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Sustainable nutrient supply of organic farming challenged by specialisation

Sissel Hansen[1], Marina A. Bleken[2], Anne K. Løes[1], Espen Govasmark[1], Anne F. Øgaard[3] and Tor Arvid Breland[2]

[1)]Bioforsk Organic Food and Farming Division, N-6630 Tingvoll, [2)]Norwegian University of Life Sciences, Dep.of Plant & Environmental Sciences, N-1432 Ås, [3)]Bioforsk Soil and Environment Division, Fredrik A. Dahls vei 20, N-1432 Ås

Introduction

Sustainable development meets the needs for the present without compromising the ability of future generations to meet their own needs. For organic farming systems, sustainable development is a self-evident aim based on the four basic principles of health, ecology, fairness and care (http://www.ifoam.org/). The organic farming movement will lose its credibility if it compromises on this ambition.

Diverse production on each farm, with livestock density well balanced with crop production, has been the traditional way to maintain the soil fertility in organic farming systems. However, there is a trend of specialisation into stockless arable or livestock farms. Stockless farming is challenged by depletion of soil mineral reserves and soil organic matter, risk of large nutrient losses after green manuring, and dependence on nutrient supply from external sources. In this paper, we focus on these challenges to sustained soil fertility.

Soil mineral reserves and organic matter content

Even on organic dairy farms, decrease in the soil content of phosphorous (P) (Løes and Øgaard, 2001) and potassium (K) (Løes and Øgaard, 2003) has been observed. On stockless farms without purchase of fertilisers, the balances for nutrients other than nitrogen (N) will be negative, and there is a large risk of soil nutrient depletion (Bakken et al., 2006). However, due to past excess fertilisation, some nutrients, particularly P, have accumulated to levels above those necessary for balanced plant growth. Consequently, utilising excess soil nutrients appears more sustainable than depleting remote resources, and some decrease in the P availability is even desirable for environmental reasons. Depending on the soil mineralogy, nutrients are also released by chemical weathering. The exploitation of such nutrients must be regarded as sustainable and included in the nutrient balance, which in the long run has to be close to neutral to maintain adequate soil nutrient status and thus ecological sustainability.

Depletion of soil organic matter is also a challenge. Many long-term trials have shown that the presence of perennial leys in the crop rotation sustains the soil organic matter content and soil structure (e.g. Riley et al., 2006; Bakken et al., 2006). Where legume seed can be grown, stockless arable farms can include perennial leys in the rotation. Growing roughage for sale implies a large export of nutrients and is therefore not a viable option for stockless organic farms unless a corresponding amount of nutrients can be returned, e.g., as animal manure from nearby organic farms.

Loss of nutrients to the environment

Large amounts of N may accumulate in green manure crops, and on light soils there is a significant risk of losing this N (Askegaard et al.; 2005, Frøseth et al., unpublished). Sturite et al. (in press) estimated that even for unharvested white clover plants, N input to the soil–plant system from plant biomass turnover was substantial. Autumn ploughing and repeated soil tillage may be required to control perennial weeds, but leaves the soil prone to leaching and erosion. Catch crops protect the soil, but during winter, catch crop and green manure biomass may also be vulnerable to nutrient losses, especially during events of freezing–thawing cycles. Sturite et al. (2007) found variable and large winter losses from aboveground biomass, but on average only 43% and 34% of lost N and P, respectively, were recovered in the seepage water. They hypothesised that immobilisation by a cold-adapted microflora might be the reason. If correct, this means that winter losses of nutrients would be substantially less severe than suggested by the loss of green manure biomass.

Challenges for sustainability caused by external supply of nutrients

In soils with low to medium nutrient content, nutrient inputs are required in stockless systems to avoid severe yield decreases. It is an ideal to recycle nutrients from society, but recycling is hampered by contamination, especially by substances such as medicines and pesticide residues and heavy metals. Also, animal manure from conventional agriculture may be contaminated and is questionable because it makes organic systems dependent on inputs from conventional farming. Application of rock powder has given interesting results, but our knowledge of the kinetics of nutrient release is inadequate for practical recommendations, and transport and distribution are challenging and energy consuming. The most sustainable way of using the limited resource rock phosphate should be evaluated.

There is a range of other products from nature and industry that are possible nutrient sources for organic farming systems. They need to be carefully evaluated with regard to sustainability and the basic principles of organic farming.

Final remarks

Sustaining soil fertility in stockless organic farming systems raises a range of challenges. Further research and scientifically based discussions and adaptations of organic farming standards will be required to design stockless organic systems that maintain or improve soil fertility and have sustainable replacement of lost and removed nutrients. This is not possible without designing safe and efficient ways of recycling P and other nutrients to agricultural land. Mixed farming faces less serious challenges with respect to soil fertility and is probably the most sustainable kind of organic production on soils with low fertility.

References

Askegaard,M., Olesen,J.E. & Kristensen,K. (2005). Nitrate leaching from organic arable crop rotations:effects of location, manure and catch crop.Soil Use and Management 21,181-188.

Bakken, A.K., Breland, T.A., Haraldsen, T.K., Aamlid, T.S. & Sveistrup, T.E. 2006 Soil fertility in three cropping systems after conversion from conventional to organic farming. Acta Agriculture Scandinavica., Sect. B, Soil & Plant Sci. 56, 81 – 90

Løes, A.K. & Øgaard, A.F. (2001). Long-term changes in extractable soil phosphorus (P) in organic dairy farming systems. Plant and Soil 237, 321-332.

Løes, A.K. & Øgaard, A.F. (2003). Concentrations of soil potassium after long-term organic dairy production. International Journal of Agricultural Sustainability 1, 14-29.

Riley, H., Eltun, R. & Korsæth, A. (2006). Changes in soil structure between 1988 and 2003 in a comparison of cropping systems in southeast Norway. In Proceedings of ISTRO 17th Triennial Conference Kiel, Sustainability - its Impact on Soil Management and Environment (Ed. Horn, R.), pp.670-675. International Soil Tillage Research Organisation, ISTRO.

Sturite,.I., Henriksen,T.M. & Breland,T.A. (2007). Winter losses of nitrogen and phosphorus from Italian ryegrass, meadow fescue and white clover in a northern temperate climate. Agriculture, Ecosystems and Environment 120, 280 – 290.

Sturite,.I., Henriksen,T.M. & Breland,T.A. (in press) Longevity of white clover (*Trifolium repens* L.) leaves, stolons and roots under northern temperate climatic conditions. Ann. Bot.