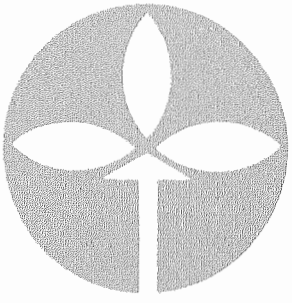


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DEPARTMENT OF AGRICULTURE, SOUTH AUSTRALIA

# Agronomy Branch Report

MINI CONFERENCE

SEED QUALITY AND PRODUCTION IN CEREALS AND OTHER CROPS

WALKERVILLE

Wednesday 30th and Thursday 31st July 1975

CONVENORS: M.R. Krause, Principal Research Officer, Agronomy  
B.J. Marshall, Research Officer, Crop Agronomy  
D.C. Bagless, Senior Seed Production Adviser

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## INTRODUCTION

P. McK. Barrow  
Assistant Director (Technical  
and Industry)

The subject for this conference is very appropriate when one considers the stage of development of our crop industries, and the pressures which are now coming from industry sources for improved supplies of high quality crop seed.

Our thanks must go to the organizers of the conference and the many representatives from all facets of our various crop industries who are giving their time to take part in the programme and to assist in making decisions which we hope will lead to improvement in seed quality and supply.

The maintenance of good quality seed supplies of cereals has been regarded as less of a problem than with pasture varieties, and we therefore have a very thorough and very successful certification scheme for pasture seeds to ensure their supply and to provide protection to buyers. Our registered seed scheme for wheat and barley has served us well for a number of years but this needs to be expanded to cover other crops such as oats and peas, and probably upgraded so far as overall control is concerned. The conference will be considering possible certification for cereals and other crops.

The upgrading of seed production schemes would lead to the development of a more vigorous crop seed industry, as such, and this could take us quite actively into the field of seed exports. There is quite a big demand for Australian crop seeds in a number of underdeveloped countries, and I think we have something of a moral obligation to help these people, quite apart from the business implications.

I wish you every success with the proceedings over the next two days, and now have pleasure in declaring your conference open.

1.1 THE REQUIREMENTS OF CEREAL SEED AS SEEN BY A FARMER/CONSUMER

B.S. Rodda  
Farmer and Member of Advisory Board  
of Agriculture.

First may I say how much I appreciate the opportunity to speak and represent the farmer consumer at this conference.

I would like to make it clear now that I believe that I represent the rural section as one of the average size farmers and therefore can only speak in the main on how I see the need for change in relation to this group.

Dramatic changes have come to all rural industries during our last ten or so years, and we have had to adjust accordingly to keep abreast with these trends. So before we bypass any important aspect in agriculture and especially this one related to cereal seed, that we are here to discuss over the next two days, I ask all present to keep firmly in your mind:-

Is the present scheme going to be adequate for the next year and the years following?

My answer is NO and I mean it in no uncertain manner.

Before I give reasons to substantiate this let me say something of great importance. In no way will I intend to reflect on any person or persons who are registered or approved growers, seed distributors or whatever who have served the rural community well. It has possibly been satisfactory generally over the twelve or so years since its inception however changes need to be made to benefit all.

Since October last year when I was appointed to the Advisory Board of Agriculture I have been approached by many who feel as I do that the need for improvement is overdue. With their points and some of my own I have based this paper into three main points ORDERLY MARKETING, PURITY OF GRAIN SAMPLES, and ROLL OF DEPARTMENT OF AGRICULTURE.

Everyone of us is aware that prices for grain from cereal growers varies by dollars because the present system allows growers to set their own market price.

The continuation of this can only do harm to your future.

To quote an example during last season I believe there was a \$4 a bag difference in two growers on the same variety of grain. Imagine the discussion that arises at meetings, bureaus etc. when neighbours meet and discuss these findings.

I think without exception all here today will agree that stabilization has been the answer to selling our grain since its introduction sometime after the Second World War. Surely looking at today's progress in society we must give consideration towards orderly prices.

Some of you may argue that soil types alter and give great variations in relation to costs of production etc. but no consideration is given when selling through boards whether you have clay country or sandhills.

Also under orderly marketing must come branding of bags. At present we have farmers picking up grain that is neither branded with name of variety or the weight of bag. How many other top line articles do we purchase today that come to us without any identification - I am not aware of them.

We sell all other grain without exception by weight, so arguments for the present system to be left as is cannot be justified. I have even had a report of a grower in our district receiving bagged wheat that weighed only 77 kg. Again one of your arguments against this will be the last two seasons in relation to rust affected samples, but why not brand accordingly, leaving no margin for buyers to find fault.

Let's now take a look at seed quality available to farmers in our State. During the ten years or so we the farmer have used seed from all sources spasmodically and I believe much of this stems from talk at various times of certain high yields in a new variety and then we all like to try a few acres. This tends to make it obvious that we are content to continue to use the same old seed over and over again and only look to cereal growers when we feel inclined to try some new variety.

With the introduction of more sophisticated bulk equipment unfortunately seed is coming contaminated at an extremely fast rate and I can see a situation arising now where demands for high quality produce for world markets, will force farmers to seek and use pure seed outlets more readily. Possibly as this occurs we may find other problems will occur such as spread of weeds and I don't necessarily mean only noxious weeds.

A very large percentage of the cereal growing area in our state is free from the more serious weeds at present and we here today have got the opportunity to play a leading roll to help maintain this present position.

By now each one of you must be saying - but what is all this going to cost.

For seed growers and Department of Agriculture working together to implement a more efficient system, we will have to bear some cost increases. I realize also that many farmers will not be pleased if confronted with increases, but many of these who will complain do not use the present system we have now.

Following on from previous discussions with Department of Agriculture Officers and members of the Advisory Board I understand that during this conference the suggestion of an analysis report will be discussed. This I feel would be an excellent move in the right direction and regardless of its expected cost increases per bag, I am sure the farming community in general would applaud the move.

During 1974 a problem arose in our district involving a cereal weed and the ill feeling between all parties concerned including a local department officer was not good for public relations. Now, I will concede that human errors will still be able to show up at anytime, however in this case all parties concerned had no way of checking out the origin of this problem, possibly because we lack considerable control with our present seed scheme.

Earlier this year I harvested clover seed for the first time and was impressed by the way the small seeds section of Department of Agriculture does its inspection of on farm storage and the administration for the protection of growers and purchasers alike.

Although I mentioned the analysis report that may be introduced I am certain that in the not too distant future, the need for a full certification scheme will have to be implemented for the protection of all involved.

Following on from what I have just said and in relation to costs - no one will convince me that pure seed is expensive against treating a problem weed. You will know well that labour and chemicals are taking large percentages of our profits.

Our system of farming with pasture crop rotation is getting adopted in countries throughout the world. We are renown for the methods we have, with a limited rainfall and we must obtain excellent clover dominant weed free pastures.

Mr. Chairman I can buy certified small seed confidently can I in the future do the same for cereal seed. I say go ahead and increase price 20-30% if you have to because farmers are all human - they will complain at first but deep down they will know it will be in their own interests.

From all this where have the Department of Agriculture been and what of them for the future. Officers in country branches have played an active part in the past however I am sure their roll in future should be to enforce more controls on seed production and distribution. I realize that the public service has tight control on extra staff appointments in the Department and possibly a revised scheme would require more personnel, but we must aim for progress to cover our requirements and staff would have to adjust accordingly.

Let's take some points one by one the first being grain seed dressings. Since it was necessary to remove the mercury grain seed dressing farmers have become confused. The present brands available do not impress me and a great number of farmers will support me on this score.

We are not concerned about an individual with his own need however contractors should be forced to use types of pickle that have been proved to be no danger to health of operator and farmer and secondly not affecting grain in storage.

Another Department of Agriculture duty is to improve its advertising in relation to availability of seed from registered and approved growers. This needs clarifying in regard to differences between registered growers and approved growers. Some farmers believe that a registered growers seed is certified and the approved growers crop is the same but the grower did not seek certification.

Although I hope changes will be made and this point may not be relevant in future I bring it to your notice so that it may be corrected if the need be.

Again for the Department in future they must take the lead with firm control on all problem weeds that may be on properties that are allowed to sell seed. In this regard it will be necessary to start at top level (or registered growers) and go down the line to approved growers and even possibly further to any property that has weed problems. This last point I am sure is important and properties that may come into this category could be traced through local weeds officers and District Councils.

Over the years farmers have gained a high regard for the Department of Agriculture, the Department has developed systems and made excellent progress for the rural community, and they must not allow it to break down at the farm gate on appearances.

Departmental officers who are in charge of cereal seed production should see that any new scheme is flexible enough to give opportunities to overcome any serious problems that arise, however they also should be prepared to act to withdraw any person they know is not keeping up the required standards.

Possibly some may see a situation arising with growers becoming reluctant to continue or take part in a complex scheme such as I am suggesting, I do not see this myself and already know some growers who would be prepared to be registered under these terms.

I could go on with many other main points I feel should be controlled under our Department of Agriculture.



Perhaps two more major factors should be looked at, first is the current situation regarding seed from interstate. Because of rust in the last two seasons a large quantity of seed has been brought into our state and we are hopeful all was clear of weed seeds and foreign matter. However in some instances germination may not occur immediately, and these areas will need to have constant checks for several years.

With growing demands for improved cereals I believe registered growers may also require larger amounts of pure seed to have quantities available in our areas without growers having to seek seed from outside their own locality. This of course is a matter that is directly concerned with our department and the growers themselves.

The final point I make is on farm hygiene. I understand this is under discussion at present and may be implemented depending on Government assistance. All here are fully aware of consequences regarding grain pests but at the present time it is open to failure by only a handful that do not obey the warnings. I again stress this point but not in relation to seed growers who I know have protection against pests through seed dressings.

To give a summary on my findings Mr. Chairman and gentlemen I will briefly mention all major points again.

1. I stressed we the farmer need orderly marketing that will I am sure if implemented give confidence to those purchasing. Also I have mentioned the need to brand for variety and weight should be considered.
2. Grain sample must be free of all foreign matter. For this to be achieved we must have analysis reports of all grain that is available to the farmer. I have also indicated that these reports are what we urgently require however I can still see a need to go further eventually to a certified scheme.
3. Costs are governing factors always, but in order to keep this state in its present high standard in relation to quality of produce don't let this alone defeat our future needs.
4. The Department of Agriculture will continue to be the backbone of our scheme.  
They must take direct action in relation to
  - a. Uniformity in grain seed dressings.
  - b. Clarify all advertising so that it is understood by rural community with ease.
  - c. Give directions to help control all weeds on properties that intend having cereal seed for sale. If these requirements are not met in specified time they must seek other growers to produce and sell cereal seeds.

- d. Give some time and advice to the appropriate authorities on controlling interstate trade - in relation to seed distribution throughout our state.
- e. Larger amounts of pure seed be available to cereal growers to enable a new variety to be obtainable by farmers.
- f. On farm inspections for grain hygiene. Although this is not directed at cereal seed growers alone I am sure they should be controlled in this regard as should each and every farmer and the only way this should be implemented is through our own Department of Agriculture.

We are in a dramatically changing world - farmers must and will be prepared to pay for improved quality - because they know their industry must meet these high demands to be able to sell our produce on world markets.

#### Discussion

In advertising registered growers each year the Department of Agriculture could spell out how the growing of registered seed can lead to the improvement of grain quality e.g. less weed seeds, better varietal purity.

The approved crop scheme was used in 1967 because of the drought affecting registered seed crops.

The old scheme of crop competitions, which was replaced by the registered grower schemes, recommended good lines of seed for sowing.

Most registered growers have made little money from growing registered crops because of the extra work involved.

There is existing legislation to ensure that bags of seed are branded correctly.

1.2 THE REQUIREMENTS FOR GENETIC PURITY IN CEREAL VARIETIES

Dr. A.J. Rathjen  
Lecturer, Plant Breeding  
Waite Agricultural Research Institute.

The plant breeder, when defining the aims for this program, has to resolve whether he should attempt to select for a single genotype particularly suited for local farming or for a fairly closely related group of genotypes which may have greater flexibility in adapting to the fluctuations in climate and disease. Genetic purity is not analagous to freedom from weeds and foreign seeds where the smaller the proportion of weeds, the more acceptable the sample. There may be circumstances when the variety should be genetically quite heterogenous.

Following the success in inbreeding in livestock and the selection of pure lines from land races in cereals, the ideal for much of this century has been the single-genotype variety. One of the major objectives of the crop competitions which flourished until recently was to encourage farmers to grow 'pure' varieties. And many breeders, I suspect, still aim to have single-genotype varieties.

However, we are probably at a stage when the demand for genetic purity in our varieties is being replaced by a call for genetic diversity. This stems from two principal sources.

1) Evaluation of the corn blight epidemic in the U.S.A., and the stem rust epidemics in Australia in 1973 and 1974. In all these, genetic uniformity through the cultivation of single or similar varieties over vast areas was a likely contributing factor to the extensive damage. (Genetic Vulnerability of Major Crops - National Academy of Science).

2) Investigations of the genetic structure of successful natural populations of self-fertilized grasses (e.g. similar to the local barley grass or wild oats) which have demonstrated that these do not consist of a single genotype, but rather a multitude of forms which co-exist.

My present ideal is a variety which combines a high degree of uniformity in certain specific characteristics with the maximum genetic diversity commensurate with high crop yield. The following table summarizes the requirements:

<u>Uniformity</u>	<u>Characteristic</u>	<u>Genetic diversity</u>	<u>Reason</u>
←	Maturity and height		East of harvest
←	Reaction to weedicides		Reliability for spraying
←	Marketing and end use		
←	Appearance		
	Resistance to aerial diseases	→	e.g. rust
	Resistance to root diseases	→	
	Response to soil and climatic variations	→	e.g. frost
	Seed Multiplication		
x ←	Seed Certification		

Uniformity for some of the end use characteristics must have a high priority. For instance, a range of grain hardness in wheat from soft (similar to Pinnacle) to hard (similar to Falcon) would deter most millers. Similarly, a variable rate of germination in barley would be disadvantageous to the maltsters. Conversely, the requirements of bakers are less exacting, and European bakers have used blends of high protein Canadian wheats with low protein European wheats extensively.

Also uniformity could possibly be required in a seed certification scheme, but I think that we should avoid this strenuously. If genetic diversity is economically desirable from either the producers' or users' viewpoint, then the seed certification scheme must be sufficiently flexible to encompass this diversity.

I would like to review briefly three types of evidence which have influenced my thoughts on the requirement for genetic purity in cereal varieties.

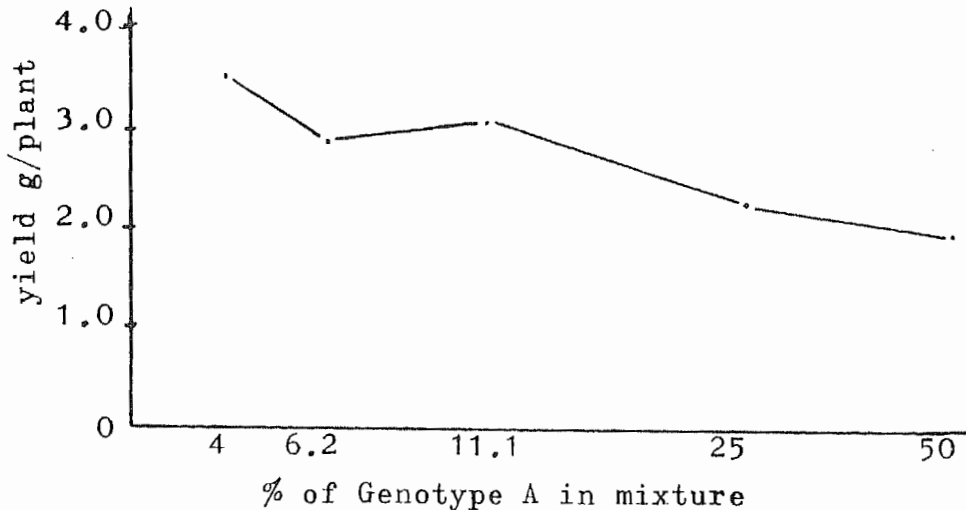
A number of techniques have been developed for isolating and identifying specific proteins, particularly the storage proteins and some of the enzymes, and these have been used to measure the degree of uniformity in some commercial varieties. It is generally accepted that the presence of one of the forms of these proteins indicates the presence of a corresponding allele, and in this respect they are a better indicator of genetic similarities than morphological characteristics. Furthermore, these proteins are not subject to deliberate selection by the breeder, so the number of alternative proteins present is a guide to the genetic heterogeneity within a variety.

Ken Shepherd, at the Waite, has typed the storage proteins in a large number of Australian wheat varieties. The accompanying slide illustrates some of his results. The three grains of Festival were uniform, the two of Festiguay show considerable differences, and one of three Glaive grains differed slightly from the other two. Similarly, Allard, Kahler and Weir (at the 2nd Int. Barley Genetics Symp.) have described the frequency of variations in barley varieties. Some of their results, where three of the five varieties show considerable heterogeneity, are reproduced below:-

Variety	A <sup>0.2</sup>	A <sup>1.0</sup>	A <sup>1.8</sup>	B <sup>1.6</sup>	B <sup>2.7</sup>	B <sup>3.9</sup>	C <sup>4.4</sup>	C <sup>4.9</sup>	C <sup>5.4</sup>
Algerian		.45	.55	.49	.49	.02	.36	.03	.61
Atlas		1.00			1.00				1.00
Club Mariout	.04	.01	.95		.04	.96			1.00
Lion	.01		.99	.01	.99			.80	.20
Vaughn			1.00		1.00				1.00

In both of these examples there is evidence of considerable genetic heretogeneity in existing varieties. This result is hardly surprising, as usually selection is completed by about the F<sub>5</sub> or F<sub>6</sub> when, on average, the lines are only 93% or 97% homozygous.

Phung has been measuring the size and extent of frequency dependant effects at the Waite. He compared the yield/plant of genotype A, when genotype A was grown in different frequencies, varying from 4-50% as a mixture in genotype B.



This graph illustrates a typical example where a variety produces more seeds/plant when it is infrequent, than when it forms a larger proportion of a mixture. In this case the yield was about 35-40% more at low frequencies than at high frequencies. Two important conclusions are derived from this work:

- 1) A low proportion of 'off types' in the original seed is likely to become a much more significant proportion of the variety after several generations of seed multiplication.

- 2) Most varieties are likely to be a fairly stable mixture of closely related genotypes, and seed multiplication practices, which start with one or a few single plants could markedly alter the properties of a variety.

The third topic I wish to introduce relates to the spread of an aerial pathogen through a cereal variety. Plant breeders have, for some time, been discussing the utility of genetic diversity in reducing the severity of damage following infections with diseases such as rust. Browing & Frey (in Ann. Rev. of Phytophath. 1969) have presented the following data:-

<u>Crop</u>	<u>Disease</u>	<u>Cultivars</u>	<u>Relative yield</u>			Obs.	Expected
			1:0	0:1	3:1		
Wheat	Stem Rust	Onas 41 : Onas 53	43	100	94	57	
Oats	Crown Rust	Clinton Clintland	56	100	75	67	

In both these cases and especially with wheat, the yield in the mixture was larger than was predicted on the basis of the performance of the varieties.

We were able to make similar observations at Roseworthy in 1973 during the severe stem rust epidemic. Halberd was grown in two different circumstances. In the first it was used as a 'check' plot in a variety trial, where it was grown in every sixth plot with other varieties grown in the remaining five. The latter varieties had a diverse origin and had, apparently, several different forms of rust resistance. In the second, Halberd was grown as a pure stand in a 'uniformity' trial (an experimental design used to describe soil heterogeneity). The mean yields of the Halberd/plot were:-

<u>As every 6th plot</u>	<u>In uniform stand</u>
503g	276g

Due to spacial separation, these results must be considered with caution, but they are suggestive of the fact that the damage from rust was much more severe when there were extensive areas of the same variety.

### Conclusion

From the plant breeder's viewpoint - or more accurately from that of the producer and consumer, as the breeder is ultimately their employee - there would seem to be a requirement for uniformity in some characters and for genetic diversity in others. Any seed certification scheme which attempts to impose absolute genetic purity within a variety (as the absurd British scheme does) could be detrimental to the whole industry. Conversely, if the scheme allows for diversity, perhaps by allowing specific ranges to be stipulated, a seed certification scheme is unlikely to hinder cereal improvement programs.

Discussion

Present varieties appear to have genetic variation e.g. Condor. With Condor there is too much variation and much appears to be due to off-types. Condor has segregated for rust resistance.

By using multiline resistance, in which a particular line is backcrossed to several resistant lines and the progeny mixed in equal proportions, it was possible to use genetic diversity to improve rust resistance. This technique is particularly useful where several strains of a given disease cause a problem.

We can only look at the phenotype, we cannot see genetic differences. In Britain 92 characters are looked at for identifying varieties and a character is not permitted to vary. In this case minor variation would hold up the release of a variety.

1.3.1 THE REQUIREMENTS OF CEREAL SEED - THE EXPORT MARKET

M.C. Jongebloed  
 Assistant Manager, South Australian  
 Seedgrowers Co-operative Limited

Over the last five years the South Australian Seedgrowers Co-operative Limited has been engaged in an expanding export market for South Australian grown pasture seeds.

To ensure success overseas with our seed we have had to sell the dryland farming technique used here in South Australia.

Coupled with these orders for pasture seed have been specific requests for cereal seed to be used in a cereal seed enterprise already under way or about to start in the particular country.

Tonnages supplied have varied from year to year and country to country, but in the last three years, over 1800 tons of seed wheat, barley and oats have been exported from South Australia.

Sales to this stage have been restricted to countries with similar soils and climate to that of South Australia.

All enquiries and sales of cereal seed could be put into two categories:-

1. General:-

Here the buyer has just asked for seed oats, barley and wheat and only specified the tonnage required. The varieties supplied have been our decision after taking into consideration our knowledge of the climate and soils of that country. These sales are generally large and involve some hundreds of tonnes.

2. Specific:-

The buyer in this category not only stipulates the tonnage of seed required, but also nominates the variety he wants. The seed supplied goes into a well regulated grain seed production scheme in the importing country. Quantities sold are generally small, but continuous over a two-three year period.

Besides the quantity and variety of seed grain, the buyer also stipulates the quantity he requires, whereas with large shipments the quality is only generally specified e.g. 98/85. (98% purity and 85% germination)

What quality do these overseas countries require?

Firstly this use of the term quality can be broken down into several factors, these I will go through listing the level of each, the overseas buyer requires:-



A - PURITY A minimum of 98% pure seed in a line is required. In actual fact we must aim higher as all too often the other two per cent is composed mainly of weed seeds.

Obtaining a better purity over a Hannaford grader seems to be no problem as it has been done in our experience many times over a line of 2-300 tonnes. Aiming for maximum throughput of a grader will lower the purity of the seed. There is no substitute for the old policy of cleaner paddocks, cleaner seeds.

B - GERMINATION Usually the minimum germination sought is 85%. A higher count is a plus for the quality you ship. Lower counts are not acceptable. Generally the buyer will not let you count fresh ungerminated seeds in the germination count of 85%.

The type of finish of the growing season will have a very marked effect on your germination of the seed.

I must add a warning here, under germination, concerning bunticides and cereals. It must be remembered that cereal seed harvested here is used within 4-5 months of treatment with chemicals. However, overseas it may not be used for up to 10-12 months after treatment.

Seed treatments that could cause any reduction in germination over this period should not be used on seed exported if the client is to receive a viable product.

C - SHAPE AND COLOUR Once in the country to where the seed has been exported, the cereal seed is generally judged by the user on the colour and plumpness of the seed. Your future market can depend very greatly on these two factors. Oats with a germination of 90% and a purity of 99% lose their attractiveness to the overseas buyer if they are badly weatherstained and blackened. Pinched grain is also a minus for your efforts if shipped to a discerning buyer.

D - PACKAGING Like colour and shape, packaging is extremely important to maintain your quality rating overseas. All sacks used must be new and of sound quality. Some countries will allow you to use once-used Japanese rice sacks. This must be supervised as some of these sacks in a bundle are very inferior. Double sewing of filled sacks is paramount during loading and unloading of ships. Slings are used for cereal seeds and this places pressure on the sacks. Once sewn, sacks seem to burst at the top quite regularly during this procedure.

All sacks must be of a common net weight which is generally 50 kg of oats. Wheat and barley is usually 50-55 kg net weights. Bags heavier than this must be handled only on pallets due to waterside worker regulations. Well, are we meeting the above standards for our overseas clients?

The general answer is yes:

We meet these standards when we supply to clients with a specific order for cereal seeds. This is because his order is usually small and so seed is bought from growers supplying seed under the present registered or pedigree seed scheme run by the Department of Agriculture. This seed is well graded, packaged, chemically treated and of good shape and colour. Germination and purity we have found are excellent.

However, with the larger general orders this is not always so.

As no large stocks of bagged machine cleaned cereal seeds are held by growers and merchants, seed must be obtained from silos on farms. It is here that we strike problems.

Any samples to establish quality are uncleaned and I am sorry to say quite often bear no relationship to what eventually turns up cleaned in bags on the wharf.

Grading of these large quantities of seed can also cause purity problems. Seed is sometimes put through cleaning machines much too quickly and screens etc., cannot be used to their proper effect in removing impurities. During this rush bags also seem to miss out on their second sewing.

It is not very easy to replace 100-150 tonnes of low grade seed oats once they arrive at a storage shed or wharf.

I have been talking about the past - what of the future markets?

This is a little more difficult. I consider that there will be specific orders for small quantities of our seeds in the future. They may not be regular however.

Orders for hundreds of tonnes could still occur, but not possibly on a year to year basis. If North African and Middle East nations continue to develop their agricultural systems at their present rates, the market could be quite large. To put a figure on it would be pre-emptive on my part as things change in emphasis quite quickly in the region.

With these future markets in mind, is there anything we should do here in South Australia to raise the quality of our cereal seeds?

Should we certify all cereal seed crops?

If all Australian states do it at the same time it would be excellent for the local and overseas markets. But if South Australia goes ahead on its own there would be problems. If we had to supply the large overseas orders only from certified South Australian cereal seed, we would lose the sale to the other states who would offer cheaper uncertified seed. However, we would not lose those specific

orders as the certified seed would be just what they require. I consider certified seed will cost more than uncertified due to extra costs being incurred in:-

- 1) Paddock Inspection Fees
- 2) Cleaning to a Certified Standard
- 3) Packaging - New Sacks
- 4) Sealing and tagging charges
- 5) Storage awaiting testing

Would farmers in this state pay the extra for certified seed, or would farmer to farmers sales increase looking for cheap seed?

Our quality of cereal seeds I consider for overseas sales can be raised by the buyer taking a more active role in the selection, sampling and cleaning of the seed. This will help him insure a more even good quality seed is supplied to the overseas market.

Whether this is good enough for the local market is a completely different thing. The farmers of this state I think would like some form of cereal seed certification.

One other aspect of overseas selling is the quarantine regulations of the importing countries. These vary in intensity. Generally sales of registered cereal seeds are to countries quite strict with their quarantine requirements. If inspecting officers of the Department of Agriculture were to submit written reports of their field inspection noting:

- 1) Whether crop was diseased - rust, hay die
- 2) The weed intensity
- 3) The varietal purity

A simple field report along these lines helps greatly in fulfilling quarantine requirements.

### Discussion

Some countries are making small orders stipulating quality and variety. In larger orders no variety is stipulated. In these larger orders are the buyers prepared to pay more for quality? These countries have less regulations regarding hygiene and health aspects, and their base requirements are therefore below the average of buyers. They calculate their price on their lowered quality needs and are therefore not likely to pay above average prices.

In the sales of small quantities of seed where the variety is stipulated, is varietal purity specified? Yes. Some countries are very specific about purity and freedom from weeds etc., as the seed is required for seed build-up purposes.

The amount of foreign seeds in registered or graded seed depends on the manpower available at grading, and the price being paid. There is a two price system, the cheaper,

when the machine is operating near its maximum output is frequently used by farmers. For a higher price, the throughput is reduced and the machine is more effective at producing seed free of unwanted materials. So the quality of the grading is in the control of the person hiring the equipment from the grading company and is not dictated by the operator.

1.3.2 REQUIREMENTS OF CEREAL SEED AS SEEN BY THE GRAIN EXPORT MARKET

F.E. Acton, Manager for South  
Australia, Australian Wheat Board

G. Lander, General Manager,  
Australian Barley Board

The Australian Wheat Board regularly exports wheat to about 40 different countries each year. In order to retain its place as one of the world's leading exporters, it is necessary that the Board defines certain quality standards to meet the market requirements. There are certain basic quality requirements of all markets, these being guaranteed minimum test weight for the grade of wheat purchased, maximum moisture content of 12.0% and freedom from insect infestation.

In addition to these basic standards, many countries have further additional specifications written into contracts. These may relate to protein content, baking quality, freedom from diseases and weed seeds, etc. Some of the larger markets, for instance, Russia, China and Egypt, while not being particularly concerned about the protein and baking quality of the A.S.W. wheat they purchase, do in fact have other requirements which are listed under what are known as the "Objects of Quarantine", which is a document appended to and forming part of the Contract of Sale. This document details the defects in the wheat which are unacceptable to the buyer. As an example, if we look at the Objects of Quarantine listed in our current contract with Russia, we find that among the prohibitions are about 15 weed seeds which are commonly found in Australia. Included in these are -

Knapweed  
Ragweed  
Innocent weed  
Couch  
Sunflower  
Poverty weed  
Silver-leaf nightshade  
Buffalo burr

and other weed seeds common to this country.

In order to meet market requirements, the Board each year before harvest defines the receival standards. As you are no doubt aware, growers suffer a financial penalty, known as a "dockage", for deliveries of wheat containing various deficiencies. If the deficiency in the wheat is caused by something outside the grower's control, the dockage is not as heavy as it is on deficiencies which could be attributable to poor farming practice. Thus dockages on

wheat containing foreign seeds are heavier than on wheat with pinched grain caused by rust. In addition to imposing dockages, the Board will not permit the delivery of wheat containing certain specified weed seeds. These seeds include Mexican poppy, wild lettuce, skeleton weed and melilotus. There is also a total prohibition on delivery of wheat which has ball smut infected grains. Despite the fact that smut is generally regarded as almost a thing of the past due to the pickles available to control it, there are still occasions when smut infected wheat is detected in wheat presented for delivery.

Growers are permitted to deliver wheat containing foreign seeds such as barley, saffron thistle, sheepweed, turnip and certain other weed seeds, but a dockage is imposed according to the degree of contamination of the wheat. Furthermore, it is Board policy, implemented through South Australian Co-operative Bulk Handling Ltd., to decline acceptance of wheat contaminated with excessive weed seeds until satisfied that the grower has at least made some effort to clean the wheat before tendering it for delivery.

In South Australia the foreign seeds which cause most problems in wheat are barley and saffron thistle. Over the last two seasons the incidence of barley in wheat presented for delivery on Yorke Peninsula has been particularly bad, despite an increase last season of 50% in the amount of dockage imposed for this contaminant. In explanation, excuses given by growers are many and varied, but some at least do admit to the fact that their seed was not as pure as it could have been. It would seem then that growers tend to delay renewing their seed wheat for too long, with the consequence that from year to year quality becomes poorer and poorer. To reap wheat from a paddock which contains some barley and then retain some of this wheat for the following year's sowing, is only compounding the problem. Similarly, it would be quite foolish for a grower to spend time and money eradicating saffron thistle from a paddock with saffron contaminated seed wheat.

It is suggested that it would be in the interests of the Marketing Boards and the growers that they should look closely at the seed they intend to sow and, if necessary, upgrade it by replacing it with new seed periodically. This will pay them in the long term because the dockages imposed for deliveries of barley contaminated wheat will cause them a financial loss greater than would be the cost of purchasing clean seed from time to time. It is appreciated, on the other hand, that eradicating barley from wheat is difficult due to the similarity in the grain shape and size. This is particularly so with wheat varieties such as Dirk and Raven, which are comparatively long grained varieties.

A key factor in successful marketing of any commodity is continuity of supply. Obviously it would not be in the Board's interests to enter into a long term agreement with, say, China, and then find itself unable to meet its commitments.

Production in Australia fluctuates considerably within States on account of climatic conditions, but generally we are able to obtain a reasonable degree of stability overall because it is unusual for all States to experience low production in the same year. However, just as droughts can curtail production, rain at the wrong time of the year can also have devastating effects. We are all aware of the extent to which rust decimated crops in South Australia over the past two seasons. When a variety becomes susceptible to rust, it is important that sufficient seed of a rust resistant variety of comparable quality is available to growers, so that the Wheat Board is in a position to maintain continuity of supply of the particular quality type to satisfy its customers. In this regard reliance is placed on the registered seed growers to obtain and multiply stocks of seed of the newer crossbreds. The wheats which are recommended for seed multiplication are normally those which will fit into the general quality pattern of the various grades of wheat which the Australian Wheat Board exports.

There have at times been difficulties in relation to advanced crossbreds getting into the hands of wheat growers who have seen in the high yield potential of some varieties an opportunity to make a quick dollar, and have multiplied the seed up at a fairly rapid rate. At times these varieties, which may be quite unacceptable in quality, have got into the hands of commercial growers. There have been at least two varieties bred in New South Wales (Wren, 8156) which have been grown commercially before adequate quality testing had been made, and it has been found subsequently that because of very poor milling and baking qualities the wheats, if exported in quantity, would have had a very damaging effect on Australia's export trade. It is essential, therefore, that varieties which are not recommended or approved by testing authorities be kept out of commercial production.

Of course much of the seed which growers use is obtained by purchase from neighbouring farmers, or by exchange. The Wheat Board attempts to control the sale of seed wheat and requires any growers wishing to sell wheat for seed, to apply to the Board for a permit to sell such wheat. The Board issues permits only for the sale of recommended or approved varieties. This system of obtaining seed, while it is obviously cheaper than dealing through a registered grower, is one which has certain inherent disadvantages. Growers who obtain seed under such arrangements should take care to ensure that the seed is sound and true to name and type. Difficulties can arise when an early maturing variety is contaminated with a variety which matures late. The export market is particularly sensitive to the presence of sappy, immature grains, and consequently the Wheat Board will not receive such wheat.

Problems sometime arise in relation to disposal of surplus seed. There will be times when more seed than ultimately required has been pickled. This may be the case, for instance, in a year like this one. Under no

circumstances should any attempt be made to deliver such grain to the Marketing Boards. Even though the amount of such wheat which may find its way into an export cargo would be rather minor, scientific apparatus available can detect the most minute trace of chemical used in the wheat pickle. The detection of this material in an export cargo could well cause the Board to lose the entire market, particularly of some of our bigger and established buyers.

Many of the fundamental requirements or specifications are, of course, common to all cereals intended for export. Dealing more specifically with barley requirements, the grower must decide whether he is going to plant a variety which will be acceptable into one of the malting grades. In South Australia this presently is confined to one variety, namely, Clipper. Then, subject to weather conditions and other factors enabling the production of good quality Clipper, the grower qualifies for a premium payment over the lower grades.

The selection to sow barley of other varieties, or an admixture of varieties, precludes the grower at the outset from making any better than one of the "Feed" (lower) grades.

Before discussing the factors which distinguish one category from the other, it is well to reiterate those which apply to barley generally as well as in the marketing of other cereals. In this bracket normal specifications include freedom from foreign grains and varieties, freedom from weed seeds, smut, mould, other diseases and insect infestation.

While the Barley Board does not have a dockage scale like that used by the Wheat Board, the effect is similar in that the equivalent of "dockage" material in barley results in the assessment of minus points on a clearly defined scale, based on the relative extent of the disability and, depending on the number of minus points, the classification can be down one or even two grades.

Obviously pure and clean seed, properly pickled, is a fundamental starting point common to all cereals if the risk of financial loss from foreign seeds, etc. is to be avoided. The ultimate delivery of clean grain true to type is, of course, still in the growers' hands and the marketing authority is obliged to take proper precautions to ensure compliance with the import restrictions at the destination end, and to present the product in a manner that will make it competitive on world markets.

Going back to the mention of those factors which relate more specifically to the purpose for which the barley is intended, let us consider malting quality first. Apart from the general specifications for cleanliness, etc., the maltster looks for low protein content, well filled grain



and freedom from mechanical damage. Low protein, because the extract potential of the malt is inversely proportional to the protein level, e.g. a 10% protein barley, all other things being equal, will produce malt with a very much higher extract potential than malt from a 12% protein barley.

Indeed, protein content having such an important bearing on malt quality, the Barley Board has a system of testing pre-delivery samples, from each paddock, of potential malting barley to enable a protein check to be made on the barley before it is binned in either of the two malting grades, which will be described as No. 1 and No. 2 Grade as from 1975/76. Previously these grades were known as Malting and No. 3 Grade.

Well filled grain, with its higher proportion of carbohydrates than in thin grain, also gives a better return of malt extract.

Mechanical damage to barley during harvesting inhibits its germinative capacity, and when a grain fails to germinate, it does not modify, and in turn a loss of extract results.

Admixtures of varieties must be avoided when catering for the malting industry, unless it has been previously established that the varieties constituting the mixture are compatible. Usually differing rates of moisture uptake and varying germination make it necessary to malt different varieties separately. While it is possible to make malt of varying quality from any sort of barley, it pays to use only the available variety or varieties which have been bred for the purpose and proved themselves to be good malting material. In South Australia now the Board only accepts Clipper variety into the malting grades, as that one has proved itself superior to the other varieties grown in this State.

The Barley Board exports barley from its malting grades to a number of countries around the world, including the U.K., Continent, Japan, Russia, Taiwan and South Korea. Clipper variety has earned a good reputation among maltsters overseas and in Australia, and it continues to be in strong demand. Such is its success that most other Australian States are now growing Clipper for malting needs.

The Board does not lay down any varietal specifications for the lower grades, apart from the distinction 2 Row or 6 Row. Fortunately, from the marketing aspect, 6 Row barley only accounts for about one per cent of the S.A. barley crop. There is a much stronger demand for 2 row barley.

Various stipulations have to be complied with even for the two low grades (sometimes called Feed grades) to comply with export standards. These include grain size, with emphasis on the percentage of screenings, soundness of the grain, the impact and type of weed seeds, with maximum tolerances occurring in the lowest grade. Certain foreign matter is banned altogether.

Protein content is not specified in the case of the low grades, but there is a maximum of 10.9% for No. 1 Grade and 12.0% for No. 2 Grade. Any Clipper barley with a higher percentage has to go into a lower classification. This tends to raise the average protein level of No. 3 and No. 4 (previously No. 4 and No. 5) grade barley appreciably, and it has been a popular belief over the years that an increase in protein enhances the feed value.

From the foregoing it will be appreciated that any variety of barley to be produced in commercial quantities must have seed that can readily be identified. This is most important both for local and export requirements. Without any ready distinguishing characteristics, checking of seed is not possible on the farm or at the silo. The grower might do his best to produce top quality barley, and find that his efforts have been frustrated through inability to check variety. When it comes to protecting export markets, it is all important when selling a stipulated variety of barley to make sure that it has not been contaminated by impure seed.

A multiplicity of malting varieties, if released together or allowed to compete for a place in malting barley markets, can produce an embarrassing situation for the Marketing Board unless, of course, the competing varieties are compatible and the odds are very much against that. The provision of separate storages for different varieties often increases storage costs because of wasted cell space, not to mention increased freight costs through partly filled trucks, and the more varieties being handled in a storage complex, the greater the risk of human error causing a mix-up.

In summary then, it could be said that the Grain Marketing Boards would like to see wheat and barley produced from clean and sound weed-free seed of the required quality. Quality, that is baking quality in the case of wheat or, with barley, malting quality, will result if growers sow those varieties recommended by the respective authorities.

Experience in South Australia over the past two years has also demonstrated the necessity for wheatgrowers to be in a position to switch to alternative varieties at short notice in order to combat new strains of rust.

Continued liaison between growers, agriculturalists and the Grain Marketing Boards is essential if desirable objectives are to be achieved.

### Discussion

With regard to barley, the likely incompatibility of varieties requires any scheme to have a fair amount of flexibility. This will avoid rapid change which, in such circumstances, so often leads to problems in the Industry. If a new barley variety is to be introduced, then it should first be tested by the Department of Agriculture, the Australian Barley Board and the consumer. Close liaison with one another is essential.

There are problems associated with soil nitrogen in barley growing. Variety and grading aspects reinforce the need for a high yielding "feed" variety.

The Australian Barley Board handles only a small proportion of the barley entering world trade. Because of this, although climatic conditions will largely govern what is available in each grade, the Board can usually sell whatever is available.

2.1 WEED CONTROL IN CEREAL SEED PRODUCTION

M.J. Catt

Senior Research Officer, Weed Control

As I see it there are two objectives of cereal seed production. The most important aspect in the early stages of seed increase programmes is to maximise the quantity of seed produced. Coupled with this is the requirements to maintain quality of seed by the exclusion of weed seeds.

Let us examine the latter aspect first. Morally, I suppose, the producer is bound to sell seed grain which is pure and with a sufficiently high germination ability. Apart from limited requirements of the Weeds Act the obligation to maintain purity with respect to weed seeds cannot, at present, be legally enforced. The Seeds Act specifically excludes wheat, barley, oats, field peas, maize and rye corn from its provisions. One can then only look to the Weeds Act for the only controlling statute and this arises in Section 31 which states:-

"Any person who brings into the State from any place outside the State, or brings into any part of the State from some other part of the State, any proclaimed weed or portion of any proclaimed weed or the seed of any proclaimed weed, either for propagation or as packing material or for any other purpose whatsoever shall be guilty of an offence". It is a moot point whether the producer or the user of seed grain contaminated with noxious weeds would be the offender but certainly an offence would be committed. Few if any such offences have been either investigated or prosecutions launched.

Obviously the prevention of the spread of proclaimed noxious or dangerous weeds is important but I feel inclined to believe that many other weeds should also be prevented from spreading from one locality to another and seed grain is a common carrier of weed seeds e.g. wild or black oats.

Any seed grain certification scheme should cover the exclusion of other weeds as well as those proclaimed in the Weeds Act.

Maximisation of the quantity of grain produced can only be achieved by adequate weed control particularly during the period up to crop tillering when maximum yield potential is determined. I would imagine that seed grain, particularly of new varieties, would carry a considerable premium as far as price is concerned so the economics of the crop obviously favours a comprehensive weed control programme. One must bear in mind the fact that additional treatments may be required to ensure that weed seeds do not contaminate the grain at harvest. These treatments may take the form of late applications of hormone herbicides e.g. to stop skeleton weed flowering or hand roguing of weeds as may be required to remove scattered wild oats from a crop.

Maximisation of yield by the use of herbicides to control weeds may have other desirable effects. The removal of weed competition often leads to significant increases in grain weight and size as well as total yield.

For example, the following figures indicate yield and 1000 grain weight increases obtained by the control of wild oats in Clipper barley with a new post-emergent herbicide, AC 84777.

Treatment	Yield t/ha	1000 grain weight gm
Nil	1.47	47.3
AC 84777	2.27 55% increase	51.2 8% increase

Several workers have indicated that larger seeds exhibit a faster growth rate, produce more tillers per plant and give higher grain yields. Thus yield maximisation may also lead to seed with greater seedling vigour and greater yield potential, both highly desirable characteristics in seed grain.

In general, weed control in cereal crops is well defined and control methods, both cultural and chemical, are available for most weeds occurring in crops. However two difficulties arise.

Firstly, whilst saying that control may be gained of most weeds occurring in crops, it is clear that in not all cases will a completely weed free crop be obtained, particularly where grassy weeds are a problem or oats are grown. This may pose a problem in ensuring that the grain is clean of all weed seeds unless good grading equipment is available. Secondly, it is possible that herbicides which have been developed through trial programmes on existing varieties and shown to be selective, may be quite disastrous if used on new varieties. For example, the wild oat herbicide Neoban<sup>(R)</sup> containing barban may be used safely on wheat and barley except for the cultivar Clipper or cultivars with Proctor in their genealogy. The susceptibility of new varieties must therefore be determined as early as possible to ensure that herbicides likely to be used in the early seed increase years can be applied with safety. There is also perhaps an argument for plant breeders to include herbicide susceptibility as a character in line selections.

The Weed Science Section of the department will certainly be able to help in regard to early testing and with the completion of a spraying table it is hoped to commence screening new and currently available herbicides against new cereal cultivars grown in pots in the glasshouse. Only small quantities of seed will be required in this programme to give an early indication of new variety susceptibility.

To summarise, weed control in cereal seed production is essential to

- (1) prevent spread of noxious weeds
- (2) prevent spread of other economically important weeds

- and (3) maximise quantity of seed produced  
 (4) as a side benefit, of unknown importance at this stage, to help increase quality of seed grain in terms of improved seedling vigour and yield potential.

### Discussion

The main problem in seed production is the cost of wild oat control. It was suggested that as some wild oats will always be present in seed production pre-emergent treatment could be a pre-requisite for entry into a certification scheme. However, at present there is no known treatment that could ensure freedom from wild oats. The search for a herbicide for better wild oat control is to be given higher priority.

Longer term weed control, perhaps in the 1-3 years before the seed crop is sown, could be the answer to weed control in a seed crop.

More emphasis needs to be given to the control of weeds in oats generally as against wheat and barley.

Stricter control on seed for seed production in regard to the introduction of weeds is needed.

The more common crop weeds are just as big a problem as noxious weeds in cereal seed.

2.2 SEEDBORNE DISEASES AND THEIR CONTROL

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Introduction

In this paper an attempt has been made to define seedborne diseases, describe the types of seedborne disease, look at the general principles of control and finally to discuss specific control of cereal smuts.

What are seedborne diseases?

Seedborne diseases are those that are carried in the sample. This includes contaminating spores, infested debris, as well as those diseases that colonize the seed. Covered smut of barley is an example of spores contaminating the seed. Ergot and wheat blotch (Septoria tritici) are examples where there is a contamination of the seed sample, with a survival structure in the case of ergot and infested straw in the case of Septoria. Loose smut of wheat and barley and glume blotch are examples of colonization of the seed by an organism.

What are the numbers and types of seedborne diseases?

In the Annotated List of Seedborne Diseases (M. Noble 1968) the following number of seedborne diseases are recorded (these include fungal, bacterial, viral and nematode diseases).

Cereal	Total recorded	No. recorded of economic importance
Wheat	30	20
Barley	23	14
Oats	26	9

Obviously not all these diseases recorded to be of economic importance will be of importance in South Australia because of the climatic conditions.

In South Australia the seedborne diseases of cereals can be roughly divided into leaf spots (e.g. glume blotch, barley scald), ergot and smuts (e.g. covered smuts of wheat, barley and oats).

General control of seedborne diseases in relation to quality

The following table shows some of the cereal seed diseases and how they are carried and controlled.

Disease	Seed contamination			Seed colonization
	Spores	Survival structure	Debris	
Glume Blotch	x	x	✓	✓
Septoria	x	x	✓	x
Barley Scald	x	x	✓	✓
Ergot	x	✓	x	x
Covered Smuts	✓	x	✓*	x
Flag Smuts	✓	x	✓+	x
Loose Smuts	x(oats)	x	x	✓
Control	Fungicides Contact or Systemic	Mechanical <sup>§</sup> Separation		Systemic Fungicides

\* Broken heads in seed sample.

+ Fragments of broken leaves.

§ Mechanical separation, e.g. seed cleaning.

Glume Blotch (*Septoria nodorum*)

This disease occurs in South Australia but at present its importance and level of infection of seed is unknown. In Western Australia the average infection is 2-4% in one year, however, it can range from 0-35%. In New South Wales similar levels have been recorded. The presently used seed dressings have not been tested in their control of *Septoria*. In overseas work Benlate is known to have some activity against *Septoria* sp.

Barley Scald (*Rhynchosporium secalis*)

The seedborne level is usually low, ranging from 0-3%. Here again seed dressings have not been assessed in South Australia. The disease is widespread throughout the state.

In both these diseases, glume blotch and barley scald, in most seed samples the levels of disease are low. Where the disease had been present for several years, controlling seedborne infection would be of little importance, because they survive best on stubble. However, the low level of disease is sufficient to introduce a disease into an area that is free of disease.



Ergot (Claviceps purpurea)

This disease has little effect on yield, however, it has nuisance value in that contaminated grain will not be accepted at receival depots. The reason for this is that ergots have toxic alkaloids which restrict blood flow in humans. Seed contamination can be greatly reduced by seed cleaning. Frequently ergots occurring in seed samples come from ryegrass weeds within the crop.

Covered Smuts (Tilletia foetida - wheat, Ustilago hordei - barley)

Covered smuts of wheat and barley do affect yields, but as with ergot it has nuisance value in that contaminated grain is rejected and will not be accepted for human consumption. Smut in barley is difficult to separate from the grain and it also gives the malt a bitter taste. Covered smut in wheat taints the flour.

Loose Smut (Ustilago tritici - wheat, Ustilago nuda - barley)

In wheat and barley loose smut can affect yields but less than covered smuts. Loose smut is only controlled by a systemic smuticide because the disease is borne in the embryo. In oats, however, the disease can be partially controlled by contact smuticides.

A specific example of fungicidal control of seedborne disease - the covered smuts of cereals

Some of the factors involved in developing a fungicidal control for a seedborne disease are as follows:

- (a) Susceptibility of varieties to the disease. Different varieties have different susceptibilities, e.g. Emblem is more susceptible than Halberd, Clipper is moderately resistant when compared with Ketch, West oats is very susceptible when compared with Avon or Swan.
- (b) Strains of fungi. There are different strains of covered smut of wheat HCB resistant and susceptible, there are also different species, Tilletia foetida and T. caries.
- (c) Field levels of disease and rate of increase. Covered smut of wheat is rarely found nowadays, however, covered smut of barley is frequently found. The rapid rate of increase of these diseases makes it necessary to have smuticides that are effective against high percentage infection of crops.
- (d) Economics. For a smuticide to be used widely by farmers it has to be cheap. There are two ways this can be achieved, that is by lower levels of active ingredient to be used, e.g. Le-San ELL (5% a.i.), Benlate (10% a.i.), Vitavax (25% a.i.) or for the chemical to be cheap, e.g. Mancozeb (75% a.i.).
- (e) Residue levels. All smuticides cleared for use now must not accumulate in animal tissues as did Hexachlorbenzene (HCB) and mercurial based seed dressings. Long term feeding studies assist in development of this knowledge.

(f) Phytotoxicity. The smuticides applied to seed must not affect the viability of the seed immediately after treatment or on storage. In South Australia, especially in the drought prone areas, treated grain must be able to be carried over from one season to the next, also not all grain treated will be used in one season.

(g) Effect of the smuticide on the operator and the flow through the equipment. Smuticides used must have low mammalian toxicity and low irritability factors. At present contender smuticides are used in field tests to assess effects on the operators and also to check the flowability of the treated grain.

(h) Efficacy. The chemical has to effectively control the disease, even under conditions of high percentage infection. This provides safety because with covered smut of wheat farmers would probably not detect its occurrence until it was heavily infected. Recent trials with Halberd wheat using 1 gm/Kgm of smuticide show the following efficacy:

<u>Treatment</u>	<u>% infected heads</u> (mean of 10 replicates)
Nil	44
Mankobunt 75%	1
Le San 5%	2
Vitavax 25%	14
Vitavax 50%	4
TBZ 20%	10
TBZ 30%	3
TBZ 40%	4
Benlate 10%	7

Mankobunt, Le San, Vitavax (50%), TBZ (30%), Benlate (10%) performed well under reasonably high infection pressure. However, their use in South Australia depends on many factors, e.g. Mankobunt affects wheat seedling emergence and is now not recommended on wheat. Vitavax 50% a.i. is more expensive than other chemicals available and will probably not be used widely, although it has good efficacy. TBZ at 30% is not registered and indications are that it might be too expensive. Benlate has a great deal of efficacy data but information on its phytotoxicity is limited. Therefore we have registered in South Australia at present for control of smuts:

Smutioide	Rate	Controls smut on		
		Wheat	Barley	Oats
Mankobunt L	1.5 g/Kgm	x*	✓	✓
Le San ELL	2 g/Kgm	✓	x	x
Vitavax 50	1 g/Kgm	✓	x	x
Progro 25	1 g/Kgm	x	✓	✓

\*Affects seedling emergence

2.3 DEVELOPMENTS IN SEED PROCESSING

H.C. Hannaford  
 Managing Director,  
 Alf Hannaford & Co. Ltd.

We make a special point of checking out various processes, especially NEW ideas. Naturally one has to see if there is another process that will supercede an existing process.

Naturally I am more competent to speak about processes that we have especially developed, or refined, and although this means talking about one's own products, please excuse same, but I feel it is far more beneficial to do this than to talk about something with which one is not so familiar and any apparent criticism of another process is made because it is considered that certain disadvantages are often overlooked. Without question, most systems have their good features, so any apparent criticism only applies to the particular angle discussed.

The mechanical sorting of seeds and weeds depends on a practical difference between the seeds concerned: the emphasis is on the word "practical".

Wheat and 2-row barley are distinctly different grains: however, they could have similar length -- similar width, and, despite difference in hectolitre weights, some grains of each will have a similar weight.

Even with selected certified seeds, it is quite common to see South Australian Department of Agriculture figures showing 10% of these selected varieties being rejected after being cleaned in the normal manner.

Considerable improvement has been made in many vegetables so they ripen at the same time. This is important when using mechanical harvesting methods, or if wanting to do a "one-pick" to save labour costs.

There would certainly be advantages if there could be a practical size difference between different cereals that are grown in the same paddock in the course of rotation; e.g. 2-row barley being sufficiently shorter and/or plumper than a grain of wheat.

Centrifugal force is used advantageously in sorting seeds so that in the case of cylindrical screening, the seed can hang to the entire inner diameter of a horizontal fast rotating cylinder, whereas, normally, grain only lies on the bottom and part way up on the left side. The Centrifugal Screener perforations rotate and the grain is held against the entire inner surface and as soon as it reaches an aperture of the right size, the particles go through. Naturally big seeds would clog the aperture, therefore, a conveying system is necessary to move large seeds beyond the apertures to the discharge end. This speeds up cleaning and the process is highly developed and should be used more extensively, even if only as a major reducer of bulk: it would leave less work for final finishing. These Screeners, with their relatively high capacity, have revolutionised the width sorting of grain, whilst being harvested.

Originally there were problems if excess moisture and succulent portions of plants went through the Screener. It became like a juice extractor, but eventually clogged the perforations. Heavy-duty models have long-life heat-treated conveyor blades. An earlier attempt was made to give extra life by having adjustments so the blades could be moved outwards, when worn: however, this did not work out satisfactorily. The blades have been re-designed and with eight spokes per circle, giving additional efficiency and higher capacity. These are available in four different size Screener units.

Centrifugal force is also being used in length separation. Dating back to the last century, slow-speed cylinders were used for length separation. The sides to the pockets formed a ledge to lift the seed. Controllable high-speed cylinders have since been introduced. Naturally, with more lifts per minute, a greater capacity is obtained. The speed is controlled so there is not a completely centrifugal action, otherwise the seed would go round in circles and remain in the pockets or indentations. By varying the speed, one can control how high the seed is lifted: this gives a wide variation to the sample lifted, so improvements can be made without changing indent sizes. The indentations are somewhat saucer-shaped, which makes for easier discharge of the seed at high speed.

The earlier type Indented Cylinder (slow-speed) made it most difficult for seed to discharge if driven faster.

We press our own Indents and have developed another size pocket which is more suitable to the Australian cereals. For general purposes, one size indentation will lift peas, lupins, rye grass, rye corn, wheat, 2-row barley, and similar size grains: the same indent, of course, will lift short matter out of longer oats. This means picking up short barley and wheat out of oats.

On the High-Speed Cylinder, an important variable adjustment is the location of the separating edge of the liftings trough. The lower the "edge" is, the more it can pick up. The higher, the less it will pick up.

On the Slow-Speed Cylinder, the trough is under-slung from the shaft, with a countershaft drive to the auger. The separation edge of the trough is normally below a 3 o'clock position. This means that the main bulk of the seed (long and short) is very close to the separation edge.

With the High-Speed unit, the trough can be placed from the 1.30 position nearly to 12 o'clock. The higher lift, despite the speed, gives better separation as the main body of the seed does not go anywhere near the separation edge of the trough.

To safeguard against undesirable matter getting into the trough, we have an especially "Built-in" stop (as an improved feature) which prevents the trough's separation edge going in a low position.

Using shaking sieves or cylindrical screens, one can scalp off the larger foreign matter but, unfortunately, not enough attention is given to screening off approximately 50% of the

largest desired product and then leaving the reduced amount for a further screening to take the fines out of the desired product. The normal practice overloads the finishing screens and this is a greater problem with small seeds, with consequent curtailment of earning capacity as one usually has to slow down the flow rate well below what one could achieve if one could scalp off a high percentage of the large seed. Naturally the two sizes of the same seed will be returned into the same stream and, therefore, mixed together in the same proportion as previously, after the very fine impurities have been removed.

Although it is quite common to use flat shaking sieves, there are big sales in America of cylindrical screens, under the title of Superior and Precision Graders.

Although common cylindrical screens normally only use one side of the bottom section of the screen, there are advantages in lifting up seed so the opposite side of the cylinder is also used. The same lifting facility can lift seeds so that they will spear through portions of perforations which normally do not have seed on that side of the cylinder.

It is more natural to clean grain out of the top of common cylindrical screen perforations because the grain is up-side-down and a little top side pressure allows the grain to fall out by gravity, whereas it is unnatural to clean a screen with a brush on the underside of a flat sheet, especially when there is other seed constantly covering the screen - when the natural weight of the seed in the perforation and other seed covering same is a disadvantage.

An important part of seed cleaning is the cleaning of equipment from one kind or variety of seed to another. Customary elevators must be easily cleaned out at their bottoms: chutes must have adequate slope for self-cleaning. Timber should be avoided where there can be cracks in same - or - particularly, where there are joints at right angles. Folded sheetmetal (corners) avoid possibilities of gaps between the floor of a chute and the sides of a chute. Particular care is necessary to clean out conveyors that are substantially horizontal. Another problem includes the lodging of seed between elevator belts and elevator buckets that are close to the belts.

A means of substantially reducing dust is to re-cycle the air and separate the medium and lightweight matter while re-cycling. We have patents on a special air re-cycler.

Two half peas have the same weight as a whole pea: however, a half section has a greater surface area where it has the flat face (i.e. where it is split) - this gives the pneumatic system more surface to lift the split peas away from the whole pea. This pneumatic system actually simplifies final cleaning by a Gravity Table but where it is impractical to use Gravity Tables, Pneumatic Separators are the nearest approach. We use this machine extensively to clean grub-damaged lupins required for planting; also for export. It is also very good to remove split rape seed. The split seed quickly gums up Cylinder Length Separators, if not removed.

Unfortunately some people expect 100% rubbish removed with no loss of good grain. Normally this is practically impossible. A wise cleaner realises it is more important to have a pure product for sale: consequently it is better to have a little good seed in with the rejects rather than have undesirable matter in the good seed.

There are decided advantages in the owner or grower of the grain, cleaning the grain that he will sell for planting. The grower should know what weeds are on his property and consequently should take precautions to eradicate them and not reap paddocks for seed that have impurities that are difficult to clean. Likewise, he should be responsible for proper harvesting, to avoid damaging the seed.

Where somebody buys seeds from a grower, they are buying an unknown quality. Just a few odd seeds or weeds that are impractical to remove can be spread throughout the State. If established cleaners could inspect the paddocks before purchase and supervise the harvesting, this problem, of course, could be overcome. As cereal varieties change, this means different grain going on to properties at frequent intervals; hence care regarding weeds has to be exercised. The weed problem would be greater than that of purchasing a pasture seed which is generally planted primarily to graze off.

There is a problem that some growers do not expect to lose medium grade grain. This, of course, should not apply to quality seed producers: however, I can quote from our own experience where people keep their own seed, they frequently claim they have not kept sufficient to length-separate and screen adequately. Often we are restricted by growers of the amount of wheat removed to try and separate 2-row barley of similar dimensions. It is common for growers to state that there is no need to worry about various weeds because they have plenty already on their own property.

It is rather staggering to find people with efficient Screeners on their Headers to remove weeds, stating they have not time to stop and collect the weeds removed by the Screener, and state they have plenty of these weeds, so there is no harm in discharging the weeds on the ground as the Header goes around the paddocks.

It is important to have seed of good virility because one can have unfavourable conditions for the initial establishment; consequently the under-developed grain has a lesser chance of survival as it has a lower food supply to establish good roots. However, it is quite common for statements to be made that seconds will grow, but only if there are favourable conditions. I feel more emphasis should be placed on "seed vigour" and less on germination percentage.

I feel sure that official figures will support the forward-looking of our cereal growers in that shortly after a new worthwhile variety has been released, it becomes well established over a wide area. Unfortunately, if this is planted on weedy paddocks, and this wheat is sold, of course it is spreading weeds.

As weeds are a menace and multiply readily, naturally the best control of same is at the source.

As previously mentioned, it is better to over-clean than under-clean. The apparent desirability of re-cleaning or re-treating of grain containing a proportion of good and bad can be undesirable because there can be a similarity - this particular sample naturally has the accumulation of the weed seeds removed by that particular unit of the cleaning plant. This accumulation, of course, really means the particular weeds are concentrated in this section so it is really a dirtier sample than the original: hence there are more likely to be weed seeds left in re-cleaned sample than the original sample which could have had heavier, plumper or longer grain which is more easily segregated.

What are today's problems are not necessarily tomorrow's problems because they are constantly being solved.

### Clipper Barley

This has the special feature of resisting wind damage much better than earlier varieties. Like many things, one thing can complicate another, and it is felt that some of the current barley in wheat problems could be attributed to the fact that the Clipper barley does not shake out readily and, therefore, is present to a larger extent when harvesting the wheat than would happen when barley had a better chance to shake out before the wheat was ready for harvesting.

Length separation to remove barley from wheat was primarily introduced to remove the then common 6-row barley and other substantially longer matter than wheat. The machine concerned was the Carter Disc Separator, and did a good job of removing 6-row barley: however, it had definite limits in removing 2-row barley from wheat. Unfortunately a Carter Disc was not a practical means of length separating longer matter from 2-row barley, nor for the removal of shorter matter from long oats.

South Australia is the Barley State of the Commonwealth and frequently the seed requirements represent approximately 1/3 barley - 2/3 wheat, plus oats ... consequently the Carter Separator did not provide length separation for a substantial proportion of the cereals planted in this State ... hence there were decided advantages in introducing the Cylinder Length Separator.

The processing of grain includes the protection of same against fungi and also insect infestation.

Looking back over recent years, it is quite obvious there would have been decided advantages in having a Commonwealth-wide discussion involving the farming and associated industries regarding continuance and introduction of new seed treatments. The emphasis is placed on "Commonwealth" as the decision was made by the Australian Agricultural Council which comprises State and Federal Ministers of Agriculture. At the time the decision was made to discontinue the use of Hexachlorobenzene and Mercurial Seed Treatments, there was then no approved replacement. If the local

cut-off day had generally been made the end of April instead of late February (just a few weeks) it would have avoided some of the problems and, at the same time, allowed more time for a second alternative wheat pickle to be marketed especially when this second wheat pickle did not have the poor emergence problems that are associated with Mancozeb.

Prior to the introduction of Mancozeb, Victoria had been using Maneb and we had already complained to the Victorian Departmental Officer in charge of the project that Maneb was an irritant and would not be acceptable to the cereal growers. Maneb is the main ingredient in Mancozeb... (co-ordination of zinc ion and Maneb).

The South Australian Department of Agriculture is to be congratulated on the very early alertness to the poor emergence problem associated with Mancozeb. The seeking of samples of seed carried over from the previous year and testing of same and giving prompt results to the farmer, plus publishing them promptly for all concerned, has been most helpful in alerting growers to the problem.



## 2.4 SEED STORAGE

P.R. Birks  
Senior Research Officer,  
Entomology.

During recent years a lot has been said about problems with insects in grain storage. It is appropriate that we should look at the situation with respect to seed storage.

### Insects of Cereals

The relationship between cereal grain and cereal seed storage is fairly obvious and direct. A wide complex of insect species attack stored cereal grain and the same insects can attack cereal seed.

### Other Crops

Seed of other crops varies in susceptibility to insect attack. Sunflower seed is particularly favoured by the moth pests of cereals, rape seed is favoured by the rust red flour beetle. It thrives large and sleek on oil seed rape. Clover, peas and grass seeds are less commonly attacked by insects, but some of the small Dermestid beetles can multiply, especially in accumulations of old seed left undisturbed for long periods.

### Seed Protection

In recent years we have not been aware of great problems in keeping seed, especially cereal seed free of pests. The reason is more apparent when we look at the composition of pickles used on cereals.

The old seed dressings, Hexabunt, Ceresan and Leytosan usually contained 0.5% lindane to protect seed from insect attack. Ceresan was sometimes used without lindane.

The new seed dressings likewise contain the insecticides lindane or maldison (see Table 1).

We are currently using these two chemicals to protect our cereal seed. Frequently the seed is put into dirty weevil infested barns, pulled out again at seeding time still in good condition. Caryover seed, often an important aspect of our dry farming system also often escapes serious insect attack - thanks to insecticides used at protectants.

### Resistance

For many years now we have been worried about our heavy reliance on insecticides to protect our export grain. If one or more species were to develop resistance to a particular protectant the material would become almost useless - forever. Because grain is food to man and animals, we can only use a limited range of the less toxic insecticides on it, therefore resistance to insecticides threatened the usefulness of the few insecticides available (see Table 2).

Resistance to lindane was starting to show in Queensland prior to 1968. More and more farmers were finding weevil in their seed wheat. In 1968 the first resistance to maldison showed up. Resistant Tribolium castaneum the rust red flour beetle, was found in peanuts, again in Queensland. Since then more and more strains of many different species have been detected showing resistance to lindane and/or maldison. This has developed most rapidly in the Eastern States, but it has developed just as inevitably, just as surely, only a bit more slowly in South Australia - and the longer we rest on our "laurels" in South Australia, the less our advantage over the Eastern States. By 1973 we had some lindane resistance, and quite a lot more maldison resistance which we knew about. It was mainly in the silo system, in flour and feed mills, with very little on farms.

### Worsening

The situation will get worse yet. Looking at a range of other chemicals we see that resistance is now developing to dichlorvos, fenitrothion and pyrethrum, the other chemicals used in or on grain. There is resistance to carbaryl the other main protectant type chemical. There is already some resistance to the chemicals soon to be released for grain treatment, viz. bioresmethrin (a synthetic pyrethrum), pirimiphos methyl, CGA 20168, and chlorpyrifos. These new chemicals will only be effective against some races of some insects. The use of mixtures, a last resort, will eventually be necessary.

The newest of the new, Juvenile hormone mimics, the so-called 3rd generation pesticides, not yet off the "drawing board" - already some Tribolium in field cultures are resistant.

### Fumigants

The situation is even worse. The fumigants which are used to kill infestation in seed or grain, but which confer no residual protection are also starting to fail. Field strains resistant to methyl bromides, phosphine, ethylene dibromide and cyanide are being found overseas.

The inevitability of fumigant resistance occurring here is brought home by the first records of phosphine resistance in Australia in 1975. One of these is from South Australia.

We try to avoid the use of fumigants on seed where possible for fear of affecting germination. High moisture content and high oil content can result in reduced germination after fumigation. We may have to use more and more fumigants. As this occurs we will have to be very careful and use them precisely and according to instructions. Phosphine (Phostoxin) must, for example, be used only under gas proof sheeting etc.

### Solution

The rural outlook has enough gloom at present without adding more by way of insect problems. Is this all inevitable and is there no solution?

The obsolescence of insecticide protectants and fumigants is inevitable - only its speed will change. The more we use a treatment against large numbers of individual pests, and the more we incorrectly use a treatment with respect to dose rates etc., the faster resistance will develop.

### Hygiene

There is a solution however, and this is through hygiene. The avoiding of large residues of grain which are left undisturbed for long periods goes a very long way to preventing the buildup of insect populations. The removal of residues removes the sources of "infection".

On some 30% of South Australian farms the present levels of grain hygiene are very good, and insect populations are small and present minimal risk of infesting seed and feed. Probably all of these could still secure their positions even further with simple improvements. On some 70% of our farms the situation is less encouraging. There are infestations large enough and close enough to storage areas to make infestation of new seed or feed almost inevitable.

In talking hygiene to the seed trade we should be preaching to the converted. The necessity to maintain seed purity calls for a level of hygiene in sheds, machinery and storage containers which will keep insect pest problems to an absolute minimum. Probably the only feature requiring special emphasis should be the matter of disposal of residues.

With all crop seeds cleaning residues should be thoroughly destroyed. Burning is the most obvious method. Seed cleaning plants should have some such facility. As second choice cleaning residues should be removed as far as possible from the cleaning premises and exposed to the elements as much as possible. Avoid dumping in heaps.

### Interrelationships

No man is an island, and no industry is independent of another. The grain pest problem has many interrelationships. Farmers deliver some insects to the silos either from using unclean equipment, or perhaps also from parking alongside heavily infested pig feed etc. The silos pass some insects to the feed mills. These in turn, through produce stores pass infestation back to farms. Screenings sales to feed mills often contain infestation. Dog feed for example is a "modern" source of infestation to farms. Road and rail trucks can spread infestation.

All parts of the industry have problems arising from their own premises, and from the premises of others. In seeking a solution to the problem no part can be considered alone.

The role of feed mills, provender stores and for that matter seed producers is seen as of special strategic importance. They are few in numbers but disseminate their produce far and wide. They need to be producing uninfested produce.

The drafting of legislation to help enforce education efforts to maximise grain hygiene is now nearing completion. It will apply to all parts of the industry system and will in principle make it an offence to have infested produce. Such produce must be disinfested before it can be moved or sold.

Seed cleaning establishments, by virtue of their distribution function are of strategic importance. By virtue of their need for high standards of hygiene to maintain seed purity, they would be unlikely to present many problems.

BUT - they may find their client's complaining about infestation in seed in a way they haven't done for years, and it will be very much in the seed merchant's interests to see that his produce really is beyond reproach.

### Discussion

Mr. Birks was asked about the feasibility of nitrogen swamping if storages could be adequately sealed. There are problems in getting air tightness in large storages at a reasonable cost. After 3 weeks of nitrogen swamping some grain insects were alive but after 4 weeks all were dead. The critical factor is that eventually resistance to nitrogen swamping will develop.

A booklet of desirable standards for grain storage equipment is being prepared by the Australian Standards Association. This booklet will be sent to all grain storage equipment manufacturers.

Prepared dog food granules commonly become infested with the red flour beetle.

Table 1 : Old and New Cereal Seed Dressings

Pickle	Colour	Content
Hexabunt	Blue	HCB 30% Lindane 0.5%
Ceresan	Red	Mercury 1.5% ± lindane 0.5%
Leytosan	Red	Mercury 1.5% Lindane 0.5%
Mankobunt-L Buntosan 75M	Green	Mancozeb 75% Lindane 0.5%
Le-San ELL	Red	fenaminosulf 5.0% Lindane 0.5%
Vitavax 50	Purple	Carboxin 50% Maldison 1%
Progro 25	Purple	Carboxin 25% Maldison 1%

Table 3 : Resistance to Insecticides

Incidence on farms in South Australia		Lindane	Maldison	Dichlorvos	Pyrethrin	Bioresmethrin	Pirimipinosmo	Chloropyrophos	CGA 20168	Juv. Hormone
Granary Weevil	40%		SA			A	A			
Rust Red Flour Beetle	30%	A	SA	A				A		F
Sawtooth Grain Beetle	29%		A		A		A			
Lesser Grain Borer	15%	A	SA	A				A	A	
Rice Weevil	8%	SA	SA		A	A	A			

SA = field resistance in South Australia

A = field resistance in other states of Australia

F = field resistance overseas.

3.1 CEREAL SEED SCHEMES IN OTHER COUNTRIES

T.G. Heard  
Senior Research Officer,  
Crop Agronomy.

I should state initially that I believe that the South Australian scheme in which initial seed build up by the Dept. of Agriculture and Roseworthy College is coupled with the current registered grower build up is serving a very useful purpose. But at the same time we must realize that by overseas standards our scheme is quite small and quite different from those in other developed countries.

Any cereal seed scheme must start with the breeder. He must initiate build up of seed when he feels that he has a promising line likely to become a commercial proposition. This is the accepted practise in the countries from which I have some knowledge of such schemes.

At the present time in South Australia we are thinking in terms of 2-3 years of extensive testing by the Department of Agriculture of new locally bred varieties before consideration for release. It is at this time 2-3 years before projected release that we should also be considering seed build up. It is at this stage of testing that many overseas breeders begin their seed build up. While this may be carried out by the breeder himself, in many instances there are seed production sections with the necessary expertise waiting to take over. At this stage there might be 30-300 kg of seed.

Seed production at this stage is seen as speculative but essential. Any lines which don't make the grade may be disposed of elsewhere but the overwhelming thought is to have reasonable quantities of seed available at the time of release.

Particularly in the U.K. but also in other countries there is a specific requirement for new varieties to be distinct uniform and stable. This is tied up with plant breeders rights and certification of varieties. Such a tight control on varieties has not been experienced in Australia but it is possible in the future particularly if variety legislation at present under consideration should come in.

At the time of release of a new variety many overseas organisations look to have at least 50 tonnes of seed available for distribution in some instances they have had ten times this. This seed may be distributed in a number of ways.

In several of the North African countries much of the seeds is distributed through farmer co-operatives on a contract basis with the majority of the produce to be returned for cleaning, grading and resale. In the U.K. over 250 agricultural merchants are involved in the British Cereal Seed Schemes producing on their own farms and under contract huge quantities of seed. At least 70% of the cereal seed sown in U.K. passes through this seed scheme. It appears that relatively little cereal seed is saved by U.K. farmers or bought uncertified because of the constant fear of carryover of weeds and diseases but more particularly through the thought of reduced yields due to out crossing. Inspections of growing crops are carried out by National Institute of Agricultural Botany and inspectors retained by the merchants (1300 in all).

In the future all cereal seed sold in U.K. will have to be certified.

In North America possibly 10-30% of the cereal seed sown is certified. This varies between states and provinces.

In the U.S.A. the land grant colleges (Universities) generally control cereal seed production and certification in each of the states. I have previously made mention of cereal seed production sections. These are particularly widespread in the U.S.A. and are generally a section within the agronomy department of the college. In some instances they may be responsible for seed build up from the breeder to the farmer but generally they are not concerned with seed beyond the basic of foundation stage. In most instances we have crop improvement associations coming in at this stage.

In the U.S.A. these are largely initiated by the colleges, their managers are often on the college staff but they have a board of directors who are mainly seed producing and using farmers.

The associations have a staff of inspectors, they allocate basic seed to farmers throughout the state, inspect the growing crops and generally assist with the distribution of the produce (i.e. as regards publicity).

In Canada the Canadian Seed Growers Association is the only cereal certifying agency. This organisation has a board of directors split 50/50 between growers and provincial D/A reps. The inspection of crops is carried out by the provincial departments while seed allocation and publicity etc. is handled by the association.

The cost of certified seed in the U.K. and North America is at least 30% higher than that of uncertified seed. This is for the lowest grade of certified seed available. The cost of basic seed, the highest grade available is at least twice that of uncertified seed. The range of prices relating to the different grades is set to enable producers of each of these grades to make a profit on his seed production operations.

The cost of setting up for the production of certified seed either by the foundation seed section of a university or by a private individual could be quite high. In the U.S.A. many farmers have their own seed cleaning plants and the majority of their income is obtained from the sale of a range of seed. Such costs should be considered before organisations or individuals set up in seed production in South Australia.

### Discussion

In the United Kingdom basic seed costs £100/tonne as against commercial seed £40/tonne. There are three other grades, between these two extremes, for which the price increases £15-20/tonne. Also in the United Kingdom a royalty of £4/tonne is paid to plant breeders under Plant Breeders Rights on first crops from purchased seed. This does not apply where varieties have been developed using public money.



Crop Improvement Associations in the United States sell only certified seeds. The prices are fixed by the seller.

In Australia more liaison between the states is needed to ensure that registered growers can build up seed ready for the release of a new variety. Registered growers have "missed out" with Condor and Kite because after they had been tested in trials in South Australia for one year, and their potential was not fully known, they were released by the New South Wales Department of Agriculture. The situation was complicated by the rust devastation in 1973 which resulted in the large scale importing of Kite and Condor from N.S.W. for sowing in 1974.

continued in part 2