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CORRELATION STUDIES AMONG SEED VIGOUR TRAITS AND YIELD IN DIFFERENT SEED LOTS OF G. HIRSUTUM L. COTTON

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ABSTRACT

Cotton is immensely important fibre crop of India having great role in economy. The quality seed is foundation for achieving desired production targets. Therefore, an experiment was conducted to assess the seed vigour traits in cotton (*Gossypium hirsutum* L.) and its association with seed cotton yield to predict the seed potential at Department of Agricultural Botany, Dr. Panjabrao Deshmukh Krishi Vidyapeeth Akola, Maharashtra (India) during the 2018–2019 with seven genotypes of *G. hirsutum* cotton *viz.*, AKH-13-55, AKH-13-81, AKH-14-59, AKH-14-12, AKH-13-92, AKH-13-26 and AKH-13-51. The analysis of six vigour traits in laboratory along with fifteen yield and yield contributing traits in field with objectives to estimate the mean performance of seed vigour traits in cotton and to assess the correlation between seed vigour traits and yield contributing characters. Genotypes *viz.*, AKH-14-12 and AKH-13-26 exhibited superiority for all six vigour traits, as well as found top ranking for most of yield contributing traits. Correlation coefficient analysis revealed that all six seed vigour parameters were significantly correlated with all fifteen yield and it's contributing traits in positive direction except ginning outturn and oil content which exhibited non significant association. The positive and highly significant correlation were recorded in between seed cotton yield per plant and all six vigour traits *viz.*, germination per cent (r=0.623**), root length (r=0.871**), shoot length (r=0.516*), seedling dry weight (r=0.754**), seed vigour index-I (r=0.905**) and seed vigour index-II (r=0.757**). Hence, utilization of seed vigour traits is possible and effective for the prediction of yield potential in cotton along with planting value of seed lot.

Keywords: Correlation, Cotton, *Gossypium hirsutum* L., Planting Value, Seed cotton yield, Seed Vigour Traits.

1. INTRODUCTION

Cotton is a major fibre crop of global importance with immense trade value; it's commercially in the temperate and tropical regions of more than seventy countries (Ujjainkar and Patil, 2021). Cotton is the "king of fiber" being the most important cash crop having profound influence on economics and social affairs of the world. It is one of the most important fiber and cash crop of India. It earns valuable foreign exchange and plays a dominant role in the industrial and agricultural economy of the country. Due to its importance in agriculture and industrial economics; it is designated as "White gold" It provides the vital raw material (cotton fibre) to cotton textile industry. In India cotton provides direct livelihood to six million farmers and about fourty to fifty million people are employed in cotton trade and processing. It's one among the crop species having great importance as multipurpose crop that supplies five basic products *viz.*, lint, oil, seed, meal and hull.

Seed is an basic input in agriculture, good quality seed is presumed to possess a high genetic purity, high seed vigour, high germination per cent, free from seed borne diseases and high yielding ability. Seed Vigour is one of the major factors that determining the success or failure of a crop. Seed vigor determines the potential for rapid and uniform emergence of plants under a wide range of field conditions. The quality of seed is a major concern in agriculture throughout the world. Rapid and uniform emergence of vigorous seedlings of the cultivar is key event to ensure high plant performance that affects uniformity of growth, yield and quality of the harvested product. These factors emphasize the importance of selecting high quality seed lots. In 1977, the International Seed Testing Association (ISTA) defined seed vigor as, (in part), "the sum of those properties which determine the potential level of activity and performance of the seed or seed lot during germination and seedling emergence." Recent advances might suggest that seed vigor is a new idea or concept being positioned for exploitation (Ujjainkar and Marawar, 2021) The basic objective of seed vigor testing is to provide a precise identification of important differences in physiological potential among commercial seed lots, mostly those having similar germination percentage, aiming to identification of seed lots having the higher probability by performance better in field or in storage (Ujjainkar and Marawar, 2021)

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Therefore, in the present study, preliminary attempts have been made to evaluate and compare the seed vigour with yield and its contributing characters in G.*hirsutum* cotton genotypes with a view to identify dependable tests for prediction of seed potential in terms of planting values and yield potential.

2. MATERIAL AND METHODS

This study included both laboratory and field evaluations of seven cotton (*Gossypium hirsutum* L.) genotypes *viz.*,AKH-13-55, AKH-13-81, AKH-14-59, AKH-14-12, AKH-13-92, AKH-13-26, AKH-13-51 to investigate the relationship existing between seed vigour traits and yield and its contributing characters in American cotton. The laboratory test was conducted at Seed Technology Research Unit, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MS) 444104. The experimental material comprises following genotypes (Table 1)

Table 1: The details of experimental material

Sr. No.	Genotypes	Source of seed
1	AKH-13-55	Cotton Research Unit, Dr. PDKV, Akola
2	AKH-13-81	Cotton Research Unit, Dr. PDKV, Akola
3	AKH-14-59	Cotton Research Unit, Dr. PDKV, Akola
4	AKH-14-12	Cotton Research Unit, Dr. PDKV, Akola
5	AKH-13-92	Cotton Research Unit, Dr. PDKV, Akola
6	AKH-13-26	Cotton Research Unit, Dr. PDKV, Akola
7	AKH-13-51	Cotton Research Unit, Dr. PDKV, Akola

Morphological observations were recorded for six seed vigour traits *viz.*,germination per cent, root length, shoot length, seedling dry weight, seed vigour index-I and seed vigour index-II along with fifteen yield and yield contributing characters *viz*., field emergence per cent, days to first flowering, days to 50% flowering, days to 50% boll bursting, plant height, number of monopodia per plant, number of sympodia per plant, number of boll per plant, number of seed per boll, boll weight, seed index, ginning per cent, lint index, oil per cent and seed cotton yield per plant. The laboratory experiment and field experiment were laid down separately using completely randomized design and randomized block design, respectively as per the standard procedures given by Panse and Sukhatme (1967).

3. RESULTS AND DISCUSSION

Analysis of Variance (ANOVA): The data were collected for six seed vigour traits and fifteen yield contributing characters were subjected to analysis of variance by complete randomized block design (Table 2) and randomized complete block design (Table 3) respectively. The variation among genotypes was found highly significant for all six vigour traits indicating substantial degree of variation among material for seed vigour traits and highlighted the differences among genotypes for initial seedling vigour in laboratory conditions.

The analysis of variance of fifteen yield and its contributing characters revealed highly significant differences among the all genotypes for morphological traits, indicated substantial degree of diversity among the experimental material for yield and its contributing traits under the study. The replication differences were non-significant for all the characters as presented in Table 3. The mean performance of genotypes for morphological traits has been given in Table 5.

Table 2: Analysis of variance of seed vigour traits of G.*hirsutum* genotypes in laboratory

Sr. No.	Characters	Source of variations	
		Genotypes (df - 6)	Error (df - 21)
1	Germination Percentage (%)	9.05**	2.17
2	Root length (cm)	3.41**	0.16
3	Shoot length (cm)	2.90**	1.11
4	Seedling dry weight (mg)	256.65**	20.83
5	Seed Vigour Index – I	165692**	1501.6
6	Seed Vigour Index – II	250.27**	20.55

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,** - significant at 5% and 1% level of significance

Table 3: Analysis of variance of yield and yield contributing characters of G.*hirsutum* genotypes in field experiment

Sr. No.	Characters	Source of variations		
		Replications (df - 2)	Genotypes (df - 6)	Error (df - 12)
1	Field emergence (%)	0.37	7.06**	1.25
2	Days to first flowering	4.33	13.63**	2.77
3	Days to 50 per cent flowering	0.19	20.85**	2.19
4	Days to 50 per cent boll bursting	2.33	12.53*	3.77
5	Plant height (cm)	9.80	165.97**	7.90
6	No of monopodia per plant	0.02	0.23*	0.06
7	No of sympodia per plant	2.35	29.56**	1.95
8	No of bolls per plant	1.04	25.50**	1.16
9	No of seeds per boll	1.66	9.06*	2.52
10	Boll weight (g)	0.01	0.15**	0.01
11	Seed Index (g)	0.22	9.68**	0.23
12	Ginning outturn (%)	0.72	6.12**	0.67
13	Lint index	0.05	2.80**	0.11
14	Oil content (%)	0.41	4.92**	0.22
15	Seed Cotton Yield per plant (g)	4.41	61.65**	5.29

,** - significant at 5% and 1% level of significance

Seed Vigour Traits: Seed vigour, a single concept reflecting several characters determines the seed quality and uniform emergence potential of plants in field under variable range of environments. Uniform vigorous seed germination, emergence along with final stand establishment is fundamental factors for a successful crop with high yields. The evaluation of germination and identification of seed lots of high performance is an important initiative towards successful crop production, and consequently information from seed laboratories must accurately detect differences in physiological potential among tested seed lots (Jadhav D.V., 2019). The mean performance of seed vigour traits *viz.*, germination per cent, root length, shoot length, seedling dry weight, seed vigour index-I and seed vigour index-II of seven genotypes has been summarised as follows (Table 4).

Table : 4 Mean performance of seed vigour traits.

Genotype	Germination (%)	Root length (cm)	Shoot length (cm)	Seedling dry wt. (mg)	Seed vigour index-I	Seed vigour index-II
AKH-13-55	90.25	12.65	11.18	40.30	2256.25	36.37
AKH-13-81	91.00	13.43	11.73	46.90	2366.00	42.79
AKH-14-59	88.25	11.90	10.38	32.85	2118.00	28.99
AKH-14-12	93.25	14.58	12.70	56.35	2680.00	52.49
AKH-13-92	90.75	13.05	11.48	45.50	2268.75	41.30
AKH-13-26	91.25	13.85	12.23	50.25	2555.00	45.87
AKH-13-51	90.00	12.30	10.93	37.25	2182.00	33.55

Range	88.25-93.25	11.90-14.58	10.38-12.70	32.85-56.35	2118.00-2680.00	28.99-52.49
GM	90.67	13.10	11.51	44.20	2346.57	40.19
SE(Mean) ±	0.73	0.20	0.52	2.28	19.37	2.26
CD at 5%	2.14	0.58	1.53	6.62	56.22	6.57

The simplest and most direct method of testing the quality of seed for its planting value is a germination test. As it is expresses the results of standard germination test (Table 4). Showed that all the seven upland cotton genotypes had germination above (65.00%) i.e. minimum standard certification level in laboratory conditions. Germination per cent ranged from 88.25 to 93.25 per cent with mean of 90.67 per cent. The maximum germination per cent was recorded in AKH-14-12 (93.25%) which is at par with AKH-13-26 (91.25%) and significantly differ from AKH-13-81 (91.00%) followed by AKH-13-92 (90.75), AKH-13-55 (90.25) and AKH-13-51 (90.00%) The lowest germination per cent was recorded in genotype AKH-14-59 (88.25%). Significant positive relationship (r=0.81*) was observed germination per cent with days to first flowering and days to 50% flowering. However, non significant but positive associations of days to 50% flowering (r=0.276) and oil per cent (r=0.190) with germination per cent as it ensures the potential of seed lot for viability and plant stand. It is concluded that the relationship of germination per cent with yield contributing characters is strong and it could be a criterion for selection of superior genotypes.

In mature plant of cotton roots accounted only 10 to 20 % of the total dry weight (Wrona 1999). Although roots are only of the most important organ to help a plant to produce quality product by providing nourishment. After twelve days, the seedling root length was measured in laboratory. The root length ranged from 11.90 to 14.58 cm with mean of 13.10 cm. The genotype AKH-14-12 (14.58 cm) and AKH-13-26 (13.85 cm) recorded the maximum and statistically significant root length followed by AKH-13-81 (13.43 cm), AKH-13-92 (13.05), AKH-13-55 (12.65) and AKH-13-51 (12.30 cm). The shortest root length was recorded in genotype AKH-14-59 (11.90 cm). In the present investigation root length showed positive correlation with all fifteen yield contributing characters with statistical significance whereas ginning outturn (%) exhibited non significant (0.103) but positive correlation with seedling root length (Table 6). Seedling root length shown highly significant and positive correlation with number of sympodia per plant (r=0.874**) followed by number of boll per plant (r=0.872**), plant height (r=0.872**), boll weight. (r=0.871**), seed cotton yield per plant (r=0.871**), lint index (r=0.803**), seed index (r=0.797**), days to 50% boll bursting (r=0.729**), number of seed per boll (r=0.711**), field emergence percentage (r=0.709**), days to 50% flowering (r=0.651**), days to first flowering (r=0.633**), no of monopodia per plant (r=0.521**) and oil per cent (r=0.445*) (Table 6).

Table 5: Mean performance of yield contributing characters

SN	Genotype	FE	FF	50%F	BB	PH	MONO	SYMP	BOLLS	SB	BW	SI	GO	LI	OIL	SCY
1.	**AKH-13-55**	87.26	57.33	62.33	107.67	71.53	1.53	15.27	18.87	18.47	3.29	9.58	36.27	5.45	14.06	26.56
2.	**AKH-13-81**	90.27	59.00	67.33	109.33	76.00	1.60	17.80	20.33	19.40	3.46	9.06	36.07	5.12	17.33	29.52
3.	**AKH-14-59**	86.37	58.00	64.67	108.00	65.40	1.13	13.33	14.00	17.53	3.12	8.73	33.20	4.34	14.16	25.11
4.	**AKH-14-12**	89.57	62.00	67.67	112.67	86.33	1.87	22.47	22.60	22.33	3.76	12.72	35.07	6.87	15.25	37.68
5.	**AKH-13-92**	87.60	59.67	64.67	107.67	74.13	1.53	17.20	19.20	19.00	3.36	9.59	33.27	4.79	14.26	28.78
6.	**AKH-13-26**	88.87	62.00	68.33	111.33	80.80	2.00	19.33	21.27	21.20	3.60	11.60	32.73	5.65	15.16	33.09
7.	**AKH-13-51**	86.45	56.67	61.67	107.67	66.87	1.73	14.40	16.53	18.07	3.20	7.38	34.67	3.92	13.43	29.48
	Range	86.37 to 90.2	56.67 to 62.0	61.67	107.67 to 112.	65.40 to 86.3	1.13 to	13.33 to	14.00 to	17.53 to 22.3	3.12 to	7.38 to	32.73 to 36.2	3.92 to	13.43 to 17.3	25.11 to 37.6

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		7	0	to 68.33	67	3	2.00	22.47	22.60	3	3.76	12.72	7	6.87	3	8
	GM	88.05	59.23	65.23	109.19	74.43	1.62	17.11	18.97	19.43	3.40	9.81	34.46	5.16	14.81	29.48
	SE(M) ±	0.64	0.96	0.85	1.12	1.62	0.14	0.80	0.62	0.91	0.06	0.27	0.47	0.19	0.27	1.32
	CD at 5%	1.90	2.82	2.51	3.29	4.77	0.44	2.37	1.82	2.69	0.17	0.82	1.39	0.58	0.80	3.90

[**Abbreviations Used: FE**- Field Emergence, **FF**-Days to first flowering, **50%F**-Days to 50% flowering, **BB**- Days to Boll bursting, **PH**- Plant Height, **MONO**-No. of monopodia per plant, **SYMP**- No of sympodia per plant, **BOLLS**-No of bolls per plant, **SB**-Seeds per Boll, **BW**-Boll weight, **SI**-Seed Index, **GO**-Ginning outturn, **LI**-Lint Index, **OIL**-Oil content and **SCY**-Seed Cotton Yield per plant.]

Table 6: Correlation coefficients between Seed vigour traits and seed cotton yield contributing characters

Sr. No.	Yield contributing characters	Correlation coefficients (r)					
		Germination (%)	Root length (cm)	Shoot length (cm)	Seedling dry wt. (mg)	Seed Vigour Index-I (SVI-I)	Seed Vigour Index-II (SVI-II)
1	Field emergence percentage	0.536*	0.709**	0.380	0.718**	0.737**	0.720**
2	Days to first flowering	0.457*	0.633**	0.524*	0.656**	0.718**	0.654**
3	Days to 50% flowering	0.276	0.651**	0.425	0.576**	0.684**	0.562**
4	Days to 50% boll bursting	0.565**	0.729**	0.538*	0.593**	0.727**	0.603**
5	Plant height (cm)	0.671**	0.872**	0.658**	0.861**	0.929**	0.859**
6	No. of monopodia/ plant	0.557**	0.521*	0.300	0.623**	0.604**	0.627**
7	No. of sympodia /plant	0.777**	0.874**	0.682**	0.869**	0.918**	0.876**
8	No. of boll/ plant	0.814**	0.872**	0.593**	0.876**	0.857**	0.888**
9	No. of seed/ boll	0.699**	0.711**	0.320	0.768**	0.788**	0.783**
10	Boll wt. (g)	0.698**	0.871**	0.541*	0.872**	0.917**	0.876**
11	Seed index(g)	0.565**	0.797**	0.564**	0.726**	0.881**	0.729**
12	Ginning per cent	0.300	0.103	0.116	0.123	0.069	0.139
13	Lint index	0.648**	0.803**	0.583**	0.736**	0.868**	0.745**
14	Oil per cent	0.190	0.445*	0.413	0.402	0.425	0.397
15	Seed cotton yield/plant (g)	0.623**	0.871**	0.516*	0.754**	0.905**	0.757**

(* , ** significant at 1% and 5% level of significance)

The seedling shoot length differed statistically significant among different genotypes. Shoot length data (Table 4) reveals that the mean performance of shoot length ranged from 10.38 to 12.70 cm, and general mean of 11.51cm. The maximum shoot length (12.70 cm) has recorded in genotype AKH-14-12 which is at par with AKH-13-26 (12.23 cm) followed by AKH-13-81 (11.73 cm), AKH-13-92 (11.48 cm), AKH-13-55 (11.18 cm) and AKH-13-51 (10.93 cm). The shortest shoot length was recorded in genotype AKH-14-59 (10.38 cm). Similar trend was observed for shoot length as in root length. The AKH-14-12 genotype has shown better shoot growth among the genotypes. The almost all the results showed positive relationship, where as all were statistically significant except days to 50% flowering (r=0.425), oil per cent (r=0.413), field emergence percentage (r= 0.380), number of seed per boll (r=0.320), number of monopodia per plant (r=0.300) and ginning per cent (r=0.116). The seedling shoot length showed highly significant positive correlation with number of sympodia per plant (r=0.682**) followed by plant height (r=0.658**), number of boll per plant (r= 0.593**), lint index (r=0.583**), seed index (r=0.564**), boll weight (r=0.541*), days to 50% boll bursting (r=0.538*), days to first flowering (r=0.524*) and seed cotton yield per plant (r=0.516*) as shown in (Table 6).

The seedling dry weight actually represents the mass in quantum of seed reservoir that could be converted into seedling biomass. It indicates the potential of seed food reservoir of seed. The seedling dry weight ranged between 32.85 to 56.35 mg with general mean 44.20 mg. The maximum seedling dry weight (56.35 mg) was recorded in the genotype AKH-14-12 followed AKH-13-26 (50.25 mg), AKH-13-81 (46.90 mg), AKH-13-92 (45.50 mg), AKH-13-55 (40.30 mg) and AKH-13-51(37.25 mg) The genotype AKH-13-81 and genotype AKH-13-92 exhibited seedling dry weight at par with both genotypes *viz.,* AKH-14-12 and AKH-13-26. (Table 4). In present investigation the genotypes *viz.,* AKH-14-12 and AKH-13-26 exhibited the better seedling dry weight i.e. more than 50 mg in comparison to other genotypes. In comparison to seed food reservoirs into vigorous seedling and subsequent yield potential. In present investigation, seedling dry weight showed significant correlation in positive direction with all fifteen yield and it's contributing traits, while numerically superiority for oil percent (r=0.402) and ginning per cent (r=0.123) in positive direction. Seedling dry weight showed highly significant and positive association with most of contributing characters indicating importance of potential of utilization of seed food reservoir for seedling growth and establishment. The characteristics of seedling dry weight showed high degree of correlation with number of boll per plant (r=0.876**), boll weight (r=0.872**), number of sympodia per plant (r=0.869**), plant height (r=0.861**), number of seed per boll (r=0.768**), seed cotton yield per plant (r=0.754**), lint index (r=0.736**), seed index (r=0.726**), field emergence percentage (r=0.718**), days to first flowering (r=0.656**), number of monopodia per plant (r=0.623**), days to 50% boll bursting (r=0.593**) and days to 50% flowering (r= 0.576**) as shown in (Table 6). The seedling dry weight show that the major role of determination of initial stamina for the seedling growth and development. Among the yield and its contributing traits *viz.,* number of boll per plant, field emergence per cent, number of sympodia per plant, number of seed per boll, seed index show significant association in positive direction.

Seed vigour defined as the sum total of those properties of the seed which determine the level of activity and performance of the seed or seed lot during germination and seedling emergence (Perry, 1970). The seed vigour index-I ranged from 2118.00 to 2680.00 with mean of 2346.57. In present investigation three genotypes *viz.,* AKH-14-12, AKH-13-26, AKH-13-81 recorded the seed vigour index more than general mean indicating. Data was found statistically significant. The maximum seed vigour index was recorded in genotype AKH-14-12 (2680.00) followed by AKH-13-26 (2555.00), AKH-13-81 (2366.00), AKH-13-92 (2268.75), AKH-13-55 (2256.25) and AKH-13-51 (2182.00). The lowest seed vigour index-I (2118.00) was recorded in genotype AKH-14-59. Seed vigour index-I may be termed as a index of seedling growth, as it's related with the seedling length. In result exhibited that shoot and root lengths were having close resemblance. Vigour testing is more sensitive measure of seed physiological quality and requires more vigorous control of test variables.

The seed vigour index-I shown highly degree of positive and significant correlation with plant height (r=0.929**), number of sympodia per plant (r=0.918**) followed by boll weight (r=0.917**). As a similar trend was found for the other yield contributing traits expressed positive and highly significant associated with seed cotton yield per plant (r=0.905**), seed index (r=0.881**), Lint index (r=0.868**), number of boll per plant (r=0.857**), number of seed per boll (r=0.788**), field emergence percent (r= 0.737**), days to 50% boll bursting (r=0.727**), days to first flowering (r=0.718**), days to 50% flowering (r=0.684**) and number of monopodia per plant (r=0.604**) the seed vigour index-I showed non-significant association but positive with oil per cent (r=0.425) and ginning per cent ((r=0.069) as shown in (Table 6).

Seed vigour index-II is determined by formula in which the multiplication of germination per cent with seedling dry weight on the day of final count is done. Seed vigour index-II ranged from 28.99 to 52.49 whereas the general mean was 40.19. The genotype AKH-14-12 recorded maximum significant (52.49) seed vigour index-II over AKH-13-26 (45.87) followed by AKH-13-81 (42.79), AKH-13-92 (41.30), AKH-13-55 (36.37) and AKH-13-51 (33.55). The least seed vigour index (28.99) was recorded in genotype AKH-14-59, In present investigation AKH-14-12, AKH-13-26, AKH-13-81 were found vigorous accordance to seed vigour index-I and seed vigour index-II as compared to other genotypes confirming the better seedling growth along with better utilization of seed food reserve during the process of germination and subsequent seedling development. The genotypes AKH-14-59, AKH-13-51, AKH-13-55 and AKH-13-92 shown less magnitude of seed vigour index-I and seed vigour index-II indicating comparatively slower seedling development and lower quality of seed reservoir along with conversion efficiency. It is further observed that there three genotypes recorded comparatively low range of test weight. The smaller seeds, due to poor hydration efficiency and comparatively lesser stored food reserves produces weaker seedlings with low vigour indices.

In present investigation seed vigour index-II shown positive correlation with all fifteen yield contributing traits *viz.* number of boll per plant (r=0.888**), number of sympodia per plant (r=0.876**) followed by weight (r=0.876**), plant height (r=0.859**), number of seed per boll (r=0.783**), seed cotton yield per plant (r=0.757**) , lint index (r=0.745**), seed index (r=0.729**), field emergence percentage (r= 0.720**), days to first flowering (r=0.654**),

number of monopodia per plant (r=0.627**), days to 50% boll bursting (r=0.603**) and days to 50% flowering (r=0.562**) etc. Whereas, seed vigour index- II was non significant but positively associated with oil per cent (r=0.397) and ginning per cent (r=0.139) Table 6.

4. CONCLUSION

Among all seven genotypes, AKH-14-12 and AKH-13-26 found top ranking in respect of seed vigour traits and yield contributing traits, which also depicted the close resemblance among vigour parameters and important yield contributing traits. The selection for quality and potential seed may be done at seedling stage in laboratory for successful crop stand. Also the seed vigour traits may be useful for predicting the potential of seed lots.

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