Paper 2

THE IMPORTANCE OF PEAS IN NEW ZEALAND ARABLE AGRICULTURE

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PRODUCTION

Peas (*Pisum sativum*) have been grown in New Zealand since the commencement of arable farming, (Claridge 1972, Jermyn 1983) and of the 30,000 hectares currently sown, 70% are threshed and 30% are vined (Table 1). They are third in importance as an annual cash crop in New Zealand, but occupy less than half the area of either wheat or barley. Canterbury is the most important district for both threshed and vined pea growing (Table 2), Hawkes Bay is also a major producer of vining peas.

Although average yields of threshed peas have increased at the rate of 1.6% per year since 1950, (Logan, 1983) the rate of increase in the last 10 years has been almost double this figure. In comparing the five year periods 1970-74 and 1980-84 the mean yield has risen from 2.5 to 3.2 t/ha, an increase of 2.9% annually.

Peas prefer a deep, well drained soil, and 220,000 hectares of such soils occur in Canterbury alone (White, 1968). The crop is also grown on soils of impeded drainage, e.g. Temuka, but there is always a risk of loss of yield through waterlogging (Scott, 1982; Greenwood and McNamara, 1985). On shallower, less water retentive soils. e.g. Chertsey, Lismore, high yielding crops can only be grown with irrigation, or by autumn sowing.

Table 1. Areas and yields of peas in N.Z.

	Threshed		Vined	
Year	Area ('000 ha)	Yield (t/ha)	Area ('000 ha)	Yield (t/ha)
1979/80	24	2.9	8	4.8
1980/81	17	3.2	7	3.7
1981/82	18	3.0	9	4.6
1982/83	23	3.4	11	n.a.
1983/84	22	3.5	10	n.a.
Mean	21	3.2	9	4.4
Wheat (1982/83)	71	4.2		
Barley (1982/83)	82	4.2		

Source: Agricultural Statistics 1979-1983.

VALUE TO THE FARMER

Farmers grow peas for two main reasons:

- for cash return;
- as a break crop for disease control and soil fertility improvement in cereal rotations.

Direct costs of growing peas are somewhat higher than for cereals, due largely to the cost of seed; gross margins compare favourably with barley, although they are currently less than wheat (Tables 3 and 4). High yields are an essential ingredient for high profitability, as production costs for high yield are little more than those incurred in producing an average to low yield.

The pea crop is also valuable for providing a break between cereals to assist in the control of diseases such as take-all (*Gaeumannomyces graminis* var. *triticus*) (Blair, 1952). This role is now assuming an even greater significance in Canterbury, where the recent decline in the growing of white clover seed has followed an earlier decline in the area of grazed pasture in cropping rotations.

Peas are commonly considered to increase soil nitrogen levels for subsequent crops, and the amount fixed has been estimated to be between 17 and 83 kg/ha (Askin *et al.,* 1985). These estimates are much lower than those reported for white clover based pastures (Sears *et al.,* 1965; Hoglund and Brock, 1978), white clover seed crops (Whelan and White, 1985) or lupins (Rhodes, 1980). In addition much of the nitrogen fixed by peas is removed in the seed,

Table 2. Main pea-growing districts (% of total area).

Region	Threshed peas* 1982/83	Vined peas + 1984/85
Canterbury	79	40
Hawkes Bay	2	32
Wellington	9	9
Marlborough	5	7
Other	5	12

Source: * Agricultural Statistics 1982/83
+ Pers com. R.A. Cawood, J.R. Wattie Canneries Limited.

Table 3. Gross margins for peas in Canterbury.

	Threshed peas				Vined peas			
Gross revenue/ha		$	$	$		$	$	$
3.5 t @ $300/t			1,050		5.5 t @ $200/t		1,100	
5.0 t @ $300/t (high yield)				1,500	7.5 t @ $200/t (high yield)			1,500
Direct costs								
Cultivation	6 hr @ $12.80	77			6 hr @ $12.50	77		
Seed	250 kg @ $600/t	150			300 kg @ 60c/kg	180		
Fertiliser	250 kg super @ $136.25/t	34			250 kg K MO super @ $166.90/t	42		
Weed control	Treflan 2.5 l/ha + application	32			Treflan 2.5 l/ha + application	32		
Irrigation		Nil			Electricity	45		
Harvesting	Contract	140				Nil		
Cartage	3.5 @ $14/t	49				Nil		
Total direct costs			482	503			376	376
Gross margin			568	997			724	1,124

Table 4. Gross margins for wheat and barley in Canterbury.

	Wheat	Barley
Yield (t/ha)	4.5	4.5
Price ($/t)	274	200
Gross return ($)	1230	900
Direct cost ($)	350	300
Gross margin ($)	880	600

particularly in threshed peas (Askin *et al.,* 1985). Less nitrogen is removed in seed when peas are vined, but if pea vines or pea straw are also removed the only nitrogen returned to the soil will be from roots and abscissed leaves. Little is recorded on the effects of peas on subsequent crop yields, but trials in Canterbury have shown that Tama ryegrass or wheat after peas (where all residue was removed) yielded 42% or 67% more respectively than after barley (Askin *et al.,* 1985). Yields after peas and after fallow were similar, which indicated that nitrogen levels were maintained by peas rather than increased.

Much basic work on nitrogen fixation by peas is occurring overseas (Brewin *et al.,* 1985) but little applied research is being conducted either in New Zealand or elsewhere. Many pea crops are grown after pasture or clover where soil mineral N levels are high and in these situations peas use mineral N rather than symbiotic N for their metabolism. Consequently, there is a real need to breed peas which have the ability to fix high levels of nitrogen in the presence of mineral nitrogen. Some attempts are being made with other legumes such as white clover (Hoglund, unpubl.) but no work has been conducted with peas. Cultivar differences in nitrogen fixation of peas are known to exist. Askin *et al.,* (1985) showed that fixation by maple peas was double that of most other cultivars they tested, with Rovar and Huka being intermediate.

EXPORTS

Peas are mainly grown as an export crop. About 70% of threshed peas and 33% of quick-frozen peas are exported, earning a total of $45.5 million in 1984 (Table 5). The most valuable produce was dried peas (marrow-fat, white, blue, partridge) going to a wide range of markets including Australia, Singapore, India, Britain and Japan. Most seed peas are garden cultivars sold to Australia. The volume of exports has not changed significantly in the last five years (Fig. 1) but the value of dried and frozen peas has risen by 96% and 141% respectively (Fig. 2).

Table 5. Exports of peas from NZ, 1984 ($m).

Product	Value ($m)
Dried	21.0
Frozen	15.0
Seed	5.4
Canned	2.1
Total	$43.5 m

THE FUTURE OF THE PEA INDUSTRY

The future of a viable New Zealand pea industry lies in improvements in three areas:

- crop yields;
- quality of product;
- packaging and marketing for export.

Yield

Peas, like most grain legumes, yield less than cereals (Table 1). In addition, yield is less stable than wheat, fluctuating considerably from year to year. However, the prospects for increasing and stabilising yield are very bright, although this can only be achieved by the combined

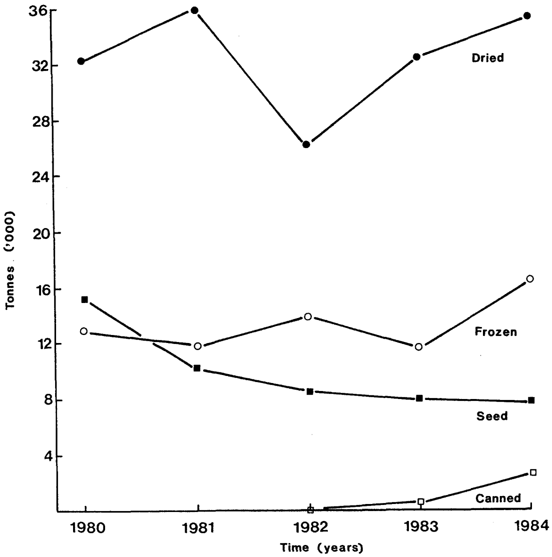

Figure 1. Volume of pea exports, 1980-84 (Source N.Z. Horticultural Statistics, 1985).

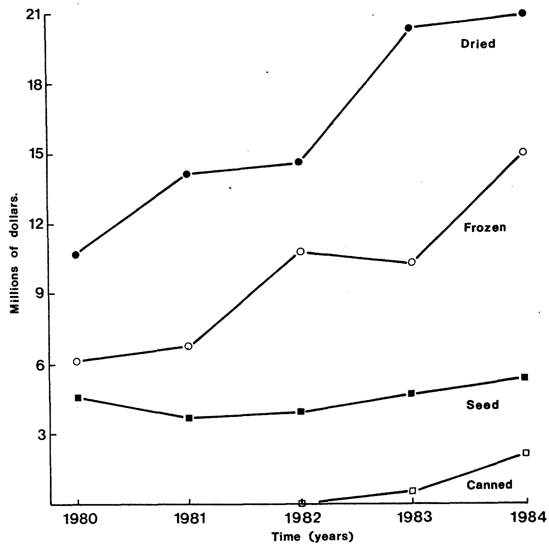

Figure 2. Value of pea exports, 1980-84 (Source N.Z. Horticultural Statistics, 1985).

efforts of farmers and scientists. The major possibilities are in autumn-winter sowing, plant structure, soil conditions, irrigation and reduced abortion.

Autumn-winter sowing

Most pea crops, including all vining peas, are spring sown and these crops are commonly affected by fluctuating water supply during growth. In districts such as Canterbury, water stress is a major limitation to yield. Some field pea cultivars have always been autumn sown on lighter soils in Canterbury, a technique which probably gives advantages similar to autumn sowing of wheat or barley, but little evaluation of this practice has been made in New Zealand. Sowing of vining peas in the autumn was advocated seventeen years ago (White, 1968) but has not been adopted commercially. Possible advantages of autumn or winter sowing are higher yields through reduced water stress, lower costs through reduced irrigation, and earlier harvesting resulting in more flexible cropping rotations including the possibility of double cropping. For example, with irrigation it may be possible to grow a barley or bean crop after vining peas are harvested. In addition, early harvesting of vining peas extends the processing season and thus makes more economic use of labour and machinery by the processing company. For this practice to be extended, research is required on such factors as optimum date of sowing, economic plant populations, disease problems, suitable soils and problems of late spring frosts. Soils with impeded drainage would be quite unsuitable, as water-logging is likely to occur during many winters. There is a need to select, and possibly breed cultivars which resist lodging (e.g. semileafless peas), are short vined and resist cold and frost. Some local cultivars are already being used (e.g. Whero) but increased cold tolerance may be obtained by crosses with Austrian winter peas.

The Plant Science Department at Lincoln College commenced trials in 1985 with three garden cultivars, Pania, Combi and Novella (semileafless) sown at four dates from 25 March to 30 May (White & Dickson unpubl.). The first two sowings died from disease attack (*Ascochyta, Pseudomonas*), the third sowing was frosted in early October when peas were in flat pod, and only the late-sown peas were vined, in mid-November. Pania was the most successful cultivar.

Plant structure

Long, weak-vined peas which lodge early, suffer from disease and cause harvesting difficulties, are a major problem in some cultivars. It is also likely that early lodging reduces photosynthetic efficiency and consequent yield. With the advent of new reduced intake viners, the ideal vining pea needs to remain erect until harvest and produce a large number of evenly maturing pods, all at the top of the vine. Plant breeders face a considerable challenge in meeting these requirements; future varieties will need to be shorter vined and stronger stemmed. Semileafless peas provide many of these attributes; they produce a much more erect crop though mutual tendril support, and are an important new release for pea growers.

Soil conditions

Peas are most sensitive to poor soil aeration and water logging than most other crops. As little as 12 hours of water logging will reduce yields while two days of waterlogging will cause death of roots and yellow foliage with little chance of recovery (Cannell *et al.,* 1979). The problem occurs mainly on soils with impeded drainage (Greenwood and McNamara, 1985) but poor soil structure, over-cultivation, or compaction by heavy machinery will increase the problem. Root death is associated with a rapid build-up of ethylene in the soil adjacent to the roots (Jackson, 1985). On poorly drained soils, heavy irrigation to above field capacity, or irrigation to field capacity immediately followed by rain (Scott, 1982) will commonly induce waterlogging. On these soils irrigation should cease well below field capacity to leave a buffer if rain follows immediately (Greenwood and McNamara, 1985). Subsoiling (e.g. paraploughing) may reduce the problem by increasing infiltration rates.

Irrigation

In Canterbury, most vining and many threshed pea crops are able to be irrigated but responses are variable, and the expected high yield increases are sometimes reduced or lost through late or excessive irrigation. Application of water at the commencement of flowering and again at pod swelling is the most common practice adopted by farmers, but this may not be the most efficient method of correcting water stress in peas. For example on shallow soils in years of severe drought or with late sowings, large responses to irrigation can be obtained by watering at the vegetative stage, well before flowering. The cost of installing irrigation and applying water is very high and farmers cannot afford anything less than a maximum response. The use of a water budgeting technique will give an accurate prediction of the level of soil water deficit, and consequently the exact time to irrigate and achieve the highest yield increase. For advisers, the use of an infra-red thermometer which measures variation in canopy temperatures due to water stress may have future possibilities for rapid, on the spot prediction of whether a pea crop needs irrigating (Scott and Gallagher, 1985).

In the long term the needs for irrigation may be reduced by using pea cultivars with a greater water use efficiency, or selecting peas with deeper roots to exploit greater water reserves.

Abortion

Much of the potential yield of peas is based on the number of pods which develop per plant, and the number of peas in each pod. Consequently, abortion of flowers or ovules during development represents a major loss of yield and is common in many pea crops. The reasons for these losses are not fully understood although water stress or shortage of photosynthates may be involved. The number of pods per plant and ovules per pod vary considerably between varieties and are thus heritable characters. The possibility of increasing yield by selecting for high heritability of these characters is being examined in the Plant Science Department at Lincoln College (Fautrier and Samad, unpubl.) and may result in major increases in potential yield in the longer term.

Quality

Peas are sold overseas for human consumption in a wide variety of forms ranging from green peas which are frozen, dehydrated or canned, to split peas, pea meal and dried peas for boiling. New Zealand grown peas already have a good reputation for quality due to our climate at harvest, and high technology in growing and processing. Such factors as size, colour, purity, chemical composition and flavour are all important for both green and dry peas.

Pea growing is expanding rapidly in EEC countries, where peas are replacing imported soybeans as a protein supplement for animal feeds. It is predicted that if this growth continues a million hectares will be planted annually by the early 1990s (Pipe, 1985; Gent, 1987). Surpluses are likely to compete with New Zealand grown peas in our traditional markets and we cannot expect to retain these markets unless our products are superior in quality thus giving an economic advantage to the consumer.

Packaging and marketing

Packaging and marketing of our green peas is already at a high level but sales of dried pea products, seed peas and peas for stock feed can certainly be improved by higher and uniform quality standards, improved packaging and well-planned marketing. Seed merchants are to be commended for the effort that they have made in export of peas in recent years. However, there is no national organisation representing the interests of pea growers other than the Vegetable and Produce Growers Association representing those farmers who grow vining peas. If such a pea growers organisation were formed it would provide a strong group to co-operate with seed merchants and Government bodies. Farmers, merchants and Government must work in unison to develop our packaging and marketing to a high level; the long term future of the pea industry depends on it. There is little purpose in increasing pea yields if the extra production cannot be sold overseas.

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