

POTENTIAL FOR FEED WHEAT PRODUCTION: A REVIEW

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SUMMARY

Along with other areas such as North America and Australia, it is expected that New Zealand will have a large increase in the use of feed grain to supplement pasture in meat production.

Genetic improvement of wheat has ensured it will share along with barley and maize a major proportion of this increased demand for stock feeds.

A description is given of the present breeding programme at Lincoln with the major emphasis on milling varieties suitable for bread. The consumption of bread is declining in many developed countries and this is leading to new plant breeding programmes aimed at developing new feed varieties.

The high yield potential of the new Mexican dwarf wheats is shown in a newly released variety Karamu and it will be used along with high yielding European varieties to breed feed wheat varieties.

Changes in the marketing of the New Zealand wheat crop to allow for classification of feed wheats and adequate storage to carry over grain surpluses are recommended.

INTRODUCTION

In recent years barley has superceded wheat as the major grain crop in the North Island. This factor, and that of transport costs have recently prompted the increase usage of barley for feed. Thus barley, compared with wheat, has become financially rather than nutritionally more attractive to the stock-feed user.

The breeding of feed wheats could lead to significant developments in the wheat industry but the potential for this grain is dependent on the price of other substitutes.

To obtain more information on overseas work, a circular letter was sent to wheat breeders in Canada, Australia and U.S.A. The replies indicated that, in Canada in 1965, a "utility" or feed wheat breeding project was started, both for domestic use and for export. Australia, being very mindful of Canadian competition, has also started a feed wheat breeding programme, but it is still in its infancy. There was only one reply from the United States and no feed wheat breeding is being carried out at that station. We are all a long way behind Mexico in the production of high yielding feed wheats, but we have the benefit of their experience and will be able to use some of their material in our own programme.

Many Canadian Research Stations see a bright future for this crop and one project leader stated that by 1980 about half of Canada's export would be of the non-bread type, food and feed or utility wheat. Only one-third of that is expected to be used by animals or fowl. The Cereal Crops Research Co-ordinator for Canada stated, "..... that we will use feed wheats domestically wherever it is economically feasible to do so."

NEW ZEALAND WHEAT BREEDING

In New Zealand there is an increasing demand for grain for use in intensive meat production. However, all wheat must first be offered to the Wheat Board and it is estimated that about 90% is offered. The Wheat Board must accept all wheat at milling price if it meets baking standards and passes tests for bug and sprout damage. Wheat that is not accepted as milling grade has no fixed price but *may* be bought by the Wheat Board at milling price. Most of the wheat not accepted as milling grade is not purchased by the Board and is available for sale on the feed grain market.

A project to develop high yielding feed wheats with yields superior to those of milling wheats is under action at the Crop Research Division, DSIR. In general, if yield is high, the wheat grain has a lower protein content, but the feed trade requires as high a level of protein as possible, in order to reduce the quantity of additives necessary to make a satisfactory meal. The wheat breeder now has two selection programmes to follow. By reselecting single plants from high yielding feed wheats, he can expect to improve the protein quality of the grain and make it more satisfactory to the poultry or the pig producer. Selection for baking quality is a separate programme.

In the 1950's, some high yielding wheat selections emerged, but were unacceptable according to the milling and baking standards adopted by the Wheat Research Committee. There was no interest in feed wheats at that time. In one line which gave rise to Aotea, the bulk selection was quite low in baking quality, but it yielded 20% above the yield of Cross 7, which in those days was the predominant variety. Reselection of single plants from the bulk produced Aotea which was 25% above Cross 7 in yield, and satisfactory in quality. Aotea within three years from its release was grown on 80% of the wheat area in New Zealand, showing how quickly the variety pattern of wheat growing can change.

New breeding programmes commence with the importation of seed of high-yielding cultivars and other lines of high quality or of improved disease resistance. Crosses are made between these wheats and with wheats already adapted to New Zealand conditions. The breeder is then able to make selections which may ultimately prove satisfactory for feed grain or milling wheat.

In the first three or four years progenies which show agronomic defects are rejected. Lines which survive these observation plots are sown in small scale replicated yield trials with a standard variety for comparison. The whole trial is harvested and the yields analysed. Samples from the standards and all lines not substantially below the standard in yield are sent to the Wheat Research Institute for quality evaluation.

A further small scale yield trial may or may not confirm the results from the first trial.

Up to this stage, there is no difference in the methods applied for milling and feed wheats. Only a few lines enter drilled trials under commercial conditions. High yielding poor quality wheats are further tested in drilled trials over three years to assess their yield as feed wheats.

To exploit wheats that are not closely related, Crop Research Division has selected one high yielding wheat from each of eight countries for crossing. Each cultivar has been crossed with the other seven giving a total of twenty eight crosses and these are now in the ground as part of a replicated F₁ trial where hybrid vigour is maximised. All overseas experience shows that F₁ performance is only a rough guide to later value, but the best crosses will be grown in growth chambers to rapidly increase the early generations to obtain yield information from field trials as soon as possible. The main objective in feed wheat breeding programmes is increased yield, but it is quite conceivable that one of the combinations may also have high quality. We have had the experience of crossing Cross 7 of good quality with Tainui with a slightly better quality to produce Hilgendorf 47 with excellent baking quality.

PERFORMANCE OF FEED VARIETIES

In Canterbury this year five or six hundred acres of the German variety Opal are being grown on land which is of good fertility. Opal is a high yielding wheat which is not very suitable for milling and baking but provided the grain reaches the minimum standard for milling wheats the Aotea price has been paid so far. Undergrade wheat becomes feed grain and is sold at a price determined by the demand.

The price paid for feed barley has ranged from 90c to \$1.20 per bushel whereas feed wheat may range from \$1.10 - \$1.50. These prices roughly equate in cents per pound.

At present there is no fixed price for undergrade wheat or feed wheat. There are only two wheats, Arawa and Kopara, which are sold at a discount. Arawa at a price of \$1.35 is in fact a feed wheat and equates with barley at \$1.10 per bushel on a cent/pound basis. At \$1.50 Kopara is a better proposition than Aotea at \$1.55. Hilgendorf at \$1.80 has a premium of 25 cents, and all other wheats, if they meet the quality standard are brought at the Aotea price. There are no cultivars which are yet officially designated as "feed wheats".

In the past Crop Research Division has not had a specific feed wheat breeding programme and potential varieties with high yielding capacity may have been lost during screening of the early generations for gluten characteristics (Zeleny test). Karamu, a spring wheat of Mexican origin was recently released commercially as a milling wheat. The baking quality of this variety has recently shown marked seasonal variation but it is still a valuable high yielding variety well suited for stock-feed. Crop evaluation trials in Canterbury during 1972/73 have shown a yield advantage for spring sown Karamu (mean 5267 kg/ha) over autumn-sown crops (mean 4508 kg/ha). Yield performances have indicated that Karamu is a higher yielding variety than Raven, Gamenya, Aotea and Kopara.

Most of the wheat in Canterbury is drilled in late autumn and early winter but in recent years there has been a trend towards spring sowing in some districts. The need for a high yielding spring sown wheat that will give cash returns as high as from either wheat drilled in late autumn or early winter, or spring sown barley is well recognised.

Karamu also significantly outyielded other spring wheat currently grown in the North Island. Trial by the Ministry of Agriculture and Fisheries in the North Island showed that the best spring wheats will almost equal barley in yield if sown in September. However, if seeding is delayed until mid-October, when barley is usually sown, barley would substantially outyield all wheats. Obviously for early spring sowing Karamu has many advantages, but for the later sowings barley is still best.

NUTRITIVE VALUE

There is no single grain or plant food derivative that could supply all essential requirements to ruminants, pigs or poultry. Both barley and wheat contain amino acids in different proportions. However, the amino acid balance of cereals is a more important consideration than breeding for specific amino acids or an increase in protein content for improved nutritional value.

At present stock feed suppliers base their mixes on cereals as the main source of energy, and they add various constituents to make a balanced feed; legume seeds, blood and bone, even fish meal. Besides being low in total protein, cereals are specifically deficient in the amino acids lysine and methionine which must be added. Costs vary with the source of supply. For example lysine from the dairy costs \$15.45 per kilogram, from grain \$4.70, from fish only \$3.80, but synthetic lysine costs only \$2.20.

Although still relatively new in this country, the practice of adding synthetic amino acids, particularly lysine and methionine, to low-protein animal feedstuffs has been widely adopted by feed processors. Each year up to 9000 kilograms of lysine are imported from Japan and the supply cannot keep up with the demand. Synthetic methionine is also imported for use in the feed trade. The other two major "limiting" amino acids – threonine and tryptophan – are being made synthetically and will be used in the near future.

The efficient stock feed processor uses linear programming to balance the varying costs and availability of the cereal grains, legume seeds, blood and bone, fish meal and the necessary amino acids to produce the most economical high energy and high protein stock feed.

As the prices of beef and mutton rise, the housewife becomes more interested in cheaper sources of animal protein. The intensive production of poultry (broiler chickens) has been most profitable in New Zealand in recent years. This is a complex business in which a company with large capital formulates the feeds, arranges specialised chicken breeding, rearing under contract and finally processes and markets the meat.

At present the majority of farmers who produce beef cattle raise them on open pasture, and supplement their feed when necessary with cereals and other additives. According to Greig (1972), the current outlook for beef feedlots in New Zealand is not encouraging and prospects are not likely to improve in the future because it is possible to fatten beef on pasture and cereal additives without the expense of buying dear feedstuffs and providing cover. The difference in returns from the pasture grazing and intensive care would not be economic. Thomas Borthwick and Sons (A'asia) Ltd., however, are establishing a feedlot for cattle close to their Feilding Works. About 100 to 150 cattle will be accommodated in each half-acre pen and there will be up to 200 pens and the cattle will be fed on grain and lucerne. The beef from Feilding will be exported, mainly to Japan. The advantage to the Company will be that the beef chains will operate throughout the year. If this operation is successful, it will stimulate other freezing companies into similar ventures.

Australian sheep farmers know that during a severe drought the sheep can be kept alive by a diet of whole wheat, but they do not fatten. An article in the "New Scientist" February 15, 1973, suggests that "tomorrow's broiler sheep stay fit on barley"; a diet of ground or crushed cereal may prove economic if precautions are taken to ensure that the cereal is not too finely ground, as it may cause bloat. It is possible that germinated wheat or barley (i.e. malted) will prove a valuable additive to the "feedstuff".

The production of pig meat has already changed. For many years New Zealand dairy farmers separated their milk and fed the skim to the pigs. Nowadays, this has changed because the advent of tanker collection and improvements in milk processing and product marketing have reduced the availability of dairy by-products. Instead of the dairy farmer keeping a few pigs as a sideline, the production of pigmeat has become specialised with grain as the main feed. Cereals, however, do not meet the optimum requirements of pigs for protein necessary for economic growth rate and feed efficiency, so additives have to be used. At present feed prices and rearing systems there appears to be little profit because of under production this year a large quantity of bacon sides has been imported. Many of our pigs and poultry depend almost entirely on cereals and supplements for their intensive care while they are being prepared for the table, and the contribution of cereals to the nutrition of the ruminant animals, particularly in winter, can only increase.

Lawrence (1972) stated that in England cereals may constitute between approximately 50 and 90% of the entire diet for animals. His experiments suggested that for pigs wheat has a digestible energy content slightly higher than sorghum and only marginally lower than maize and that the values for barley were 14% lower than the contents of maize, sorghum and wheat. Analytical data presented by Hove (1971)

indicated that barley grain is equal or superior to wheat. However, in feeding trials with monogastrics differences between feeding efficiency responses of barley and wheat were not great (5-10%) and not always significant statistically. In practical feeding experience barley and wheat gave nearly the same performance; however, wheat was always slightly ahead since the superior nutrient levels of barley were counter-balanced by low digestibility due to the presence of fibre.

Barley has a wide acceptance as a feed grain and straw residue has a reasonable feed value for ruminants. In contrast wheat straw has a low feeding value.

MARKETING

In a good season, a fair amount of "biscuit" wheat could be milled without reducing the baking quality of the flour to any marked extent, but in a poor season most of this would be undergrade, and there might not be sufficient quantity of wheat of milling standard to satisfy the baking trade. This has happened recently, when sprouted wheat from Southland was exported and Australian milling wheat was imported in the one season.

Therefore, along with the development of feed wheats, a system of marketing should be designed using definite contract acreages, providing specific markets (e.g. Taiwan) are available.

Feed wheats and milling wheat should be specifically designated. The price set for milling wheat should be based on milling and baking quality and it has been suggested (Smith & Marshall, 1973) that instead of the system of premiums and discounts applied by varieties only, there should be a new system of payment by quality and variety; then grain for milling could be grown in accordance with the baking quality needs and surplus lines could compete with other feed grains on the basis of their feed value. The use of irrigation with grain and the associated potential yield increase may compensate for the lower price associated with lower milling quality. However, other considerations are the variation in protein levels with irrigation and the economic rates of fertilizer application to feed grains.

A comparison of the quantities of wheat imported and exported (Table 1) from New Zealand over the past five years suggests that there would be considerable savings in expenditure if a reasonable quantity of storage for feed grains was provided. Although some studies on the relative costs of storing grain have been made recently in New Zealand, the basic data on quantities of grain stored and the differential prices for export and import do not appear to be in line with recent situation in New Zealand. Grain storage of about 264,000 tonnes would appear to be close to the present optimum requirement for adequate reserve carry over in relation to seasonal yield fluctuations.

TABLE 1: The production, export and import figures for wheat in New Zealand over the last four years

Year	Production tonnes	Export tonnes	Import tonnes
1969	2,214,828	317,272	—
1970	1,392,996	—	363,509
1971*	1,570,800	—	313,671
1972*	1,848,000	148,084	—

*Estimated

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