**Customized Backpack Sprayers for Site-Specific Herbicide Application in Forestry Operations**

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**PROBLEM STATEMENT**

- Significant amount of forestry herbicide application in Southeast US applied using manual labor
- Concerns about accurate labor records
- Quality of work performed unknown
- Unable to document manual labor used during forestry silvicultural operations
  - site preparation
  - regeneration
  - stand management

**BACKPACK CONCERNS**

- Worker Safety & Compliance
  - Walking through the contaminated vegetation all day (reentry issues)
  - Improper personal protective equipment
  - Compliance with worker regulations

- Quality Issues
  - Proper ground speed
  - Skips and double sprayed rows
  - Tank mix not correct
  - Dumping product
  - Wand height not correct

**PRECISION FORESTRY**

- The use of geospatial-based tools and technologies
  - for planning and conducting site-specific and condition-specific forest management activities and operations
  - to improve wood product quality and utilization, reduce waste, increase profits, and maintain environmental quality
  - for quality assurance and compliance of timber management practices

**OBJECTIVES**

- Design a new style of backpack sprayer for chemical application in forestry operations
- Develop a compact spatial data logger system for documenting worker activity

**SITE-SPECIFIC DATA**

- End Users
  - Landowner
  - Consultants
  - Contractor

- Information
  - Verification of services provided
  - Input to management decisions
  - Audits for SFI compliance
  - Certification
DATALOGGER DESIGN
- Small and lightweight
- Mounted at the top of backpack
- Tamper proof by worker
- Use low-cost GPS to document worker activity
- Ground speed readout for worker
- Record data to a compact storage device
  - Position, Speed, and Spray activity (On/Off)
- Used for spatially documenting other operations
  - Machine spraying, tree planting, site prep, etc.

SPATIAL DATALOGGERS
- Microcontroller based system
- 4 analog inputs
- Garmin 18 DGPS receivers
- Data recorded to compact flash card
- Data downloaded into GIS to generate as-applied maps and analyses

SMARTPACK SOLUTION
- Meet and exceed all safety standards
  - Nozzle at the rear of sprayer
  - Battery-powered pump unit to decrease worker energy output
  - High-quality backpack frame and harness for worker comfort
- Collect spatial data for worker performance and production
- Quality Issues
  - Real-time ground speed feedback for worker
  - Data collection for evaluating and reporting actual ground speed, product dumping, skips, and double sprayed rows
  - Rear adjustable fix mount wand to assure proper wand height

SMARTPACK SYSTEM
- Speed Display
- Toggle Switch

SMARTPACK
- Banded application

AS-APPLIED MAP
- SmartPack No.
  - SP 1
  - SP 2
  - SP 3
  - SP 4
- 12 ft row spacing
**SmartPack Activity Report**

**Landowner**

- **Contractor:** NA
- **Date of Application:** 3/15/2005
- **Amount of Product Used:** 10.1 oz/acre Velpar, 2.9 oz/acre SFM 75
- **Total Acres Covered:** 74.6 acres

**Contractor**

<table>
<thead>
<tr>
<th>SmartPack</th>
<th>AVG Speed</th>
<th>Target +/- 15%</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.6</td>
<td>68.0%</td>
</tr>
<tr>
<td>2</td>
<td>2.6</td>
<td>68.0%</td>
</tr>
<tr>
<td>3</td>
<td>2.5</td>
<td>69.0%</td>
</tr>
<tr>
<td>4</td>
<td>2.6</td>
<td>69.0%</td>
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</tbody>
</table>

**Target Speed:** 2.5 MPH

**Feet of Row Sprayed**

<table>
<thead>
<tr>
<th>SmartPack</th>
<th>Feet of Row Sprayed</th>
<th>Acres per Hour</th>
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</thead>
<tbody>
<tr>
<td>0</td>
<td>70,118</td>
<td>6.4</td>
</tr>
<tr>
<td>2</td>
<td>65,750</td>
<td>6.0</td>
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<tr>
<td>3</td>
<td>68,231</td>
<td>6.3</td>
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<tr>
<td>4</td>
<td>66,467</td>
<td>6.1</td>
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<tr>
<td><strong>Totals</strong></td>
<td><strong>270,566</strong></td>
<td><strong>24.8</strong></td>
</tr>
</tbody>
</table>

**Acres Covered:** 74.6 acres

**SUMMARY**

- A new site-specific backpack system developed with primary considerations for worker safety and comfort.
- Spatial datalogger permits the collection of worker activity.
- Provide contractor, consultants, and landowners various feedback on worker performance and compliance.

**QUESTIONS**