

doi:<http://dx.doi.org/10.15414/afz.2015.18.si.128-130>

Intercropping experiments in Hungarian vineyards

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Intensive mechanical soil cultivation and herbicide treatment was often the preferred technology in vineyards in the second half of the 20th century. In the last decades we increasingly experienced the disadvantages of these suboptimal technologies: soil degradation, erosion and deflation damages. Alternative cultivation methods were sought for research and practice, especially in organic viticulture. The use of well-adapted cover-crop mixtures in the vine inter-rows poses a possible solution for weed control, soil conservation and biodiversity development. The technology has a special importance on steep slopes: it helps to prevent erosion damages and provides easier cultivation circumstances. In 2012 the Hungarian Research Institute of Organic Agriculture in collaboration with other experts and growers began to study three different species-rich cover crop mixtures (Biocont-Ecovin, Legume mixture, Grass-herb mixture) in Hungarian vineyards. Each mixture was sown in three neighbouring inter-rows at each experimental site. After sowing (March 2012) we studied vegetation composition (June 2012, 2013 and 2014), pruning weight and diameter of the second bearing spur of the stocks, yield quality and quantity. Most of the sown species established successfully and in 2012 we found that Biocont-Ecovin and the mixture of legumes were the most effective in weed suppression. For 2013 we detected lower weed coverage in the inter-rows sown with the grass-herb and legume mixtures, while in control and Biocont-Ecovin inter-rows we detected increasing weed coverage. In the third year (2014) we found in every plot that the grass-herb mixture-covered inter-rows were the least weedy. The most successful species in the inter-rows are: *Coronilla varia*, *Lotus corniculatus*, *Medicago lupulina*, *Onobrychis viciifolia*, *Plantago lanceolata*, *Trifolium repens*, *Trifolium pratense*. Viticultural measurements (2014) show a 10-13 % decrease of yield in case of covered inter-rows, and a 26 and 21 % reduction in pruning weight (Gróf Degenfeld and Tokaj-Hétszőlő), especially apparent in young plantations. For Hungarian conditions it is therefore recommended to implement this technology in every second inter-row where erosion control is not required.

Keywords: grapevine, cover crops, erosion, biodiversity, species rich mixtures

1 Introduction

Mechanical cultivation is one of the most frequently applied inter-row management techniques in Hungarian vineyards. However, mechanical cultivation can result in several negative effects, such as soil desiccation, due to higher evaporation, decayed soil structure, erosion and nutrient loss (Aljibury and Christensen, 1972; Bauer et al., 2004; Dijck and Asch, 2002). Sustainable alternative technologies (e.g. covering with mulch or intercropping) can positively affect the water content of the soil (Rinaldi et al., 2000; Varga and Májer, 2004). However, suboptimal intercropping systems can also have negative effects on the soil moisture and on vine-growth, due to e.g. water concurrence with the vine. We have to develop the best practice to each production site. The use of cover crops has a special importance for providing environmentally friendly soil management solutions, especially on steep slopes and hill-valley planted vineyards. Locally adapted species-rich cover crop mixtures help not only to prevent erosion and provide easier cultivation, but also have

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a positive effect on soil structure, soil fertility and ecosystem functions (Hoffmann et al., 2008). By using legumes, atmospheric nitrogen can be fixed in the soil, providing an additional benefit for the vineyard (King and Berry, 2005; Wheaton et al., 2008). Previous vineyard cover-crop experiments from Hungary (e.g. Varga et al., 2007; Göblyös et al., 2011) investigated mixtures with mainly foreign provenance. However, research results show that species and even ecotypes of local provenance can establish better under local environmental conditions (Mijnsbrugge et al., 2010). In case of this research started in 2012, our aim was to develop well-adapted species-rich cover crop mixtures for Hungarian vineyards by using native species of Hungarian provenance where it was possible.

2 Material and Methods

Between 2012-2014 we investigated three seed mixtures: Biocont-Ecovin (12 species), Grass-herb (16 species) and Legume (9 species) mixtures. Biocont-Ecovin is a commercial seed mixture, which was developed during the Ecovin project (Vér and Takács, 2013), whereas the Legume and Grass-herb mixtures were developed by us especially for this research, involving local vine growers and seed mixture experts. As Control, the weed flora of the mechanically cultivated or mown inter-rows were recorded. We considered all unsown plants as weeds. The experimental sites are in the Tokaj and Szekszárd wine regions. Five vineyards were involved in the study: Gróf Degenfeld, Oremus Budaházi and Szentvér vineyards (Tokaj wine region), Illyés Kúria, and Tringa Borpince (Szekszárd wine region). Each seed mixture was sown in the spring (March) of 2012 in three adjacent inter-rows. The coverage of vascular plant species was recorded in the central sown and control inter-rows in five 1×1 meter permanent plots in June, 2014. The yield was measured by picking ten-ten zigzag chosen vines in each block. Sugar content (MM°) and titrable acidity (g/l) of the must were measured in the laboratory of the Research Institute of Oenology and Viticulture, Tokaj wine region.

3 Results

3.1 Botanical results

We found that Biocont-Ecovin and Legume mixture were the most effective in weed suppression during 2012. In 2013 we detected lower weed coverage in inter-rows sown with the Grass-herb and Legume mixtures, while in control and Biocont-Ecovin inter-rows we detected increasing weed coverage. Botanical results show that to the third year (2014) on most sown sites the highest total coverage was detected in the inter-rows sown with the Grass-herb mixture and Legume mixture, but these differences were significant only at two sites. The percentage of sown species-coverage compared to whole coverage (sown+weed) is also highest in the Grass-herb treatment at most sites, and in case of four out of five sites there are significant differences. According to the experiences of the three years, most successful species in the inter-rows are: *Coronilla varia*, *Lotus corniculatus*, *Medicago lupulina*, *Onobrychis viciifolia*, *Plantago lanceolata*, *Trifolium repens*, *Trifolium pratense*.

3.2 Viticultural results

Viticultural measurements show a tendency of decreasing yield in case of inter-rows with cover crops, but the difference is significant only at one site. This reduction was measured also in case of the pruning weight. The indices of the must quality were not significantly affected by the applied cover crop. There were no differences in the diameter of the internodes among treatments.

4 Conclusions

Our findings show that Ecovin-type mixtures that often contain cheaper seeds of annual plants (e.g. *Camelina sativa*, *Fagopyron esculentum*, *Phaecelia tanacetifolia*, *Sinapis alba*) can help to avoid damages of erosion in the year of seeding. However, to the second-third

year these species mostly disappear from the inter-rows. In case of suboptimal climatic conditions (e.g. extreme dry periods) weeds can better occupy the loose inter-rows. In Hungarian climate, where arid periods are frequent in summer, our results show that it is more safe to create cover-crop mixtures from perennial species, with low percentage of annuals.

Most examined indices of grapevines were not significantly affected by the applied cover crop, however, our results show that in our climate, every second inter-row sowing may be more optimal for vine-growth and yield, where erosion control is not required. Differences in must quality were not found. Hungarian growers show high interest to apply alternatives to mechanical tillage in vineyards. Our results help them to create optimal cover crop floor management systems, taking into account the age of the grapevines and the local edaphic and climatic conditions.

5 Acknowledgements

The authors are thankful to E. Illyés, Á. Albert, B. Kelbert, Cs. Molnár. and K. Tóth for their contribution to the trial concept, field and laboratory work. Special thanks to the postdoctoral scholarship of the Hungarian Research Institution of Organic Agriculture. Authors (T.M., O.V., A.K., P.T.) were supported by the European Union and the State of Hungary, co-financed by the European Social Fund in the framework of TÁMOP 4.2.4. A/2-11-1-2012-0001 'National Excellence Program'; research equipment and infrastructure were partly supported by TÁMOP-4.2.1./B-09/1/KONV-2010-0007, TÁMOP-4.2.2/B-10/1-2010-0024, TAMOP-4.2.2.C-11/1/KONV-2012-0010, OTKA PD 100 192 (P.T.), OTKA PD 111807 (O.V.) and the Internal Research Grant of the University of Debrecen (O.V.).

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