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CORRELATION AND PATH ANALYSIS STUDY OF SEED COAT COLOUR AND SEED DETERIORATION IN GREEN GRAM (*VIGNA RADIATA* L.)

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ABSTRACT
The present study was undertaken to record the relationship between seed coat colour and seed deterioration. Other seed characters like germination percentage speed of germination, seedling fresh and dry weight, seed vigour, seed protein content, hundred seed weight and electrical conductivity of leachates were also studied for seeds with 'Yellow', 'Green' and 'Brown' seed coat colour. The correlation coefficient of pooled data of three years in different location indicated that germination percentage has got positive and significant correlation (0.798) with vigour index but negative significant correlation with hundred seed weight and electrical conductivity (-0.612). Path analysis of pooled data of three years has indicated that the germination percentage has got negative direct effects on electrical conductivity. The maximum direct effect has exhibited by root-shoot ratio followed by vigour index. As we have consider rate of seed deterioration in nine varieties of *Vigna radiata* with three different seed coat colours, from our present study it can be concluded that depending on electrical conductivity results, variety under green seed coat colour can be ranked as best as they showed less deterioration rate (0.09 to 0.15μS/cm) and highest deterioration (0.18 to 0.26 μS/cm) was found in case of seed with yellow seed coat colour. Varieties with green seed coat colour recorded maximum germination percentage, which can be selected for sowing purpose leading to maximum yield and the same varieties having less deterioration rate can be stored for a longer period.

INTRODUCTION

Green gram is an important pulse crop and occupies as good position due to its high seed protein content and ability to store the soil fertility through symbiotic nitrogen fixation (Manik, 1994). It is grown in kharif and summer seasons, but also cultivated in rabi season in Valsad, Navsari, Surat, Bharuch and Vadodara districts as a post-rainy season crop. It contributed significantly to enhancing the yield of subsequent crops (Jat *et al.*, 2012). Pulses represent the second largest family of higher plants, second only to grasses in agricultural importance (Doyle and Luckow, 2003). A comparative study of different green gram varieties indicated statistical significant difference at 5% level of significance of seed vigour and storability (Barman, 2006). Correlation studies indicate the magnitude of association between pairs of characters and are useful for selecting genotypes with desirable combinations of characters and also in crop improvement. In green gram with different seed coat colours exhibited different rate of seed deterioration which was correlated with protein content, electrical conductivity and other characters (Barman *et al.*, 2009). Path coefficient analysis has been found useful to find out direct and indirect causes of association and measures the relative importance of each causal factor. The knowledge of the interrelationship of grain yield with other important characters is necessary to determine which of these characters could be used for high grain yield. The effect of seed coat colour on germination in horsegram was studied by Omokanye (1995) and showed that the germination was maximum in grey and brown seed coat type, which is about 94.1%, basing on such type of information present investigation was undertaken. Correlation studies indicate the magnitude of association between pairs of characters and are useful for selecting genotypes with desirable combinations of characters thereby assisting the plant breeder in crop improvement. Grain yield is a complex character and is controlled by many factors (Anonymous, 2012). The per capita availability of protein in the country is 28 g/ day, while WHO recommended it should be 80 g/day, consequently most serious problem of the malnutrition existing among the poor people, where most of the people have vegetarian diet and avoid the animal protein (Prasad *et al.*, 2013). Path coefficient analysis, on the other hand, is an efficient statistical technique specially designed to quantify the interrelationship of different components and their direct and indirect effects on seed yield (Ikanovic *et al.*, 2011). The main hypothesis was to identify seed coat colour showing rapid seed deterioration and special care can be recommended for better storage of those seeds.

MATERIALS AND METHODS

The seeds were collected from the Department of seed science and technology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, W.B. The experimental materials include

Table 1: Mean of characters of different varieties of Green gram (*vigna radiate* L.Wilezek)

Name of the variety	Seed coat colour	Germination percentage	Rate of germination	Seedling Fresh weight (g)	Seedling dry weight (g)	Root length (cm)	Shoot length (cm)	Root-shoot ratio	Vigour index	Protein content (%)	100 see weight (g)	Electrical conductivity (iS/cm)
A-20	Yellow	60.89(51.96)	10.78	2.64	0.64	13.12	20.97	0.65	2032.70	23.61	3.40	0.26
A-89	Yellow	75.44(65.96)	17.18	1.81	0.41	15.61	15.61	0.75	2132.68	20.18	2.47	0.18
A-93	Yellow	79.78(69.66)	19.11	1.51	0.19	19.24	19.24	0.70	2637.31	22.11	2.33	0.22
A-151	Green	67.00(57.08)	18.22	1.46	0.30	15.61	15.61	0.60	1887.98	24.47	2.13	0.15
A-119	Green	73.56(60.05)	16.67	2.10	0.41	17.66	17.66	0.82	1444.57	22.00	2.34	0.13
A-130(1)	Green	88.78(74.73)	19.30	1.58	0.19	17.81	17.81	0.72	2791.26	22.01	2.08	0.09
Tgl	Brown	83.89(71.49)	18.11	1.67	0.18	18.43	18.43	0.90	2928.43	20.55	2.31	0.10
A-33	Brown	71.67(58.59)	15.00	2.32	0.35	16.53	16.53	1.21	2489.65	20.11	2.35	0.13
A-160(1)	Brown	83.56(71.75)	19.00	1.36	0.21	15.89	15.89	0.82	2363.66	24.30	2.43	0.17

Figures in the parenthesis are arc-sine transformed values

Table 2: Correlation study between pairs of characters in *vigna radiata* (L.)

		1	2	3	4	5	6	7	8	9	10	11
1	Germination percentage	1.000	-0.012	-0.660	-0.826	0.156	-0.182	0.138	0.798**	-0.253	-0.594	-0.612**
2	Speed of germination		1.000	-0.359	-0.213	-0.354	-0.318	-0.233	-0.195	0.272	-0.323	-0.124
3	Seedling fresh weight			1.000	0.857**	0.429**	0.481*	0.290	-0.233	-0.234	0.689**	0.359
4	Seedling dry weight				1.000	-0.064	0.344	-0.124	-0.630**	0.088	0.801**	0.598**
5	Seedling root length					1.000	0.238	0.871**	0.625**	-0.661	-0.019	-0.336
6	Seedling shoot length						1.000	-0.229	0.242	0.053	0.560**	0.467
7	Root-Shoot ratio							1.000	0.398*	-0.629**	-0.190	0.467
8	Vigour Index								1.000	-0.496**	-0.417*	-0.561**
9	Protein content									1.000	0.250	0.397*
10	Hundred seed weight										1.000	0.792**
11	Electrical conductivity											1.000

*Significant at 5% level of significance, ** Significant at 1% level of significance.

those nine cultivars of *vigna radiata* with seeds of three seed coat colour *i.e.* Yellow-A-20 (V_1), A-89 (V_2) and A-93 (V_3); Green-A-151 (V_4), A-119 (V_5) and A-130 (V_6) and the Brown- Tgl (V_7), A-33 (V_8) and A-160 (V_9).

Determination of germination percentage, seedling fresh and dry weights were taken as per normal procedure. Speed of germination and Vigour index were taken as per process described by Maguire (1962) and Gontia (1999) respectively.

The electrical conductivity test is more commonly being used for determining the seed vigour. This is best on the principle that seeds which are loosing vigour, release materials such as sugars and other electrolytes into de-ionized waters rapidly than normal vigorous seeds. The electrical conductivity (E.C.) was measured as process described by Sen and Ghosh (1999).

The method consists of soaking 3 grams of seeds (in two replication of one and half gram each) in 250mL of de-ionized water at 20ºC for 24 hrs. A control beaker with de-ionized water is also used without any seed. At the end of the specific period the contents of the beaker are gently stirred using a glass rod, poured into another beaker and reading was taken using a digital conductivity meter (Testronix 15). Both the measuring beaker and the electrodes should be rinsed with de-ionized water between consecutive readings. The conductivity of the control was subtracted from each reading which is expressed micro-mhos/cm/gm of the seed and the two replicates were calculated.

The readings were taken for 3 consecutive years and statistical calculations were done on the basis of 3 years pooled data for a results and satisfactory conclusions.

RESULTS AND DISCUSSION

From Table 1, the mean germination percentage was found to be highest in case of variety A-130(1) which is under green seed coat group and lowest in case of A-20 which is under yellow seed coat group. The brown seed coat group of seeds showed an intermediate germination percentage (Table 1). Similarly, electrical conductivity, which is the most important criteria for seed deterioration, was recorded highest in case of A-20, indicating speedy seed deterioration and the variety A-130(1), indicating lowest rate of seed deterioration.

It is clear that the germination percentage showed positive and significant correlation with vigour index but negative significant correlation with hundred seed weight and electrical conductivity (Table 2). Negative correlation between germination percentage and electrical conductivity was also reported earlier by Kumar *et al.* (1989). Rate of germination exhibited negative correlation with seedling fresh weight, seedling root length and hundred seed weight. Character association and path analysis was also reported in case of sorghum (Arunkumar, 2013). Significant positive correlation was exhibited by seedling fresh weight (0.857); dry weight (0.801), hundred seed weight (0.792) and seedling shoot length (0.560) at 1% level of significance. It was noted that the seedling fresh weight was positively correlated with seed weight as reported by Mc Daniel (1969). Such type of relationship was reported by Saroj *et al.* (2013). Seedling fresh weight showed negative non- significant correlation with electrical conductivity (Table 2). Seedling dry weight recorded significant correlation of seedling root length with root-shoot ratio and

Table 3: Direct and Indirect effects of different characters on Electrical conductivity of *vigna radiata* (L.)

		1	2	3	4	5	6	7	8	9	10
1	Germination percentage	-2.425	-0.0003	1.564	-1.326	-0.867	-0.318	0.647	2.552	0.091	-0.519
2	Speed of germination	0.029	0.023	0.852	-0.343	1.971	-0.555	-0.625	-0.625	-0.098	-0.283
3	Seedling fresh weight	1.600	-0.008	-2.370	1.377	-2.387	0.839	1.366	-0.745	0.084	0.602
4	Seedling dry weight	2.001	-0.005	-2.032	1.606	0.358	0.601	-0.584	-2.017	-0.032	0.700
5	Seedling root length	0.378	-0.008	-1.016	-0.103	-5.568	0.416	4.100	1.999	0.238	0.016
6	Seedling shoot length	0.442	-0.007	-1.139	-0.553	-1.237	1.746	-1.080	0.774	-0.019	0.523
7	Root-Shoot ratio	-0.333	-0.005	-0.687	-0.199	-4.849	-0.400	4.708	1.274	0.226	-0.166
8	Vigour Index	-1.933	-0.005	0.551	-1.012	-3.477	0.422	1.873	3.201	0.178	-0.365
9	Protein content	0.612	0.006	0.555	0.141	3.679	0.093	-2.962	1.588	-0.359	0.219
10	Hundred seed weight	1.440	-0.008	-1.633	1.287	0.105	1.047	0.894	-1.337	0.090	0.874

Residual = 0.0504, Matrix of Direct and Indirect effects. Direct effects on main Diagonal.

vigour index was recorded, the root-shoot ratio character exhibited positive significant correlation with hundred seed weight and electrical conductivity. Vigour index which is very important character in our study, exhibited negative significant correlation with seed protein content, hundred seed weight and electrical conductivity. Hundred seed weight showed significant positive correlation with electrical conductivity confirming earlier findings as low vigour seeds leach out more leachates, which is responsible for electrical conductivity (Table2). Genetic correlation between yield contributing characters was reported by Kumar *et al.* (2013) in case of green gram.

From the Table 3 it can be concluded that root-shoot ratio, vigour index, seedling root length, seedling dry weight and hundred seed weight has direct contribution towards electrical conductivity, which is very important character to study seed deterioration. As we considered rate of seed deterioration in nine varieties of vigna radiata with three different seed coat colours, from our above study it can be concluded that the variety A-130(1) or V_6 under green seed coat group can be ranked as best seed as it showed less deterioration rate. But variety A-20 or V_1 under yellow seed coat group exhibited highest deterioration rate indicating the role of seed coat colour in controlling deterioration rate. Therefore, it is proved that there is a relation between seed coat colour and seed deterioration rate such type of information was also reported by Omokanye (1995). In the present study the varieties with green seed coat colour exhibited maximum (88.78%) percent of germination followed by seeds with brown seed coat colour and minimum germination percentage (60.89%) was obtained in seeds with yellow seed coat colour indicating poor seed vigour. This finding helps in selecting specific varieties having green seed coat colour for sowing to get maximum seedlings per unit area leading to more yield. Second important information which can help for choosing better storage material for seeds with yellow seed coat colour where most speedy seed deterioration was found. By studying seed coat colour farmers can select green seed coat colour for better seedling which can make more profit and finally for green gram the seeds with green seed coat can be stored for longer time.

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