CARIBBEAN FOOD CROPS SOCIETY

51

Fifty-first Annual Meeting 2015

Paramaribo, Suriname
Volume LI

PROCEEDINGS

OF THE

51ST ANNUAL MEETING

Caribbean Food Crops Society
51ST Annual Meeting
July 19 – July 24, 2015

Royal Ballroom Hotel Torarica,
Paramaribo, Suriname

Edited by
Ranoe S.Mangal-Jhari, Lydia Ori, Abdullah Adil Ansari, and
Wilfredo Colón

Published by the Caribbean Food Crops Society

ISSN 95-07-0410

Copies of this publication may be obtained from:

CFCS Treasurer
Agricultural Experiment Station
Jardín Botánico Sur
1193 Calle Guayacán
San Juan, Puerto Rico 00936-1118

CFCS Website: http://cfcs.eea.uprm.edu/

Proceedings of the Caribbean Food Crops Society. 51:107-113. 2015

HYBRID RICE IN SURINAME: YES OR NO? AN OBSERVATIONAL YIELD TRIAL WITH SIX HYBRID RICE VARIETIES

Jerry R. Tjoe Awie. Anne van Dijk Rijst Onderzoekscentrum Nickerie (SNRI/ADRON), ADRON-weg 45, Nickerie, Suriname. E-mail: jerrytjoeawie@aol.com

Abstract: In December 2009, SNRI/ADRON received from Bayer CropScience six of its hybrid rice varieties SRH10001, SRH10002, SRH10003, SRH10004, SRH10005 and SRH10006, which have been tested with three of ADRON varieties, ADRON-117, ADRON-125 and ADRON-130 in an Observational Yield Trial. The hybrid varieties were sown at a density of 45 kg seed/ha and the ADRON varieties at two densities 45 kg/ha and 150 kg/ha. The experiment was executed in two instalments sown some four weeks apart to see if sowing date would have an effect on the performance of the varieties. Overall, the earlier plantings gave higher yields both for the hybrids and the ADRON varieties. The later sowing date had a more profound effect on the performance of the hybrids with SRH10003 and SRH10004 yielding approximately 2 ton/ha less. The different seeding rates used with the ADRON varieties did not seem to result in big differences in yield, thus suggesting that for the inbred ADRON varieties a lower seeding rate could be applied. While the hybrid varieties gave good yields, traits as phenotypic acceptability, grain dimensions, culm strength and milling quality were not as good as the ADRON varieties.

Keywords: Suriname, hybrid rice, yield, milling quality, *Oryza sativa.*

INTRODUCTION

Rice (*Oryza sativa* L.) has been grown in Suriname for several centuries, but initially, until 1873, there was just dry land rice, grown upcountry. To this day the maroons in upper Suriname grow a large variety of upland rices in a shifting cultivation scheme under dry land conditions. The precise source of these rices remains subject to speculation. Starting in 1873, the immigrants from the Indian subcontinent and Indonesia brought Asian rice varieties and the use of commercial wetland paddies to Suriname (Van Amson, 1987). Suriname has some 60,000 ha of rice land and rice research and breeding started in the early 1940s. Surinamese rice varieties generally have stiff straw, extra long grains, smooth leaves and glumes and short to medium long maturity durations (D. HilleRisLambers, unpublished document). Suriname has a name for its extra long grain, dry cooking rice that has been developed through conventional breeding methods. Suriname's rice industry is strongly world-market oriented, and about half of the harvest goes into export. Production methods in the country are highly mechanized. They have been developed through Government support to companies and to the Foundation for Mechanized Agriculture in Suriname, SML (D. HilleRisLambers, unpublished document). In 1974, Chinese scientists successfully transferred the male sterility gene from wild rice to create the cytoplasmic genetic male-sterile (CMS) line and hybrid combination thus using hybrid vigour in first-generation seeds (or F_1) in rice. Up till then the use of hybrid technology in rice was limited due to the self-pollination character of that crop (Anon., 2004).

Hybrid rice seed production technology is different from that for inbred rice seed production, and is more complex than the seed production for many other hybrid crops (Virmani et al., 2002). Hybrid rice commands about 50% of the total rice area in China because new male sterile cytoplasm sources and inter-subspecies crosses have contributed to the development of super rice breeding in China. However, sustainable improvements of hybrid rice yield potential, grain quality, and tolerance to biotic and abiotic stresses continue to be a great challenge (Cheng et al., 2007). Hybrid rice varieties having the potential to yield 15 to 35% more than the best inbred varieties grown in similar conditions account for approximately 14% of the cultivated rice area in the world. In China alone, 90% of all the hybrid rice of the world is cultivated (Anon., 2008). Sartaj and Abeysekera (n.d.) conclude that the major challenge in indica hybrid rice breeding is to ensure that heterotic rice hybrids possess a grain quality that is at least comparable if not superior to inbred check varieties grown by farmers. Thus far, there have been no efforts at producing hybrid rice varieties in Suriname and it is unlikely that hybrid rice breeding activities will be carried out in the near future.

MATERIALS AND METHODS

An Observational Yield Trial (OYT) with six hybrid and three inbred varieties was carried out at the Anne van Dijk Rijst Onderzoekscentrum Nickerie (SNRI/ADRON) during the 2009-2010 dry season crop. Twelve treatments were used (table 1) with treatments T1-T6 for the hybrid varieties provided by Bayer CropScience at a seeding rate of 45 kg/ha, T7-T9 being ADRON's varieties also at a seeding rate of 45 kg/ha and T10-T12 comprised of ADRON's varieties at the seeding rate normally used by Surinamese farmers of 150 kg/ha.

Table 1. Treatments used in the OYT

Treatment	Variety Code	Plot area (m^2)	Seeding Rate (kg/ha)	Treatment	Variety Code	Plot area (m^2)	Seeding Rate (kg/ha)
T1	SRH10001	200	45	T7	ADRON-125	200	45
T2	SRH10002	200	45	T8	ADRON-117	200	45
T3	SRH10003	200	45	T9	ADRON-130	200	45
T4	SRH10004	200	45	T10	ADRON-125	200	150
T5	SRH10005	200	45	T11	ADRON-117	200	150
T6	SRH10006	200	45	T12	ADRON-130	200	150

The 4th edition of the Standard Evaluation System for rice (SES) was used to record the different traits (Anon., 1996). Agronomic traits as Heading (Hdg), Culm strength (Cs), Lodging incidence (Lg), phenotypic acceptability (PAcp) and Grain yield (Yld) were recorded. To assess the grain quality traits such as chalkiness (Clk), Grain length (GrL), Grain width (GrW), Brown rice length (Len), Brown rice shape (BrS) and 100-grain weight (GW) were determined. Also the Head rice yield (HRY) and the crack percentage have been recorded.

The entries were sown in plots of 40*5 m^2. Before sowing, the seeds were soaked in water for 24 hours and subsequently kept moist for 24 hours. The experiment was installed on two dates in order to see if sowing date had an influence on the performance of the varieties. The first instalment was sown on 24 December 2009 and harvested in April 2010 while the second was sown on 27 January 2010 and harvested in May 2010. The latter sowing date is considered less favourable because normally the sowing period extends from mid November to beginning of January. Urea was applied in three splits of 85, 85 and 100 kg each at 20, 35 and 50 days after sowing. Pests were treated as needed. The treatment was uniform for all plots. Water management was optimal. In short, the growing conditions were very favourable.

RESULTS AND DISCUSSION

Weather data

In table 2 monthly values for average temperature, total precipitation and total bright sunshine hours are presented.

Table 2. Weather data

Month	Average temperature (°C)	Total precipitation (mm)	Total bright sunshine hours
December 2009	26.7	21.2	304
January 2010	26.0	78.6	299
February 2010	26.0	47.8	275
March 2010	26.4	20.2	309
April 2010	26.6	185.2	291
May 2010	26.6	210.4	296

Agronomic traits

The agronomic traits for the first instalment are presented in table 3.

Table 3. Agronomic traits for the first instalment

Treatment	Hybrid Code	Hdg	Cs	Lg	PAcp	Yld (kg/ha)
T1	SRH10001	76	9	100	7	6,884
T2	SRH10002	73	9	100	7	7,324
T3	SRH10003	78	9	100	7	7,904
T4	SRH10004	73	9	100	7	8,118
T5	SRH10005	78	9	100	7	8,174
T6	SRH10006	64	9	100	7	8,202
T7	ADRON-125	66	1	0	3	6,979
T8	ADRON-117	75	1	0	3	6,847
T9	ADRON-130	66	1	0	3	6,729
T10	ADRON-125	61	1	0	3	6,852
T11	ADRON-117	71	1	0	3	7,128
T12	ADRON-130	61	1	0	3	7,098

It shows that the hybrids had very poor culm strengths, which resulted in 100% lodging incidence (illustrated in picture 1). Perhaps the applied amount of fertilizers was too high which resulted in a vigorous vegetative growth. SRH10006 recorded the highest yield for the hybrids, while ADRON-117 did that for the inbreds. On average the highest yielding hybrid produced approximately 1100-1500 kilograms more grains per ha than the inbreds. The two seeding rates used with the inbreds did not seem to translate in a big difference in grain yield. On average the higher seeding rate resulted for ADRON-117 and ADRON-130 in a yield advantage of 300–400 kilograms per ha. By contrast, ADRON-125 recorded a higher yield for the lower seeding rate. It also seemed that the varieties seeded at a lower seeding rate flowered a few days later than the ones sown at a higher seeding rate. It could be that the higher inter-plant competition which is likely to occur more intensively at a higher seeding rate resulted in earlier flowering.

Picture 1. SRH10006 had 100% lodging while ADRON-125 stood firm

The agronomic traits for the second instalment are presented in table 4.

Table 4. Agronomic traits for the second instalment

Treat.	Variety Code	Hdg	Cs	Lg	PAcp	Yld	yield difference between 1st -2nd instalment (kg/ha)
T1	SRH10001	76	9	100	7	6,209	675
T2	SRH10002	74	9	100	7	6,995	328
T3	SRH10003	79	9	100	7	6,044	1,861
T4	SRH10004	76	9	100	7	6,279	1,839
T5	SRH10005	79	9	100	7	6,706	1,467
T6	SRH10006	69	9	100	7	6,730	1,473
T7	ADRON-125	69	1	0	3	5,611	1,368
T8	ADRON-117	76	1	0	3	6,574	273
T9	ADRON-130	69	1	0	3	5,930	799
T10	ADRON-125	60	1	0	3	5,648	1,203
T11	ADRON-117	70	1	0	3	7,599	- 471
T12	ADRON-130	60	1	0	3	6,180	918

The yield results for the second instalment followed a very different trend. ADRON-117 had the highest yield producing approximately 500 kilograms more grains per hectare than the highest yielding hybrid. In some instances the yield difference between the first and second instalment was dramatic, e.g. SRH10003 and SRH10004 producing in the second instalment almost two tons less per hectare than in the first instalment. This clearly is an indication that sowing date plays a very important role in the performance of the hybrids, be it more pronounced for some than others. The entries in the first instalment flowered late February-beginning March. From table 2 we can deduce that the precipitation in that period was much lower than April when the entries in the second instalment flowered. It is known that rainfall during flowering often results in lower yields. Looking at the inbreds, we noticed that ADRON-125 also appeared to have suffered from the late sowing date. It looked like only ADRON-117 benefitted from a later sowing date. The difference in heading dates for the two sowing rates appeared to have increased, for ADRON-125 and ADRON-130 even exceeding one week.

Grain quality

The grain quality traits for the first instalment are presented in table 5 while those for the second instalment are given in table 6.

Table 5. Grain quality traits for the first instalment

Treat.	Variety Code	GrL	GrW	GW	Len	BrS	100% chalk	white belly (%)	white core (%)	white back (%)	crack (%)	HRY (%)
T1	SRH10001	8.6	2.2	2.45	6.4	1	8.4	5.2	8.8	0.0	40	44.5
T2	SRH10002	9.2	2.1	2.49	7.1	1	3.2	0.4	11.6	0.0	36	44.7
T3	SRH10003	8.9	2.3	2.80	7.3	1	0.8	4.8	4.4	0.0	54	26.8
T4	SRH10004	9.3	2.1	2.66	7.2	1	8.4	11.2	8.0	0.4	5	41.3
T5	SRH10005	9.5	2.1	2.70	7.1	1	2.8	1.6	4.0	0.4	64	26.3
T6	SRH10006	9.5	2.1	2.68	7.3	1	1.6	0.4	12.8	0.0	4	55.6
T7	ADRON-125	10.5	2.3	3.10	8.1	1	0.0	0.0	1.2	0.0	6	54.0
T8	ADRON-117	10.4	2.1	2.58	8.2	1	4.4	0.0	3.2	2.0	8	52.7
T9	ADRON-130	10.2	2.3	2.89	8.0	1	0.8	2.8	4.0	0.4	4	59.3
T10	ADRON-125	10.5	2.5	3.21	8.3	1	0.8	0.1	3.6	0.0	2	54.1
T11	ADRON-117	10.8	2.1	2.56	8.0	1	2.8	0.2	5.6	0.4	8	52.3
T12	ADRON-130	10.1	2.4	2.96	7.9	1	1.6	4.4	6.8	0.1	0	57.2

Table 6. Grain quality traits for the second instalment

Treat.	Variety Code	GrL	GrW	GW	Len	BrS	100% chalk (%)	white belly (%)	white core (%)	white back (%)	crack (%)	HRY (%)
T1	SRH10001	8.6	2.3	2.69	6.4	1	10.4	14.0	6.4	0.0	17	41.6
T2	SRH10002	9.8	2.3	2.78	7.2	1	10.8	9.2	6.4	0.0	9	50.0
T3	SRH10003	9.6	2.2	3.06	7.3	1	2.6	1.2	2.8	0.0	29	33.0
T4	SRH10004	9.4	2.2	2.79	7.1	1	2.8	4.0	13.6	0.0	8	39.8
T5	SRH10005	9.4	2.2	2.77	7.2	1	0.8	9.6	9.6	0.0	41	36.7
T6	SRH10006	9.4	2.0	2.79	7.5	1	9.6	7.2	13.6	0.0	4	47.8

T7	ADRON-125	10.4	2.6	3.07	8.3	1	1.6	0.8	10.0	0.0	3	52.9
T8	ADRON-117	10.5	2.1	2.77	8.3	1	6.8	0.4	4.4	2.4	0	46.1
T9	ADRON-130	10.1	2.5	3.04	8.1	1	2.8	2.8	10.0	0.0	5	55.9
T10	ADRON-125	10.6	2.5	3.18	8.4	1	0.4	0.4	9.6	0.0	4	53.0
T11	ADRON-117	10.9	2.1	2.78	8.2	1	0.4	0.4	13.2	0.0	0	46.6
T12	ADRON-130	10.5	2.9	2.48	7.9	1	3.2	2.0	10.4	0.4	0	51.4

- grain dimensions: if the grain dimensions are considered it can be deduced that the hybrids fall in the long grain category. Suriname is known for its extra long grain rice and the mills have been adapted to processing that kind of rice. Shorter grains are also not preferred by the farmers.
- chalkiness: the hybrids seemed to have a higher incidence of chalkiness. Chalkiness is an important quality factor for the Surinamese rice since a great deal of our rice production is exported and consumers are not keen on buying rice with a high amount of chalky grains. In the rice breeding in general chalkiness is becoming a more pressing issue due to the changes in the climate of which higher temperatures affect the rice grain quality around the world. It is widely believed that higher temperatures promote the incidence of chalkiness in the rice grain.
- crack: the hybrids appeared to be more prone to the occurrence of crack in the grains which often translates in a lower HRY. This can cause a problem on most markets since these markets often require whole or unbroken grains, therefore cracked grains can reduce payments received by the grower and the miller.
- HRY: Head rice yield is a very important factor and can be defined as the weight percentage of rough rice that remains as whole rice (three-fourths kernel or greater) after complete milling. Since whole rice catches a higher price on the market, the miller will try to obtain as high a HRY as possible. The hybrids seemed to underperform with no distinction between the two installments whereas the ADRON varieties in general had a higher HRY when planted earlier in the season, but overall still scored better HRYs than the hybrids.
- Appearance: the physical appearance of the hybrids seemed a little dull as compared to the ADRON varieties. In picture 2, SRH10001 and ADRON-125 are compared illustrating the somewhat duller appearance of SRH10001.

Picture 2. SRH10001 has a duller appearance than ADRON-125

CONCLUSION

The fact that all the hybrids lodged makes them unsuitable for mechanized harvesting with a combine harvester, which is common practice in Suriname. Suriname is known for its extra long grain and all the hybrids fall in the long grain category. Farmers will not be inclined to plant those varieties and the millers will have to adjust their equipment to process the shorter grains. Head rice yield and chalkiness are important factors in the Surinamese rice sector and the hybrids seem to have a disadvantage compared to the ADRON varieties. Because more than half of our rice production is exported it will be difficult to introduce hybrids to the farmers unless these hybrids are superior in agronomical and grain quality aspects compared to the varieties, which are being bred in the inbred programme. The majority of the farmers use farmer saved seed and do not have the tradition of purchasing seed for every crop. With hybrids they will have to change their practice.

REFERENCES

Amson van, F.W., 1987. A review of agricultural crops in Suriname. Part 1. Rice (*Oryza sativa*, L.). Landbouwbank N.V.

Anonymus, 1996. Standard Evaluation System for rice. 4th edition. INGER Genetic Resources Center, International Rice Research Institute.

Anonymus, 2004. Hybrid rice for food security. Food and Agriculture Organization of the United Nations.

Anonymus, 2008. Tomorrow's Rice. Bayer CropScience.

Cheng, Shi-Hua, Jie-Yun Zhuang, Ye-Yang Fan, Jing-Hong Du and Li-Yong Cao, 2007. Progress in Research and Development on Hybrid Rice: A Super-domesticate in China. In: Annals of Botany 100: 959–966, 2007.

Sartaj, I.Z. and S.W. Abeysekera, n.d. Present status of hybrid rice grain quality in Sri Lanka. Rice Research and Development Institute, Batalagoda.

Virmani, S.S, C.X. Mao, R.S. Toledo, M. Hossain and A. Janaiah, 2002. Hybrid rice seed production technology and its impact on seed industries and rural employment opportunities in Asia. International Rice Research Institute.

ACKNOWLEDGEMENTS

The author wishes to acknowledge Mr. Bhan Soechit from Nouvelle Rizerie Du Nord who initiated the contact with Bayer CropScience and Dr. Ed Roumen, Rice Breeding & Trait Development Manager from Bayer CropScience who provided the seed material for the trial.