



Less adaption of newly approved variety Basmati 515 among aromatic basmati rice varieties in *Kallar Tract* of Punjab, Pakistan

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ABSTRACT

A field survey was conducted after harvesting of rice crop 2016 to identify the reasons for less adaption of aromatic rice variety Basmati 515. The rice growers adopting rice-wheat cropping pattern in *kallar tract* were included in population of research study. Thirty male farmers from each selected district making a total of 180 respondent farmers were interviewed by convenience sampling method. The survey findings showed that the aromatic rice variety Basmati 515 was cultivated on only 2.7% rice area while maximum area (47.3%) was under Super basmati variety. The comparison of Basmati 515 was made with Super basmati and PS 2 due to comparatively more cultivated area and declared yield potential of these varieties. Overall the farmers were applying under dosed phosphorus fertilizer (DAP) as 0.25, 0.20 and 0.22 bag ha⁻¹ respectively for basmati 515, super basmati and PS-2 varieties. The descriptive analysis showed that the less adaptability of basmati 515 was due to less yield and more attacks of borer (11%), BLB (10%) and leaf roller (3.25%) in comparison to other aromatic and fine rice varieties. Similarly maximum lodging (16%) was recorded on basmati 515. Maximum yield was estimated for PS 2 variety (4.7 t ha⁻¹) followed by super basmati (4.0 t ha⁻¹) and basmati 515 (3.78 t ha⁻¹). The market price of super basmati was still higher due to its natural aroma, long & thin grain and export demand. The research institutes should focus for development of new aromatic high yielding and more qualitative rice varieties to increase the rice production and export.

INTRODUCTION

Rice (*Oryza sativa*) is one of the important food crops in the world and ranks second in terms of area and production. It is the staple food for about 50 per cent of the population in Asia where 90 percent of the world's rice is grown and consumed. Asia's food security depends largely on the irrigated rice fields which account for more than 75 percent of the total rice production (Virk et al. 2004). Today the majority of all rice produced comes from China, India, Indonesia, Bangladesh, Vietnam, Thailand, Myanmar, Pakistan, Philippines, and Japan. Asian farmers still account for 92% of the world's total rice production. Pakistan is the world's fourth largest producer of rice after China, India and Indonesia (Shoib 2016).

Rice being second staple food after wheat and major source of foreign exchange earnings after cotton accounts for 3.0 percent in value added in agriculture sector and 0.6 percent of Pakistani GDP (Govt. of Pakistan 2017). During 2016 in Pakistan rice crop was cultivated on 2.724 million hectare showing a decrease of 0.6 percent over the last year's area of 2.793 million hectare. While an increase in rice production of 0.7 percent was recorded. Rice area decreased due to decline in domestic prices of rice and the growers shifted to some extent to sugarcane and maize crop (Govt. of Pakistan 2017). In Punjab it was being cultivated on an area of 1.736 million hectares with 2.5% decrease over the previous year due to low market price. While 3.475 million tons of production with 10.8% increases in basmati production was achieved that accounts 51% of total national production of rice in Pakistan. The yield remained better due to adequate supply/availability of inputs at subsidized rates and intermittent rains at appropriate intervals (Govt. of Punjab 2017).

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Punjab province is famous for the production of Basmati rice (aromatic, fine long grain). The soil and climate of Punjab favors the production of Basmati rice. The soil is either clayey with restricted drainage or loamy with good drainage. The climate is sub-humid, sub-tropical type with 400-700 mm of rainfall mostly in July-August. Maximum day temperature is 40°C, rice growing season is fairly long and is suitable for the cultivation of Basmati varieties which are grown mainly in the "Kallar Tract" of Punjab comprising of Sialkot, Sheikhupura, Narowal, Gujranwala and Hafizabad districts (Mushtaq and Muahammad 2007). More than 70% of basmati rice production in the country is contributed by Gujranwala, Hafizabad, Sheikhupura, Narowal, Sialkot, M.B.Din, Okara and Jhang districts of Punjab (Abedullah et al. 2007).

Three types of rice varieties are cultivated in Pakistan i.e. Basmati types (aromatic), medium long grain (IRRI type) and bold grain (hybrid). Basmati rice is famous throughout the world for its excellent cooking and eating qualities combined with very pleasant aroma. Super basmati rice variety being the aromatic was released about two decades back in 1996 and is still popular among the farmers, consumers and traders. Although two more basmati varieties namely "Basmati 2000" and "Basmati 515" were released during 2001 and 2011 respectively but both the varieties could not compete or completely replace the "Super Basmati" variety in the field. Basmati 515 was an outcome of three way cross of F1 (Basmati 320 x 10486) with 50021 during 1995-96. The pedigree method of selection was continued up to five filial generations at Rice Research Institute Kala Shah Kaku, Punjab, Pakistan. It was put in to observational trials, varietal yield trials, micro plot yield trials and regional adaptability trials (National uniform yield trials) from 2002 to 2009. However this variety was introduced and approved in 2011. It was concluded that Basmati 515 variety showed higher paddy yield (3.72 t ha⁻¹) than Super Basmati (3.41 t ha⁻¹). The variety was additionally found to be moderately resistant to foot rot and blast diseases. In physio-chemical tests its head rice recovery along with grain length remained better than super basmati. Especially elongation ratio (2.10) was better than most of the existing extra-long grain varieties (Muhammad et al. 2014).

Adaption commonly refers the decision to use a new technology or practice by economic units on a regular basis. Different factors including demographic (age, gender, family size, dependence ratio, education), land related (land holding, land fragmentation), income related (farm income and off-farm income), market access, institutional factors (extension services, access to credit), natural factors (climate, location) and productivity

may be considered for adaption decision (Getnet 2015). The intervening variables like needs, perception and knowledge are the key determinants of the adaption behavior (Msuya 2007; Düvel 1991; Koch 1987). The independent factors like personal, institution, environmental and socio-economic have been related to adaption behavior (Matata et al. 2001; Mtenga 1999 and Nanai 1993). Years to adapted practices or new technology is considered most feasible as a measure of adaption (Getnet 2015).

Agricultural extension training programs, the purchase of rice at international market rates, provision of irrigation water, crop insurance, minimizing the role of middle man, encouraging young educated people to choose farming as a profession are the indicators for future of rice crop in *kallar tract* of the Punjab, Pakistan. However the key indicator might be the development of new high yielding disease resistant and more aromatic rice varieties (Muhammad 2015).

During 2014 the area of varieties Super basmati, Basmati 515 and Pakistan selection two (PS 2) was recorded as 41.5%, 2.5% and 6% respectively from three districts i.e. Gujranwala, Sialkot and Hafizabad (Falak et al. 2015). Similarly during 2015 the area of Super basmati, Pakistan selection 2 (PS 2) and Basmati 515 was decreased by 15%, 4% and 30% respectively over the year in agro-climatic zone of Gujranwala (Falak et al. 2016). These findings showed less adaption of Basmati 515 in rice-wheat cropping pattern in *kallar tract*. Therefore this study was planned to identify the reasons for less adaption of newly approved variety Basmati 515 among aromatic basmati rice varieties in *kallar tract* of Punjab, Pakistan.

MATERIALS AND METHODS

A field survey was conducted after harvesting of rice crop 2016 to identify the reasons for less adaption of aromatic rice variety Basmati 515. The rice growers adopting rice-wheat cropping pattern in *kallar tract* were included in population of research study. The districts Gujranwala, Hafizabad, Gujrat, M.B.Din, Narowal and Sialkot were purposively included in sampling frame due to the core area of rice crop. Then thirty male farmers from each selected district making a total of 180 respondent farmers were interviewed by convenience sampling method due to time and cost constraints. Well-structured and pretested questionnaire was employed. For data collection the questions were asked in Punjabi (local language) and the response was translated into English to fill the questionnaire.

The procedure adopted by Muhammad et al. (2017), Farooq et al. (2011) and Muhammad et al.

(2016) was used for estimating the economic cost of production, gross revenue and BCR. The data was analyzed by using statistical package for social sciences version 17.

RESULTS AND DISCUSSIONS

The field survey showed that the basmati 515 was cultivated on only 2.7% rice area while maximum area (47.3%) was under super basmati variety. The comparison of Basmati 515 was made with Super basmati and PS 2 due to comparatively more cultivated area and claimed yield potential of these fine varieties (Muhammad 2014) (Table 1 and Figure 1).

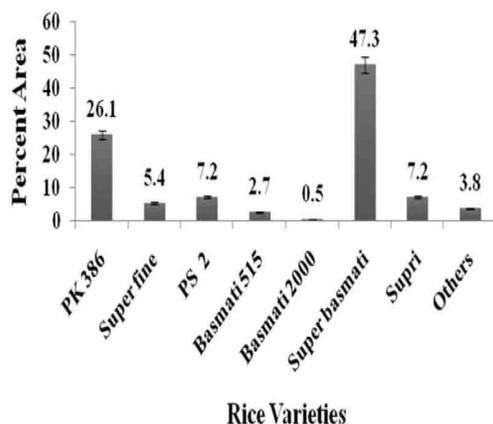


Figure 1. Cultivated area (%) of rice varieties

In the light of survey calculated mean values are given below in Table 2. The farmers whom adapted basmati 515 were younger (42.35 year) than non-adapters (45.5 year and 48.2 year) which showed that innovation and risk bearing was linked with lower age. In the studies conducted by Voh (1979), Atala (1980), Akinola (1983) and Atala et al. (1992) age was found to have influence on adaption on which they reported that adopters were younger than non adopters. However, Paul et al. (2003) in their studies found that age of a farmer correlates negatively with the probability of being an early innovator but younger farmers had a higher rate of adaption than conservative old

farmers.

Mostly surveyed farmers were educated having secondary level of education. Nairi (2005) shared that more schooling years of farmers would significantly influence adaption of the recommended certified rice seed technology. Basmati 515 variety was being adapted from short time period of 1.5 years while approved since 2011. Several studies conducted by Rogers (1962), Osuji (1983), Omokore (1986) and Kudi et al. (2010) found that the farmer's years of formal schooling was positively related to adaption. Education and age help to improve the managerial ability of the farmer and both are expected to contribute constructive role in dealing with rapid change in farming system and the improving system's efficiency (Iqbal 2002). But findings of this survey study showed that farmers are of old ages with low education level and their experience was not utilized efficiently.

Most of the farmers were applying irrigations according to crop needs but fertilizer application was below the recommended level. Particularly the use of phosphorus was in negligible amount (i.e. DAP bag ha⁻¹ was applied @ 0.25, 0.20 and 0.22 respectively for basmati 515, super basmati and PS-2 varieties). Falak et al. (2015) estimated 3.5 kg ha⁻¹ DAP fertilizer applied by only 10% farmers. Grotz and Guerinot (2002) reported that due to the complexity of phosphorus chemistry in soil only about 20% of the Phosphatic fertilizer is utilized by the first crop and remaining 80% is fixed in soil in unavailable form. This scientific fact may be the reason for not applying the adequate phosphorus in rice. According to Vance et al. (2003) application of phosphatic fertilizers is not much feasible because of its low use efficiency, highly increased prices and environmental concerns.

The descriptive analysis showed that the less adaptability of basmati 515 was due to more attacks of BLB (10%), borer (11%) and leaf roller (3.25%) than other fine rice varieties. Similarly, maximum lodging (16%) was recorded on basmati 515. Ashfaq et al. (2015) recorded more plant height of basmati 515 (125 cm) than super basmati (115 cm) which might be one of the reason of more lodging

Table 1. Detail of rice varieties (% area) cultivated in agro-climatic zone of Gujranwala

District/variety	Narowal	Sialkot	Gujranwala	Gujrat	Hafizabad	M.B.Din	Overall
PK 386	10.0	29.6	51.3	18.4	20.2	27.0	26.1
Super fine	1.2	7.0	6.0	1.5	8.8	7.8	5.4
PS 2	0.0	1.1	1.9	1.3	37.3	1.7	7.2
Basmati 515	4.5	4.0	1.6	3.5	0.5	1.8	2.7
Basmati 2000	0.8	1.5	0.5	0.2	0.0	0.0	0.5
Super basmati	76.3	34.7	35.8	71.3	5.7	60.0	47.3
Supri	1.8	20.1	1.5	0.0	19.7	0.0	7.2
Others	5.5	2.0	1.6	3.9	7.8	1.7	3.8
Total	100	100	100	100	100	100	100

Table 2. The salient findings of field survey (mean values)

Item	Basmati 515	Super basmati	PS 2
Farmer age (years)	42.35	45.50	48.20
Farmer schooling year	10.68	9.50	9.50
Years to grow variety	1.50	6.70	4.20
Land rent (Rs ha ⁻¹)	92625	92625	92625
No. of irrigation ha ⁻¹	31.74	31.74	31.74
Urea (Bag ha ⁻¹)	2.20	2.27	2.35
DAP(Bag ha ⁻¹)	0.25	0.20	0.22
Zinc Sulphate (Kg ha ⁻¹)	9.26	8.65	8.77
Attack of BLB (%)	10.00	6.40	8.45
Attack of BLS (%)	4.50	5.00	5.40
Attack of Borer (%)	11.00	3.33	5.00
Attack of Leaf Roller (%)	3.25	2.00	1.50
Lodging (%)	16.00	10.00	8.00
Duration of crop (days)	113	118	112
Harvesting cost (Rs ha ⁻¹)	6434	6200	5866
Yield (t ha ⁻¹)	3.78	4.00	4.70
Market price (Rs t ⁻¹)	34250	37125	33500
Gross income (Rs ha ⁻¹)	129434	148552	157381
Operational cost of production (Rs ha ⁻¹)	70395	67925	63232
Net Income (Rs ha ⁻¹)	59039	80627	94149
Benefit cost ratio	1.84	2.19	2.49

in basmati 515. Falak et al. (2016) stated that the plant height of basmati 515 was recorded maximum with low tillering capacity which may caused lodging and low yield. The grain yield reduction by increase in plant height of rice could be the result of increased lodging as long statured crop varieties are more prone to lodging (Mackill et al. 1996). Lodging was more prevalent in direct seeded rice (DSR) compared with conventional transplanted rice (Farooq et al. 2011).

During field survey almost all the farmers informed that among rice varieties the basmati 515 was most feasible variety for manual harvesting method due to easily threshing out factor. However, grains fell from spikes if harvesting operation may got late for some days. Mazhar et al. (2015) stated that if the plant population was increased up to eighty thousand plants/acre at proper time of transplanting then basmati 515 may provide higher yield.

The output yield and market price are always the most important factors for adaption of any crop or variety. Jack (2013) concluded that an increase in output prices leads to a corresponding increase in area of crop. Aloyce et al. (2000) explained that the factors such as price of input and output, taste and preference of individual households, and input distribution and availability may enhance or limit the adaption and diffusion process of the technologies.

Maximum yield was estimated for PS 2 variety (4.7 t ha⁻¹) followed by super basmati (4.0 t

ha⁻¹) and basmati 515 (3.78 t ha⁻¹). Farmers usually sow new variety with better land preparation, better plant protection measures and more fertilizer application so that, the potential of new variety could be achieved. But if new variety provide same yield according to prevailing varieties then its adaption may be affected adversely. Ashfaq et al. (2015) recorded higher yield potential of super basmati (7.1 t ha⁻¹) than basmati 515 variety (6.4 t ha⁻¹). Yield is a direct measure of varietal performance. In the studies on the adaption of new maize varieties, Kudi et al. (2010) in their study on adaption of improved maize varieties found that the yield was positive and highly significant at 1% level of probability thus signifying that increase in yield will lead to increase in adaption of new maize varieties.

Market price of super basmati was still higher (Rs 37125 t⁻¹) than Basmati 515 (Rs 34250 t⁻¹) and PS 2 (Rs 33500 t⁻¹). The price of super basmati might be higher due to its natural aroma, long & thin grain and export demand.

Rice Research Institute Kala shah kaku, Agriculture Department, Punjab, Pakistan has introduced three new basmati rice varieties namely Punjab Basmati, Kissan Basmati and Chenab basmati for kharif season 2017. But their yield potential and market price will be determinants to decide whether these varieties are better and alternate for existing basmati varieties or not. Further research work is needed in this regard.

CONCLUSIONS

Although Basmati 515 variety had been approved since 2011 but its adaptation level was very poor. The quality, aroma and yield potential of super basmati was still better and it could not be replaced by Basmati 515. The reasons might be more pest attack, less yield potential, more lodging factor and lower market price etc. As availability of fertile land is decreasing day by day due to residential projects. Therefore rice production may be increased vertically through varietal development.

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