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DEPARTMENT OF AGRICULTURE, SOUTH AUSTRALIA

Agronomy Branch Report

THE IMPORTANCE OF SEED QUALITY

By D.C. Ragless,
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Foreword

This report formed the basis of a paper entitled "Why Quality?", presented by Mr. Ragless at the 7th National Convention of the Australian Seed Industry Association held in Adelaide, October, 1974.

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1. WHAT IS QUALITY SEED?:

Quality seed is seed which will give the best possible field results without introducing or aggravating crop pest or disease problems.

Ideally, seed for sowing should be uniform, should keep well in storage and when sown germinate simultaneously. The seedlings should be vigorous and capable of establishing in a wide range of environmental conditions, such as extremes of drought, waterlogging, heat and cold. They should be capable of withstanding microbial interference and capable of growing rapidly to fill the space allocated to them in a crop to produce the highest possible yield of the best possible quality of the desired product. This should be achieved in a short a space of time as possible. The seed should not introduce any new or unwanted weed or crop seeds or introduce new or crop damaging pests or diseases.

2. FACTORS CONTRIBUTING TO QUALITY SEED:

The factors which contribute to the quality of seed can be grouped as follows:-

2.1 Mechanical Purity

Freedom from seed-borne diseases, weed seeds, other crop seed and inert matter.

2.2 Genetic Purity

Trueness to type and/or resistance to disease or insect pest attack.

2.3 Viability

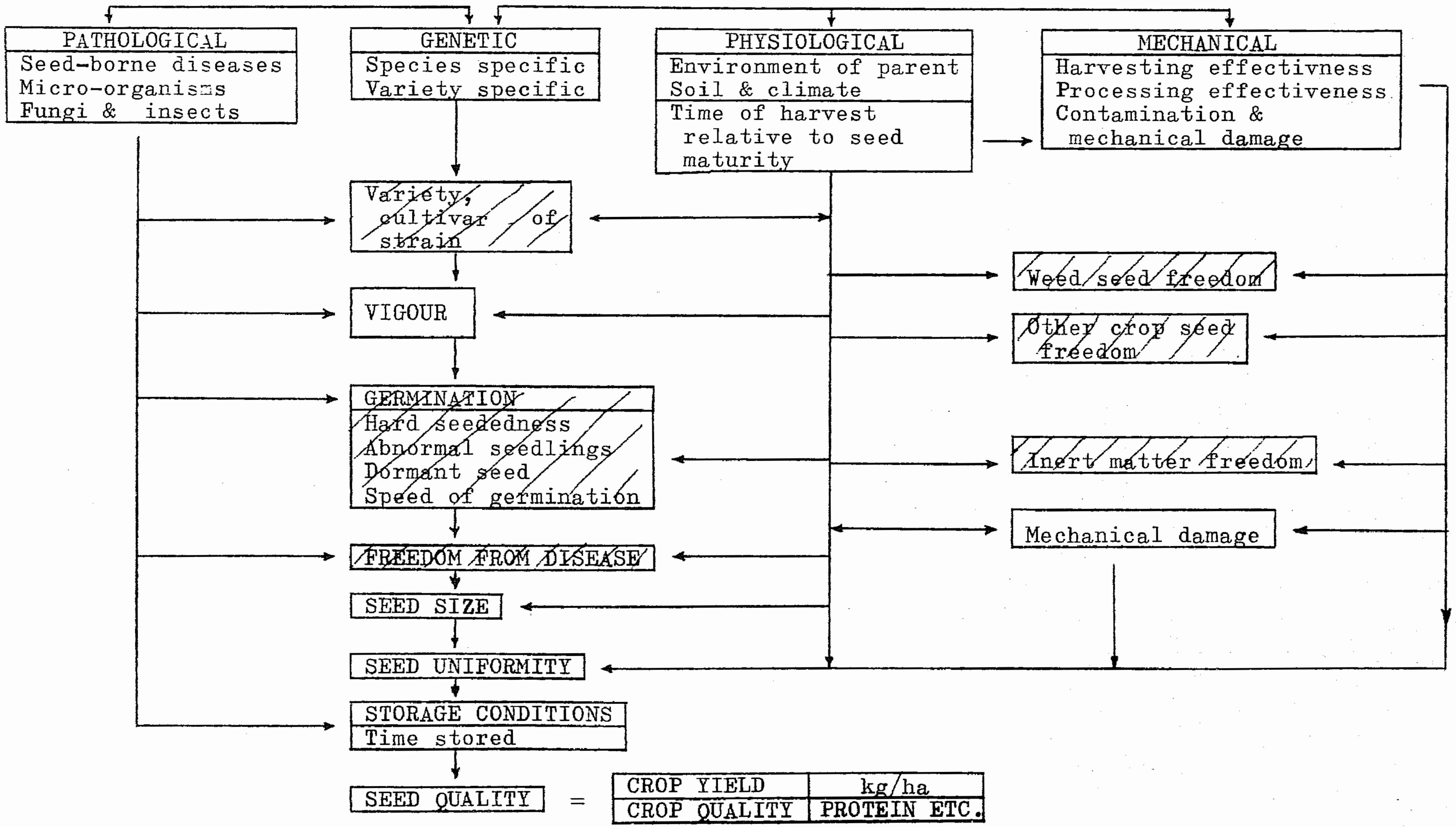
Germination, vigour, seed size and storage life.

It is a mistake to consider individual quality factors in isolation, because they interact. The following flow chart shows the sort of complex picture which emerges if we try and represent each factor in relation to overall seed quality.

The shaded boxes in the chart represent factors which can currently be adequately measured either in a seed testing laboratory and/or in a seed certification programme.

Table 1: Interaction of Aspects of Seed Quality

Shaded areas can currently be measured and identified by laboratory tests or by seed certification schemes.



It can be seen that seed quality is controlled firstly by Genetic inheritance and then by Physiological, Pathological and Mechanical factors and finally by Storage conditions and Length of storage.

3. THE MEASUREMENT OF SEED QUALITY FACTORS:

Freedom from weed seeds, other crop seeds, inert matter and some seed-borne diseases, can be readily measured by analyses in a seed testing laboratory and results obtained which are meaningful to field use of the seed.

The variety of the seed can sometimes be assessed in a seed testing laboratory, but more often the only means of identifying variety is by means of seed certification programmes. Often seed certification programmes are also needed to determine freedom from seed-borne diseases.

Germination potential measured in the seed testing laboratory under the best possible environmental conditions is often not an accurate guide to field performance.

Seed size and seed uniformity are factors which can be determined by examination, but no tests are currently provided. Both factors determine the storability and ultimate vigour of the seed.

No adequate tests for a range of species are recognised or available to test seed vigour or storability. Speed of germination is a guide to both however. Seed with a highest first count laboratory germination can be expected to have best vigour and storability provided other factors are comparable.

4. THE EFFECT OF QUALITY ON FIELD PERFORMANCE:

In Australia the effect of seed quality on performance is not generally appreciated, and freedom from weed seeds is often the only factor farmers are concerned about. However, I wonder how many fully realise the losses which can be caused by weed seed introduction. For example, recently discuvered planting and establishment of skeleton weed seed (introduced in Evening Primrose seed) to a farm, has meant the following. A 20% reduction in farm land value. Control measures aimed at eradication of the skeleton weed are estimated to cost $30 per acre - spread over three years. All farm produce is regarded as suspect by other farmers, consequantly, lower stock seed grain and hay prices. In all, a very costly mistake which could have been avoided by a $1.00 purity analysis.

Freedom from seed-borne diseases is in Australia not yet a real concern of the seed trade or farmers because many diseases have up to now been prevented from entering Australia by plant quarantine restrictions. In New Zealand the introduction of the lucerne disease, Bacterial wilt, is regarded as having cost millions because of destruction of lucerne stands and productivity. The programme to breed new varieties of lucerne with a degree of resistance is costly and may ultimately cost as much as the initial destruction. Until resistant varieties are developed, tested and released, production will remain poor. Finally, the new resistant varieties will, based on European and American experience, be of lower productivity than the non-resistant ones they replace. As more and more diseases which can be seed-borne are discovered in Australia, the aspect of freedom from disease organisms will become increasingly important.

The value of improved varieties (cultivars or strains) is well understood for horticultural and cereal crops, but not as well appreciated in Australia for herbage and forage plants.

In a farmer's field test at Padthaway recently, the lucerne variety, Paravivo, yielded a 50% greater tonnage of lucerne cubes than the Hunter River variety during the winter, and a 25% increase in annual tonnage. In future, the value of improved varieties for special purpose intensive fodder production will become better recognised and more sought after by farmers.

It is impossible to consider seed <u>vigour</u> without considering other factors such as seed size, germination, the effects of uniformity and the constraints of all pathological, genetic, physiological and mechanical factors determining seed quality. More than any other single factor vigour determines the storability of seed and its value to grow crops and pastures. Unfortunately, there are few recognised methods for testing vigour in a laboratory. We can't define standards for vigour without knowing the length of time and conditions under which the seed will be stored and the situation in which it will be used.

Vigour is the sum total of all seed attributes which fosters crop establishment under unfavourable field conditions. The most meaningful concept is that of a continuum which can be drawn as follows:-

lesser vigour ←			→ greater vigour
seeds dead	seed not dead in all parts but incapable of emergence	seedlings capable of emergence but not continued growth	seedlings capable of emergence and continued growth

Laboratory germination does not give a good idea of vigour or field performance. The following tables (Heydecker, 1969), show results of seedling emergence under ideal laboratory conditions, and under various field conditions. Results highlight the difficulty in defining germination or vigour quality without some reference to the situation on which the seed will be used.

Table 2: Seedling Emergence Under Different Conditions

Crop	Seed Lot	Conditions					
		SOIL (LABORATORY)					
		DRY → WET					
Cauliflower	(a)	40	95	90	85		
	(b)	10	80	65	50		
		SOIL (LABORATORY)					
		DRY	MOIST	WET			
Onion	(a)	60	63	65			
	(b)	27	65	34			
		LABORATORY		SOIL (OUTDOORS) DRY		MOIST	WET
Spinach	(a)	79		33		59	48
	(b)	72		10		33	41
		LABORATORY		SOIL (OUTDOORS)		MOIST	WET
French Beans	(a)	100				63	47
	(b)	96				39	15
		LABORATORY		LABORATORY WATER STRESS - 4.5 ATM			FIELD EMERGENCE
Peas	(a)	70		50			32
	(b)	30		75			37
	(c)	65		65			69
	(d)	45		70			52

The prime importance of vigour is in obtaining rapid, healthy crop establishment. However, experiments with agricultural and horticultural crops have indicated that high vigour seeds can give 2-10% higher crop yields than seeds of equal laboratory germination but lower vigour. This aspect consequently, should not be ignored.

5. STORAGE OF SEED:

Seed is a living organism and is quite as perishable (although not as rapidly,) as eggs or meat. Respiration is going on within a seed, and factors which speed up respiration will hasten seed deterioration.

Storability of seed is inseparable from vigour of seed. The poorer the condition for storage and the greater the length of time the seed is stored the more important vigour and its various aspects, such as seed size, uniformity, viability and disease freedom become.

Temperature and moisture are the enemies of good seed storage. Experiments have shown that for each 1% increase in moisture (between 5-14%), the storage life of seed can be expected to be halved. Likewise, for each 5% C in temperature (between 0^{o}-50^{o}C), the storage life of seed is halved. These two factors interact and can produce an added effect. High oxygen levels and ultra violet light also hasten seed deterioration.

6. THE CHALLENGE OF THE FUTURE:

Seeds are the basis of our horticultural, agricultural and livestock production. Consequently man's existence and health are directly (or indirectly) dependent upon seeds.

We are now in the last third of the twentieth century and it looks as if this period may be the most difficult that mankind has experienced. If the most recent population projections materialise we shall be influenced more by the number of people than by any other single factor. World food surpluses no longer exist. In the future, provisions of food will become of paramount importance. Seeds with the best possible field performance will become a necessity.

The challenge facing the seed industry is to produce, identify and market better quality seed. This will involve some changes. Currently trade is based on certain quite arbitrarily defined minimum standards, for quality measurements which have limitations. Little effort has been spent in defining quality standards by testing seed in situations approximating those in which it will be used or stored.

The challenge of the future is not limited to the seed trade. It involves the plant breeder to produce plants capable of producing more vigorous seeds. The seed scientist, to develop meaningful tests for vigour. It involves seed technicians, to provide new and more sophisticated services for official seed evaluations. It involves the producer in the production of seed of sound quality, and finally, in order to cope with the challenge, the seed trade will need to place increasing emphasis on technologically trained staff, make greater use of official testing facilities and become increasingly aware of the actual needs of the seed and user.

The seed trade has a responsibility for keeping seed growers informed of the consumer needs in such a way that it influences production quality. This will mean pricing policies at both wholesale and retail levels which makes highest quality seed worth more than the lower quality seed.

The introduction of "truth in labelling" type seeds acts should provide some stimulus for this development.

7. SUMMARY:

Quality determines the value of seed for crop establishment and crop performance. This is important because crop performance is the key to providing food and fibre for the world's rapidly expanding population. Quality is difficult to measure. Seed vigour more than any other single factor, controls performance. Vigour is controlled by genetic, pathological, physiological and mechanical factors.