

Nutrient flows in Organic Fruit Orchards in Baden-Wuerttemberg

K. Möller¹ and S. Zikeli²

Abstract

The nutrient management in intensive organic apple production systems relies entirely on external inputs. Therefore, meeting crop nutrient demands and maintaining long-term sustainability depends on the nutrient composition of the used fertilizer inputs. To gain insight on current practices this study analyzed fertilization strategies and nutrient flows of the apple production of 50 fields in 15 organic orchards in Southwest Germany for a cropping period of five years. The calculations did also consider the inputs of macronutrients introduced via pesticides. Soil samples were also taken. The results indicate imbalances in the input-output relationship of most major elements.

Keywords: Nutrient flows, organic apple orchards, sulphur input, nutrient imbalances

Introduction

In organic production systems, N-input by biological N fixation (annual or perennial legumes) is essential for crop fertilisation. In addition, recycling of nutrients via animal husbandry is another important practice. In organic fruit production, however, such strategies are in most cases not used due to the high specialisation of the production system or to the difficulties in practical application. Therefore, organic fruit producers in Germany rely strongly on external commercial fertilisers that are permitted in organic farming like vinasse, keratin products or residues from food production like spent grains. Based on the nutrient export, it is very likely that nutrient imbalances in such cropping systems exist as the ratio of nutrients in the exported product does not match the ratio of nutrients in the imported fertilisers (Zikeli et al., 2017). So far, no information is available on the fertilization strategies of organic fruit growers and on the nutrient flows in organic orchards. Therefore, an on-farm survey was conducted in order to assess the status quo on nutrient flows in organic apple orchards in Baden-Wuerttemberg was conducted with the aim to analyse fertilisation strategies, to calculate nutrient balances based and to assess the soil status of plant available P, K and Mg as well as the nutrient content in the fruits.

Material and Methods

In summer 2016, members of the organic association “Fördergemeinschaft Ökologischer Obstbau e.V.” (FÖKO), were asked to participate in the survey in their regular newsletter. A total of 15 fruit apple growers from three different fruit growing regions in Baden-Wuerttemberg volunteered to participate in the survey. All participants were visited personally and a semi-structured interview was done. For the survey, 5 sites per farm were selected, whenever possible with similar apple cultivars (e.g. Elstar, Topaz, Jonagold). Furthermore, fields with differences in the timespan since conversion to organic farming were selected between 5 and nearly 50 years were selected. The documentation for the nutrient inputs and outputs as well as for plant protection was done for the years 2012-2016 and nutrient budgets were calculated for all sites. In addition, on all sites, a mixed soil sample from 0 to 30 cm was compiled for the tree strip and the grass strip separately. The soil samples were

¹ Landwirtschaftliches Technologiezentrum Augustenberg, Kutschenweg 20, 76287 Rheinstetten-Forchheim (email: kurt.moeller@alumni.tum.de)

² Coordination for Organic Farming and Consumer Protection, University of Hohenheim, Fruwirthstr. 14, 70593 Stuttgart (email: sabine.zikeli@uni-hohenheim.de)

analysed for plant available P, K and Mg as well as for total contents of C, S and N (combustion) and of P, K, Ca, Mg, Na and Cl (aqua regia extraction). In addition, the soil pH was determined. In the apples, P, Ca, Mg, K, Na were analysed after microwave extraction.

Results and Discussion

The fertilisation strategies of the farmers were in most cases strongly determined by the use of external commercial fertilisers. On average, 76 % of all N applied per ha and year resulted from external commercial fertilisers, while only 24 % was introduced to the system by organic base fertilisers (e.g. composts of different origins). Only four growers used compost at all. On average, ca. 37 kg N, 4,3 kg P, 22 kg K, 42 kg Ca, 4,6 kg Mg, 47 kg S, 3,8 kg Na and 3,5 kg Cl were applied per ha and year, while 25 kg N, 1,5 kg P, 40 kg Ca, 3,1 kg Mg, 46 kg S, 3,2 kg Na and 3,0 kg Cl were removed via fruits (Fig. 1). This resulted in a deficit of 13 kg K ha⁻¹ y⁻¹. Due to the high inputs of sulfur containing inputs (pesticides, keratins), the overall management indicate an acidifying effect of the overall management on the soil.

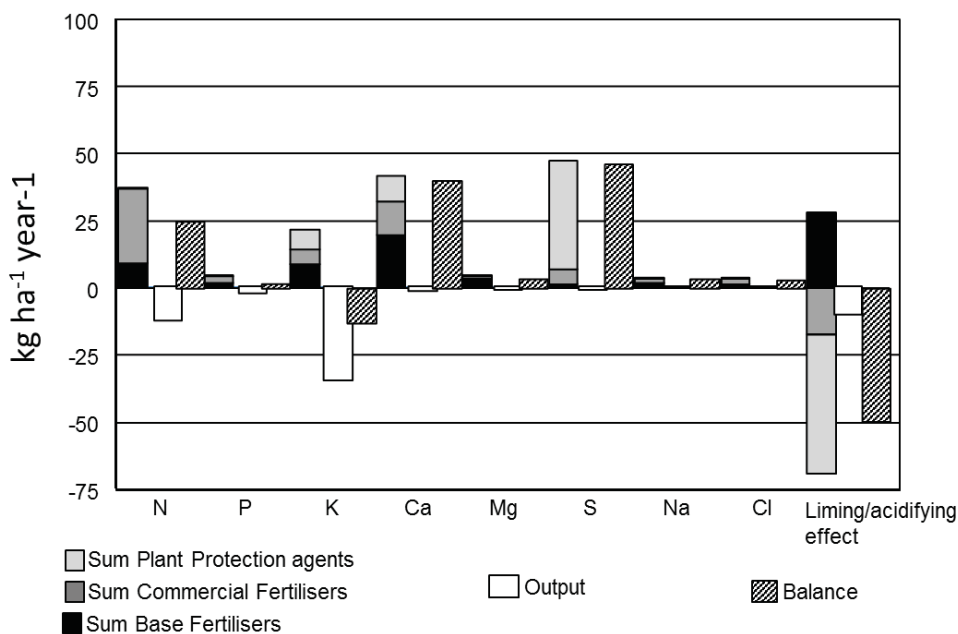


Figure 9: Nutrient inputs via base organic fertilizers, commercial fertilizers and plant protection agents

We found large differences in the nutrient balances between orchards managed based on composts and those managed without composts. The orchards fertilized based on composts showed a slightly positive K balance and higher surpluses of all assessed macro-elements than orchards managed only with commercial fertilizers.

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References

Zikeli, S., L. Deil, K. Möller (2017): The challenge of imbalanced nutrient flows in organic farming systems: A study of Organic greenhouses in Southern Germany. *Agric, Ecosyst Environ* 244, 1-13.