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Comparative Agrobotanical Characteristics of an Enhanced Rice Cultivar DTPMFe+ and its Parents (AWGU-DWARF-W and IJ86-W) *Oryza sativa* Linn.

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Abstract: DTPMFe+ along with its parent AWGU-DWARF-W and IJ86-W were evaluated under a planting spacing of 15×30 cm for morphological and yield contributing parameters. DTPMFe+ showed a selection gain over it parents in plant height (Dwarf), tillering (heavy), maturity date (early), panicle length (long), number of spikelets per panicle (dense), caryopsis size (long and slender), erect plant form, erect flag leaf and leaf below flag leaf, awnlessness, synchronization of booting, all tillers bearing panicles. DPTMFe+ produced a better pattern of protein distribution in the transverse section of the grain than the parents; with fewer protein bodies in the aleurone layer which will preserves its protein during grain milling.

Key words: Comparative, agrobotanical, DTPMFe+, AWGU-DWARF-W, IJ86-W, protein

INTRODUCTION

The history of rice varietal improvement in Nigeria is as old as rice cultivation in the country, like in all part of the world. Crop varietal selection was started by the farmers, hence farmers were regarded as the pioneer plant breeders. Plant breeding employ the basic principles of genetics which still play a major role in the improvement of rice varieties, though molecular biotechnology is much in vogue.

Hawkes (1990) and Olorode (2004) felt strongly that germplasm enhancement i.e., the minimal improvement of raw germplasm should be routinely done to make them more attractive to breeders and general users. This minimal improvement may involve hybridization to highly bred cultivars, backcrossing and selection giving rise to enhanced lines which breeders might find more attractive.

The evaluation of improved rice germplasm continues to play a major role in varietal improvement programmes (Abifarin, 1991; Septiningsil *et al*., 2003; Lee *et al*., 2005). The West Africa Rice Development Agency (WARDA) has carried out extensive characterization and evaluation work in West Africa of many introduced rice cultivars for various adaptations to local conditions like diseases, drought, salinity and iron toxicity. This effort has lead to the identification of many genetic resources from local and exotic germplasm materials.

Ten single plant selections were made at the F2 of a cross between AWGU-DWARF-W, a dwarf, heavy tillering and late maturity cultivar from AGWU in Abia State, Nigeria and IJ86-W, a tall, medium maturing, low tillering selection collected from Ijesa-Isu in Ekiti State, Nigeria. The selections were based on dwarfness, dense panicle, heavy tillering, long grains, erect plat type, early to medium maturing date (not greater than 120 days) full exertion and awnlessness. These plants were grown in the field and selfed for six generations until a DTPMFe+ selection was made.

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This present study w as therefore undertaken to investigate the superiority of the potentials of the hybrid (DTPMFe+) over its parents and its usefulness to increase the yield of the peasant rice farmer.

MATERIALS AND METHODS

DTPMFe+, AWGU-DWARF-W and IJ86-W were grown in the field during the month of May 2002 at the Reforestation Nursery Site of Department of Botany, Obafemi Awolowo University, Ile-Ife. Each of the cultivars was represented by a single row of 10 plants with 15 cm between plants and 30 cm between rows in a randomized complete block design with four replications. Three weeks old seedlings were transplanted at rate of one seedling per hill. No fertilizer application was carried out, standard cultural practices were carried out till the crops were matured. At maturity five plants were randomly selected from middle rows for each of the cultivars.

The following parameters were evaluated for DTPMFe+, AWGU-DWARF-W and IJ86-W.

Leaf-(Flag and leaf below it) shape, tiptype, pubescence, length, blade colour, sheath colour. Culm-number, height and form. Panicle-length, type number of secondary branches, exertion and total number of spikelets. Grain -length, width and awn. Pigmentation -awn, apiculus, stigma, lemma and palea, caryopsis colour. Maturity date-this was recorded for individual plants. All the above parameters were measured according to descriptors for Rice, *Oryza sativa* L. (Anonymous, 1980).

The selection gain for height, tillering, maturity date, length of panicle, number of spikelets, caryopsis size were evaluated using the formulae:

$$\text{Selection gain} = \frac{\text{Value of DTPMFe+} - \text{Value of Midparents}}{\text{Value of Midparents}} \times 100$$

Pattern of protein distribution in the Rice grain were studied using the protein specific bromophenol blue stained microscopic screening method standardized by Kaul *et al.* (1969). The preparations were scored and classified according to the procedure described by Vilawan and Siddiq (1973). The major protein distribution patterns were documented in photomicrographs taken in bright field on Leitz Dialux Research Microscope.

RESULTS

The erect plant form in DTPMFe+ is superior to the erect form in IJ86-W, heavy tillering of 28 tillers is higher than heavy tillering of 23 in AWGU-DWARF-W, the high number of secondary branches of 41.60±28 was inherited from AWGU-DWARF-W. The broad leaf shape was inherited from IJ86-W. It also shows that DTPMFe+ combines both parental characters of perennial habit, compact panicle, awnlessness straw, ripened hull, white stigma, green leaf, white apiculus, long and broad leaf (Table 1).

DTPMFe+ showed a considerable selection gain over both parents reduction in plant height (-44% dwarf), heavy tillering (44.60%), early maturity (-32.12%), panicle length (13.41%), number of spikelets (144.1%), increase caryopsis length (21.95%) and a reduction in spikelet breadth (15.42%) (Table 2). Figure 1 shows comparative pattern of protein distribution in transverse section through the caryopsis of DTPMFe+ and its parents. The pattern of protein distribution diffusing into the endosperm observed in DTPMFe+ was similar to the patterns observed in the original parents IJ86-W and AWGU-DWARF-W. The difference is that DTPMFe+ has fewer protein bodies in the aleurone layer when compared to both parents which have more of their protein in the aleurone layer and less diffusing into the endosperm.

Table 1: Comparative agrobotanical characteristics of DTPMFe+ and its parents: IJ86-W and AWGU-DWARF-W

	Form	Habit	Panicle Type	Height (cm)	Tiller No.	Maturity (days)	No. of secondary branches	Panicle length (cm)	Cultivar Awn
DTPMFe+	Erect	Perennial	Compact	56.10±1.75	Heavy, 28	92	41.60±1.20	29.80±0.79	-
IJ86-W	Erect	Annual	Compact	143.34±5.16	Low, 08	121	28.20±2.40	28.14±1.24	-
AWGU-DWARF-W	Open	Perennial	Compact	54.11±1.72	Heavy, 23	154	40.30±2.21	24.50±0.93	Partial

	Pigmentation				Leaf		Grain	
Cultivar	Ripen hull	Stigma	Leaf	Awn/ apiculus	Leaf length (cm)	Breadth (cm)	Grain length (mm)	Grain breadth
DTPMFe+	Straw	White	Green	White	57.63±1.02	2.21±0.03	7.50±0.11	2.30±0.01
IJ86-W	Straw	White	Green	White	65.85±2.60	2.05±0.03	6.10±0.12	2.50±0.02
AWGU-DWARF-W	Straw	White	Green	White	42.17±1.12	1.85±0.05	6.21±0.06	2.30±0.01

Table 2: Comparative selection gain of yield parameters of DTPMFe+ and its parents IJ86-W and AWGU-DWARF-W

Cultivar	Height (cm)	Tillering	Maturity (day)	Panicle length (cm)	No. of spikelets	Caryopsis length (mm)	Caryopsis breadth (mm)
DTPMFe+	56.10±1.75	Heavy, 28	93	29.85±1.24	410	7.50	2.03
IJ86-W	143.34±5.6	Low, 08	120	28.14±1.24	180	6.10	2.50
AWGU-DWARF-W	54.11±1.72	Heavy, 23	154	24.50±0.93	160	6.20	2.30
Selection grain	-44.00%	44.6%	-32.12%	13.41%	144.1%	21.95%	15.42%

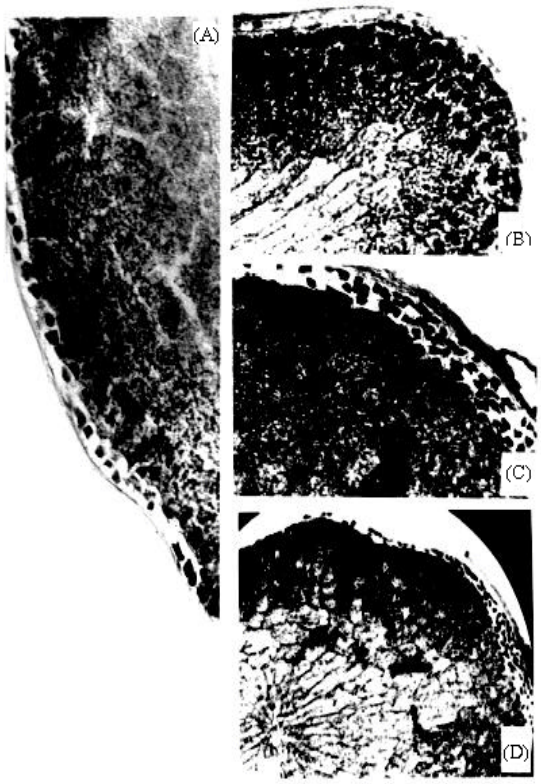

Fig. 1: Pattern of protein distribution in transverse section of DTPMFe+, AWGU-DWARF-W and IJ86-W grain. (A) DTPMFe+, (b-d) AWGU-DWARF-W and IH86-W (B = Front, C = Aleurone at × 40, D = Aleurone at scanning)

DISCUSSION

The combination of many valuable agrobotanical characteristics in DTPMFe+ is as a result of the richness of the parents in genetic variability. This shows the richness of our local rice germplasm in genetic variability and the urgent need for their exploitation in rice improvement programme. According to Faluyi and Nwokeocha (1993) the strength of peasant rice germplasm is it variability which is owed to lack of conscious selection by man.

The considerable selection gains in plant height, tillering, maturity date, panicle length, number of spikelets per panicle, caryopsis length/breadth showed the improvement of DTPMFe+ over its parents. The incorporation of these attributes made DTPMFe+ to fall into the second category of use of germplasm for breeding proposed by Hawkes (1990) i.e., the crossing of landrace and primitive crops primarily to enrich the gene pool of the crop. This made DTPMFe+ fall into the category of enhanced rice germplasm and allowed it to be useable for all attribute for which it had potentials.

According to Faluyi and Nwokeocha (1993) no conscious selection had been carried out by local rice farmers for better plant types, yield, grain quality and other agronomic traits which has contributed to their loss. The late emergence of panicle towards the end of milk stage is of importance in preventing birds from feeding on panicle during this stage; synchronization of all tillers during booting allow panicle harvest at the same time and all tillers bearing panicles has the ability to increase grain yield.

The pattern of protein bodies observed in transverse section of DTPMFe+ grain indicates that it is the most ideal as described by Vilawan and Siddiq (1973).

About 29% of the total protein content in rice grains is usually lost during milling and polishing due to the concentration of protein in the peripheral aleurone and subaleurone layers (Grist, 1959; Annie *et al*., 1992).

The protein distribution pattern in the caryopsis of DTPMFe+ indicate that not much loss will take place during milling. If the pericarp and aleurone are lost, the substantial amount of the protein is embedded in the layer of large protein bodies and the massive tiny bodies which infiltrates it and ramify into the core. DTPMFe+ is therefore a highly proteinous rice variety which will keep much of its protein quantity after milling.

CONCLUSION

Production of DTPMFe+ would add to the choice of planting materials available to peasant farmers making them to have access to more germplasm containing novel variation than is currently available to them in form of landraces. This would go a long way in improving the yield of their crops making them to progress beyond their subsistence level.

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