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WORKING PLAN

0.5 HA HERBICIDE TRIALS, NELSON REGION

C.F. Thompson
WORKING PLAN

TITLE WORKING PLAN FOR 0.5Ha HERBICIDE TRIALS, NELSON REGION

Report prepared by: C.F. Thompson (Signature) (Typed)

Report & Distribution approved by: (Signature) (Typed)

(a) Wide Distribution
(b) Limited
   (i) Internal - Branch only
   (ii) External - Designated
   (iii) Ministry only

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Silviculture Branch
Regional Office
District offices

Approved: D.L. Oswald (Signature) (Typed)
WORKING PLAN

FOR 0.5 ha HERBICIDE TRIALS

IN PLANTATIONS THREATENED

BY BRUSH COMPETITION

Introduction:

The Pesticide Control Branch has instigated a simplified pesticide application permit procedure for research trials covering up to 0.5 ha. This working plan is designed to cover such trials; it is appropriate for operational trials, where the main objective is the local calibration or validation of chemicals that have been well proven in other locations.

If, after a literature review, the suitability of the proposed chemical is still uncertain then a more comprehensive design, such as that being currently drafted by J. Pollack and L. Herring, should be used.

Objectives:

To assess the effect on tree regeneration and/or competing brush of:
- different herbicide formulations e.g., glyphosate vs. 2,4-D
- different application rates of one herbicide
- different application dates of one herbicide
- combinations of the above.

Alone or in combination with manual treatments.
Limitations:

1. The maximum number of chemically based treatments per trial that is recommended is five. At this level, approximately 1,600 seedlings per hectare are required to provide 20 seedlings per measurement unit (Table 1). Few plantations meet this requirement.

2. It is assumed that all chemical treatments will be ground applications.

3. Only one tree species can be considered.

4. The essential control treatment is not included in this total, neither are any mechanical treatments.

Design and Layout:

A completely randomized design will be used. Each treatment will be replicated three times, with plot size depending on the number of treatments elected (Table 1). Each plot will be isolated by a minimum of 10 m from the next. An example is shown in Figure 1.

Plot orientation will be governed by the logistics of application, but plots will be located to minimize variations in seedling stocking, brush cover, and ecological site type between plots.
TABLE 1
SPECIFICATIONS FOR HERBICIDE TRIALS - .5 ha BASIS

<table>
<thead>
<tr>
<th>Number of Treatments(^1)</th>
<th>Replications</th>
<th>Treatment Number(^5)</th>
<th>Treatment Area ((m^2))</th>
<th>Plot Size ((m))</th>
<th>Measurement Plot Area ((m^2))</th>
<th>Measurement Plot Size ((m))</th>
<th>Total Treated Area (^2) ((ha))</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3</td>
<td>6</td>
<td>800</td>
<td>40 x 20</td>
<td>476</td>
<td>34 x 14</td>
<td>.48</td>
</tr>
<tr>
<td>3</td>
<td>3</td>
<td>9</td>
<td>550</td>
<td>30 x 18</td>
<td>288</td>
<td>24 x 12</td>
<td>.495</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
<td>12</td>
<td>400</td>
<td>20 x 20</td>
<td>196</td>
<td>14 x 14</td>
<td>.48</td>
</tr>
<tr>
<td>5</td>
<td>3</td>
<td>15</td>
<td>300</td>
<td>20 x 15</td>
<td>126</td>
<td>14 x 9</td>
<td>.45</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Minimum Stocking Required(^3)</th>
<th>Trees - to - Measure Chemical</th>
<th>Additional(^4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>420</td>
<td>120</td>
</tr>
<tr>
<td>3</td>
<td>694</td>
<td>180</td>
</tr>
<tr>
<td>4</td>
<td>1020</td>
<td>240</td>
</tr>
<tr>
<td>5</td>
<td>1587</td>
<td>300</td>
</tr>
</tbody>
</table>

1. Excluding control or mechanical treatments
2. For chemical treatments. Mechanical treatments are additional. Excludes untreated buffers.
3. To provide 20 sample trees in Measurement Plot. (stems per ha.)
4. For control, same number for additional treatments.
5. Plus 3 for control, etc.

NOTE: Plot dimensions are subject to change, pending logistical trials.
Basis; 2 chemical treatments replicated 3 times, plus control (x3)

More chemical treatments would result in more, but smaller plots necessitating higher stocking levels (Table 1)

Treatments allocated to plots randomly.
Measures:

Assessments are planned preceding application, and after bud set in growing season 1, 2, 3 and 5 (1 being the season of application).

a) Seedling Response:

This will be based on 20 well spaced crop trees per measurement plot. Each seedling will be located before herbicide application and will be marked by a numbered stake or tag tied to a lateral. Each tree will be measured after bud set in growing seasons 0, 1, 2, 3, and 5. Sample trees are best located before spring revegetation.

Measures will be: height to the base of the terminal bud measured to the nearest centimetre, stem caliper at 5 cm above the root collar, measured to the nearest millimetre; and condition and damage (Appendix 1).

b) Vegetation Response:

Assessments should be scheduled before autumn leaf fall before the end of active growth. Based on Total Competitive Index (TCI) as described by Wagner (n.d.)\(^1\)--and segregated by brush species. The same trees in a) (above) will be used as plot centres, with plot radius = 1.95 m (12 m\(^2\) or 0.0012 ha, i.e. growing space per tree at 850 s.p.ha). Plots will probably overlap at higher stocking levels, this is unavoidable.

b) Vegetation Response (continued)

The sum of Competitive Indices (CI's) by species for one plot gives the Total Competitive Index (TCI) for that plot. Data will be separated by species to permit an assessment of the relative impact of the treatment on different competing species.

CI's will be determined for living brush only (not total biomass), in this way, a comparison of TCI's over time will provide a measure of the relative effectiveness of the treatment and its duration.

For each trial up to three major competing species will be identified separately (these are presumably the "target" species) the remainder will be "others (herbaceous)" and "others (woody)". Target species are generally those species in greatest concentration, that are hypothesised as having the greatest inhibiting effect on seedling growth. Target species are determined for the area being tested not for just one plot. It is possible to have minor representation of a target species in a plot due to natural site variation. This is not desirable.

The calculation of CI's is described in Appendix 2.

The CI concept does not totally cover the relationship between competing species and trees--this is rectified by the "status" of the tree (Appendix 1).
Records:

Site details will be recorded on FS 711.

Seedling details and vegetation details will be computer compatible, recorded in the format shown in Appendix 3.

Treatment records will be maintained as required by the pesticide application permit.

Project Records will also note the phenological stage of major competing species and notes on the weather one week preceding and two weeks following application.

Data Analysis:

The basic data collected, height growth, diameter growth and Competitive Index, will be subject to analysis of variance. Additional covariance analysis may be applied to determine the relationship between pre-treatment seedling growth (height/age) and condition, and growth response following treatment.

If sufficient projects are implemented some analysis of the influence of site and subzone on the effectiveness of herbicide treatment may be possible. In the short term this is unlikely.
Roles and Responsibilities:

District Resource Officer

Locate treatment areas.
Prepare herbicide permit applications.
Make necessary referrals.
Obtain necessary supplies and equipment.
Layout areas.
Apply treatments.
Measure treatment units.

Regional Coordinator

Coordinate supplies and equipment if requested.
Provide advice to district.
Prepare summary reports for SX Records.
Act as intermediary for Branch (Victoria).
Assist where possible with all phases of field work.
Monitor district activities, briefs Silviculture Officer.

Regional Research Officer

Prepare Trial Working Plan.
Advise on application of plan.
Conduct analyses on data.
Prepare data summary and interpretation for report.
Assist where possible.
APPENDIX I
TREE CONDITION CODES

Each plot tree will be classified by:

a. Condition—a 5 point scale, with all values relative to that stand.
   Thus an "excellent" tree in one stand could be only "good" if compared
to another stand.
0 - dead (will not occur in the initial assessment)
1 - poor = unlikely to survive
2 - fair = may improve (also may not!), below average appearance
3 - good = a crop tree with average to good appearance, growth and
   vigour
4 - excellent = used sparingly. An exceptional tree on all points,
   a "plus tree".

Conceptually - "good" is the broadest classification. At the first
assessment all trees should be "good" or better.

b. Damage—a three column alphabetic assessment.
   Column 1 - Position of Damage
      F - Foliage
      B - Branch
      L - Leader
      S - Stem
   Columns 2 & 3 - A two letter code for causal agent
      e.g., RO = rodent thus:
      FRO would be rodent damage to foliage.
Abnormal growth (except llama growth) should be recorded as damage.

Damage by herbicide would be "HE".

Mechanical damage (e.g., whipping by dead brush would be "MW" and damage by a log rolling would be "ML". There are 598 possible two letter combinations, use realistically and sparingly.

Codes used will be part of the project record.

c. Status
   0 = Overtopped
   T = Threatened
   F = Free Growing

See attached diagrams.
APPENDIX 1a

Tree "Status"

Overtopped

Threatened

Free Growing
APPENDIX 2
CALCULATION OF COMPETITIVE INDEX (CI)

$$CI = \frac{H.C}{10 (\frac{CD}{FD})}$$

where

- $H$ = Average Height (m) of Weed Species
- $C$ = Percentage (%) cover of Weed Species to nearest 5%
- $CD$ = Distance (m) from plot centre (sample seedling) to closest
  cover of weed species, or 0.1 m, whichever is the greater.
- $FD$ = Distance (m) from plot centre to furthest cover of weed
  species or 1.95 m, whichever is the lesser.

**NOTE:** all measures are entered as metres (m) to the nearest 0.1 m.

$$TCI = CI_1 + CI_2 + CI_3 \ldots + CI_n$$

**Note:** formula 1 differs from that published by Wagner to accommodate the larger metric units.

**EXAMPLE:**

**FIGURE 2**

For calculations see over........

:0089r

December 14/83
<table>
<thead>
<tr>
<th>Species</th>
<th>% Cover</th>
<th>H</th>
<th>CD</th>
<th>FD</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>40</td>
<td>1</td>
<td>0.4</td>
<td>1.95</td>
</tr>
<tr>
<td>B</td>
<td>5</td>
<td>1.3</td>
<td>0.5</td>
<td>1.3</td>
</tr>
<tr>
<td>C</td>
<td>5</td>
<td>2</td>
<td>0.9</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Thus: \( C_{IA} = \frac{1 \times 40 (1 - 1)}{10 (0.4, 1.95)} \)

\[ = \frac{40 (2.5 - 0.5)}{10} \]

\[ = 4 (2) \]

\[ = 8 \]

\( C_{IB} = 0.8 \)

\( C_{IC} = 0.5 \)

TCI = 8 + 0.8 + 0.5 = 9.3

**NOTE:** Extreme values of CI are demonstrated:

<table>
<thead>
<tr>
<th></th>
<th>% Cover</th>
<th>H</th>
<th>CD</th>
<th>FD</th>
</tr>
</thead>
<tbody>
<tr>
<td>LO</td>
<td>5</td>
<td>0.5</td>
<td>1.8</td>
<td>1.95</td>
</tr>
<tr>
<td>HI</td>
<td>90</td>
<td>2</td>
<td>0.1</td>
<td>1.95</td>
</tr>
</tbody>
</table>

\( C_{IHI} = 170.77 \)

\( C_{ILO} = 0.01 \)
### APPENDIX #3

#### DATA RECORDS FORMAT

<table>
<thead>
<tr>
<th>LOCATION</th>
<th>ASSESSMENT</th>
<th>TREATMENT</th>
<th>PLOT</th>
<th>TREE</th>
<th>HEIGHT (cm)</th>
<th>CALIFER</th>
<th>CONDITION</th>
<th>DAMAGE</th>
<th>STATUS</th>
<th>WEDD</th>
<th>CI</th>
<th>WEDD</th>
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<th>WEDD</th>
<th>CI</th>
<th>WEDD</th>
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</tbody>
</table>

**LOCATION - name**

**ASSESSMENT - number**

**TREATMENT** 0 = Control 1, 2 etc.

**Plot - number 01-99**

**CONDITION** 0 = Dead 1 = Poor 2 = Fair 3 = Good 4 = Excellent (use sparingly)

- relative to the Stand...

**DAMAGE** Col 1 = Foliar 2 = Branch 3 = Stem

**STATUS** O = Overtopped  T = Threatened  F = Fire Growing

**WEED #1 - Species Name** 1st 2 letters of genus 1st 2 letters of species

**CI - Competitive Index** for species; calculate externally and add later
CALCULATION OF COMPETITIVE INDEX
Using Programmable Calculators

HP 97

001 *LBLA
002 STO1
003 R↓
004 STO2
005 R↓
006 1/X
007 STO3
008 R↓
009 1/X
010 RCL3
011 -
012 RCL2
013 RCL1
014 ×
015 1
016 0
017 ÷
018 ×
019 DSP1
020 RTH
021 R/S

Example:

C. Dist .1 ENT↑
F. Dist 1.65 ENT↑
Av. Ht. .8 ENT↑
% Cover 30.0 GSEA
22.5 ***

022 1.0 ENT↑
023 1.4 ENT↑
024 2.0 ENT↑
025 5.0 GSEA
026 0.3 ***

HP 41C

027 *LBL "COMPIND"
028 *LBL 01
029 "C. DIST?"
030 PROMPT
031 1/X
032 "F. DIST?"
033 PROMPT
034 1/X
035 -
036 "AV. HT?"
037 PROMPT
038 1/X
039 *
040 10
041 16 /
042 17 *
043 "C.I.="
044 "% COVER?"
045 PROMPT
046 ×
047 10
048 "C. I.="
049 "F T X 1"
050 "C. I. -"
051 "C I. =22.8"
052 "% COVER?"
053 20 ARCL X
054 "C. I.=0.3"
055 21 RUN
056 22 STOP
057 23 HOFF
058 24 GTO 01
059 25 STOP
060 26 END