), (Rs.1800), (Rs.2275), (Rs.843), (Rs.1940) and (Rs.1700) respectively. Similarly for fungicides the recommended dose and actual dose used was 0.05 liter and 0.10 liter per hectare, which incurred a cost of Rs. 80 and Rs. 190 per hectare, respectively.

Table 1: Actual use vis-a-vis recommended dose of pesticide by sample farmers (N=120)

Pesticides	Recommended		Actually used		Difference	
	Qty. (l/ha)	Cost (Rs./ha)	Qty. (l/ha)	Cost (Rs./ha)	Qty. (l/ha)	Cost (Rs./ha)
1. Non-IPM						
A. Insecticides						
a. Flubendiamide	0.30	625	0.67	1395	0.37	770
b. Cloropyriphos	0.80	800	1.85	1850	1.05	1050
c. Profenophos	0.80	1200	1.70	2550	0.90	1350
d. Rhynaxypyr	0.06	600	0.40	2400	0.36	1800
e. Monocrotophas	0.60	1300	1.65	3575	1.05	2275
f. Diclorovas	0.80	500	2.15	1343	1.35	843
g. Dimethoate	0.68	1245	1.74	3185	1.06	1940
h. Spinosad	0.06	600	0.23	2300	0.17	1700
B. Fungicides	0.05	80	0.10	190	0.07	110
2. IPM						
A. Insecticides						
a. Flubendiamide	0.30	625	0.42	875	0.12	250
b. Cloropyriphos	0.80	800	1.12	1120	0.32	320
c. Profenophos	0.80	1200	0.95	1425	0.15	225
d. Rhynaxypyr	0.06	600	0.21	2100	0.15	1500
e. Monocrotophas	0.60	1300	1.13	2448	0.53	1148
f. Diclorovas	0.80	500	1.45	906	0.65	406
g. Dimethoate	0.68	1245	1.69	3143	1.01	1899
h. Spinosad	0.06	600	0.18	1800	0.12	1200

Similarly, in case of IPM farmers, it was manifested from table that the recommended dose of Flubendimide (0.30 l/ha), Cloropyriphos (0.80 l/ha), Profenophos (0.80 l/ha), Rhynaxypyr (0.06 l/ha), Monocrotophas (0.60 l/ha), Diclorovas (0.80 l/ha), Dimithoate (0.68 l/ha) and Spinosad (0.06 l/ha) whereas the farmers actually used Flubendimide (0.42 l/ha), Clorophyiphos (1.12 l/ha), Profenophos (0.95 l/ha), Rhynaxypyr (0.21 l/ha), Monocrotophas (1.13 l/ha), Diclorovas (1.45 l/ha), Dimithoate (1.69 l/ha) and Spinosad (0.18 l/ha) extra cost incurred due to excess use of insecticides (Rs.250), (Rs.320), (Rs.225), (Rs.1500), (Rs.1148), (Rs.406), (Rs.1899) and (Rs.1200) respectively.

Farmer's response towards pesticide use

It could be seen from Table 2. that among the IPM farmers, majority of the farmers (97%) reported that pesticides use was adequate, followed by quality of pesticide (62%) and awareness about labels (92%) and expiry date (57%) and farmers bought from registered company (87%). Similarly, in

case of non-IPM farmers, 98 percent were opined the adequacy of pesticides use, quality of pesticides (47%), bought from registered company (68%) and awareness about labels (73%) and its expiry date (38%).

Table 2: Awareness of pesticide use by farmers

Information on Pesticides Usage	IPM (n=60)		Non-IPM (n=60)	
	Yes	No	Yes	No
Pesticide used is adequate	58 (97)	2 (3)	59 (98)	1 (2)
Bought from registered company	52 (87)	8 (13)	41 (68)	19 (32)
Quality was good	37 (62)	23 (38)	28 (47)	32 (53)
Bought packed pesticides	60 (100)	0 (0)	60 (0)	0 (0)
Labels were seen by respondents	55 (92)	5 (8)	44 (73)	16 (27)
Aware of expiry date	34 (57)	26 (43)	23 (38)	37 (62)

Note: Figures in the parentheses indicate percentage to respective sample size

Use and maintenance of sprayer

In practice two different types of sprayer (knapsack sprayer and power sprayers) were used by farmers in the study area. Among them, about 47 percent of the farmers used knapsack sprayer and remaining 53 percent of the farmers used power sprayers.

In relation to cleaning after the spray, about 98 percent of the farmers washed sprayer after its use and hardly 2 percent of them did not wash sprayer after use. Nearly 89 percent of the farmers let the washed water on the farm and remaining 11 percent of the famers allowed washed water into irrigation channel. About 65 percent of the farmers were used to throw pesticide bottle in fields itself and only 3 percent of them were used to sell the bottles. None of the farmers were burying pesticide bottles in fields. About 32 percent of the farmers used bottles for their self-use (Table 3).

Table 3

Sl. No.	Particulars	Pigeon pea farmers		
		IPM (n=60)	Non-IPM (n=60)	Total (N=120)
1.	Type of sprayer used			
a.	Knapsack sprayer	27 (45)	30 (50)	57 (47)
b.	Power sprayers	33 (55)	30 (50)	63 (53)
2	Washing sprayer after use	60 (100)	58 (97)	118 (98)
3	Disposal of washed water			
a.	To field	55 (92)	52 (87)	107 (89)
b.	To irrigation channel	5 (8)	8 (13)	13 (11)
4	Disposal of pesticide empty containers			
a.	In field	40 (67)	38 (64)	78 (65)
b.	Sell	2 (3)	2 (3)	4 (3)
c.	Burying in field	0 (0)	0 (0)	0 (0)
d.	Self-use	18 (30)	20 (33)	38 (32)

Note: Figures in the parentheses indicate percentage to respective sample size

Pesticide handling practices

The pesticide handling practices followed by sample farmers are presented in Table 4. In total, most of the farmers (72.5%) applied chemicals across the wind direction. It also revealed that 8 percent of the farmers applied pesticides along the wind direction. About 19 percent of farmers did not consider the wind direction. This might be due to unawareness about importance of wind direction. It was interesting to note that 55 percent of the farmers were not using any protective coverings. This shows the lack of knowledge of the farmers about its ill effects. From the survey, it was revealed that none of the farmers used shoes during chemicals spraying, whereas 21 percent of the farmers used hand gloves, around 12 percent of them were using face masks and 12 percent of farmers used both hand gloves and face masks while spraying.

Table 4: Pesticide handling practices followed by sample farmers

Sl. No.	Particulars	Farmers		
		IPM (n=60)	Non-IPM (n=60)	Overall (N=120)
1	Direction of PPC application			
a.	Along the wind	6 (10)	4 (6)	10 (8)
b.	Across the wind	45 (75)	42 (70)	87 (72.5)
c.	Do not consider wind direction	9 (15)	14 (23)	23 (19)
2	Use of protective coverings			
a.	No protective covering	35 (58)	32 (53)	67 (55)
b.	Use of hand gloves	10 (17)	15 (25)	25 (21)
c.	Use of face masks	5 (8)	9 (15)	14 (12)
d.	Use of both hand gloves and face masks	10 (17)	4 (7)	14 (12)
3	Hand washing practice after pesticide application			
a.	Wash hands	60 (100)	60 (100	120 (100)
b.	With soap	55 (92)	58 (97)	113 (94)
c.	With mud	5 (8)	2 (3)	7 (6)
4	Take bath after spraying	60 (100)	56 (93)	**116 (97)**
5	Pesticide and water mixing practices			
a.	Use of wooden stick	20 (33)	30 (50)	50 (42)
b.	Use of sprayer lancer	5 (8)	0 (0)	5 (4)
c.	By pouring PPC into half-filled pesticide sprayer with water	35 (58)	30 (50)	65 (54)
6	Measurement of pesticides			
a.	Measuring jar	10 (16)	5 (8)	15 (12.5)
b.	Pesticide bottle cap	40 (67)	32 (53)	72 (60)
c.	On average basis	10 (16)	23 (38)	33 (27.5)

Note: Figures in the parentheses indicate percentage to respective sample size

All farmers washed their hands after spraying. In the total sample farmers, around 94 percent of them washed their hands with soap and remaining 6 percent of them washed their hands with mud. About 97 percent of the farmers have taken bath soon after spraying and remaining hardly 3 percent

of them did not bath immediately after spraying.

With regard to mixing of the pesticides with water was concerned, majority of the farmers (54%) mixed chemicals with pouring water and 42 percent of farmers have used wooden stick for mixing. Remaining 4 percent of them used sprayer lancer method. For measuring the chemicals, out of total respondents, 12.5 percent of them used pesticide measuring jar, while 60 percent of them were used bottle cap and remaining 27.5 percent of farmers used to measure the spraying chemicals on an average basis.

Sources of information about pesticides use by the sample farmers

The sources of information about pesticides use for the farmers are presented in Table 5. In case of IPM farmers, majority of (53 percent) the farmers have got information about pesticide usage from pesticide shop dealers, followed by 17 percent from their own experience, 14 percent from extension workers, 7 percent each from neighbouring farmers, staff of Karnataka State Department of Agriculture (KSDA) and State Agricultural Universities (SAUs), whereas most of the non-IPM farmers (63 percent) have got information on usage of pesticide, from pesticide shop dealers, followed by neighbouring farmers (20%), 12 percent from of their own experience and 5 percent from staff of Agricultural University and Agricultural Department.

Table 5: Sources of information about pesticides use for farmers

Sl. No.	Sources	IPM (n=60)	Non-IPM (n=60)	Overall (N=120)
1.	Pesticide dealers	32 (53)	38 (63)	70 (58)
2.	Own experience	10 (17)	7 (12)	17 (14)
3.	Neighbours	5 (8)	12 (20)	17 (14)
4.	Extension workers	8 (14)	0 (0)	8 (7)
5.	KSDA and SAUs	5 (8)	3 (5)	8 (7)

Note: Figures in the parentheses indicate percentage to respective sample size.

Discussion

In both IPM and non-IPM farmers, the sample farmers were used excess quantity of pesticides than the recommended dose of pesticides. There was noticeable difference in case of non-IPM farmers than that of IPM farmers. This was due to risk aversive nature of farmers to avoid crop loss due to pest infestation but in economic sense, any increase in higher use of pesticides than the recommended level is really uneconomical and irrational one. Moreover, in the process of overusing pesticides leads to environmental problems. Thus, the farmers are need to be educated about the recommended dose of pesticide use in order to avoid problems related to environment, human health, animal health and other beneficial insects Sudha [8].

Among the two categories of farmers, even though majority of the farmers in both the category opined that pesticide use was adequate (Table 2). But still they were not aware about expiry date and its proper usage of pesticides in case of IPM farmers (43 percent) and non-IPM farmers (62 percent). IPM farmers (62 percent) also expressed that the quality of pesticide was good since, most of the pesticides are of new molecules and showed good controlling capacity towards pest. Thus, the farmers have to be educated about expiry date, labels and adequacy of pesticide use. This will help the farmers in minimization of cost on PPCs, improvement in quality of the product and also reduction in the ill effects on health hazards on human being, animals and other beneficial insects.

It was seen that majority of the respondents used power sprayer (53%) and knapsack sprayers (47%) for spraying of pesticides. With respect to maintenance of the sprayer, majority of the respondents opined that, they used to wash their sprayer immediately after its usage (98%), followed by disposal of washed water and empty pesticide containers in the field itself (Table 3). Majority of the respondents (54%) mix the chemicals by pouring chemical into half-filled tank of water and later on, filling the tank with reaming required water, followed by mixing with wooden stick (42%). Nearly 60 percent of the respondents were used pesticide bottle cap for measuring pesticides which is wrong method. On an average basis, 27.50 percent of farmers followed without using any standard measuring instrument. Only few of them were used measuring jar (12.5%) for measuring pesticides which is correct method to measure the pesticides. The volume of water used by the farmers was rough approximation which often did not yield the required dilution as per scientifically recommendation.

The sources of information which influenced farmers in their application of pesticides were very diverse, about 58 percent of sample farmers got the information from pesticide shop dealers followed by their own experience, contact with neighbouring farmers, extension workers and staff of Karnataka State Department of Agriculture and State Agricultural Universities (Table 5).

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