SWATAI 2014: A NEW HIGH YIELDING RICE VARIETY FOR HILLY AREAS OF KHYBER PAKHTUNKHWA, PAKISTAN

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ABSTRACT

Trials were conducted on newly developed variety "Swatai 2014"to evaluate its agronomic features, economic value, disease and insect resistance at various locations in comparison to JP5 and various other rice lines. The data on phonological traits, yield related parameters and paddy yield showed superiority of "Swatai 2014" over JP5 and other rice lines in comparison. "Swatai 2014" achieved maximum plant height of 110 cm, maximum of 110 days to maturity and boosted maximum paddy yield of 8.89 tons per hectare in the trials compared to JP5 and other rice lines. Moreover, infestation of rice stem borer on "Swatai 2014" was much lower than the cultivated variety JP5. Newly developed variety was tolerant to bacterial leaf blight, stem rot and blast diseases. The new variety proved to be more profitable to the farming community of the area in terms of economic comparison with JP5. "Swatai 2014" found to be far more superior to JP5 in agronomic, insect pest resistance and economic comparison.

Keywords: *Rice Variety, Economic Value & Multiple Locations*

INTRODUCTION

Rice is essential crop for our earth globe. It is life for more than half of the world population including millions of starving humans. It is the grain that has shaped cultures, diets and economies of billions of the people of the world. For them life without rice is simply unthinkable. It is arguably one of the most important cereals in the world feeding well in excess of four billion people. In the current scenario of ever increasing population of the world, it is very important for the populace of this planet to augment their food resources. As rice is major food commodity, adequate attention should be paid to enhance its production. According to estimates rice requirements in coming two decades must be increased by 20% to 30% to fulfill the food requirements of the next generation (IRRI KB, 2013).

Rice, being major food crop of Pakistan is cultivated on an area of about 2.57 million hectares (Agricultural Statistics of Pakistan, 2012). It occupies conspicuous position in agro-based economy of Pakistan. Rice ranks second amongst the staple food crop of Pakistan. Besides meeting the dietary needs of the people, it contributes for about 2.7% of the value added in agriculture and about 1% of the GDP (Pakistan Bureau of Statistics, 2012-13). Course rice varieties are grown on about 60% areas out of total rice cultivating area. It has been proved during many trials that newly developed rice variety has potential of high yield as compared to other established rice varieties.

Simultaneously, average yield of existing rice varieties is very low in Pakistan as compared to other countries of the world.

LITERATURE REVIEW

The Khyber Pakhtunkhwa province grows rice on an area of about 50,081 hectares (Crop Statistics, KPK, 2011-12). Most of this cultivated area (74%) is situated in the cooler, high altitude areas of the mountainous valleys of the province (Malakand and Hazara divisions, and the attached tribal areas). It is the staple food of the local population in the hilly areas and their economy largely depends on its production. Besides being a food grain, rice straw is used for feeding livestock as dry roughage in the winter season when the green fodders become scarce. Rice, apart from being the subsistence crop of the landed peasantry of these area, also provides employment to the rural labor through operations such as transplanting, harvesting, threshing and as a commodity of trade. In hilly areas of Khyber Pakhtunkhwa cold is a serious problem that causes considerable losses to rice production (Zhou, Zeng & Hu, 2012).

Farrell, Fox, Williams, Fukai and Lewin (2006) also reported significant reduction in crop yield due to lower temperature at reproductive stages. So it has become need of the day to develop a cold tolerant rice variety for the hilly areas of Pakistan. As in Pakistan especially in Khyber Pakhtunkhwa rice is grown under diverse climatic and edaphic conditions. The newly developed cold tolerant rice variety "Swatai 2014" plays a major role in boosting the current yield and thus contributing to sustainable food security. In an increasing competitive environment, the higher productivity of newly developed rice variety will also contribute to improve the profitability and competitiveness of rice cultivation.

MATERIALS AND METHODS

Study on the development of early maturity, cold tolerant and high yielding variety of rice "Swatai 2014" was conducted at the Agricultural Research Institute, Mingora, Swat and in different regions of Malakand division. The experiment was laid out in Randomized Complete Block design with 3 replications. The objective of the trials was to register its morphological, botanical, physiochemical and other characteristics with the Federal Seed Certification & Registration Department (FSCRD). The morphological and botanical data was recorded by using the FSCRD proforma, while the physiochemical analysis was carried out by the Rice Technology Laboratory at NARC, Islamabad. For conducting the experiments, nursery was sown in the 1st week of May and transplanted in the month of June in the age of thirty days.

The field was thoroughly prepared and water was applied to the field for puddling. After puddling, fertilizer at the rate of 120-60-40 NPK kg/ha was applied. Half dose of nitrogen and full dose of phosphorus and potash were applied to the puddled field before transplanting. While the remaining nitrogen was applied to the crop after 25-30 days of transplantation. For optimum plant population

row to row and plant to plant distance of 20 cm was maintained. The recorded data was subjected to statistical analysis through statistical software, Statistics 8.1 package. The weather data recorded during the year 2014 is presented in Table1.

Breeding History

The developed variety "Swatai 2014" was selected from the IRCTN nursery received from IRRI, Philippines during 2001. The genotype YUNLEN 2 was selected during kharif season, 2001 at Agricultural Research Station, Mingora and Swat. It was tested in preliminary yield and agronomic trials for three consecutive years. After that, adaptability trials were conducted for three years on farmers' field. The variety was then tested in National Uniform Rice Yield Trials (NURYT) for two years. The parentage and pedigree of "Swatai 2014" is as under:

Parentage/Pedigree

Received in INGER Nursery "IRCTN"
Designation: YUNLEN 2
IRIS ID: 311079
Sample Unique ID: IRTP 18363
Origin: China

Table 1 Weather Data Recorded at ARI, Mingora, Swat During the Year 2014

Year 2014	Minimum Temperature (˚C)	Maximum Temperature (˚C)	Total rainfall (mm)
January	-0.922	19.57	13.8
February	1.487	19.83	113.88
March	3.261	24.8	185.2
April	8.27	32.34	61.4
May	10.67	34.92	91.6
June	15.4	37.99	7.9
July	19.72	37.12	68.5
August	16.24	34.68	57.8
September	16.76	32.84	54.3
October	9.43	30.43	77.4
November	2.285	22.73	1.8
December	-1.03	21.37	0

Source**:** Soil Fertility Section, Agricultural Research Institute, Mingora, Swat.

RESULTS AND DISCUSSION

Morphological and Other Yield Characters

Data recorded on paddy yield and other related parameters are presented in Tables 2, 3, and 4. The trials on newly developed variety "Swatai 2014" in comparison to JP5 were conducted at the

Agricultural Research Institute, Mingora, Swat and on farmers' field in different areas of Malakand division. The data recorded on days to 50% flowering, maturity, tillers per hill, plant height, grains per panicle, 1000 grain weight and paddy yield showed significant differences. The genotypes have different responses for the cold tolerance at different growth stages which showed significant for field emergence, seedling length, seedling mortality, days to 50% flowering, pollen viability, panicle exertion, panicle length and spikelet sterility (Neelima, Rani, Raju & Keshavulu, 2015). The newly developed variety "Swatai 2014" showed earliness in maturity and produced higher paddy yield than the existing variety JP5 of the region. Varieties cultivated in the cold regions are characterized by short growing period having earliness in maturity. The genotypes taking maximum days in maturity, either fail to mature or having grain sterility by giving low yield. Sabouri, Rabiei and Fazalalipour (2008) also reported that different rice genotypes showed variations in days to maturity.

The existing variety of the area is JP5, but it is tall with weak stem and lodging is a big problem. The other characters responsible for low yield are late maturation and the minimum number of grains/panicle. In early stages low temperature causes slow seedling establishment, reduce the seedling vigor and grain production of rice crop (Ali, Naylor & Mathews, 2006). Ghadimezhad and Fallah (2014) reported that all the phonological stages of rice and grain production affected by cold temperature. It is also reported that from germination to grain filling stages cold temperature can be harmful during the entire development phase of rice plant (Ye, Du, Tang, Li & Xiong, 2009 and Cruz, Sperotto, Cargnelutti, Adamski, Terra & Fett, 2013). It is also indicated from the results that early maturing rice varieties escape the cold damage and thus producing higher paddy yield. Tahir et al (2002) also reported that grain yield/plant and number of grains/panicle were sensitive to environment and environmental coefficient of variation (ECV) was the highest for these characters. Maulana and Teso (2011) reported that during the seedling stage, cold temperature delayed flowering and maturity of the crop. Sperotto (2014) also reported that delayed and lower percentage of germination are the most common problems in cold temperature.

Table 2 Phonological and Yield Data of Rice Variety "Swatai 2014" in Comparison with JP5 at ARI, Swat

SN	Variety/Line	Days to		Tillers/ hill	Plant height (cm)	Paddy yield (t/ha)
		50% Flowering	Maturity			
1	IR60010-4B-1-1-1	75 A	103 B	17	156 A	7.36 ABC
2	CHOJANG	57 CD	96 BC	18	103 F	6.32 ABC
3	HWANG HAEZO	55 D	96 BC	17	112 EF	5.52 BC
4	IR62443-2B-7-2-2-1	84 BC	101 B	15	138 BC	6.24 ABC
5	PR26881-PJ16-4B-78-5-1	65 B	98 BC	16	114 EF	8.36 AB
6	PYONGBUK 21	48 E	88 C	17	83 G	5.28 C
7	SWATAI 2014	56 D	101 B	14	112 EF	8.56 A
8	H278-24-1-2	63 BC	90 C	13	102 F	6.72 ABC
9	Bas.385	65 B	105 B	17	121 DE	6.80 ABC
10	JP5	78 A	118 A	17	144 B	5.20 C

Table 3 Phonological and Yield Data of Rice Variety "Swatai 2014" in Comparison with JP5 at Farmer Field

SN	Variety/Line	Days to		Tillers/ hill	Plant height (cm)	Paddy yield (t/ha)
		50% Flowering	Maturity			
1	IR 59471-2B-20-2-1	69B	109B	15	134A	6.98CD
2	CHOJANG	59C	108B	17	103B	7.11BCD
3	ILLABONG	70B	108B	21	109B	8.28AB
4	IR 62443-2B-7-2-2-1	68B	109B	13	133A	4.68F
5	PR 26881-PJ16-4B-78-5-1	61C	107C	13	109B	7.72ABC
6	SWATAI 2014	61C	109B	11	112B	8.89A
7	H 278-24-1-2	68B	106D	14	100B	5.38EF
8	JP5	81A	124A	15	137A	6.24DE

Table 4 Phonological and Yield Data of Rice Variety "Swatai 2014" in Comparison with JP5 under NURYT*

SN	Variety/Line	Days to		Tillers/ hill	Plant height (cm)	Grains/ panicle	1000 grain weight (gm)	Paddy yield (t/ha)
		50% Flowering	Maturity					
1	ILLA BONG	62	112 B	19	103 D	----	----	8.08 BC
2	PR2 6881-PJ16-4B-78-5-1	62	111 B	15	106 C	----	----	7.76 CD
3	SWATAI 2014	61	110 B	20	110 B	178	31	8.64A
4	IRI 384	61	99 C	18	93 E	----	----	7.60 D
5	GZ 5830-63-1-2	58	92 D	16	92 E	----	----	8.12 B
6	JP5	74	120A	16	132A	100	26	8.00BC

*NURYT: National Uniform Rice Yield Trial

Insect Pests and Disease Resistance

The data recorded on insect pests and diseases on the newly developed rice variety "Swatai 2014" and JP5 are presented in Tables5 and 6. Figures in the tables showed that the infestation level recorded during the mentioned year is below the economic injury level i.e., 5% infestation, so sowing of the newly developed rice variety "Swatai 2014" is highly recommended for the cold and mountainous areas of Khyber Pakhtunkhwa. There are many diseases of rice, like bacterial leaf blight, stem rot and blast, but fortunately "Swatai 2014" is moderately resistant (6-12% tolerance) as compared to JP5 and resistant to other two diseases.

Table 5 Average Percent Infestation of Rice Stem Borer on Rice Varieties "Swatai 2014" and "JP5" Recorded During 2013 and 2014 at ARI, Mingora, Swat

SN	Variety	2013 (infestation level)	2014 (infestation level)
1	Swatai 2014	0.35 (3.5%)	0.40 (4.0 %)
2	JP 5	0.83 (8.3 %)	0.67 (6.7 %)

Table 6 Level of Resistance/Tolerance against Major Diseases of Rice Varieties "Swatai 2014" and "JP5"at ARI, Mingora, Swat

SN	Varieties	Bacterial Leaf Blight	Stem rot	Blast
1	Swatai 2014	T	0	0
2	JP 5	T	0	0

T = Tolerant

Economic Analysis

The data recorded on economic comparison of "Swatai 2014" and JP5 is presented in Table 7. The ultimate goal of the varietal approval and release is to enhance the net income of the farmers and hence to improve their socio-economic condition. The cost of production and comparison on the basis of yield and market prices was made between candidate variety "Swatai 2014" and JP5 and form the results it is cleared that the newly developed rice variety "Swatai 2014" is more profitable for the rice farming community of the area as compared to JP5.

Table7 Economic Analysis of Rice Varieties "Swatai 2014" and "JP5"

Variety	Paddy yield (kg/acre)	Rate/kg (PKR)	Income (PKR)	Production cost (PKR)	Net income (PKR)	Difference (PKR)
Swatai 2014	2600	53	137,800	38,872	98,928	47,800
JP5	1800	50	90,000	38,872	51,128	----------

CONCLUSIONS AND RECOMMENDATIONS

The newly developed rice variety "Swatai 2014" has proved to be high yielding, early maturing, resistant to lodging, diseases and insect pests and having better grain quality than the commercial variety of the region. Based on the potential characteristics exhibited in the trials conducted, this newly developed variety can successfully be grown in specified upper cooler hilly areas of Malakand division. This will have positive impact on the socio-economic condition of the farming community of the area. Owing to the facts collected form the above study, it is recommended that "Swatai 2014" is best fit for cultivation in terms of yield, biotic and abiotic stresses for the upper cooler hilly areas of Khyber Pakhtunkhwa.

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