Response of Argentine Canola Seedlots to Four Laboratory Vigour Tests

Joseph Onyilagha, Bob Elliott and Owen Olfert

Agriculture and Agri-Food Canada, Saskatoon Research Centre.

Abstract

Sixteen seedlots from four varieties of Argentine canola, *Brassica napus* L., were subjected to four laboratory vigour tests including the modified germination test, accelerated aging test, controlled deterioration test and conductivity test. Results indicated that within each variety, high germination seedlots had lowest conductivity readings and were least prone to accelerated aging or controlled deterioration. Conversely, low germination seedlots had highest conductivity and were most prone to deteriorate after exposure to 45ºC for 24 h. Germination counts of seedlots in each vigour test were correlated with field data from early May plantings at Saskatoon, Watrous and Rosebank in 2000. Pearson correlation coefficients indicated that the modified germination test, accelerated aging test, controlled deterioration test and seedling dry weight in controlled deterioration test provided the best indication of seedling emergence and seedling establishment. Seedling dry weight in the controlled deterioration test provided the highest statistical correlation with seedling fresh weight and biomass. Conductivity readings were inversely correlated with seedling establishment and biomass.

Introduction

Argentine canola, *Brassica napus* L. is an important oilseed crop in western Canada. The crop is often seeded in early May when environmental conditions limit germination, emergence and seedling growth. Seed quality and vigour are important factors in the production of Argentine canola. Several laboratory tests have been developed to evaluate seed quality and seed vigour (Matthews, 1980; Powell and Matthews, 1985; ISTA, 1995; Elias and Copeland, 1997; Larsen *et al.*, 1998). In this investigation, vigour of 16 seedlots from four varieties of Argentine canola, *Brassica napus* L. was evaluated using a modified germination test, accelerated aging test, controlled deterioration test and conductivity test. Our aims were to investigate the effect of high temperature on vigour of moistened seed. Vigour ratings and conductivity readings were correlated with field data to determine which test provided the best indication of seedling establishment and seedling growth of Argentine canola in early May plantings.

Materials and Methods

Laboratory Tests

The quality and vigour of 16 seedlots of Argentine canola were evaluated using a modified germination test (MGT), controlled deterioration test (CDT), accelerated aging test (AAT) and conductivity test (CT). In the MGT and AAT, moisture content of the samples was standardized at 10%. Seeds were placed on aging trays, then inserted into aging chambers containing 40 ml of de-ionized water (ISTA, 1995). Seeds were aged at 20ºC (MGT) and 41ºC (AAT) for 24 hours. Samples were transferred to the growth cabinet maintained at 20ºC, 50% R.H. and 16 hours light and 8 hours darkness. Tests were replicated four times with 50 seeds per replicate. Numbers of normal germinated, abnormal and dead seeds were assessed seven days after planting. Normal seedlings were harvested after the seventh day and dried in the oven (60ºC) for six days. Seedling dry weight was then measured. In the CDT, seed moisture was standardized at 20%. Seeds were sealed in aluminum foil bags and equilibrated at 10ºC for 24 h. Samples were then deteriorated at 45ºC for 24 hours, transferred to thermal gradient plates maintained at 20ºC. Number of seeds and replications were identical to MGT and AAT tests. In the CT, seed moisture content was standardized at 10%. Seeds were placed on aging trays, then inserted into aging chambers containing 40 ml of de-ionized water. Seeds were incubated at 20ºC for 24 hours. At the end of incubation period, samples were immersed in 60 ml de-ionized water. Conductivity was measured after four and eight hours.

Field Tests

Field tests were conducted at Saskatoon, Rosebank and Watrous in 2000. Seedlots were treated with a commercial seed treatment and planted in six-row plots at 200 seeds per 6.0 m row in early May. Tests were replicated four times using a randomized complete block design. Seedlings/row and fresh weight (n=10 plants/plot) were assessed 14 and 21 days after seeding (DAS). Biomass was calculated from seedlings/row and fresh weight.

c) Statistical Analysis

Data were analyzed using the General Linear Model procedure of the Statistical Analysis Systems (SAS). Germination counts in the MGT, CDT and AAT were correlated with field data to identify which test provided the best indication of seedling emergence and seedling growth.

Results and Conclusions

1. In the modified germination test (MGT), germination of Argentine seedlots ranged from 88% to 99% after 7 days (Table 1). Seedlots L40 and L63 did not meet the germination standard ($\geq$90% germination) for No. 1 certified seed after 7 days.

2. In the accelerated aging test (AAT), germination of Argentine seedlots ranged from 79% to 99% after 7 days. Seedlots L54, L51, L40 and L63 had the lowest vigour ratings and were the most prone to aging at 41ºC.

3. In the controlled deterioration test (CDT), germination of Argentine seedlots ranged from 27% to 99% after 7 days. Seedlots L54, L36, L57, L51, L38, L56, L49, L40, L63 and L62 had the lowest vigour ratings and were most prone to deterioration at 45ºC.

4. Conductivity readings differed among seedlots, ranging from 24µS to 68µS after 8 hours (Table 1). In each variety, high germination seedlots had the lowest conductivity readings whereas low germination seedlots had the highest conductivity readings.

5. Germination counts in the MGT, AAT and CDT were positively correlated with seedlings/row and biomass in early May plantings (Table 2). Germination counts in the AAT and CDT had the highest statistical correlation with seedling emergence 14 DAS (r=0.62 - 0.69) and seedling establishment 21 DAS (r=0.65 - 0.67).

6. Conductivity readings after 4 and 8 hours were negatively correlated with seedlings/row, fresh weight and biomass in early May plantings (Table 2). Conductivity readings were more highly correlated with seedlings/row ($r \geq -0.42$) and biomass ($r \geq -0.36$) than with fresh weight ($r \geq -0.12$).

Acknowledgments
We are grateful to Sharon Leung and Larry Mann for their technical assistance and Ralph Underwood for preparing the poster. The research was funded by the Federal Matching Investment Initiative.

References

Elias, S. G. and Copeland, L. O. 1997. Evaluation of seed vigour tests for canola. *Seed Technol*. 19(1): 78 - 87.

ISTA, 1995. *Handbook of Vigour Test Methods*. Hampton, J. G. and Tekrony, D. M. eds. International Seed Testing Association, third edition, Zurich, Switzerland, 117pp.

Larsen, S. U., Povlsen, F. V., Eriksen, E. N. and Pedersen, H. C. 1998. The influence of seed vigour on field performance and the evaluation of the applicability of the controlled deterioration vigour test in oil seed rape (*Brassica napus*) and pea (*Pisum sativum*). *Seed Sci. & Technol*. 26: 627 - 641.

Matthews, S. 1980. Controlled deterioration: A new vigour test for crop seeds. In: *Seed Production* (P. D. Hebblethwaite, ed.), Butterworths, London. pp. 647 - 660.

Powell, A. A. and Matthews, S. 1985. Detection of differences in seed vigour of seedlots of kale and swede by the controlled deterioration test. *Crop Research* (Hort. Res.) 25: 55 - 61.

Table 1. Percent germination of Argentine seedlots in the modified germination test (MGT), accelerated aging test (AAT) and controlled deterioration test (CDT). Conductivity readings are also shown.

		MGT	AAT	CDT	Conductivity (µS)	
Variety	Seedlot	7 days	7 days	7 days	4 hours	8 hours
4	L54	92	81	48	24	39
	L36	94	90	65	28	41
	L41	99	98	93	19	28
	L55	99	99	90	21	32
	L46	99	96	95	15	24
5	L42	96	92	89	25	39
	L57	99	97	85	22	34
6	L51	92	87	57	37	49
	L38	96	96	54	30	45
	L56	93	91	31	38	49
	L49	96	96	83	20	29
	L53	97	96	89	19	28
7	L40	88	79	27	53	68
	L63	88	88	54	33	46
	L62	94	96	80	26	39
	L50	99	98	99	20	28
	LSD (p=0.05)	**5**	**8**	**13**	**4**	**5**

Table 2. Correlation coefficients between attributes in laboratory tests and performance of seedlots in early May plantings.[1]

Laboratory test	Incubation period	Seedlings/row		Fresh weight		Fresh biomass	
		14 DAS	21 DAS	14 DAS	21 DAS	14 DAS	21 DAS
Modified germination	7 days	**0.50***	**0.58***	0.32	0.19	**0.63****	0.41
seedling dry weight	7 days	-0.32	-0.26	0.32	0.26	0.02	0.10
Accelerated aging	7 days	**0.62****	**0.65****	0.27	0.31	**0.60***	**0.52***
seedling dry weight	7 days	-0.17	-0.09	0.30	0.25	0.17	0.20
Controlled deterioration	7 days	**0.69****	**0.67****	0.44	0.26	**0.73****	0.48
seedling dry weight	7 days	**0.60***	**0.62****	**0.65****	0.42	**0.74*****	**0.59***
Conductivity	4 hours	-0.42	**-0.56***	-0.30	-0.12	**-0.54***	-0.36
	8 hours	-0.49	**-0.63****	-0.30	-0.14	**-0.59***	-0.41

[1] *, **, and *** Pearson correlation coefficient significant at 5%, 1% and 0.1% probability level, respectively (n=16 seedlots).