PROMOTING CERTIFIED SEED AVAILABILITY OF WHEAT (*TRITICUM AESTIVUM* L) THROUGH PUBLIC-PRIVATE PARTNERSHIP AND ITS IMPACT ON YIELD IN RAINFED AREAS

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ABSTRACT:- The use of poor quality seed results in poor crop stand and eventually in lesser vegetative growth leading to poor crop yield. Hence, it is the need of the time to enhance provision of certified seed of improved varieties to the farmers. An approved wheat variety 'Chakwal-50' of rainfed areas was selected for certified seed production and distribution in rainfed District Chakwal under joint venture of a study on comparison of seed source(Certified vs. Farmer's seed) contribution towards wheat yield at six sites in the District. All the agronomic practices were the same in both treatments. The number of fertile tillers m^{-2} were significantly higher in certified seed source than the farmer's own seed that resulted in significant increase in grain yield. Other yield contributing parameters including number of spikelet per spike, numbers of grains per spike and 1000 grain weight were at par in both seed sources. It was concluded that healthy and pure seed source gave high seed germination and good crop stand which enabled the plants to withstand abiotic stress especially drought during the crop season. The seed multiplication of crop varieties of rainfed areas can be done in irrigated areas to ensure the quality of seed and its availability in rainfed areas, which ultimately will increase the income of the farming community of the area.

Key Words: Wheat; Certified Seed; Rainfed Farming; Public- Private Partnership; Crop Yield; Income; Pakistan.

INTRODUCTION

Wheat crop yield is very low in rainfed areas due to the use of old and obsolete varieties by most of the farmers. Consequently area under wheat crop is reducing, resulting in decreased production and eventually farmers loose profit, which increases poverty level within the local community. Another consequence of the prevailing situation is the change in land use from agriculture to commercial purposes. The process of land use conversion could be retarded if productivity from available land could be enhanced. An essential element for increasing productivity of any crop is provision of quality seed. The certified seed of recommended varieties is available to very few farmers in Pakistan. The situation is even worse in rainfed areas as authentic seed companies including Punjab Seed Corporation (PSC) are not supplying certified seed of even main cash crops in the area (GoP, 2010). The frequent climatic variations in the areas discourage the seed companies to manufacture

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and market quality seed to farmers in the rainfed areas. The farmers are consequently using poor quality old low yielding varieties seed produced locally. Due to non-availability of improved seed in rainfed tract substantial area remains devoid of agriculture crops that result in exposure of soil to erosion and leads to soil degradation and desertification.

It was, therefore, essentially required to explore mechanism for availability of certified seed of improved varieties to farmers in the rainfed areas to prevent further expansion of land degradation and desertification process. Furthermore, a comparison between the farmer's own seed and certified seed had to be measured to ascertain magnitude of effect on crop yield. Besides that, the impact of supply of supplementary irrigation water on yield of certified seed in rainfed areas had to be gauged to realize the maximum potential of the improved variety in semi- arid environment.

MATERIALS AND METHOD

The study was conducted in the rainfed District of Chakwal and irrigated District of Okara in Punjab province during 2010-12. The first part of the study is the Public Private Partnership (PPP) mode for certified seed production in District Okara and the second part is the distribution of certified seed in District Chakwal and assessment of the crop yield.

Public-Private Partnership in Seed Production

An innovative approach was adopted to overcome the climatic variations that affect production of certified seed in the rainfed areas. A PPP arrangement was concluded between Zamindara Seed Corporation (ZSC) and the Government of Punjab through the funds provided by the Sustainable Land Management Project (SLMP). The standard operating procedures (SOPs) approved by the Government of Punjab for functioning of Foundation Seed Cell established in the Ayub Agriculture Research Institute, Faisalabad were used. The project invited sealed bids from the 25 seed companies to produce certified seed with the support of SLMP and Barani Agricultural Research Institute (BARI), Chakwal. ZSC gave the highest bid to contribute 52% of the total cost of the project.

The production of certified seed was restricted to wheat since it was the main cash crop in the study area. Chakwal-50, a high yielding drought tolerant variety developed by BARI was selected for seed production. Basic seed of Chakwal-50 was provided by BARI to the ZSC for the production of certified seed through contract growers in Okara District. The Geographic Information System (GIS) specialist of SLMP measured the area cultivated using Global Positioning System (GPS) and Remote Sensing (RS) techniques. The seed crop was monitored by BARI and Federal Seed Certification and Registration Department, Islamabad (FSC& RD) for true to type, purity and healthy seed production.

The ZSC procured seed of the variety from the contract growers on premium price. The process of seed grading/cleaning/storage/fumigation and packing under required conditions was carried out by ZSC under the supervision of BARI and

FSC&RD. The certified seed produced by the ZSC in District Okara was made available to farmers in District Chakwal through four seed dealers, BARI and also from its headquarter in District Okara.

Comparison of Crop Yield

The certified wheat seed (T_1) and farmer's own kept seed (T_2) were sown at six different sites to compare the yield from the two treatments under rainfed conditions in Chakwal district. One acre plot size, 45 kg $acre^{-1}$ seed rate and 22.5 cm row spacing was maintained for both treatment. Similar cultural practices and fertilizer doses (one bag each of Diammonium phosphate, urea and potash per acre) were applied on all plots at the time of sowing. The treatments were sown on November 21, 2011 and harvested on April, 28-30, 2012. Different variables on plant growth measured during the trial included plant height (cm), number of fertile tillers m^{-2}, spike length (cm), numbers of spikelets $spike^{-1}$, number of grains $spike^{-1}$, 1000 grain weight (g) and grain yield (tha^{-1}). The results of different crop variables were bulked up to each location and treatment for the principal component analysis (PCA) (Jolliffe, 1986). The ANOVA means for crop yield of certified and farmer's seed for different sites were obtained by using MSTAT-C statistical analyses programme (Steel and Torrie, 1980). The ANOVA means for crop yield of certified seed under irrigated and rainfed conditions was obtained by using MSTAT-C statistical analyses programme. The overall differences between individual means were examined by LSD tests (Cochran and Cox, 1957). Any two means whose difference exceeded the LSD value at alpha=0.05 were considered to be significantly different.

RESULTS AND DISCUSSION

Public-Private Partnership in Seed Production

Due to timely availability of canal irrigation water in District Okara during *rabi* season the seed crop of wheat was satisfactory as certified in the reports of FSC&RD. ZSC had to plant the basic seed (3750 kg) of the variety over 75 acres as per agreement to produce certified seed in District Okara, however, using about 136,639 kg seed was procured from the growers by the ZSC and 90,000 kg quality seed was eventually obtained after cleaning/grading etc. It can be estimated that about 34% seed was lost during the grading, cleaning and packaging stages. The major distribution of certified seed in District Chakwal was through BARI (25,300 kg) whereas the remaining distribution of seed was through four seed dealers of Tehsil Talagang and Kalar Kahar.

Comparison of Crop Yield

The results showed that the average of 6 locations for two parameters i.e., number of fertile tillers m^{-2} and number of spikelet per spike were significantly different for farmer's own seed and certified seed. Whereas, there was no significant difference between the farmers's own seed and certified seed among plant height, spike length, number of grains per spike and 1000 grain weight. Meaningfully, the percent increase in number of tillers m^{-2} and

Table 1. Location wise comparisonn of certified and farmer's own seed for yield and yield components under rainfed conditions of wheat in Chakwal District

Location	Seed source	Height (cm)	No. of fertile tillers (m^2)	Spike length (cm)	No. of spike lets/ spike	No. of grains / spike	1000 grain wt (g)	Yield (tha^{-1})
Jhamra	Certified seed	89.0	400.0	9.8	18.3	20.3	26.7	2.18
	Farmer's own seed	85.3	278.3	7.7	14.3	18.3	37.5	1.79
Miani	Certified seed	82.7	409.3	10.1	19.0	25.0	33.5	3.48
	Farmer's own seed	84.3	309.3	9.3	17.0	26.3	41.7	3.01
Dhurnal	Certified seed	78.7	246.3	9.7	18.3	19.7	24.6	1.00
	Farmer's own seed	86.0	201.3	8.7	13.0	18.7	24.3	0.76
Pindi Gujran	Certified seed	82.7	361.0	9.7	19.0	24.0	33.9	2.50
	Farmer's own seed	83.3	268.3	8.7	16.3	25.0	28.2	1.70
Talagang	Certified seed	84.3	351.7	10.5	19.0	29.7	33.5	3.13
	Farmer's own seed	85.0	256.3	10.0	18.3	24.7	28.9	1.84
Rahna Sadaat	Certified seed	91.3	322.0	10.7	18.3	29.7	28.5	2.47
	Farmer's own seed	76.7	192.3	9.6	19.0	24.0	26.1	1.00
Avg. of 6 locations	Certified seed	84.8	348.4	10.1	18.7	24.7	30.1	2.46
	Farmer's own seed	83.4	251.0	9.0	16.3	22.8	31.1	1.66
	% increase over farmer's own seed	2	28	11	13	8	-3	32

number of spikelet per spike was 28% and 13% for certified seed over farmer's own seed, respectively (Table 1).

The PCA indicated that the crop yield obtained from the farmer's seed was strongly correlated to the number of tillers and 1000-grain weight (Table 2). Furthermore, the increase in number of tillers was correlated with 1000-grain weight (Table 2). It can be inferred that the yield from farmer's own seed was dependent upon the number of tillers whereas the length of spikes impacted the yield of certified seed. The germination of non-certified seed is relatively low that increases space between the plants. Consequently the number of tillers was relatively more in non-certified seed to fill up the empty space between plants

Table 2. Cross-products matrix containing correlation coefficients among crop variables obtained through Principal Components Analysis (PCA) for farmer and certified seed used at the six locations

Variables	Yield	Height	No. of Tillers	Spike length	Spikelets $spike^{-1}$	Grains $spike^{-1}$	1000-grain wt
Farmer Seed							
Yield	**1**						
Height	0.287	**1**					
No. of tillers	0.931	0.485	**1**				
Spike length	0.085	-0.406	-0.205	**1**			
Spikelets $spike^{-1}$	0.246	-0.671	0.008	0.799	**1**		
Grains.$spike^{-1}$	0.554	-0.360	0.340	0.729	0.805	**1**	
1000 grain wt.	**0.890**	0.390	**0.897**	-0.302	-0.079	0.143	**1**
Certified seed							
Yield	**1**						
Height	0.265	**1**					
No. of Tillers	0.777	0.372	**1**				
Spike length	0.532	0.582	0.079	**1**			
Spikelets $spike^{-1}$	0.735	-0.368	0.472	0.071	**1**		
Grains $spike^{-1}$	0.657	0.433	0.142	**0.924**	0.378	**1**	
1000 grain wt.	0.740	-0.121	0.642	0.021	0.747	0.238	**1**

Degrees of freedom (df) = 28; Values in bold are significantly correlated at alpha = 0.05 for farmers' seed and 0.01 for Certified seed

(Ahmad et al., 1999; Amjad and Anderson, 2006; Behera, 1995). On the contrary, the increase in length of spikes had strong correlation with the grains produced per spike for certified seed. Due to better germination of certified seed the plants are close to each other that allow vertical rather than horizontal growth. Presumably it was due to the same reason that the length of spikes was longer and eventually produced higher number of grains per spike that resulted in better yield of certified seed (Lesznyak, 1996; Iqbal et al., 2010).

The crop yield obtained from the certified seed was significantly higher than the seed used by the farmers from own source (Table 3). A 32% increase in crop yield was observed due to use of certified seed. The difference in crop yield was highly significant between the six sites for both certified and farmer's seed (Table 3). The overall interaction between the sites and certified seed was also highly significant. It is a typical feature of the rainfed areas that the crop yield varies for different sites and even within the same site due to climatic variation (Ercoli and Masoni, 1995; Malik et al., 1996). Availability of soil moisture on sustained basis particularly in semi-arid climatic conditions is a major limiting factor towards obtaining optimum crop yield (Shoukat et al., 1999; Subhani et al., 2012).

The yield obtained from the certified seed with application of tube well supplementary irrigation was significantly higher than that under rainfed condition at two sites (Jhamra, Miani) in Chakwal (Table 4). The increase in crop yield on overcoming the water limitation was 41%. This has clearly been shown from the results that even the yield of certified seed increased on providing sustained supply of water to the crop as compared to the same seed cultivated under rainfed conditions without varying the site. It may be concluded that the farmers have a choice to double their yield by using improved seed and by applying supplementary irrigation where possible in rainfed climate.

It was a unique PPP between BARI, Chakwal; Govt. of Punjab and a local seed company. The PPP arrangement undertaken as part of the Project is the first of its kind in the seed sector. The arrangement was cost effective since all parties had suitable human resource and infrastructure available to achieve the desired outputs. The use of GPS and RS technology to measure

Table 3. ANOVA means of wheat yield (tha^{-1}) for farmer own seed and certified seed at different sites

Sites (ST) Seed Quality (S)	Jamra N=6	Miani N=6	Talagang N=6	Pindi Gujran N=6	Bilal Abad N=6	Rahna Sadat N=6	Mean (S) N=36	F test P-Value (ST)
Farmer seed (N=18)	1.79^{cd}	3.00^{a}	0.75^{e}	1.69^{d}	1.83^{cd}	0.99^{e}	2.46^{a}	
Certified seed (N=18)	2.17^{bc}	3.47^{a}	0.99^{e}	2.50^{b}	3.13^{a}	2.47^{b}	1.68^{b}	
Mean (ST) N=36	1.98^{c}	3.24^{a}	0.88^{d}	2.10^{bc}	2.49^{b}	1.74^{c}		0.0000
F test P-Value (S)							0.0075	S*ST=0.0038

LSD value = 5.306; LSD value for ST= 5.129 and for S= 5.306 at alpha 0.05

Table 4. ANOVA means of Wheat Yield (tha^{-1}) obtained from certified seed produced by SLMP at Jhamra & Miani site under irrigated and rainfed variations

Irrigation (I)	Mean (I) N=12
Irrigated (N=6)	4.76^{a}
Rainfed (N=6)	2.82^{b}
F test P-Value (I)	0.000

Values with the same superscript are not significantly different at alpha=0.05 & alpha=0.01
LSD value at alpha 0.05 = 4.20, LSD value at alpha 0.01 = 6.59

cultivated area has potential for replication by crop assessment wing of agricultural institutions. Although the seed company was slightly reluctant to cultivate rainfed variety of wheat under the impression that the crop yield will be quite less, however, due to higher resilience of the rainfed variety the crop yield was quite high. The seed production and distribution stages were timely completed. The role of BARI in the PPP was pivotal since all seed companies; agriculture extension workers and local farmers have working relationship with the research institute on initiatives related to dry land agriculture. It may be concluded that any PPP arrangement can successfully be implemented if lead role is given to an intermediary institution that has long term technical and social acceptability for all parties.

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