Green manures in conventional and organic farming systems

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HDRA
Garden Organic
Why grow fertility building crops?

- To add nitrogen to the system by fixation
- To prevent leaching
- To modify the availability of nitrogen and other nutrients
- To build soil organic matter and encourage microbial activity
- To prevent erosion
- To help with pest, disease and weed control
Why not use them?

- Could use the land to grow cash crops instead
- Time and money spent in looking after them
- Often too late to sow them by the time cash crop has been harvested
- Not thought of as a priority
- Cost of seed
A choice of fertility building crop types (many species and mixtures available in each category):

• Long or short term leys
• Winter green manures
• Summer green manures
• Intercropping/undersowing
NITROGEN FIXERS
(legumes)
Quick fix – especially suitable in a vegetable rotation

- Red clover
- Crimson clover
- Vetch
- Fenugreek
- Persian clover
Red clover (*Trifolium pratense*)

- Most commonly used green manure
- Rapid establishment
- Reliable in most circumstances
- Only good for 1-2 years
- Disease prone (nematodes and sclerotinia) so need a 5 year break (probably not carried out in practice)
Crimson clover (*Trifolium incarnatum*)

- Very short term – 1 year annual
- Rapid growth and establishment
- Spectacular display of flowers but less biomass than red clover
- Larger seed so good for sowing later in autumn
- Less susceptible to disease than red clover
Persian clover (*Trifolium resupinatum*)

- Short term or medium term
- Very rapid growth and good competition against weeds
- Establishment not always reliable
Vetch (*Vicia sativa*)

- Good rapid growth
- 1 year (includes overwintering)
- High N fixation
- Can be sown later in the season than clovers so good for fitting in after harvesting vegetable crops
- Doesn’t like being cut
- Some growers have had problems with establishment (pigeons and weevils)
Fenugreek

*(Trigonella foenum-graecum)*

- Rapid growth and competitive
- Not frost hardy so 1 year annual
- Needs inoculating
- Can graze but will taint milk
- Seed currently expensive as not produced on wide scale
Medium term N fixing crop

eg Sweet clover (*Melilotus officinalis*)

- Capable of rapid growth and biomass production once it gets going
- In practice establishment not always reliable
- Does not tolerate topping as well as clovers so not so good on soils with high weed pressure
- Needs inoculating
- Cannot be used for silage
Longer term N fixing crop (maybe more suitable for mixed farming)

- White clover (usually with grass)
- Lucerne (alfalfa)
White clover (*Trifolium repens*)

- Slower to get going than red clover and usually not so vigorous
- More persistent than other clovers – can be used in longer term ley but some growers have found it can come back as a weed in subsequent crops
- Commonly used for grazing
Lucerne (*Medicago sativa*)

- Can be slow to get going in first year but more prolific in following years
- Can be grazed
- Good on light soils and low rainfall – definitely does not do well where there is soil compaction or poor drainage
- Needs inoculating
Undersowing

Traditionally used to establish clovers in a cereal crop but has also been tried with intercropping vegetables
Yellow trefoil (*Medicago lupulina*)

- Good rapid establishment
- Low growing
- Forms thick mat on the ground
Subterranean clover

*(Trifolium subterraneum)*

- Very low growing
- Small leaves – establishment quite slow
- Unusual growth habit – flowers under the soil
Non legume green manures with other useful functions

Grazing rye (*Secale cereale*)

- Very effective N lifter (up to 90% reduction in leaching)
- Establishes rapidly
- Can still be sown in late autumn
- Can become a weed in next crop if not incorporated properly
Mustard (and other brassicas)

• Good overwinter N lifter
• Very commonly grown
• Rapid establishment (although pigeons can be a problem)
• Seed is cheap
• Will be killed off by hard frost
• Some varieties (Caliente type) may have activities against nematodes or soil borne diseases
• Brassica so is not useful to include in vegetable rotations
Chicory

• Produces large tap root that can break through plough pan

• Often included in grazing mixtures as good source of micronutrients for animals
Mix it all up!

• Red clover / ryegrass
• Oats / peas / vetch
• Rye / vetch
• Crimson clover / Sweet clover / trefoil / cocksfoot grass
How can these crops best be fitted into a rotation?
Nutrient budgeting

• Often recommended as a way of assessing a rotation
• Careful interpretation of the findings is needed
• Timing of nutrient availability more important than overall amounts
Nitrogen from fertility building crops (and other legumes)

• Not all their nitrogen is newly fixed
• Actually measuring fixation is difficult, expensive and only gives site specific information
• Various published tables show a huge range of nitrogen additions
• Account must be taken of the actual performance of crops concerned
Nitrogen added to soil by various crops grown at Hunts Mill
Soil mineral nitrogen (ie nitrogen available to plants)

- Usually the most important plant nutrient but the hardest to predict
- Greatly affected in the short and long term by the choice of fertility building strategy
- We have many times assessed the patterns of mineralisation by regular soil sampling (although this is not practical commercially)
Growing a longer ley had much more effect than a FYM application
The use of computer models

• Modelling can be a way of predicting what will happen in the field
• We have been working on a project (EU-ROTATE_N) to develop a new model
• This could help farmers to assess various potential rotations
• Crop yields and overall gross margins are calculated as well as leaching losses
Predictions of soil mineral nitrogen

Red dots: measured values
Blue lines: simulations
The EU-ROTATE_N model is now publicly available

- It is very versatile but more work is needed to make it user friendly
- The FBC model was developed by Steve Cuttle (IBERS)
- The NDICEA model was developed at the Lois Bolk Institute
Soil organic matter and structure

• It is easy to focus on soil N because it is straightforward to measure
• Many of the benefits of using green manure may be more subtle and difficult to assess but more important (especially in conventional situations)
• Not all soil organic matter is the same!
Conclusions

• Green manures are a vital part of an organic crop rotation and can bring many benefits to a conventional system

• They must be used carefully in order to maximise the benefits – the right crops should be chosen

• It is important to give them adequate attention
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