

The “GreenManager” – an innovative machine for flexible cover crop management

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Abstract

A new concept for flexible management of cover crops in fruit growing and viticulture has been developed. The concept follows the principle that cover crops are allowed to develop lush biomass if there is enough moisture available in deep layers of the soil. Under dry conditions the competition for water caused by the cover crop has to be reduced or even stopped completely. This is done using an array of strong, medium and weaker measures. The concept of flexible cover crop management can now be put into practice with the help of the GreenManager®. This innovative machine was developed in collaboration between Bio Forschung Austria and the companies Güttler GmbH and Ertl-Auer GmbH. All measures of soil management, seeding of cover crops or reduction of their biomass aim to minimize the risk of erosion. This is achieved through permanently covering the soil surface with biomass of living or dead plants. Maximum soil protection and the well-being of the fruit trees and vines are the primary goal of the flexible cover crop management.

Keywords: avoidance of drought stress, erosion prevention, seed equipment, soil management

Cover crops are the basis for an erosion-free soil management in orchards and vineyards. The plant foliage covers and protects the soil and together with an intensive root formation counteracts erosion. Via roots and root exudates plants are able to bring organic matter also into deeper soil layers as food for the soil microorganisms. The excrements of the soil (micro-)fauna stick together the mineral soil constituents to form a crumb structure. This in turn improves soil structure and porosity, water infiltration and soil water holding capacity. That way cover crops help to make orchard and vineyard soils fit to face the challenges of the climate change.

The water demand of cover crops, however, may pose problems for the water supply of the trees and vines in dry seasons. Therefore it is necessary to adjust the growth of the cover crops to the actual water conditions in order to avoid drought stress and lack of available nitrogen due to drought for the trees and vines.

Material and Methods

A field experiment was set up in a vineyard on the Falkenberg in Vienna including four cover crop treatments:

- (1) every second row middle with cover crop (sown in autumn), the other without cover crop, area underneath the vines kept clear,
- (2) every second row middle with cover crop sown in spring the others with cover crop sown in spring of the previous year, area underneath the vines kept clear,
- (3) same as (2), but re-seeding of cover crops not every year, but only as required,
- (4) same as (3), but area underneath the vines with undergrowth.

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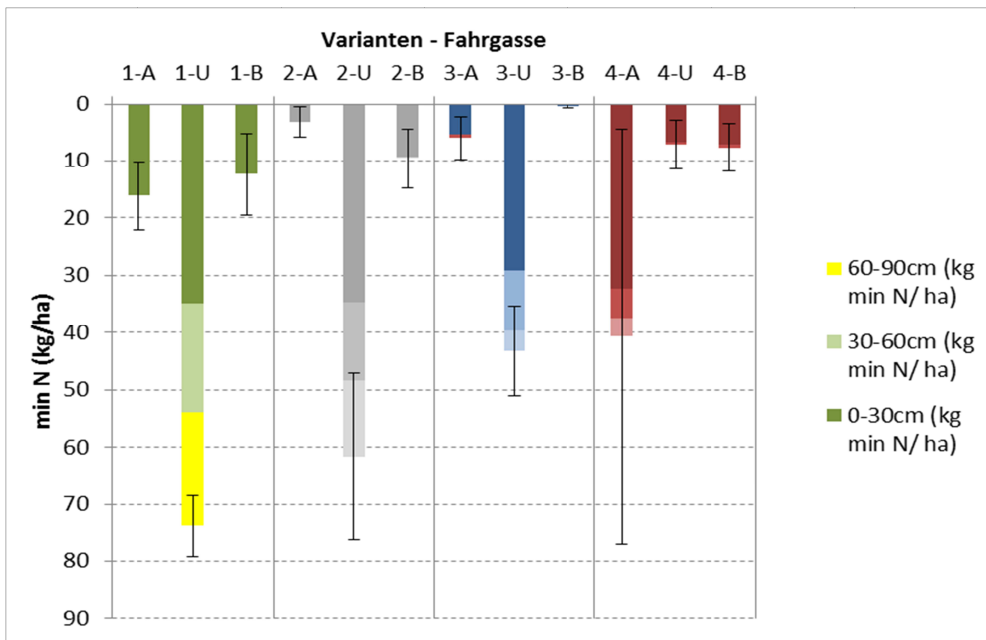


Figure 1: N_{min} in the soil in rows (U) and row middles (A and B) of treatments 1 – 4 before flowering of the vines. (4.5.2011).

Results

The results of the experiment show decreasing soil N_{min} contents with increasing intensity of cover cropping and of plant growth underneath the vines (Fig. 1 and 2). This will result on the long term in unsatisfactory growth of the vines and on the short term in decreasing free assimilable nitrogen (FAN) content in must of grapes from the treatments with increasing intensity of cover cropping and especially with plant growth underneath the vines (Fig. 3). Therefore a method for an quick and modulable reduction of the competition for water is essential.

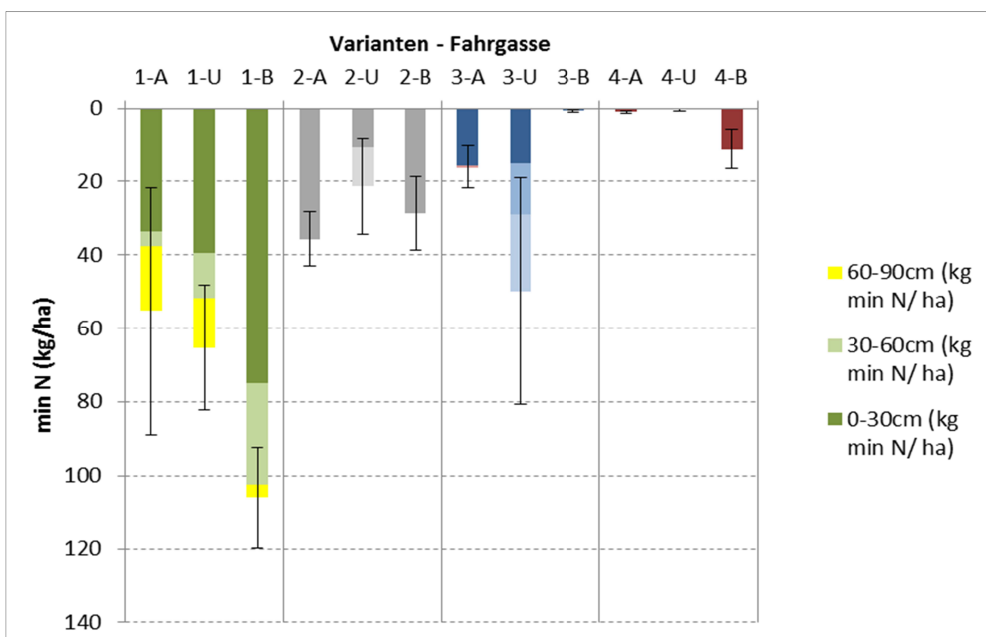


Figure 2: N_{min} in the soil in rows (U) and row middles (A and B) of treatments 1 – 4 after flowering of vines (27.6.2011).

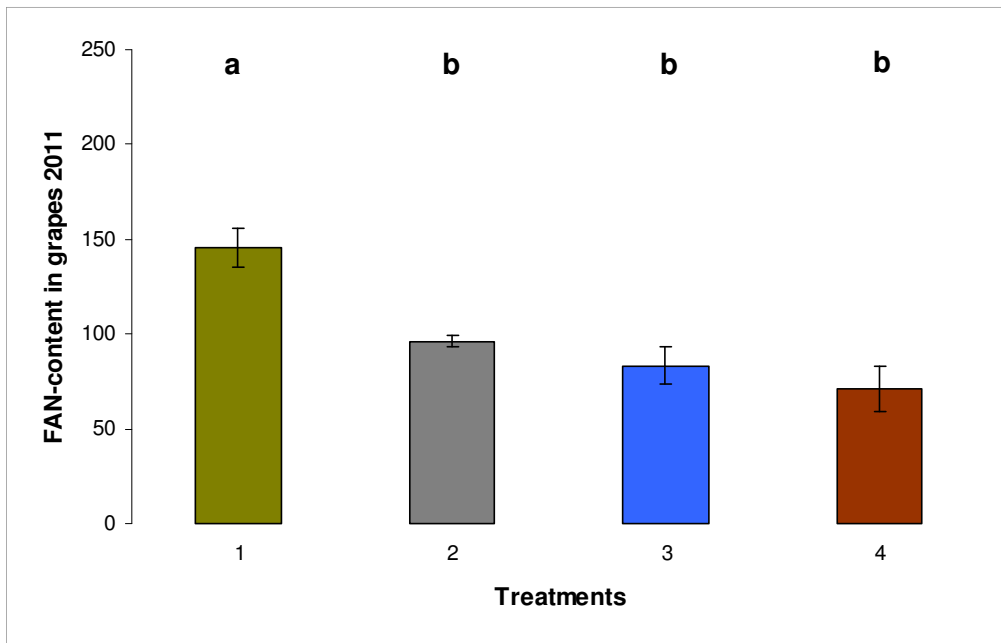


Figure 3: FAN (free

assimilable nitrogen) content in must in treatments 1 – 4.



Figure 4: Sowing of cover crops with the GreenManager® in vineyards in Vienna.



Figure 5: Grain legumes cover crop sown with the GreenManager® in the central part of the row middle.



Figure 6: GreenManager® in flowering apricot orchard, cutting cover crop roots a few cm beneath the soil surface.



Figure 7: Cover crop in an apricot orchard. Competition for water was stopped by cutting the roots a few cm beneath the soil surface.

Discussion

The concept of the flexible cover crop management follows the principle that cover crops are allowed to develop lush biomass till flowering and formation of seeds as long as there is enough moisture available from rainfall or stored in deep layers of the soil. Under dry conditions, however, the growth of the cover crop must be restricted to stop the competition for water, sometimes even by cutting off the cover crop roots. Rainfall may be very variable during the year, and weather extremes become more frequent with climate change, so it is sometimes necessary to adjust the cover crop management several times a year.

A new innovative equipment, which can perform all the tasks necessary for the flexible cover crop management has been developed together with the agricultural machinery manufacturers Bodenwerkstatt Ertl-Auer GmbH and Güttler GmbH. The GreenManager® device consists of three modules, namely a specific type of cultivator, a harrow and a prismatic roller with seeding equipment, which can be used separately or in combination.

The GreenManager® can reduce the growth of cover crops by flattening the plants in the whole row middle, by bringing down the cover crops with the harrow, or by horizontally cutting the cover crop roots a few centimetres beneath the soil surface in the central part of the row middle or in the whole row middle. These measures reduce the water competition by cover crops without generating further losses of soil moisture through intensive soil cultivation. At the same time the risk of soil erosion is kept to a minimum, because the soil remains covered by dead plant biomass.

Simultaneously with cutting the roots of the standing vegetation in the row middle, the GreenManager® can prepare the seedbed and sow cover crop seeds for the next cover crop generation. Large-grain cover crop seeds are drilled in the central part of the row

middle several centimetres deep with the cultivator, while the small grains are spread on the surface of the whole row middle in a seedbed prepared by the prismatic roller or the harrow module. Adapting the seeding depth to the seed size improves the seed germination rate. So it is secured that on rewetting of the soil the next generation of cover crops will be established straight away.

For re-seeding it is also possible to use only the roller together with the seeding equipment, or combined with the harrow. Thus the GreenManager® on the one hand allows to establish dense, species-rich cover crops, and on the other hand makes it possible to reduce them quickly and efficiently to the necessary extent.

In all cases, however, the soil remains covered with living or dead plant biomass, so that the erosion risk is minimized. Uppermost goals of the flexible cover crop management are the well-being of the fruit trees and vines and maximum erosion protection of the soil.