

MORPHOLOGICAL AND PHYSIOCHEMICAL ATTRIBUTES OF NEWLY DEVELOPED HIGH YIELDING RICE VARIETY “SWATAI 2014”

Naeem Ahmad, Ahmad Zada, Akhtar Ali

Agricultural Research Institute, Mingora, Swat, Khyber Pakhtunkhwa-Pakistan

KEYWORDS	ABSTRACT
Rice Variety, Physiochemical, Morphological, Lodging, Tillering, Plant Height	Variety development comprises consistent evaluation and data recording for period of almost 5-7 years' time span. Research studies were carried on rice variety “Swatai 2014” “at Agriculture Research Institute, Mingora, Swat during the period” of 2006-2013 in order to evaluate and record the physiological, chemical, agronomical and the registration data on required parameters for the development of this variety. The variety has recently been “approved by Provincial Seed” Council and “released” for general cultivation in temperate climatic region of KP. Besides, its earliness in maturity (20 days) and 20% high trend in yield as compared to the commercial variety JP5 of the area are other attributes. Thus, ultimate goal of Swatai 2014 approval and release was to increase paddy yield per unit area in the upper colder zones of Malakand division, where other varieties usually fetch low yield. The newly developed rice variety “Swatai 2014” is thus having the great importance to enhance the net income of the farmers and to improve their socio-economic condition of the poor farmers.

INTRODUCTION

Pakistan lies in the subtropical zone of the globe but altitude from sea level of different regions has granted it diversified climatic conditions. This vital placement has gifted peculiar growing seasons for “several types of rice, i.e. aromatic long fine grain, medium grain and round grain Japonica type”. Rice is cash crop with high export value. Pakistan “annually exports about 3.0 to 3.5 million tons of rice which is about 9-10 percent of the world rice trade” (MINFA, 2017-18). The “exports of Basmati and coarse rice are made mainly to Southeast”, South Asian, European and African markets. Coupled with best agronomic management practices, “variety is considered most important determinant” factor in the market. At present a “large number of rice varieties are grown in different rice growing zones” of the country. Scientists at Cereals section ARI Mingora are striving hard through breeding program to “refine and improve the genetic characteristics that influence quality and yield to tailor most desirable varieties for local as well as foreign market”.

Rice is “important Kharif crop” of Khyber Pakhtunkhwa (KP) and its “cultivation stands next to wheat and maize and is characterized by being grown under two diverse agro-climatic conditions, i.e. the plains and upper mountainous valleys”. Most of “cultivated area (74%) out of the total of 50081 hectares is situated in the cooler, high altitude areas of Malakand and Hazara divisions and KP nearby tribal areas” (Crop Statistics KP 2013-14). The “average rice yield in country and in KP is far behind what can be obtained from potential of the variety”. Many issues contribute to this yield deficit which are irregular cooler climatic conditions having “low air and water temperatures. Water temperature remains 18°C during growing season” (Soomro & Mclean, 1972), due to which cultivation of some high yielding coarse and “fine basmati rice varieties” having low tolerance to cold stress could not be successful. Major constraints in getting “higher rice yields are existing low temperatures and sub-optimal cultural practices” (IRRI, 1974; Kaneda & Beachell, 1972).

In “high altitude, cold and mountainous areas” of “Malakand division (34.5 to 36.00N) rice is cultivated from elevation of 800 to 1800m above sea level. The lowest minimum air temperature” fluctuates within the range of “8.5°C to 18.5°C during the rice growing season (May to October) with also large amount of precipitation in these months”. Irrigation “water comes from the melting snow over the mountains in river swat. Water temperature in the river remains below 15°C in the rice growing season whereas the temperature of irrigation water depends on the distance from main channel which rarely increases above 18°C in rice field”. Therefore, in the “cold climatic areas of province, cold damage to rice has been a problem to rice growers. Low air and water temperatures damage the rice crop” (Imin et al., 2004; Zhou et al., 2012). This is why the modern high yielding “rice varieties and the fine basmati types cannot be grown successfully in these areas”. Mostly coarse varieties (Fakhre Malakand, JP5, Swat-1 and others) are “grown in cold climates, while basmati type (Basmati 385 and others) are cultivated in areas where temperature is not so severe”.

LITERATURE REVIEW

The interaction between genotypes and environmental are the instrumental in the crop improvement. The breeders work rigorously for obtaining positive interaction between these two key factors for fetching higher yields from the newly developed cultivars. Islam and Salam (2017) reported that cultivars with the improved agronomic practices can certainly increase paddy yield in interaction with favourable environmental conditions. Uddin et al (2011) reported in his study that new cultivars gave good overall results in comparison with other locally grown varieties. Yield increment of new cultivars over locally grown cultivars of rice was observed also by Hossain. (2005) Mondal et al. (2005) and Sohail et al. (2009) found in their studies that genetic variation can have positive impact on yield of rice. Kanegara and Kargbo (2011) observed lodging in those taller “varieties having length of 4th and 5th internode equal to or more than” 15cm. The genetic variation coupled with varieties of key factor in developing high yielding cultivars (Islam & Salam 2017; Mohammad at al., 2002).

The leaf yellowing, “stunting in seedling and early vegetative stage, delayed heading and sterility in the reproductive stage are common consequences of cold stress”. However, it is “possible to double average yield by adopting” newly out cold tolerant, high yielding varieties with improved production technology under these conditions. The cultivation of high yielding varieties “lowers production cost” and increases growers’ net profit. The commercial variety of region is JP5, but it is tall statured with weak stem. Hence lodging is big problem which ultimately causes yield reduction. Rice yield can easily be increased by introducing high yielding varieties. With the intensive and incessant efforts aimed for development of high yielding, early maturing rice variety with better cooking and eating quality will boost up rice production in “Malakand and Hazara” divisions and adjacent KP tribal areas and similar ecological areas of Pakistan and Azad Kashmir. To increase the paddy yield with increase in income of the farmers, new short bold grain rice variety (Swatai, 2014) has developed which is high yielding more resistant to lodging and pests and earlier in maturity than JP5.

MATERIALS AND METHODS

The newly developed variety “Swatai 2014” was compared with commercial variety JP5 which is being cultivated in Malakand division since long. Trials were “conducted at the Agricultural Research Institute, Mingora, Swat” and at various agro ecological zones of upper and lower swat on farmer’s fields. Nurseries were “sown in 2nd week of May and transplanted at the age of twenty-five to thirty days”. Before transplanting, the field was thoroughly prepared. Trials were “laid out in randomized complete block (RCB) design having” six treatments per replication with the maximum of three replications. The well

puddled field was supplied with basal doze of NPK 120, 60, 40 kg ha⁻¹. Half of nitrogen and all phosphorus along with potash were applied before transplanting. The remaining half of the nitrogen was applied one month after transplantation. Row to “row and plant to plant distances was” 20cm each. The morphological, botanical and the physiochemical characteristics of the variety “Swatai 2014” were compared with JP5. Morphological data was recorded in light with proformas provided by the “Federal Seed Certification and Registration Department, Islamabad”. Physiochemical characteristics were analyzed and recorded in quality analysis laboratory at the “National Agricultural Research Centre (NARC), Islamabad”.

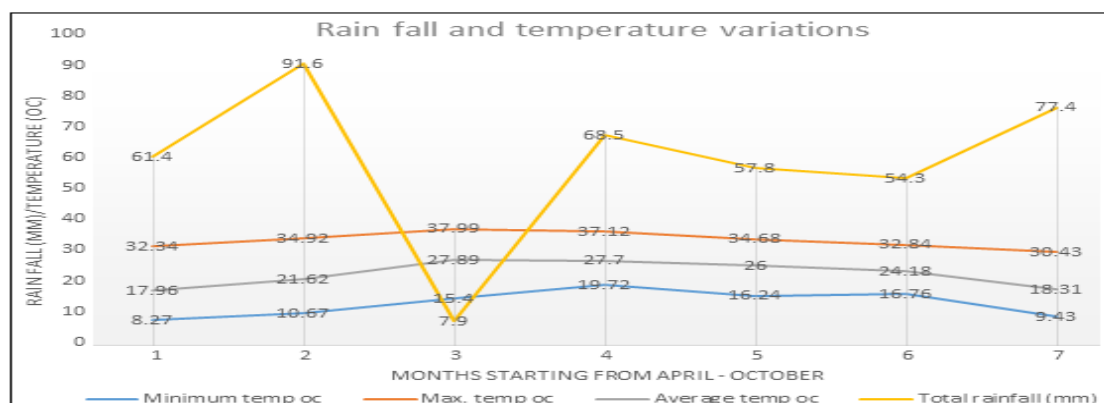
Breeding History

Swatai 2014 was selected from the IRCTN nursery received from IRRI, Philippines with the designation of YUNLEN 2 during Kharif 2001 at Agricultural Research Station, Mingora, Swat. The genotype was tested in the agronomic and preliminary yield trials consecutively for three years. It was then tested for adaptability on the farmers’ field for three years and in the National Yield Trials for two years consecutively.

Parentage/Pedigree

Received in INGER nursery “IRCTN”	Designation: YUNLEN 2
IRIS ID: 311079; Origin: China	Sample Unique ID: IRTP 18363

Figure 1: Weather Data of ARI, Mingora, Swat During Rice Cropping Season



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

RESULTS AND DISCUSSION

Morphological Characteristics

Table 2: Morphological Characteristics of Rice Varieties “Swatai 2014” and “JP5”

SN	Morphological Characters	Varieties	
		Swatai 2014	JP5
1	Leaf color	Light green	Dark green
2	Stem stiffness	Stiffy	Stiffy
3	Productive tillers (No)	12-22	10-15
4	Plant height (cm)	110-118	130-135
5	1000 grain weight (gm)	31	26
6	Grains/panicle	165-192	100
7	Maturity (days after seeding)	130-140	158-160
8	Paddy yield (t/ha)	6.0 – 7.0	5.0 – 6.0
9	Average percent increase over JP5	20	-

Table 2 shows the comparison between morphological characteristics of two varieties i.e. "Swatai 2014" and JP5. Newly developed variety "Swatai 2014" was lighter in color than commercial variety JP5 with alike stem stiffness. Data on yield contributing parameters including productive tillers, 1000 grain weight and grains/panicle was more in "Swatai 2014" thus showing higher paddy yield as compared to JP5. "Swatai 2014" was earlier and showed 20% increase in paddy yield than JP5. The results are in conformity with Yang et al. (2007) and Yang and Hwa (2008) who reported differences in physiological and morphological characteristics in various rice cultivars.

Physiochemical Characteristics

Table 3: Physiochemical Characteristics of Rice Varieties "Swatai 2014" and "JP5"

SN	Physiochemical Characters	Varieties	
		Swatai 2014	JP5
1	Total recovery (%)	80.57	81.19
2	Head rice (%)	97.65	86.23
3	Breadth (mm)	2.38	2.11
4	Length (mm)	5.09	5.23
5	Length/breadth ratio	2.14	2.48
6	Size/shape	Short/bold	Short/bold
7	Brown rice (%)	84.4	84.0
8	Broken rice (%)	2.70	15.37
9	Cooked grain appearance	Chalky	Chalky/belly
10	Elongation ratio (%)	1.52	1.52
11	Alkali spreading value	-	-
12	Gelatinization temperature	Low	Low

Physiochemical characteristics of the rice varieties "Swatai 2014" and JP5 is presented in Table 3. Most of physiochemical features in both varieties were similar except broken rice percentage was much lower in "Swatai 2014" and head rice percentage is much higher in "Swatai 2014" as compared to JP5 proving it far more popular and the superior variety than JP5 in hilly areas. Owing to low percentage of broken rice, the new cultivar will boost up rice production with better eating and the cooking quality for the people those who are continuously use. Hence this will enhance the income of the farmers and improve their socio-economic condition.

Paddy yield and related traits

Table 4: Paddy Yield and Other Data of Rice Genotypes on Farmer's Field at Upper Swat

SN	Variety/Line	Tillers hill ⁻¹	Plant height (cm)	Paddy yield (t/ha)
1	ILLA BONG	14 B	85 D	4.40 B
2	PR26881-PJ16-4B-78-5-1	10 C	104 B	4.88 A
3	SWATAI 2014	15 A	100 C	5.04 A
4	IRI 384	14 B	82 E	4.56 B
5	GZ 5830-63-1-2	14 B	78 F	4.44 B
6	JP5	14 B	116 A	3.64 C

Table 5: Paddy Yield and Other Data of Rice Genotypes on Farmer's Field at Lower Swat

SN	Variety/Line	Tillers hill ⁻¹	Plant height (cm)	Paddy yield (t/ha)
1	ILLA BONG	15 B	104 C	5.76 C
2	PR 26881-PJ16-4B-78-5-1	10 E	115 B	6.00 BC
3	SWATAI 2014	16 A	114 B	7.68 A
4	IRI 384	14 C	103 C	5.88 BC
5	GZ 5830-63-1-2	12 D	90 D	4.64 D
6	JP5	15 B	140 A	6.16 B

Table 6: Paddy Yield and Other Data of Rice Genotypes on Farmer's Field at Malakand

SN	Variety/Line	Tillers hill ⁻¹	Plant height (cm)	Paddy yield (t/ha)
1	ILLA BONG	15	11B	5.72
2	PR26881-PJ16-4B-78-5-1	14	112B	4.44
3	SWATAI 2014	16	115B	6.52
4	IRI 384	15	103C	6.04
5	GZ 5830-63-1-2	15	92D	5.20
6	JP5	15	139A	5.04

The data presented in Tables 4, 5 and 6 was recorded at three different locations, upper, lower swat and district Malakand respectively. The comparison of the newly developed variety, "Swatai 2014", with the cultivated variety of the area, JP5 and other genotypes indicated significant differences. At both the locations more tillers hill⁻¹ was observed for the variety "Swatai 2014" than all the compared rice germplasm. Plant height of JP5 was higher than "Swatai 2014" but ultimately paddy yield was higher in "Swatai 2014" than JP5. The basic reason for lower yield in JP5 is that, it's more height is prone to lodging; also, extended vegetative growth adversely affects its grain yield as compared to early maturing variety "Swatai 2014". Kanegara and Kargbo (2011) also observed lodging in taller varieties having length 4th and 5th internode equal or more than 15cm.

The newly developed variety "Swatai 2014" was found to be medium in plant height, with more tillering ability, cold tolerant, resistant to lodging, comparatively more tolerant to stem borers, grass hoppers and diseases and at milling the head rice percentage is more as compared to the commercial variety JP5 of the region. The newly developed rice variety "Swatai 2014" produce higher yields at different locations in comparison to the locally grown rice variety JP5. It might be due to interaction of genetic makeup with conducive environmental conditions. The yield increment of new cultivars over locally grown cultivars were observed by Hossain. (2005) and Mondal et al. (2005). Positive impact of genetic variations among different genotypes on rice yield was also reported by Sohail et al. (2009).

CONCLUSION

Owing to vital genetic differences, cultivars can produce higher yield in different crops. Genetic make-up of different rice genotypes in interaction with favorable environmental condition can evolve different rice cultivars "with high yield and better grain quality". On basis of morphological and physiochemical study it is concluded that newly developed rice cultivar "Swatai 2014" will certainly fetch high yield with better grain quality in the upper hilly areas of Khyber Pakhtunkhwa.

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