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Biochemical Properties of Medicinal Rice Njavara (Oryza Sativa L.) as Influenced by Different Management Systems

KEYWORDS: Njavara rice, management systems, nutrient sources, biochemical components

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ABSTRACT *Studies were initiated for two consecutive years to find out the effect of nutrients sources under different management systems on biochemical properties of medicinal rice Njavara grain at Cropping Systems Research Centre, Karamana, Thiruvananthapuram, Kerala. The experiment was laid out in split plot design with four replications. The treatments consisted of four management systems viz., System of Rice Intensification SRI (M1), Integrated Crop Establishment Method (ICM) (M2), Package of practices (PoP) (M3) of KAU (Kerala Agricultural University) and Farmers' practice (M4) in main plots. Nutrient sources viz., organic sources (S1), integrated nutrient sources (S2) and inorganic sources (S3) were the sub plot treatments.*

Introduction

Njavara is a unique land race of rice valued for its medicinal properties. It issued in treating circulatory, respiratory, and digestive ailments in ayurvedic medicine. The landrace's medicinal property appears to be attributable to the sulfur containing amino acid, methionine, which is involved in the metabolic pathway of the biosynthesis of thiamine (VitaminB 1), the deficiency of which causes beriberi. Black glumed Njavara is richer than pulses in free amino acid content, entitling it to be called a proteinaceous cereal. Cagampang *et al*. (1982) inferred that the concentration of free aminoacids in the developing grain of high protein lines was higher than that in the grain of lines low in protein. During the embryo differentiation stage, free amino acids in rice were dominated by serine, alanine, aspartate and glutamate, whereas, in the maturation stage serine, alanine, arginine and lysine were the main components constituting free amino acid content (Zhang and Tang, 1986). Black glumed Njavara contained the amino acids DL-2-amino-n-butyric acid and DL-iso-leucine while, golden yellow glumed Njavara contained L-Histidine monochloride, L-ornithine monochloride and DL-iso-leucine. Black-glumed and yellow glumed Njavara had an inverse relationship between yield and quality (Menon and Potty, 1999). The free amino acid content in Njavara grains ranged from 0.090 mg g^{-1} to 0.190 mg g^{-1}. Free amino acids coupled with soluble carbohydrates may be contributing to the production of active protein and secondary metabolites (Reddy, 2000). Starch is a mixture of amylose and amylopectin. Juliano (1998) reported starch as the major constituent of rice and as such, starch and protein accounted for 98.5 percent of the constituents of milled rice. Most of the Njavara genotypes tested had intermediate amylose content (18.88-23.27%). So they had consumer preference (Kumar, 2006).

Materials and methods

The field experiment was conducted for two consecutive years *i.e.*, summer/third crop/puncha season of 2007 and 2008 at Cropping Systems Research Centre, Karamana, Thiruvananthapuram, Kerala. The soil was acidic in reaction, high in organic carbon content, medium in available nitrogen, medium in available phosphorus and medium in available potassium status. The experiments was laid out in a split plot design by keeping the management systems in main plots *viz.* SRI (System of Rice Intensification) (M_1), ICM (Integrated Crop Establishment Method) (M_2), PoP (Package of Practices) (M_3) recommendation of Kerala Agricultural University) as well as the Crop Management Practices of Farmers (M_4). Nutrient sources viz., organic sources (S1), integrated nutrient sources (S2) and inorganic sources (S3) were allotted to sub plots. All the treatments were replicated thrice. Black glumed type of Njavara was selected as the test crop. Eight, twelve and eighteen days old seedlings as per treatments were transplanted at the rate of 1, 2 and 3 seedlings per hill at 20x20 cm, 20x20 cm and 15x10 cm spacings in SRI, ICM and PoP treatments respectively. In Farmers' practice treatment pre germinated seeds were broadcasted on the same day. Nutrient management recommendation of Package of Practices: Crops (2007) of Kerala Agricultural University was adopted i.e 5t FYM (Farmyard manure) + 40:20:20 kg NPK (Nitrogen, Phosphorus and Potassium) per ha. Full FYM + 2/3 N + Full P + ½ K were to be applied as basal. 1/3 N + ½ K were to be applied at panicle initiation. In the organic treatments 40:20:20 kg NPK ha^{-1}were supplied through FYM, rock phosphate and wood ash. In integrated nutrient management treatments 40: 20: 20 kg NPK ha^{-1} were supplied through urea, rock phosphate and muriate of potash along with 5t FYM. In the inorganic treatments NPK contribution by 5t FYM was calculated and they were supplied through urea, rock phosphate and muriate of potash. NPK was also applied at the rate of 40:20:20 kg ha^{-1} respectively.

Results and Discussion

Effect of management systems on biochemical properties of Njavara grain

Among the biochemical properties of grain, total free amino acid content in both the years and amylopectin content in 2007 were significantly influenced by management systems whereas phenols, starch, crude protein and amylose content remained unaffected. System of Rice Intensification (SRI) recorded highest free amino acid content (32.85/31.54 mg 100 g^{-1} in 2007/2008) and it was on par with ICM (32.16/30.10 mg 100g^{-1} in 2007/2008) and both were significantly higher than PoP (30.02/27.77 mg 100 g^{-1} in 2007/2008) and Farmers' practice (28.24/25.59 mg 100g^{-1} in 2007/2008) which in turn differed significantly from each other (Table 20). Total free amino acid content in SRI was 19/23% higher in 2007/2008 than that in Farmers' practice, 9/14% higher in 2007/2008 than that on PoP and 2/5% higher in 2007/2008 than that in ICM. The result is in conformity with the finding of RenQuan (2008) who reported that cultivation of hybrid rice under control of damp irrigation increased amino acid content of grain than submerged irrigation regimes. In 2007 highest amylopectin was recorded in ICM (30.53%) which was significantly higher than the other three management systems (Table 22). ICM was followed by Farmers' practice (30.47%) which was on par with PoP (29.77%) which in turn was on par with SRI (29.45%).

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Effect of nutrient sources on biochemical of grain

Nutrient sources significantly influenced the biochemical properties like starch (52.07% in 2008), crude protein (7.98% in 2007 and 8.23% in 2008) and amylopectin (30.62% in 2007 and 29.62% in 2008) whereas total free amino acids, phenols and amylose content of grain remained unaffected. The highest starch, amylopectin and crude protein content of grain were realized in organic source and this was significantly higher than that recorded in integrated and inorganic nutrient sources. Saha *et al*, (2007) and Ram *et al*, (2011) suggested that organic nutrient sources can perform comparatively well as regards chemical and physico-chemical properties than inorganic fertilization.

Conclusion

The biochemical constituents of organically and inorganically produced Njavara grains did not vary except in crude protein, starch and amylopectin content. Organically produced Njavara grains were significantly superior to inorganically produced ones with respect to crude protein, starch and amylopectin content.

Table 1. Effect of management systems and nutrient sources on total free amino acid, phenols and starch content of grain

	Total free amino acids (mg $100g^{-1}$)		Phenols (mg $100g^{-1}$)		Starch (%)	
Treatments	2007	2008	2007	2008	2007	2008
Management systems						
M_1 (SRI)	32.85	31.54	9.47	9.65	51.20	50.68
M_2 (ICM)	32.16	30.10	9.20	9.55	51.79	51.11
M_3 (PoP)	30.02	27.77	9.33	9.64	51.70	52.22
M_4 (F.P)	28.24	25.59	9.22	9.46	52.00	51.06
SEd	0.334	0.767	0.198	0.113	0.546	0.537
CD (0.05)	0.756	1.736	NS	NS	NS	NS
Nutrient sources						
S_1 (Organic)	31.03	28.86	9.38	9.55	52.14	52.07
S_2(Integrated)	30.65	28.59	9.27	9.56	51.70	50.95
S_3 (Inorganic)	30.78	28.81	9.26	9.59	51.18	50.77
SEd	0.324	0.730	0.151	0.113	0.549	0.548
CD (0.05)	0.324	0.730	NS	NS	1.130	1.131

Table 2. Effect of management systems and nutrient sources on crude protein, amylose and amylopectin content of grain

	Crude protein (%)		Amylose (%)		Amylopectin (%)	
Treatments	2007	2008	2007	2008	2007	2008
Management systems						
M_1 (SRI)	7.21	7.33	21.74	22.44	29.45	28.24
M_2 (ICM)	7.27	7.52	21.26	22.51	30.53	28.60
M_3 (PoP)	7.05	7.27	21.65	22.62	29.77	29.60
M_4 (F.P)	7.22	7.39	21.53	22.53	30.47	28.52
SEd	0.078	0.079	0.223	0.346	0.318	0.781
CD (0.05)	7.94	NS	NS	NS	0.719	NS
Nutrient sources						
S_1 (Organic)	7.98	8.23	21.52	22.45	30.62	29.62
S_2(Integrated)	6.00	6.17	21.81	22.74	29.89	28.21
S_3 (Inorganic)	7.58	7.74	21.31	22.39	29.65	28.39
SEd	0.077	0.079	0.228	0.223	0.320	0.498
CD (0.05)	5.94	0.162	NS	NS	0.661	1.028

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