MANAGEMENT STRATEGIES FOR LESS RISK IN PEA CROPPING

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ABSTRACT

The objectives of this paper are to explain why peas are a risky crop and to detail for farmers and advisors the management decisions and their timing which will reduce the risks inherent in growing peas.

The pea plant is physiologically more sensitive than cereals to moisture, either in excess or deficit, and to short duration weather changes at crucial growth stages. It is less sensitive to applied mineral fertiliser than most other crops.

In addition, peas are susceptible to a wide range of fungal and virus diseases for which no control measures, other than cultivar resistance to some, are known. These factors, coupled with the lack of knowledge about the wide diversity in types of pea cultivars available, combine to induce high risk in pea cropping.

This paper will show what decisions must be made, and why they must be made prior to planting.

It is concluded that much of the risk in pea cropping can be reduced early, leaving a low cost, low maintainance crop with high potential return.

Additional Key Words: water stress, fertilisers, disease resistance, suitable cultivars, weed control.

INTRODUCTION

Farm advisors and seed merchants have noted an increasing reticence among cropping farmers to sow peas, especially garden peas, in recent season. This has been largely due to low contract prices coupled with unreliable yield on an individual farm basis in comparison with cereal crops. Additionally, farmers have become disillusioned with a crop that seems to need everything in its favour; soil type and fertility, weather, irrigation, weed control, and a lot of luck as well.

This paper examines the factors that affect pea crop performance and discusses the nature and timing of management decisions farmers need to make for maximum net return and minimum risk of production loss.

RELATIVE PERFORMANCE

Trends in New Zealand average yield of wheat, barley, oats and peas are shown in Table 1 along with the mean and standard deviation of annual yields for the seasons 1970-1980.

TABLE 1: New Zealand average crop yields for wheat, barley, oats and peas. (tonnes/ha.)

Year	Wheat	Barley	Oats	Peas
1950-51	2.91	2.31	2.29	1.94
1960-61	3.35	2.92	2.42	2.21
1970-71	3.34	3.19	2.70	2.30
1979-80	3.56	3.43	3.12	2.86
1970-80 incl.	3.47 ± .21	3.30 ± .37	3.05 + .25	2.63 ± .25
Increase 1950-1980	22%	48%	36%	47%

Since 1950, pea and barley yields have increased at approximately 1.6% per annum, more than oats (1.2%), and wheat at 0.73% p.a. Although remaining the lowest yielding of the four crops discussed, peas have kept pace with increased crop productivity over the past 30 years. Their relative price has generally more than compensated for this yield difference, except in high yield situations for cereals.

In the last decade, barley mean yields have seasonally fluctuated more widely than those for the other crops. On a national scale, peas are no more variable than wheat or oats. Yields are increasing steadily and seasonal means do not indicate excessive fluctuations, which could be taken as evidence of risk. However, with barley for example, a high yield cultivar under optimum conditions of fertility and irrigation can be set up for a high yield, and this goal can be achieved. With peas, farmers can do likewise but an event like a week of strong north west winds in Canterbury will depress yield substantially. Annual national yields could mask the on-farm situation, where there now exist wheat and barley (especially) cultivars capable of very high yields under irrigation or good conditions. In these high yield situations peas have been left behind on relative performance and in a dryland situation show yield unreliability.

Peas, and crop legumes in general, yield less than cereals worldwide. There is a simple biological explanation for this phenomenon. Legume seeds are higher in protein than cereals and thus gram for gram, more energy expensive to produce. Sinclair and de Wit, (1975), calculated that wheat would produce more seed per gram of photosynthate than peas in any environment.

Peas also have a high nitrogen demand during seed fill which is unable to be met by uptake. Translocation from vegetative tissue prevents continuation of photosynthesis processes, and thus the plant self-destructs in the course of supplying nitrogen to the seed. It is this critical shortage of nitrogen and consequent self-destruction at grain fill that continues to limit the yield and yield potential of grain legumes (Sinclair and de Wit, 1975).

REACTION TO ENVIRONMENT

Soil moisture levels have a major effect on crop yields. Farmers know that peas are susceptible to excess soil moisture and tend to avoid low-lying paddocks or poorly drained soils. Belford *et al* (1980) showed that even short periods of waterlogging were more harmful to peas that to winter wheat. In England, winter wheat waterlogged for six days in May yielded 0.2 t/ha less that well drained wheat, but peas waterlogged for five days yielded 0.9 t/ha less than those well drained. The effect of waterlogging was more harmful to yield the closer it occurred to flowering.

Extensive irrigation studies (Stoker and Drewitt, 1977) have shown that peas are more responsive to irrigation than most other crops except lupins (Muir, 1979). Particularly on low water holding capacity soils such as Lismores, the large response in comparison with cereals is more an indication of low dryland yields than high yields with irrigation.

MINERAL FERTILISER

Nitrogeous (N) fertilisers are extensively used in cropping to increase yield and yield determinants. Research into the composition, amount, timing, and likely outcome of applying N fertiliser to wheat for example, has been widely reported for New Zealand and elsewhere. Farmers accept that nitrogen is a useful management tool. Although trial yield responses to applied nitrogen have been variable, positive responses have generally been obtained where N was low. McCloy (pers.comm.) states that 25 kg/ha available N per tonne of wheat expected is useful 'rule of thumb' for estimating crop N requirements. Unlike cereals, peas do not respond to N fertilisers (Hawthorn and Pollard, 1958; McLeod, 1979; Stoker, 1979). While this means less input costs, it also removes a method of modifying the crop growth rate or reproductive potential once the crop is established.

Advisory publications recommend applying phosphate fertilisers to peas (Clarridge, 1972) but no yield increases from applied phosphate have been reported in New Zealand trials (McLeod, 1979; Stoker, 1979), where soil fertility levels are already medium to high.

Thus another managment tool with proven effectiveness on pasture and other crops is of no value to the pea grower, unless soil fertility levels are low, in which case peas should probably not be considered as an alternative crop anyway.

DISEASES

Peas are attacked by a considerable number of fungal and viral diseases. Because peas are a cool temperate crop, conditions favouring optimal crop growth also favour the development of fungal pathogens.

Root diseases affecting peas are caused by *Aphanomyces euteiches, Phoma medicaginis pinodella, Pythium* sp. *Fusarium solani pisi* and *Fusarium oxysporum pisi* races 1 and 2.

Cultivar resistance has been developed against the Fusarium wilt races 1 and 2, but there is as yet no cultivar resistance or chemical control available against any of the other diseases. At DSIR Lincoln, and elsewhere, cultivars tolerant to Fusarium root rot are being developed.

Control depends on pre-planting management in avoiding known infected soils (Aphanomyces) or keeping a minimum of five years between pea crops to avoid inoculum build up of the Fusarium and Phoma root rot pathogens.

Foliar diseases caused by *Mycosphaerella pinodes, Ascochyta pisi, Septoria pisi,* and the downy mildew fungus *Peronospora pisi* occasionally cause severe crop damage but outbreaks are limited to situations and seasons were cool temperatures and relatively high humidity occur together. There are presently no control measures for these diseases, although registration is being sought for a fungicide (Apron 70SD, Ciba-Geigy N.Z. Ltd) which has shown some control of downy mildew in the U.K.

Breeding programs to develop tolerance to the Mycosphaerella/Ascochyta complex and to downy mildew have been in progress in Europe, Australia, Canada and the United States for some years without success.

Peas are affected by a number of aphid-borne legume viruses. In New Zealand, two of these, Bean Yellow Mosaic Virus (BYMV) and Subterranean Clover Red Leaf Virus (SCRLV) were serious diseases until resistant garden and field pea cultivars were released. (Goulden and Crampton, 1976).

Evaluation of foreign cultivars in private and state research organisations begins (and often ends) with screening for reaction to BYMV and SCRLV. Cultivars susceptible to BYMV are less suited to the North Island pea growing ares whereas those susceptible to SCRLV do not yield well in Canterbury and Marlborough. Southland and South Otago are relatively free of virus problems.

With the appearance of the blue green lucerne aphid *Acyrthosiphon kondoi* and the pea aphid *A. pisum,* the virus spectrum has changed, with Alfalfa mosic virus (AMV) becoming more prevalent over the last three seasons (Ashby, 1980). There is no known resistance to AMV overseas and studies at Lincoln to date have confirmed this finding. Cultivars differ in tolerance to AMV and investigation into the genetic control of this tolerance are under way.

CULTIVARS

There are at least 20 garden pea cultivars grown in New Zealand for seed production and a similar number of field pea cultivars. Although the disease reaction of most of these is known, yield potential and agronomic requirements of many are not known or not widely publicised. There is no National List Trial structure as exists for some other crop species. To add complication, seed merchants frequently code common cultivars before contracting with farmers who then don't know exactly what they are growing.

There is a lack of base data necessary to allow farmers an informed decision about choice of cultivar and agronomic requirements of a chosen cultivar. What data is available should still be used in the cultivar selection process.

DECISIVE MANAGEMENT EARLY

With insufficient information on cultivars, and virtually no recourse to chemicals as management aids, what can a grower do to reduce risk in pea cropping?

All the following decisions must be made prior to planting.

Site selection

Select a free draining soil. If peas grown previously, get disease index (DI) from MAF Plant Health Diagnostic Station. If DI is 70-100, peas should no longer be planted in this paddock. If 50-69; pea cropping is risky; if < 50, paddock may be planted with safety.

Irrespective of index, peas should never be planted closer than 5 years in a rotation.

Cultivar selection

Find out as much as possible about the cultivars available within each type of pea e.g. garden, maple, blue, white, marrowfat, and select most appropriate for the locality. Refer to Aglinks FPP 350, AST 70 and AST 71. Make the cultivar selection based on yield potential, maturity date, straw length, disease susceptibility, climatic requirements, as well as contract prices offered or market possibilites.

TABLE 2: Sowing rates and plant populations.

Pea Type	Dryland	Irrigation
Branching varieties e.g. Whero, Partridge, Huka	70 pl/m^2	70-100 pl/m^2*
Non-branching varieties e.g. most garden peas, Rondo	100 pl/m^2	100-140 pl/m^2*

Expected Field Establishment	Target Population Plants/M^2	1000 Seed Weight Multiplication Factor
80%	70	0.87
	100	1.25
90%	70	1.77
	100	1.11

* The higher end of the range may not necessarily produce a higher yield, but can be supported under irrigation.

Seed selection

Seed should be of high purity and germination, vigour (if garden pea), and known 1000-seed-weight. The Vigour Test is available from MAF Seed Testing Station and grades seed as follows:

A. high vigour — plant in most conditions
B. intermediate
C. low vigour — plant in ideal conditions only

Plan to establish 70-100 plants/m^2 (higher for non-branching and garden varieties) or higher if irrigation is available and calculate seeding rate from 1000 seed weight. See Table 2.

Drilling

Drill slowly, 4-7cm deep and ensure that large-seeded cultivars are not being cracked or crushed in drills. Peas should be rolled after drilling to bury stones and provide an even seed-bed for herbicide application and harvesting. Rolling after emergence can spread disease, especially Bacterial blight *Psuedomonas pisi.*

Fertilisers

Get soil tested, and apply lime, phosphate, potash if indicated by pH less than 6.0 and low phosphate levels. Don't overdo fertilisers. As peas like high fertility but don't readily respond to recently applied fertilisers, any fertility correction necessary should be carried out well before planting.

Weed control

Essential. Wide range of effective herbicides available. Refer Aglink FPP 407. Peas are poor competitors with weeds, and high yield responses are obtainable with control.

Disease control

Minimize disease loss by rotation and resistant cultivars.

Irrigation

Plan to irrigate at flowering and pod-fill. Farmers should find out the water holding capacity of their soil types and irrigate to restore deficits. There is a risk of yield depression with overwatering.

Harvesting

Peas should be headed at 14-16% moisture. Unlike cereals, peas may be subject to loss from shattering or quality loss from bleaching if harvesting is delayed.

CONCLUSIONS

Past and recent production figures indicate that peas can give a reasonable, reliable yield under good conditions which means potentially high net returns at present prices. Lack of response to chemicals and minerals means low input costs. Sound pre-plant management coupled with effective use of herbicides and irrigation will minimise the uncontrolled seasonal and disease risk factors.

REFERENCES

Ashby, J.W. 1980. Virus diseases of annual legume crops. *Proceedings Agronomy Society of N.Z. 10:* 77-80.

Belford, R.K., Cannell, R.G., Thomson, R.J., Dennis, C.W. 1980. Effects of waterlogging at different stages of development on the growth and yield of peas (Pisum sativum L.) *Journal of the Science of Food and Agriculture 31:* 857-869.

Claridge, J.H. 1972. "Arable Farm Crops of New Zealand". DSIR and A.H. and A.W. Reed, Wellington.

Goulden, D.S., Crampton, M.J. 1976. Breeding of vining peas for New Zealand. *Proceedings Agronomy Society of N.Z. 6:* 15-17.

Hawthorn, L.R., Pollard, L.H. 1958. Effects of soil fertility and rate of seeding on the yield, viability, and quality of seed peas. Bulletin 458. Agricultural Experimental Station, Utah State University, Logan, Utah.

McLeod, C.C. 1979. Pea rates of seeding fertiliser trial results 1970-78. Proceedings Pea Agronomy Workshop. Lincoln College Press: 8-9.

Muir, B.L. 1979. Legumes under irrigation on Canterbury soils. Aglink FPP 105. MAF Information Services.

Sinclair, T.R., deWit, C.T. 1975. Photosynthate and nitrogen requirements for seed production by various crops. *Science 189:* 565-567.

Stoker, R., Drewitt, E.G. 1977. Cropping on light land with peas. *N.Z. Journal of Agriculture 138 (12):* 34-37.

Stoker, R. 1979. Irrigation and fertiliser trials with peas. Proceedings Pea Agronomy Workshop. Lincoln College Press. 10-12.