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Research Article

ADOPTION GAPS IN THE USE OF AGROCHEMICALS FOR POTATO PRODUCTION IN GURDASPUR DISTRICT OF PUNJAB

Jagshand Singh Chhina[1] and *Satpal Singh[2]
[1]Punjab Agricultural University Regional Station, Gurdaspur - 143 521, Punjab
[2]Department of Agronomy, PAU, Ludhiana
**Author for Correspondence*

ABSTRACT
An on-farm study was conducted at Gurdaspur district of Punjab to determine the adoption gaps between the recommended and un-recommended farm practices in potato crop for the three consecutive years viz. 2009-10, 2010-11 and 2011-12. Hundred potato growers were selected randomly from the different villages as sample farmers and the information was collected on the basis of personal interview on pre-tested questionnaire. It was observed that seed treatment before sowing was carried out by 50.7 per cent of the farmers and only 1.3 per cent of farmers treated their seed with recommended fungicides and recommended procedure. The average of three years showed that 0.7, 0.7 and 23.8 per cent of farmers applied recommended pesticides like Ridomil MZ @ 1250 g, Rogor 30 EC@750 ml and Indofil M-45 @ 1250 g, respectively while 66.5 per cent of farmers used the un-recommended pesticides. On an average, the farmers who used the recommend varieties recorded an average yield of 290.4 qha^{-1} which was higher by 12.3 per cent over un-recommeded varieties. The net returns under recommended practices were Rs 36817 which was higher by 57.5 per cent over un-recommended practices. It can be concluded that a wide gap exist between the proper use of various agrochemical inputs in the cultivation of potato crop in the study area.

Keywords: *Adoption Gaps, Agrochemical, Production Technology, Potato*

INTRODUCTION
Potato (*Solanum tuberosum* L.) is one among the four major food crops of the world i.e. rice, wheat and maize. It is a member of the family *Solanaceae*. This is one of the principal cash crops of India and contributes to Indian economy in several ways. India is the largest producer of potato in Southwest Asia and third most important producer in the world (Ezeta, 2008). In Punjab, the area under potato was 83.1 thousand hectare with a total production of 21.2 lakh tonnes during 2009-10 (Anonymous, 2010). Like cereals, carbohydrates are the major constituents of potato. Besides, it contains essential nutrients such as proteins and minerals like calcium, phosphorus, iron, and vitamins (B1, B2, B6 and C). It can supplement the food needs of the country in a substantial way as it produces more dry-matter, has well balanced protein and produces more calories per unit area per unit time than other major food crops. The problem of malnutrition can be solved largely in the country if potato is accepted as a major food crop rather than a vegetable. It can prove a great foreign exchange earner for India by exporting potatoes both for seed as well as table purposes to the neighboring countries i.e. South-East Asia and Middle East. It has been observed that farmers prefer to use un-recommended practices for the production of this crop. The objectives of the study was to find out the extent of adoption gaps in the use of various fungicides and insecticides for plant protection of potato that affects the productivity, net returns and cost of cultivation per unit area.

MATERIALS AND METHODS
To determine the extent of adoption gaps in the use of various fungicides and insecticides in the cultivation of the potato, a survey was conducted in Gurdaspur district of Punjab. The data was collected from 100 potato growers selected by random sampling technique for the three consecutive years i.e. 2009-10, 2010-11 and 2011-12. The operational holding of the sample farmers was 365.6 ha. The data was collected for various fungicides and insecticides used. The collection of data was based on personal

interview method on specially designed pre-tested questionnaires. The data was analyzed on the basis of mean and percentage.

RESULTS AND DISCUSSION

Potato is a short duration cash crop and has high yield potential. The success of potato cultivation depends largely upon the appropriate management practices and judicious use of inputs like seed, fertilizer, herbicide, water and plant protection measures.

A large gap has been reported to exist between the recommended and actual farm practices being followed by the growers. They are using the insecticides either higher or lower than the recommended dose.

This leads to increase in cost of production, depletion of natural resources and reduced net returns. A survey was conducted on fungicide and insecticide use to determine the extent of adoption gap at farmers' field and recommended practices. The results of the survey are discussed as follows:

Seed Treatment

Seed treatment before sowing involves little efforts but pays great dividends in terms of disease control, better crop stand, better returns etc. It is evident from the Table 1 that seed treatment before sowing was carried out by 50.7 per cent of the farmers. Only 1.3 per cent of farmers treated their seed with recommended fungicides and recommended procedure.

The accurate method of seed treatment is by dipping the cold stored seeds in fungicide solution for 10 minutes before sowing. But majority of the farmers treated their seed by spraying with different doses of fungicides after spreading them on the floor. This does not inhibit the occurrence of diseases completely during cultivation. This calls the extension functionaries to create awareness among the farmers regarding the importance of seed treatment before sowing.

Pesticide Use

Pesticide use pattern greatly depends upon the availability in the market and being sold to growers by the traders. Judicious use of pesticides is recommended for management of crop pests. Many times, due to ignorance or lack of knowledge, wrong pesticides along with their un-recommended doses are used by farmers. The excessive and indiscriminate use of pesticides not only increase the cost of production but also have sick effects such as residue, resistance, resurgence, destruction of natural enemies and environmental degradation (Magallona, 1989).

The average data of three years (Table 2) showed that 0.7, 0.7 and 23.8 per cent of farmers applied recommended pesticides like Ridomil MZ @ 1250 g, Rogor 30 EC @ 750 ml and Indofil M-45 @ 1250 g ha^{-1}, respectively while 66.5 per cent of farmers used the un-recommended pesticides.

The farmers used one spray of single pesticide as well as two or three sprays of different pesticides. Out of various non-recommended pesticides, 29.8 per cent of farmers used combination of Indofil M-45 @ 1250 g plus Rogor 30 EC @ 625 ml ha^{-1}.

While, there were many other non-recommended pesticides viz. combination of Indofil M-45 @ 1250 g and Cypermethrin 10 EC @ 625 ml used by 3.6 per cent of farmers which was followed by another combination of Indofil M-45 @ 1250 g and Endosulphan @ 875 ml (used by 2.8 per cent of farmers), Rogor 30 EC @ 625 ml (used by 5.5 per cent of farmers), Cypermethrin 10 EC @ 625 ml (used by 2.1 per cent of farmers) and so on. Therefore, the study attributed that farmers preferably used non-recommended pesticides for the control of pests.

Crop Yield

The average yield of the recommended varieties i.e. Kufri Jawahar, Kufri Pukhraj, Kufri Jyoti, and Kufri Badshah is 350, 325, 300 and 325 qha^{-1} and their comparable yield at famers field was 270.6, 310.3, 322.0 and 268.6 qha^{-1}, respectively (Table 3). On an average, the farmers who used the recommend varieties recorded an average yield of 290.4 qha^{-1} which was higher by 12.3 per cent over un-recommeded varieties. The yield of un-recommended varieties i.e. S1, Kufri Chipsona, 1013, Pushkar, K3 and 302 was 251.2, 267.3, 235.7, 294.2, 320.1 and 290.8 qha^{-1} which was lower than the recommended. It is advocated that to obtain higher yields, farmers should adopt the recommended package of practices.

Table 1: Fungicides used for seed treatment by potato growers during 2009-10 to 2011-12

Chemical (dose ha^{-1})	**Per cent farmers**			
	2009-10	**2010-11**	**2011-12**	**Average**
Un-treated	**46**	**48**	**54**	**49.3**
Recommended				
Emisan-6 @ 625 g	**2**	**0**	**2**	**1.3**
Un-recommended				
Emisan-6 @ 125 g	8	0	2	3.3
Emisan-6 @ 150 g	4	0	14	6.0
Emisan-6 @ 175 g	6	4	4	4.7
Emisan-6 @ 250 g	18	30	10	19.3
Emisan-6 @ 300 g	0	6	0	2.0
Emisan-6 @ 375 g	2	10	4	5.3
Emisan-6 @ 500 g	2	0	0	0.7
Emisan-6 @ 250 g & Hostathion 40 EC 1500 ml	0	2	0	0.7
Emisan-6 @ 1250 g (Dipping potatoes)	0	0	2	0.7
Bagllol @ 250 g	0	0	2	0.7
Emisan-6 @ 250 g & Moncern 250 SL @ 750 ml & Carbendazim 500 WP @ 250 ml	2	0	0	0.7
Emisan-6 @ 175 g& Carbendazim 500 WP @ 250 ml	2	0	0	0.7
Emisan-6 @ 150 g & Carbendazim 500 WP @ 250 ml	0	0	2	0.7
Emisan-6 @ 625 g & Carbandazim 500 WP @ 250 ml (Dip)	0	0	2	0.7
Carbandizim 500 WP @ 250 ml	4	0	2	2.0
Carbandizim 500 WP @ 500 ml	4	0	0	1.3
Total (un-recommeded)	**52**	**52**	**44**	**49.4**
Total (treated+untreated)	**100**	**100**	**100**	**100**
Total (treated)	**54**	**52**	**46**	**50.7**

Table 2: Application of pesticides in potato during 2009-10 to 2011-12

Pesticide (dose ha^{-1})	**Per cent farmers**			
	2009-10	**2010-11**	**2011-12**	**Average**
No application	14.5	4.2	6.3	**8.3**
Recommended				
Ridomil MZ @ 1250g	0.0	0.0	2.0	0.7
Rogor 30 EC @ 750 ml	2.1	0.0	0.0	0.7
Indofil M-45 @ 1250 g	16.7	38.3	16.3	23.8
Sub Total	**18.8**	**38.3**	**18.3**	**25.2**
Un-recommended				
Chlorpyriphos 20 EC @ 5000 ml	0	0	2	0.7
Cypermethrin 10 EC @ 625 ml	0	6.4	0	2.1
Endosulfan 35 EC @ 1250 ml	0	2.1	0	0.7
Monocrotophos 36 SL @ 800 ml	2.1	0	0	0.7
Rogor 30 EC @ 625 ml	12.5	0	4.1	5.5
Indofil M-45 @ 2500 g	0	0	4.1	1.4
Blitox @ 1250 ml & Imidacloprid 200 SL @ 500 ml	0	0	6.1	2.0
Indofil M-45 @ 2500 g & Rogor 30 EC @ 625 ml	0	0	2	0.7
Indofil M-45 @ 1250 g & Imidachloprid 200 SL @ 250 ml	0	6.4	0	2.1
Indofil M-45 @ 1250 g & Imidacloprid 200 SL @ 500 ml	0	0	2	0.7
Indofil M-45 @1250 g & Malathion 50 EC @ 750 ml	6.3	0	0	2.1
Indofil M-45 @1250 g & Trigen @ 500 ml	0	0	2	0.7
Indofil M-45 @ 1250 ml & Chlorpyriphos 20 EC @ 1250 ml	0	2.1	6.1	2.7
Indofil M-45 @ 1250 g & Cypermethrin 10 EC @ 250	0	0	2	0.7
Indofil M-45 @ 1250 g & Cypermethrin10 EC @ 625 ml	0	10.7	0	3.6
Indofil M-45 @ 1250 g & Endosulfan 35 EC @ 750 ml	2.1	0	0	0.7
Indofil M-45 @ 1250 g & Endosulfan 35 EC @ 875	8.3	0	0	2.8
Indofil M-45 @ 1250 g & Endosulfan 35 EC @ 1250 ml	2.1	2.1	4.1	2.8
Indofil M-45 @ 1250 g & Monocrotophos 36 SL @750 ml	0	4.3	0	1.4
Indofil M-45 @ 1250 g & Monocrotophos 36 SL @ 875 ml	2.1	0	0	0.7
Indofil M-45 @1250 g & Rogor 30 EC 625 ml	31.2	23.4	34.7	29.8
Imidacloprid 200 SL @ 500 ml, Bendco @ 1875 ml & Chlorpyriphos 20 EC @ 875 ml	0	0	4.1	1.4
Indofil M-45 @ 1250 g ,Chlorpyriphos 20 EC @ 1250 ml & Cypermethrin 10 EC @ 250 ml	0	0	2	0.7
Sub Total	**66.7**	**57.5**	**75.4**	**66.5**
Total	**100.0**	**100.0**	**100.0**	**100.0**

Table 3: Potato yield (q ha^{-1}) during 2009-10 to 2011-12

Name of variety	2009-10	2010-11	2011-12	Average
	Recommended			
Kufri Badshash	254.3	255.7	295.9	268.6
Kufri Jawahar	308.8	268.2	234.7	270.6
Kufri Pukhraj	313.0	304.2	313.7	310.3
Kufri Joyti	--	308.8	335.2	322.0
Mean	**292.0**	**284.2**	**294.9**	**290.4**
	Un-recommended			
S 1	222.3	247.0	284.4	251.2
Kufri Chipsona	280.5	234.7	286.8	267.3
1013	245.8	225.5	---	235.7
Pushkar	-	-	294.2	294.2
K3	-	-	320.1	320.1
302	-	-	290.8	290.8
Others	-	-	257.0	257.0
Mean	**249.5**	**235.7**	**288.9**	**258.0**

Table 4: Economics of potato cultivation during 2009-10 to 2011-12

Year	Yield (q ha^{-1})	Price (Rs q^{-1})	Gross returns (Rs)	Total variable cost (Rs)	Returns over variable costs (Rs)
			Recommended		
2009-10	292.0	390	113880	59862	54018
2010-11	284.2	378	107428	62109	45319
2011-12	294.9	269	79328	68213	11115
Mean	**290.4**	**345.7**	**100212**	**63395**	**36817**
			Un-recommended		
2009-10	249.5	390	97305	60766	36539
2010-11	235.7	378	89095	64168	24927
2011-12	288.9	269	77714	69047	8667
Mean	**258.0**	**345.7**	**88038**	**64660**	**23378**

Economics of Potato Cultivation

The perusal of data in Table 4 showed that the productivity of potato was estimated to be 292.0, 284.2 and 294.9 qha^{-1} for recommended practices which was higher by 17.0, 20.6 and 2.1 per cent over un-recommended during 2009-10, 2010-11 and 2011-12, respectively. The average productivity of three conjunctive years of potato was estimated to be 290.4 and 258.0 qha^{-1} for recommended and un-recommended practices, respectively.

The overall variable costs were estimated to be Rs. 59862, 62109 and 68213 per ha for recommended and Rs. 60766, 64168 and 69047 for un-recommended during 2009-10, 2010-11 and 2011-12, respectively. The respective figures pertaining to the net returns over variable costs for the above said periods were estimated to be Rs. 54018, 45319 and 11115 for recommended and Rs. 36539, 24927 and 8667 ha^{-1} for un-recommeded practices and it was higher by 47.8, 81.8 and 28.2 per cent.

Average of data for three years clearly indicated that net returns were Rs 36817 under recommended practices in comparison to Rs. 23378 ha^{-1} under un-recommended practices which was higher by 57.5 per cent.

The above results clearly show that the net returns over variable costs were found to be lowest during the year 2011-12 due to comparatively lower price coupled with higher inputs costs especially labour and fertilizers.

Conclusion

The present study was undertaken to determine the agrochemical adoption gaps in the production technology of potato crop from 2009-10 to 2011-12 in Gurdaspur district of Punjab. In order to achieve the stipulated objectives both secondary as well as primary data were used. The cost of cultivation of potato was also computed by using enterprise budgeting technique. It was noticed that 50.7 per cent of the farmers treated the seed before sowing and only 1.3 per cent farmers used the recommend chemicals. At the same time, 8.3 per cent farmer did not apply any pesticide and 66.5 per cent used un-recommended pesticides. The farmers who used the recommend varieties recorded the average yield of 290.4 qha^{-1} which was higher by 12.3 per cent. Average of data for three years clearly indicated that net returns were Rs 36817 under recommended practices in comparison to Rs. 23378 ha^{-1} under un-recommended practices which was higher by 57.5 per cent. It was noticed that the farmers used one spray of single pesticide as well as two or three sprays of different pesticides. It can be concluded that a large adoption gap exist in the proper use of various agrochemicals in potato. Thus, there is a need to educate the potato growers regarding the benefits of the judicious use of various agrochemical inputs and package of practices to obtain higher yield and returns.

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