Comparison of species-rich cover crops mixtures in Hungarian vineyards

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Key words: cover crop, grapevine, erosion, species-rich, steep slope vineyard

Abstract

Cultivation in steep slope vineyards can endanger the soil. Moreover, because the climate change we can anticipate extreme weather conditions, like heavy rainstorms. In the past few decades, vine growers and botanical experts have renewed efforts to improve floor management of the inter-row and under vine floors. In the Hungarian vineyards, the threat of the low annual precipitation combined with potential and actual periodic heavy rains is a great concern. Commercially available seed mixtures for covering threatened soils are criticized for their non-native species content, foreign sourcing of some seed, and height of the vegetation. The goal of on-farm trials started in 2012 was to investigate three cover crop seed mixtures (Biocont-Ecovin mixture, mixture of legumes, mixture of grasses and herbs) in vineyards of the Tokaj and Szekszárd wine regions of Hungary. Each mixture was sown on three consecutive inter-rows at 10 experimental sites. Besides botanical measurements, yield, must quality, and pruning weight was studied for each seed mixture at each site. Prevalence of weed species was much lower in the sown inter-rows than in the control inter-rows regardless of seed mixture used. Total plant coverage in the sown inter-rows exceeded 80% for two trials in 2012. Experimental sites where control blocks had the weed flora mown in every inter-row showed increased, but not significant, yield than was measured in some blocks using cover crops. However, in cases where every second inter-row of the control blocks were mechanical cultivated and inter-rows mown, higher yields were measured, but again the difference was not significant. The much higher total plant cover for the seeded inter-rows than observed in the control blocks is promising for erosion control, but in a drier climate and with unirrigated vineyards, sowing every second inter-row appears more optimal provided erosion control is not required.

Introduction

Sustainable floor management has played an important role in viticulture recently. Intensive agricultural practices of past decades - like mechanical cultivation on steep slope vineyards - endanger the vineyards. Suboptimal inter-row and undervine floor management, especially coupled with extreme weather conditions can lead to heavy soil degradation. In addition, because of climate change we anticipate heavier rainstorms, which can accelerate degradation of the soil. In Hungarian viticulture, preservation of soil moisture is extremely important because of the low amount of annual precipitation (sometimes less than 500 mm per year) and evapotranspiration from June to August is typically higher than precipitation (Bauer et al., 2004). Therefore, the use of cover crops in the inter-row can be beneficial, particularly on steep slopes and in case of organic farming to provide environmentally friendly soil management. One of the most often used soil management methods in the vineyards of Hungary is mechanical cultivation. But when this is used too often or inadequately, several negative effects can be observed: dry soil caused by increased evapotranspiration, deteriorating soil structure, increased erosion and nutrient losses (Bauer et al., 2004; Aljibury and Christensen, 1972; Dijck et al., 2002). Continuous mechanical soil management can also lead to topsoil and subsoil compaction from long-term traffic (Ferrero et al., 2005; Zanathy, 2006). For soil covering, several materials (e.g. straw, reed, sedge) or cover crops can be used. The species-rich cover crop mixture helps to not only to prevent erosion and provide easier of cultivation, but has a positive effect on soil structure, soil fertility and ecosystem functioning. The growth of the roots is influenced by soil structure, so the growth of the grapevine is also influenced by compaction and soil moisture (Wheaton et al., 2008). Requirements for a suitable cover crop species are as follows: it should save the soil from erosion and compaction caused by the movement of workers and machines and it should not compete significantly with the grapevines. In addition of these parameters, the optimal mixture contains local species from local provenance.

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Material and methods

In the spring of 2012 we began to develop and test several species-rich cover crop mixtures. The experiment was set up in the Tokaj and Szekszárd (Northeast, and Southwest-Hungary) wine regions. Botanical surveys were performed in the years 2012 and 2013. The investigated varieties of vines were 'Furmint', and 'Hárslevelű' (Tokaj wine region) and 'Kékfrankos' (Szekszárd wine region). During the experiments, three species-rich cover crop mixtures (Biocont-Ecovin mixture, Legume mixture, Grass-herb mixture) were compared in the vineyards. Each mixture was sown in three inter-rows (adjacent to each other) at each place of the experiment. We investigated five blocks per treatment (five vines in one block). Besides botanical measurements, grape yield, must quality, and pruning weight was studied in every treatment. The experimenets were located in slope areas where prevention of erosion is especially important. Another aim was to study which kind of native plants are optimal to cover the inter-rows instead of mechanical cultivation for our climate.

Results

The results showed that out of the sown species *Centaurea cyanus*, *Lotus corniculatus*, *Medicago lupulina*, *Onobrychiis viciifolia*, *Plantago lanceolata*, *Trifolium pretense*, *Trifolium repens* and *Vicia sativa* established during the two years long period in the inter-rows, coverage of weed species was much lower in the sown inter-rows regardless of sown seed mixture than in the control inter-rows (Table 1).

Table 1. The coverage (%) of the weed species in the years of 2012 and 2013

	Biocont-Ecowin		Legume mixture		Grass-herb mixture		Control	
	2012	2013	2012	2013	2012	2013	2012	2013
Gróf Degenfeld	55,6	63,5	84,1	35,2	48,2	16,9	105,9	96,7
Illyés Kúria	7,5	18,7	19,9	13,5	16,7	9,9	74,0	76,9
Tokaj-Oremus / Budaházi	2,6	0,6	49,1	1,7	19,8	0,1	100,2	94,7
Tringa Borpince	25,3	27,8	53,1	2,5	56,0	9,5	87,0	110,4

Total plant coverage in the sown inter-rows exceeded just over 80% in two trials already in 2012 (Table 2). The much higher total plant cover than seen in the control for the sown inter-rows is promising for erosion control.

Table 2. Total plant coverage (%) of the inter-rows in the years of 2012 and 2013

	Biocont-Ecowin		Legume mixture		Grass-herb mixture		Control	
	2012	2013	2012	2013	2012	2013	2012	2013
Gróf Degenfeld	69,0	88,6	69,0	96,6	80,6	94,0	44,4	77,0
Illyés Kúria	49,4	85,4	63,0	90,6	86,0	88,0	14,0	68,0
Tokaj-Oremus / Budaházi	37,0	86,0	39,6	87,0	58,6	62,0	11,0	46,0
Tringa Borpince	30,0	96,6	46,0	97,6	46,0	95,6	42,0	73,4

Experimental sites where controll blocks in every inter-row had the weed flora mown, higher yield – but not significantly – was seen in some blocks using cover crops (Figure 3). However, Figure 4. shows higher yield of the experiment sites in cases where every second inter-row of the conroll blocks was mechanical cultivated, combined with mown inter-rows. The difference was not significant. In our drier climate, and in unirrigated vineyards, sowing every second inter-row appears more optimal provided erosion control is not required. Abnormal circumstances in the soil, for example lack of water, may cause stress to the plants, which negatively influences both growth and yield (Fardossi, 2002).

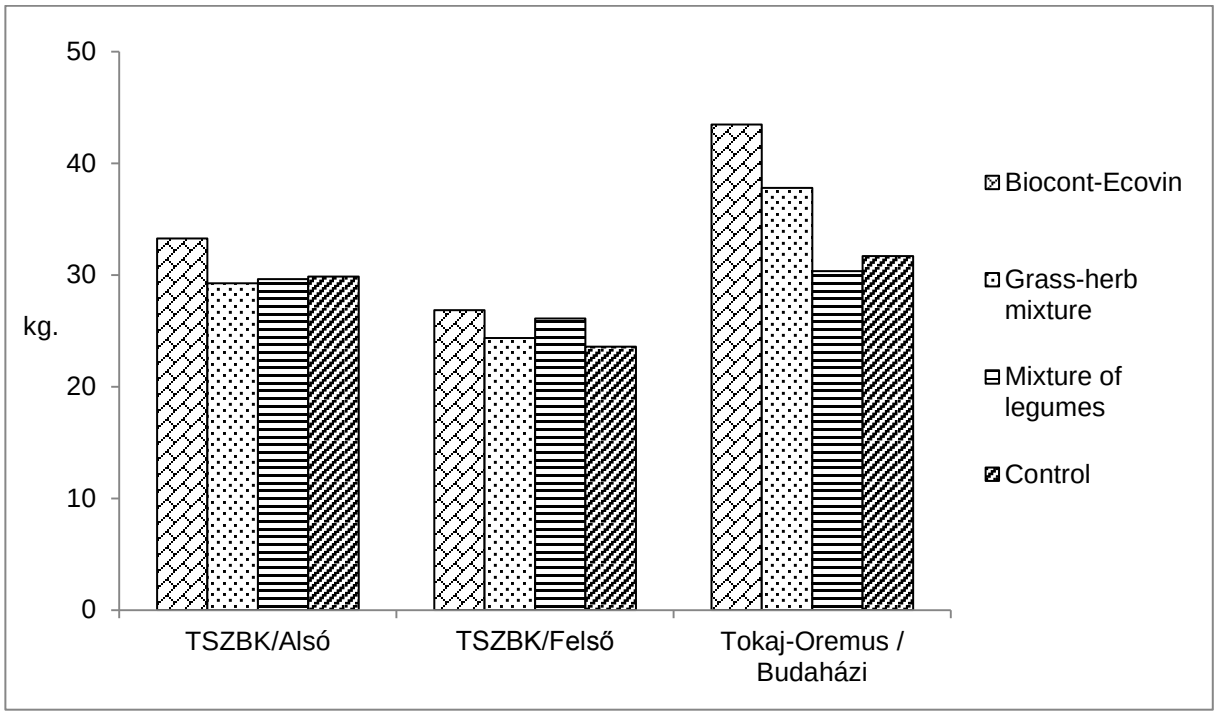

Figure 3. Yield of 25 grapevines in case of every treatment in the year of 2012

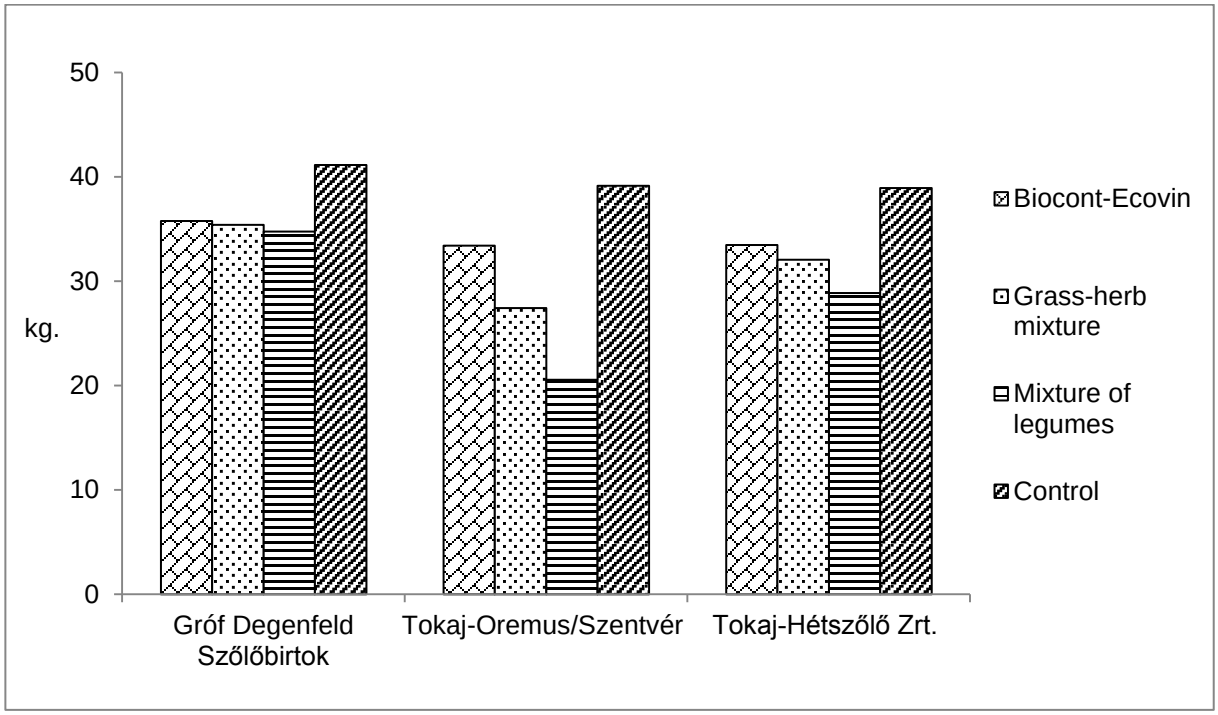

Figure 4. Yield of 25 grapevines in case of every treatment in the year of 2012

Discussion

Vine growers showed high interest in the importance of this practice, thus we involved other wine regions of Hungary in the experiment in 2013. A lack of water leads to a decrease in photosynthetic activity, which causes less vigorous vegetative growth, lower yield and lower grape quality (Azevedo et al., 2008; Escalona et al., 2003). That is why we have to compose optimal mixtures and explore management technology, to avoid water stress, but also to save the soil from degradation. The results of our experience can help the Hungarian vine growers to choose optimal cover crop mixtures in their vineyards, depending on the age of the grapevines, and in consideration of edafic and climate conditions.

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