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The impact of fall-planted legume and grass cover crops on grape production

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Depending on plant type, biomass production, and time of plow down, cover crops can have substantial effects on several elements of grape production. We have conducted several multi-year experiments in vineyards located in Fresno, Madera, and Napa Counties to determine the impact of fall-planted legume and grass cover crops on weeds, insects, spiders, soil fertility, vine nutrient status, water use, plant parasitic nematodes, and grape yield and quality. In one vineyard (Kearney Agricultural Center, Fresno Co.), we compared two systems, one that used rye/vetch cover crop for dry mulch in combination with pre- and/or postemergence herbicides for weed suppression in vine rows; and a second system that used clean cultivation of row middles and pre- and/or postemergence herbicides for weed control in vine rows. In two other vineyards (Madera Co. and Napa Co.), we compared oat/vetch or rye/vetch cover crop-based systems with a clean-cultivated system. The cover crop systems included a green manure (early-till) system and a reseed (late-till) system. Vegetation in vine rows were controlled with pre- and postemergence herbicides in the Madera vineyard, and with postemergence herbicides and in-row mowing in the Napa vineyard. In 1996, we initiated another experiment at the Kearney Agricultural Center for mechanistic studies of the interaction of the late-till and clean-cultivated systems with nitrogen fertilizer, and the impact of these interactions on the biology and abundance of leafhoppers and their natural enemies.

Our findings to date indicate that rye/vetch or oat/vetch cover crops can have a substantial but variable impact on several elements of grape production. The impact depended largely on cover crop management, water use, and vineyard age. In the

cover crop and mulch system, weed populations were maintained at acceptable levels with mulch and one late winter application of postemergence herbicides. By the fourth year (1996), mulch in vine rows in combination with postemergence herbicides reduced the cumulative negative effect of summer weeds on grape yield and quality in bare and non-mulched plots that had been treated only with postemergence herbicides. To maintain vines at similar water status, the mulch and cover crop system (Kearney) and the reseed system (Madera) utilized approximately 30% more irrigation water than the clean-cultivated or green-manure systems. The cover crop and mulch system provided the greatest relative increase in soil fertility, soil microbial biomass (Kearney) and vine nitrogen levels compared with the clean-cultivated systems. The green manure and reseed systems in the Madera site maintained similar level of vine nitrogen compared with the clean-cultivated system that used fall-applications of compost, but the reseed system resulted in slightly improved grape yield and quality. Water and nutrient stresses occurred in the reseed systems in very young vineyards (first year at the Napa site) where supplemental water was not provided to the vines and the cover crop was primarily composed of oat (vetch grew poorly during the first year because of late planting) and weeds were not controlled well in the vine row. These conditions resulted in lower grape yield, but higher grape and wine quality in the reseed system. During the second year at the Napa site, both oat and vetch grew well, while nitrogen stress was less than the previous year, and water stress was alleviated by providing the vines with approximately 30% more irrigation water in June. These adjustments reduced the negative effects of cover crops on vine growth and yield, while maintaining leafhopper populations at substatially lower levels in the late-till plots compared with clean-cultivated plots.

Densities of leafhopper pests depended on cover crop management and vineyard age and their resulting impact on spider abundance and vine nitrogen. In the 'young' Kearney vineyard, leafhopper problems were exacerbated at the end of the season in two out of four years in the cover crop and mulch system, primarily due to higher nitrogen levels and low resident spider populations, which lacked species that are

well known to respond positively to the presence of reseed cover crop systems. We have not previously observed higher levels of leafhoppers in association with reseed rye/vetch systems. In the Madera and Napa sites, leafhopper abundance was maintained at substantially lower levels in the reseed (without mulch) system compared with green manure and clean-cultivated systems, but for different reasons. In the 'young' Napa vineyard, the reseed system caused a reduction in vine nitrogen (and probably water) levels which are known to negatively affect leafhopper abundance. By contrast, vine nitrogen and water levels were not affected by any of the vegetation management systems in the Madera vineyard, where leafhopper abundance was negatively associated with spider abundance. Both the Napa and Madera results were duplicated in another Kearney vineyard where rye alone resulted in lower nitrogen and leafhopper levels than clean-cultivated plots, but spider densities were similar in both rye and clean-cultivated plots without added nitrogen. In contrast, as observed in the Madera vineyard, a mixture of rye and vetch (without added nitrogen) maintained nitrogen levels at similar densities to the rye alone plots, but resulted in substantially higher spider densities and lower leafhopper densities than in the clean-cultivated plots. We have previously determined that a spider assemblage similar to that found in the Madera and Kearney vineyards can cause significant reductions in leafhopper abundance.

The effects of vegetation management on operating costs represented a trade-off in water, fertilizer, pesticide and resource use. The use of cover crops (despite greater water demand) significantly reduced operating costs where savings were realized by reducing chemical (pesticide, herbicide, and nitrogen fertilizer) inputs. These savings were greatest where the use of cover crops (primarily as reseed with and without mulch) increased grape yield and/or quality. Savings may also increase if we were to include the potential costs where environmental contamination or increased health risk to humans and wildlife are likely to occur as a result of the use of selected pesticides, herbicides and synthetic fertilizers.