The Fennel Battle on MCB Camp Pendleton: Partnerships and Techniques in Combating the Invasion

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- Collaborative efforts to control fennel, artichoke thistle, and other upland weeds
- Artichoke thistle (*Cynara cardunculus*) control initiated in 1984
- Fennel (*Foeniculum vulgare*) is the most widespread upland weed on Base today
- Over 1,200 acres of fennel dominated habitat treated; over 18,466 acres remain
Fennel Biology / Ecology

- Apiaceae family; perennial herb
- Native to S. Europe & Mediterranean
- Commercially grown for young edible root and seeds for cooking
- Reproduces via rhizome and seed
- Prolific seed production and viability
- Disperses via water, traffic, wildlife, etc.
- Disturbance (e.g., vehicles) can encourage dispersal and establishment
Baseline Research

• Santa Cruz Island study
  – Wet season herbicide applications significantly more effective than dry season application (Brenton & Klinger 2002, 1994)
  – Triclopyr (Garlon) applied in early spring had 95-100% kill
  – Glyphosate (Roundup) applied in early spring had 75-80% kill (Dash & Gliessman 1994 in Bossard et al. 2000)

• Base funded study by SDSU
  – Fennel density and height was significantly lower in annually burned vs. unburned areas before treatment
  – No significant difference between burned and unburned areas 1 year after treatment
  – Garlon treatments are far more effective than burning alone
  – Remove biomass before treatment
• 4 replications of 9 different treatments & 1 untreated control for two years (plots = 15’x2’)
• Results indicate Triclopyr and a mix of Glyphosate/Triclopyr to be more effective on fennel than Glyphosate alone @ 1 & 2 lbs/A
• % cover and biomass for the Glyphosate/Triclopyr (1+2 lbs/A) treatment was 0
• Triclopyr did not appear to affect purple needle grass (Nassella pulchra)
Fennel biomass 4 months after treatment

Fennel cover 4 months after treatment

Purple needle grass cover 4 months after treatment

Fennel biomass 4 months after treatment

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Rate (lbs/A)</th>
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</thead>
<tbody>
<tr>
<td>1. Glyphosate</td>
<td>1</td>
</tr>
<tr>
<td>2. Glyphosate</td>
<td>2</td>
</tr>
<tr>
<td>3. Triclopyr (Garlon 4)</td>
<td>1</td>
</tr>
<tr>
<td>4. Triclopyr (Garlon 4)</td>
<td>2</td>
</tr>
<tr>
<td>5. Glyphosate + triclopyr</td>
<td>1+1</td>
</tr>
<tr>
<td>6. Glyphosate + triclopyr</td>
<td>1+2</td>
</tr>
<tr>
<td>7. Glyphosate + triclopyr</td>
<td>2+1</td>
</tr>
<tr>
<td>8. Glyphosate (spot spray)</td>
<td>2%</td>
</tr>
<tr>
<td>9. Triclopyr (spot spray)</td>
<td>1%</td>
</tr>
<tr>
<td>10. Untreated control</td>
<td></td>
</tr>
</tbody>
</table>

Untreated control 4 mo. after treatment

- Fennel biomass = 2.475 kg/15'x2'
- Cover = 65.414%

(Bell C. 2005)
Treatment Methods

• Depends on terrain and vegetation
• Combo of boom sprayers (6 ft wide), backpack (SP1), hose (100 ft), 4 x 4 vehicles
• Mow flatter areas > 50% fennel cover, then herbicide after 1 month re-growth
• Fire following and aerial treatments have potential
• Multiple year treatments (3 years) required
Strategies & Implications

• Large scale treatment strategy
  – Base-wide weed mapping (every 5 years)
  – Prioritize areas for treatment using ranking system and GIS modeling
  – Monitor to determine success

• Cost effectiveness
  – Best herbicide(s)/qty. (e.g., Garlon vs. Telar)
  – Long-term goals (e.g., restoration/succession)

• Research and fennel data needed
  – Population biology (e.g., seed production, germination, viability, etc.)
  – Invasion and treatment following fire
  – Biocontrol: no insects or fungi known; grazing
  – New technology: equipment, prediction, aerial, etc.
Conclusions

• Cooperation & vast efforts are required
• Available current research & reporting
  – Online & grey literature
  – Open communication
• Long term monitoring
• Adaptive management
Acknowledgments & Sources

• Funded by: MCB Camp Pendleton

• Partners / contactors:
  – Agrichemical Supply and Recon Environmental
  – Seiger et al., San Diego State University, 2003
  – Bell, UC Cooperative Extension, 2005

• Sources:
  – Personal communication with partners / contractors
  – Brenton & Klinger 2002, 1994; Dash & Gliessman 1994; Miller in Bossard et al. 2000
Questions ?