FV 10a
PN 3

FV/10a Vegetable seed: Assessment and improvement of vigour

Project Co-ordinator: Dr A A Powell

Project Leader: Dr S Matthews

Location: Wolfson Unit of Seed Technology
Department of Agriculture
University of Aberdeen

Start Date: 1.7.87

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PN3

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Staff

Janet Thornton, BSc has been appointed research assistant on the project. She began work for H.D.C. on the start date having previously gained several months experience in our laboratories on other seed projects.

The high cost of vegetable seed and transplant production has led to a demand for seed of high quality which will germinate rapidly and uniformly and produce a vigorous seedling from every seed. With this in mind the work has two main objectives:

1. Assessment of the quality of seed used by growers
2. Improvement of seed quality available to them

Survey of growers seed

Contact has been made with ADAS at Kirton through whom small samples of seed used by growers will be obtained. Samples of cauliflower, leek, cabbage, onion and Brussels sprouts will be collected from propagators in the area. Following an initial contact with ADAS the main vegetable processing companies in Humbershide have also agreed to supply samples of the seed given to their growers. Samples of seed from Scottish growers will be obtaind through the East of Scotland College of Agriculture. The quality of the seed samples will be tested using germination tests and vigour tests developed within the unit.

Seed quality testing

Assessment of vegetable seed quality can be achieved using the controlled deterioration (CD) vigour test and it is possible that a modification of the conductivity test of pea seed vigour may be applied to small seeded vegetables.

Experience has been gained in the use of the CD test in which seed was aged at high moisture content (20%) and raised temperature (45°C) for 24 hours in a waterbath. Seed of high viability and vigour showed little reduction in percentage germination after deterioration whereas seed which is of acceptable viability but low vigour had a reduced percentage germination after deterioration.

The potential of the electrical conductivity of seed soak water as a vigour test for brassicas has been examined for a number of seed lots differing in germinability. The conductivity of the soak water of individual seeds was measured using an automatic seed analyser (ASA). There was a good relationship between percentage germination and the conductivity of the soak water, conducitivity increasing as germination decreased (Table 1). Dead seeds lose solutes such as potassium ions to soak water more readily than do living seeds.

Table 1 Germination and soak water conductivity of five seed lots of Brussels Sprouts after 24 hours soaking. All values are a mean of 20 seeds.

Seed lot	Germination (%)	Conductivity (m amps/g seed)
A	100	4.99 (0.85) (standard deriation)
B	100	5.75 (1.97)
C	70	9.89 (4.87)
D	20	8.22 (2.26)
E	0	12.28 (5.16)

The differences in conductivity and standard deviation for lots A and B both with 100% germination could indicate vigour differences.

Improvement of seed quality

Problems of reduced emergence and lack of seedling uniformity may arise due to the use of seed of low vigour as a result of deterioration, probably caused by ageing. There are several possible ways of improving deteriorated seed:

a) Seed sorting i.e. separation of deteriorated from non-deteriorated seed
b) Repair of deteriorated seeed
c) Prevention of deterioration

Following the observation that poor germination was associated with high conductivity of whole seed samples (Table 1) soak water conductivity of individual seeds has been examined as a possible means of sorting viable from non-viable seed. The idea being tested was that seed which had a soak water conductivity above a predetermined value, sometimes called the partition value, will not germinate whereas seed with a conductivity below that value will germinate.

The electrolyte leakage from individual weighed seeds taken from each of the five seed lots of Brussels Sprouts (Table 1) was measured using the ASA. Readings from individual seeds within each seed lot were spread over a wide range, the magnitude increasing as percentage germination decreased. Seeds from each lot which failed to germinate tended to be those with conductivities at the higher end of the range. The levels of conductivity seen for the dead seeds in one lot were not the same for the dead seeds from another seed lot. No one conductivity value could therefore be identified which could be applied as a partition value to differentiate between viable and non-viable seeds in all lots.

Methods have been developed whereby the effects of any treatments aimed at achieving improvements in seed quality via methods b and c can be evaluated. Seed was artificially aged using controlled deterioration with the extent of the deterioration being determined by the length of time the seeds were held in a water bath at 45°C and 20% moisture content. In this way seed was produced that had a high percentage germination but reduced rate and uniformity of germination. The seed so produced has similar characteristics to that of seeds naturally aged in storage. Using this technique we have clearly defined stages of deteroration from which to begin improving the seed and can therefore accurately assess the extent of any improvement achieved.

Fv 10a
PN 4 ②

FV/10a Vegetable seed: Assessment and improvement of vigour

Project Co-ordinator: Dr A A Powell

Project Leader: Dr S Matthews

Location: Wolfson Unit of Seed Technology
Department of Agriculture
University of Aberdeen

Start Date: 1.7.87

SURVEY OF GROWERS SEED

Introduction

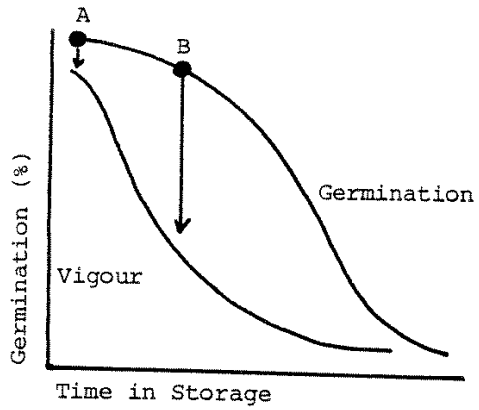
The aim of the seed survey was to assess the quality of brassica seed being used by growers in 1987/88 for module production.

Method

89 samples of cauliflower seed used for overwintering module production were collected from Lincolnshire propagators and assessed for laboratory germination (16 replicates of 25 seeds) and seed vigour. Vigour was assessed by the controlled deterioration vigour test which has been shown to indicate the seed vigour of a number of species of small seeded vegetables as it is expressed in their relative field emergence and storage potential. The basis of the test is described below:

THE VIGOUR TEST

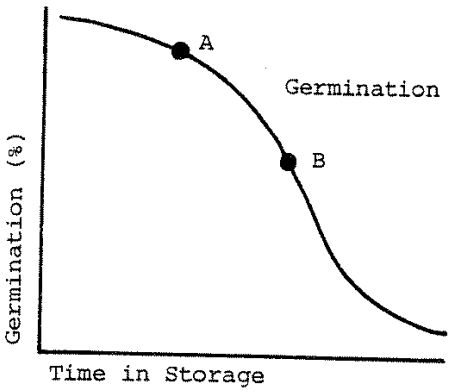
Before controlled deterioration:



This graph illustrates the way in which seed germination changes during a period of storage. Initially germination falls slowly as time in storage progresses and then rapidly until the curve levels off again and very few seeds still germinate. During this time the vigour curve falls much more rapidly than germination. Two seedlots such as A and B which have very similar germinations will therefore have very different levels of vigour, A being a high vigour seedlot whilst B is a low vigour seedlot.

Some method is therefore required to differentiate between such high and low vigour seedlots since an ordinary germination test will not do so. The controlled deterioration test is one way in which this can be done.

After controlled deterioration:



Controlled deterioration ages seed by a given amount and therefore moves the germination of each seedlot along the germination curve. Seedlot A with an initially high germination and vigour will move along the curve due to ageing but the germination after the test remains high. However, seedlot B which was initially of high germination but low vigour will move over the shoulder of the germination curve as a result of ageing and have a mich reduced germination after the test.

The germination of seed after controlled deterioration therefore gives an indication of where a seedlot lies along the initial part of the germination curve and hence whether it is of high or low vigour.

RESULTS

The germination tests showed that all the samples assessed had a high and commercially acceptable germination, that is over 70% (Table 1). 80% of the seedlots tested had over 90% germination and only 3 had germinations in the 70-79% category.

However, the vigour test results revealed lagre differences in the vigour of the seed with the CD germinations spread more evenly over a much wider range of germination categories. Thus 28 lots retained a very high germination (above 90%) after controlled deterioration which is indicative of high vigour, whereas one lot fell in the 20-29% category suggesting very low vigour and 19 lots were below 70%.

Table 1 The number of seedlots per germination category following laboratory germination and controlled deterioration tests

Germination percentage	Frequency Lab germination	CD (vigour)
>90	71	28
80-89	15	20
70-79	3	22
60-69		11
50-59		4
40-49		1
30-39		2
20-29		1

The results for each individual seedlot are presented in Table 2. There were differences in seed vigour within most of the varieties. For example, seven lots of Revito had CD germinations ranging from 54 to 92%, 9 lots of Jubro gave germinations of 37 to 92% and 3 lots of King had CD germination percentages of 25, 74 and 96. These differences within varieties also occurred between samples having the same lot number. For example, Jubro, lot reference a, had CD germinations of 65, 79, 90 and 92%. Such differences could possibly be due to differences in the handling and storage of the samples at the seed houses and the propagators. These differences in vigour revealed by the CD test were probably due to deterioration of the seed.

There were, however, some varietal or genetic differences in vigour. Such varieties as Carillon and White Summer had very good CD results with little variation between them and produced very vigorous seedlings. The only exception to this was the Carillon sample from propagator 8 which had a much lower CD germination than the rest of the Carillon seeds. This was probably because the seed was a very poor sample with a lot of split seedcoats and damaged seed.

Perfection is an old variety of known low vigour. However, the high CD results from this variety which ranged from 75 to 90% indicated that its low vigour had a genetical basis and was not due to deterioration.

The emergence of seeds sown in modules by growers was examined for 19 seed samples (Table 3). In each case the proportion of empty cells, that is where seeds failed to emerge, was counted. Where seed vigour was high as indicated by a high CD germination, there were few empty cells. However, far more empty cells were found where low vigour (low CD germiantion seed was sown (Table 3).

Table 2 Germination and controlled deterioration test results for 89 lots of cauliflower seed

Propagators indicated by numbers 1 to 12
Seed lots indicated by letters i.e. seedlots with the same lot number have the same letter. u = reference number unknown

Variety	Propagator	Seed lot reference	Germination after 10 days		Controlled deterioration
			Normal %	Abnormal %	%
White Summer	1	a	98.5	1.0	98
	2	b	99.0	0.25	100
	4	c	96.0	1.5	81
	5	d	98.5	0.5	100
	3	u	99.25	0.25	100
Carillon	1	a	99.25	0.75	100
	2	a	99.0	0.5	100
	6	a	98.75	1.0	99
	8	a	82.25	10.5	79
	4	a	99.5	0	98
	5	b	96.5	2.0	92
	3	u	99.25	0	96
	7	u	98.75	0.75	98
Jubro	1	a	94.75	2.25	92
	2	a	94.25	1.25	92
	6	a	92.5	3.0	90
	8	a	94.5	2.5	65
	4	a	93.75	2.5	65
	5	a	93.75	2.75	90
	9	a	93.0	2.5	79
	9	u	93.25	2.25	80
	7	u	91.0	1.5	37
Montano	2	a	87.25	0.5	88
	4	b	95.75	1.5	96
	3	u	97.5	0.5	91
	7	u	96.0	1.25	77
Revito	1	a	94.5	1.75	88
	2	a	94.5	2.0	77
	9	a	94.75	2.25	60
	4	a	91.5	3.5	54
	1	b	94.25	4.5	96
	5	c	94.25	3.5	69
	3	u	94.0	2.25	77
Perfection	8	a	85.5	6.0	79
	9	a	74.0	5.7	80
	4	a	89.75	2.75	85
	10	a	90.25	3.25	75
	6	b	94.0	2.25	89
	5	c	87.75	5.75	77
	12	d	87.25	4.5	87
	7	u	91.75	4.75	90
Oberon	6	a	90.5	3.25	79
	3	u	91.25	2.75	61

Variety	Propagator	Seed lot	Normal %	Abnormal %	CD %
Begum	6	a	95.5	1.25	86
	4	a	93.0	3.5	86
	5	a	90.5	2.5	65
	3	u	90.5	6.5	80
Panda	1	a	89.5	2.25	92
	8	b	93.25	2.0	72
	4	c	90.75	2.5	82
	7	u	97.0	1.25	78
Malvina	1	a	93.5	1.25	78
	5	b	95.5	1.0	62
	11	c	96.5	1.5	74
King	2	a	95.25	1.75	96
	4	u	78.25	6.5	25
	7	u	94.75	1.0	74
Fortuna	4	a	96.75	1.25	90
	3	u	95.25	0.25	85
	7	u	93.75	1.5	46
White Rock	1	a	92.0	4.0	89
	4	b	94.75	1.75	90
	5	c	95.75	2.25	88
Corvillia	9	a	91.0	3.25	85
	11	a	92.0	3.5	65
	4	b	90.0	5.0	71
White Ball	1	a	89.25	5.75	73
	3	u	91.5	4.5	64
Paloma	8	u	98.0	0.75	95
	3	u	98.75	0.75	99
Grodan	4	a	88.25	4.25	88
	3	u	91.5	3.5	93
Linas	4	a	94.25	3.25	62
	5	b	91.25	3.75	72
Linda	8	u	76.0	9.0	51
Cambridge Mid Giant	5		92.5	3.75	52
Elgon	5		99.25	0.5	93
Tavia	1		85.75	8.5	52
SG109	1		87.75	1.0	84
Erfurt	7		98.75	1.0	84
Elby	6		81.1	5.8	67
Boston Early Prize	12		92.5	2.0	61
Andes	3		97.25	0.5	79
SG4006	4		92.25	2.75	72
Vernon	10		98.0	1.0	92
Sparto	10		98.0	1.0	92
Tundra F_1	1		87.25	6.0	89
Plana	5		85.5	7.75	39

Table 3 Laboratory germination, germination after 24 hours controlled deterioration and percentage of empty cells for 19 lots of cauliflower seed. (Correlation coefficient = 0.64 between CD and empty cells)

Variety	Lab. Germ. (%)	C.D. (%)	Empty Cells (%)
Carillon	99	100	1.0
Carillon	99	99	1.5
Montano	96	96	6.6
Revito	94	96	8.8
Paloma	98	95	0.8
Jubro	95	79	6.7
Oberon	91	79	6.7
Malvina	94	78	7.3
Corvilia	91	77	5.7
Panda	93	72	3.1
Elby	81	67	18.5
White Ball	92	64	11.9
Oberon	91	61	8.1
Revito	95	60	6.9
Revito	92	54	11.2
Linda	76	51	11.0

SUMMARY

1. All of the seedlots tested (89 cauliflower) had a high and commercially acceptable germination, with 80% having over 90% germination.

2. The controlled deterioration (CD) vigour test revealed considerable differences in seed vigour. Germination after controlled deterioration ranged from 100 down to 25%.

3. The percentage of empty cells in trays produced by propagators, counted for 18 lots of cauliflower seed, ranged from 18.5 to 1.0% and was significantly correlated with the CD germination of the lots; high CD (high vigour) lots giving the least number of empty cells. For example, the lot with a CD germination of 100% has 1% empty cells.

FV 10a
PN5

FV/10a Vegetable Seed: Assessment and Improvement of Vigour

Project Co-ordinator: Dr A A Powell

Project Leader: Dr S Matthews

Location: Wolfson Unit of Seed Technology
Department of Agriculture
University of Aberdeen

Start Date: 1.7.87

SURVEY OF GROWERS SEED

Introduction

The aim of the seed survey was to assess the quality of brassica seed being used by growers in 1988 for module production.

Method

307 samples of brassica seed used for spring and summer module production have been received from propagators in Lincolnshire, Humberside and Scotland. These included cauliflower, Brussels Sprout, broccoli and cabbage varieties (Table 1). Approximately 130 samples have so far been assessed for laboratory germination (16 replicates of 25 seeds) and seed vigour. Vigour was assessed by the controlled deterioration vigour test which has been shown to indicate the seed vigour of a number of species of small seeded vegetables as it is expressed in their relative field emergence and storage potential. The basis of this test was described in the previous report.

Table 1 The number of seed lots and varieties of four species received from propagators in Scotland, Lincolnshire and Humberside

Species	Number of seed lots received	Number of varieties
Cabbage	122	74
Brussels Sprouts	83	41
Cauliflower	72	28
Broccoli	30	17
Total	307	160

Results

The germination tests showed that all the samples assessed had a high and commercially acceptable germination, that is over 70% (Table 2). 85% of the seed lots tested had over 90% germination and only 2 lots of cabbage seed had germinations in the 70-79% category.

Large differences in seed vigour were, however, revealed by the vigour test results with the CD germinations spread more evenly over a much wider range of germination categories. The extent of the spread of the CD germinations varied between species.

Table 2 The number of seed lots per germination category following laboratory germination and controlled deterioration tests

Germination percentage	Frequency							
	Cabbage		Brussel Sprouts		Cauliflower		Broccoli	
	LG*	CD*	LG	CD	LG	CD	LG	CD
>90	33	24	38	24	30	15	9	5
80-90	4	11	8	8	5	9	1	2
70-79	2	1		8		3		1
60-69				3		3		1
50-59		1		1		3		1
40-49		1				1		
30-39		1				1		
20-29				1				
10-19								
0-9				1				

*LG = Laboratory Germination (normal seedlings)
*CD = Controlled deterioration germination

The cabbage seed showed least variation with 62% of the seed lots having CD germinations of over 90%, which is indicative of high vigour. Only 10%,or four seed lots, of cabbage had CD germinations below 80% indicating that there were few lots of low vigour. The Brussels Sprouts and cauliflower seed included 52 and 43% of the seed lots respectively with over 90% germination, that is having high vigour. Both species also showed a greater spread of CD germinations than the cabbage seed, indicating a greater range in seed vigour. The Brussels Sprouts had 8 lots in the 80-89% category with a further 14 lots with CD germinations below 80%, one of these being in the 0-9% category, indicating very low vigour. The spread of CD germinations for the cualiflower seed was similar to that for the Brussels Sprouts. The ten broccoli seed lots tested included 5 in the over 90% CD germiantion category, however, there have been too few seed lots assessed so far to draw any conclusions regarding their overall seed quality.

The emergence of four seed lots of cauliflower with a range of CD germinations was also assessed in module trays (Table 3). As CD germination decreased both the rate of emergence and the final percentage emergence decreased. This was particularly clear for the very high and low CD germination lots with the two intermediate lots being very similar. Thus, 80% of the high vigour lot White Summer had emerged two days after emergence began compared with only 18% of the low vigour Precision lot. The final emergence of the high vigour lot was 89%, decreasing to 78% for the low vigour lot. The vigour results, as indicated by CD germination, seem therefore to correlate well with emergence in trays.

Table 3 Laboratory germination, germination after 24 hours controlled deterioration and percentage emergence on days 1 and 2 after emergence began and final emergence of four lots of cauliflower seed.

Variety	Lab (%) germination	CD (%) germination	Percentage emergence Day 1	Day 2	Final
White Summer	98	99	18	80	89
Cambridge Mid Giant	88	69	4	51	85
Linda	81	55	6	52	81
Precision	90	37	1	18	78

Future Work

The remaining seed lots are now being assessed for laboratory and CD germinations. Selected seed lots will then be sown in module trays to assess emergence and correlate this with CD germination. The degree of variation found in the seedlings produced from seed differing in seed vigour will also be assessed. It is also hoped to develop a technique for measuring the conductivity of seed soak leachates so that this may be used as a measure of seed vigour along with or as an alternative to the controlled deterioration vigour test.

FV 10a
PN6

FV/10 A VEGETABLE SEED : ASSESSMENT AND IMPROVEMENT OF VIGOUR

Project Co-Ordinator: Dr A A Powell

Project Leader: Dr S Matthews

Location: Wolfson Unit of Seed Technology
Department of Agriculture
University of Aberdeen

Start Date: 1.07.87

INTRODUCTION:

The two main objectives of the work undertaken by the research assistant (Janet Thornton), stated in the first HDC report, were to assess the quality of seed currently used by growers and to find ways of improving the quality of the seed available. The previous two reports (April '88 and August '88) summarised the survey of the seed used by growers for autumn and for spring/summer sowings. Improvements of seed quality may be achieved in two ways, by (1) physiological improvement and (2) seed sorting. Our recent work has been concerned with the physiological improvement or invigoration of seeds which is the subject of this report. The major cause of low seed vigour is deterioration or ageing, which results in the slow germination of seeds over a long period of time leading to considerable variability in seedling size. In addition deterioration has been found in our survey to be the main cause of low vigour seed and poor performance in modules. Emphasis has therefore been given to treatments giving improvements in deteriorated (low vigour) seed. Previous work has suggested that periods of hydration can result in improved seed vigour. We have examined the effect of a system of aerated hydration developed over several months on the seed and seedling vigour of Brussels Sprouts and cauliflower seeds.

METHOD:

High vigour seed of Brussels Sprouts cv Asmer Aries and cauliflower cv Hipop was deteriorated to produce seed having a high germination but low vigour. This low vigour seed was used to examine the effects of an invigoration treatment developed over a period of six months.

The treatment developed was to hydrate samples of seed in 500 ml of water contained in a 0.5 m long by 5 cm diameter vertically held perspex column through which air was bubbled at a rate of 1.5 l/minute. In comparisons of 4, 6, 8 and 10 hours hydration at 10, 15, 20, 25 and 30°C the optimum conditions were found to be an 8 hour hydration at 25°C. Each treatment column was replicated 3 times in any one experimental run. After treatment the seed was dried back overnight in open dishes in the laboratory to its original moisture content. Assessments were made of the extent of improvements achieved by comparing untreated and treated seeds in the following ways.

1) Germination percentage - assessments after 6 and 10 days.
2) Germination rate - 12 hourly counts for the first 48 hours then daily,
3) Seedling root lengths - measured after 4 days in germination tests.
4) Seed vigour - assessed by the controlled deterioration vigour test. (for details see previous report).

RESULTS:

For both Brussels Sprouts and cauliflower the final percentage germination of the low vigour seed was not affected by the hydration treatment and remained high (Figure 1 (a)). After treatment the germination rate was increased by 24% for Brussel Sprouts and 26% for cauliflower (Figure 1 (b)). The mean root length after 4 days in germination tests was increased most impressively by the hydration treatment, from 3.3 to 8.0 mm (143% increase) for Brussel Sprouts and from 2.8 to 7.6 (170%) for cauliflower (Figure 1 (c)). Germination after controlled deterioration (CD), the measure of seed vigour found to relate well with emergence performance in modules in the growers survey, was also markedly improved by the treatment. In the case of Brussels Sprouts the germination after CD was increased from

21 to 56% after treatment and from 4 to 34% for cauliflower. The responses to treatment seen in the low vigour seed were highly repeatable, similar results being found in four different experimental runs.

Much evidence, especially the increases in germination after controlled deterioration, indicates that the aerated hydration treatment improved seed by repairing the adverse effects of deterioration. Further evidence that the improvements of the low vigour seed resulted from repair was suggested by the lack of any marked improvements in germination after controlled deterioration in high vigour seed following treatment. In unaged high vigour seed there would be little deterioration to repair. There were, however, some increases in the rate of germination and the root length of unaged seed after treatment suggesting that the advancement of germination as well as repair was occurring.

CONCLUDING REMARKS:

1) These findings are the first clear evidence of the repair of deterioration resulting from pre-germination treatments.

2) So far the treatment has not restored low vigour seed to the level of performance of the high vigour seed but further work is in progress to enhance the effects reported here.

3) Although the scale of the operation in these experiments is limited, the principle of seed invigoration by a convenient and inexpensive process has been established and provides a basis for the scaling up of treatments to deal with larger volumes of seed.

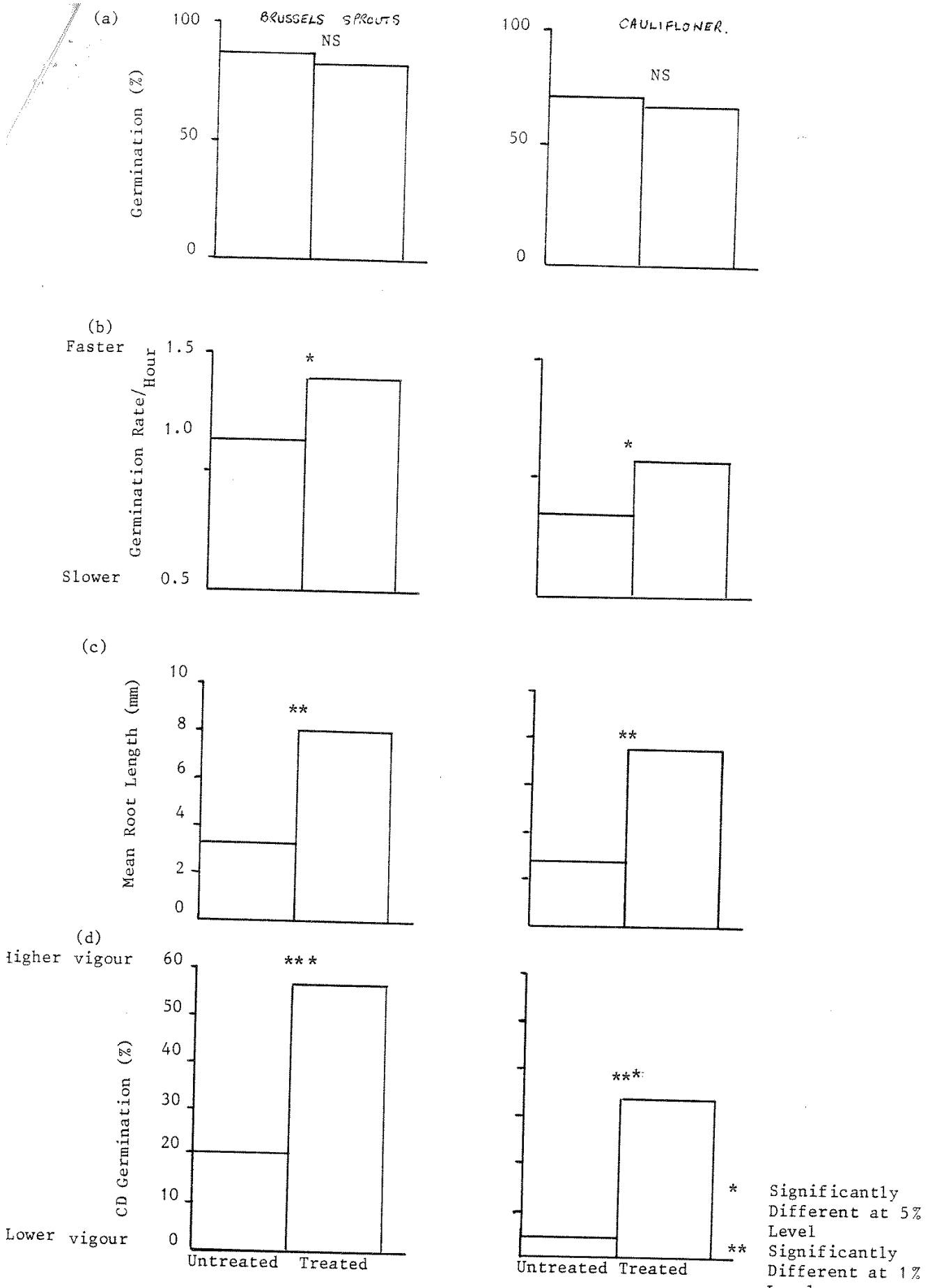


Figure 1 Effect of aerated hydration on low vigour Brussels Sprouts and cauliflower seed. (a) Germination (b) Germination Rate (c) Root Mean Length and (d) controlled deterioration germination

FV 10a
PN 7

FV/10a Vegetable seed: Assessment and improvement of vigour

Project Co-ordinator: Dr A A Powell

Project Leader: Dr S Matthews

Location: Wolfson Unit of Seed Technology
Department of Agriculture
University of Aberdeen

Start Date: 1.7.87

Introduction

The aim of the seed survey was to assess the quality of brassica seed being used by growers. This report summarises the results of the spring/summer survey from 1988 which was presented in part in Project New Number 6. The controlled deterioration (CD) test clearly revealed the existence of low vigour seed material amongst seed used by growers, some of which would be unsuitable for transplant production. This test is however time-consuming (up to 14 days) and assessments of seed quality may be required more rapidly. One rapid assessment used in peas and other grain legumes is the measurement of seed leachate conductivity. We have therefore investigated the possible use of conductivity after CD to assess vigour.

Method

In the spring/summer survey 323 samples of brassica seed were tested for germination and seed vigour. Vigour was assessed using the controlled deterioration vigour test carried out at 45°C and 20% moisture content for 24 hours after which germination tests were set up and assessed after 6 and 10 days. An alternative method of vigour assessment was also examined. Seeds were deteriorated using the CD test as above then soaked in 50 ml deionised water at 20°C for 24 hours. The electrical conductivity of the seed soak water was measured and compared with the results of the CD test as a measure of seed vigour.

Results and Discussion

Over 73% of the seed lots tested in the survey had CD germinations of over 80% and therefore would be categorised as high vigour seed. The range of CD values was however large with some lots having CD germinations of less than 10% which is indicative of very low vigour (Table 1). In view of the range of seed vigour available for transplant producers, three categories of seed vigour were drawn up which reflected the suitability of seed for transplant production. Seed lots with over 80% CD germination are classified to be of high vigour and therefore suitable for module production whereas seed lots with 60-80% CD germination are of medium vigour and only suitable if no alternative seed lot or cultivar is available. Any seed lot with below 60% CD germination would be unsuitable for module production. The criteria on which seeds are considered suitable for transplant production is based on the correlation (0.64, $p \leq 0.01$) between the number of empty module cells following emergence and the seed vigour as assessed by the CD test (Project News Number 4). Thus seed with CD germination of above 80% (high vigour) gave an average of only 3.7% empty cells compared to 7% for seeds with CD values between 60 and 80% and over 11% for seed with CD's of below 60% (low vigour).

The CD vigour test takes three days to deteriorate the seed followed by 10 days for the germination test. The measurement of seed soak water conductivity after CD was therefore examined as an alternative and faster method of vigour assessment. To determine the effectiveness of this method seed of the Brussels sprouts cv. Asmer Aries was artificially aged to give seed with high germination but differing vigour according to the CD test (Table 2). As the CD germination and hence seed vigour fell the conductivity of the soakwater increased due to increased electrolyte leakage from the seed.

Thus the seed with a CD germination of 53% had a leachate conductivity of almost double that of the sample with 88% CD germination (Table 2). Furthermore there was a significant correlation between the CD vigour results and the soak water conductivity measurements ($r = 0.843$, $p \leq 0.05$). These seven samples clearly fell into the low, medium and high vigour categories determined from the vigour survey (Figure 1). The samples also fall into the same groupings when separated according to conductivity, with the high vigour lots having conductivities below 125 uS and the low vigour lots having conductivities above 155 uS.

The CD/conductivity vigour assessment therefore gave the same vigour results as the conventional CD test but in only 3-4 days as opposed to 14. We are currently examining the effectiveness of this more rapid vigour assessment on commercial seed samples of all brassica species to determine its suitability as a routine vigour test.

Conclusion

There is clearly a basis for the feasible classification of seed intended for use in transplant production into high, medium and low vigour categories. Seed companies may be encouraged to adopt such a vigour classification by the feasibility of a rapid test based on controlled deterioration followed by measurement of seed leachate conductivity.

Table 1 The number of seed lots per germination category following controlled deterioration tests

Germination percentage	Frequency			
	Cabbage	Brussels sprouts	Cauliflower	Calabrese
>90	75	37	32	14
80-89	32	23	19	11
70-79	7	15	9	2
60-69	3	6	8	3
50-59	2	3	7	2
40-49	1	-	1	-
30-39	3	1	2	1
20-29	1	1	-	-
10-19	-	-	-	-
0-9	1	1	-	-

Table 2 Germination, controlled deterioration germination and soak water conductivity measurements for seven sample of Brussels sprouts seed

Seed Lot	Germination (%)	Controlled (%) deterioration	Conductivity (uS cm^{-2} g^{-1})
1	92	88	111
2	92	84	119
3	96	70	132
4	88	69	138
5	84	69	150
6	93	51	164
7	84	53	202

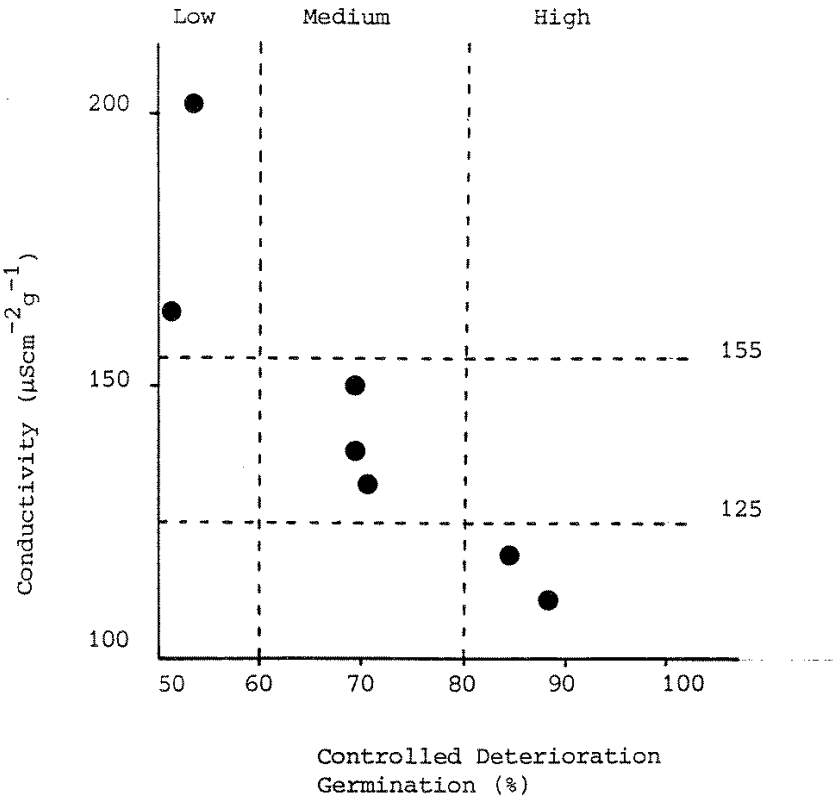


Figure 1 Comparison of vigour assessment by controlled deterioration and conductivity methods, on 7 samples of Brussels sprouts seed cv. Asmer Aries

FV 10a
PN 8

FV/10a Vegetable Seed: Assessment and Improvement of Vigour

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Project Leader: Dr S Matthews

Location: Wolfson Unit of Seed Technology
Department of Agriculture
University of Aberdeen

Start Date: 1.7.87

Introduction

In Project News Number 7 we reported the preliminary results from a rapid vigour assessment involving the measurement of seed leachate conductivity after a period of controlled deterioration. In this initial work artificially aged seed was used to determine that a single conductivity measurement after 24 hours soaking could replace the germination test in the conventional controlled deterioration vigour test.

We have now done further research using many seed lots to determine whether measurement of leachate conductivity following controlled deterioration can be used to identify high, medium and low vigour seeds.

Method

A total of 28 seed samples from several sources of both cauliflower and Brussels sprouts were used having a range of seed vigour, most of the samples being treated with fungicide. However, for six cultivars of each species, samples of both treated and untreated seeds were obtained to determine whether treatment affected the conductivity readings.

Approximately 400 seeds from each seed sample were deteriorated as in the controlled deterioration test at 20% moisture content for 24 hours at 45°C. Three replicates of 100 seeds were then soaked for 24 hours in 50 ml of deionised water at 20°C and the electrical conductivity of the seed soak water measured. The remaining 100 seeds were set up in a germination test to enable comparison of the conductivity results with the results of germination after controlled deterioration.

Results and Discussion

Seed samples having low germination after controlled deterioration and hence low seed vigour gave high values for the conductivity of the soakwater, indicating high electrolyte leakage from the seeds, whereas samples with high controlled deterioration germinations had low conductivity values. Thus for example, the cauliflower seed sample with a controlled deterioration germination of 95% had a leachate conductivity of 79 $uSml^{-1}g^{-1}$ compared with 207 $uSml^{-1}g^{-1}$ for a sample with a controlled deterioration germination of 39%. Furthermore, there was a significant correlation between the germination after controlled deterioration and the soak water conductivity measurements for both cauliflower ($r=-0.867$, $p\leq 0.01$) and Brussels sprout ($r=-0.786$, $p\leq 0.01$). Seed from both species which was not treated with fungicide gave conductivity values comparable with treated seed having similar controlled deterioration (CD) germinations (Figures 1 and 2)

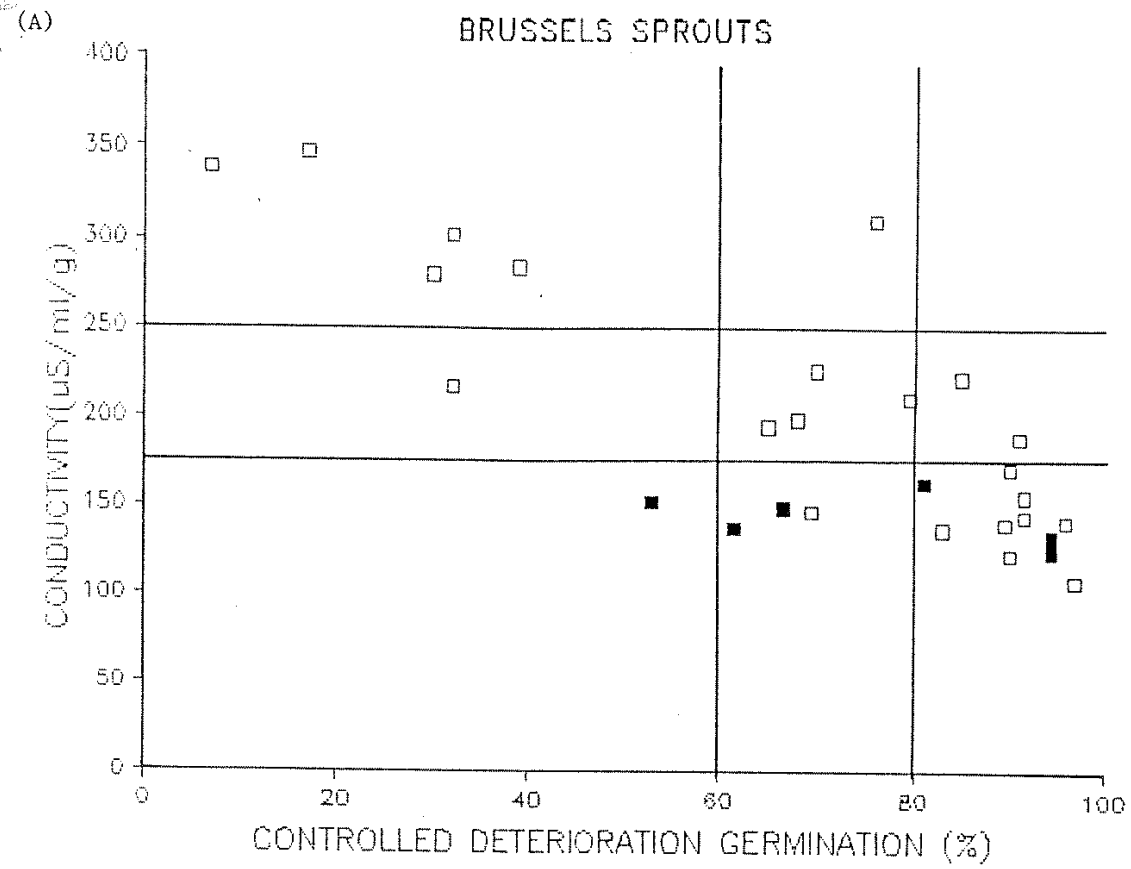
The samples for both species could be divided into high, medium and low vigour categories determined by the CD vigour test. Thus high vigour seed would have above 80% CD germination, medium vigour between 60 and 80% and low vigour below 60%. (Project News Number 7). Similar groupings of vigour can be drawn up according to leachate conductivity (Figures a and b). For Brussels sprouts the high vigour samples had conductivities below 175uS whereas the low vigour samples had conductivities above 250uS. These limits were slightly

lower for the cauliflower samples. Thus the conductivity values for high vigour seeds were below 125 uS and those for low vigour seeds above 200 uS.

Any seed sample with very high or low vigour was classified into the same vigour groupings by either germination or conductivity after CD. Those seed lots with medium vigour were more likely to fall into different categories depending on the method used. A conductivity measurement after deterioration could therefore be carried out initially to separate out those lots with high and low vigour. Further tests could be run on seed lots which fall close to the boundary conductivities to confirm to which vigour category they belong.

Measurement of conductivity after CD therefore gave similar vigour results to the conventional CD test. Use of a conductivity measurement rather than germination has the clear advantage of achieving a vigour assessment in only 3-4 days compared with 14.

These findings should encourage seed companies to undertake the CD vigour test along with conductivity measurements in a routine manner. Growers would thereby be justified in requesting a vigour test prior to seed purchase to guarantee high quality and maximum productivity in modules and field sowings.



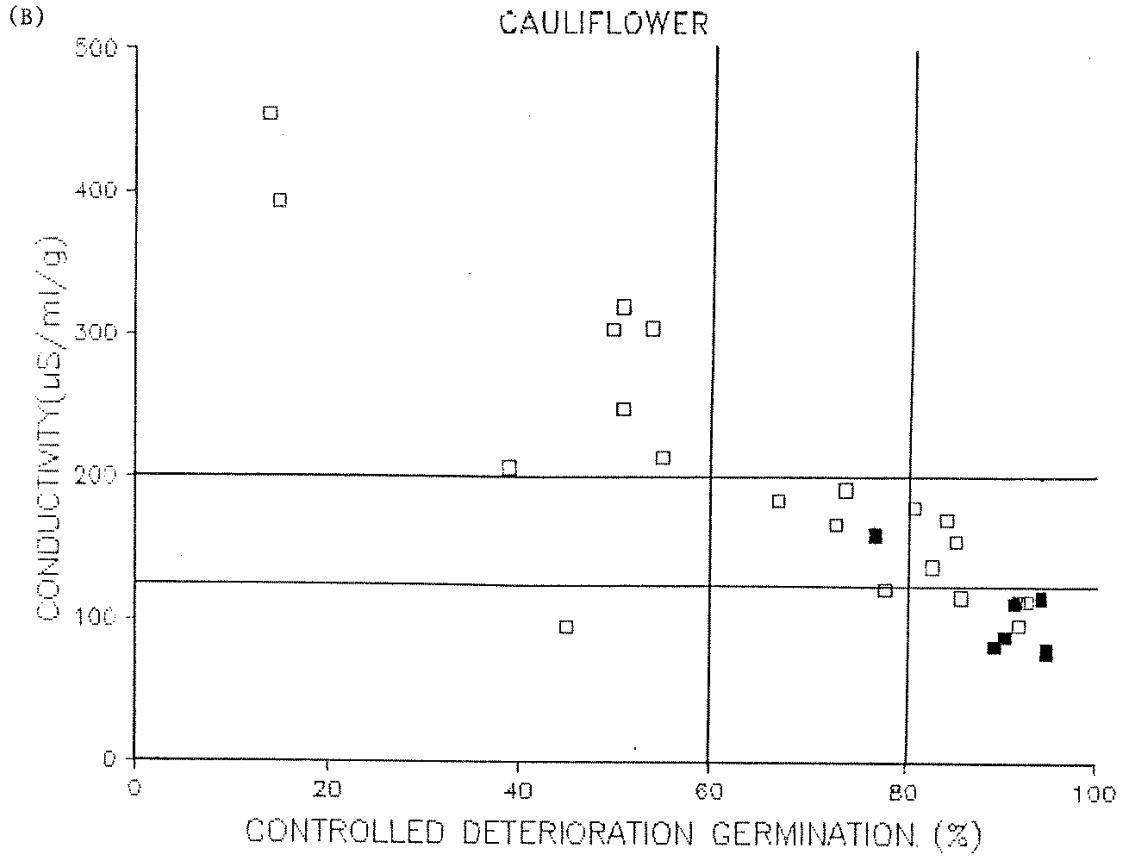


Figure 1 Comparison of vigour assessment by controlled deterioration and conductivity methods for (A) Brussels sprouts and (B) Cauliflower ■ untreated samples