Effects of Vineyard Floor Management Practices on the Development of Distinct Weed Communities in a California Vineyard

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INTRODUCTION

Runoff of pesticides from agricultural land is a key water quality concern on the Central Coast of California. Growers are under increasing pressure to reduce runoff and associated sediment and pesticide loads. 139,299 pounds of simazine were used on 23% of the grape acreage in 2000 (NAPIAP, 2000). This material has been the subject of concern regarding contamination of groundwater. However, it is an exceedingly useful material that provides long-term, economical control of a wide spectrum of weeds in vineyards. It is frequently tank mixed oxyfluorfen to extend the spectrum of weeds; this mixture is commonly used as a strip spray application in the winter in Monterey County. Due to concerns regarding water quality, this project was initiated to examine alternative weed control strategies and vineyard floor management techniques to reduce runoff in vineyards in Monterey County.

METHODS

The study was established in 2000 in a drip-irrigated vineyard in Greenfield. The annual rainfall in Greenfield typically varies from 4 to 8 inches per year. The vineyard was established in 1996 with *Vitis vinifera* L. cv. Chardonnay on Teleki 5C (*V. berlandieri* Planch. x *V. riparia* Michx.) rootstock. Vine spacing was 8 feet between rows and 6 feet within rows. The soil was Elder Loam with gravelly substratum.

Weed control treatments were applied to a 3 foot wide strip in the vine row and included the following treatments: 1) standard preemergence (simazine @ 1.8 lb a.i./A + oxyfluorfen @ 1.0 lbs a.i./A) applied in the winter followed by postemergence herbicides (glyphosate @ 2.0% + oxyfluorfen @ 1.0%) applied in the spring and summer as needed with a Patchen® light activated sprayer; 2) postemergence herbicide treatment (glyphosate @ 2.0% + oxyfluorfen @ 1.0%) and supplemented by applications of glufosinate @ 3%, applied in the spring and summer as needed with a Patchen® light activated sprayer; and 3) cultivation treatment with a Radius Weeder® (Clemens & Co., Wittlich, Germany) cultivator utilized in the spring and summer as needed. The cultivation treatment consisted of a metal bar held perpendicular to the direction of tractor movement. When inserted slightly below the soil surface, it severs weed shoots from their roots. The cultivation treatment was supplemented with had weeding around the base of the vines in the summer. Herbicide applications and cultivations were timed in accordance with grower practices.

Cover crops were planted in the row middles. The cover crop treatments included: 1) no cover crop (bare ground), 2) *Secale cereale* L. cv. Merced rye (rye), and 3) X *Triticosecale* Wittm. ex A. Camus cv.Trios 102 (triticale). Cover crops were planted with a vineyard seed drill in the

center 32 inches of the row middles just before the start of the rainy season in the winters of 2000-01, 2001-02, 2002-03, 2003-04 and 2004-05. They were mowed in spring for frost protection and they senesced in summer. Before planting new cover crop seed each November, middles were disced to smooth out dried stubble remaining from the previous winter's cover crop and any weeds that became established during the growing season. Bare ground middles disced during the spring and summer as needed.

Weed control treatments (established in the vinerows) and cover crop treatments (established in the middles) were arranged in a 3 x 3 split-block design with three replicate blocks, covering a total of 23 vineyard rows (7.0 acres). Each block contained six vinerows and six adjacent middles. Weed control treatments, the mainplot treatments, were applied along the entire length of each vine row, which included approximately 300 grapevines. Cover crop treatments, the subplot treatments, were applied along one-third of each middle and were continuous across mainplot treatments in each block. Each replicate mainplot x subplot treatment combination included approximately 100 grapevines and covered an area of 0.11 acre. Data was collected from every other vine row and adjacent middle. Weed evaluations were conducted 4 to 5 times during the spring through fall. Percent vegetative cover and plant diversity were estimated using a line-intercept technique. Plant species intersecting points at 12 inch intervals along a 100 foot transect (18% of the plot) were recorded in each plot. Cash costs for weeding were calculated by collecting information on each weed control operation: quantities and types of materials used, dates and time to complete operations, type of equipment used and time to cultivate or hand weed. Soil compaction was measured in the vine row in the fall of 2003, 2004 and 2005 with a Field Scout Soil Compaction meter SC-900 (Spectrum Technologies, USA).

RESULTS AND DISCUSSION

Percent vegetative cover (weed frequency) over five years indicated that distinct weed communities developed in each weed control treatment. There were more weeds in the cultivation treatment than either the preemergence or post emergent weed control strategies (Figure 1). There were low levels of purslane (*Portulaca oleracea*) and shepherds purse (Capsella bursa-pastoris) at the onset of the trial, presumably due to good control of these two weed species with the combination of cultivation and post emergent weed control strategy that was used in the vineyard prior to the initiation of the trial. However over five years, shepherds purse and purslane have increased dramatically and are the dominant winter and summer weeds in the cultivation treatment (Figures 2 & 3). Shepherds purse and purslane were mostly are at low levels in the preemergence and post emergent treatments. In the postemergence treatment horseweed (*Conyza canadensis*) increased in frequency in 2003 (Figure 4). The increase in population of this weed was stable may be due to the use of glyphosate and oxyfluorfen in 2001 and 2002, both of which provide limited control of this weed. To bring this weed under adequate control it was necessary to apply glufosinate in the 2003, 2004 and 2005 seasons. In 2004 and 2005 the population of this weed was stabilized, but still persistent in the post emergent treatment. Nutsedge (*Cyperus esculentus*) was the dominant weed in the preemergence weed control treatment in all years except 2004 (Figure 5). It is not controlled by the preemergence herbicides, but was partially controlled with post emergent applications of glyphosate. The

population was persistent, but evidently the weed control strategy that was employed in the trial significantly reduced the population of this weed in 2003, 2004 and 2005.

The weed populations affected weed control costs in the vineyard. The cultivation treatment evolved into the most expensive weed control treatment over time, principally due to the expense of hand removal of purslane that clumped around the trunk of the vines (Table 1). The post emergent treatment was the least expensive weed control treatment from 2001 to 2004, but in 2005 the preemergence treatment was least expesive. The cultivation treatment also had greater soil compaction than the herbicide treatments (Figure 6), but the compaction did not reduce the yields or quality of the grapes over the course of the trial (data not shown).

The three weed control strategies developed distinct weed control communities. The weeds present in these communities were species that took advantage of the weaknesses of each control strategy.

LITERATURE CITED

[NAPIAP] National Pesticide Impact Assessment Program. 2002. Crop profile for grapes (wine) in California. Available online: http://www.ipmcenters.org/cropprofiles/docs/cagrapes-wine.html

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Table 1. Weed control cash costs from 2002 to 2005

Weed Control Strategy	2002	2003	2004	2005
Cultivation	102	137	274	381
Post emergence	94	131	85	196
Preemergence FB post emergence	138	138	115	172

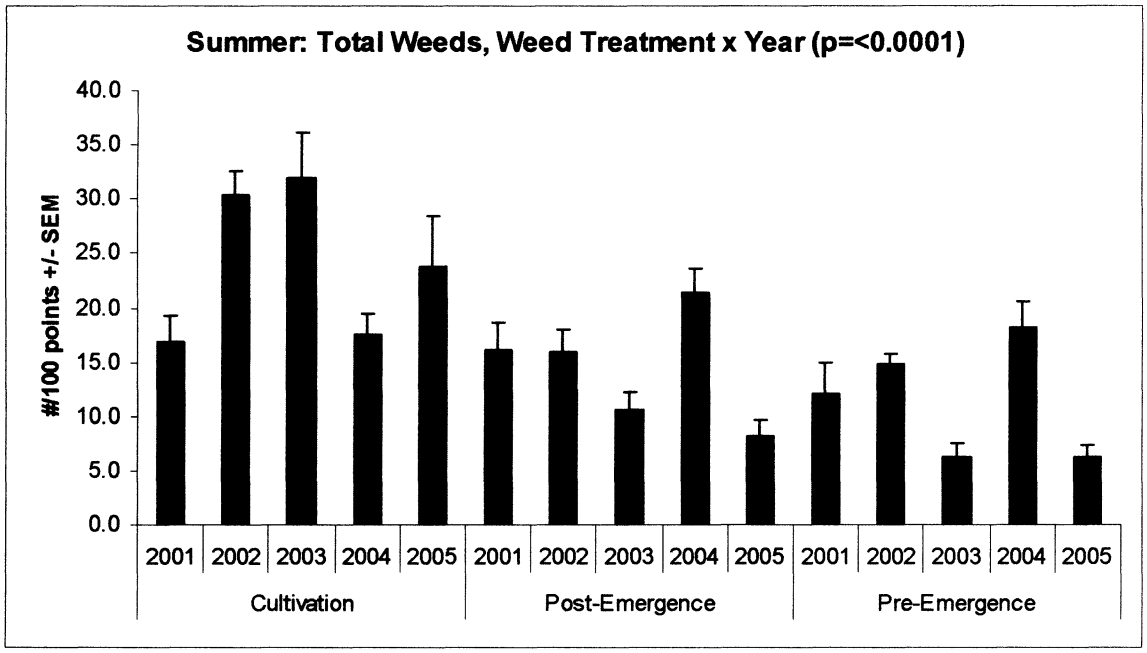

Figure 1. Total weed frequency in the summer in weed control treatment over five years.

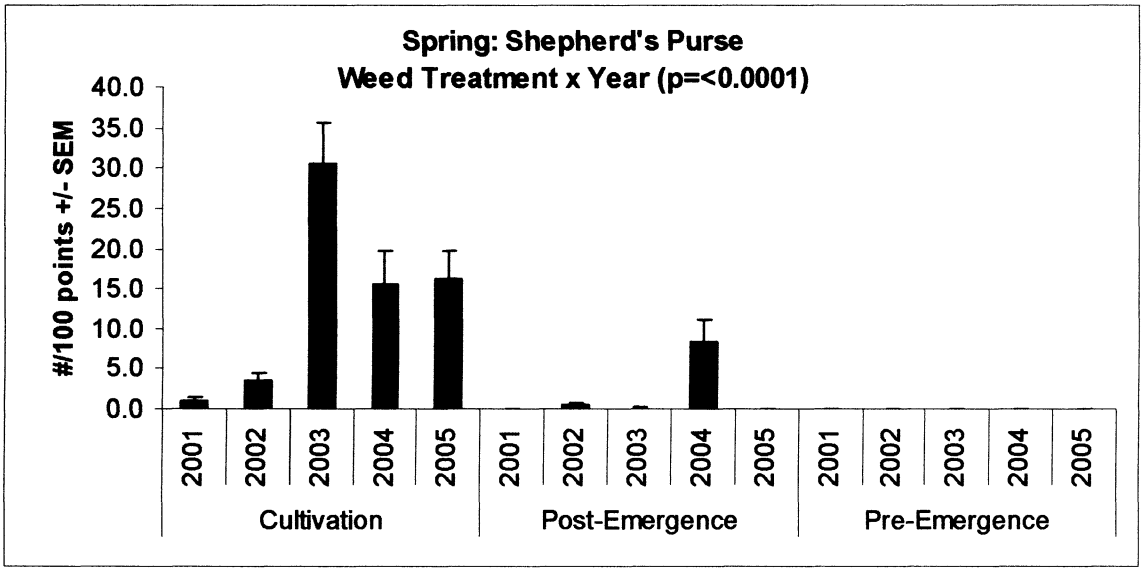

Figure 2. Shepherds purse frequency in all weed control treatments over five years

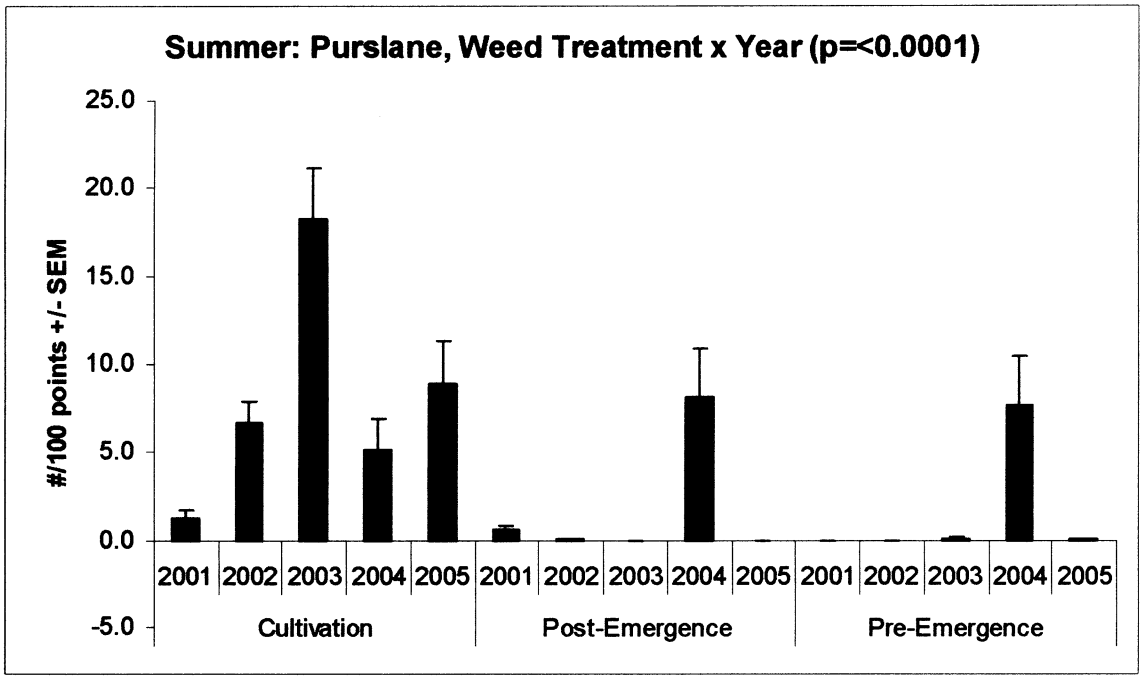

Figure 3. Purslane frequency in all weed control treatments over five years

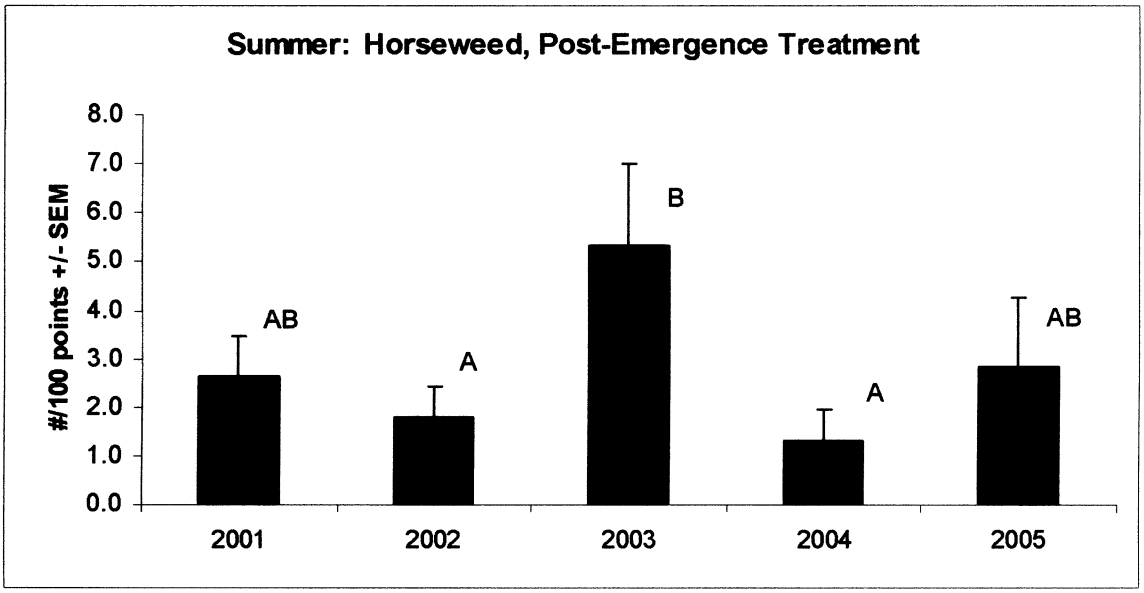

Figure 4. Horseweed frequency in post emergence treatment over five years

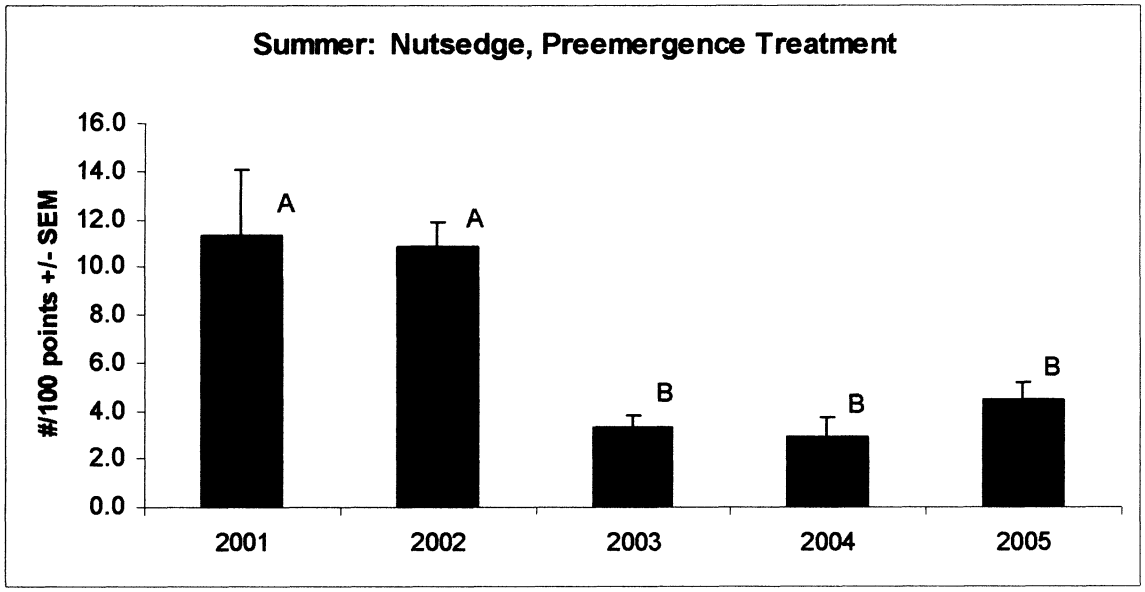

Figure 5. Nutsedge frequency in preemergence treatment over five years

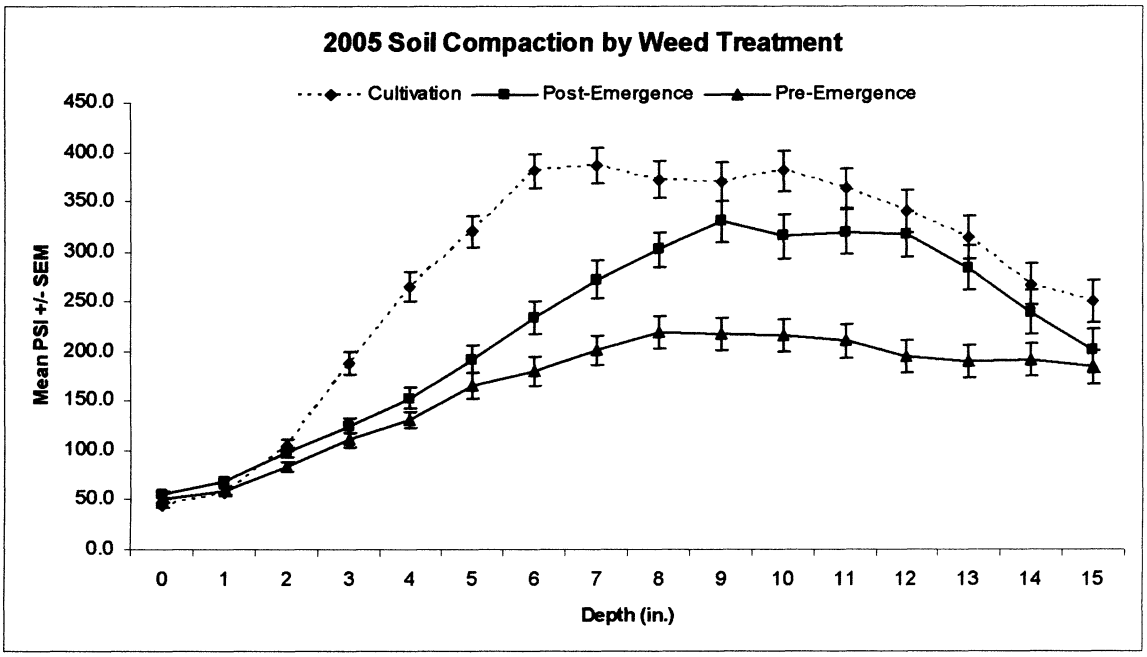

Figure 6. 2005 Soil compaction in weed control treatments