ST. JOHNS LANDFILL

COVER VEGETATION PLAN:

1994 DEMONSTRATION PLOT WORK PLANS AND COST ESTIMATES

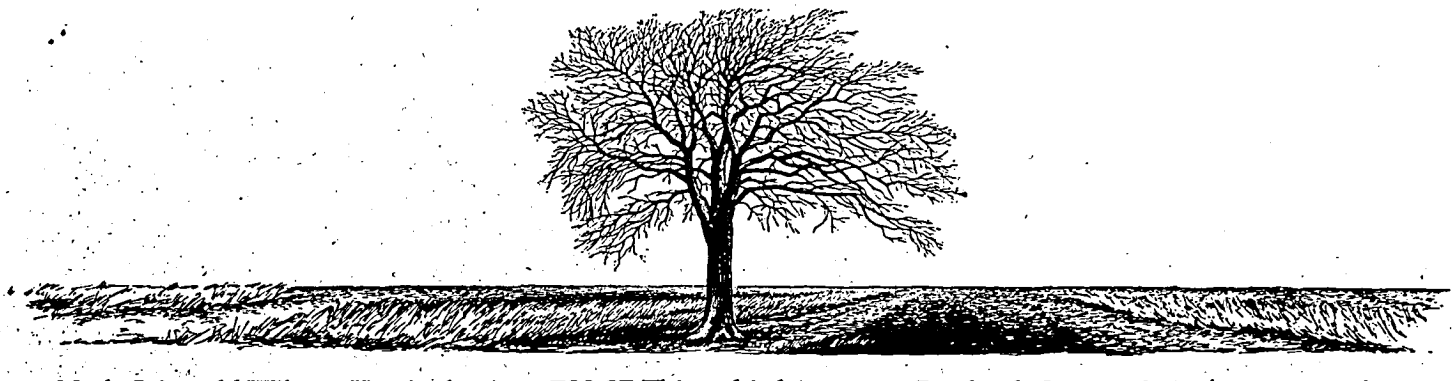
Prepared for

METRO SOLID WASTE DEPARTMENT

Submitted by

Mark Griswold Wilson
Environmental Restoration and Horticulture

April, 1994



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PART I: PROPOSED 1994 WORK

SUBAREA 1 DEMONSTRATION PLOTS: PEST PLANT CONTROL AND GRASS SEEDING APRIL THROUGH SEPTEMBER 1994

INTRODUCTION

A landscape composed primarily of native grassland species has been identified by METRO as the most appropriate plantings to be used for the permanent closure of the landfill. In order to accurately determine protocols for the site preparation, establishment, and first year maintenance of these grasslands, a series of demonstration plots are proposed. Data collected from these test plots will then be used to prepare contract specifications for future work.

Demonstration Plots 1 through 3 are proposed to be established on the long, shallow, south facing slopes of Subarea 1. This area, seeded with the covercrop Regreen in the fall of 1992, has now totally reverted to a vegetative cover composed primarily of Ryegrass (*Lolium sp.*) and other undesirable crop weeds such as Vetch (*Vicia spp.*), Mustard (*Brassica spp.*) and Radish (*Raphanus spp.*). This area is adjacent to the main Subarea 1 road and free of surface piping. Demonstration Plot 4 is proposed to be sited on the shallow, south facing slope of Subarea 2 on either side of the main haul road. This area was seeded with the covercrop Regreen in the fall of 1993; but, at this time there are large patches of Ryegrass (*Lolium sp.*) and the aforementioned undesirable throughout the area. The exact locations of the demonstration plots can be sited in the field by the METRO consultant.

Following are descriptions of proposed: Pest Plant Control Work Schedules; Native Grass Seeding and; Cost Estimates for all proposed work.

description of pest plant work:

Demonstration Plot Number 1:
Proposed Pest Plant Control Methods- Herbicide/No till
Herbicide/Till

Area: 1 acre of each control method = 2 Acres Total

WORK GOAL- **Achieve an 80% kill of all perennial and annual weeds at time of herbicide application. Thereafter, use both till or no till practices to determine the best means of seedbed preparation.**

Discussion
These Subarea 1 demonstration plots will contrast the effectiveness of preparing ground for the seeding of native grasses using: 1) An Herbicide/Till approach of applying herbicide and then repeatedly discing, harrowing, etc.; and 2) An Herbicide/No till method of seeding directly into herbicide killed thatch using a no-till drill or a heavy harrow.

WORK SCHEDULE-

ASAP: Field Identify Plots/Test Soil Seedbank in each Subplot

April:
fourth week- Apply Herbicide (both subplots)
May:
third week - Repeat Herbicide Application (both subplots)
June:
second week- Flail Mow (both subplots)
fourth week- Disc the Till Subplot

July through mid September:
once/month - Repeat Discing the Till Subplot

September:
second week- Test Soil Seedbank in each Subplot
Seed both subplots w/ native grasses

SEE HERBICIDE SPECIFICATION AND PESTICIDE NOTE IN APPENDIX A-

Demonstration Plot Number 2:
Proposed Pest Plant Control Method-Soil/Seedbank Solarization

Area: .3 Acre Total

WORK GOAL- **Use solarization plastic to achieve sufficient soil heating necessary to kill perennial and annual seeds and propagules in the seedbed.**

Discussion
Solarization uses sunlight to raise soil temperatures. This Subarea 1 demonstration plot will utilize solar heat trapped beneath plastic sheeting to sterilize the top few inches of a soil seedbank contaminated with noxious (or undesirable) plant propagules and seeds.

WORK SCHEDULE-

ASAP: Field Identify Plots/Mow/Test Soil Seedbank in each Subplot

April:
fourth week - Disc Plot/Install Solarization Plastic

September:
second week- Remove Solarization Plastic
Test Soil Seedbank
Seed both subplots w/ native grasses

SEE SOLARIZATION SPECIFICATIONS IN APPENDIX A-

Demonstration Plot Number 3:

Pest Plant Control Methods- Acid Ph Manipulation
Alkaline Ph Manipulation

Area: 1 acre of each control method = 2 Acres Total

WORK GOAL- Manipulate the soil Ph to disfavor ryegrass and other undesirable grasses.

Discussion

These Subarea 1 demonstration plots will utilize both Calcium (Ca) and elemental Sulphur (S) to either raise or lower the soil Ph. The alkaline Ph goal is 8.5; the acid Ph goal is 5.5. See Ryegrass Fertilizer Guide in Appendix B for additional information.

WORK SCHEDULE-

ASAP: Field Identify Plots/Mow/Test Soil Seedbank & Ph in each Subplot/Conduct tests to determine Ca/native soil mixture.

April:
fourth week- Disc Plots/Amend soil w/ Sulphur and Calcium

late May through August:
once/month - Repeat Disc Acid & Alkaline Subplots

September:
second week- Test Soil Seedbank & Ph in each Subplot
Seed both subplots w/ native grasses

SEE CALCIUM/SOIL TEST MIXTURE SPECIFICATIONS IN APPENDIX A-

Demonstration Plot Number 4: 4 Acres Total Area

Proposed Pest Plant Reduction Methods-Swathing (Side cutting)
Flail Mowing
Control Burning
No Manipulation
(No action)

Area: 1 acre of each control method = 4 Acres Total

WORK GOAL- **Using selected mechanical and controlled burning techniques, determine the best means of reducing populations of undesirable grasses.**

Discussion

These Subarea 2 demonstration plots will determine the best means of reducing the seedbank and seed set of undesirable grasses and agricultural weeds during the first growing season after the final closure of each Subarea. Three of the proposed methods will utilize either cultural or mechanical methods; the fourth, a control plot will demonstrate the affect of taking no action.

WORK SCHEDULE-

ASAP: Field Identify Plots/Test Soil Seedbank in all Subplots

Mid April:
Swath(side cut) existing vegetation in subplot prior to grass flowering/Leave cut hay on surface
Flail mow existing vegetation in subplot prior to grass flowering

Mid May through Mid July:
Repeat Sidecutting and Flail mowing as required once/monthly (or more often as required) to prevent undesirable grasses from seeding

Mid August:
Disc fireline/Control burn subplot using Field Flammer

September:
second week- Test Soil Seedbanks in all Subplots
Seed both subplots w/ native grasses

SEE FIELD FLAMMER AND SIDECUTTER MANUFACTURER'S BROCHURES IN APPENDIX B

description of seeding work:

DESCRIPTION OF AREA TO BE SEEDED:

Approximately 4.5 Acres of Subarea 1 is proposed for seeding with native grasses in the fall of 1994. This area corresponds to the acreage total of Demonstration Plots 1 through 3.

PROPOSED SCHEDULE OF WORK:

April 1994-

Seed Acquisition.

METRO recently established a native grass seed credit account with Granite Seed in Utah. A seed order on this account should be placed this spring by the METRO consultant, MGW. Two native grasses are recommended to be seeded in the Subarea 1 Demonstration Plots: *Bromus carinatus* (California Brome) and *Elymus glaucus* (Blue Wildrye).

September 1-15, 1994

Seedbed Preparation.

Final seedbed preparations for seeding Demonstration Plots 1, 2, and 3 should be completed during this time. Such prep work can be accomplished by METRO staff but work should be inspected by a qualified expert prior to seeding.

September 15-20, 1994

Seeding of Native Grasses.

The recommended method for seeding the native grasses is by drilling; preferably with a range or no-till drill or similar equipment capable of cutting the seed into dead thatch or soil. MGW, the METRO consultant, will try to arrange to borrow or rent a suitable grass seed drill.

Spring 1995

Demonstration Plot Monitoring and Maintenance.

All Demonstration Plots should be monitored during the spring and early summer of 1995. High mowing, using an adjustable flail mower will probably be a necessary maintenance practice during the first growing season.

REQUIRED SUBMITTALS:

Seed Tags. All ordered native grass should be labeled with a tag specifying its purity, viability and weed and crop seed content. After the tags are submitted, seeding rates for Pure Live Seed can be calculated.

Soil Test Results. In order to make needed fertilizer recommendations for the native grasses soil samples from the Demonstration Plots should be submitted for testing.

SEE NO-TILL DRILL MANUFACTURER'S BROCHURE IN APPENDIX B

cost estimates

NOTE: It should be realized that there is an economy of scale relative to the size of the proposed treatment areas; costs for the treatment of small 1-2 acre areas may be comparable to costs for much larger acreage.

An off-set cover crop disc, sized to fit the Kubota tractor, is specified for use in the preparation of the soil and seedbed of all Demonstration Plots. Multnomah County Parks may own and loan a suitable disc or it could be purchased from a farm equipment dealer as reconditioned equipment. A sidecutter bar (swather) (sized to fit the Kubota tractor) is specified for use on Demonstration Plot Number 4; the cost of the sidecutter has been included in the estimate for Plot Number 4. Both the disc and the sidecutter could be used throughout the landfill for future: site preparation; vegetation establishment and maintenance; and native grass seed harvest.

Three work tasks are specified to be carried out by skilled subcontractors: herbicide application; field flamming; and native grass seed drilling. Permits for both herbicide application and field flamming activities may be necessary and the Oregon Department of Environmental Quality, the local fire district and perhaps the Portland Planning Bureau should be consulted. MGW, the METRO consultant will identify local contractors qualified for herbicide application, field flamming and native grass drilling.

All quoted prices for materials are at cost to the METRO Consultant, MGW. Labor time estimates assume METRO staff support.

Estimated costs for pest plant control and seeding of the Demonstration Plots follow:

COST ESTIMATES FOR PEST PLANT CONTROL ON PLOTS NUMBER 1-4:

Demonstration Plot Number 1: 2 Acres Total Area
Proposed Pest Plant Control Methods- Herbicide/Till
Herbicide/No till

DESCRIPTION OF MATERIALS/LABOR	ESTIMATED COST	
1. Two Applications of Roundup Herbicide (Negotiated Contract for Materials/Labor)	$400.00	
2. Field Discing Labor: (for Herbicide/Till subplot only)		
Initial (April)		2 hrs.
Once/Monthly (May through September)		5 hrs.
3. Two Soil Seedbank Tests/subplot (before and after treatment)	$200.00	
ESTIMATED PLOT NUMBER 1 COST	**$600.00 (Plus METRO Labor)**	
PER ACRE COST	**$300.00 (Plus METRO Labor)**	

Demonstration Plot Number 2: .3 Acre Total Area
Proposed Pest Plant Control Method-Soil/Seedbank Solarization

DESCRIPTION OF MATERIALS/LABOR	ESTIMATED COST	
1. 1 Roll 6 mil. poly 24 ft X 100 ft. (1 year lifetime)	$107.00	
2. Miscellaneous Supplies (plastic weights, etc)	$25.00	
3. Field Discing Labor: Initial (April)		2 hrs.
4. Plastic Installation Labor: (2 people)		8 hrs. (total)
5. Two Soil Seedbank Tests (before and after treatment)	$100.00	
ESTIMATED PLOT NUMBER 2 COST	**$232.00 (Plus METRO Labor)**	
PER ACRE COST	**$696.00 (Plus METRO Labor)**	

Demonstration Plot Number 3: 2 Acres Total Area
Proposed Pest Plant Control Methods-Acid Ph Manipulation
Alkaline Ph Manipulation

DESCRIPTION OF MATERIAL/LABOR	ESTIMATED COST
1. Tons Calcium (Ca) carbonate (assumed SJL soil Ph= 6.1)	$ 0
2. Ca/native soil mixture Ph tests	$12.00
mixture test labor	4 hrs.
3. 700 pounds of 90% elemental Sulphur (S) (assumed SJL soil Ph= 6.1)	$105.00
4. Sulphur Delivery Labor:	2 hrs.
5. Field Discing Labor:	
Initial (April)	4 hrs.
Once/Monthly (May through September)	10 hrs.
6. Two Soil Seedbank & Ph Tests/subplot (Test before and after treatment)	$220.00
ESTIMATED PLOT NUMBER 3 COST	**$337.00 (Plus METRO Labor)**
PER ACRE COST	**$162.50 (Plus METRO Labor)**

Demonstration Plot Number 4: 4 Acres Total Area
Proposed Pest Plant Reduction Methods-Swathing (Side cutting)
Flail Mowing
Control Burning
No Manipulation
(No action)

DESCRIPTION OF MATERIAL/LABOR	ESTIMATED COST
1. 3-Point Sidecutter Rental	Not available
OR	
3-Point Sidecutter Purchase	$3600.00
2. Sidecutting/Flail Mowing Labor	
Initial (April)	10 hrs.
Once Monthly (May through July)	20 hrs.
3. Field Flamming (negotiated contract for equipment/labor)	$500.00
4. Two Soil Seedbank Tests for each subplot (before and after treatment)	$400.00
ESTIMATED COST	**$4500.00 (Plus METRO Labor)**
PER ACRE COST	**$450.00 (Plus METRO Labor)**

pest plant subtotal: $5669.00

COST ESTIMATE FOR SEEDING OF DEMONSTRATION PLOTS NUMBER 1-3:

Note: As METRO has a native grass seed credit with Granite Seed, Inc. (Utah) there is no anticipated seed cost; however, Granite may charge for preparing the seed for seeding in a no-till drill. Labor/Equipment charge for drilling seed could be shared with the anticipated cost of seeding a planned 10 Acre Subarea 3 test plot.

DESCRIPTION OF MATERIAL/LABOR	ESTIMATED COST
1. Seed Preparation and No-till drilling of native seed (negotiated contract for travel/equipment/labor)	$1000.00

seeding subtotal: $1,000.00

TOTAL ESTIMATED COST: $6,669.00

PART II: PROPOSED 1995 WORK TASKS

AREA	TASK
Subarea 1:	Implement Year 1 Maintenance activities on Demonstration Plots 1-3 as required. **Acreage: 4.5 Acres** **Estimated Labor Time: 1 hour/week** **(March through July)**
	Prepare all remaining pipe-free areas for seeding with native grasses using site prep methods showing best result in Demonstration Plot 1-3 trials. Maintain farm equipment as needed. **Estimated Acreage: 30** **Estimated Labor Time: 10 hours/week** **(May through September)**
	Maintain vegetation in remaining areas of steep slopes and/or piping using method showing best result in Demonstration Plot 4. Maintain farm equipment as needed. **Estimated Acreage: 15** **Estimated Labor Time: 5 hours/week** **(March through July)**
Subarea 2:	Maintain vegetation throughout Subarea using method showing best result in Demonstration Plot 4. Maintain farm equipment as needed. **Estimated Acreage: 60** **Estimated Labor Time: 20 hours/week** **(March through July)**
Subarea 3:	Maintain vegetation throughout Subarea using method showing best result in Demonstration Plot 4. Maintain farm equipment as needed. **Estimated Acreage: 50** **Estimated Labor Time: 15 hours/week** **(March through July)**
SJL Site:	Select a suitable site for SJL reveg. nursery. In the fall of 1994 prepare 1 Acre of ground for woody plant nursery production and construct a small unheated seasonal hoop house for woody and herbaceous plant seed production. In the late fall and winter collect seed and propagation wood of suitable species for planting in the hoop house and/or hedging in rows. See Appendix B for additional information. **Estimated Acreage: 1.5** **Estimated Labor Time: 20 hours/week** **(October through March)**

SJL Site: The grazing of certain areas of Subarea 1 and 2 using sheep may be a feasible means of maintaining vegetation during the 1995 spring season.
Estimated Labor Time: as required

APPENDIX

A: Herbicide Specifications and Pesticide Note
Solarization Specifications
Calcium Soil Mixture Specifications

B: Sidecutter Brochure
Field Flammer flyer
Truax No-till drill brochure
Article: Soil Solarization for Restorationists
Perennial Ryegrass Fertilizer Guide
Native Plant Growing at SJL
(selected from SJL Vegetation Management Plan)

SPECIFICATIONS FOR HERBICIDE APPLICATION

[Adapted from: 1993 Pacific Northwest Weed Control Handbook; Pacific Northwest Cooperative Extension Service; Corvallis, OR.]

Application Goal: Achieve an 80% kill of grasses and other annual and perennial weeds alive at time of application.

Materials: Roundup Herbicide
Rate- 3 qt./Acre (2.25 lbs. ae/Ac.)

Ammonium sulfate fertilizer (21-0-0)
(translocation enhancer)
Rate- 20#/100 gallons spray water

Execution: Apply to actively growing grasses at early boot stage (time of heading) but prior to flower formation. Rainfall within 6 hours may reduce effectiveness. Spray to adequately cover, but not to point of runoff. Repeat application may be required for control.

Caution: Roundup (Glyphosate) is a non selective herbicide and can control other actively growing vegetation.

PESTICIDE NOTE: Any discussion of or recommendation for the application of any herbicide, insecticide or other chemical product is not intended to be an endorsement of the use of such product, the method or timing of application, or the specific brand of any such product by the authors of this document or by those the authors represent or are employed by. Any use of any herbicide, insecticide or other chemical product should only be made in full accordance with all applicable local, state, and federal laws. Any use of any herbicide, insecticide or other chemical product should only be made in accordance with the product manufacturer's instructions and any questions concerning product use or application should be directed to the appropriate manufacturer. All appropriate safety measures should always be taken by any individual applying any herbicide, insecticide or chemical product. Nothing in this document is intended to contradict or be contrary to any local, state, or federal laws or any manufacturer's instructions or recommendation with respect to any herbicide, insecticide or chemical product.

SOIL SOLARIZATION SPECIFICATIONS

Preparation:

Disc and cross-disc all existing vegetation.

Materials:

1 Roll 6 mil. poly 24 ft X 100 ft. (1 year lifetime)

Timing:

Place plastic on prepared ground by late April-early May when soil moisture levels are still high.

Procedure:

Adjust field disc to excavate a 1' wide by 4-6" trench around the inside perimeter of the treatment unit; layout sheeting carefully insuring plastic contact with treated ground before backfilling the free edges in the trenches. Tamp backfill to minimize loss of heated air and soil moisture. Place small plastic "ziplock" sandwich bags filled with soil (or comparable) to weight the center of each covered treatment unit to prevent wind billowing. Check and repair any leaks observed during growing season. Remove plastic after September 15.

CALCIUM/SOIL TEST MIXTURE SPECIFICATIONS

Materials:

20 pounds each: Calcium, Native soil from SJL plots

4- Five gallon plastic buckets with holes in bottom

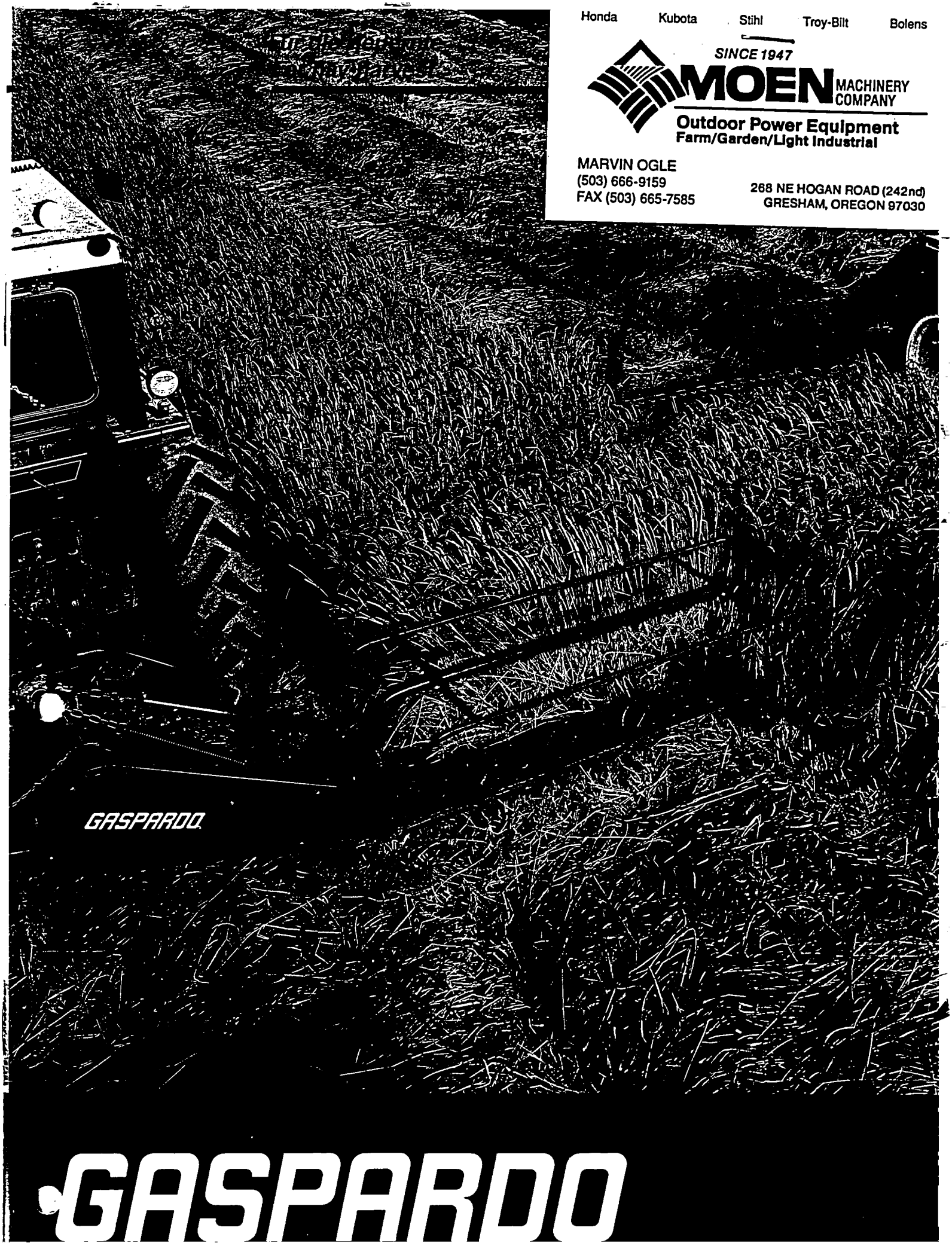
Timing:

As soon as possible, dig representative soil samples from identified Alkaline Demonstration subplot and Calcium samples from stockpile at SJL and submit both for Ph tests.

Procedure:

After Ph test results have been returned, use buckets to prepare representative mixtures of soil and calcium in order to formulate a mixture equaling a Ph of 8.5. Record mixture recipes.

Allow mixes to stabilize for 1 week; resubmit samples for Ph testing.



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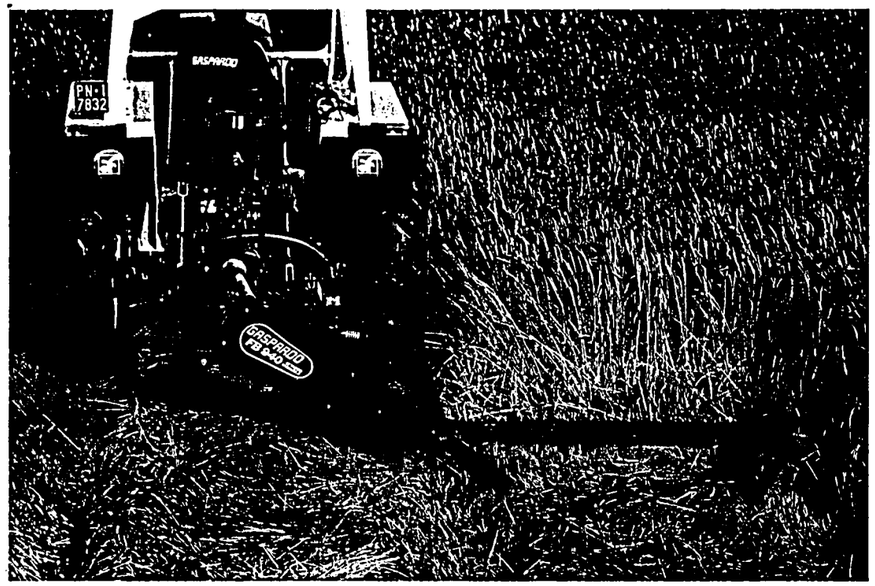
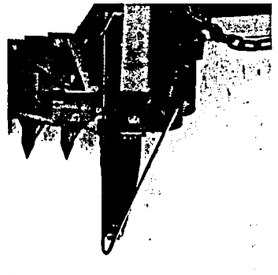


1

Qualität
FB 940 (Abb. 1) ist das Produkt einer zweckgerichteten Entwurfsplanung, die sich auf eine langjährige Erfahrung in dem betreffenden Bereich stützt. Wie für alle Produkte aus dem Hause Gaspardo wurden auch für diese Maschine nur ausgewählte Materialien zugelassen.
Die beiden Pleuel, welche die Doppelbewegung Zahn/Klinge bewirken, laufen auf Rollen- und Kugellagern, die auch bei der Mähgeschwindigkeit von 12 Stundenkilometern, welche durch diese Maschine erreicht wird, jegliche Erschütterung auffangen.

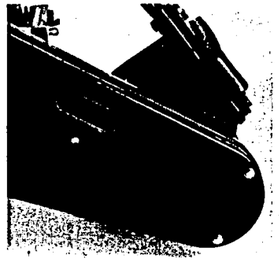
3

Ganz vorne dabei
Dank ihres Blattprofils und der außergewöhnlichen Form des inneren Gleitschuhs (Abb. 2) scheut FB 940 auch vor schwierigsten und kompaktesten Pflanzensorten nicht zurück (Abb. 3).
Die Ausmaße des auf dem Gleitschuh aufliegenden Pleuelwerks wurden so gering wie möglich gehalten, ohne dabei jedoch Funktions- oder Leistungsfähigkeit zu beschneiden.
Die genannten Eigenschaften machen, zusammen mit den verwendeten Spezialzähnen, aus FB 940 die Maschine mit dem höchsten Verbreitungsgrad auf dem Markt.



2

Sicherheit
Die Maschine besitzt eine automatische Abkupplungsvorrichtung, durch welche sie vor einer eventuellen Beschädigung durch unvorhergesehene Hiebe bewahrt wird. Das Gehäuse zum



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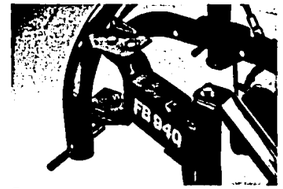
Schutz der Treibriemen bietet den bestmöglichen Unfallschutz, da es rundum geschlossen ist. Das Überprüfen der Riemen erfolgt durch ein eigens dafür vorgesehenes Fenster (Abb. 4).

Quality
FB 940 (fig. 1) is the result of an exclusive design based on the long experience acquired in this sector. Like all Gaspardo products, it is b[illegible] with best quality materials.
The two connecting rods, generating the double tooth-blade motion, are mounted on roller and ball bearings which eliminate any vibration even at the considerable working speed this machine is capable of reaching (12 Km/h).

Penetration
Thanks to the bar profile and the exclusive shape of the inner shoe (fig. 2), FB 940 can easily cope with the most compact and difficult forage (fig. 3).
The dimensions of the connecting rod assembly resting on the shoe has been reduced as much as possible, leaving its functionality and power intact.
These features, together with the use of special teeth, endows FB 940 with the best penetration coefficient on the market.

Safety
The automatic release device protects the FB 940 from possible damage due to accidental shocks. The case protecting the driving belts offers the best guarantee against accidents, as it is completely closed; a special door makes possible the inspection of the driving belts (fig. 4).

Vielseitgkeit
Bei einer geeigneten Einstellung der Hubketten und bei Ausschluß des Schwadblechs am äußeren Gleitschuh arbeitet FB 940 bei einer Geländeneigung bis zu ± 60°.
Genannte Eigenschaft läßt diese Maschine unerläßlich für das Abmähen von Kanal- und Dammböschungen, Wasserrinnen, Gräben usw. werden.
Außerdem verfügt FB 940 über eine verstellbare Kupplungsvorrichtung (Abb. 5, 6, 7), so daß durch einfaches Verstellen ein Benutzen mit sämtlichen Traktoren Spurweiten möglich wird (Abb. 8).



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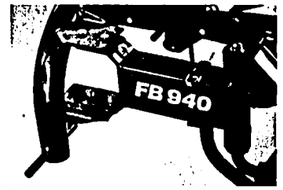

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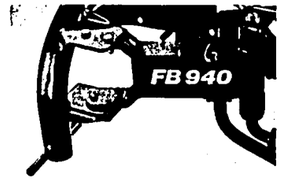

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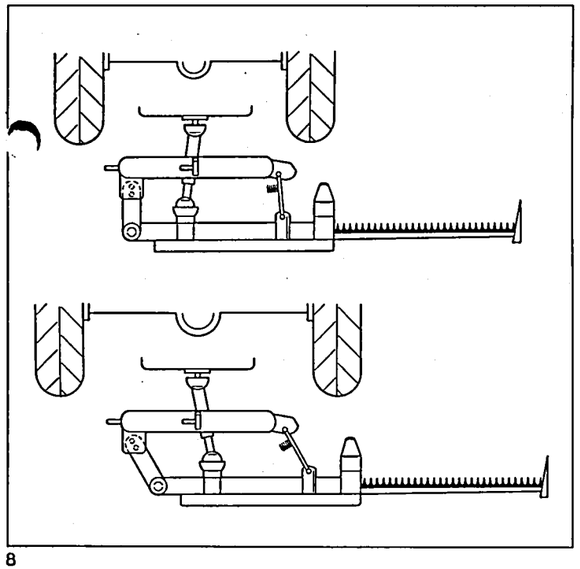

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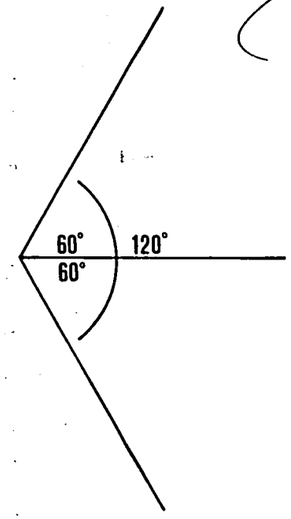


Versatility
FB 940 can operate with the bar at an inclination up to ± 60° by suitably adjusting the hoisting chains and excluding the guide swath of the outer shoe.
This feature makes it an essential tool for the mowing of ditches, canals, embankments, drainage canals, etc.
FB 940 is also provided with an adjustable coupling (fig. 5-6-7) which, by a simple movement, makes possible the operation with any tractor track (fig. 8).
Technical features:
Standard bar lenght: 1.75 m
Minimum power: 25 HP
P.T.O. revolutions: 540 r.p.m.
Cutting speed: 10/12 Km/h
Alternative cutting widths: 1.30-1.45-2.05 m
Three-point coupling
Standard supply: 2 cutting blades, Cardan joint, wrench, double tooth.

Technische Eigenschaften:
Länge des Standard-Mähbalkens: 1,75 m
Erforderliche Mindestleistung: 25 PS
Drehzahl an der Zapfwelle: 540 U./min.
Mähgeschwindigkeit: 10/12 km/h
Weitere Schnittbreiten: 1,30/1,45/2,05 m
Drei Punkte Auschluß mit verstellbarer Kupplungsvorrichtung.
Standardausrüstung: 2 Messerklingen, Kardangelenk, Schlüssel, Doppelzahn.

Anwendungsbereich der Zähne FB 940 *FB 940 tooth utilization*	*Normalzahn / Standard tooth* *(Stärke) (Strength)*	*Spezialzahn Special tooth* *(Durchdringung) (Penetration)*
Pflanzensart *Type of grass*	*Dick, holzig Thick, wooden* *Licht Thin* *Trocken (meistens) Dry (mostly)* *Hoch Tall*	*Dünn, zart Thin, tender* *Dicht und dünn Dense (cat's fur)* *Feucht (meistens) Wet (mostly)* *Niedrig Short*
Bodenart *Type of ground*	*Steinig Stony*	*Nicht steinig Not stony*
Schnitt Periode *Mowing period*	*Mittlere Intermediate*	*Erste oder letzte First or last*
Gelände Eigenschaften *Regional features*	*Flachland Level ground* *Höhenlagen bis 400 m ü.d.M.* *Altitude 400 m below sea level*	*Hügellandschaft Piedmont areas* *Höhenlagen ab 400 m ü.d.M.* *Altitude 400 m above sea level*

REAR'S Mfg Co.

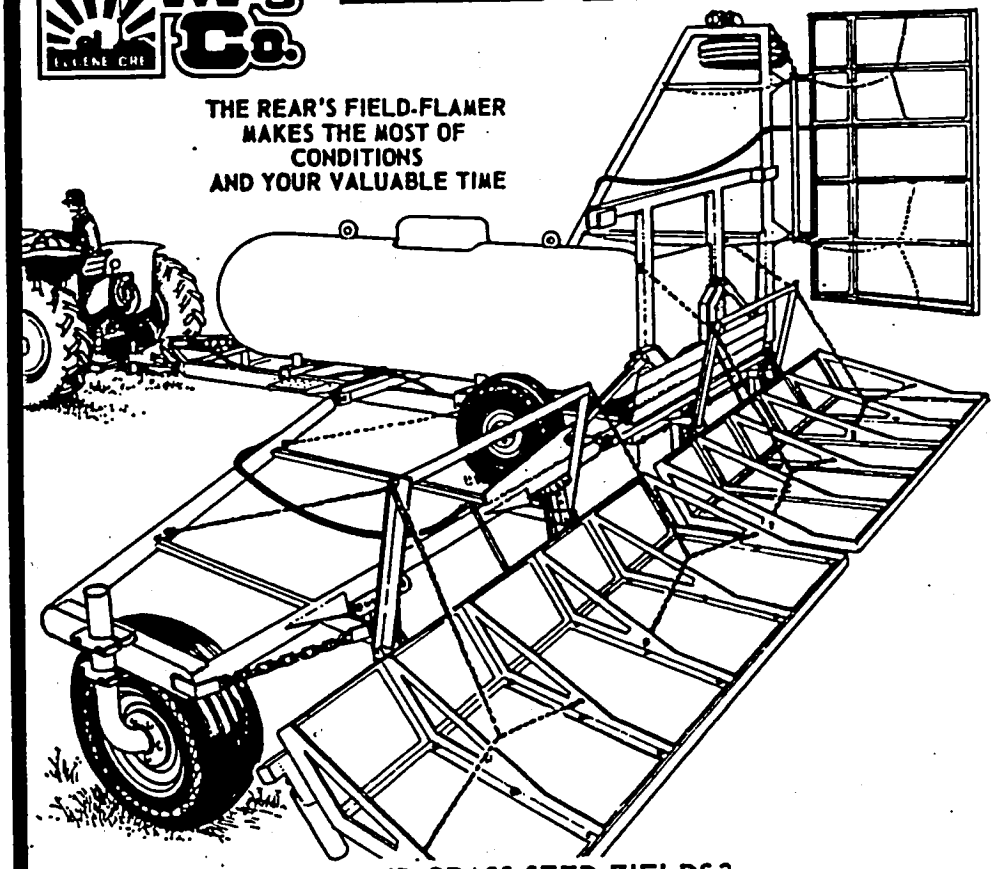
FIELD-FLAMER

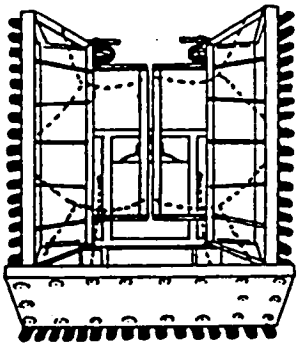
30 FT SWATH

CONVENIENT HYDRAULIC FOLDING WINGS

COMES WITH CONTROLS AND HOSES, READY FOR PROPANE TANK ATTACHMENT

THE REAR'S FIELD-FLAMER MAKES THE MOST OF CONDITIONS AND YOUR VALUABLE TIME





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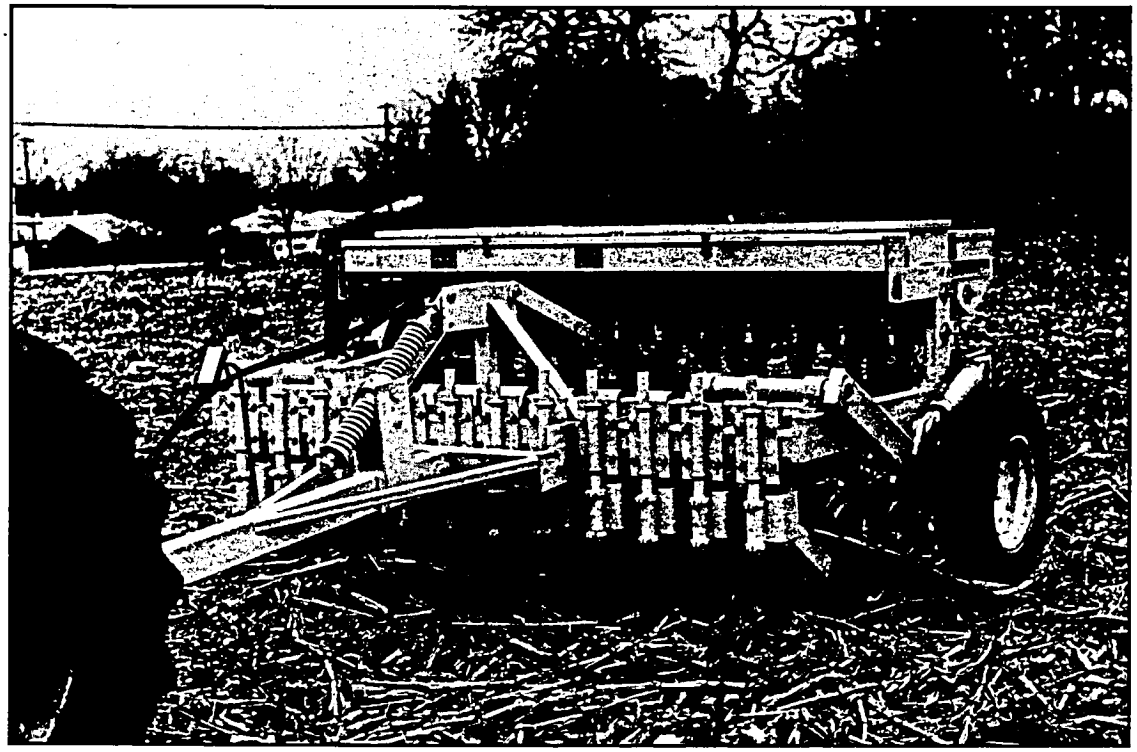

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Soil solarization for restorationists

Solar energy can be used to kill weeds, seeds, and soil pathogens on restoration sites.

by David A. Bainbridge

Soil solarization is the use of sunlight, aided by clear polyethylene sheeting, to heat areas being prepared for planting to kill weeds, weed seeds, and pathogens in the top 5–15 cm (2–6") of the soil. This technique, which is increasingly used by farmers and gardeners, but not yet widely known among restorationists, is a good alternative to herbicides, fumigants, and other conventional methods of weed control under some conditions.

Solarization can be useful in many restoration situations. I have used it under the most difficult conditions, preparing a clean seedbed for native plant production in a very weedy garden, and it worked better than VAPAM, a very toxic herbicide. It is well suited for small to medium scale restoration efforts in areas where summer temperatures are high, with air temperatures greater than 30 degrees C (90 degrees F) during the midafternoon. It should be well suited for the preparation of prairie restoration sites, where weeds often present serious problems before the perennial native plants become established.

Like many "sustainable" agricultural techniques, soil solarization has a long history. Farmers of the Deccan plateau in India have long exploited a solar form of heating soil in the summer to control weeds. They plow the weedy soil just before the hottest summer period, when maximum daily air temperatures usually exceed 40 degrees C (104 degree F), and leave it fallow long enough for the high soil temperatures to kill weeds, weed seeds, and soil pathogens. However, this technique is effective for bare soil only if the air temperatures are very high and solar radiation is intense. Adding a clear plastic cover makes it possible to heat the soil to similar temperatures under somewhat more temperate conditions. Recent studies have suggested that a double layer of plastic (bubble-pack may work well) can provide similar soil temperatures even under relatively cool conditions. With a single layer of plastic solarization should be effective in areas with plenty of sun and average maximum air temperatures near 30 degrees C for at least six to eight weeks. A single layer of plastic provided sufficient solar heating to raise the soil temperature at the International Center for Research In the Semi-Arid Tropics (ICRISAT)in India to 54 degrees C (130 degrees F) at a depth of 5 cm and 48 degrees C (118 degrees F) at a depth of 10 cm, with mean air temperatures of 43 degrees C. Under the clear plastic, soil temperatures at 5 cm deep remained at or above 45 degrees C (113 degrees F) for 48 days, more than twice as long as this temperature was maintained in bare soil. Moreover, while the soil temperature of bare soil at 10 cm deep never reached 45 degrees C, it remained at or above this temperature for 23 days under plastic.

Table 1. Response of some common weeds to solarization

Effective control	
Cocklebur	*Xanthium spinosum*
Common chickweed	*Stellaria media*
Common groundsel	*Senecio vulgaris*
Field bindweed (seed)	*Convolvulus arvensis*
Henbit	*Lamium amplexicaule*
Jimsonweed	*Datura stramonium*
Lambsquarters	*Chenopodium album*
Miner's lettuce	*Montia perfoliata*
Nettleleaf goosefoot	*Chenopodium morale*
Prickly lettuce	*Lactuca serriola*
Prickly sida	*Sida spinosa*
Shepherd's purse	*Capsella bursa-pastoris*
Tolerable control	
Large crabgrass	*Digitaria sanguinalis*
Purslane	*Portulaca oleracea*
Partial control (more effective if repeated)	
Bermuda grass	*Cynodon dactylon*
Field bindweed (plant)	*Convolvulus arvensis*
Johnsongrass	*Sorghum halepense*
Nutsedge	*Cyperus* spp.
Lovegrass	*Eragrostis* spp.

(Pullman et al., 1984)

The influence of these high temperatures on weeds, seeds, and pathogens is complex and not fully understood. Solarization is especially effective, however, in controlling cool-season weeds and grasses that make up a large share of the problem plants restorationists have to deal with, especially in the early stages of a project (Table 1).

In general, deep-rooted summer weeds with rhizomes are usually knocked back but may not be killed. Control can be improved by repeating the solarization process after retilling the soil. Adding compost and other soil amendments may improve control of the more resistant species by increasing microbiological activity in the soil.

In addition to its effectiveness against many weeds, solarization also controls a number of common plant pathogens, including Fusarium and Verticillium fungi, and in fact most of the research on solarization has been carried out for this reason (Katan et al., 1987). Fortunately for restorationists, the heating apparently has little effect on beneficial organisms such as mycorrhizae and

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actinomycetes. There is also evidence of control of some insect pests. Because most of the research has been carried out in connection with agriculture, the effects of solarization on earthworms and various other beneficial and native organisms have not been explored in depth, but I didn't observe any obvious change in earthworm populations in my test.

One of the interesting effects of solarization is an increase in growth rates. This effect is greater than can be accounted for by effects on pathogens and weeds alone. While this effect is not fully understood, some studies suggest that an increase in available nutrients may account for much of the improvement (Stapleton et al., 1985). For example, nitrate nitrogen tripled in the surface soil during one solarization trial at ICRISAT. This is presumably the result of accelerated microbiological activity and the release of nutrients from the detritus. In any event, this process may be advantageous in some restoration situations where it would allow native plant species a head start on weeds.

The most common restoration-oriented use of soil solarization may be for preparing seed beds for prairie and meadow plantings on sites with full sun. It can also be used on many other sites that are being restored from the ground up, though it is unlikely to work on north-facing slopes. It may also prove useful in open woods and shrublands where summer temperatures are high (at least 40 degrees C [104 degrees F]) and canopy cover is limited. Solarization is also excellent for preparing seed beds for nursery production of native plants. While little has been published on the use of solarization in the preparation of soil mixes, it should be effective for controlling diseases and weeds in soil mixes without the adverse effects associated with steam heating or chemical fumigants.

To Solarize Your Soil

Although techniques may vary with climate, solar exposure, soil type, plant community, specific weed problems, and planting techniques the following approach has been refined by studies with many types of crops and in many climates:

Soil solarization should be undertaken during the sunniest, hottest part of the year, and should continue for at least four weeks and preferably six weeks or even more. Soil temperatures of more than 40 degrees C (104°F) for several weeks are desirable. In cooler areas with periodic cloudy periods, solarization may still be effective if the plastic is left in place longer. Soil thermometers are inexpensive, under $15, and two or three set at different depths make it easy to monitor soil temperatures. If temperatures are not high enough, try adding a second layer over a small area. The small bags of dirt used to hold the first sheet down can be arranged to support the second sheet a couple of centimeters above the bottom sheet.

Begin by cultivating the area thoroughly; then carefully level the surface to eliminate clods, stubble, sticks, and stones that might tear the polyethylene sheeting. If the soil is dry, apply about 2.5 cm (one inch) of water immediately before laying the sheeting. The moisture improves the heat capacity of the soil and enhances heat transfer for better soil heating. Fertilizer and other soil amendments may be applied and tilled in before the plastic is laid.

Apply sheets of clear (not black or colored) 1–2 mil polyethylene (4–6 mil in windy areas) at dawn, or when it is the least windy. The thinner plastic is preferred because it lets more solar energy through. The plastic doesn't have to lie flat on the ground for good heating, but it may flap less if it is smooth and in contact with the surface. If plastic with UV inhibitors is used, the plastic can be lifted and reused. Non-stabilized plastic may begin to become brittle and break down in 2–3 months, and on agricultural fields it is often left in one place and allowed to disintegrate. Since heating is less intense at the edges, extend the covering a meter or so beyond the planted area, if possible. When planning the layout, be sure to allow for access to other areas and for drainage, either to a drain furrow or to other plantings nearby. This is especially important on slopes, where special care should be taken to avoid erosion problems caused by runoff from covered areas. Straw bale dams or grassed waterways may be advisable in some situations. In semi-arid and arid areas, on the other hand, runoff water may be used to irrigate plants started in the spring or the year before. Use wide sheets to minimize joints (6 m [20 ft] and 12 m [40 ft] widths are common), and place the edges of adjacent sheets in furrows and cover them with soil. The free edges should also be buried and the soil around them compacted by tramping to minimize the loss of heated air and moisture. To keep the plastic from flapping and tearing in the wind, place weights 2–3 m (6–10 ft) apart on the sheeting. Small plastic bags (sandwich size) filled with soil should work well on all but the windiest sites. These can be gently tossed into place to avoid walking on the plastic.

During the solarization period inspect the site regularly. If holes develop in the polyethylene sheeting, they should be patched with wide clear plastic (package) tape. You can find holes by looking for areas without condensed moisture on the bottom of the plastic. Avoid walking on the plastic, and use smooth-soled shoes or bare feet if you have to walk on the sheeting to make repairs.

Although farmers often plant into holes punched in the sheet following solarization, restorationists may prefer to remove the plastic for reuse. Remember that the soil may be wet when the plastic is removed, and make take several days to dry to a workable condition. If you cultivate before planting, keep cultivation shallow (2–5 cm) to avoid moving viable weed seeds from the deep soil to the surface.

Soil solarization is not perfect. It does not work against all weeds and pathogens, requires the use of chemicals and energy to make the polyethylene, and leaves waste plastic. But it is much cleaner and safer than herbicides and fungicides and at least as effective. Best of all it is inexpensive [polyethylene costs around 18 cents per square meter (2 cents/sq. ft.) for non UV-stabilized 2 mil (4 cents

for 4 mil, 6 cents for 6 mil, 10 cents for bubble pack)]—generally far less than costs of machine or handweeding.

Let us know how it works for you.

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Fertilizer Guide

PERENNIAL RYEGRASS

(Western Oregon—West of Cascades)

FG 46
Revised April 1982

Good management practices are essential if optimum fertilizer responses are to be realized. These practices include use of recommended varieties, selection of adapted soils, weed control, disease and insect control, good seed bed preparation, proper seeding methods, and timely harvest.

Recommended soil sampling procedures should be followed in order to estimate fertilizer needs. The Oregon State University Extension Service agent in your county can provide you with soil sampling instructions, soil sample bags, and information sheets.

NITROGEN (N)

Liberal amounts of available N are required for optimum yields of perennial ryegrass seed.

On new seedings, place 20-40 lbs N/A 1 to 2 inches below the seed. At least 1 inch of soil should separate the seed and fertilizer.

On established stands, a total annual application of 120 to 140 lbs N/A is suggested.

Apply 20 to 30 lbs N/A in the fall. Apply 80 to 100 lbs N/A between March 15 and April 15.

Higher rates of fall applied N can be used where fields are grazed during the winter months.

Do not make spring applications of N until grazing has been completed.

The application of nitrate N to wet soils can result in the loss of N through reduction of nitrate.

PHOSPHORUS (P)

Soil testing should be used to evaluate the need for P fertilization.

On new seedings, when the OSU soil test for P is below 30 ppm, place 30 lbs P_2O_5/A near the seed. At least 1 inch of soil should separate the seed and fertilizer. The application rate should be increased by 50% when P is broadcast rather than placed near the seed.

On established stands, *P should be broadcast in the fall.*

If the OSU soil test for P reads (ppm):	Apply this amount of phosphate (P_2O_5): lbs/A
0 to 15	40 - 60
15 to 25	30 - 40
Over 25	None

POTASSIUM (K)

Soil testing should be used to evalute the need for K fertilization.

On new seedings, when the OSU soil test for K is below 100 ppm, place 25 lbs K_2O/A near the seed. At least 1 inch of soil should separate the seed and fertilizer. The K application rate should be increased by 50% where K is broadcast.

On established stands, *K should be broadcast in the fall.*

If the OSU soil test for K reads (ppm):	Apply this amount of potash (K_2O): (lbs/A)
0 to 100	60
Over 100	None

SULFUR (S)

Include 10-15 lbs/A of S in the annual fertilizer program for perennial ryegrass. S is sometimes contained in fertilizers used to supply other nutrients such as N, P, and K, but may not be present in sufficient quantity.

Plants absorb S in the form of sulfate. Fertilizer materials supply S in the form of sulfate and elemental S.

Elemental S must convert to sulfate in the soil before the S becomes available to plants. The conversion of elemental S to sulfate is usually rapid for fine ground (less than 40 mesh) material in warm moist soil.

S in the sulfate form can be applied at planting time. Some S fertilizer materials such as elemental S and ammonium sulfate have an acidifying effect on soil.

The S requirements of perennial ryegrass can be provided by:

OREGON STATE UNIVERSITY EXTENSION SERVICE

Extension Service, Oregon State University, Henry A. Wadsworth, director. Produced and distributed in furtherance of the Acts of Congress of May 8 and June 30, 1914. Extension work is a cooperative program of Oregon State University, the U. S. Department of Agriculture, and Oregon counties. Extension invites participation in its programs and offers them equally to all people.

1. The annual application of 10-15 lbs S/A in the form of sulfate or as fine ground (finer than 40 mesh) elemental S. Elemental S will not be available to plants until the soil warms up.

2. Applying 30-40 lbs S/A as sulfate or fine ground elemental S every second year.

3. Applying coarser ground elemental S at higher rates and less frequently.

OTHER NUTRIENTS

Responses of perennial ryegrass to nutrients other than those discussed in this guide have not been observed in Oregon.

LIME

Perennial Ryegrass has responded to applications of lime in experiments conducted on acid soils in the Willamette Valley.

The application of lime is suggested when the soil pH is below 5.5 or the soil test for calcium (Ca) is below 5.0 meq Ca/100g. Lime should be worked into the seedbed at least several weeks before seeding. The amount of lime required is based on an SMP lime requirement test.

If the OSU SMP buffer test for lime reads:	Apply this amount of lime (T/A):
Below 5.2	4 - 5
5.2 - 5.5	3 - 4
5.5 - 5.8	2 - 3
5.8 - 6.2	1 - 2
Over 6.2	0

The suggested liming rate is based on 100 score lime. Liming materials should be checked for score.

A lime application is effective over several years.

The use of N fertilizers for grass seed crops will tend to increase soil acidity (decrease soil pH). This should be considered in establishing or renovating perennial grass seed fields.

The surface application of lime to established seed fields could increase the soil pH in the surface one-half inch of soil and thereby increase the possibility of N loss from ammonium N and urea due to volatilization. Also, broadcasting lime on established stands of perennial grasses is not as effective as mixing lime with the soil.

Evaluate the soil acidity problem before making new plantings. The lime application should allow for some decrease in soil pH during the life of a perennial stand of grass.

Some soils may have a fairly high OSU SMP buffer value (over 6.2) and a low pH (below 5.3). This condition can be caused by the application of acidifying fertilizer. In this case the low pH value is temporary and the pH of the soil will increase as the fertilizer completes its reaction with the soil. This temporary "active" acidity from fertilizer is encountered following recent applications of most nitrogen fertilizer materials. Acidifying fertilizers also have a "long term" acidifying effect on soil which is cumulative and leads to lower OSU SMP buffer readings.

Sandy soils to which fertilizers have not been recently applied sometimes record low pH and high SMP buffer values. In such cases, a light application of lime (1 to 2 T/A) should suffice to neutralize soil acidity.

For acid soils low in Mg (less than 0.5 meq Mg/100g of soil) one ton/A of dolomite lime can be used as a Mg source. Dolomite and ground limestone have about the same ability to neutralize soil acidity.

The P, K, and lime recommendations are based on soil test values from the Soil Testing Laboratory, OSU, Corvallis, Oregon.

Prepared by Thomas Doerge, Department of Soil Science; Hugh Gardner and T. L. Jackson, Extension Soil Scientists; and Harold Youngberg, Extension Agronomist; Extension Service and Agricultural Experiment Station, Oregon State University, Corvallis, Oregon.

NATIVE PLANT GROWING AT SJL

The economic feasibility of growing native plant materials off the capped surface on lands adjacent to the SJL site should be explored. When evaluating a particular growing site the soil suitability, proximity to irrigation water, and type and availability of planting equipment and/or labor should be considered. Additionally, the construction of a small unheated hoop style greenhouse at the growing site would increase production efficiency and provide winter protection for woody and herbaceous container stock. Considering native plant shortages in the marketplace and the probable site reveg requirements, the on-site growing of native grasses, trees and shrubs, particularly softwood plant species such as willow and cottonwood, may provide some project cost savings and an excellent environmental education training opportunity for interested local citizens. Supervised volunteer labor could be organized and trained to assist with the planting, maintenance & harvest of nursery materials.

Many native plants are easily propagated from both hard and softwood cuttings or seed placed directly in prepared growing beds or in containers. Several methods of growing native grasses and wildflowers should be explored: Medium sized pure stand plots (containing 1 species only) could be laid out and sized according to the scale of available planting and harvest labor and/or machinery. Small mixed species plots containing grasses and wildflowers could be laid out for hand seed harvest or dry hay harvest using hand scythes, small gas powered test plot harvesters or tractor mounted side bar cutters. Good site selection and pre-planting preparation is necessary when growing native grasses. One to two years of fallowing and/or herbicide application may be necessary before planting grasses and wildflowers in order to rid the ground of undesirable seedbanks of aggressive non-native species that may out compete native plant seedlings.

RECOMMENDED PROPAGATION METHODS FOR WOODY & EMERGENT PLANTS FOR SJL REVEGETATION

TREES/SHRUBS

Acer macrophyllum (Big leaf Maple) SEED
Alnus rubra (Red Alder) SEED
Amelanchier alnifolia (Serviceberry) SEED/ROOT CUTTING
Cornus stolonifera (Red Osier Dogwood) SEED/STEM CUTTING
Corylus cornuta (Hazel) SEED/LAYERING
Crataegus douglasii (OR Hawthorne) SEED
Fraxinus latifolia (OR Ash) SEED
Lonicera involucrata (Twinberry) SEED/STEM CUTTING
Philadelphus lewisii (Mock Orange) STEM CUTTING
Populus trichocarpa (Black Cottonwood) IN-SITU STEM CUTTING
Prunus emarginata (Chokecherry) SEED/LAYERING
Rhamnus purshiana (Cascara) SEED
Rosa nutkana (Nootka Rose) SEED/STEM CUTTING
Rosa pisocarpa (Swamp Rose) SEED/STEM CUTTING
Salix lasiandra (Pacific Willow) STEM CUTTING
Salix piperi (Piper's Willow) IN-SITU STEM CUTTING
Salix scouleriana (Scoulers Willow) STEM CUTTING
Sambucus cerulea (Blue Elderberry) SEED/STEM CUTTING
Sambucus racemosa (Red Elderberry) SEED/STEM CUTTING
Symphoricarpos albus (Snowberry) SEED/ROOT & STEM CUTTING

OPTIONAL TREES & SHRUBS

Arctostaphyllos columbiana (Hairy Manzanita) STEM CUTTING
Arctostaphyllos uva-ursi (Kinickinick) STEM CUTTING
Myrica californica (CA Myrtle) ROOT CUTTING
Pinus contorta (Shore Pine) SEED

GRAMINOIDS

Juncus tenuis (Slender Rush) SEED/DIVISION
Juncus effusus (Soft Rush) SEED/DIVISION

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