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**VIGOUR ASSESSMENT IN *Pinus radiata* D. DON SEEDS**

A thesis presented in partial  
fulfilment of the requirements for the degree of  
Master of Agricultural Science in Seed Technology  
at Massey University, Palmerston North,  
New Zealand

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**ABSTRACT**

Kartiko, H.D.P.: M.Agr.Sc. (Seed Technology)

Title of Thesis: Vigour Assessment in *Pinus radiata* D. Don Seeds

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The sensitivity and/or predictivity of various vigour test methods (which include conductivity, tetrazolium, x-ray contrast, seedling growth, controlled deterioration, complex stressing vigour, and low temperature/osmotic stress tests) for prepared lots of *Pinus radiata* seeds were investigated in this study. The best tests were the controlled deterioration test with two days aging treatment (CD2d test), the prechilled seedling growth test (SG+pr test), and the complex stressing vigour test (CSV test). These were then further investigated to evaluate their ability to predict the performance of different seed lots at the Forest Research Institute (FRI) nursery, Rotorua.

The CD2d, SG+pr and CSV tests showed good correlation, especially with percentage of plantable seedlings at the FRI nursery. In addition, these tests seem to have met most of the AOSA's (1983) criteria for a practical vigour testing, as they are simple and can be done in a relatively short period of time. For application purposes, it is suggested that the test parameters which gave the highest correlation coefficient value with percentage of plantable seedlings in the nursery should be used as a reliable measurement. Therefore,

percentage normal seedlings should be used in either the CD2d or the CSV test, whereas T<sub>50</sub> radicle emergence seems more predictive in the SG+pr test.

For application in other nurseries, these tests may still be valid, especially if pre-sowing treatment and nursery conditions are about the same as in the FRI nursery. If conditions do differ, however, the CD2d and SG+pr tests are more likely to be useful than the CSV test. This hypothesis is based on the fact that the CD2d and SG+pr tests also gave good correlations with the glasshouse (optimum conditions) and winter field tests (sub-optimum conditions). In contrast, there was no significant correlation given by the CSV test in relation to the glasshouse and winter field tests.

Seed weight had a significant effect on seedling dry weight and T<sub>50</sub> radicle emergence if there was a large seed weight variation between seed lots. In this case, generally heavier seeds had better performance than the lighter ones. If there was only small variation in overall seed weight among seed lots, however, the important effects of individual differences in seed weights were masked.

The direction of further studies would seem to be to evaluate the reproducibility of correlation coefficient values and regression equations by the CD2d, SG+pr and CSV tests in the same nursery site over several sowings. Additionally, vigour test evaluation using seed lots from individual clones would also seem to be important.

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## TABLE OF CONTENTS

|  | <u>Page</u> |
|--|-------------|
| ABSTRACT .....   | i           |
| ACKNOWLEDGEMENTS .....   | iii         |
| TABLE OF CONTENTS .....  | iv          |
| LIST OF TABLES .....   | viii        |
| LIST OF FIGURES .....  | ix          |
| LIST OF APPENDICES .....   | xii         |
| <br>   |             |
| I. INTRODUCTION .....  | 1           |
| <br>   |             |
| II. LITERATURE REVIEW .....  | 4           |
| 2.1. <i>Pinus radiata</i> : the need for high vigour seed .....                | 4           |
| 2.1.1. The role of seed vigour in <i>P. radiata</i> forest establishment ..... | 4           |
| 2.1.2. The problem of low vigour .....   | 4           |
| 2.1.2.1. The condition of the mother trees .....                               | 5           |
| 2.1.2.2. Collection date .....   | 7           |
| 2.2. Seed deterioration .....  | 8           |
| 2.2.1. Factors affecting seed deterioration .....                              | 8           |
| 2.2.1.1. Effect of genotype .....  | 8           |
| 2.2.1.2. Effect of storage environment .....                                   | 10          |
| 2.2.1.3. Artificial aging conditions .....                                     | 11          |
| 2.2.2. Mechanism of seed deterioration .....                                   | 12          |
| 2.3. Seed vigour testing .....   | 14          |
| 2.3.1. The importance of seed vigour testing .....                             | 14          |
| 2.3.2. Seed vigour testing methods .....                                       | 15          |
| 2.3.2.1. Tests not involving germination .....                                 | 16          |
| 2.3.2.2. Tests involving germination .....                                     | 20          |
| 2.3.2.3. Stress tests .....  | 22          |
| 2.3.3. Scope for further investigation .....                                   | 23          |

|          |   |    |
|----------|---|----|
| III.     | MATERIALS AND METHODS .....   | 35 |
| 3.1.     | Deterioration in <i>P. radiata</i> seeds .....  | 35 |
| 3.2.     | Vigour tests evaluation in <i>P. radiata</i> seeds using 5 seed lots<br>which varied according to seed size and age .....                           | 37 |
| 3.2.1.   | Seed lot preparation .....  | 37 |
| 3.2.2.   | Vigour testing .....  | 38 |
| 3.2.2.1. | Seedling growth tests .....   | 38 |
| 3.2.2.2. | Tests not involving germination .....   | 38 |
| 3.2.2.3. | Stress tests .....  | 41 |
| 3.2.3.   | Glasshouse test .....   | 43 |
| 3.2.4.   | Winter field test .....   | 44 |
| 3.3.     | Vigour tests evaluation in <i>P. radiata</i> seeds using 16 seed lots<br>which varied according to type of mother tree and<br>collection date ..... | 45 |
| 3.3.1.   | Seed weight and vigour tests .....  | 47 |
| 3.3.1.1. | Seed weight test .....  | 47 |
| 3.3.1.2. | Vigour tests .....  | 47 |
| 3.3.2.   | Nursery and standard germination tests carried out by FRI<br>(the New Zealand Forest Research Institute) .....                                      | 47 |
| IV.      | RESULTS .....   | 48 |
| 4.1.     | Deterioration in <i>P. radiata</i> .....  | 48 |
| 4.2.     | Vigour tests evaluation in <i>P. radiata</i> seeds using 5 seed lots<br>which varied according to seed size and age .....                           | 54 |
| 4.2.1.   | Seed lot performance in the glasshouse test .....   | 54 |
| 4.2.2.   | Conditions and seed lots performance in the winter field tests .....  | 54 |
| 4.2.3.   | Seed lots performance in seedling growth test .....   | 62 |
| 4.2.4.   | Seed lot performance in radiographic test .....   | 68 |
| 4.2.5.   | Seed lot performance in topographical tetrazolium test .....  | 68 |
| 4.2.6.   | Seed lot performance in the conductivity test .....   | 69 |
| 4.2.7.   | Seed lot performance in the controlled deterioration (CD) test .....  | 69 |
| 4.2.8.   | Seed lot performance in the complex stressing vigour test .....   | 69 |
| 4.2.9.   | Seed lot performance in low temperature/osmotic stress test .....   | 72 |
| 4.2.10.  | Correlation between vigour tests and glasshouse/winter field test .....   | 72 |



|          |   |     |
|----------|---|-----|
| 4.3.     | Vigour tests evaluation in <i>P. radiata</i> seeds using 16 seed lots which varied according to type of mother tree and collection date ..... | 87  |
| 4.3.1.   | Seed lot performance in the standard germination and nursery tests carried out by FRI .....   | 87  |
| 4.3.2.   | Seed weight .....   | 88  |
| 4.3.3.   | Seed lot performance in the vigour tests done at Seed Technology Centre .....   | 88  |
| 4.3.4.   | Correlation of seed weight, standard germination, and vigour tests with FRI nursery test .....  | 94  |
| 4.3.4.1. | Correlation between seed weight and nursery test .....  | 94  |
| 4.3.4.2. | Correlation between standard germination test by (FRI) and the nursery test .....   | 97  |
| 4.3.4.3. | Correlation between vigour tests and nursery test .....   | 97  |
| V.       | DISCUSSION .....  | 103 |
| 5.1.     | Deterioration in <i>P. radiata</i> seeds .....  | 103 |
| 5.1.1.   | The pattern of deterioration .....  | 103 |
| 5.1.2.   | The role of high temperature and relative humidity .....  | 104 |
| 5.1.3.   | Changes which may be associated with the loss of vigour and viability .....   | 105 |
| 5.1.4.   | Changes in normal seedling dry weight .....   | 106 |
| 5.2.     | Vigour test evaluation .....  | 106 |
| 5.2.1.   | Promising suitable vigour tests for <i>P. radiata</i> .....   | 107 |
| 5.2.1.1. | The controlled deterioration test with 2 days aging (CD2d test) .....   | 108 |
| 5.2.1.2. | The prechilled seedling growth test (SG+pr test) .....  | 110 |
| 5.2.1.3. | The complex stressing vigour test (CSVST) .....   | 113 |
| 5.2.1.4. | The low temperature germination test at 10°C, 0 bar .....   | 114 |
| 5.2.2.   | Suitable vigour tests for assessing seedling establishment at Rotorua (FRI) nursery .....   | 115 |
| 5.2.3.   | The effect of seed coat condition on germination performance and the conductivity test result .....   | 117 |
| 5.2.3.1. | The effect of seed coat condition on germination performance .....  | 117 |

|          |  |     |
|----------|--|-----|
| 5.2.3.2. | The effect of the condition of the seed coat on the conductivity test result .....                             | 120 |
| 5.2.4.   | The relationship between seed weight and seedling performance .....  | 122 |
| VI.      | CONCLUSION .....   | 125 |
| 6.1.     | Deterioration in <i>P. radiata</i> seeds .....   | 125 |
| 6.2.     | Promising suitable vigour tests for <i>P. radiata</i> .....  | 125 |
| 6.3.     | Suitable vigour tests for assessing seedling establishment of <i>P. radiata</i> at Rotorua (FRI) nursery ..... | 126 |
| 6.4.     | The relationship between seed weight and seedling performance .....  | 128 |
| 6.5.     | Scope for further studies .....  | 128 |
|          | BIBLIOGRAPHY .....   | 130 |
|          | APPENDICES .....   | 146 |

## LIST OF TABLES

| <u>Table</u>  | <u>Page</u> |
|---|-------------|
| 2.1. Vigour tests not involving germination .....   | 24          |
| 2.2. Vigour tests involving germination .....   | 29          |
| 2.3. Stress tests .....   | 32          |
| 3.1 Planting years and clone number of parent trees of the seed lot<br>used in the aging study of <i>P. radiata</i> seeds ..... | 35          |
| 3.2. Moisture contents after the controlled deterioration test .....  | 42          |
| 3.3 Description of <i>P. radiata</i> seed lots .....  | 46          |
| 4.1. 100 seed weight data for the different seed lots .....   | 89          |

## LIST OF FIGURES

| <u>Figure</u>  | <u>Page</u> |
|--|-------------|
| 4.1.A. Changes in % radicle emergence, during accelerated aging at<br>40° C and 45° C with 100% RH up to 14 days .....   | 49          |
| 4.1.B. Changes in % normal seedlings during accelerated aging at<br>40° C and 45° C with 100% RH up to 14 days .....   | 50          |
| 4.1.C. Changes in T <sub>50</sub> radicle emergence and T <sub>50</sub> normal seedlings during<br>accelerated aging at 40° C with 100% RH up to 14 days ..... | 51          |
| 4.1.D. Changes in T <sub>50</sub> radicle emergence and T <sub>50</sub> normal seedlings during<br>accelerated aging at 45° C with 100% RH up to 14 days ..... | 52          |
| 4.1.E. Changes in normal seedlings dry weight during accelerated aging<br>at 40° C and 45° C with 100% RH up to 14 days .....                                  | 53          |
| 4.2.A. Percentage of normal seedlings in glasshouse test .....   | 55          |
| 4.2.B. T <sub>50</sub> normal seedlings in glasshouse test .....   | 56          |
| 4.2.C. Normal seedlings dry weight in glasshouse test .....  | 57          |
| 4.3.A. Cumulative emerged and normal seedlings in the winter field test .....  | 58          |
| 4.3.B. Surviving emerged and normal seedlings in the winter field test .....   | 59          |
| 4.3.C. Time of 50% emergence and 50% establishment of normal seedlings<br>in the winter field test .....   | 60          |
| 4.3.D. Dry weight of shoots of normal seedlings in the winter field test .....   | 61          |
| 4.4.A. Percentage of radicle emergence in seedling growth test .....   | 63          |
| 4.4.B. Percentage of normal seedlings in seedling growth test .....  | 64          |
| 4.4.C. T <sub>50</sub> radicle emergence in seedling growth test .....   | 65          |
| 4.4.D. T <sub>50</sub> normal seedlings in seedling growth test .....  | 66          |
| 4.4.E. Normal seedlings dry weight in seedling growth test .....   | 67          |

| <u>Figure</u>  | <u>Page</u> |
|--|-------------|
| 4.5. Seed lot performance in controlled deterioration (CD) test .....  | 70          |
| 4.6. Seed lot performance in complex stressing vigour test .....   | 71          |
| 4.7.A. Percentage of radicle emergence at 10° C .....  | 73          |
| 4.7.B. T <sub>50</sub> radicle emergence at 10° C .....  | 74          |
| 4.7.C. T <sub>50</sub> radicle emergence at 15° C .....  | 75          |
| 4.8. Radicle emergence from seedling growth test + prechilling treatment<br>vs surviving normal seedlings in the field .....                             | 77          |
| 4.9. Radicle emergence from seedling growth test without prechilling<br>vs surviving normal seedlings in the field .....                                 | 78          |
| 4.10. Normal seedlings from the controlled deterioration test with 2 days<br>aging treatment vs normal seedlings in the glasshouse .....                 | 79          |
| 4.11. Normal seedlings from the controlled deterioration test with 2 days<br>aging treatment vs T <sub>50</sub> normal seedlings in the glasshouse ..... | 80          |
| 4.12. Normal seedlings from the controlled deterioration test with 2 days<br>aging treatment vs surviving normal seedlings in the field .....            | 81          |
| 4.13. Normal seedlings from the controlled deterioration test with 2 days<br>aging treatment vs T <sub>50</sub> normal seedlings in the field .....      | 82          |
| 4.14. Normal seedlings from the complex stressing vigour test vs surviving<br>normal seedlings in the field .....  | 83          |
| 4.15. Radicle emergence in 10° C, 0 bar vs surviving normal seedlings in<br>the field .....  | 84          |
| 4.16. Radicle emergence in 15° C, 0 bar vs surviving normal seedlings in<br>the field .....  | 85          |
| 4.17. Radicle emergence in 20° C, 0 bar vs surviving normal seedlings in<br>the field .....  | 86          |

| <u>Figure</u>   | <u>Page</u> |
|---|-------------|
| 4.18.A. 100 seed weight of <i>Pinus radiata</i> clones on lot 13 at moisture<br>content 7.69% .....   | 90          |
| 4.18.B. 100 seed weight of <i>Pinus radiata</i> clones of lot 14 at moisture<br>content 7.69% .....   | 91          |
| 4.18.C. 100 seed weight of <i>Pinus radiata</i> clones of lot 15 at moisture<br>content 7.69% .....   | 92          |
| 4.18.D. 100 seed weight of <i>Pinus radiata</i> clones of lot 16 at moisture<br>content 7.69% .....   | 93          |
| 4.19. Seed weight vs seedling height in the nursery .....   | 95          |
| 4.20. Seed weight vs seedling diameter in the nursery .....   | 96          |
| 4.21. Radicle emergence from the controlled deterioration test with 2 days<br>aging treatment vs plantable seedlings in the nursery .....                       | 98          |
| 4.22. Normal seedlings from the controlled deterioration test with 2 days<br>aging treatment vs plantable seedlings in the nursery .....                        | 99          |
| 4.23. T <sub>50</sub> radicle emergence in the controlled deterioration test with 2 days<br>aging treatment vs T <sub>50</sub> germination in the nursery ..... | 101         |
| 4.24. T <sub>50</sub> normal seedlings in the controlled deterioration test with 2 days<br>aging treatment vs T <sub>50</sub> germination in the nursery .....  | 102         |

## LIST OF APPENDICES

| <u>Appendix</u>   | <u>Page</u> |
|---|-------------|
| 1. Quantitative tetrazolium test results .....  | 146         |
| 2. Nursery and standard germination test procedures (carried out by FRI) .....  | 148         |
| 3. Temperature in glasshouse test .....   | 150         |
| 4.A. Temperature in the winter field test .....   | 151         |
| 4.B. Rainfall in the winter field test .....  | 152         |
| 5. Seed lot performance in glasshouse and winter field tests .....  | 153         |
| 6. Seed lot performance in vigour tests .....   | 154         |
| 7. Correlation (r) between vigour tests and glasshouse/winter field test .....  | 157         |
| 8. Seed lot performance in standard germination and nursery tests<br>(carried out by FRI) .....                                     | 161         |
| 9. Seed lot ranking in standard germination and nursery tests according<br>to relative vigour score .....                           | 162         |
| 10. Seed lot ranking in the overall seed lots in standard germination<br>and nursery tests according to relative vigour score ..... | 163         |
| 11. Calculation of mean relative vigour score in nursery test .....   | 164         |
| 12. Seed lot performance in vigour tests done at Seed Technology Centre .....   | 165         |
| 13. Seed lot ranking in vigour tests according to relative vigour score .....   | 166         |
| 14. Seed lot ranking (within groups) in vigour test according to mean<br>relative vigour score .....                                | 167         |
| 15. Seed lot ranking in vigour tests according to mean rvs .....  | 168         |
| 16. Calculation to obtain mean relative vigour score (rvs) in vigour tests .....  | 169         |

| <u>Appendix</u>   | <u>Page</u> |
|---|-------------|
| 17. Correlation of seed weight, standard germination, and vigour tests<br>with nursery test .....                         | 170         |
| 18. Summary of weather during seedling growth of <i>P. radiata</i> in the<br>nursery at the FRI, Rotorua in 1987/88 ..... | 171         |



## I. INTRODUCTION

*Pinus radiata* which originally might have come from Ano Nuevo Point, on the southwestern part of the North American coast (Bannister, 1973) nowadays covers over one million hectares of plantation forests in New Zealand (FRI, 1987) and produces a very useful and versatile wood, e.g. logs, solid timber, wood chips, pulp and paper. These account for ten percent of New Zealand's overseas earnings (Clifton, 1985). It has a medium density soft wood with an even texture. In addition, the physical structure of the wood permits ready preservative treatment. Therefore, the end products are stable, strong, resistant to insects and fungi, and easily finished with a variety of stains, clear finishes, paint and overlays (FRI, 1987).

For planting purposes, a large number of genetically improved seed is needed, and for 1984-1985 season, for example, the seed demand was about 3500 kg. To fulfil this demand, almost all of the current seed production is from 850 series clones and half of the total quantity is collected from Gwavas orchard. By 1990, production from 850 series clones is planned to be reduced and almost completely replaced by seed from 268 and 875 series clones collected mainly from Kaingaroa orchard (Vincent, 1986). Despite the fact that these seeds are genetically improved, the vigour of the seeds at present seems to be quite low, even though laboratory germination tests show that at least 90% of seeds are viable (see section 2.1.2.). Therefore, it is important to select the best seed production methods, and the best clones which can produce high vigorous seeds. This requires the identification of suitable vigour tests for this species.

It appears that there are not many reports concerning vigour tests in *P. radiata* or other tree species. In the few studies which have been conducted there has been little attempt to

correlate results with field performance. This analysis is very crucial, as high vigour seeds according to a vigour test do not always produce good performance in the field (see section 2.3.).

In some agricultural seeds, some vigour tests gave high and significant correlation with field performance in certain stations. However, they may give poor correlations with field performance in other stations (see section 2.3.). Therefore, an investigation to look for a general vigour test with suitability for all kind of field conditions seems to be over ambitious (see Hampton and Coolbear, 1990).

Based on these reasons, vigour test evaluation in *P. radiata* was conducted in this study with objectives as follows:

- (i) to characterise the seed deterioration pattern in *P. radiata*, in order to determine suitable aging treatments for creating seed lots which have different vigour levels,
- (ii) to investigate promising suitable vigour tests for *P. radiata*, and
- (iii) to investigate these tests for their suitability for predicting seedling establishment in the nursery at the Forest Research Institute (FRI), Rotorua.

To fulfil these objectives, three stages of experimentation were conducted in this study. The first stage was a study using accelerated aging techniques to determine the best methods of preparing deteriorated seed lots. The second stage was evaluation of various vigour test methods using 5 prepared seed lots which varied according to seed weight and age. The third stage was evaluation of the best test methods (i.e. the controlled deterioration test with 2 days aging treatment, the prechilled seedling growth test, and the

complex stressing vigour test) to predict seedling performance at the FRI nursery using 16 mixed seed lots which varied according to type of mother tree and collection date.