GUIDELINES FOR VEGETATION MANAGEMENT
SX TRIALS

(DRAFT)

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ABSTRACT

Guidelines for two types ("Ordinary" and "Advanced" Level) of vegetation management Sx Trials (Silviculture Branch Trials) are described in this report. The topics presented include guidelines on the number and size of trial (experimental) and assessment (sampling) plots, number of target weed species and crop trees, plot layout, and assessment procedures. Two forms for vegetation management Sx Trials - Pre-treatment Site Information and Treatment Records - are also presented.
# TABLE OF CONTENT

<table>
<thead>
<tr>
<th>TABLE</th>
<th>PAGE</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABSTRACT</td>
<td>i</td>
</tr>
<tr>
<td>TABLE OF CONTENTS.</td>
<td>ii</td>
</tr>
<tr>
<td>ACKNOWLEDGEMENT.</td>
<td>iii</td>
</tr>
<tr>
<td>1.0  INTRODUCTION</td>
<td>1</td>
</tr>
<tr>
<td>2.0  OBJECTIVE OF VEGETATION MANAGEMENT SX TRIALS</td>
<td>2</td>
</tr>
<tr>
<td>3.0  GENERAL RECOMMENDATION FOR VEGETATION MANAGEMENT SX TRIALS</td>
<td>2</td>
</tr>
<tr>
<td>4.0  &quot;O&quot; LEVEL SX TRIALS: GUIDELINES</td>
<td>4</td>
</tr>
<tr>
<td>5.0  &quot;A&quot; LEVEL SX TRIALS: GUIDELINES</td>
<td>6</td>
</tr>
<tr>
<td>6.0  ASSESSMENT FOR &quot;O&quot; AND &quot;A&quot; LEVEL SX TRIALS</td>
<td>9</td>
</tr>
<tr>
<td>6.1  Assessment (Sampling) Plots</td>
<td>9</td>
</tr>
<tr>
<td>6.2  Selection of Crop Trees and Target Weed Species</td>
<td>10</td>
</tr>
<tr>
<td>6.2.1 Woody Plants (Single Tree or clump)</td>
<td>10</td>
</tr>
<tr>
<td>6.2.2 Herbaceous Weed Species.</td>
<td>10</td>
</tr>
<tr>
<td>6.3  Assessment (Pre- and Post-treatment).</td>
<td>10</td>
</tr>
<tr>
<td>6.3.1 Crop Trees</td>
<td>11</td>
</tr>
<tr>
<td>6.3.2 Woody Weed species</td>
<td>12</td>
</tr>
<tr>
<td>6.3.3 Herbaceous Weed species.</td>
<td>12</td>
</tr>
<tr>
<td>6.3.3.1 Procedure for plant cover assessment.</td>
<td>12</td>
</tr>
<tr>
<td>6.3.4 Regrowth Assessment.</td>
<td>13</td>
</tr>
<tr>
<td>7.0  APPENDICES:</td>
<td></td>
</tr>
<tr>
<td>A. Pre-treatment Information for Vegetation Management SX Trials.</td>
<td>14</td>
</tr>
<tr>
<td>B. Treatment Records for Vegetation Management SX Trials.</td>
<td>15</td>
</tr>
</tbody>
</table>
ACKNOWLEDGEMENTS

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GUIDELINES FOR VEGETATION MANAGEMENT SILVICULTURE TRIALS (SX TRIALS)

1.0 INTRODUCTION

The following guidelines are prepared for the Ministry of Forests personnel involved with Vegetation Management SX Trials. All vegetation management trials conducted under the SX category would be required to follow the guidelines provided in this report. This approach is intended to provide common standards of trial design, sampling, data recording etc. for vegetation management SX projects within the Ministry.

All SX trials are administered by the Silviculture Branch. The Branch issues identification numbers for all SX trials. For all trials involving the use of herbicides only the registered herbicides will be tested. Trials with the unregistered herbicides are now under the jurisdiction of the Research Branch and should be conducted as Experimental Projects (EP's). Both registered and unregistered herbicide trials may be conducted as EP's by the Research Branch.

Two types of vegetation management SX trials are proposed in this report. They are: "O" (Ordinary) Level and "A" (Advanced) Level. Replications of treatment (trial) plots are required in the "A" Level SX trials but not in the "O" Level SX trials. Hence, the "O" Level SX trials should be less time consuming than the "A" Level trials.
2.0 OBJECTIVES OF VEGETATION MANAGEMENT SX TRIALS

Some objectives of vegetation management Sx Trials are as follows:

a) To refine or validate data proven elsewhere to local conditions

b) To determine the cost effectiveness of a particular vegetation management method

c) To provide experience and training etc. in the use of a particular method to operational people

d) To provide some answers to a particular problem in a relatively short time period. That is an Sx trial is not a long-term project. In general the project may not exceed 5 years.

e) To be used for demonstration purposes. For vegetation control Sx trials involving the use of herbicides, it is advisable to include a non herbicide treatment method(s).

3.0 GENERAL RECOMMENDATION FOR VEGETATION MANAGEMENT SX TRIALS

In an Sx trial, it is advisable to test only a single factor at a time. All other factors should be held constant. For example, one of the following (a to f) can be tested in a single trial.

a) Methods
   eg. Herbicide (at recommended rate), Manual and Mechanical.

b) Types of herbicides
   eg. Roundup, 2,4-D (at the recommended rates)

c) Rates of one herbicide
   eg. Roundup at 0 L/ha, 3L/ha, 6 L/ha

d) Time of Treatment using one particular method
   eg. Manual Treatments in June, July, August
e) Diameter or Height classes of trees
   eg. Roundup injection on diameter classes of alder.

f) Equipment
   eg. CP 3 backpack, Solo backpack efficiency

Do not attempt to combine many factors e.g. Herbicide Types X Application Rates X Season of Application. With replications, the treatment plots will be too many and the project will become time-consuming.
4.0 "O" LEVEL SX TRIALS: GUIDELINES

4.1 Number of Trial Plots. A minimum of two trial plots (one treated and one untreated (control) plot), to a maximum of 3 treated plots per site. [A representative untreated area (swath) within or adjacent to the treated plot(s) can serve as a control plot].

4.2 Replications. Replication of treatments in the same site is not mandatory. Hence the trial area should be homogenous. The same trial can be repeated in other locations (sites).

4.3 Size of Trial Plots. There is no limit placed on the size of the Trial Plots. Each trial plot should be sufficiently large to accommodate the required number of assessment plots.

4.4 Assessment Plots. Twenty circular plots of 20 square metres (radius = 2.52 m) will be used as assessment plots. The investigator should ensure that the target weed species and/or crop trees occur in each of the assessment plot.

4.5 Target weed species. No more than 3 weed species should be assessed in a single trial if the objective of the trial is vegetation control. The target weed species must be known prior to the installation of the plots.

4.6 Crop Trees. One species is recommended.

4.7 All trees or plots should be permanently tagged and marked sequentially throughout the whole trial area. Do not start at 1 (or A) again for each trial plot.

4.8 Statistical Analysis. In general, a t-test will be the minimum requirement for statistical analysis.
4.9 Layout of the Trial Plots
   a) Install the trial plots in areas represented by the target weed species and/or crop trees.
   b) Randomly assign treatments to the selected trial plots.

Example: A typical layout can be as follows:

<table>
<thead>
<tr>
<th>PLOT A</th>
<th>PLOT B</th>
<th>PLOT C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Cutting</td>
<td>Untreated Control</td>
<td>Glyphosate Treatment</td>
</tr>
</tbody>
</table>

4.10 Assessment Plots and Methods of Assessment
Refer to Section 6.0
5.0 "A" LEVEL SX TRIALS: GUIDELINES

5.1 **Number of Treatments**

A minimum of two treatments, [including one untreated (control)] to a maximum of five treatments, (i.e. one untreated plus four treated) are allowed per site.

5.2 **Replications and Number of Trial Plots** A minimum of 3 replications of each treatment per site, is required. Therefore, the minimum number of trial plots is six. Rectangular (or square) trial plots are recommended.

5.3 **Size of Trial Plots.** There is no fixed size for treatment plots. The size of the plots will be influenced by the method of treatment (e.g. aerial or ground). Each plot however, should be large enough to accommodate the required number of assessment (sampling) plots.

5.4 **Assessment Plots.** Twenty circular sub-plots of 20 square metres (radius = 2.52 m) will be located in each trial plot. The investigator should ensure that the target weed species and/or crop trees are present in each of the assessment plots though not necessarily in the same amounts in each plot.

5.5 **Target weed species.** The recommended maximum number of target species is three. However, the investigator can make some general comments on other species if necessary. The target species should be known prior to the installation of the trial.

5.6 **Crop trees.** One species is recommended. (Do not select more than 2 crop species).
5.7 The required number of treatment plots, assessment plots, crop trees and target vegetation should be selected and permanently identified prior to treatment. A map of the plots will help future identification. Numbering of trees (or clumps) or plots should be sequential for the whole trial area. Do not start at 1 (or A) again for each treatment plot.

5.8 Statistical Analysis. A one-way Analysis of variance is generally recommended.

5.9 Layout of Trial Plots

a) Install the required number of trial (treatment) plots in areas represented by the target weed species and/or crop trees. Assign sequential identification numbers (e.g. A ... X) to the plots.

b) Randomly assign (e.g. by means of Random Tables) treatments to the selected trial plots.

c) Identify each plot permanently by its number and treatment.

d) Relocation of plot centres prior to treatment, and re-establishment of these centres after treatment may be necessary where site disruption by a treatment (such as site preparation) is expected.

Example of Plot Layout: Assume 3 treatments in a trial to determine the effects of 3 rates of Roundup (e.g. 0, 3L, and 6L product per ha). With replications of 3 per treatment the total number of trial (treatment) plots will be 9. Random allocation of plots can be as follows:
<table>
<thead>
<tr>
<th>Plot A</th>
<th>Plot B</th>
<th>Plot C</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 L/ha.</td>
<td>6 L/ha.</td>
<td>0 L/ha.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plot D</th>
<th>Plot E</th>
<th>Plot F</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 L/ha.</td>
<td>3 L/ha.</td>
<td>6 L/ha.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plot G</th>
<th>Plot H</th>
<th>Plot I</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 L/ha.</td>
<td>0 L/ha.</td>
<td>3 L/ha.</td>
</tr>
</tbody>
</table>

(The above is a completely random design. This design assumes that there are no known or anticipated sources of variation other than those of treatment effects).

5.10 Assessment Plots and Methods of Assessment
Refer to Section 6.0
6.0 ASSESSMENT FOR "O" AND "A" LEVEL SX TRIALS

6.1 Assessment (sampling) Plots

a) Within each of the trial plots, randomly select an area for the first of the twenty 20 sq. m assessment plots. The rest of the assessment plots are laid out systematically from the first.

b) It is advisable to place the assessment plots some few metres away from the edge of the trial (treatment) plots.

c) Establish a plot centre with a crop tree and/or with a permanent stake for each assessment plot.

Example of assessment plot layout

<table>
<thead>
<tr>
<th>#A</th>
<th>#B</th>
<th>#C</th>
<th>Assessment (sampling) Plots</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#D</td>
<td>#E</td>
<td>#F</td>
<td>Treatment (Trial) Plots</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>#G</td>
<td>#H</td>
<td>#I</td>
<td>Trial Area</td>
</tr>
</tbody>
</table>


6.2 Selection of Crop Trees and Target Weed Species

6.2.1. Woody Plants (Single Tree or clump): Crop Trees and Woody Target Species.

A representative crop tree and/or one of each target woody species will be selected per each assessment plot. [That is a total of twenty individual trees or clumps for each treatment (trial) plot].

Provide a permanent tag for each selected woody species prior to treatment.

6.2.2. Herbaceous Species.

Herbaceous vegetation will be assessed by recording the percent of the plot area covered by each of the target weed species. (See Section 6.3.3.1 below).

6.3 Assessment (Pre- and post treatment). The selected and identified crop trees and target weed species should be assessed prior to treatment and 1, 2 and 3 growing seasons following treatment. A 5th year post-treatment assessment would be allowed if deemed necessary. The preferred period of assessment is at the end of the growing season. The latter is generally in August and before leaf colouration. Disturbance (e.g. trampling) of vegetation should be avoided during assessment. The same selected woody species or assessment plots (in the case of herbaceous vegetation) should be used for all measurements.
6.3.1 Crop Trees. For each selected crop tree,

a) Measure total Height (nearest 5%)

b) Measure annual Height (leader) growth of each of the last two growing seasons during pre-treatment (and where applicable during the 5th year post-treatment) measurements. The current (and complete) season's growth should be recorded for the 1st, 2nd and 3rd year's post-treatment measurements.

c) Measure diameter (DBH or root collar diameter)

d) State whether crop tree is healthy or unhealthy (If unhealthy specify cause).

e) Visually estimate the degree of brush encroachment or release of each crop tree using a 0 to 100 linear scale system.

0 = Free growing (no brush influence)

100 = Total encroachment

f) Assess damage due to treatment using the 0 to 100 linear scale system (Expert Committee on Weeds system) during the post-treatment assessment.
6.3.2 Woody weed species

a) Measure height of vegetation to the nearest 5%.

b) Visually estimate the condition of the vegetation. The ECW 0 to 100 linear scale rating system should be used.

(i) **Defoliation**:

\[ 0 \quad \rightarrow \quad 100 \]

- no control (green foliage) \(
-\) complete foliage kill (no green foliage) or total defoliation

(ii) **Stem kill**

\[ 0 \quad \rightarrow \quad 100 \]

- no effect \(
-\) complete kill

(Stem kill can be checked by cutting a slice off the stem)

6.3.3 Herbaceous weed species (Forbs and Grasses)

Estimate the reduction in ground area occupied by target vegetation using the ECW 0 to 100 linear scale systems:

\[ 0 \quad --- \quad \text{no reduction (no effect)} \]

\[ 100 \quad --- \quad \text{complete reduction or kill} \]

6.3.3.1 Procedure for plant cover assessment:

Divide each circular assessment plot (20 sq.m, \( r = 2.52 \)) into quadrants. Then,

(i) estimate visually the proportion of each quadrant occupied by all non-crop vegetation. Sum up for all the quadrants. (Vegetated plus non vegetated areas should equal 100%)
(ii) estimate the area covered by each of the selected target weed species. (Because of canopy overlaps the sum of all the target weed species can exceed 100%).

The following guide can be used to estimate canopy coverage in the 20 sq. m assessment plots.

<table>
<thead>
<tr>
<th>Ground Cover Coverage (%)</th>
<th>Equivalent area (sq. m)</th>
<th>Example of approx. equivalent dimension (cm x cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1.0</td>
<td>100 x 100</td>
</tr>
<tr>
<td>10</td>
<td>2.0</td>
<td>140 x 140</td>
</tr>
<tr>
<td>15</td>
<td>3.0</td>
<td>175 x 175</td>
</tr>
<tr>
<td>20</td>
<td>4.0</td>
<td>200 x 200</td>
</tr>
<tr>
<td>25</td>
<td>5.0</td>
<td>225 x 225</td>
</tr>
</tbody>
</table>

6.3.4 Regrowth Assessment

In addition to the above, comments on regrowth (resprouting or suckering) are required when reporting the results of the effect of treatments. Regrowth is not reported as a 0 to 100 rating scale. The information on regrowth is to supplement the percent kill (or control) data (Sections 6.32 and 6.33). The investigator should include the number of resprout shoots which originated from each original plant. The following system is suggested.

A. Resprouts -- upper 1/2 of stem (number/original stem)
B. Resprouts -- lower 1/2 of stem (number/original stem)
C. Resprouts -- at root collar  (number/root collar)
D. Root suckers -- (number/root)

A typical recording system could be:

60B8 where 60 represents e.g. 60% defoliation
and 88 represents 8 resprouts per stem at the lower 1/2 of stem.
APPENDIX A

PRETREATMENT SITE INFORMATION FOR VEGETATION MANAGEMENT SX TRIALS

LOCATION: (Attach map if possible)
Lat.________; Long.________; Elev.________; Aspect_______% Slope________

SOIL DESCRIPTION:________________________

SITE INDEX:________________________(specify base age and species);
Annual Rainfall _______cm; Annual temperature range _______ºC

ECOLOGICAL: Subzone:
: Association________________________

SITE HISTORY:
Original Stand:
Harvest: Year & Season________________________Method________________________
Site Preparation: Year________________________Type________________________
Reforestation: Type [ ] Natural [ ] Seeding [ ] Planting; Year________
Species and Stock type________________________Initial Stocking Level________________________Trees/ha
Other Silviculture Activities________________________

TRIAL OBJECTIVE(S):________________________

SITE VEGETATION AT TIME OF TREATMENT
Vegetation type: [ ] Predominantly hardwood [ ] Predominantly conifer [ ]
Mixed conifer/hardwood [ ] Non-commercial brush [ ]
Young conifer plantation [ ] Other________________________
Crop Tree(s): Name(s)________________________
Survival and Stocking Level:________________________
Height: _______m Diameter _______cm or mm ( ___ DBH or ___ Root collar diameter)
Physiological state: [ ] Budset; [ ] Flushing; [ ] Needle elongation [ ]
Other________________________

Vigour: [ ] Healthy [ ] Unhealthy (specify)________________________
Target Weed species: Names________________________
Growth form: [ ] Trees [ ] Saplings [ ] Sprout clumps [ ]
[ ] individual shrubs [ ] Patches
Density of competing Vegetation: _______ Ground cover %, and/or _______ stems/ha
Height: _______m (herbaceous); _______m (shrubs); _______m (trees and saplings)
Diameter: _______cm (trees and saplings); _______cm (base of clumps or shrubs)
Physiological state: [ ] Dormant (winter); [ ] Bud swelling (early spring)
[ ] Active growth (spring/summer); [ ] Early dormant (late summer/fall)
[ ] Other________________________
Vigour: [ ] Healthy [ ] Unhealthy (specify)________________________
APPENDIX B
TREATMENT RECORDS FOR VEGETATION MANAGEMENT Sx TRIALS

TREATMENT(S):

Date(s)____________________

Methods: a) _______ Manual; _______ Aerial Herbicide; _______ Ground Herbicide;

☐ Mechanical  ☐ Biological;  ☐ Prescribed Burning;

☐ Other____________________

b) ☐ Broadcast;  ☐ Spot or clump;  ☐ Tree injection

☐ Stump;  ☐ Girdling;  ☐ Other____________________

Types and Model of Equipment (tool) used:______________________________________________

HERBICIDE TREATMENT (only)

Pesticide Use Permit No. ___________________ Permit Period ________________

Contractor: Name _________________________________________________________________

: Address________________________________________________________________________

: Service License No. ______________________________________________________________

<table>
<thead>
<tr>
<th>Treatment No.</th>
<th>Herbicide (Common Name)</th>
<th>Formulation</th>
<th>Additives (vol/unit)</th>
<th>Diluent or Carrier (vol/unit)</th>
<th>Application Rate (a.i.) Kg/ha % soin.</th>
<th>Total Spray Volume (Litres)</th>
<th>Hectares Treated</th>
</tr>
</thead>
<tbody>
<tr>
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</tbody>
</table>

Aerial Herbicide Spraying (and ground spraying where applicable)

Nozzles: Number____________; Type and Size__________ Orientation__________

Boom Type: __________________________________________________________

Application: Flying Height ______ m; Pressure ______ kPa;

Speed ______ km/hr; Delivery Rate (output) ______ L/min.;

Swath width ______ m
 Conditions of Operation

<table>
<thead>
<tr>
<th>Time</th>
<th>Start</th>
<th>Finish</th>
<th>Temp. (°C)</th>
<th>Precip. cm</th>
<th>RH %</th>
<th>Sky Condition</th>
<th>Wind Speed km/hr Direction</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Additional Comments:

1. Condition of Water used for mixing Chemicals

2. a) Dew Conditions
   b) Snowfall

3. Weather Problems

4. General Weather for the Spraying Period

5. Rainfall in the first week after Application

6. Chemical Spills

7. Accident(s) and First Aid

8. Equipment Malfunction or Breakdown

9. Container Disposal Method

10. Crew Size _______ Hours required for Treatment _______

11. Other Comments ____________________________

Calculations:

I certify that the above summary is accurate and true.

Project Supervisor:

Name: (print)________________________________________

Applicator's Certificate No.___________ (where applicable)

Signature:_________________________ Date____________