

## Inter-row management and its role in fertilisation strategies in organic apple cultivation on farms in South-West Germany

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### Abstract

*Management practices in organic apple cultivation include the mulching of the inter-row. In Germany, some organic apple producers transfer the biomass from the inter-row to the tree row. This is done for several reasons, e.g. to reduce evaporation of soil water and to suppress weeds. These approaches can be opposed to other management goals like a low nutrient supply during summer. To gain a better understanding of the purposes and the practices of inter-row mulching in South-West Germany a survey and an on-farm data collection was done to a) document the status quo of inter-row management strategies and the motives of the organic apple producers and b) to measure the biomass produced in the inter-row in one season and to analyse the nutrients, that are potentially transferred from inter-row to tree row. The research was conducted in different regions of South West Germany during the vegetation period in 2019. The interviews indicated that the most important aims of biomass transfer are soil cover and increase of soil organic matter, but not fertilisation. The number of cuttings of the inter-row and the associated biomass transfer varied greatly among the farms. The biomass transferred from inter-row to tree row contained 38 – 69 kg N per ha and year, 6 – 11 kg P, 39 – 67 kg K, 4 – 5 kg Mg and 7 -13 kg Ca. To improve the sustainability of the system, farmers should re-evaluate their inter-row management, considering the transfer of nutrients to the tree row and integrate the inter-row mulching in their fertilisation strategies.*

**Keywords:** Nutrient transfer, mulching, internal nutrient supply in orchards.

### Introduction

In organic apple cultivation farmers implement different strategies of inter-row management. In addition to an establishment of flower strips, many methods are possible regarding mulching and transfer of the biomass to the tree row. In choosing specific strategies of mulching, farmers often pursue multiple goals, such as the improvement of soil structure, fertilisation, reduction of soil water loss by a mulch layer or weed control. Different goals can be opposed to each other, like soil protection to avoid water loss versus low nutrient supply during summer. However, little is known about inter-row management in farming practice. To better evaluate and improve different strategies, information is needed on a) the status quo on inter-row management strategies on farms and b) the transfer of nutrients and carbon from inter-row to tree row.

### Material and Methods

To find practice partners for the research (survey and on-farm data collection), farmers were contacted via FÖKO (Fördergemeinschaft ökologischer Obstbau e.V.), the German farmer's Association for Organic Fruit Growing. The semi-structured interviews about their inter-row management strategies were done with 11 farmers in South-West Germany (Lake

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Constance region: 9, Freiburg region: 2). On six farms (Lake Constance region: 4, Freiburg region: 2), on-farm data collection was done in the orchards during the vegetation period of 2019. The biomass production was quantified and the nutrient content (N, P, K, Mg and Ca) was analysed before every mulching event in three randomly selected inter-rows per farm covering an area of 20 trees and their respective inter-row. The percentage of legumes, herbs and grasses in the inter-row was estimated and soil samples (0 – 30 cm) were taken in spring in the tree row and in the inter-row for the analysis of soil mineral N ( $N_{\min}$ ), CAL extractable P and K content,  $\text{CaCl}_2$ -extractable Mg content as well as soil pH ( $\text{CaCl}_2$ ).

## Results and Discussion

In the interviews the most frequently mentioned goals of transferring the biomass to the tree row were soil cover in general (45% of the farmers), reduction of water loss (45%), weed control (36%) and enhancement of soil organic matter content (36%). Fertilisation as a motive for biomass transfer only played a minor role (27%). Four farmers had flower strips in their orchards (these were not mulched regularly and thus were not integrated in the measurements), seven did not. Farmers stated the length of the grass when mulched to be between 10 and 40 cm, with the majority mulching at a grass length of around 20 cm. Mulching was done three to nine times per year, while farmers transferred the biomass to the tree row either only in spring, in spring and summer or with every cut during the whole vegetation period.

On the six farms the amounts of nutrients in the cut biomass were 38 – 69 kg N per ha and year, 6 – 11 kg P, 39 – 67 kg K, 4 – 5 kg Mg and 7 -13 kg Ca (Table 1). The C:N ratio was higher in the biomass of the less frequently mulched inter-rows.

Table 1: Management, number of cuts, C:N ratio and nutrient content in the inter-row biomass ( $\text{kg ha}^{-1}$ ) used for mulching of the tree row of the vegetation period 2019 on the six organic farms in South West Germany.

Farm Region	A1	A2	A3	A4	B1	B2
	Lake Constance				Freiburg	
Flower strip	yes	yes	no	no	yes	no
Number of cuts	6	7	7	3	4	3
C:N	13.2	11.4	13.6	15.3	17.9	18.8
N	55.7	60.2	69.2	45.9	38.9	37.7
P	8.19	8.23	11.34	8.71	7.58	5.94
K	60.1	58.1	66.8	56.8	48.1	38.5
Mg	3.70	4.84	5.44	4.92	4.09	3.45
Ca	12.4	10.5	12.7	10.4	6.54	8.96

Soil samples partly showed depletion of extractable P ( $51 \text{ mg kg}^{-1}$ ), K ( $128 \text{ mg kg}^{-1}$ ) and Mg ( $120 \text{ mg kg}^{-1}$ ) in the inter-row, while at the same time, in the tree row these nutrients showed high values according to the governmental soil nutrient classification (P:  $94 \text{ mg kg}^{-1}$ , K:  $264 \text{ mg kg}^{-1}$ , Mg:  $142 \text{ mg kg}^{-1}$ ). This can be explained by the application of fertilisers exclusively in the tree row, as well as by the transfer of nutrients via the mulched biomass from inter-row to tree row.

The transfer of nutrients needs to be considered when designing sustainable fertilisation strategies for organic apple orchards, although the cut biomass is often not moved to the tree row completely due to the performance of the mulching machines; e.g. Engel et al. (2009) measured a transfer rate of 25-50% of the biomass. Based on these results, farmers

can quantify the fertilisation effect of their mulching strategies and integrate it in their fertilisation management, which may result in a reduced need for input of external fertilisers. At the same time, a considerable nutrient transfer between tree row and inter-row takes place, which may warrant additional fertiliser inputs in the inter-row to avoid nutrient depletion in the long run in parts of the orchard. In addition, farmers need to re-evaluate the importance of the other goals of transferring the biomass to the tree row. Due to the low nutrient requirement of the trees in summer, it is recommended to adapt the management in order to avoid an “overfertilisation” during that time of the season.

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### **References**

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### **Citation of the full publication**

The citation of the full publication will be found on Ecofruit website as soon as available.