



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(8): 412-416
Received: 02-05-2026
Accepted: 08-06-2026

Jyothi Mallappa Doddamani
Department of Seed Science and
Technology, University of
Agricultural Sciences, Raichur,
Karnataka, India

Sangeeta I Macha
Department of Seed Science and
Technology, University of
Agricultural Sciences, Raichur,
Karnataka, India

Basavaraja S Ganigara
Department of Seed Science and
Technology, College of Agriculture,
Gangavati, Karnataka, India

Vijaykumar Kurnalliker
Seed Unit, University of
Agricultural Sciences, Raichur,
Karnataka, India

Suvarna
Department of Genetics and Plant
Breeding, University of
Agricultural Sciences, Raichur,
Karnataka, India

Beladhadi RV
Department of Soil Science and
Agricultural Chemistry, University
of Agricultural Sciences, Raichur,
Karnataka, India

Corresponding Author:
Jyothi Mallappa Doddamani
Department of Seed Science and
Technology, University of
Agricultural Sciences, Raichur,
Karnataka, India

Correlation between seed coat colour and longevity of seeds in sorghum genotypes

**Jyothi Mallappa Doddamani, Sangeeta I Macha, Basavaraja S Ganigara,
Vijaykumar Kurnalliker, Suvarna and Beladhadi RV**

DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i8f.6263>

Abstract

Seed coat colour of sorghum was in relation to seed longevity. A laboratory experiment was conducted in the Department of Seed Science and Technology, UAS Raichur to study the correlation of seed coat colour on longevity of sorghum genotypes during 2021-2022. The study consists of 20 sorghum genotypes of different seed coat colour which were stored for ten months in cloth bag. Results revealed highly significantly positive correlation of seed coat colour with germination (0.710 and 0.674), seedling vigour index-I (0.855 and 0.834), seedling vigour index-II (0.706 and 0.615) and total dehydrogenase activity (0.701 and 0.807) whereas negative correlation with seed moisture content (-0.249 and -0.077) and electrical conductivity (-0.855 and -0.868) both at initial and at the end of ten months of storage period. Among the different colour sorghum genotypes, black seed coat colour sorghum genotype (IS25040) recorded significantly highest seed quality parameters *i.e.*, germination (95.50 and 80.00), seedling vigour index-I (3127 and 2064), seedling vigour index-II (15805 and 11480) and total dehydrogenase activity (0.208 OD value and 0.200 OD value) and lowest moisture content (10.24% and 9.94%) and electrical conductivity (0.10 dSm⁻¹ and 0.24 dSm⁻¹). Whereas lowest seed quality parameters were observed in white seed coat colour genotype (DJ6514) (84.53% and 69.00%, 1696 and 600, 13305 and 8625, 0.179 OD value and 0.145 OD value, 10.58% and 10.18%, 0.15 dSm⁻¹ and 0.39 dSm⁻¹) both at initial and at the end of ten months of storage period.

Keywords: Sorghum, correlation, longevity, seed quality

Introduction

Sorghum is the fifth most important cereal in the world followed by maize, rice, wheat and barley. It is a cultivated diploid (2n = 20) tropical cereal C₄ grass plant, belonging to Poaceae family. It is an important grain and forage crop of semiarid regions due to its high adaptability and suitability to rain-fed low input agriculture (Anagholi *et al.*, 2000) [3].

One of the unique features of sorghum seed is its variation in seed colour. Seed coat colour is simple and excellent indicator of seed quality parameters. The colour of seed coat is most obvious physical characteristic which varies widely with white, cream, red, black *etc.* Differences in seed coat colour have been associated with differences in the composition of chemical compounds in the seed coats or the presence of phenolic compounds in the seed coats. The actual colour is determined primarily from three variables: seed coat (pericarp) colour and thickness, the presence or absence of a sub-layer beneath the pericarp called the testa and the endosperm colour and texture.

Phenolic compounds in seed coat play important role in seed longevity contributing to seed hardness, inhibition of microorganism growth and also help in defence system of seeds that are exposed to oxidative damage by many environmental factors such as light, oxygen, free radicals and metal ions. Pigmented seed coats have a prolonged storage life because of presence of phenolic compounds. The main purpose of seed storage is to secure the supply of good quality seed for a planting programme whenever needed. Seed storage and retention of seed viability is an important post-harvest operation that decides the success of seeds in the next generation. So seed coat is having the central role in seed longevity as it is the primary defence against adverse environmental condition.

Substantial research has been conducted to know the effect of seed coat colour on longevity of sorghum genotypes. With that overall goal, the focus of this research paper was to compare different seed coat colour sorghum genotypes with respect to their seed quality characters and to find the correlation of seed coat colour with longevity of sorghum genotypes.

Materials and Methods

Seed materials

A laboratory experiment was conducted in Department of Seed Science and Technology, College of Agriculture, Raichur during 2021-22, to know influence of seed coat colour on longevity of sorghum. The experiment was laid in a completely randomised design. There were 20 genotypes, white (G_1, G_2, G_3), pearly white (G_4, G_5), chalky white (G_6), whitish purple (G_7), purple (G_8), yellow (G_9), red (G_{10}, G_{11}), light red (G_{12}, G_{13}, G_{14}), light brown (G_{15}, G_{16}), dark brown (G_{17}, G_{18}), black (G_{19}, G_{20}). The seeds were harvested during February 2021. They were dried at 10 per cent moisture level and kept for storage under ambient condition in the month of August. These seeds were used for testing seed quality parameters.

Moisture content

Moisture content was determined according to the method described by ISTA., 2013 [9]. The five gram of seed material is added to the cup. The samples were incubated in hot air oven at high constant temperature at 130°C for one hour. After completion of drying period, the moisture cups are removed and kept in desiccators with silica gel for 15-20 minutes and then the weight was taken (M_3). The moisture percentage was calculated using below mentioned formula

$$\text{Moisture content (\%)} = \frac{M_2 - M_3}{M_2 - M_1} \times 100$$

Where

M_1 = weight of the container + lid (g), M_2 = weight of the container + lid + seed before drying (g), M_3 = weight of the container + lid + seed after drying (g)

Seed germination (%)

One hundred seeds from each replication were taken from each treatment. They were kept for germination and number of germinated seeds was counted as per the formula

$$\text{Seed Germination (\%)} = \frac{\text{Number of normal seedlings}}{\text{Total number of seeds}} \times 100$$

Seedling vigour index (SVI-I)

The seedling vigour index – I was calculated as per the method followed by Abdul-Baki and Anderson (1973) [1].

$$\text{SVI-I} = \text{Germination (\%)} \times \text{Seedling length (cm)}$$

Seedling vigour index (SVI-II)

The seedling vigour index-II was worked out by multiplying the per cent seed germination and mean seedling dry weight (Abdul-Baki and Anderson, 1973) [1].

$$\text{SVI-II} = \text{Germination (\%)} \times \text{Seedling dry weight (mg)}$$

Electrical conductivity (dSm^{-1})

Seeds were soaked overnight by keeping in an incubator maintained at $25^\circ\text{C} \pm 1$ for twelve hours. The seed leachate was

collected and measured in digital conductivity bridge with a cell constant 1.0 and the mean values were expressed in deci Siemens per meter (dSm^{-1}) as described by Milosevic *et al.*, 2010 [13].

Total dehydrogenase activity (OD value)

Twenty five seeds from each treatment were pre conditioned by soaking in water overnight at room temperature. The half cut seeds was steeped in 0.25 per cent solution of 2, 3, 5-triphenyl tetrazolium chloride and kept in dark for 2 hours at 40°C for staining. The stained seeds was then soaked in 10 ml of 2 methoxy ethanol and kept overnight for extracting the red colour formazan. The intensity of red colour was measured using spectrophotometer using blue filter at 620 nm wave length and methyl cellosolve was used as a blank. The OD value obtained was reported as dehydrogenase activity (Kittcock and Law, 1968) [10].

Data analysis

The mean data of the laboratory experiments was statistically analyzed by adopting appropriate statistical methods as outlined by Panse and Sukhatme (1985) [15]. The critical differences were calculated at one per cent level of probability wherever 'F' test was found significant.

Results and Discussion

Results and discussion for the present laboratory experiment on "correlation between seed coat colour and longevity of seeds in sorghum genotypes" were analyzed using standard statistical methods, which are presented and discussed below.

Among the 20 sorghum genotypes of different seed coat colour, black seed coat colour genotype recorded lowest moisture content (10.24% and 9.94%) at the beginning and at the end of the storage period compared to all other genotypes and the highest was noticed by white seed coat colour genotype (10.58% and 10.18%) at initial and after ten months of storage respectively. Seed coat colour exhibited negative correlation with seed moisture content (-0.249 and -0.077).

The highest moisture content in white seed coat colour genotype may be due to thinner seed coat. Similar results were explained by Mokashi (2017) [14] coated that unpigmented seed having thinner seed coat absorbs more moisture than pigmented seeds. Giang and Gowda (2007) [6] reported that the fluctuation in moisture content may be due to the hygroscopic nature of the seeds which absorb or desorb moisture from the environment. Since cloth bag is moisture and vapor pervious in nature, the moisture content of seeds showed more fluctuation and greater loss of seed quality.

Black seed coat colour genotype (G_{20}) recorded significantly highest seed germination (95.50% and 80.00%) compared to white seed coat colour genotype (G_3) (84.53% and 69.00%) both at initial and after ten months of storage respectively. However, G_{20} was on par with G_{17} (78.25%), G_{18} (77.00%), G_{15} (76.25%), G_{16} (76.00%), G_{12} (75.75%), G_{10} (75.50%) after the end of ten months. Seed coat colour exhibited positive significant correlation with germination (0.710 and 0.674).

The lowest seed germination in white seed coat genotype might be due to the presence of some various phenolic compounds in unpigmented seed. Similar results were noticed by Mokashi (2017) [14] in cowpea. He stated that, some phenolic compounds present in unpigmented genotype hinders the metabolism preparatory to germination and prevent the access of oxygen to embryo and release of carbonic acid which make it deteriorate faster than the pigmented genotypes. Abdullah *et al.* (1988) [2] in long bean, noticed that black seed coat colour genotypes were

more resistant to mechanical damage, such resistance means less nutrient leakage from the seed during germination.

As germination alone may not reveal the real potential of seed lots, so assessment of seedling vigour index is of prime importance. The highest seedling vigour index-I (3127 and 2064) and seedling vigour index-II (15805 and 11480) was noticed by black seed coat colour genotype G₂₀ both at initial and at the end of the storage period. Whereas white seed coat colour sorghum genotype recorded lowest vigour indices at initial and after ten months of storage [(1696 and 600) and (13305 and 8625) respectively]. There is a positive significant correlation of seed coat colour with seedling vigour index-I (0.855 and 0.834) and seedling vigour index-II (0.706 and 0.615).

Seed vigor which indicated by coefficient velocity of germination was much more sensitive to high temperature and relative humidity than germination as suggested by Spears *et al.* in 1997. So the lowest seedling vigour indices in white seed coat genotype might be due to lowest germination percentage, seedling length and seedling dry weight. These findings are in line with Roberts (1972)^[16], Anuradha *et al.* (2009)^[4] in chickpea, Mokashi (2017)^[14] in cowpea.

Dehydrogenase enzyme played crucial role in the transfer of electrons during the respiratory process. The black seed coat colour sorghum genotype recorded significantly highest total dehydrogenase activity both at initial and at the end of storage period (0.208 OD value and 0.200 OD value respectively). While the lowest was found in white seed coat colour genotype (0.179 OD value and 0.145 OD value) at beginning and after end of storage month. Seed coat colour showed positive significant correlation with dehydrogenase enzyme activity (0.701 and 0.807).

The least dehydrogenase activity in white seed coat genotype might be due to its highest moisture content. Mokashi (2017)^[14] studied different seed coat coloured cowpea genotypes and suggested that unpigmented genotypes have thin seed coat and

absorbs more moisture from the environment during storage which inturn reduces all the seed quality parameters and thus the cotyledon of the seeds fails to stain 2, 3, 5- tri phenyl tetrazolium chloride. These findings are also in accordance with Saxena and Maheswari (1980)^[17] in soybean.

Significantly lowest electrical conductivity was recorded by black seed coat colour genotype at the beginning and at the end of storage period (0.10 dSm⁻¹ and 0.24 dSm⁻¹) whereas white seed coat colour genotype recorded significantly highest electrical conductivity at initial and at the end of storage period (0.15 dSm⁻¹ and 0.39 dSm⁻¹). Seed coat colour exhibited negative correlation with electrical conductivity (-0.855 and -0.868).

The highest electrical conductivity in white or unpigmented genotypes was attributed to thinner seed coat. Similar findings were recorded by Capeleti *et al.* (2005)^[5] and Kumar *et al.* (2020)^[11] in soybean. They suggested that thinner seed coat in white seed coat colour genotype leads to water uptake into the outer cells of cotyledons that might disrupts the cell membranes and resulting in high solute leakage from the embryo.

Correlation study between seed coat colour and seed longevity

Seed coat colour exhibited positive significant association with germination (0.710 and 0.674), seedling vigour index-I (0.855 and 0.834), seedling vigour index-II (0.706 and 0.615) and total dehydrogenase activity (0.701 and 0.807), alpha amylase activity (0.734 and 0.184), Protien (0.587 and 0.802), Starch (0.361 and 0.519), Iron (0.795 and 0.805), Zinc (0.749 and 0.788), Crude fibre (0.588 and 0.144), Tannin (0.771 and 0.779) at initial and at the end of storage respectively but it is significantly negatively correlated with electrical conductivity (-0.855 and -0.867). Whereas initially, seed moisture content exhibited negative significant correlation with seed coat colour (-0.249) but at the end of the storage month, non significantly negative correlation was found between seed moisture content and seed coat colour (-0.077).

Table 1: Effect of seed coat colour on moisture content (%) and seed germination (%) during storage in sorghum genotypes

Seed coat colour	Genotypes	Storage period											
		Moisture content (%)						Seed germination (%)					
		Initial (Aug)	2 (Sep)	4 (Nov)	6 (Jan)	8 (Mar)	10 (May)	Initial (Aug)	2 (Sep)	4 (Nov)	6 (Jan)	8 (Mar)	10 (May)
White	G ₁ - IS37224	10.56	10.67	10.85	11.53	10.35	10.01	86.59	86.25	85.50	81.75	77.25	69.50
	G ₂ - M 35-1	10.49	10.60	10.72	11.12	10.20	10.01	87.85	87.25	86.25	82.00	78.75	69.75
	G ₃ - DJ6514	10.58	10.69	10.89	11.81	10.46	10.18	84.53	84.25	83.50	81.00	76.75	69.00
Pearly white	G ₄ - RSL46	10.44	10.56	10.75	11.53	10.28	10.10	88.92	88.75	87.50	83.75	79.00	71.50
	G ₅ - RSL54	10.48	10.62	10.73	11.50	10.32	10.13	88.25	88.00	87.25	82.50	78.75	70.75
Chalky white	G ₆ - RSL49	10.55	10.58	10.79	11.56	10.34	9.98	87.98	89.75	87.75	82.00	78.75	69.50
Whitish purple	G ₇ - IS3572	10.40	10.58	10.67	11.10	10.38	9.97	90.12	94.60	92.25	84.25	79.25	72.25
Purple	G ₈ - IS16310	10.39	10.57	10.77	11.58	10.34	10.11	90.75	89.75	88.00	84.29	79.50	72.25
Yellow	G ₉ - IS16006	10.38	10.53	10.68	11.11	10.22	10.12	90.82	90.50	89.50	84.75	79.75	72.50
Red	G ₁₀ - IS37247	10.35	10.59	10.64	11.09	10.20	10.11	93.45	93.00	92.00	86.25	82.25	75.50
	G ₁₁ - RSL69	10.35	10.49	10.68	11.02	10.21	10.10	92.75	92.50	90.50	86.00	82.00	74.50
Light red	G ₁₂ - RSL57	10.34	10.58	10.69	11.08	10.23	10.10	93.56	93.25	92.50	87.25	83.25	75.75
	G ₁₃ - IS37349	10.37	10.46	10.54	11.04	10.31	10.09	92.69	92.00	90.25	85.75	81.00	73.75
	G ₁₄ - IS37304	10.38	10.53	10.67	11.09	10.33	10.05	91.48	86.25	85.50	84.75	79.75	73.25
Light brown	G ₁₅ - IS37355	10.28	10.43	10.73	11.07	10.41	10.04	93.86	91.25	89.50	87.25	83.50	76.25
	G ₁₆ - IS6508	10.28	10.57	10.67	11.12	10.23	10.03	93.88	93.25	93.00	87.25	83.75	76.00
Dark brown	G ₁₇ - IS37225	10.25	10.38	10.53	11.08	10.19	9.95	94.86	93.50	93.00	88.25	84.75	78.25
	G ₁₈ - IS22436	10.25	10.40	10.61	11.11	10.31	10.00	94.76	95.00	94.50	88.28	84.25	77.00
Grey	G ₁₉ - IS2618	10.42	10.58	10.65	11.05	10.27	10.01	89.99	90.25	88.25	84.00	79.25	72.00
Black	G ₂₀ - IS25040	10.24	10.39	10.46	11.08	10.17	9.94	95.50	87.00	86.00	89.75	85.75	80.00
Mean		10.39	10.54	10.69	11.23	10.29	10.05	91.13	90.77	89.59	85.05	80.86	73.46
S.Em±		0.24	0.25	0.25	0.27	0.25	0.24	1.42	1.45	1.49	1.55	1.58	1.76
CD @1%		NS	NS	NS	NS	NS	NS	4.01	4.10	4.21	4.39	4.49	4.98

Table 2: Effect of seed coat colour on seedling vigour index-I and seedling vigour index-II during storage in sorghum genotypes

Seed coat colour	Genotypes	Storage period											
		Seedling vigour index-I						Seedling vigour index-II					
		Initial (Aug)	2 (Sep)	4 (Nov)	6 (Jan)	8 (Mar)	10 (May)	Initial (Aug)	2 (Sep)	4 (Nov)	6 (Jan)	8 (Mar)	10 (May)
White	G ₁ - IS37224	1899	1837	1283	1022	765	632	13759	13429	13064	11919	10753	8715
	G ₂ - M 35-1	2042	1892	1484	1255	969	746	14082	13777	13308	12169	11017	9061
	G ₃ - DJ6514	1696	1588	1194	957	729	600	13305	13118	12725	11648	10553	8625
Pearly white	G ₄ - RSL46	2089	2034	1794	1541	1059	858	14378	14085	13598	12496	11305	9467
	G ₅ - RSL54	2070	2010	1701	1444	1047	807	14235	13957	13515	12301	11151	9346
Chalky white	G ₆ - RSL49	2543	2465	1432	1331	1196	1044	14006	13703	13261	11997	11001	8847
Whitish purple	G ₇ - IS3572	1962	1939	1439	1156	937	716	14626	14306	13754	12629	11412	9754
Purple	G ₈ - IS16310	2304	2150	1778	1602	1137	983	14729	14386	13802	12635	11504	9768
Yellow	G ₉ - IS16006	2743	2574	2263	1725	1596	1306	14740	14453	14025	12772	11612	9817
Red	G ₁₀ - IS37247	2633	2536	2181	1918	1550	1259	15298	14954	14499	13188	12132	10646
	G ₁₁ - RSL69	2304	2150	1778	1602	1137	983	15155	14837	14245	13124	12070	10348
Light red	G ₁₂ - RSL57	2780	2681	2303	2015	1640	1364	15325	14995	14578	13410	12304	10734
	G ₁₃ - IS37349	2596	2521	2099	1635	1485	1202	15136	14757	14196	13068	11834	10192
	G ₁₄ - IS37304	2632	2412	1796	1670	1436	1165	14875	14627	14060	12916	11628	10109
Light brown	G ₁₅ - IS37355	2825	2672	2273	1946	1695	1434	15412	15004	14685	13550	12383	10843
	G ₁₆ - IS6508	2866	2784	2446	2085	1700	1490	15434	15138	14722	13559	12445	10830
Dark brown	G ₁₇ - IS37225	2958	2826	2576	2303	2144	1866	15671	15447	15035	13741	12619	11205
	G ₁₈ - IS22436	2909	2865	2495	1898	1769	1555	15616	15316	14649	13745	12528	11026
Grey	G ₁₉ - IS2618	2243	2171	1686	1453	1094	886	14569	14288	13654	12558	11396	9713
Black	G ₂₀ - IS25040	3127	2767	2477	2477	2315	2064	15805	15507	15122	14028	12777	11480
Mean		2456	2349	1925	1648	1370	1148	14808	14504	14025	12873	11721	10026
SE _m ±		59.91	57.20	47.40	41.27	35.19	29.85	354	347	336	308	281	241
CD @1%		169.90	162.21	134.41	117.04	99.78	84.66	1005	984	952	874	796	684

Table 3: Correlation of seed coat colour with longevity of sorghum genotypes

Parameters		X ₁	X ₂	X ₃	X ₄	X ₅	X ₆	X ₇	X ₈	X ₉	X ₁₀	X ₁₁	X ₁₂	X ₁₃	X ₁₄	X ₁₅	X ₁₆	X ₁₇	X ₁₈	S.C
X ₁	I	1.000	0.738	-0.178	-0.348	-0.439	-0.487	-0.358	-0.521	-0.476	0.159	-0.504	-0.444	-0.449	-0.423	-0.357	-0.435	-0.372	-0.432	-0.249*
	F	0.956	0.560	-0.004	-0.137	-0.247	-0.320	-0.147	-0.349	-0.331	-0.043	-0.344	-0.267	-0.318	-0.353	-0.168	-0.287	-0.231	-0.237	-0.077
X ₂	I	0.738	1.000	-0.650	-0.857	-0.831	-0.778	-0.866	-0.827	-0.734	0.742	-0.839	-0.834	-0.743	-0.496	-0.848	-0.808	-0.644	-0.843	-0.735**
	F	0.707	0.992	-0.666	-0.867	-0.842	-0.782	-0.878	-0.830	-0.735	0.756	-0.827	-0.839	-0.733	-0.494	-0.847	-0.811	-0.633	-0.850	-0.749**
X ₃	I	-0.178	-0.650	1.000	0.766	0.645	0.713	0.767	0.607	0.522	-0.750	0.588	0.649	0.500	0.276	0.714	0.610	0.547	0.688	0.710**
	F	-0.457	-0.785	0.565	0.846	0.966	0.749	0.867	0.935	0.970	-0.593	0.942	0.979	0.969	0.799	0.873	0.980	0.718	0.942	0.674**
X ₄	I	-0.348	-0.857	0.766	1.000	0.924	0.770	0.998	0.868	0.804	-0.864	0.871	0.908	0.784	0.506	0.920	0.875	0.666	0.943	0.856**
	F	-0.302	-0.827	0.730	0.920	0.870	0.709	0.932	0.785	0.715	-0.871	0.834	0.870	0.765	0.454	0.903	0.877	0.557	0.861	0.809**
X ₅	I	-0.439	-0.831	0.645	0.924	1.000	0.783	0.939	0.941	0.947	-0.697	0.940	0.978	0.915	0.715	0.880	0.952	0.735	0.980	0.739**
	F	-0.341	-0.864	0.774	0.955	0.889	0.771	0.963	0.850	0.772	-0.901	0.855	0.913	0.778	0.540	0.953	0.875	0.682	0.929	0.855**
X ₆	I	-0.487	-0.778	0.713	0.770	0.783	1.000	0.780	0.779	0.741	-0.642	0.746	0.791	0.696	0.564	0.745	0.757	0.647	0.807	0.668**
	F	-0.394	-0.818	0.693	0.894	0.877	0.816	0.902	0.869	0.813	-0.764	0.843	0.882	0.776	0.578	0.863	0.837	0.733	0.906	0.777**
X ₇	I	-0.358	-0.866	0.767	0.998	0.939	0.780	1.000	0.883	0.824	-0.864	0.886	0.925	0.805	0.529	0.930	0.894	0.682	0.954	0.855**
	F	-0.312	-0.847	0.752	0.938	0.879	0.730	0.950	0.807	0.731	-0.894	0.847	0.889	0.777	0.477	0.933	0.887	0.587	0.884	0.834**
X ₈	I	-0.521	-0.827	0.607	0.868	0.941	0.779	0.883	1.000	0.941	-0.618	0.961	0.949	0.883	0.750	0.847	0.916	0.751	0.950	0.706**
	F	-0.465	-0.770	0.578	0.813	0.871	0.694	0.830	0.916	0.867	-0.559	0.897	0.873	0.850	0.671	0.824	0.864	0.580	0.868	0.615**
X ₉	I	-0.476	-0.734	0.522	0.804	0.947	0.741	0.824	0.941	1.000	-0.504	0.910	0.953	0.938	0.842	0.796	0.932	0.768	0.938	0.617**
	F	-0.457	-0.785	0.565	0.846	0.966	0.749	0.867	0.935	0.970	-0.594	0.942	0.979	0.968	0.798	0.873	0.980	0.718	0.942	0.674**
X ₁₀	I	0.159	0.742	-0.750	-0.864	-0.697	-0.642	-0.864	-0.618	-0.504	1.000	-0.637	-0.699	-0.510	-0.203	-0.802	-0.669	-0.530	-0.747	-0.855**
	F	0.200	0.772	-0.794	-0.878	-0.707	-0.672	-0.879	-0.654	-0.531	0.960	-0.642	-0.726	-0.524	-0.272	-0.838	-0.675	-0.561	-0.770	-0.868**
X ₁₁	I	-0.504	-0.839	0.588	0.871	0.940	0.746	0.886	0.961	0.910	-0.637	1.000	0.946	0.932	0.702	0.881	0.939	0.722	0.926	0.701**
	F	-0.441	-0.884	0.707	0.949	0.943	0.780	0.960	0.940	0.860	-0.783	0.959	0.952	0.877	0.620	0.949	0.945	0.675	0.949	0.807**
X ₁₂	I	-0.444	-0.834	0.649	0.908	0.978	0.791	0.925	0.949	0.953	-0.699	0.946	1.000	0.940	0.766	0.918	0.975	0.753	0.981	0.734**
	F	-0.366	-0.864	0.725	0.955	0.945	0.757	0.968	0.868	0.824	-0.845	0.912	0.941	0.860	0.565	0.941	0.931	0.659	0.933	0.814**
X ₁₃	I	-0.449	-0.743	0.500	0.784	0.915	0.696	0.805	0.883	0.938	-0.510	0.932	0.940	1.000	0.801	0.871	0.946	0.695	0.882	0.587**
	F	-0.348	-0.788	0.691	0.909	0.895	0.766	0.913	0.872	0.828	-0.789	0.804	0.887	0.730	0.579	0.831	0.829	0.740	0.938	0.802**
X ₁₄	I	-0.423	-0.496	0.276	0.506	0.715	0.564	0.529	0.750	0.842	-0.203	0.702	0.766	0.801	1.000	0.599	0.747	0.581	0.716	0.361**
	F	-0.433	-0.594	0.382	0.631	0.799	0.633	0.651	0.819	0.882	-0.360	0.769	0.843	0.836	0.967	0.693	0.832	0.601	0.800	0.519**
X ₁₅	I	-0.357	-0.848	0.714	0.920	0.880	0.745	0.930	0.847	0.796	-0.802	0.881	0.918	0.871	0.599	1.000	0.903	0.658	0.898	0.795**
	F	-0.360	-0.858	0.725	0.943	0.903	0.751	0.951	0.852	0.801	-0.834	0.895	0.924	0.855	0.598	0.975	0.915	0.653	0.921	0.805**
X ₁₆	I	-0.435	-0.808	0.610	0.875	0.952	0.757	0.894	0.916	0.932	-0.669	0.939	0.975	0.946	0.747	0.903	1.000	0.685	0.943	0.749**
	F	-0.376	-0.853	0.707	0.941	0.936	0.756	0.954	0.877	0.846	-0.805	0.928	0.951	0.899	0.621	0.961	0.950	0.662	0.935	0.788**
X ₁₇	I	-0.372	-0.644	0.547	0.666	0.735	0.647	0.682	0.751	0.768	-0.530	0.722	0.753	0.695	0.581	0.658	0.685	1.000	0.771	0.588**
	F	-0.211	-0.199	0.170	0.233	0.337	0.264	0.234	0.364	0.409	-0.054	0.277	0.314	0.280	0.408	0.173	0.263	0.453	0.354	0.144**
X ₁₈	I	-0.432	-0.843	0.688	0.943	0.980	0.807	0.954	0.950	0.938	-0.747	0.926	0.981	0.882	0.716	0.898	0.943	0.771	1.000	0.771**
	F	-0.432	-0.842	0.684	0.938	0.981	0.802	0.950	0.950	0.937	-0.747	0.925	0.982	0.885	0.734	0.901	0.944	0.761	0.993	0.779**

* - Correlation is significant at 0.05 level (0.219) ** - Correlation is significant at 0.01 level (0.286)

S.C- Seed coat colour

X1: Seed moisture content (%)	X2: Test weight (mg)	X3: Germination (%)	X4: shoot length (cm)
X5: root length (cm)	X6: seedling dry weight (mg)	X7: Seedling vigour index-I	X8: Seedling vigour index-II
X9: Speed of germination	X10: Electrical conductivity (dSm ⁻¹)	X12: Alpha amylase activity (mm)	
X11: Total dehydrogenase activity (OD value)		X15- Iron (mgKg ⁻¹)	X16- Zinc (mgKg ⁻¹)
X13- Protein (%)	X14- Starch (%)		
X17- Crude fibre (%)	X18- Tannin (mg/100 g) I: Initial (August) F: Final (May)		

The negative correlation between seed coat colour along with seed moisture content and electrical conductivity suggested that these seed quality parameters decrease as the intensity of darkness of the seed coat increase in sorghum genotypes. These findings also suggest that seed coat colour may be used as important parameters to prescreen superior quality genotypes of sorghum. The science behind this may be because seed coat colour determines seed composition, which further affects seed germination and seedling growth. Similar findings were reported by, Mavi (2010) ^[12] in crimson sweet watermelon, Zhang *et al.* (2014) ^[20] in canola seeds, Hacisalihoglu and Settles (2013) ^[7] in common bean, Yousif (2014) ^[19] in soybean, Tiriyaki *et al.* (2016) in common vetch and Mokashi (2014) ^[14] in cowpea.

Conclusion

Results from this study indicate that in sorghum, seed coat colour can be used as a visual indicator of seed quality, deterioration and storage potential. Results also show that black seed coat colour sorghum genotypes with good quality can be safely kept at ambient conditions at least for ten months. Hence genotypes with black seed coat colour are best in maintaining the seed quality parameters during storage.

References

1. Abdul-Baki AA, Anderson JD. Vigor determination in soybean seed by multiple criteria. *Crop Science*. 1973;13(6):630-633.
2. Abdullah WD, Powell AA, Matthews S. Association of differences in seed vigour in long bean (*Vigna sesquipedalis*) with testa colour and imbibition damage. *Journal of Agricultural Science*. 1991;116(2):259-264.
3. Anagholi A, Kashiri A, Mokhtarpoor H. The study of comparison between inside forage sorghum cultivars and speed feed hybrids. *Agricultural Science and Natural Resources Journal*. 2000;7(4):73-83.
4. Anuradha C, Gaur PM, Pande S, Gali KK, Ganesh M, Kumar J, *et al.* Mapping QTL for resistance to botrytis grey mould in chickpea. *Euphytica*. 2011;182(1):1-9.
5. Capeleti I, Bonini EA, Ferrarese MLL, Teixeira ACN, Krzyzanowski FC, Ferrarese-Filho O. Lignin content and peroxidase activity in soybean seed coat susceptible and resistant to mechanical damage. *Acta Physiologiae Plantarum*. 2005;27(1):103-108.
6. Giang PL, Gowda R. Influence of seed coating with synthetic polymers and chemicals on seed quality and storability of hybrid rice. *Omonrice*. 2007;15:68-74.
7. Hacisalihoglu G, Settles AM. Natural variation in seed composition of 91 common bean genotypes and their possible association with seed coat color. *Journal of Plant Nutrition*. 2013;36(5):772-780.
8. Atis I, Atak M, Can E, Mavi K. Seed coat color effects on seed quality and salt tolerance of red clover (*Trifolium pratense*). *International Journal of Agriculture and Biology*. 2011;13(3).
9. International Seed Testing Association. International rules for seed testing. *Seed Science and Technology*. 2013;27:25-30.
10. Kittock DL, Law AG. Relationship of seedling vigor to respiration and tetrazolium chloride reduction by germinating wheat seeds. *Agronomy Journal*. 1968;60(3):286-288.
11. Kumar SJ, Kumar A, Ramesh KV, Singh C, Agarwal DK, Pal G, *et al.* Wall bound phenolics and total antioxidants in stored seeds of soybean (*Glycine max*) genotypes. *Indian Journal of Agricultural Sciences*. 2020;90:118-122.
12. Mavi K. The relationship between seed coat color and seed quality in watermelon Crimson Sweet. *Horticultural Science*. 2010;37(2):62-69.
13. Milosevic M, Vujakovic M, Karagic D. Vigour tests as indicators of seed viability. *Genetika*. 2010;42(1):103-118.
14. Mokashi YS. Effect of seed coat color on seed quality, nutrition and seed longevity in cowpea [*Vigna unguiculata* (L.) Walp.]. Bengaluru: University of Agricultural Sciences; 2017.
15. Panse VG, Sukhatme PV. Statistical methods for agricultural workers. New Delhi: Indian Council of Agricultural Research; 1985. p. 158-161.
16. Roberts EH. Storage environment and the control of viability. In: Roberts EH, editor. *Viability of seeds*. Dordrecht: Springer; 1972. p. 14-58.
17. Saxena OP, Maheshwari DC. Biochemical aspects of viability in soybean. *Acta Botanica Indica*. 1980;8(2):229-234.
18. Tiriyaki G, Cil A, Tiriyaki I. Revealing seed coat colour variation and their possible association with seed yield parameters in common vetch (*Vicia sativa* L.). *International Journal of Agronomy*. 2016;2016.
19. Yousif AM. Increased stored soybean dietary fibre concentration is positively correlated to testa darkening measured chromaticity. *Journal of Cereal Science*. 2014;60(1):25-30.
20. Zhang J, Cui Y, Zhang L, Wang Y, Li J, Yan G, *et al.* Seed coat color determines seed germination, seedling growth and seed composition of canola (*Brassica napus*). *International Journal of Agriculture and Biology*. 2013;15(3).