Research Article

Broccoli: Introduction and Adoption Constraints in Pakistan

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Abstract | Broccoli production for more than just food has created needs to expend its cultivation spectrum in Pakistan. Present studies conducted during 2016-17 and were designed to understand socio-economic and agronomic constraints associated with adoption of broccoli in Pakistan. Growers and other stakeholders were contacted by personal visits, telephone calls and distribution of the structured questionnaire. Information was collected from Punjab, Balochistan, Khyber Pakhtunkhawa (KPK) provinces, Kashmir and Islamabad. A total of 167 farmers and amateurs growers, engaged in the cultivation of high value or medicinal crops were contacted. Out of these, 68 found as broccoli growers and most probably due to shyness only 37 contributed in data collection process. In the perspectives of health-promoting properties of broccoli 62% were unaware of health benefits and 7% aware of beneficial properties against heart diseases. In case of selection of varieties 37% were unaware of the name of variety and 22% cultivate "Marathon" while a small group was cultivating other improved varieties. In case of agronomic input 96% farmers were applying fertilizers and observing other recommendations for cauliflower. In case of postharvest handling 49 % were not specific for packing material whereas broccoli leaves were being used for wrapping of florets by 30% while 21.6% farmers were using paper for wrapping. The present studies concluded that broccoli has great potential for adoption especially for smallholding growers. But it needs government and media assistance for creating awareness for its health benefits and crop production technology.

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Introduction

Brassicaceae, formerly Cruciferae, the mustard family of flowering plants, composed of 338 genera and some 3,700 species. The family includes many plants of economic importance that have been extensively altered and domesticated by humans, especially those of the genus Brassica, which includes cabbage, Brussels sprouts, kale, kohlrabi, cabbage, turnip, rutabaga and broccoli (Aires, 2015).

Brassica vegetables have been identified as rich source of anti-oxidants, vitamins C and E, glucosinolates, carotenoids, polyphenols, and minerals. Besides strengthening human immune system against acute infectious diseases, it plays a significant role in fighting against cancers and cardiovascular diseases. However, the mode of action of these phytochemical against cancers and cardiovascular diseases is not clear. Over a decade broccoli (*Brassica oleracea* L. var. italic) sprouts have attained enormous scientific attention due to the exceptionally rich source of phytochemicals that protect against cancer and other

degenerative diseases (Shapiro et al., 2001; Fahey et al., 2002; Fahey et al., 2006). Numbers of prospective studies have investigated inverse association between crucifers' vegetables consumption and risk of various types cancers like, stomach, breast, lung bladder, colorectal and prostate cancer (Traka and Mithen, 2009; Krish et al., 2007; Zhao et al., 2007; Fowke et al., 2003; Hansson et al., 1993).

Broccoli is now considered as a super food because of its amazing contribution towards a healthy diet. Unpredictable shelf life and rapid deteriorating post-harvest quality is the major issue for the growers and consumers as well. Broccoli was introduced in Pakistan as a salad crop but could not gain popularity among masses and is cultivated on a limited scale. Since the awareness for the presence of high-value health-protecting compounds, area under cultivation for broccoli is increasing rapidly in developed countries (AgMRC, 2018). However, in Pakistan, it is gradually spreading but still confined to Lahore, Islamabad and Northern areas. (Irfan, 2016; Tahir, 2016; Qurban, 2017; Zubair, 2017)

Globally many workers have submitted their findings identified as constraints in adoption of the crop in developing countries like Pakistan, India, Bangladesh, Ghana, Timor and Eretria (Asgedom et al., 2011; Ahmed et al., 2004). In this regard number of factors viz insufficient and right time supply of seeds, fertilizers, proper marketing infrastructure, and postharvest facilities are listed as key constraints (Rohit et al., 2018). Various reports and research findings based socio-economic survey reveal the importance of such survey in designing strategies for creating awareness among stakeholders for production and increasing growers range, consumption and policy designing (UNECA, 1997). There is lack of information on socio-economic, crop production and protection technology, therefore the present project was designed to conduct a socio-economic survey to identify constraints in adopting of broccoli by general farmers but with special emphasis on smallholding growers.

Materials and Methods

The surveys were conducted on a scheduled plan from September to November 2016 and September to November 2017. The survey locations in Punjab province were Kasur, Bedian, Sharkpur, in Khyber Pakhtunkhawa (KPK) province; Abbottabad, Mansehra, Swat, Kalam valley, In Balochistan province; Quetta, Killa Saifullah, In Kashmir; Muzzafarabad and the capital city Islamabad. Information was gathered on a structured questionnaire developed as adopted by Babalola, et al. (2016) with some modification and through informal interviews.

Key informant survey and informal meetings with the representatives of Agriculture Department and seed distributing companies were also carried out to identify targeted farmers in each area. Field survey information was focused on:

1. Awareness of health benefits (general health, against cancer and cardiovascular diseases)
2. Selection of variety
3. Agronomic inputs and Insect or diseases of economic importance
4. Postharvest handling and marketing network

Information collected from the surveys were analysed using the Descriptive statistics analysis tools in SPSS version 10. Descriptive Statistics are used to present quantitative descriptions in a manageable form of percentages and frequencies. Microsoft Excel for Windows 10 was used to draw a graphical representation of survey data.

Results and Discussion

Keeping in view initial findings made on contacting, the respondents were categorized in the groups of amateur farmers and professional growers. The difference in the response among the groups and expert opinion public and private sector is summarised in (Table 1).

Awareness of health benefits

Overall farmers were little aware of the health benefits of broccoli while 62% of all interviewed growers were unaware about the nutritional properties of broccoli. A further in-depth investigation revealed over 30% of the interviewees recognized as healthy vegetable whereas less than 5% knew a positive impact of broccoli against cancer or cardiovascular diseases (Figure 1). Comparing the two identified categories of broccoli, 91% of amateur farmers were aware of healthy aspects while 36% of commercial farmers knew broccoli as a healthy vegetable.

Table 1: *Summary of findings as a result of survey with broccoli growers.*

	Category 1 amateur farmer	Category 2 commercial farmer
Number of farmers interviewed	12	25
Average farm size	0.01 ac	0.25 ac
Awareness on nutritional value of broccoli	91%*	36%*
Source of Seeds	• Vender • Self • Relative/friend	Vender
Fertilizer application	• Mostly no fertilizer use • Very little use	• All using fertilizers • NPK • Urea
Pest and pest control	• No pesticide use	• Use pesticides as a regular practice • Few monitor for pest and then spray
Postharvest measures	• Washing	• No recommended measures • Wrapping florets in leaves and papers for transportation
Selling points	• No sale • Household or friends and family use	• Already established contacts with hotels • Produced is taken by contactor • Local Market in big cities
Constraints	• Growing techniques • Improved seeds • Recipes	• Seeds availability • Marketing • Support from government • Chilling storage and transportation facilities • Price control • Growing techniques
Suggestion for promotion of Broccoli cultivation and consumption in Pakistan	• Awareness regarding heath properties • Government support projects • Involvement of NGOs working with communities and health issues in Pakistan • Improved and quality seeds	• Marketing facilities • Government subsidy • Storage and transport facilities • Inputs and seeds from government • Trainings on cultivation techniques on new crop

Area and varieties of broccoli in surveyed locations

Findings indicated that Armatures farmers were mostly located in the periphery of Lahore and Islamabad and had an area 0.01 ac under this crop, whereas commercial farmers had 0.25 ac under broccoli. Mostly farmers were unaware of the variety of broccoli they were growing because not enough information was available on variety selection. Farmers were dependent on vender or seed supplier for variety selection. Over 32% of farmers interviewed were unaware about the variety they were growing, while a variety "marathon" appeared the most popular and was adopted by over 22% of surveyed farmers (Figure 2). Some other varieties were also reported by the growers. Responded farmers (96%) were relying on vender for seeds and variety while less than 3% had the opportunity from other sources including abroad. They were frequent travellers and would buy seeds from other countries.

Agronomic practices and Insect or diseases of economic importance

No proper information on sowing time, seedling preparation, plant to plant or row to row distance was available to all farmers. NPK and urea were being used by of the farmers while in case of commercial farmers 100% farmers were using fertilizers but without any recommendations. Similarly, over 96% of commercial farmers were using pesticides as routine practice without any pest monitoring. It was very interesting to record that neither insect pest nor any disease reported by any respondents. Nevertheless, attack of aphids and caterpillars were observed in the later stages of the crop usually after harvest of the florets.

Marketing network and postharvest handling

Regarding the marketing systems, the respondents show that there were not proper sale points for broccoli. A specific class of society or modern restaurants in big cities like Lahore, Islamabad, and

Karachi are the main buyers. As broccoli is a winter crop, therefore, its cultivations shift to various parts of the country according to required climatic conditions and to meet the regular demand. In the light of survey results, a marketing network map has been developed to present the current scenario of broccoli cultivation and marketing. (Figure 3)

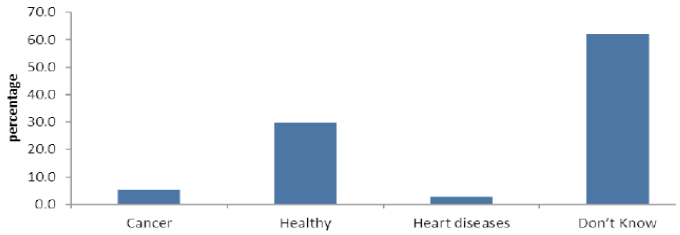

Figure 1: *Awareness on nutritional/health properties of broccoli among growers.*

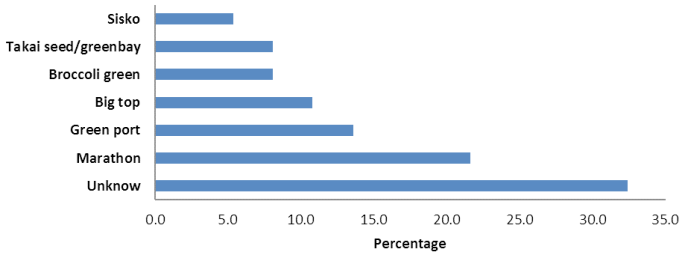

Figure 2: *Varieties of broccoli grown in Pakistan.*

Figure 3: *Marketing network of broccoli in Pakistan.*

All the respondent farmers reported broccoli as a highly perishable crop but none were practicing any postharvest measures. Broccoli leaves being used as a wrapping material for broccoli florets by 22% while 14% of farmers were using paper for wrapping, in order to transport broccoli to market. Not any packing material was being used by 65% of farmers during transportation of broccoli (Figure 4). Just a single farmer who was highly progressive commercial farmer reported the use of crushed ice during transport of broccoli florets to good class hotels and store of Lahore and Islamabad.

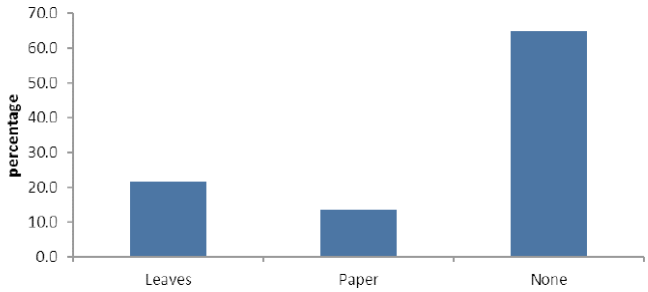

Figure 4: *Use of postharvest packing materials.*

Major constraints

Awareness appeared as a core constraint by 38% of the respondents followed by availability of quality seeds or cultivars and marketing issues with 32%. Nevertheless, the rest of the respondents realized growing techniques and postharvest deterioration as one of the major issues in broccoli adoption in Pakistan. (Figure 5).

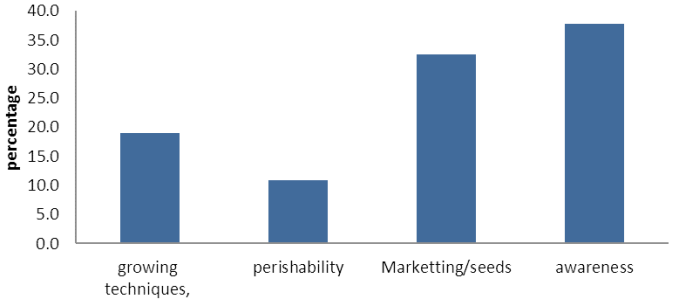

Figure 5: *Major constraints in adoption of broccoli.*

Due to increasing awareness for health-protecting compounds like antioxidants and phytochemicals interest for broccoli production and consumption is increasing gradually. But there is a scarcity of information regarding crop production and technology or marketing strategy in Pakistan. It is believed that cultivation of high-value crops or introduction of change in the farming community for the adoption process is linked with economic development (Rola et al., 2003; Rosegrant et al., 2001). Therefore, before initiating for the studies on postharvest quality characteristics, a pilot scale investigation was conducted during 2016-17. It was pointed out that limited scale group of progressive growers and amateurs are working on broccoli production and marketing without having a strong interaction with federal or provincial agriculture departments or among themselves. Therefore, survey investigations were focused on socio-economic factors associated with production and marketing constraints. It was pointed out that still broccoli is not commonly consumed but is popular among the modern class of society. In modern food culture iceberg, lettuce and kale and broccoli are used as a raw salad (Henseler and Philip, 2014).

The data was collected on farm size, awareness for health benefits, fertilizer application, plant protection, post-harvest handling, constraints and suggestions and was analyzed and results are summarized in (Table 1). It is interesting to point out that more than 62% farmers were not aware of health benefits of the crop whereas 30% were of the view that it is healthy crop but were not aware of its anti-cancerous or heart diseases properties. Same was the case for varietal selection where 32% were growing without knowing about variety and 22% were cultivating a variety called "Marathon" because this was mostly available in local market. Lack of information on variety selection emerged as one of the serious constraint. Similar results have been reported by Hensler and Philip (2014), Asgedom et al. (2011). No serious insect pest and diseases have been revealed out from this study, one of the reasons could be that this is a comparatively new crop and grown on a very limited area. Further being a crop of cold weather it is less attacked by insect pests and diseases. An in-depth study primarily focusing on Insect pests and diseases of broccoli is required to cope with the future plant protection challenges.

On the basis of awareness, it was noted that amateur growers were little more familiar for variety and health benefits than progressive growers or followers of progressive growers. Awareness and application of fertilizers cannot be compared with health benefits or varietal selection because more than 96% of commercial growers apply fertilizer. The cumulative assessments for constraints highlighted next to lack of awareness were the availability of certified seed and marketing facilities for perishable crops. These findings are in line with conclusions drawn by Guiji and Pretty (1992), Ahmad et al. (2005). All of the respondents were aware of perishable nature and rapid post-harvest quality deterioration and argued lack of marketing infrastructure is a key constraint in its adoption. A similar nature of issues like crop management and post-harvest practices, limited finance and poor knowledge of improved techniques of high-value vegetables have been investigated by Henseler and Philip (2014), Laste et al. (2007).

On addressing these problems, cultivation of broccoli can prove a reliable source of income for farmers especially the small growers have holding unit of less than 2.5 hectares. However, it needs Government support as financial assistance or subsidies to meet high labour cost, postharvest losses. These factors decrease returns on vegetables mainly due to lack of infrastructure, poor handling, and lack of marketing know-how as highlighted in the previous studies of Prigojin et al. (2005), Ali and Abedullah (2002).

Conclusions and Recommendations

Awareness for health benefits, selection of varieties and postharvest handling at the end of farmers and negligence in facilitating farmers for innovation cultivation culture at state machinery end appeared as most serious production constraint. Ignorance of stakeholders was might be due to unavailability of broccoli production and marketing statistics or research reports in the country. Though the rate of adoption is slow, it is hoped that this crop would hold a strong place in the vegetable market of Pakistan. Therefore, it is responsibility of all stakeholders of high value or innovation crop production to create awareness for health and financial benefits for consumer and grower in Pakistan

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Novelty Statement

This is first survey report on broccoli in Pakistan. Core constraints for promotion of broccoli cultivation and consumption have been identified. Current marketing network of broccoli was also investigated which can help policy makers and agriculturists for further development of this crop in Pakistan.

Author's Contribution

Muhmmad Shakeel: Conceptualized the study. formal analysis, methodology and writing of original draft/manuscript.
Salik Nawaz: Supervised, reviewed and ed-ited the manuscript. Provided technical guidelines during the

study.

Yasar Saleem: Designing of survey format and compilation and interpre-tation of data.

Shazia Shafiq: Revision and editing, supervision and technical input.

Ateeq Tahir and Muhammad Riaz: Field visits for collection of data and preparation of figures and graphs.

Conflict of interest

The authors have declared no conflict of interest.

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