Observations on Agronomic Challenges during Conversion to Organic Field Vegetable Production

P.D. SUMPTION, C. FIRTH and G. DAVIES
IOR-HDRA, Ryton Organic Gardens, Coventry, CV8 3LG, UK

ABSTRACT
Prior to conversion, growers perceived agronomic challenges such as controlling weeds, pests and diseases as their biggest concerns. Through monitoring of commercial farms since 1997, the DEFRA-funded 'Conversion to Organic Field Vegetable Production' project aimed to provide information to growers on the economic and agronomic performance of farms during conversion. Many of those technical challenges of production have been successfully overcome. While there have been some problems with nitrogen availability, especially where insufficient attention has been paid to fertility building and also on lighter land, there have been few major changes in soil nutrient levels. Investment in new weeding equipment and new techniques has enabled growers to reduce costs of controlling weeds. Perennial weeds do not appear to be increasing though there have been localized problems. Seasonal effects, such as wet weather, have had a strong influence on levels of weeds, pests and diseases, and the cost of their control. All growers have had to adapt to new techniques and new crops, but those with vegetable growing experience and those growing crops they had grown before have adapted quickest to the technical challenges of production. While there are still agronomic challenges to overcome, the concerns of growers have shifted towards the marketing issues.

INTRODUCTION

Since the mid-1990s many new producers have converted to organic field vegetable production in response to the rapid increase in the market and the introduction of conversion grants from the government (Firth *et al.*, 2003). The aim of this paper is to make some preliminary observations on the agronomic challenges these farms faced during the conversion process and to make some initial judgements as to whether these have been overcome.

HDRA has been leading the DEFRA-funded 'Conversion to Organic Field Vegetable Production' project which has monitored ten farms converting from conventional production to an organic system which includes organic field vegetables, since 1997. The farms range in size from 20 to 1900 ha with target conversions of between 4 and 700 ha, and are on varied soil types and geographical locations. They have converted from predominantly arable, livestock and intensive vegetable systems. In 2002 each farm grew between 2 and 115 ha of organic vegetables. The principal concerns of many growers at the start of conversion were weed control, pest and disease pressure and plant nutrition.

METHODS

HDRA staff and OAS advisers have visited the farms on average six times per year during and after conversion. Information has been gathered through a combination of farmers' records, interviews with farmers and detailed field assessments. Weeds, pest and disease incidence have been monitored through regular crop walks. Quadrat samples were

used to assess individual weed occurrence and percentage total weed cover. Presence and levels of damage due to pests and diseases were recorded at the same time. Records of farm operations are taken for farm strategies on weed management and pest and disease control. Soil samples were taken in the spring of each year to monitor soil nutrient status, pH, soil organic matter and trace elements. Yields from crops were assessed from farm records. All this information has been used to build up case studies of each farm system.

OBSERVATIONS

Good soil management and a healthy soil are at the heart of successful organic production. Building fertility through the use of leguminous crops is a central component of organic farming systems. In the rush to convert with new government conversion grants and a seemingly booming organic market some of the growers neglected, initially, to pay sufficient attention to the fertility-building period. Mistakes or inappropriate practices such as failing to use legumes can lead to conversion-specific yield reductions (Lampkin *et al.*, 2002). Four of the farms had completely stockless systems in which the success of the ley phase is crucial. Establishment and management of leys was a new technique to the farmers converting from conventional arable or horticultural production. Poor establishment, allowing leys to grow too tall (the mulch preventing regrowth and permitting weeds and crop to seed), the removal of silage, and therefore of plant nutrients, off the farm, and poor incorporation of the leys have been issues on some of the farms. Two farms had nitrogen-stressed crops in the latter stages of the rotation due to shortage of time in, and quality of, fertility building. Generally in those phased conversions, later blocks of land have been given more extended fertility-building, of up to two years, after following advice. Farmers appear increasingly to be recognizing the importance of fertility building and the use of cover crops.

Problems relating to plant nutrition have been mainly on the light sandy soils (two farms) both of which had problems of nitrogen availability for crops towards the end of the first season of organic cropping (even after a full two-year fertility building). On one of these farms composting of the manure has helped, while the other received derogations for a restricted input of pelleted poultry manure.

Monitoring of soil nutrient changes has shown that there has been very little change in soil organic matter levels or major nutrient levels. Soil phosphorus (P) is an issue on six of the farms with low or marginally low levels (according to the Elm Farm Research Centre (EFRC) interpretation) and though there are some declines in readily available P, there is very little evidence of any long-term decline of potentially available reserves. Monitoring of the stockless system (with no inputs) at HRI Kirton has shown an initial decline in soil available P with levels stabilising and later increasing. There were also declines in soil potassium (K), which may be levelling out.

Soil compaction, while also a problem in conventional production and not due to conversion itself, has been a problem. In the first two years of organic cropping, problems due to soil compaction were observed on several farms, following two very wet autumns when crops had been harvested in wet conditions. In 2002 it was not observed as a problem. However, the percentage of fields recording high levels of manganese, which may indicate compaction, according to the EFRC soil analysis interpretation, rose from 24% in 1999 to 54% in 2003. Soil analysis also indicated that the biological activity of the soil was out of balance, with associated problems of micro-nutrient availability for between 61% and 74% of fields sampled between 1999 and 2003.

Weeds were perceived by growers as being their biggest technical challenge prior to conversion. Weeds have generally been managed effectively, with a few exceptions. The challenge has been to keep costs down by reducing the hand labour necessary. Adoptions of new technologies such as the finger-weeder have made a significant impact, with many crops such as brassicas being managed exclusively with mechanical weeding. Although weed control equipment is the biggest proportion of conversion-related investment, ranging from 3% to 69% on six of the farms (average 37%), these investments have led to savings being made. Farmers have had to adapt to new techniques and new equipment. Instances of problems included: 1) wet seasons when weeding windows were missed, or weeds have grown fast and/or re-grown after mechanical weeding operations; 2) on farms with large weed-seed banks, on fertile black fen soils and where there have been high weed seed returns in the past; 3) coping with expansion - under-estimation of management time needed in organic systems and being under-staffed during rapid expansion of organic cropping.; 4) poor management of grass leys with seed returns and poor incorporation of leys; and 5) early crops, especially those under fleece have been difficult to manage.

Weeding costs can be significantly reduced in an efficient organic vegetable system but timing is critical and adverse weather conditions can have a huge impact on costs. On one farm the average weeding costs were £1625/ha in 2000, which was a wet season, and £949/ha in 2002, which was drier, though experience and new equipment would also have contributed to these lower costs.

Perennial weeds are a big concern for growers. On two farms converting from arable systems couch has been a problem with bastard fallowing necessary to reduce weed levels and also a change in the rotation. This has had a cost. Creeping thistle has only been a problem on two farms and does not appear to be increasing. Docks have only been a problem on one farm converting from a pasture-based system and also do not appear to be increasing.

A wide diversity of pests and diseases has been observed on the reference farms, with some of the most significant losses being due to vertebrate pests such as rabbits, pigeons and geese. Of all pest and disease damage considered severe 21% was due to these large vertebrate pests. Losses due to disease have also been significant, accounting for 42% of severe damage. In some cases this has had an impact on the rotation, e.g. not being able to grow onions after *Sclerotium cepivorum* (white rot). Brassicas were the most problematic crops to grow having a wide range of pest and disease problems, but also accounting for 42% of the severe rated problems. It is not surprising therefore that the greatest efforts taken to combat pest and diseases have been in brassicas, with a higher cost for these crops than others. The strategies on the farms have polarised, with farms either having intensive spraying regimes with high use of potassium soap, *Bacillus thurungiensis* (Bt), sulphur and copper, or no control measures at all. The farms with the most use of sprays tend to be the larger farms with bigger field sizes supplying into the packers and supermarkets. These are also the farms with the biggest risks (if crop is rejected there may be no alternative market). As specifications for organic produce have got tighter (Firth *et al.*, 2003), appearing to approach zero tolerance of pest or disease damage or presence, so have the number of sprays used increased on these farms. There also appears to be a correlation between plot size and severity of pest or disease attack, with more on larger plots (Davies *et al.*, 2002). There is considerable seasonal variation with wet summers such as 2000 bringing problems of slugs, *Phytopthora infestans* (Potato late

blight) and *Septoria apiicola* (Celery leaf blight). Drier summers such as in 2002 have seen fewer problems.

DISCUSSION

Seasonal weather effects play a huge role in the extent that weeds, pests and diseases are problems. Wet summers can be particularly problematic and costly and dry seasons, though not without challenges can provide a grower with more management options and opportunities. This seasonal variation makes it difficult to evaluate any long-term trends. Although growers appear to be mastering many of the technical challenges of crop production, it remains to be seen in the long term whether issues such as perennial weeds, soil structure and compaction and retention of nutrients will become more important. These will continue to be monitored on five of the farms in the new HDRA-led Sustainable Organic Vegetable Network Project, funded by DEFRA, together with five new farms. The market plays a crucial role and a drive for growers to specialise in certain crops and to meet very high specifications could force growers into standardised and intensive management practices that sacrifice diversity. Growers on a smaller scale supplying direct markets and those with a diversity of marketing are better placed to withstand these pressures. Many factors beyond the growers' control, such as soil type, past land use (weed seed burden and soil-borne disease) and intensity of production in the surrounding area will all have influence on the success of conversion.

CONCLUSIONS

Conversion is often described as a steep learning curve. There are many new techniques to master. Arable growers are not used to growing fertility-building crops, and the demands of rotation mean that many growers have a more complex cropping plan post-conversion with new crops that they have not grown before. Some growers had little or no experience of growing vegetables. Not surprisingly, those with experience of field vegetables and those that grew crops that they had previously grown conventionally, had most success.

Growers have tackled many of the technical challenges of conversion as they have adapted to or learnt new skills. Weed control has generally been managed effectively through conversion, though with some problems as they have expanded their cropping areas and learnt new techniques. Many of the problems of pests and diseases can and have been controlled effectively, though often with direct rather than cultural methods. The market will continue to pressure growers to reduce costs and tight specifications will also mean that the risks for large-scale growers tied into one market will be high.

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