

Nutrient management in organic horticulture

Peter von Fragstein und Niemsdorff, University of Kassel,
Dept. Organic Vegetable Production

Introduction

There is a special challenge for practitioners of vegetable and herb species because of the broad range of botanical interrelations on the one hand and the partially highly diverging demands for growing period, site conditions, nutrient supply and response to weeds, pests and diseases on the other hand. The gardening practice is much more based on a stockless growing system compared to farming. In order to meet the nutrient requirement of highly demanding crops the purchase of fertilisers is very common for organic market gardens and vegetable farms. Although listed on the annexes of organic producer organisations or governmental declarations i.e. EU Declaration 834/2007 (2nd edition of 2092/91) not all fertilisers are consistent to the concept of Organic Agriculture with regard to their origin, their composition or their process of manufacturing. This is mainly true for the use of processed slaughterhouse by-products that are rich in nitrogen i.e. blood meal and meat meal, but, to some extent, also true for the use of plant based fertilisers i.e. seed cakes as by-products of seed extrusions. All these nutrients that are going to become part of an organic cultivation system are originated in non-organic production systems which Organic Agriculture tries to be distinctly distinguishable from at any case. That includes a clear exclusion of specific housing systems which also includes the use of synthetic animal therapeutics and medicinal feed stuff and of synthesized fertilisers and synthesized plant protection products. There is a clear task to terminate this discrepancy of organic crop cultivation dependent upon recycled nutrient sources out of conventional farming, to find alternate strategies and to disseminate them among the farming and gardening community.

Figure 1 presents an listing of valuable nutrient sources for organic crop husbandry by distinguishing the on- and off-farm sources.

Figure 1: Nutrient supply in organic crop husbandry

On-farm sources	Off-farm sources
Soil reserves	Composts
Crop rotation	<ul style="list-style-type: none"> • Source separated compost • Plant-based compost
<ul style="list-style-type: none"> • Crop residues • Green manures • mixed cropping 	(Feed stuff)
Dung	(Straw)
<ul style="list-style-type: none"> • Staple manure • Manure compost • Slurry • Liquid manure 	Rock dusts
	<ul style="list-style-type: none"> • Calcareous rock • Rock phosphate • Silicate rock
	Organic fertilizers
	Mineral fertilizers

On-farm nutrient sources

Soil quality, preferably fertile soils derived from favoured mineralogical composition and other site conditions, is the main key for successful crop growing. In order to achieve the goal for a maintaining growing system aspects of rotational and nutritional management have to be taken into account.

Rotational management

To fulfil the need for sufficient N supply mainly forage legumes have to be part of the growing systems. But in intensive vegetable production this is increasingly jeopardized and replaced by short-term winter-hard legumes i.e. winter vetch.

Complex growing systems i. e. mixed cropping systems are highly interesting from the academic view point and most convenient to natural site conditions, but they are the at most neglected growing design by commercial practitioners.

On-farm nutrient cycling

Farmers of mixed farming systems can make use of animal faeces if there are adequate housing systems including the right collection and storing of these sources. In response to the specific nitrogen demand of various vegetable species and the continuous degradation of humus through mechanical weeding these on-farm nutrient and carbon sources are highly valid for organic growing systems.

Off-farm sources

Among the off-farm nutrient sources composts play a key role in organic vegetable production systems due to regular mechanical weeding and the corresponding degradation of soil structure. Beside this purchasable soil conditioner various rock types processed to fertilisers are important sources of individual or a group of nutrients. Organic fertilisers are the main group of purchase fertilisers in vegetable farms. Off the mineral fertilisers the potassium supply is the main focus.

Off-farm composts are meanwhile an important source for the recycling of humus and a broad range of plant nutrients and are a valid complementary source to farmyard manure (Fragstein et al. 1995, Fragstein & Schmidt 1999). They can be understood as end product of an off-farm nutrient cycling process the acceptance of which is essentially dependent upon the process control during composting and the final composition of the compost.

The use of **rock dusts**, only physically treated by grinding, highly corresponds to the basic understanding of organic agriculture (Fragstein 1993). In specific the slow release fertilisers rock phosphate and silicate rock dust demand additional biological weathering either through close contact with farmyard manure or compost material or through directed application to soils at a high microbial status i. e. incorporation of green manure or forage crops.

Organic fertilisers, animal based, plant based or microbe based belong to the mostly used purchase N sources of organic vegetable farmers. Because most of the processed by-products are originated from conventional farming products the transformation of their nutrients into organically certified products have to be seen as one of the existing discrepancies of organic standards. This is mainly true for animal based fertilisers i. e. blood or meat meal, but is also true for extruded seed cake material. Therefore new strategies must be found and introduced into organic horticulture for the substitution of these critical materials (Mueller & Fragstein und Niemsdorff 2006, Fragstein und Niemsdorff & Mueller 2006).

Plant based, seed originated fertilisers are more and more in focus of organic vegetable farmers. Mainly of interest are the seeds of grain legumes. Actually these fertilisers can be imported from conventional farms (at least till now), from farms in conversion and those that are certified as organic (much more convenient for a balanced understanding of organic agriculture).

Mineral fertilisers are also known in organic crop husbandry provided they refer to potassium salts and trace element fertilisers. The high potassium demand by many vegetable and herb crops have to be more taken into account by organic practitioners and valuable K sources should be available in adequate time and quantity either delivered by soil minerals, manures, crop residues or by potassium salts (the necessity of which has to be proofed by certifying authorities).

References:

- Council of EU 2008: Council Regulation (EC) No 834/2007 on organic production and labelling of organic products and repealing regulation (EEC) No 2092/91. Official Journal of the European Union, L189, 1-20.
- Fragstein, P. von and Schmidt, H., 1999: External N sources in an organic stockless crop rotation - useful or useless additives? In: <Effects on plant development, crop yield and nitrogen dynamics>, Olesen, J.E., Eltun, R., Gooding, M.J., Jensen, E.S. & Kpke, U. (eds), Designing and testing crop rotations for organic farming. DARCOF Report no. 1, pp. 203-212.
- Fragstein und Niemsdorff, P. von, Müller, T., 2006: Plant based organic fertilisers - a viable nutrient source for organic market gardens. *Acta horticulturae* 700, pp. 255-260.
- Fragstein, P. von, Fuchshofen, W. und Vogtmann, H., 1995: P- und K-Versorgung landwirtschaftlicher Kulturen aus unterschiedlichen Kompostquellen. In: "Kolloquium über die Verwertung von Komposten im Pflanzenbau", (Hrsg.) Budig, M., Schaaf, H. und Schaumburg, E., Hessisches Landesamt für Regionalentwicklung und Landwirtschaft, S. 21-30.
- Fragstein und Niemsdorff, P. von 1993: Einsatz mineralischer Zusatzstoffe im Ökologischen Landbau zum Zwecke der Bodenverbesserung und des Nährstoffeintrages in das Agrarökosystem. Universität Kassel, Fachbereich Landwirtschaft, Internationales rurale Entwicklung und Umweltsicherung, Habilitationsschrift.
- Müller, T. and Fragstein und Niemsdorff, P. von (2006). Organic Fertilisers Derived from Plant Materials: II. Turnover in field trials. *Journal of Plant Nutrition & Soil Science* 169: 265-273.