Research Article

Adoption Constraints of Improved Technologies Regarding Tomato Cultivation in District Mardan, KP

Urooba Pervaiz[1], Abdus Salam[1], Dawood Jan[2], Ayesha Khan[1] and Mahmood Iqbal[1]

[1]Department of Agricultural Extension Education and Communication, The University of Agriculture, Peshawar; [2]Department of Agriculture and Applied Economics, The University of Agriculture, Peshawar, Pakistan.

Abstract | The present study was conducted in district Mardan of Khyber Pukhtunkhawa (KP) to analyze constrains in the adoption of improved technologies regarding tomato cultivation in March-April 2016. Two union councils Fatima and Babeni from tehsil Mardan were selected purposively based on tomato cultivation. Two villages were randomly selected from each union council. All tomato growers given training by the extension department were selected for interview, thus 104 respondents were interviewed for the study through well-structured interview schedule. Paired t-test was used for the comparison before and after training. The results show that 43% of the respondents were young, literate (85%), owner cultivator (49%), majority (81%) have total tomato cultivated area between 1-3 acres. Training was given to all the farmers, results of t-test showed that after getting training; tomato yield, income, total cost of seed, weeding, and pesticides were increased, while seed rate gm per acre was decreased. It is concluded that all the respondents adopted HYVs. Major constrains in the adoption of extension recommendations were high price of agricultural inputs, non-availability of; cold storage, agricultural credit and certified vegetable seeds, lack of fertilizers and technical knowledge, pest and diseases incidence, improper marketing of produce in the study area.

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***Correspondence** | Urooba Pervaiz, Department of Agricultural Extension Education and Communication, The University of Agriculture, Peshawar; **Email:** drurooba@aup.edu.pk
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Introduction

Agriculture contributes 19.8% to gross domestic product (GDP) of Pakistan. To meet the demand of growing population, agriculture growth should be in line to meet the food requirements of the country. Availability of modern inputs like certified seeds, mechanization, agricultural credit, adequate and proper use of fertilizers and strong linkage between research and extension enabled the community to shift from old agricultural practices with greater ease and productivity (GoP, 2016).

Globally annual production of fresh tomato is around 159 million tones. During 2011 tomato production was 530 thousand tones recorded in Pakistan. (Khokhar, 2013). In Pakistan the area under tomato cultivation has increased from 27.9 to 50 thousand ha from 2007-08 to 2015-16, tomato production is also increased from 268.8 to 476.8 thousand tons, indicating the crop as potentially a routine productive crop for the famers to earn decent profit. On 10 years average the per hectare growth statistics for present national yield of tomato is estimated to be around 10.1 tones/ha which is found quite low. Maximum potential of yield can be achieved through introduction of high yielding varieties of seed, improved production technology and sound knowledge of tomato farming

(GoP, 2016).

Low yield per acre production of tomato has resulted because in Pakistan farmers are not fully aware of recommended agricultural technologies and modern practices that are employed in profitable tomato farming (Ahmad et al., 2007). In Pakistan farmers do not have the opportunity to opt for modern technology because of the high risk and cost. Such hurdles can be overcome through interlinking and mainstreaming extension servicing system aiming at pointing ways for getting grants from concerns associations, sectors, transferring appropriate practices/technology, skills and knowledge to small and medium farmers (Mari et al., 2007). Increase agricultural production needs to be strengthened through the provision of need-based technologies through well-organized extension activities; ranging from traditional extension models to Farmer's Field Schools (Ahmed, 2005).Adoption of innovation should be part of agricultural policies at a national level to address farmers' problems. Private agencies such as fertilizer companies in support of innovation contact farmers and guide them accordingly in adopting new ways of farming as technology transfer and adoption are interrelated processes and are vital for production of any agricultural commodity (Mirani, 2012).

Vegetables are used both for domestic consumption and export earnings. Tomato plays an important role in our rural economy. Pakistan is the land of agricultural opportunities and vision for maximum possibility and feasibility of growing almost all kinds of vegetables and cash crops in its ecological zone, favorable climate and land geography. In Pakistan, vegetables are grown over total 220,500 hectare (ha) of which 29,900 ha area is in Khyber Pakhtunkhwa (KP). Total cropped area of KP was two million ha in 1999-2000 and area under vegetables was 20,800 ha. Which is 1% of total cropped area, Latest statistics shows that total cropped area in KP is 1.84 million ha and cropped area 695 ha and yield was 7165 kg/ha (GoP, 2016).

The ultimate requirement for better tomato crop requires warm weather and plenty of sunshine to grow evenly it cannot favor low temperature zone, as it cease its production margin. It is a warm season crop. It is not likely to be profitable in regions where frost-free period is less than three and a half months duration. Foliar diseases results in tomato due to high humidity with high temperatures which affects its productivity and life span. Tomato is vital part of our cooking, and nearly have all essential minerals, vitamins and other trace elements of vital importance, and a dish is incomplete with its addition. Tomato is the richest source of vitamin C, iron, and phosphorous. A ripened tomato of 135gm contains about 94% water, 25 calories of energy, 0.07mg thiamine, 28mg ascorbic acid, 33mg phosphorous, 0.6gm carbohydrates, 0.6mg iron, 0.8-0.9 mg lycopene, 1.0gm water soluble protein, 4mg sodium, 300mg potassium,0.2gm fat, 16mg calcium, 0.9 mg niacin, and 0.05mg riboflavin. It is consumed fresh, as well as in processed form and can be stored for months in special cool chimera to prolong its storage period (Hafeez, 2001).

Objectives of this research paper is to study

1. The existing situation regarding tomato production in the study area.
2. Constraints in the adoption of improved tomato technologies in the study area.
3. The effect of trainings given by extension department on tomato production in the study area.

Methodology

District Mardan of KP was the universe of the study. It is one of the major tomato producing districts in the province. There are three tehsils in district Mardan; namely Mardan, Takht Bhai, and Katlang. Tehsil Mardan was purposively selected based on tomato cultivation. Two union councils i.e Babeni and Fatima were randomly selected. All villages from the selected union councils were listed with the help of local Agriculture Officer (AO). Subsequently, two villages were randomly selected from each union council. From the selected villages only those farmers were interviewed who got training from extension department during March-April 2016. Data was collected through a well-structured interview schedule. SPSS version 20 was used to analyze the data. Results were presented in terms of counts and percentages, paired sample-t test was used to compare result before and after extension recommendations.

Results and Discussion

Demographic characteristics of the sample respondents are presented in Table 1. Age is positively correlated with the adoption of any new technology. In other words, younger the age greater will be the rate of adoption (Iqbal and Nawab, 2013). In the present

study age variable was divided into three categories: 18 -30 years, 31-40 years, 41and above. Data reveal that 43% of tomato growers were young in the study area. Human performance is directly or indirectly affected by education. Literate people have more favourable attitude towards adoption of different technologies and skills (Iqbal and Nawab, 2013).Table 1 shows that majority i.e. 85% of tomato growers were literate, while 15% were illiterate.

Table 1: *Demographic characteristics of sample respondents*

Age (in years)	Frequency	Percentage
18-30	45	43
31-40	28	27
41 and above	31	30
Education		
Illiterate	16	15
Primary	12	11
Middle	35	34
Metric	23	22
12 and above	18	18
Family Size		
Up to 4	23	22
5-8	49	47
10 and above	32	31
Tenancy status		
Owner cultivator	51	49
Owner cum tenant	36	35
Tenant	17	16
Area under tomato cultivation in acres		
Below 1	12	11
1-3	84	81
Above 3	8	8

Source: Field survey 2016

There is a negative correlation between socio-economic parameters with household size. Household size comprises of dependents including children and people of old age (Belay et al., 2012). Data regarding household size were also indicated in Table 1 shows that 47% respondents having household size of 5-8 members and the remaining 22% of the respondents having house hold size above 10 members. Table 1 also shows tenancy status of the respondents in the study area, 49% respondents were owners cultivate 35% owner- cum-tenants, while 16% were tenants.

Data regarding area under tomato cultivation are also depicted in Table 1, 81% respondents reported that their area under tomato cultivation was between 1-3 acres, 8% reported that they were having tomato cultivated area above 3 acres, while remaining 11% reported land below 1 acre under tomato cultivation. This trend shows that majority of the farmers have small land holdings in the study area.

High yielding varieties

Table 2 shows data regarding adoption of high yielding varieties. All the respondents reported that they were growing different high yielding varieties. The second portion of the table shows that 48 respondents reported that Sahel were grown as a HYV, 30 respondents reported that they grew Success as a HYV, 24 respondents reported that HT-100 were grown as a HYV,10 respondents reported that they grew SiS as a HYV, 11 reported that they grew Cosmic as a HYV, 9 respondents reported that H-646 were grown as a HYV, 8 reported that Best California was grown as a HYV and the remaining 6 respondents reported that best American were grown as a HYV. Results of the study shows that all HYVs of tomato were adopted by all the respondents in the study area.

Our results are inline with Chohan and Ahmad (2008) who also reported the adoption of HYVs of tomato in Azad Jammu and Kashmir. Awan et al. (2012) stated that variety Roma was ideal variety, followed by Rio Gring and Heir loom variety of tomato.

Diseases/pest attack

Data regarding diseases/pest of tomato are given in Table 3, show that 74 respondents reported leaf mold disease (*Passalora fulva)*, 64 reported Gray leaf spot disease (*Stemphyliumsolani)*, 50 respondents reported Verticillium wilting disease (*Verticillium albo-atrum)*, while 37 reported root- knot nematodes (*Meloidogyne* spp), 46 respondents reported septoria leaf spot disease (*Septoria lycopersici)*, 23 respondents reported bacterial canker, while remaining 40 respondents reported gray mold (*Botrytis cinerea*) disease on tomato in the study area.

Ahmad et al. (2012) also reported that in Jordan disease/pest attack is a major factor affecting adoption of protected farming practices among farmers.

Preventive measures of tomato diseases

Data regarding preventive measures of tomato diseases are given in Table 4, shows that 104 respondents reported that they used pesticide/fungicides spray as a precautionary measure, 38 respondents reported that they used irrigation as a precautionary measure, and

Table 2: *Frequency distribution of respondents regarding high yielding varieties of tomato*

Villages	HYVs adoption		Total	High yielding varieties(HYVs)								Total
	Yes	No		Sahel	Success	Best American	Sis	Cosmic	Ht-100	Best California	H-646	
Babeni	15	0	15	12	2	2	3	0	5	1	0	25
Hamza Khan	33	0	33	17	6	1	1	3	5	4	3	40
Platoona	19	0	19	11	7	0	1	7	0	0	1	16
Sadar Kali	37	0	37	18	15	4	5	1	14	3	5	65
Total	104	0	104	48	30	6	10	11	24	8	9	146

Source: Field survey 2016

Note: Total may not tally due to multiple answers

Table 3: *Distribution of sample respondents on the basis of tomato diseases attack*

Villages	Gray Leaf spot	Verticillium Wilting	Root -knot Nematodes	Septoria leaf	Bacterial canker	Gray mold	Leaf mold	Total
Babeni	5	10	7	3	4	9	14	52
Hamza Khan	22	16	14	19	3	12	27	113
Platoona	17	9	6	9	4	2	8	55
Sadar Kali	20	15	10	15	12	17	25	114
Total	64	50	37	46	23	40	74	334

Source: Field survey 2016

Note: Total may not tally due to multiple answers

35 respondents reported that they used hoeing/inter-culturing as a preventive measurement in the study a-rea. Results of the study is quite alarming, all the respondents use fungicide/pesticide spray and the use of Integrated Pest Management (IPM) is very low in the study area. Farmers of the study area need to be train regarding IPM to reduce the residual effect in tomato.

Table 4: *Distribution of respondents based on preventive measures used*

Villages	Irrigation	Spray/insecticide and pesticide	Hoeing	Total
Babeni	6	15	6	27
Hamza Khan	12	33	12	57
Platoona	7	19	7	33
Sadar Kali	13	37	10	60
Total	38	104	35	177

Source: Field survey 2016

Note: Total may not tally due to multiple answers

Knowledge about extension worker existence and their cooperation

An agricultural extension is responsible to informally teach the targeted farmers; the ways and techniques of improve farm production and motivate them to adopt appropriate agricultural technologies (Mulayim, 1995). In order to deliver effectively primarily aimed at the adoption and application of new technologies; extension agents are expected to imply effectively the available tools and techniques to the farmers (Ceylan, 1988). Data regarding extension workers and their cooperation in the study area were presented in Table5, show that 56% respondents reported that they knew agriculture officer both by name and face, while remaining 44% reported that they knew him by face. Results in the study area shows that all the respondents knew extension worker; this is may be due to the fact that respondents who get training from extension department were selected for the present study.

Table 5 also represents the co-operation of agriculture extension workers. Majority i.e. 51% of the respondents reported that the extension worker was co-operative, while 49% reported that the extension agent was non co-operative.

Training received by farmers

Data regarding types of training provided to the farmers in the study area is depicted in Table 6, show that 99 respondents reported that training were given

Table 5: *Distribution of sample respondents about extension worker and their co-operation*

Villages	By name	Name and face	Total	Non co-operative	Co-operative	Total
Babeni	5(33)	10(67)	15	4(27)	11(73)	15
Hamza Khan	14(42)	19(58)	33	21(64)	12(36)	33
Platoona	8(42)	11(58)	19	9(47)	10(53)	19
Sadar Kali	19(51)	18(49)	37	17(56)	20(54)	37
Total	46(44)	58(56)	104	51(49)	53(51)	104

Source: Field survey 2016
Note: Values in parenthesis are percentages

Table 6: *Distribution of sample respondent on the basis of types of training received*

Villages	Sowing methods	Weed control method	Irrigation method	Pest control method	Total
Babeni	15	12	8	15	50
Hamza khan	29	15	5	31	80
Platoona	17	10	1	15	43
Sadar kali	27	10	5	38	80
Total	88	47	19	99	253

Source: Field survey 2016
Note: Total may not tally due to multiple answers

about pest control, 88 respondents reported that training were given about sowing method of tomato, 47 respondents reported training were given about weed control in the tomato, 19 respondents reported that training were given about irrigation methods of the tomato.

Comparison before and after training

To find out the mean significant difference of seed rate, seed cost, weeding cost, pesticide cost, yield and income of tomato before and after extension recommendation spaired t-test was applied and is given in Table 7. Results showed highly significant (P≤ 0.05) difference in the seed rate of the respondents. The mean difference in seed rate observed was -72.317gm, means that seed rate is decreased after adoption of extension recommendations. Seed cost was increased after extension recommendations. The reason behind this is after getting training from the extension department farmers used certified HYVs (the price of HYVs are high as compare to local varieties).

Results also showed highly significant (P≤ 0.01) difference in the weeding cost of the respondents. The mean difference observed was 4402.07. The reasons behind this increase, is may be due to chemical control instead of mechanical. Results show that there is significant increase pesticide cost after adoption of extension recommendations. The reason behind this increase may be is due to high attack of pest and environmental changes; the use of pesticides increase remarkably.

Table 7 also shows highly significant (P≤ 0.01) difference in the yield after getting the training from the extension department. The mean difference of yield observed was 338.59 kg/ acre. The reason may be that they are following the new and up to date information provided by the extension department. Whereas income of the respondents was increased by 115,832.01 Rs/acre. The reason behind this increase is may be due to high production of tomato after getting training from the extension department.

Constraints in the adoption of agriculture extension recommendations

Table 8 shows the constraints in the adoption of agricultural extension recommendation in the study area. Majority of the respondents i.e.97 respondents reported high price of agricultural inputs, 88 reported non-availability of cold storage, 72 reported non-availability of certified vegetable seeds, while 70 respondents reported that pest and diseases incidence were the major constrains in the adoption of extension recommendation, 47 reported lack of agriculture credit facilities, 42 reported improper/ defective marketing of produce, 19 reported lack of fertilizers and the remaining 14 respondents reported lack of technical knowledge as the major constrain in the adoption of extension recommendation regarding tomato

Table 7: *Comparison before and after training*

Crop	Variable	Before extension recommendations		After extension recommendations		Difference	t-value	p-value
		Mean	SD	Mean	SD			
Tomato	Seed rate in (gm)	135.05	35.971	62.72	41.758	-72.33	13.792	.000***
	Seed cost (Rs)	1415.96	488.062	11156.15	8174.674	9741.15	-12.141	.000***
	Weeding cost (Rs)	3123.17	1413.38	7525.24	3416.10	4402.07	-14.075	.000***
	Pesticide cost (Rs)	4183.13	1295.29	11282.42	5467.98	11240.59	-12.735	.000***
	Yield (kg/acre)	4051.62	861.365	4390.21	926.357	338.59	-7.911	.000***
	Income (Rs)	471854.3	74730.23	587686.34	66300.66	115832.04	-6.919	.000***

*** *represents significance level 1 percent*

Table 8: *Distribution of sample respondents on the basis of constraints in the adoption of agricultural extension recommendations*

Villages	Lack of agriculture credit facilities	Defective marketing of produce	Non availability of certified vegetable seeds	Non-availability of cold storage	High cost of agriculture inputs	Pests and diseases incidence	Lack of fertilizer	Lack of technical knowledge	Total
Babeni	13	9	12	14	15	10	2	1	76
Hamza Khan	11	10	21	25	30	24	3	3	127
Platoona	9	9	19	19	19	10	6	1	92
Sadar Kali	14	14	20	30	33	26	8	9	154
Total	47	42	72	88	97	70	19	14	449

Source: Field survey 2016

Note: Total may not tally due to multiple answers

cultivation.

Our results are in similarity with Ajagbe et al. (2014) who reported that the main constraints of tomato post-harvest techniques were insufficient funding, exhausting tomato processing practice, and poor extension services. Jat et al. (2012) also stated that tomato growers were facing financial, inputs, educational, technical and marketing constraints in the study area.

Conclusions and Recommendations

The study concluded that all farmers were given training especially in pest control. Total cost of seed, weeding, pesticide per acre was increased; while seed rate in (gm) was decreased, yield and income of tomato growers were increased after getting training from extension department.

It was also concluded that high price of agricultural inputs, non-availability of cold storage and certified seeds, pest and diseases incidence, lack of agricultural credit facilities, improper/defective marketing of produce, lack of fertilizers and technical knowledge were the major constrains in the adoption of extension recommendations regarding tomato cultivation in the study area.

The study suggest some recommendations:

1. Farmers should be provided new, practical, timely, and scientific knowledge regarding tomato cultivation, in order to increase tomato production in the study area. In order to reduce the residual effect of pesticides on tomato crop the efficacy of IPM through focused training needs to be taken into serious consideration by the line department.
2. Necessary inputs such as disease resistant and HYVs, chemical fertilizers etc should be provided at reasonable prices and right time in local market through extension staff.
3. Cold storage facility should be provided to the farmers in the study area.
4. Extension staff should regularly contact the farmers for diffusion and adoption of improved agricultural technologies especially in tomato cultivation.

Author's Contribution

Urooba Pervaiz: Conceived the idea and wrote the manuscript.
Abdus Salam: Helped in data collection
Dawood Jan: Helped in data analysis.
Ayesha Khan: Edited and proofread the article and provided technical assistance in manuscript.
Mahmood Iqbal: Helped in data collection and assisted overalll.

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