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SEED VIABILITY AND VIGOUR ASSESSMENT OF DIFFERENT SEED LOTS OF TETRAPLOID AND DIPLOID COTTON

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ABSTRACT

The experimental study comprised of two seed lots, freshly harvested and aged seed (carryover seed) of two tetraploid (*Gossypium hirsutum*), Suraj and LRA-5166 and two diploid (*Gossypiumar boreum*), PA-255 and AKA-8 cotton varieties procured from Division of Crop Improvement, ICAR-CICR, Nagpur were evaluated for their viability and vigour parameters in laboratory as well as field conditions in complete randomised block design with three replications during 2018-19. The results revealed that among the four varieties of cotton, the variety LRA-5166 was observed to be significantly superior for all the viability and vigour parameters *viz*., standard germination test, methanol test, cold test, pot germination test, accelerated ageing test, cool warm vigour index, other vigour indices and seedling establishment. It was followed by cotton varieties, PA-255 and Suraj indicating medium vigour seeds. However, the seed lot of variety AKA-8 was poorly performed and found inferior due to low vigour and viability parameters. It was also inferred that the freshly harvested seed lot had exhibited superior for all the viability and vigour parameters due to high seed vigour as compared to aged seed lot (carryover seed) which might have deteriorated during the storage.These vigour tests alone or in combination can be useful for predicting vigour of cotton seed lots before being utilization for planting in the field.

(Key words: Cotton, Gossypium, seed viability and vigour assessment)

INTRODUCTION

Cotton (*Gossypium Spp*.) is one of the most economically important fiber crops of the world. It is one of the most commercially important cultivated fiber crops throughout the world because of its natural textile fiber and cottonseed oil. Cotton seed quality includes readily measurable characteristics such as viability, seed lot purity, health, and mechanical damage, but a further essential component is the more enigmatic trait of seed vigour (Perry,1980). Seed is seldom planted immediately after harvesting; it is stored for a few days, weeks, months or years during which the seeds deteriorate, moving inexorably towards death (Gregg *et al*., 1994). During deterioration, vigour is the first component of seed quality, which is lost, followed by a loss of germination capacity and viability (Trawatha *et al*., 1995). Nevertheless, reduction in seed germination andseedling vigour is affected by various factors, among which the most important is seed borne pathogens (Kasherwani *et al*., 2018).Whereas, application of fungicidal and biocontrol agents increases the seedling vigour index by keeping seed borne mycoflora under check (Kasherwani *et al*., 2018 and Jogi *et al*., 2010).Vigour is an aspect of seed quality which controls field stand establishment ability and hence, vigour tests are required to obtain reliable assessments of field performance (Bishnoi and Delouche, 1980). Moyo *et al*. (2015) suggested that vigour test methods are better than the standard germination test in predicting field emergence. Earlier work on seed vigour has been largely directed towards developing the basis for testing and quantifying differences between lots, which is of great industrial relevance. Understanding how seed lots age and deteriorate, minimizing the rate and impact of this deterioration, and the negative impact of suboptimal seed production and processing has established a framework for controlling, predicting, and maintaining seed performance, and forms the basis of industrial seed technology and current seed vigour testing (Powell, 2006).The present investigation was therefore, carried out to evaluate and assess different seed vigour and viability parameters of diploid and tetraploid cotton varieties.

MATERIALS AND METHODS

The experimental study material comprised two each cotton varieties of tetraploid (*Gossypium arboreum*), Suraj and LRA-5166 and diploid (*Gossypium hirsutum*), PA-255 and AKA-8. The present study comprised two each of tetraploid, Suraj and LRA-5166 and diploid, PA-255 and

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AKA-8 varieties of cotton. Each varieties having two seed lots, freshly harvested and aged seed (Carryover seed) were procured from Division of Crop Improvement, ICAR-CICR, Nagpur.The experiment was conducted at ICAR-CICR, Nagpur in complete randomised block design with three replications during 2018-19. Each seed lot of all the four varieties were used for various seed viability and vigour parameters in the laboratories, pot cultures and field experiments. The observations were recorded for standard seed germination (Anonymous, 2015), root, shoot, seedling lengths and vigour index (Abdul-Baki and Anderson, 1973), cold/cool germination test (Delouche and Baskin, 1970), methanol test (Hernandez, 1987), accelerated ageing test (Byrd and Delouche, 1971), cool warm vigour index (Metzer, 1987), critical root length (Jensen, 2002), pot germination and field emergence. The replicated data recorded during the experiments conducted in laboratory, pots and field were processed and statistically analysed with the help of 'Statistical Software Package for Agricultural Research Workers' developed by Sheoran *et al.* (1998).

RESULTS AND DISCUSSION

Mean values and range of different vigour and viability test parameters for different seed lots of cotton varieties have been given in Table 1. The standard seed germination at 4th day had overall mean 73.0% and range varied from 67 to 81%. Similarly, mean standard seed germi -nation at 7th day was 83% and ranged from 76.3 to 90.7%. Varietal mean was found to be maximum for LRA-5166 (86.4%) and minimum for AKA-8 (79.3%) indicating that the LRA-5166 had good vigour and viable seed as compared to AKA-8. Maeda *et al.* (2021) reviewed and explained that the hardness of the cotton seed coat, storage conditions, extreme temperatures, soil moisture, seed moisture content and dormancy are some of the factors that can influence cotton seed germination.Seedling length showed variation from 17.7 to 26.1 cm with an overall mean of 22.0 cm. The maximum seedling length was recorded for LRA-5166 (26.0 cm) followed by PA-255 (21.8 cm) and Suraj (20.6 cm). The lowest seedling length was observed for AKA-8 (19.8 cm) which showed poor seedling vigour. The germination and seedling length of aged seed lot was found to be lower than freshly harvested seed. Decline in germination and seedling length in old seed lot as compared to fresh seed lot was earlier reported by Kaul (1969) in triticale with well correlation among them.

The vigour index calculated by standard germination (%) multiplied by the seedling length (cm) at 4th day had overall mean 692.9 and range varied from 457.4 to 972.9. Similarly, mean vigour index 7th day was ranged from 1349.4 to 2371.8 with an overall mean was 1837.4. Varietal mean for vigour index was found to be maximum for LRA-5166 (2244.1) and minimum for AKA-8 (1574.1) indicating that the seed of LRA-5166 had good vigour and viability as compared to AKA-8. Madhu *et al.* (2014) reported that genotype H-1226 was observed to be superior for all the vigour parameters except seedling length, vigour index-I, seed weight and seed density in American cotton.

Sowmeya *et al.* (2018) reported that fresh seed lot recorded significantly higher germination (77.00%), seedling vigour index (1257), dehydrogenase enzyme activity (0.555 OD value) and alpha amylase activity (23.23 mm) as compared to old seed lot (70.66%, 1089, 0.337 OD value and 19.50 mm, respectively) in carrot.

The cold germination test had overall mean 41.1% and range varied from 24.7 to 58.3%. Varietal mean for cold germination test was found to be maximum for LRA-5166 (49.0%) and minimum for AKA-8 (33.9%) indicating that the seed of LRA-5166 had good vigour and viability as compared to AKA-8. The efficiency of cool germination test to evaluate vigour of cotton seeds has been shown by Dias and Alvarenga (1999) and was considered most efficient test for monitoring the vigour of stored cotton seeds (Freitas *et al.*, 2000).

The cool germination vigour index had overall mean of 356.4 and range varied from 97.6 to 1224.3. Varietal mean for cool germination vigour index was found to be maximum for LRA-5166 (612.2) and minimum for AKA-8 (179.1) indicating that the seed of LRA-5166 had good vigour and viability as compared to AKA-8. Savoy (2005) observed that a vigour index based on a combination of cool and standard germination test results is a good predictor of field emergence in cotton.

The critical root length had overall mean of 4.8 cm and range varied from 2.17 to 7.47 cm. Varietal mean for critical root length was found to be maximum for LRA-5166 (7.4 cm) and minimum for AKA-8 (2.7 cm) indicating that the LRA-5166 had good vigour and viable seed as compared to AKA-8. Madhu *et al.* (2014) observed that amongst different seed lots of cotton varieties H-1098, H-1117 and H-1226, the genotype H-1117 was observed to be inferior for almost all the tested vigour parameters. Jensen (2002) found a good correlation between the percentage of germinated cotton seedlings with a critical root length and field emergence under cool soil conditions.

The cool warm vigour index had overall mean of 114.1 and range varied from 91.67 to 139.3. Varietal mean for cool warm vigour index was found to be maximum for LRA-5166 (125.0) and minimum for AKA-8 (104.2) indicating that the LRA-5166 had good vigour and viable seed as compared to AKA-8. Gregory *et al.* (1986) and Metzer (1987) showed good correlations between the cool-warm vigour index (CWVI) test and initial stand establishmentin cotton. They further reported that the cool-warm vigour index (CWVI) test was a good indicator of final stand taken 6 weeks after planting.

The methanol germination test had overall mean of 64.5% and range varied from 53.3 to 76.7%. Varietal mean for methanol germination test was found to be maximum for LRA-5166 (69.7%) and minimum for AKA-8 (61.0%) indicating that the LRA-5166 had good vigour and viable seed as compared to AKA-8. Lee *et al.* (2000) shown that methanol concentration was linearly related to viability and so can be relevant as biochemical indicator of seed vigour in soybean. Methanol stress mimicked the effect of field weathering relative to seed deterioration, germination, reaction to seed-seedling pathogens, stand establishment and it is reliable technique to determine the quality, viability and vigour of cottonseed (Hernandez, 1987). Hernandez *et al*. (1988) further demonstrated that the methanol stress technique was also effective for altering viability and vigour of cottonseed.

Lovato *et al*. (2001) observed that accelerated aging test is one of the most often used tests for vigour testing in maize today, first of all because it is well correlated with field emergence.Stress condition provided by the artificial ageing for 96 hours in accelerated ageing chamber indicated that the seed deterioration was slow till 48 hours of accelerated ageing seed however, germinability had dropped sharply after 48 hours of accelerated ageing till 96 hours. Iqbal *et al*. (2002) reported similar findings with concomitant decrease in the seedling length, seedling fresh weight and seedling dry weight with reduction of germination percentage in cotton.The accelerated ageing test had overall mean of 83.0% germination reduced to 65.9% after 48 hours, 43.7% after 72 hours and finally 24.9% after 96 hours. The varietal mean for accelerated ageing test was found to be maximum for LRA-5166 due to initial higher vigour and minimum for AKA-8 during the test indicating that the LRA-5166 had good vigour and viable seed as compared to AKA-8. Egli and Tekrony (1996) reported that noncarryover seed had higher prediction accuracy than carryover seed for standard germination, but there was little difference for accelerated ageing in soybean. They considered accelerated ageing test as standardized and correlated with field emergence under a variety of seedbed conditions. Gholami and Golpayegani (2011) studies suggested that the effect of artificially aged rice seeds leads to considerable loss in seedling vigour with passage of ageing period.Cotton seeds deteriorate at a fast rate as they are prone to free radical damage due to a high linoleic acid content and membrane lipid peroxidation due to imbalance in the reactive oxygen scavenging system (Goel *et al*., 2003).

The pot germination had overall mean of 71.3% and range varied from 54.7 to 85.7%. Varietal mean for cool warm vigour index was found to be maximum for LRA-5166 (78.0%) and minimum for AKA-8 (64.5%) indicating that the LRA-5166 had good vigour and viable seed as compared to AKA-8. Ellis (1992) emphasized that seed vigour may affect seedling emergence but the extent to which this parameter might influence subsequent seedling or plant growth is not clear enough. The impacts of vigour on seedling establishment from seeds of commercial quality have been observed in small-seeded vegetable species and a wide range of other crops (Powell, 2006).

The field emergence had variation ranging from 51.0 to 83.7% with overall mean emergence of 68.7%. Varietal mean for field emergence was found to be maximum for LRA-5166 (75.5%) and minimum for AKA-8 (62.2%) indicating that the LRA-5166 had good vigour and viable seed as compared to AKA-8. Similar findings regarding the superiority of high vigour seed lot over others was also reported by Jhamb (2008) in cotton.The poor performance of AKA-8 seed lot in terms of all the vigour parameters may be due to a decline in seed vigour and viability that might have caused by a variety of biochemical processes in the seed that can be accelerated under inappropriate temperature and moisture conditions (McDonald, 1999). Similar impacts of seed vigour on seedling establishment from seeds of commercial quality have been observed in wide range of other crops (Powell, 2006). Recently, Ebone *et al*. (2020) reported that the seeds with the highest vigour level showed higher uniformity and faster emergence in soybean.

Results from this experiment provided useful information regarding the assessment of cotton seed physiological potential. It is inferred from the above results that high vigour seed lots performed better in all the tested vigour and viability parameters as compared to the low vigour seed lot. The variety LRA-5166 was observed to be significantly superior for all the viability and vigour parameters due to high initial seed vigour. Whereas, the other cotton varieties, PA-255 and Surajhad medium vigour seed and performed next to LRA-5166. However, the seed lot of variety AKA-8 was poorly performed in all the vigour and viability parameters and found inferior due to low initial seed vigour. It was also inferred that the freshly harvested seed lot had exhibited superior for all the viability and vigour parameters due to high seed vigour as compared to aged seed lot (carryover seed) which might have deteriorated during the storage. These vigour tests alone or in combination can be useful for predicting vigour of cotton seed lots before being utilization for planting in the field.

Table 1. Mean values of different vigour and viability test parameters for different seed lots of cotton varieties

Varieties (A)*	Seed Lot (B)#	Std. Germn 4th day (%)	Std. Germn 7th day (%)	Seedling g Length, (cm)	Vigour Index 4th Day	Vigour Index 7th Day	Cold Test Germ. (%)	Cool Germ Vigour Index	Critical Root Length (cm)	Cool Warm Vigour Index	Methanol Test Germn. (%)	Accelerated Ageing Test 24 hrs	48 hrs	72 hrs	96 hrs	Pot Germn. (%)	Field Emergence 7thDay (%)
Suraj	Fresh Seed	76.7	84.3	21.7	761.1	1824.2	45.3	381.1	5.13	122.00	64.0	85.7	68.3	48.7	26.7	73.0	70.33
	Aged Seed	68.0	80.3	19.4	558.6	1553.8	34.7	179.1	3.63	102.67	59.0	82.7	59.7	37.0	20.3	62.0	59.67
Variety Mean		**72.4**	**82.3**	**20.6**	**659.8**	**1689.0**	**40.0**	**280.1**	**4.40**	**112.3**	**61.5**	**84.2**	**64.0**	**42.9**	**23.5**	**67.5**	**65.00**
LRA-5166	Fresh Seed	81.0	90.7	26.1	972.9	2371.8	58.3	751.0	7.37	139.33	76.7	91.7	75.7	60.7	38.0	87.7	83.67
	Aged Seed	71.0	82.0	25.8	769.3	2116.4	39.7	473.3	7.47	110.67	62.7	80.0	64.0	42.3	22.3	70.3	67.33
Variety Mean		**76.0**	**86.4**	**26.0**	**871.1**	**2244.1**	**49.0**	**612.2**	**7.40**	**125.0**	**69.7**	**85.9**	**69.9**	**51.5**	**30.2**	**78.0**	**75.50**
PA-255	Fresh Seed	78.7	89.0	24.8	937.6	2205.6	52.7	501.1	5.70	131.33	74.3	87.0	72.3	55.7	34.3	83.0	80.33
	Aged Seed	68.0	79.0	18.7	629.1	1479.5	30.7	207.5	4.03	98.67	57.0	78.0	60.3	32.0	16.7	67.0	64.00
Variety Mean		**73.3**	**84.0**	**21.8**	**783.4**	**1842.6**	**41.7**	**354.3**	**4.90**	**115.0**	**65.7**	**82.5**	**66.3**	**43.9**	**25.5**	**75.0**	**72.20**
AKA-8	Fresh Seed	73.7	82.3	21.9	523.6	1798.8	43.0	260.6	3.17	116.67	68.7	83.3	70.0	46.3	28.7	74.3	73.33
	Aged Seed	67.0	76.3	17.7	391.2	1349.4	24.7	97.6	2.17	91.67	53.3	75.3	57.0	27.0	12.0	54.7	51.00
Variety Mean		**70.4**	**79.3**	**19.8**	**457.4**	**1574.1**	**33.9**	**179.1**	**2.70**	**104.20**	**61.0**	**79.3**	**63.5**	**36.7**	**20.4**	**64.5**	**62.20**
Overall Mean		**73.0**	**83.0**	**22.0**	**692.9**	**1837.4**	**41.1**	**356.4**	**4.80**	**114.10**	**64.5**	**83.0**	**65.9**	**43.7**	**24.9**	**71.3**	**68.70**
Range		67.0-81.0	76.3-90.7	17.7-26.1	457.4-972.9	1349.4-2371.8	24.7-58.3	97.6-1224.3	2.17-7.47	91.67-139.3	53.3-76.7	75.3-91.7	57.0-75.7	27.0-60.7	12.0-38.0	54.7-85.7	54.0-83.7
CD at 5% (A)*		**NA**	**3.26**	**1.84**	**85.2**	**176.1**	**3.39**	**41.80**	**0.63**	**5.89**	**4.02**	**1.54**				**4.31**	**5.07**
SEm (±) (A)*		**1.39**	**1.08**	**0.61**	**28.2**	**58.2**	**1.12**	**13.82**	**0.21**	**1.95**	**1.33**	**0.55**				**1.42**	**1.66**
CD at 5% (B)#		**2.98**	**2.30**	**1.3**	**60.2**	**124.5**	**2.40**	**29.56**	**0.45**	**4.17**	**2.84**	**1.09**				**3.05**	**3.59**
SEm (±) (B)#		**0.98**	**0.76**	**0.43**	**19.9**	**41.2**	**0.79**	**9.77**	**0.15**	**1.38**	**0.94**	**0.39**				**1.01**	**1.17**

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