

## USE OF DIVERSE ROTATIONS



Alemam B (2014). Quantifying and simulating movement of the predator carabid beetle *Pterostichus melanarius* in arable land. PhD thesis. Wageningen University

Photo: B Alemam

### PROBLEM

Monocultures and pest, disease and weed issues

### SOLUTION

Increasing diversity in the rotation, including cultivation date and method helps break weed and pest cycles. Variation in rooting depth can also reduce crop competition for nutrients and water, as well as bring up nutrients from deeper in the soil profile.

### OUTCOME

Variation in crops grown breaks weed and pest cycles, reducing the risk of persistent problems and potentially reducing the need for expensive remedial inputs.

Potential savings can be found through reduced fertiliser use by using legumes, and cover-crops such as buckwheat. Use of deep-rooting species within grass leys can help during droughts and improve water infiltration, and therefore reduced poaching, during wet seasons.

### APPLICABILITY

#### Applicable production types



#### Application time

All year

#### Equipment/resource required

Normal farm machinery

#### Best in

All arable and grass cropping systems

## PRACTICAL RECOMMENDATIONS

### IMPLEMENTATION

- A traditional arable rotation was always based around take-all reduction and so tended to involve different crops but similar drilling periods (mainly autumn), but this has led to persistent weed issues, particularly blackgrass.
- Advice regarding blackgrass control is now to use spring crops within the rotation, extending this to include different crops such as linseed and maize.
- Different drilling dates can also allow to use stale seedbeds to reduce weed seed levels in the soil.
- The longer period between harvest and drilling can also be used to grow short term cover crops to incorporate as green manures or to feed livestock such as stubble turnips for sheep, adding fertility, income and soil organic matter.
- Diversity can also extend to cultivations, with the plough, min-till and direct drilling techniques all providing different effects on weeds. Variation of tillage depth to suit crop being planted can also lead to soil structural improvements, and reduced weed burden on shallow rooting crops.
- Legumes in rotation can add nitrogen, beans reducing nitrogen requirement by 30 kg/ha in following conventional crops, and providing a fertility source in organic crops.
- Broadleaved crops can compete with weeds because they are more shading, grass weeds preferring more upright crops with similar growth structures.
- Deep rooting crops can provide useful competition with deep rooting weeds in addition to reducing mineral leaching by harvesting the minerals from deep.



- Intercropping techniques could increase benefits by combining deep rooting with shallow rooting crops, adding to competition with weeds, and mining nutrients from deeper in the soil profile.
- longer rotations will reduce risk of soil borne diseases becoming a problem.
- A simple rule of thumb from organic systems is-Shallow-rooted crops follow deep-rooted crops
- High root-mass crops follow low root-mass crops
- Weed-susceptible crops follow weed-suppressing crops
- Nitrogen-demanding crops follow nitrogen-fixing crops.
- A mixture of rooting depths reduces plant competition for nutrients in each layer of the soil.
- Cover crops and green manures also add to the diversity of the rotations by providing short-term variety, nutrient harvesting and ground cover which all help weed and pest control.
- Livestock can also be considered as part of the more diverse rotation.
- The diversity could be extended to companion cropping, meaning that more than one crop is grown at the same time, sometimes to harvest such as peas and barley which can be separated at harvest, or mustard sown with oilseed rape to reduce flea beetle problems which is then controlled chemically after the risk period is over, leaving the rape to be harvested.
- Some retailers are driving the production of home-grown protein sources (i.e. as replacement for imported soya) which could increase uptake

## EASE OF ADOPTION ON NON-ORGANIC FARMS

Rotation is already a part of most farming systems but those in conventional systems have become very short. Widening the rotation to include spring and root crops as well as grass/clover breaks could improve soil health as well as pest and disease management. Some farmers already have longer rotations, and so this is not limited to organic systems.

## BENEFITS OF IMPLEMENTATION

- The effect of improving diversity in cropping system extends to soil health improvements, improved pest and dis-ease management and ease of cultivations. A diverse rotation also improves farm resilience by reducing the dependence on a small range of crops and allowing a more entrepreneurial attitude.
- Some non-commodity markets are looking for suppliers of specialist crops
- Whole farm profitability is more important than individual crop gross margins, and the reduction in costs which can accrue in later crops in the rotation can benefit the farm, even if one part is less profitable.

## DRAWBACKS OF IMPLEMENTATION

- The addition of extra crops into the rotation could lead to increased workloads and lengthen harvest, which is particularly significant if contractors are used.
- There is the danger that new crops add new weed and pest problems, particularly if similar to what is grown in the existing rotations.

## BARRIERS AND RISKS

- Additional crops could lead to a more complicated harvest, particularly concerning in wetter regions.
- Marketing opportunities for less common crops are often seen as a difficulty
- Increased infrastructure costs for storage of grain

## FINANCIAL ANALYSIS

The financial effect of increased diversity in rotation is likely to be minimal (less than 10% margin increase), with a slight decrease in spray use and slight increase in yields.

Initial investment	Ongoing costs	Yields	Effect on productivity	Expected effect on margin
~	↓	↑	~	~

Rating approach used to describe the effect and direction of change (increase or decrease): Unknown = ? None = ~ Low = ∨ Moderate = ∨∨ High = ∨∨∨



The assumptions made for the financial implications were:

- Spray use can be decreased by approximately 5% across the rotation, because of better control of weed, pests and diseases
- There is potential for increase in yields by approximately 5% across the rotation

## FURTHER INFORMATION

### Further reading and weblinks

- AHDB (2010) Guide to managing weeds in Arable rotations: <https://www.gwct.org.uk/farming/advice/sustainable-farming/crop-rotation/>
- Soil Association (2015) Organic Arable Production factsheet: <https://www.agricology.co.uk/resources/organic-arable-production-rotations>

## CASE STUDY FARMER APPLYING THE PRACTICE: UPINCOTT FARM

**Location:** Devon

**Size:** 260 hectares of which 140 ha is arable

**Enterprises:** Cereals, cattle and sheep

James Lee said:

“We have no defined rotation, it is very much dependant on field characteristics but also influenced by market opportunities. The broad rotation is winter wheat, winter barley, oil seed rape, winter wheat, maize or spring oats. But linseed and grass leys are also used where they fit because the farm ranges from steep Devon hills to flood prone river valleys. Maize is never grown on the steep land but linseeds deep rooting structure makes it a useful option on this more drought prone land. Building soil organic matter is a key part of our system so ploughing is kept to a minimum and a Claydon drill has been used for the last 12 years. We are trialling maize with the Claydon but the technology is not quite right yet.

“One of the reasons for the diverse rotation is to access different herbicides so that sterile brome, a local problem and associated with non inversion systems, does not build up. It will also hopefully prevent blackgrass which is starting to appear in the southwest. Rotating between spring and winter crops also helps prevent this build up, particularly when cover crops are grown over winter, these are used for sheep feed or just as soil improvers, with legumes and linseed commonly added to the mixtures as they both drive soil health and fertility. Linseed, when grown as a cash crop or cover crop, often leads to the highest crop yields because of the massive root growth improving soil and bringing nutrients to the surface.

“Our farming system is based on the view that we need to understand how something fits into the whole system, and work the whole farm as a system and not be constrained by a rigid cropping policy which forces crops into inappropriate places in the farm.”



## ABOUT THIS PRACTICE ABSTRACT

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