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Original Research Article

Variety-wise adoption of wheat crop in rice-wheat cropping pattern in Gujranwala

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Abstract

The study was conducted to evaluate varietal adoption of newly approved varieties of wheat at Adaptive Research Gujranwala zone (rice-wheat system) during 2015-16. The primary data was collected by convenience sampling method by interviewing one hundred and fifty farmers after purposively selecting three Districts i.e. Gujranwala, Sialkot and Hafizabad. The study results showed that education, age/farm practical experience and operational land size played a significant role in adoption of newly approved wheat varieties overtime. Logit and probit models were used to quantify the effects of these factors while Tukey and LSD test were employed to estimate significant yield differences among the recorded varieties. Faisalabad 2008 was found to be the most popular variety cultivated by 51% farmers covering 34% area, due to its better yield (43 mounds acre^{-1}), better cooking quality, medium sized grain and resistance against rust. The non significant yield difference was recorded between Faisalabad 2008 and Punjab 2011. The maximum rust incidence was recorded on Sehar 2006 (31%), Shafaq 2006 (19%) and Lasani 2008 (14%). At the end it was concluded that the potential varieties should be promoted by enhanced extension services and an improved system of multiplication and distribution of certified seeds in farming community.

Keywords: Variety, adoption, factors, wheat, yield, Gujranwala, Punjab-Pakistan

Introduction

Wheat (*Triticum aestivum*) is cultivated in Pakistan on an area of 9.04 million hectares with an annual production of 23.8 million tons and the national average grain yield of 66 mound ha^{-1} (Anonymous, 2010). Wheat variety having the higher yield potential, disease and insect resistance and better adaptability is highly demanding because low yield may be due to impure seed along with improper usage of inputs and by the adoption of poor management practices. Yield may be increased significantly through the evolution of high yielding genotypes having disease (rust) resistance (Ahmad *et al*., 2005 and Bakhsh *et al*.,

2005). The commonly fungal diseases of wheat are rust, smut (Iftikhar *et al.,* 2010) and black point disease (Iqbal *et al.,* 2014).Yellow or stripe rust infects the wheat crop at low temperature and wet weather condition (Boyd, 2005 and Iqbal *et al.,* 2015). The wheat-rice rotation is one of the world's largest agricultural production systems and consists on about 14 million hectares in Pakistan, India, Nepal and Bangladesh (Zia *et al.* 2000). Wheat breeding research in Punjab had been adding Rs. 30.5 billion annually as an additional outcome since 1990-91 to 2013-14. From table 1 it is showed that this economic gain has

helped the farming community to meet with their essential farm and non- farm requirements. Faisalabad 2008 variety was more adopted than others, while the

area of Sehar 2006, Lasani 2006 showed increasing trend. However area of Inqlab 91, AAS 2011 and Watan showed decreeing trend (Javed *et al.,* 2016).

Table 1: Economic impacts of wheat breeding research in Punjab

Variety	(Rs. in millions)			% change over year	
	2011-12	2012-13	2013-14	2011-12 to 2012-13	2012-13 to 2013-14
Inqlab 91	10783.6	8849.9	7737.5	-17.93	-12.57
Watan	7444.2	8613.3	8693.8	15.70	0.93
Sehar 2006	14407.7	16713.1	20183.1	16.00	20.76
Lasani 2006	414.9	697.7	1348.5	68.16	93.28
Faisalabad 2008	495	1346.8	3821.2	172.08	183.72
AAS 2011	854.2	1586.4	1267.7	85.72	-20.09

Therefore this study has been planned to estimate the varietal adoption with factors that affect the adoption level at Adaptive Research Gujranwala zone (rice-wheat system) during 2015-16.

Materials and Methods

The study was conducted to evaluate varietal adoption of newly approved varieties of wheat at Adaptive Research Gujranwala zone (rice-wheat system) during 2015-16. The primary data was collected by purposively selecting three districts i.e. Gujranwala, Sialkot and Hafizabad due to maximum share of wheat area (i.e. 237, 207 and 158 thousand hectare respectively) (Anonymous, 2015). Due to time and cost constraints 150 farmers (50 from each selected district) were interviewed from different villages by convenience sampling method (Latif *et al*., 2015). The interview schedule was prepared in the light of pre-set objectives and the efforts were made to include all the information needed. To study the factors affecting the adoption of new wheat varieties the socio-economic variables like age, education and area under cultivation were considered by employing probit and logit regression analysis. The dependent variable (dummy variable) in regression model was defined as:

Adoption of new wheat variety before or after 1st year of approval = 1

Adoption of new wheat variety after 2nd year of approval = 0

This method was in line with Iqbal *et al.,* (1999) and Iqbal *et al.,* (2002).

Keeping in view the requirements of the study, statistical techniques i.e. Tukey and LSD test, averages, their comparison and percentages were analyzed using SPSS package. This procedure was recorded by Farooq *et al.,* (2007). Yellow/Strip rust incidence in different wheat varieties was calculated by applying the formula which was already used by Ali *et al.,* (2015).

$$\text{Disease incidence (Rust attack)} = \frac{\text{No. of infected plants} \times 100}{\text{Total no. of plants visited}}$$

Results and Discussion

Data regarding the operational land holding showed that overall 53% farmers fall in below subsistence level (small farmers) and had up to 5 acres land. While 36% and 11% farmers were medium and large farmers respectively. Griffin (1970) found a positive relationship between farm size and productivity. Most of the farmers (35%) adopted new varieties after four years of approval while only few farmers (5%) adopted just at first information or after 1st year of approval (11%). Seeds in Pakistan distributed through Punjab Seed Corporation and private sector (sale point and agro-chemical shops of registered national and international companies) as well as informal channel (other farmer, commission agent, private input dealer etc). The results showed that 63% farmers obtained new seed by other farmer/relative, 13% from Agriculture department/Seed Corporation, while 24% famers obtained new varieties from local market. Majority of the farmers (50%) told the reason for non adoption of improved new wheat seed that improved seed was expensive while others stated non availability of new improved seed (34%) and lack of information (16%) respectively (Table 2).

Table 2: Description of some field survey

Detail		Hafizabad	Gujranwala	Sialkot	Overall
Education (mean value)		8.3	9.26	8.9	8.8
Average age (year)		43.35	45.5	48.2	45.7
Average land holding size		8.45	6.31	5.75	6.8
Average land rent (Rs./ha)		80275	89330	70197	79934
Seed cost (Rs./50 kg)		2100	2038	2087	2075
Distribution of operational land holding size (%)	Small farmers (5 acre)	52	46	62	53
	Medium farmers (5.01-12.5 acre)	34	43	30	36
	Large farmers (> 12.5 acre)	14	11	8	11
Distribution of farmers regarding varietal adoption level (%)	At 1st information	4	6	4	5
	After 1st year of approval	12	10	10	11
	After 2nd year of approval	22	24	20	22
	After 3rd years of approval	30	24	28	27
	After and above 4th years of approval	32	36	38	35
Source of new seed (percent)	Agri. Department/Seed corporation	14	12	14	13
	Other farmer/Relative	64	62	66	63
	Market	22	26	20	24
Reasons of non adoption of the improved wheat varieties (%)	Improved seed expensive	52	48	48	50
	Lack of information	18	16	14	16
	Non availability	30	36	38	34

Almost 22% farmers cultivated more than one variety during Rabi 2015-16, either as yield comparison experiment (51%), to minimize risk factor against Rust and Aphid attack (34%) and obtaining seed purpose (15%). Although the surveyed farmers were cultivating wheat varieties other than the mentioned here but for statistical analysis, only those varieties were considered which were being adopted by at least 5 farmers. With this limitation, only 11 varieties were left. The result was in line with Ghimire et al., (2012). For adoption of new variety by multivariate relationship the probit and logit estimates for age were found significant and negative. One plausible reason for this could be that our surveyed farmers were in the average age 45.7 years. Educational status was another distinguishing variable factor for judging the farmers behavior towards adoption of new varieties. Both estimates for education were found positive (probit estimate showed significant effect). Similarly area under cultivation estimate also found positive effect which denotes that progressive farmers mostly adopt new varieties (Table 3). The results were in line with Iqbal et al., (1999).

Table 3: Regression results for factors affecting adoption of new wheat varieties

Variable	Probit model	Logit model
Constant/intercept	-2.909*	-5.509*
Education	0.127*	0.252
Age	-0.003*	-0.008*
Area under cultivation	0.003	0.006
R^2	0.77	0.78

*significant at 5% level

From Table 4; Faisalabad 2008 was found most popular regarding area (34%) cultivated by 51% farmers and mean yield (43 mounds acre^{-1}). Similarly the Punjab 2011 was adopted by 34% farmers with 23% wheat area share and provided mean yield of 41 mounds acre^{-1}. The non-significant yield difference was recorded between both these varieties. After this the yield of Galaxy 2013 was found significantly less than Faisalabad 2008 and Punjab 2011 with area share 8% and adopted by 12.4% farmers. The introduction of high yielding varieties and the rate at which they

are diffused to farmer's fields indicated the speed of transferring the benefits of breeding efforts to farmers. The rust disease appeared on all varieties and its incidence (%) was recorded in Sehar 2006 (31%); Shafaq 2006 (19%); Lasani 2008 (14%) and Galaxy 2013 (8.6%). However minimum attack was recorded in Faisalabad 2008 (2.2%); Millat 2011 (3.3%) and AARI 2011 (3.6%). Ali *et al.,* (2015) reported rust incidence on Sehar (65%), Faisalabad-2008 (55%), Inquilab-91(40%), and Millat 2011 (25%).

Table 4: Distribution of varietal adoption key indicators for different wheat varieties

Variety	Mean years to variety grown	Proportion of farmers [a] (%)	Area wise proportion of wheat (%)	Incidence of rust %	Yield (mound acre^{-1})
Inqlab 91	7.5	4	2.50	8	25
Shafaq 2006	3.9	5.6	4.00	19	28.50
Sehar 2006	4.5	10.8	6.50	31	30.5
Lasani 2008	5.2	11.4	8.60	14	31
Faisalabad 2008	6.3	51	34.00	2.2	43.42
Punjab 2011	3.4	34	23.00	6.6	41.33
AAS 2011	2.5	5.5	1.80	5.2	38.5
AARI 2011	1.9	4.5	2.90	3.6	32
Millat 2011	2.8	5.4	5.00	3.3	32.5
Galaxy 2013	2.1	12.4	8.00	8.6	39
Ujala 2016	0.5	7	3.70	4.3	36

[a] some farmers were growing multiple varieties; therefore total sum of this column will not be equal to 100.

Tukey and LSD test were employed to estimate significant yield differences among the recorded varieties. The test results are being explained in Table 5 for top three yield potential varieties i.e. Faisalabad 2008; Punjab 2011 and Galaxy 2013. The non-significant yield difference was recorded between

Faisalabad 2008 and Punjab 2011. While significant yield difference was recorded between Faisalabad 2008 and others (i.e. Inqlab91; Shafaq 2006; Sehar 2006; Lasani 2008; AAS 2011; AARI 2011; Millat 2011; Galaxy 2013 and Ujala 2015). The non significant effect was also recorded in Punjab 2011.

Table 5: Multi Comparison test (Tukey and LSD) between results

Variety		Tukey HSD	Sig.	LSD Level	Sig.
Faisalabad 2008	Inqlab91	19.9609*	0.00	19.9609*	0.00
	Shafaq2006	16.4909*	0.00	16.4909*	0.00
	Sehar2006	13.4309*	0.00	13.4309*	0.00
	Lasani2008	11.9189*	0.00	11.9189*	0.00
	Punjab2011	2.5651	0.70	2.5651	0.06
	AAS2011	9.7761*	0.00	9.7761*	0.00
	AARI2011	11.2981*	0.00	11.2981*	0.00
	Millat2011	5.4505*	0.00	5.4505*	0.00
	Galaxy2013	7.6745*	0.00	7.6745*	0.00
	Ujala2015	7.3650*	0.00	7.3650*	0.00
Punjab 2011	Inqlab91	17.3957*	0.00	17.3957*	0.00

	Shafaq2006	13.9257*	0.00	13.9257*	0.00
	Sehar2006	10.8657*	0.00	10.8657*	0.00
	Lasani2008	9.3537*	0.00	9.3537*	0.00
	Faisalabad2008	-2.5651	0.70	-2.5651	0.06
	AAS2011	7.2109*	0.00	7.2109*	0.00
	AARI2011	8.7329*	0.00	8.7329*	0.00
	Millat2011	2.8853	0.53	2.8853*	0.03
	Galaxy2013	5.1093*	0.01	5.1093*	0.00
	Ujala2015	4.7998*	0.02	4.7998*	0.00
Galaxy 2013	Inqlab91	12.2864*	0.00	12.2864*	0.00
	Shafaq2006	8.8164*	0.00	8.8164*	0.00
	Sehar2006	5.7564*	0.00	5.7564*	0.00
	Lasani2008	4.2444	0.06	4.2444*	0.00
	Faisalabad2008	-7.6745*	0.00	-7.6745*	0.00
	Punjab2011	-5.1093*	0.01	-5.1093*	0.00
	AAS2011	2.1016	0.89	2.1016	0.12
	AARI2011	3.6236	0.20	3.6236*	0.01
	Millat2011	2.2241	0.85	2.2241	0.10
	Ujala2015	0.3095	1.00	0.3095	0.82

*significant yield difference at 5% level

The farmers were asked to describe the performance (%) of the wheat varieties against different traits which enlisted in Table 6. The response of performance (%) was recorded in the form of "well" or "very well" and is being described for top three yield potential varieties. Faisalabad 2008 variety recorded maximum performance response (%) against different traits like grain yield (86%); aphid resistance (65%); rust resistance (62%) and good cooking quality (91%).

Table 6: Performance (%) of varieties against different traits

Traits	Faisalabad 2008	Punjab 2011	Galaxy 2013
Grain yield	86.3	80.9	74
Grain size	78.1	73.6	79
Resistance to aphid	64.8	60	54
Resistance to rust	61.6	40	39
Resistance to lodging	62.1	79	68
Good cooking quality	91	68	69
Average score	74	67	64

Conclusion

Faisalabad 2008 and Punjab 2011 should be promoted due to maximum yield potential; grain size; less lodging; rust resistance and better cooking quality. The potential varieties should be easily available for small and illiterate farmers or less educated farmers. However extension services should be enhanced and an improved system of multiplication and distribution of certified seed easily delivered to the farming community.

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