Understanding weed management strategies between BIFS and conventional growers

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Objectives

- Assess pesticide use trends for BIFS and Conventional growers in San Joaquin County
- Investigate whether alternative weed management practices help BIFS growers reduce their use of pre-emergent herbicides
What is the BIFS winegrapes program?

- BIFS: Biologically Integrated Farming System
- Overall goals for BIFS on winegrapes: reduce the use of harmful pesticides and promote the use of alternatives
- Winegrape BIFS: for this program, one objective is to reduce use of pre-emergent herbicides (e.g., simazine and diuron) by using alternative practices and/or reduced-risk contact herbicides
- Participants: from 1996-1998, Lodi-Woodbridge growers volunteered for the BIFS winegrape program
Weed Management: Conventional vs. BIFS practices

Conventional practices
- use of agrochemicals to suppress weeds – [Simazine, Karmex (diuron), paraquat, roundup (glyphosate), Goal (oxyfloufen)]

BIFS practices
- monitoring and need-based spraying
- Enviromist-type shielded sprayer with Roundup (requires less material per sprayed acre, but expensive)
- Mechanical weed management
- Use of cover crops

Methods

Data Sources:
1. PUR data (1993-2001) from DPR
2. Weather data from CIMIS (DWR)
3. Pesticide economic and efficacy literature

Study Location: San Joaquin County
- 49 BIFS fields (~ 3,000 acres)
- ~ 1100 non BIFS fields (~ 75,000 acres)

Chemicals examined
- Pre-emergents: simazine, diuron, oryzalin, oxyflourfen, norflurazon
- Contact: glyphosate, paraquat dichloride
Methods (continued)

Measures:
- Lbs of active ingredients/acre planted
- Ratios
  - lbs of AI per acre planted of glyphosate over simazine
  - lbs of AI per acre planted for BIFS over CONV

Spatial analysis: to examine spatial patterns, we used the PUR – GIS, a program that links GIS functionality to the pesticide use records.

Characterization of fields (each field received a designation based on herbicide use):
- GLY: used glyphosate, but no simazine
- SMZ: used simazine, but no glyphosate
- BSG: used both simazine and glyphosate
- NSG: used neither simazine or glyphosate
- NR: no reported use
## Trends of BIFS practices

<table>
<thead>
<tr>
<th>BIFS Management Practice</th>
<th>% of vineyards using practice</th>
<th>BIFS Management Practice</th>
<th>% of vineyards using practice</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cover Crops: Annual</td>
<td>38%</td>
<td>34%</td>
<td>28%</td>
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<tr>
<td>Cover Crops: Perennial</td>
<td>53%</td>
<td>46%</td>
<td>44%</td>
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<tr>
<td>Weekly Monitoring</td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
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<tr>
<td>Strip sprays: Pre-emergent herbicides</td>
<td>70%</td>
<td>57%</td>
<td>59%</td>
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<tr>
<td>Strip sprays: Contact herbicides</td>
<td>19%</td>
<td>35%</td>
<td>39%</td>
</tr>
<tr>
<td>Mechanical weed control under vine</td>
<td>10%</td>
<td>8%</td>
<td>7%</td>
</tr>
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</table>
Pesticide use and index (price x effectiveness)

Lbs of pre-emergent AI used on BIFS fields

Lbs of AI applied on BIFS vineyards
PRE EMERGENT

active ingredient (lbs)

Year


- diuron
- simazine
- trifluralin
- oryzalin
- oxyflourfen
- napropamide
- norflurazon
Lbs of contact AI used on BIFS fields

![Graph showing the use of paraquat and glyphosate active ingredients on BIFS vineyards from 1992 to 2001. The graph indicates a peak in 1999 and a decrease in subsequent years.]
Glyphosate to simazine ratio

GLY:SMZ ratio

Year

ratio (lbs AI per ac. plt of GLY/ lbs AI per ac. plt SMZ)

BIFS-weed focus group (n=18)
Conv (n=1120)
BIFS-all (n = 49)
BIFS/CONV use ratio for pre-emergent herbicides

Use Ratio (lbs of AI per ac.plt, BIFS/CONV)
PRE EMERGENT

Year

Use ratio
0 0.5 1 1.5 2 2.5 3 3.5 4 4.5 5

- diuron
- simazine
- trifluralin
- oryzalin
- oryzalin
- oxyflourfen
- norflurazone
- Pendimethalin
BIFS/CONV use ratio for contact herbicides

Use Ratio (lbs of AI per ac.plt, BIFS/ CONV)

Year

Use ratio

paraquat

glyphosate

Rainfall and BIFS simazine use

$r^2$: before (93-95) .13  during (96-98) .38  after (99-2000) .05

Data source: Rainfall from CIMIS, pesticide data from DPR

Lodi Rainfall (Station 42) and BIFS simazine use

- Rainfall (mm)
- Simazine

Date

Jan-92  Jan-93  Jan-94  Jan-95  Jan-96  Jan-97  Jan-98  Jan-99  Jan-00

Lbs of AI

0  50  100  150  200  250  300

Rainfall (mm)

0  50  100  150  200  250  300
## Acreage composition of BIFS field categories

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<tbody>
<tr>
<td>SMZ</td>
<td>27.9%</td>
<td>36.7%</td>
<td>36.1%</td>
<td>18.9%</td>
<td>8.1%</td>
<td>23.2%</td>
<td>28.3%</td>
<td>15.4%</td>
<td>7.4%</td>
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<tr>
<td>GLY</td>
<td>22.0%</td>
<td>14.6%</td>
<td>22.7%</td>
<td>36.5%</td>
<td>23.2%</td>
<td>21.7%</td>
<td>23.7%</td>
<td>30.0%</td>
<td>27.9%</td>
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<tr>
<td>BSG</td>
<td>13.4%</td>
<td>11.5%</td>
<td>12.2%</td>
<td>12.0%</td>
<td>33.3%</td>
<td>36.9%</td>
<td>18.9%</td>
<td>34.9%</td>
<td>12.6%</td>
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<tr>
<td>NSG</td>
<td>9.1%</td>
<td>2.3%</td>
<td>13.1%</td>
<td>1.6%</td>
<td>22.8%</td>
<td>3.0%</td>
<td>18.1%</td>
<td>0.0%</td>
<td>20.8%</td>
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<tr>
<td>NR</td>
<td>27.6%</td>
<td>34.9%</td>
<td>15.9%</td>
<td>31.0%</td>
<td>12.7%</td>
<td>15.2%</td>
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<td>3082</td>
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<td>NSMZ</td>
<td>58.7%</td>
<td>51.8%</td>
<td>51.7%</td>
<td>69.1%</td>
<td>58.6%</td>
<td>39.9%</td>
<td>52.8%</td>
<td>49.7%</td>
<td>83.1%</td>
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### Ratio of CT to PE herbicide use on BIFS fields (by application)

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<tr>
<td>SMZ</td>
<td>0.64</td>
<td>0.65</td>
<td>0.78</td>
<td>0.67</td>
<td>0.75</td>
<td>0.50</td>
<td>0.38</td>
<td>0.45</td>
<td>0.44</td>
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<td>GLY</td>
<td>7 to 0</td>
<td>2.00</td>
<td>7.00</td>
<td>3.20</td>
<td>2.56</td>
<td>2.83</td>
<td>1.31</td>
<td>3.00</td>
<td>4.67</td>
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<tr>
<td>BSG</td>
<td>1.00</td>
<td>1.50</td>
<td>1.38</td>
<td>1.20</td>
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<td>NSG</td>
<td>1.00</td>
<td>1.00</td>
<td>2.25</td>
<td>2 to 0</td>
<td>1.00</td>
<td>1.25</td>
<td>1.11</td>
<td>0 to 0</td>
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<td>1.41</td>
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<td>NSMZ</td>
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<td>1.56</td>
<td>3.83</td>
<td>3.60</td>
<td>1.78</td>
<td>2.20</td>
<td>1.23</td>
<td>3.00</td>
<td>2.71</td>
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## Chemicals use for BIFS group

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<td>diuron</td>
<td>10.9%</td>
<td>7.6%</td>
<td>7.9%</td>
<td>9.1%</td>
<td>4.3%</td>
<td>6.5%</td>
<td>9.5%</td>
<td>9.4%</td>
<td>3.5%</td>
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<td>glyphosate</td>
<td>13.9%</td>
<td>17.6%</td>
<td>18.3%</td>
<td>21.2%</td>
<td>21.5%</td>
<td>25.9%</td>
<td>20.3%</td>
<td>26.2%</td>
<td>32.6%</td>
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<td>napropamide</td>
<td>1.5%</td>
<td>0.8%</td>
<td>0.8%</td>
<td>1.2%</td>
<td>2.4%</td>
<td>0.5%</td>
<td>0.6%</td>
<td>2.6%</td>
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<tr>
<td>norflourazon</td>
<td>2.9%</td>
<td>8.4%</td>
<td>5.6%</td>
<td>3.6%</td>
<td>5.3%</td>
<td>4.2%</td>
<td>3.2%</td>
<td>3.1%</td>
<td>3.5%</td>
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<td>oryzalin</td>
<td>8.8%</td>
<td>8.4%</td>
<td>4.8%</td>
<td>4.2%</td>
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<td>3.7%</td>
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<td>oxyflourfen-2xl</td>
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<td>0.0%</td>
<td>1.2%</td>
<td>10.5%</td>
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<td>oxyflourfen-g1.5</td>
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<td>paraquat</td>
<td>21.9%</td>
<td>16.8%</td>
<td>24.6%</td>
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<td>22.5%</td>
<td>24.5%</td>
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<tr>
<td>pendimethalin</td>
<td>1.5%</td>
<td>1.7%</td>
<td>0.8%</td>
<td>0.0%</td>
<td>1.9%</td>
<td>0.5%</td>
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<td>0.5%</td>
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<td>sethoxydim</td>
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<td>4.2%</td>
<td>0.8%</td>
<td>0.0%</td>
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<td>1.3%</td>
<td>0.0%</td>
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<tr>
<td>simazine</td>
<td>23.4%</td>
<td>16.0%</td>
<td>18.3%</td>
<td>18.8%</td>
<td>16.3%</td>
<td>17.6%</td>
<td>11.4%</td>
<td>18.3%</td>
<td>12.8%</td>
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<tr>
<td>trifluralin</td>
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<td>thiazopyr</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
<td>0.0%</td>
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<td>0.0%</td>
<td>0.5%</td>
<td>0.0%</td>
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<tr>
<td>TOTAL_APPS</td>
<td>137</td>
<td>119</td>
<td>126</td>
<td>165</td>
<td>209</td>
<td>216</td>
<td>158</td>
<td>191</td>
<td>86</td>
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</table>
Spatial examination of BIFS fields

Conclusion

- Pre-emergent reduction on BIFS fields: BIFS program was successful in reducing several pre-emergent herbicides in the inaugural year: simazine, oryzalin, and oxyfloufen decreased in use on BIFS fields in the initial year (1996)
  - Particularly, weed focus group (n = 18)
- Increase in contact herbicides on BIFS fields: Ratio of contact to pre-emergent herbicide use has increased since the inception of the program
- Field categories: since program started, the majority of acreages shifted from SMZ to GLY in 1996; then to BSG in 1997 and 1998 (more diversified approach)
  - GLY group: overall, this group used fewer applications herbicides per field (avg. 3). Of the ones they used, contact herbicides were favored by a 3 to 1 ratio
  - SMZ group: used more applications of herbicides per field (avg. 6) and favored pre-emergents by 2 to 1 ratio
- Spatial examination: there was no apparent pattern
**Discussion**

- Potential factors contributing to initial reduction of simazine and other pre-emergents in 1996:
  - Initial enthusiasm for project
  - Low weed pressure in 1996
  - Use of alternative practices
  - Grower-driven program (meetings run by growers) – both small and large operations were involved
- Increase in pre-emergent use in 1998:
  - Unusually high rainfall contributed to increased weed problems, thus higher simazine use
- After-effect: influence from program can be seen years after the program ends. (e.g., contact herbicide use on the rise)
- PUR data disagrees with LWWC (PUR shows more use than LWWC). One possible explanation is that field resolution within the PUR database is not good enough. PUR data might be including herbicide use from adjacent non-BIFS lots (but PUR recognizes it as one field).
Questions ?