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RESEARCH PAPER

Effect of accelerated ageing on storability of coloured maize inbreds

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Abstract : The seeds of maize inbreds were visually colour graded into orange, light orange, yellow, light yellow, purple and white and physiological parameters were evaluated to predict their storability through accelerated ageing at 40 ± 1° C and 100 % RH for 2,4 and 6 days. Antioxidant property was evaluated in the seed by the 2, 2-diphenyl-1-picrylhydrazyl (DPPH) free radical scavenging activity assay. The results indicated that the yellow coloured UMI 176 inbreds followed by purple coloured CAU M39 inbred were superior to other coloured inbreds for the germination and vigour parameters.

Key Words : Colour variation, Physiological parameters, 2, 2-diphenyl-1-picrylhydrazyl radical scavenging activity

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INTRODUCTION

Corn (*Zea mays* L.) is a globally important cereal crop and plays a significant role in human and livestock nutrition. Colours are one of the earliest characteristic features associated with genetic studies, since Mendel. Although pigmentation in seeds has been extensively studied in various crops (Lepiniec *et al.*, 2006). However, natural products that cause colors are currently attracting attention because of their antioxidant properties (Dixon and Sumner, 2003). In maize demand for coloured kernels is increasing for making specialty foods. Srimathi and Malarkodi (2002) traced out influence of seed coat colour polymorphism on its seed quality and storability in rice bean. Anuradha *et al.* (2009) also revealed that colour sorting of Bengalgram is necessary for superiority in seed quality parameters. The fundamental cause(s) for genetic differences in seed longevity among various species of single crop is still exorable. In accelerating ageing test, the seeds were incubated for a short period (a few days) under high humidity and temperature as developed by Delouche and Baskin (1973) is used for predicting the storability of seed. Santipracha *et al.* (1997) revealed that the response to the accelerated aging test is different among the inbreds. Hence, studies were initiated by evaluating the six inbred lines of maize with kernel colour for their seed qualty and antioxidant property through accelerated ageing.

MATERIAL AND METHODS

The study was initiated in the Department of Seed Science and Technology and CPMB Tamil Nadu Agricultural University, Coimbatore with six inbreds of various kernel colour with the following genotypic variation (Table 1).

Accelerated aging:

The seeds were accelerately aged in dublicate for 2, 4 and 6 days at 40 ± 1° C and 100 % RH in a desiccators with frequent stirring as per the procedure adopted by Delouche and Baskin (1973). The aged seeds were shade dried for 48 hrs and evaluated for the biochemical changes and antioxidant

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Table A : List of inbrds and their kernel colour variation		
Inbred (Name)	Source of germplasm	Kernel colour
UMI 285	TNAU[1]	Orange
UMI 395	TNAU[1]	White
UMI 1200	TNAU[1]	Light orange
CAU M39	CAU[2], Manipur (Temperate)	Purple
UMI 176	TNAU[1]	Yellow
HP467-15	CIMMYT[3] (Temperate line)	Yellow

Key: [1]Tamil Nadu Agricultural University; [2]Central Agricultural University; and [3]CYMMIT, International Maize and Wheat Improvement Centre

property along with fresh seeds.

Seed and seedling quality characters:

For seedling characters, the germination test was conducted using three replications of 100 seeds from each sample in rolled towel papers as per procedure described by ISTA (1999). Vigour index was determined by Abdul-baki and Anderson (1973). The seedlings used for recording were dried in an oven at 103^0 C for 12 hours. Measurement of dried samples was recorded on an electronic balance and expressed in g^{-10} seedlings.

Total antioxidant activity (DPPH radical scavenging method):

For the 1, 1-diphenyl-2-picrylhydrazyl (DPPH) test the maize seeds extract was prepared by mixing 0.3 g of whole grain flour with 10 mL of 70% (v/v) acetone. After continuous shaking for 30 min at room temperature, the solution was centrifuged for 20 min at 20000g. The obtained supernatant was used for DPPH radical scavenging activity according to modified Abe *et al.* (1998) assay. An aliquot of extract (0.1 ml) was mixed with ethanolic DPPH solution (0.5 mM, 0.25 ml) and acetate buffer (100 mM, pH 5.5, 0.5 ml). After standing for 30 min in dark, the absorbance was measured at 517 nm against a blank containing absolute ethanol instead of a sample aliquot. The results are expressed as IC value that represents the amount of flour (in mg DW) providing 50% inhibition of DPPH radicals. All the assays were done in duplicate, from two separate extractions.

Statistical analysis:

The data collected from various experiments were analysed statistically adopting the procedure described by Panse and Sukhatme (1985). AGRES package was used for finding critical differences (CD) values.

RESULTS AND DISCUSSION

Ageing, the deterioration of seed is highly influenced by the genetic factors (Varghese and Rai, 2005). Accelerated ageing is most commonly employed to evaluate seed vigour

Table 1 : Germination %, vigour index and dry matter production of fresh and acceleratedly aged seeds

Inbreds	Germination %				Mean	Vigour index				Mean	Dry matter				Mean
	Ageing period					Ageing period					Ageing period				
	0	2	4	6		0	2	4	6		0	2	4	6	
UMI 285	96	88	76	33	73	2944	2515	2141	654	2063	0.551	0.434	0.384	0.368	0.434
UMI 395	97	84	52	0.0	58	2555	2052	625	0	1308	0.696	0.520	0.155	0.368	0.343
UMI 1200	100	100	80	33	78	2639	2487	1760	711	1899	0.927	0.582	0.538	0.521	0.642
CAU M39	100	100	88	68	89	2517	2467	2158	1498	2159	0.378	0.371	0.327	0.318	0.349
UMI 176	100	100	95	87	95	2682	2560	2382	1838	2365	0.628	0.487	0.489	0.386	0.497
HP467-15	100	96	76	31	76	2125	1769	1053	365	1328	0.686	0.373	0.381	0.311	0.438
Mean	99	95	78	42		2577	2308	1687	844		0.644	0.461	0.379	0.318	
	1	P	IXP			1	P	IXP				1	P	IXP	
SED	0.816	0.667	1.633			35.74	29.18	71.47				0.013	0.010	0.025	
C.D. (P=0.05)	1.642	1.340	3.283			71.86	58.67	143.72				0.025	0.020	0.050	

Table 2 : The free radical scavenging activity of coloured maize inbreds

Inbreds	Ageing period				Mean
	Initial	2	4	6	
UMI 285	50.37	46.27	30.47	23.4	37.62
UMI 395	45.50	44.53	2.82	1.42	23.56
UMI 1200	50.70	50.10	32.13	26.07	39.75
CAU M39	50.07	50.73	40.33	30.88	43.00
UMI 176	52.07	50.27	42.83	35.26	45.11
HP467-15	52.30	49.13	31.48	22.00	38.73
Mean	50.17	48.50	30.01	23.17	
		I	P	IxP	
S.E.±	0.373		0.304	0.745	
C.D. (P=0.05)	0.749		3.705	9.076	

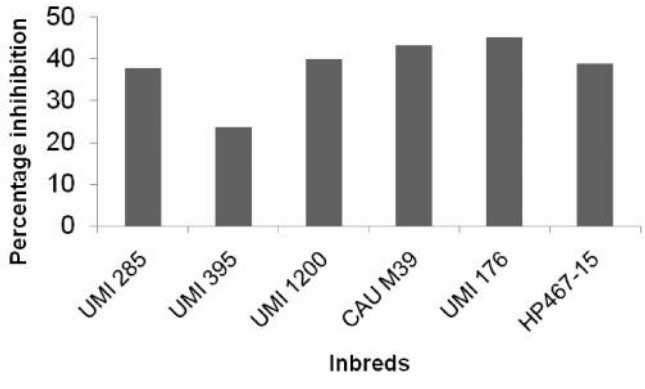

Fig. 1 : Total antioxidant capacity of different colored maize inbreds compared for their free radical scavenging activity as determined by measuring the radical scavenging activity against 2, 2 – Diphenyl– 1-picryl hydrazyl radical (DPPH). The vertical bars represent the mean of each inbreds (Fresh, 2, 4, 6 days accelerated aged seeds).

and storage potential also expressed similar seed quality variation with ageing. Krishnaveni (1984) and German *et al.* (1993) working on maize reported a significant negative correlation with physiological seed quality characters as response to period of ageing. Similar results were also obtained by Varghese and Rai (2005) and Kumar and Rai (2009). In the present study, seed quality parameters germination percentage and time, vigor index and root, shoot and seedling dry weights of maize were significantly affected by ageing. The results on accelerated ageing upto 6 days revealed that irrespective of the inbreds, the seed quality characters decreased with advances in ageing period. Among the inbreds UMI 176 (yellow colour) registered the maximum germination of 87 per cent and was followed by CAU M39 (purple colour) which recorded 68 per cent germination (Table 1). All the other entries except UMI 395 recorded germination in between 40-30 % while UMI 395 which recorded nil germination after 6 days of ageing. The seedling quality characters expressed similar variations except HP467-15 which had higher germination but lower seedling vigour compared to other inbreds.

In the present study antioxidant potential of seeds has been determined as the free radical scavenging ability using a stable DPPH radical (Table 2), which refer to the mass of flour at which DPPH radicals were scavenged by 50% and are negatively correlated to antioxidative ability. Relatively stable DPPH radical has been widely used to test the ability of compounds to act as free radical scavengers or hydrogen donors and thus these are used to evaluate the antioxidant activity of genotypes (Jao and Ko, 2002). It is one of those indicators which are important in determining antioxidant potential of selected bioactive molecules or extract. Our DPPH assay results revealed that among the inbreds, UMI 176 recorded higher free radical scavenging activity of 35.26 per cent at 6 days of ageing, which was followed by CAU M39 having 30.88% of free radical scavenging activity (Fig1). Thus the study explained that the yellow coloured inbred (UMI 176) had a superior potential which exhibited higher level of seed and seedling quality and antioxidant property for seed storability.

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