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Standardization of Vigour Test for Measuring the Vigour Status of Mustard Genotypes

¹V. Vijaya Geetha, ²P. Balamurugan and ³M. Bhaskaran

¹Department of Seed Science and Technology, Krishi Vigyan Kendra, Tamil Nadu Agriculture University, Vriddhachalam, India

²Department of Seed Science and Technology,

³Seed Centre, Tamil Nadu Agriculture University, Coimbatore, 641 003, India

Corresponding Author: V. Vijaya Geetha, Department of Seed Science and Technology, Krishi Vigyan Kendra, Tamil Nadu Agriculture University, Vriddhachalam, India

ABSTRACT

Vigour has been recognized as one of the important aspects of seed quality and makes a good impact on crop performance of various species as the agronomic traits including yield are reported to be significantly affected. Therefore, to realize the full genetic potential of a variety, the seed should possess high germination and vigour at the time of seeding. Keeping in view the above facts, the present study was initiated with the main objective of standardization of vigour test for measuring the vigour status of mustard genotypes viz., Rohini, Bio 902, Kranti, Maya, GM-2, Varuna, PCR 7, Pusa Bold and RN 393. The result indicated that a genotypic difference in vigour was obvious in mustard genotypes. The correlation studies using eight vigour tests revealed that ammonium chloride stress test was highly correlated with field emergence. Therefore, ammonium chloride stress test could be used as a powerful vigour test to predict field performance potential in mustard genotypes.

Key words: Mustard genotypes, vigour, germination, stress condition, oil seeds

INTRODUCTION

The seed vigour concept was developed on the basis of the observation of genotypes or lots with similar viability performed differently under stress condition (Delouche and Baskin, 1973). Several vigour tests have been developed and successfully used to evaluate the seed quality of different seed lots with similar germination percentage in major agricultural crops (AOSA, 1983; Hampton and TeKrony, 1995). Therefore, in developing suitable vigour test, there should be an agreement as to precisely which trait is to be measured as different tests differ in the degrees of efficiency (Kulkarni, 1981). Seed vigour gained significance as the germination potential does not reflect field performance of different genotypes under varied environmental conditions. Although, standardization of simple test for measuring seed vigour status has been attempted in the past, hardly few of them are reliable for testing seed vigour among genotypes in mustard. Therefore, a comparative study has been made in the present investigation to prepare a suitable and easy vigour test to determine the field emergence potential of the genotypes.

MATERIALS AND METHODS

Genetically pure seeds of mustard genotypes obtained from National Research Centre on Rapeseed and Mustard, Bharatpur, Rajasthan constituted the material for the study. With a view

to realize the objective, the field and laboratory experiments were carried out in the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore between 2004-2007. The experimental details and methods adopted are enumerated.

Standardization of vigour test: The genetically pure seeds of the nine varieties as were subjected to the following vigour tests. The results were compared and correlated with field emergence.

- Brick gravel test (Hiltner and Ihssen, 1911)
- Paper piercing test (Fritz, 1965)
- Accelerated ageing (Delouche and Baskin, 1973)
- Ammonium chloride soak test (Vanderlip *et al.*, 1973)
- D-Mannitol soak test (Lad, 1986)
- Anaerobic germination (ISTA, 1999)
- Electrical conductivity test (Presley, 1958)
- Peroxidase activity (Malik and Singh, 1980)
- Field emergence (%)

The total number of plants plot⁻¹ were counted on 7th day in each replication and mean values was expressed in number.

The following observations were recorded in all the above vigour tests and compared with the field emergence (%) to arrive out the result.

Germination: Germination test was conducted with four replicates of hundred seeds each using between paper method in the germination room maintained at 25±2°C and 96±2% RH. The germination percentage was calculated based on the normal seedling evaluated on 7th day and it was expressed in percentage (ISTA, 1999).

Vigour index: Vigour index value was computed using the following formula suggested by Abdul-Baki and Anderson (1973) and expressed as whole number.

$$\text{Vigour index} = \text{Germination (\%)} \times \text{Total seedling length (cm)}$$

RESULT

The different vigour tests were evaluated and compared with field emergence for each variety. Highly significance variation was observed for all the vigour tests except electrical conductivity.

Initial evaluation: The germination percentage was maximum in Maya (99%) which was on par with Kranti (96%), Pusa Bold (96%) and PCR 7 (93%), whereas Rohini, Bio 902 and GM-2 registered minimum germination of 85, 85 and 80 (%), respectively. The computed vigour index value was maximum in Varuna (2609) which was on par with Maya (2532), Pusa Bold (2599) and Kranti (2420), whereas Rohini (2170), Bio 902 (1957) and GM-2 (1973) registered the minimum (Table 1).

Brick gravel test: Among the genotypes, highest germination of 92% was registered in Bio 902, Kranti, PCR 7 and RN 393 while GM-2 registered the lowest germination of 72%. Maximum vigour

Germination (%) and vigour index

Digits in parenthesis are arc sine values

index value of 1923 was recorded in Kranti which was on par with RN 393 (1858) and Bio 902 (1812) while it was minimum in GM-2 (1433) which was on par with Maya (1497) (Table 1).

Paper piercing test: Among all the genotypes evaluated, Pusa Bold recorded the highest germination of 68% while the minimum germination was registered by Kranti (28%). Maximum vigour index was registered in Pusa Bold (1496), while it was minimum in PCR 7 (659) (Table 1).

Accelerated ageing: The maximum germination percentage of 76% was registered in Bio 902 Pusa Bold and RN 393 and it was minimum in Varuna and Maya (68%). The computed vigour index values were the maximum in Varuna (1732) which was on par with in Pusa Bold (1755) and RN 393 (1648) while it was minimum in Bio 902 (1437) which was on par with Kranti (1536), GM-2 (1454) and PCR 7 (1513) (Table 1).

Ammonium chloride test: The germination percentage was maximum of 64% in Bio 902, GM-2, Pusa Bold and RN 393 while Rohini, Maya and PCR 7 registered the minimum of 56%. Among the genotypes, highest vigour index value of 852 was recorded in Kranti which was on par with Bio 902 (819) and of 672 was recorded in PCR 7 (Table 1).

D-Mannitol test: The maximum germination percentage of 76% was recorded in Maya while minimum of 56% in Bio 902 and GM-2. Among the genotypes, highest vigour index value was recorded in Maya (540) which was on par with Kranti (533) and it was lowest in Bio 902 (414) (Table 1).

Anaerobic germination: The maximum germination percentage of 80% was recorded in GM-2 and minimum in Pusa Bold (20%). Maximum vigour index was registered in GM-2 (528) while minimum of 136 in Pusa Bold.

Electrical conductivity ($\mu\text{dS m}^{-1}$): There was no significant variation in electrical conductivity due to different genotypes of mustard (Table 2).

Peroxidase activity (OD value): The highest and lowest peroxidase activity of 0.150 and 0.001 was observed in Kranti and RN 393, respectively (Table 2).

Table 2: Electrical conductivity ($\mu\text{dS m}^{-1}$), peroxidase activity (OD value) and field emergence (%) for assessment of seed vigour in mustard genotypes

Varieties	Electrical conductivity ($\mu\text{dS m}^{-1}$)	Peroxidase activity (OD value)	Field emergence (%)
Rohini	53.07	0.126	85 (67.21)
Bio 902	53.09	0.107	85 (67.21)
Kranti	53.14	0.150	92 (73.57)
Maya	53.16	0.144	92 (73.57)
GM-2	53.23	0.129	80 (63.43)
Varuna	53.24	0.105	88 (69.73)
PCR 7	53.41	0.089	92 (73.57)
Pusa bold	53.38	0.105	92 (73.57)
RN 393	53.36	0.001	92 (73.57)
SEd	0.868	0.020	1.633
CD (p=0.5)	NS	0.040	3.431

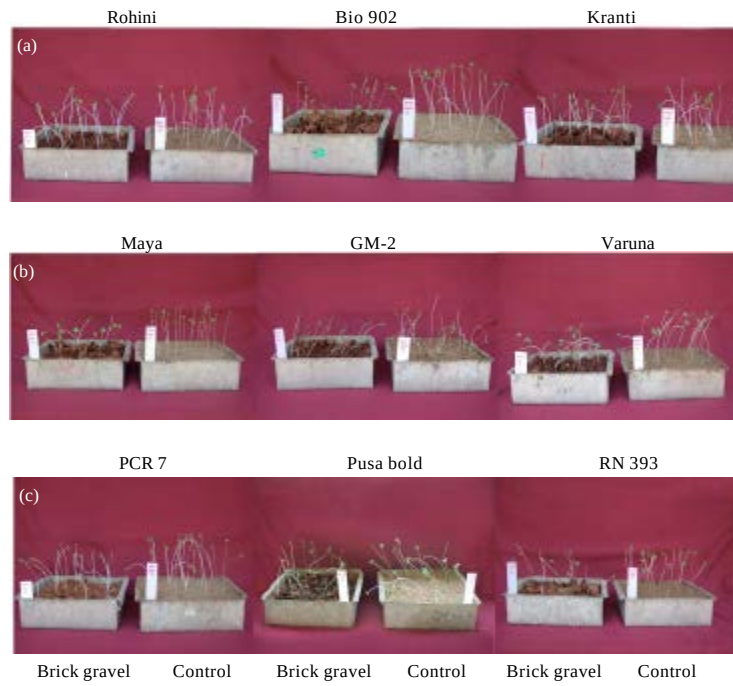


Fig. 1(a-c): Effect of brick gravel test on different genotypes of mustard along with control



Fig. 2(a-b): Effect of accelerated ageing test on different genotypes of mustard, (a) Control and (b) 5 days after accelerated ageing

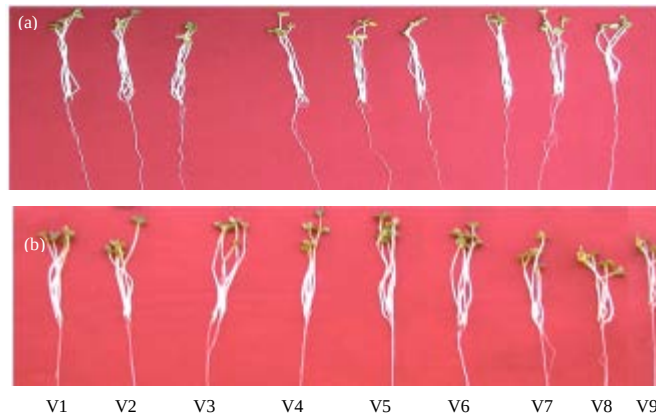


Fig. 3(a-b): Effect of ammonium chloride test on mustard genotypes, (a) Control and (b) Ammonium chloride treated



Fig. 4: Field emergence in different mustard genotypes

Field emergence (%): Maximum field emergence of 92% was registered in Kranti which was on par with Maya, PCR 7, Pusa Bold and RN 393 by recording 92% while minimum of 80% was recorded in GM-2 (Table 2).

DISCUSSION

Seed vigour gained significance as the germination potential does not reflect field performance of different genotypes under varied environmental conditions. Although, standardization of simple test for measuring seed vigour status has been attempted in the past, hardly few of them are reliable for testing seed vigour among genotypes in mustard. Therefore, a comparative study has been made in the present investigation to prepare a suitable and easy vigour test to determine the field emergence potential of the genotypes.

In the present study, to evaluate seed vigour status of nine varieties, eight vigour tests have been employed which were compared with field emergence (Fig. 1-4). Among the varieties PCR 7, Varuna and GM-2 showed superiority over other varieties as performed well in most of the vigour tests used. Among the vigour test, ammonium chloride stress test resembled very predicting field emergence in all the genotypes except RN 393 in which none of the vigour test was correlated with field emergence. It was evident from the present investigation that genotype performing well under field emergence test could maintain its superiority in vigour test under most of the methods employed for vigour testing. The results were in conformity with the observations reported by Egli and Tekrony (1978), Jha *et al.* (1986) in soybean and Soltani *et al.* (2001) in wheat, Ahmed (2003) in rice, Nisha (2007) in wheat.

Mere comparison would not be useful to determine the appropriate test that could be used to predict field performance potential of all the varieties under study. Therefore, in the present study, the results of the vigour tests were correlated to field emergence individually for best three genotypes viz., GM 2, Varuna and PCR 7 (Table 3-5). The correlation revealed that in all the genotypes, field emergence was positively correlated with ammonium chloride stress test followed by D-Mannitol test. The results indicated that ammonium chloride stress test provided a more sensitive parameter in ranking the genotypes as well as showed higher correlation with field emergence than did any other tests which implies its usefulness as reported by Ram and Wiesner (1988) in wheat, Bhering *et al.* (2000) in cucumber, Panobianco and Marcos-Filho (2001) in tomato and Nisha (2007) in wheat.

Table 3: Comparison of correlation coefficient of vigour test with field emergence in GM-2

	Accelerated												EC			POX		FE	
	Brick gravel		Paper piercing		ageing		NH ₄ Cl		D- Mannitol		Anaerobic								
	-----	-----	-----	-----	-----	-----	-----	-----											
G (%)	VI	G (%)	VI	G (%)	VI	G (%)	VI	G (%)	VI	G (%)	VI								
Brick gravel																			
G (%)	1																		
VI	0.95	1																	
Paper piercing																			
G (%)	0.94	1.00*	1																
VI	0.90	0.99	1.00	1															
Accelerated ageing																			
G (%)	0.25	-0.08	-0.11	-0.20	1														
VI	0.99	0.88	0.86	0.82	0.41	1													
NH₄Cl																			
G (%)	-0.97	-0.83	-0.81	-0.76	-0.49	-1.00	1												
VI	-0.52	-0.21	-0.18	-0.10	-0.96	-0.65	0.72	1											
D- Mannitol																			
G (%)	0.07	-0.26	-0.28	-0.37	0.98	0.24	-0.33	-0.89	1										
VI	0.93	0.76	0.74	0.68	0.58	0.98	-0.99	-0.80	0.43	1									
Anaerobic																			
G (%)	0.96	1.00*	1.00	0.99	-0.03	0.90	-0.86	-0.26	-0.21	0.79	1								
VI	0.93	1.00*	1.00*	1.00	-0.12	0.86	-0.81	-0.17	-0.30	0.73	1.00	1							
Electrical conductivity																			
G (%)	0.91	1.00*	1.00*	1.00	-0.17	0.83	-0.77	-0.12	-0.35	0.70	0.99	1.00*	1						
Peroxidase																			
G (%)	0.87	0.98	0.99*	1.00	-0.27	0.77	-0.71	-0.02	-0.44	0.62	0.97	0.99	1.00	1					
Field emergence																			
G (%)	0.92	1.00*	1.00*	1.00	-0.14	0.85	-0.79	1.00*	-0.32	0.72	0.99	1.00*	1.00*	0.99	1				

*Significant at the 0.05 level, **Significant at the 0.01 level

Table 4: Comparison of correlation coefficient of vigour test with field emergence in Varuna

	Brick gravel		Paper piercing		Accelerated ageing		NH ₄ Cl		D- Mannitol		Anaerobic				
Vigour test	G (%)	VI	G (%)	VI	G (%)	VI	G (%)	VI	G (%)	VI	G (%)	VI	EC	POX	FE
Brick gravel															
G (%)	1														
VI	0.95	1													
Paper piercing															
G (%)	0.78	0.53	1												
VI	0.94	1.00	0.51	1											
Accelerated ageing															
G (%)	1.00*	0.97	0.73	0.96	1										
VI	0.93	1.00	0.49	1.00	0.95	1									
NH₄Cl															
G (%)	0.98	0.87	0.88	0.86	0.97	0.84	1								
VI	0.99*	0.99	0.67	0.98	1.00	0.97	0.94	1							
D- Mannitol															
G (%)	1.00*	0.96	0.75	0.95	1.00*	0.94	0.97	0.99	1						
VI	0.94	1.00*	0.50	1.00**	0.96	1.00*	0.85	0.98	0.95	1					
Anaerobic															
G (%)	0.54	0.78	-0.11	0.80	0.60	0.81	0.37	0.66	0.57	0.80	1				
VI	0.61	0.83	-0.03	0.84	0.66	0.86	0.45	0.72	0.64	0.85	1.00	1			
Electrical conductivity															
G (%)	0.83	0.96	0.29	0.97	0.87	0.98	0.71	0.91	0.85	0.97	0.92	0.95	1		
Peroxidase															
G (%)	0.71	0.90	0.11	0.91	0.76	0.92	0.57	0.81	0.74	0.91	0.97	0.99	0.98	1	
Field emergence															
G (%)	1.00**	0.95	0.78	0.94	1.00*	0.93	0.98	1.00*	1.00*	0.94	0.54	0.61	0.83	0.71	1

*Significant at the 0.05 level, **Significant at the 0.01 level

Table 5: Comparison of correlation coefficient of vigour test with field emergence in PCR 7

	Brick gravel		Paper piercing		Accelerated ageing		NH ₄ Cl		D- Mannitol		Anaerobic				
Vigour test	G (%)	VI	G (%)	VI	G (%)	VI	G (%)	VI	G (%)	VI	G (%)	VI	EC	POX	FE
Brick gravel															
G (%)	1														
VI	0.99	1													
Paper piercing															
G (%)	0.77	0.86	1												
VI	0.82	0.90	1.00*	1											
Accelerated ageing															
G (%)	0.88	0.94	0.98	0.99	1										
VI	0.91	0.96	0.97	0.98	1.00*	1									
NH₄Cl															
G (%)	0.85	0.92	0.99	1.00*	1.00*	0.99	1								
VI	0.89	0.95	0.98	0.99	1.00*	1.00*	1.00	1							
D- Mannitol															
G (%)	0.85	0.92	0.99	1.00*	1.00*	0.99	1.00**	1.00*	1						
VI	0.89	0.95	0.98	0.99	1.00*	1.00*	1.00	1.00**	1.00	1					
Anaerobic															
G (%)	0.33	0.47	0.85	0.81	0.74	0.69	0.78	0.73	0.77	0.72	1				
VI	0.56	0.68	0.96	0.93	0.89	0.86	0.91	0.88	0.91	0.87	0.97	1			

Table 5: Continue

	Brick gravel		Paper piercing		Accelerated ageing		NH ₄ Cl		D- Mannitol		Anaerobic				
	-----		-----		-----		-----		-----		-----				
Vigour test	G (%)	VI	G (%)	VI	G (%)	VI	G (%)	VI	G (%)	VI	G (%)	VI	EC	POX	FE
Electrical conductivity	0.92	0.97	0.96	0.98	0.99	1.00*	0.99	1.00	0.99	1.00*	0.67	0.84	1		
Peroxidase	0.95	0.99	0.93	0.95	0.98	0.99	0.97	0.98	0.97	0.99	0.60	0.78	1.00	1	
Field emergence	0.90	0.96	0.97	0.99	1.00*	1.00**	0.99	1.00*	0.99	1.00*	0.70	0.86	1.00*	0.99	1

*Significant at the 0.05 level, **Significant at the 0.01 level

Therefore, from the present investigation, it was evident that ammonium chloride stress test is highly correlated with field emergence and could be recommended as the appropriate vigour test for mustard genotypes.

CONCLUSION

An attempt was made to identify a suitable vigour test for mustard genotypes viz., Rohini, Bio 902, Kranti, Maya, GM-2, Varuna, PCR 7, Pusa Bold and RN 393 indicated that genotypic differences in vigour was obvious in mustard genotypes. The correlation studies using eight vigour tests revealed that Ammonium chloride stress test was highly correlated with field emergence. Therefore, ammonium chloride stress test could be used as a powerful vigour test to predict field performance potential in mustard genotypes.

REFERENCES

- AOSA, 1983. Seed vigor testing handbook: Contribution no. 32 to handbook on seed testing. Association of Official Seed Analysis, Springfield, IL., USA., pp: 1-93.
- Abdul-Baki, A.A. and J.D. Anderson, 1973. Vigor determination in soybean seed by multiple criteria. *Crop Sci.*, 13: 630-633.
- Ahmed, A.S., 2003. Hybrid seed yield maximization through supplementary nutrition, hybrid vigour assessment and seed quality enhancement by polykote coating in ADTRH 1 and CORH 2 rice hybrid and their parents. Ph.D. Thesis, Tamil Nadu Agricultural University, Coimbatore.
- Bhering, M.C., D.C.F.S. Dias, J.M. Gomes and D.I. Barros, 2000. Vigour evaluation methods of cucumber seeds. *Revista Brasileira Sementes*, 22: 171-175.
- Delouche, J.C. and C.C. Baskin, 1973. Accelerated aging techniques for predicting the relative storability of seed lots. *Seed Sci. Technol.*, 1: 427-452.
- Egli, D.E. and D.M. Tekrony, 1978. The relationship between soybean seed vigour and field emergence. *Aust. Seed Sci. News Lett.*, 4: 49-51.
- Fritz, T., 1965. Germination and vigour tests of cereals seed. *Proc. Int. Seed Test. Assoc.*, 30: 923-927.
- Hampton, J.G. and D.M. TeKrony, 1995. Handbook of Vigor Test Methods. 3rd Edn., International Seed Testing Association, Zurich, Switzerland.
- Hiltner, L. and G. Ihssen, 1911. Uber das schlechte auflaufen and die auswinterung des gefreides infolge befalls durch *Fusarium*. *Landwirtsch Fb. Bayern*, 1: 20-60, 231-278, 315-362.
- ISTA, 1999. International rules for seed testing. Annex to chapter 5: The germination test. *Seed Sci. Technol.*, 27: 27-32.
- Jha, B.N., S.K. Banerjee and S.K. Sinha, 1986. Comparative efficacy of different vigour tests. *Seed Res.*, 14: 216-221.

- Kulkarni, G.N., 1981. Seed Vigour and Viability. In: Principles of Seed Technology, Kulkarni, G.N. (Ed.). Kalyani Publishers, New Delhi, pp: 31-65.
- Lad, S.K., 1986. Effect of different osmotic media of mannitol and polyethylene glycol-4000 on germination and early seedling growth of sorghum variety M-35-1. *Sorghum Newslett.*, 29: 90-91.
- Malik, C.P. and M.B. Singh, 1980. Plant Enzymology and Histoenzymology. Kalyani Publishers, New Delhi, India, pp: 53.
- Nisha, C., 2007. Assessment of seed quality in wheat (*Triticum aestivum* L.) varieties as influenced by different alien rust resistant genes under varying production conditions. Ph.D. Thesis, Tamil Nadu Agricultural University, Coimbatore.
- Panobianco, M. and J. Marcos-Filho, 2001. Evaluation of the physiological potential of tomato seeds by germination and vigor tests. *Seed Technol.*, 23: 151-161.
- Presley, J.T., 1958. Relation of protoplast permeability of cotton seed viability and predisposition of seedling diseases. *Plant Dis. Rep.*, 42: 582-582.
- Ram, C. and L.E. Wiesner, 1988. Effects of artificial ageing on physiological and biochemical parameters of seed quality in wheat. *Seed Sci. Technol.*, 16: 579-589.
- Soltani, A., E. Zeinali, S. Galeshi and N. Latifi, 2001. Genetic variation for and interrelationships among seed vigor traits in wheat from the Caspian Sea Coast of Iran. *Seed Sci. Technol.*, 29: 653-662.
- Vanderlip, R.L., F.E. Mockel and H. Jan, 1973. Evaluation of vigor tests for sorghum seed. *Agron. J.*, 65: 486-488.