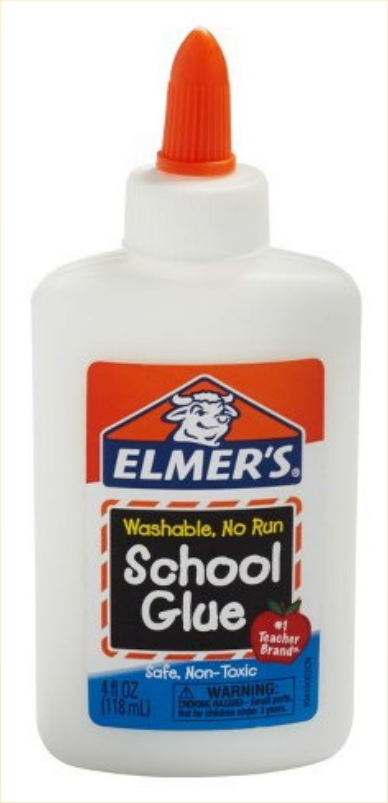
ELMER'S, CENTRUM and PENNIES

2019 SFNMC Contact Meeting
Shreveport, LA
July 16, 2019

Nina Dowling Payne
SFNMC
Auburn University



2018 Soil Stabilizer Product Study

2018 Micronutrient Product Study

2018 Copper Rate Study

Soil Stabilizer Product Study

To compare the effectiveness of 3 soil stabilizer products

- Bareroot trial installed at Rayonier Elberta AL Nursery

- Products tested:

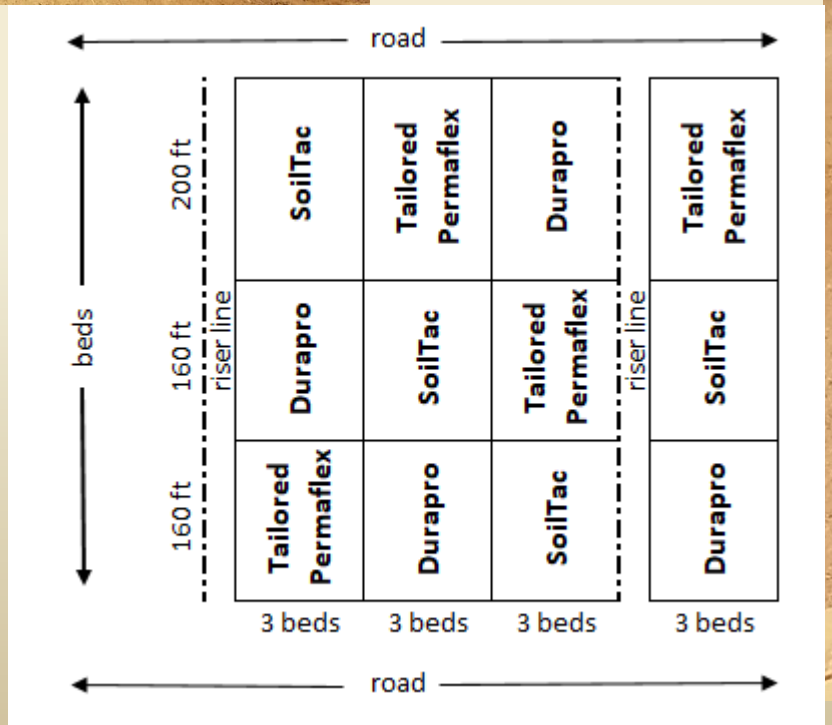
  PermaFlex 625 by Tailored Chemical Products

  P-1490 by DuraPro Adhesives

  SoilTac by SoilWorks

early May 2018

All products applied operationally



PermaFlex plot

late May 2018: Tropical Storm Alberto made landfall

July 2018: Germination counts made for each product

October 2018: Seedlings collected and measured by drill for each product

Results of 2018 Soil Stabilizer Study

Germination counts at 8 weeks post-sowing

Product	Density (ft^2)
Operational (SoilTac)	19.8
DuraPro P-1490	20.4
Permaflex 325	18.2

- No differences between products in 8 week germination counts

Results of 2018 Soil Stabilizer Study

Loblolly pine seedling characteristics measured in October 2018

Product	Density of All Drills (ft^2)	Density of Outside Drills (ft^2)	Density of Inside Drills (ft^2)	Shoot Height (cm)	RCD (mm)	Shoot Weight (g)	Root Weight (g)
Operational (SoilTac)	20.4	4.9	15.5	25.4	4.06	2.76	0.40
DuraPro P-1490	22.3	5.4	16.9	26.3	4.02	2.57	0.36
Permaflex 325	19.8	4.9	14.9	25.0	4.03	2.87	0.41

- No differences between products in seedling densities when counted by drill

- Cost comparisons of 3 products not included in this study
- Other products are available on the market: DirtGlue
- Powdered formulations available; generally more expensive even after considering transportation costs
- Tailored Chemical Products has relabeled Permaflex® 325 as **AgriLock®** in 2019; will produce an **AgriLock®Plus** product

Thanks to:

Tom Anderson, IFCO Shubuta MS Nursery
Bill Rowan and crew, IFCO Jesup GA Nursery
Mark Davis and crew, Rayonier Elberta AL Nursery

Chase Tolusic, DuraPro Adhesives
Hunter Dinsmore, Tailored Chemicals
Chris Anaya, Soilworks, LLC

Contact:

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2018
Soil Stabilizer Study
RR 19-06

Southern Forest
Nursery Management Cooperative

RESEARCH REPORT 19-06

SOIL STABILIZER TRIALS ON LOBLOLLY PINE SEEDBEDS

by
Nina Payne, Ryan Nadel, and Scott Enebak

INTRODUCTION

Agricultural soil stabilization in the U.S. has focused primarily on mechanical rather than chemical methods, as seen by the creation and practices of the Soil Erosion Service in 1933 and its successors, the Soil Conservation Service and the Natural Resources Conservation Service (NRCS). Following severe rain and wind events resulting in seed loss, forest-tree nursery managers began investigating the use of chemical soil stabilizers. Few stabilization methods or products were available from the agricultural sector, so interest in the development of chemical products for stabilization of forest-tree nursery seedbeds began in the 1980s.

The Spring 1987 SFNMC newsletter contained an article reporting on the use of GeoTech, a soil stabilizer product developed by the Borden Chemical Company. Rates, application methods, costs and benefits of GeoTech applications in a pilot study at the former MacMillan Bloedel Nursery in Pine Hill, Alabama were discussed. Another article on soil stabilization appeared in the May 1987 issue of the Southern Journal of Applied Forestry describing trials conducted in 1984 and 1985 in three Weyerhaeuser Company nurseries using GeoTech. Seventeen years later, the increased operational use of soil stabilizers in SFNMC nurseries was evident as an article in the Spring 2004 newsletter reported that of 31 nurseries surveyed, 25 routinely used soil stabilizers following sowing.

In 2004, a field trial was conducted by the SFNMC at three Cooperative member nurseries to study the effects of soil stabilizer on seed efficiency. The resulting report (RR 05-01) found that soil stabilizer is most beneficial when rain events cause seed loss, but also that the benefits of preventing seed loss with stabilizer in years without major rain events (and less seedbed damage) was still cost-effective.

As member nurseries continue to apply soil stabilizers operationally, newer products from the soil stabilization field have been developed and are available to growers. Because little is known about these new chemistries, membership requested that they be examined to determine if seedlings were tolerant to the materials (germination) and effective in soil stabilization. The objectives of this trial were to compare the effects of three soil stabilizer products on bed stability, seedling densities and growth characteristics at one nursery site.

METHODOLOGY

The study was installed at the Rayonier Nursery in Elberta, Alabama in May 2018 at the time of sowing. Samples

Questions/comments?

Liquid Copper Rate Study

To determine level of tolerance of loblolly pine to over-the-top applications of liquid copper during the growing season

- Bareroot trials installed at 8 weeks post-sowing at K & L Forest Nursery in Buena Vista, GA and Rayonier Elberta, AL Nursery

- Product tested:

Ele-Max Copper FL
Helena-Agri Enterprises


ELE-MAX
PRECISION NUTRITION
Copper FL
4-0-0
Foliar Nutritional Liquid Flowable

A formulated product for the treatment of copper deficiency by foliar application.

GUARANTEED ANALYSIS
Total Nitrogen (N) 4.00%
4.00% Urea Nitrogen
Copper (Cu) 33.00%

Derived from urea and copper oxide
Nutrient content per gallon: 4 lb. 3 oz. Copper (Cu)

KEEP OUT OF REACH OF CHILDREN
WARNING
Harmful if swallowed
May be harmful in contact with skin
Causes serious eye irritation
Causes mild skin irritation
May be harmful if inhaled
Very toxic to aquatic life with long lasting effects

Contains diicopper oxide.

WT. PER GAL: 12.4 lbs (5.65 kg)
NET CONTENTS: ... 2.5 gals (9.46 L)
... 250 gals (946.35 L)

Information about the components of this lot of fertilizer may be obtained by writing to Helena Chemical Company, 225 Schilling Boulevard, Suite 300, Collierville, TN 38017 and giving the lot number which is found on the container.
Information regarding the contents and levels of metals in this product is available on the Internet at http://www.aapfco.org/metals.html

Contents Made In Great Britain
FZ24
MANUFACTURED FOR
HELENA CHEMICAL COMPANY
225 SCHILLING BOULEVARD, SUITE 300
COLLIERVILLE, TN 38017
901-761-0050

PRECAUTIONARY STATEMENTS
HAZARDS TO HUMANS AND DOMESTIC ANIMALS
WARNING
BEFORE USING THIS PRODUCT, READ ALL PRECAUTIONS, DIRECTIONS FOR USE, CONDITIONS OF SALE-LIMITED WARRANTY AND LIMITATIONS OF LIABILITY AND REMEDIES.
Harmful if swallowed. May be harmful in contact with skin. Causes serious eye irritation. Causes mild skin irritation. May be harmful if inhaled. Very toxic to aquatic life with long lasting effects. Keep product locked up and out of the reach of children. Wash thoroughly with soap and water after handling and before eating, drinking, chewing gum or smoking tobacco. Remove and wash contaminated clothing before reuse. Do not take internally. Avoid contact with or inhalation of spray application mist if present Do not apply this product in such a manner as to directly expose workers or other persons. If product is being mixed with pesticides and/or spray adjuvants, follow all precautionary statements on the accompanying product(s) labeling. Not for human or animal consumption.
Personal Protective Equipment (PPE): Wear protective eyewear (goggles or face shield), chemical-resistant gloves, long-sleeved shirt and long pants, and shoes plus socks when using this product. Take off any contaminated clothing and wash before reuse.

Disclaimer: Always refer to the label on the product before using Helena or any other product.

FIRST AID
IF IN EYES:
- Rinse cautiously with water for several minutes. Remove contact lenses, if present and easy to do. Continue rinsing.
- Call a poison control center or doctor for treatment advice.

IF INHALED:
- Move person to fresh air and keep at rest in a position comfortable for breathing if they feel unwell.
- If not breathing, call 911 or an ambulance, then give artificial respiration, preferably mouth-to-mouth if possible.
- Call a POISON CENTER or doctor for treatment advice.

IF ON SKIN OR HAIR:
- Take off immediately all contaminated clothing. Rinse skin with water or shower.
- Get medical attention if irritation develops or persists.
- Wash contaminated clothing before reuse.

IF SWALLOWED:
- Call a POISON CENTER or doctor immediately.
- Rinse mouth. Do NOT induce vomiting.
- Do not give anything to mouth to an unconscious person.
- Immediately call a POISON CENTER or doctor.

HOT LINE NUMBER
Have the product container or label with you when calling a poison control center or doctor, or going for treatment. You may also contact 1-800-424-9300 for emergency medical treatment information.

STORAGE AND DISPOSAL
Do not contaminate water, food or feed by storage or disposal.
STORAGE: Store in original container only. Keep container tightly closed. Do not allow water to be introduced into the contents of this container. Do not store near heat or open flame. Do not store with oxidizing agents or ammonium nitrate. Keep locked up and out of the reach of children.
CONTAINER DISPOSAL: Do not reuse empty container. Triple rinse (or equivalent) during mixing and loading and add rinse water to spray tank. Recycling decontaminated containers is the best option of container disposal. The Agricultural Container Recycling Council (ACRC) operates the national recycling program. To contact your state and local ACRC recycler visit the ACRC web page at www.acrecycle.org. Decontaminated containers may also be disposed of in a sanitary landfill.

For help in chemical emergencies involving spill, leak, fire or exposure, call toll free 1-800-424-9300.

GENERAL INFORMATION
Ele-Max® Copper FL 4-0-0 is a formulated product for the treatment of copper deficiency by foliar or soil application. When used at standard application and dilution rates, Ele-Max® Copper FL 4-0-0 is compatible with a wide range of agrichemicals. This product may be applied using a variety of agricultural application equipment and techniques. This product is recommended for use as a supplement to a regular fertilizer program only. It is not intended nor implied to be a substitute for sound soil fertilization and good conventional cultural practices.
For additional information on product or programs, or if you are unfamiliar with any of the application methods, contact your local Helena representative or authorized Helena dealer.
Avoid application under extremes of climate, e.g., rapid drying conditions, extremely slow drying conditions, frost, rain, or when frost or rain are anticipated. Clean all equipment before and after use.

DIRECTIONS FOR USE
Shake the container thoroughly before use.
FERTILIZER IMPREGNATION
May be coated onto dry fertilizer granules.
WARNING: This product must not be used with straight ammonium nitrate fertilizer, or any other fertilizer product classified as an oxidizing agent – Class 5.1 material. For further advice, please consult your Helena representative.

FOLIAR DOSE RATE AND TIMINGS
Foliar fertilization is intended as a supplement to a regular fertilization program and will not, by itself, provide all the nutrients normally required by agricultural crops.
The following table is a guide for the use of Ele-Max® Copper FL 4-0-0 as a plant nutrient. Rates and frequency of application will depend on individual management programs. Use of Ele-Max® Copper FL 4-0-0 or any crops not listed on this table must be as a result of recommendations from your local agricultural authority.

RECOMMENDED CROPS* and RATES*
Alfalfa: 0.5 pints/acre applied at start of tillering. Water rate: 20 gallons/acre.
Apple: 0.5 pints/acre applied after harvest before leaf fall. Water rate: 50 gallons/acre.

- Single application

- 3 rates tested to induce toxicity:

  1 qt./ac, 4 qt./ac, 8 qt/ac

  (4X, 8X, 32X recommended label rate)

Results of 2018 Liquid Copper Rate Study

Loblolly pine seedling characteristics measured in October and November 2018

Nursery	Rate	Density (ft^2)	Shoot Height (cm)	RCD (mm)	Shoot Weight (g)	Root Weight (g)
A	0 oz./ac	28.6	29.7	4.18	2.61	0.47
	1 qt./ac	27.6	29.6	4.15	2.60	0.46
	4 qt./ac	27.9	29.6	4.21	2.66	0.46
	8 qt./ac	29.3	30.6	4.20	2.57	0.46
	LSD=0.1	3.4	1.0	0.26	0.33	0.05
B	0 oz./ac	22.5	23.8	3.84	2.40	0.36
	1 qt./ac	20.0	24.1	3.87	2.31	0.38
	4 qt./ac	20.7	22.5	3.88	2.37	0.37
	8 qt./ac	20.8	23.8	4.05	2.43	0.38
	LSD=0.1	3.3	1.5	0.32	0.39	0.08

- No differences between treated and nontreated seedling characteristics

Thanks to:

Ken Singleton, K & L Forest Nursery Inc. Buena Vista, GA
Mark Davis, Rayonier Elberta, AL Nursery

Dr. David South, Auburn University
Dr. Zach Taylor, Helena-Agri Enterprises

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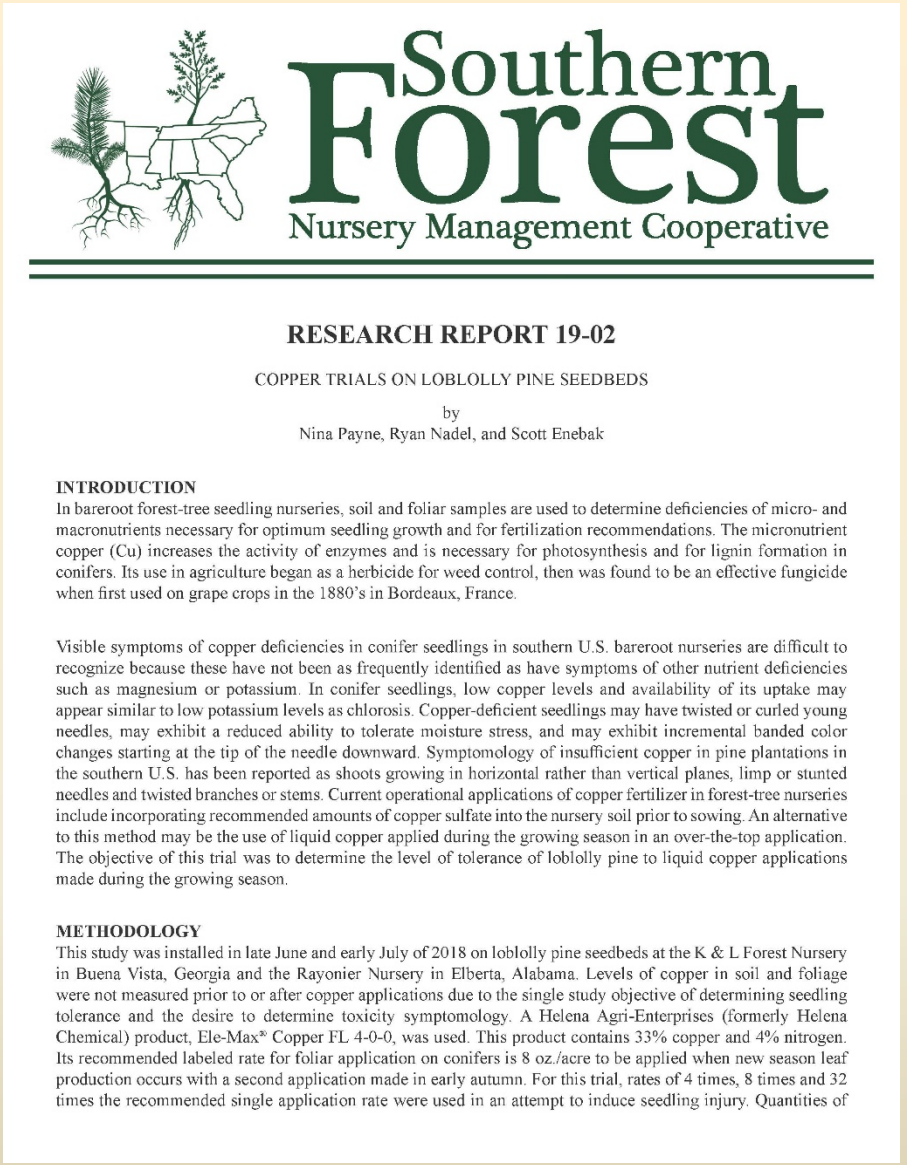
2018

Liquid Copper Rate Study
RR 19-02



Southern Forest
Nursery Management Cooperative

RESEARCH REPORT 19-02

COPPER TRIALS ON LOBLOLLY PINE SEEDBEDS

by
Nina Payne, Ryan Nadel, and Scott Enebak

INTRODUCTION

In bareroot forest-tree seedling nurseries, soil and foliar samples are used to determine deficiencies of micro- and macronutrients necessary for optimum seedling growth and for fertilization recommendations. The micronutrient copper (Cu) increases the activity of enzymes and is necessary for photosynthesis and for lignin formation in conifers. Its use in agriculture began as a herbicide for weed control, then was found to be an effective fungicide when first used on grape crops in the 1880's in Bordeaux, France.

Visible symptoms of copper deficiencies in conifer seedlings in southern U.S. bareroot nurseries are difficult to recognize because these have not been as frequently identified as have symptoms of other nutrient deficiencies such as magnesium or potassium. In conifer seedlings, low copper levels and availability of its uptake may appear similar to low potassium levels as chlorosis. Copper-deficient seedlings may have twisted or curled young needles, may exhibit a reduced ability to tolerate moisture stress, and may exhibit incremental banded color changes starting at the tip of the needle downward. Symptomology of insufficient copper in pine plantations in the southern U.S. has been reported as shoots growing in horizontal rather than vertical planes, limp or stunted needles and twisted branches or stems. Current operational applications of copper fertilizer in forest-tree nurseries include incorporating recommended amounts of copper sulfate into the nursery soil prior to sowing. An alternative to this method may be the use of liquid copper applied during the growing season in an over-the-top application. The objective of this trial was to determine the level of tolerance of loblolly pine to liquid copper applications made during the growing season.

METHODOLOGY

This study was installed in late June and early July of 2018 on loblolly pine seedbeds at the K & L Forest Nursery in Buena Vista, Georgia and the Rayonier Nursery in Elberta, Alabama. Levels of copper in soil and foliage were not measured prior to or after copper applications due to the single study objective of determining seedling tolerance and the desire to determine toxicity symptomology. A Helena Agri-Enterprises (formerly Helena Chemical) product, Ele-Max* Copper FL 4-0-0, was used. This product contains 33% copper and 4% nitrogen. Its recommended labeled rate for foliar application on conifers is 8 oz./acre to be applied when new season leaf production occurs with a second application made in early autumn. For this trial, rates of 4 times, 8 times and 32 times the recommended single application rate were used in an attempt to induce seedling injury. Quantities of

ALWAYS TEST NEW PRODUCTS IN A SMALL AREA OF NURSERY PRIOR TO LARGER-SCALE USE!

Questions/comments?

Micronutrient Product Study

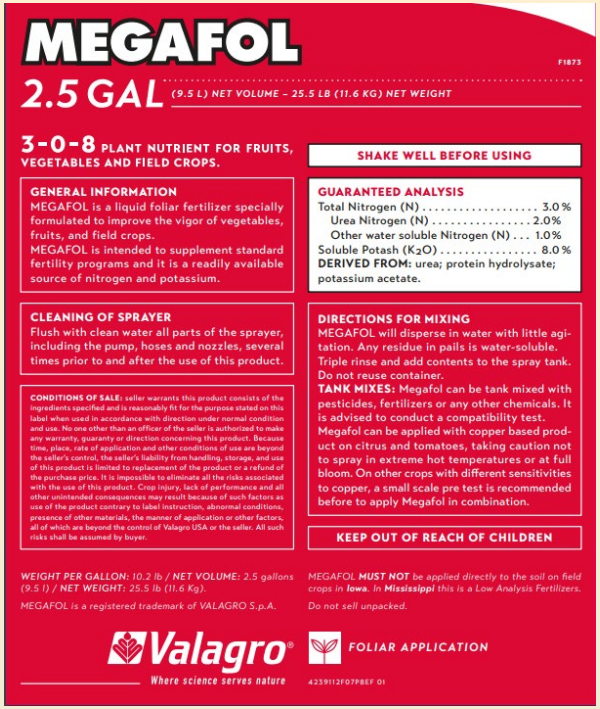

Holiday Inn
Express

Micronutrient Product Study

To determine effects of 3 plant micronutrient products on seedling tolerance

- Bareroot loblolly pine trials installed at:
  IFCO Jesup, GA Nursery
  K & L Forest Nursery Buena Vista, GA
  Rayonier Nursery Elberta, AL (+ slash pine)

- Products tested: Megafol by Helena Agri-Enterprises
  Axilo Mix 5 by Valagro
  Foliar Blend + O2YS by AgriGro



MEGAFOL

2.5 GAL (9.5 L) NET VOLUME – 25.5 LB (11.6 KG) NET WEIGHT

3-0-8 PLANT NUTRIENT FOR FRUITS, VEGETABLES AND FIELD CROPS.

SHAKE WELL BEFORE USING

GENERAL INFORMATION
MEGAFOL is a liquid foliar fertilizer specially formulated to improve the vigor of vegetables, fruits, and field crops.
MEGAFOL is intended to supplement standard fertility programs and it is a readily available source of nitrogen and potassium.

GUARANTEED ANALYSIS
Total Nitrogen (N) ..... 3.0 %
Urea Nitrogen (N) 2.0%
Other water soluble Nitrogen (N) ... 1.0%
Soluble Potash (K_2O) ..... 8.0 %
DERIVED FROM: urea; protein hydrolysate; potassium acetate.

CLEANING OF SPRAYER
Flush with clean water all parts of the sprayer, including the pump, hoses and nozzles, several times prior to and after the use of this product.

DIRECTIONS FOR MIXING
MEGAFOL will disperse in water with little agitation. Any residue in pails is water-soluble. Triple rinse and add contents to the spray tank. Do not reuse container.
TANK MIXES: Megafol can be tank mixed with pesticides, fertilizers or any other chemicals. It is advised to conduct a compatibility test. Megafol can be applied with copper based product on citrus and tomatoes, taking caution not to spray in extreme hot temperatures or at full bloom. On other crops with different sensitivities to copper, a small scale pre test is recommended before to apply Megafol in combination.

CONDITIONS OF SALE: seller warrants this product consists of the ingredients specified and is reasonably fit for the purpose stated on this label when used in accordance with direction under normal condition and use. No one other than an officer of the seller is authorized to make any warranty, guaranty or direction concerning this product. Because time, place, rate of application and other conditions of use are beyond the seller's control, the seller's liability from handling, storage, and use of this product is limited to replacement of the product or a refund of the purchase price. It is impossible to eliminate all the risks associated with the use of this product. Crop injury, lack of performance and all other unintended consequences may result because of such factors as use of the product contrary to label instruction, abnormal conditions, presence of other materials, the manner of application or other factors, all of which are beyond the control of Valagro USA or the seller. All such risks shall be assumed by buyer.

KEEP OUT OF REACH OF CHILDREN

WEIGHT PER GALLON: 10.2 lb / NET VOLUME: 2.5 gallons (9.5 l) / NET WEIGHT: 25.5 lb (11.6 Kg).

MEGAFOL is a registered trademark of VALAGRO S.p.A.

*MEGAFOL **MUST NOT** be applied directly to the soil on field crops in **Iowa**. In **Mississippi** this is a Low Analysis Fertilizers.*

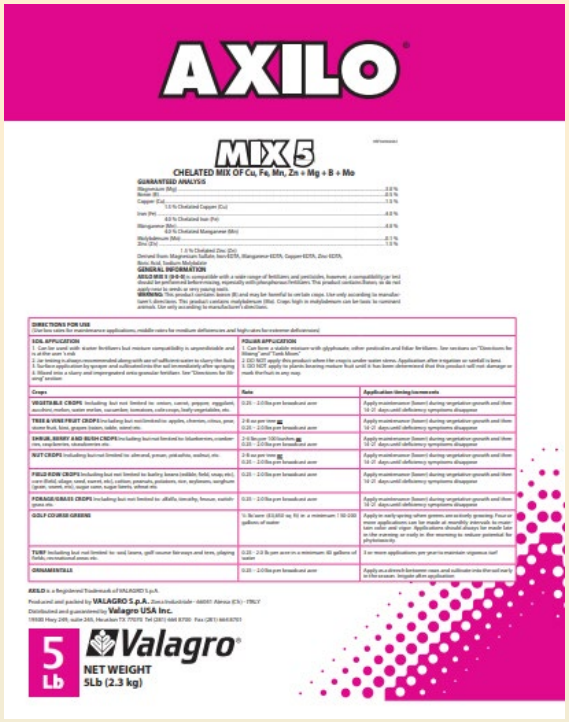
Do not sell unpacked.

Valagro
Where science serves nature

FOLIAR APPLICATION

4259112F07PBEF 01

Megafol:
Nitrogen 3.0%
Potash 8.0%



AXILO

MIX 5
CHELATED MIX OF Cu, Fe, Mn, Zn + Mg + B + Mo

GUARANTEED ANALYSIS

GENERAL INFORMATION

DIRECTIONS FOR USE

SOIL APPLICATION

FOLIAR APPLICATION

Crops	Rate	Application timing/comments
VEGETABLE CROPS	0.25 – 2.0 lbs per broadcast acre	Apply maintenance (lower) during vegetative growth and then 14 -21 days until deficiency symptoms disappear
TREE & VINE FRUIT CROPS	2 lb ac per tree 0.25 – 2.0 lbs per broadcast acre	Apply maintenance (lower) during vegetative growth and then 14 -21 days until deficiency symptoms disappear
BERRY, BERRY AND BUSH CROPS	2 lb/acre/100 trees 0.25 – 2.0 lbs per broadcast acre	Apply maintenance (lower) during vegetative growth and then 14 -21 days until deficiency symptoms disappear
NUT CROPS	2 lb ac per tree 0.25 – 2.0 lbs per broadcast acre	Apply maintenance (lower) during vegetative growth and then 14 -21 days until deficiency symptoms disappear
FIELD ROW CROPS	0.25 – 2.0 lbs per broadcast acre	Apply maintenance (lower) during vegetative growth and then 14 -21 days until deficiency symptoms disappear
FORAGE/GRASS CROPS	0.25 – 2.0 lbs per broadcast acre	Apply maintenance (lower) during vegetative growth and then 14 -21 days until deficiency symptoms disappear
GOLF COURSE GREENS	1 lb acre (0.1450 oz. fl) in a minimum 100 GPA gallons of water	Apply in early spring when greens are actively growing. Four or more applications can be made at monthly intervals to maintain color and vigor. Applications should always be made later in the morning or early in the morning to reduce potential for phytotoxicity.
TURF	0.25 - 2.0 lb per acre in a minimum 30 gallons of water	3 or more applications per year to maintain vigorous turf
ORNAMENTALS	0.25 – 2.0 lbs per broadcast acre	Apply as a drench between uses and cultivate into the soil early in the season. Irrigate after application

AXILO is a Registered Trademark of VALAGRO S.p.A.

Produced and packed by VALAGRO S.p.A.

Distributed and guaranteed by Valagro USA Inc.

5 Lb

Valagro

NET WEIGHT
5Lb (2.3 kg)

Axilo:
Magnesium 3.0%
Boron 0.5%
Copper 1.5%
Iron 4.0%
Manganese 4.0%
Molybdenum 0.1%
Zinc 1.5%

FoliarBlend®

by AgriGro

Product Information

Directions for Use

Mixing Instructions

Recyclable Container

CAUTION!
KEEP OUT OF REACH OF CHILDREN

Guaranteed Analysis 1-0-0

Boron Warning

Conditions of Sale, Limitation of Warranty & Liability.

Manufactured by:

FoliarBlend:
Nitrogen 1.0%
Boron 0.03%
Cobalt 0.002%
Manganese 0.1%
Molybdenum 0.002%
Zinc 0.05%

- Multiple applications made:
  8 weeks post-sowing (late June/early July)
  10 weeks post-sowing (mid-July)
  12 weeks post-sowing (early August)
  15 weeks post-sowing (late August)

- Each product applied at 1 pint/acre

- pH buffering of mixture required and adjuvant/surfactant used when recommended

- Applications made in morning and after irrigation or rainfall when feasible

Results of 2018 Micronutrient Study

Loblolly pine seedling characteristics measured in October and November 2018

Nursery	Product	Seedling Density (ft^2)	Shoot Height (cm)	RCD (mm)	Shoot Weight (g)	Root Weight (g)
A	Control	19.6	32.3	4.84	4.41	0.65
	Axilo	19.7	31.8	4.77	4.33	0.67
	FoliarBlend	19.4	31.2	4.64	4.18	0.64
	Megafol	20.9	31.0	4.70	4.15	0.68
B	Control	29.7	28.4	3.89	2.25	0.38
	Axilo	31.0	28.2	3.80	2.18	0.34
	FoliarBlend	29.1	27.4	3.82	2.18	0.37
	Megafol	29.4	29.1	3.90	2.33	0.39
C	Control	21.0	25.0	4.09	2.59	0.41
	Axilo	20.5	26.2	4.27	2.72	0.41
	FoliarBlend	23.2	24.5	4.06	2.44	0.38
	Megafol	20.8	25.3	4.05	2.48	0.38

Results of 2018 Micronutrient Study

Slash pine seedling characteristics measured in October 2018

Product	Density (ft^2)	Shoot Height (cm)	RCD (mm)	Shoot Weight (g)	Root Weight (g)
Control	23.8	25.5	3.89	2.66	0.35
Axilo	25.2	25.0	3.87	2.49	0.39
FoliarBlend	25.0	25.0	3.84	2.42	0.36
Megafol	26.6	25.5	3.97	2.58	0.36

Results of 2018 Micronutrient Study

Foliar nutrient levels of
Axilo-treated loblolly and slash pine seedlings measured in January 2019
nutrients in BOLD are in Axilo product

Nursery	Species	Product	N (%)	S (%)	P (%)	K (%)	**Mg (%)**	Ca (%)	Na (%)	**B (ppm)**	**Zn (ppm)**	**Mn (ppm)**	**Fe (ppm)**	**Cu (ppm)**	Al (ppm)
		Deficient Levels	*<1.1*	*<0.1*	*<0.09*	*<0.4*	***<0.05***	*<0.12*		***<3***	***<5***	***135-1677***	***<30***	***<3***	185-2097
A	Loblolly	Control	1.58	0.17	0.18	0.82	**0.13**	0.26	0.04	**23**	**56**	**458**	**275**	**12**	433
	Loblolly	Axilo	1.54	0.17	0.16	0.93	**0.12**	0.34	0.04	**22**	**56**	**436**	**454**	**11**	485
B	Loblolly	Control	1.64	0.12	0.15	0.66	**0.07**	0.27	0.01	**47**	**60**	**1197**	**87**	**8**	480
	Loblolly	Axilo	1.76	0.12	0.14	0.62	**0.08**	0.28	0.01	**48**	**54**	**1120**	**119**	**6**	488
C	Loblolly	Control	1.49	0.09	0.14	0.49	**0.08**	0.30	0.02	**42**	**57**	**802**	**105**	**7**	437
	Loblolly	Axilo	1.39	0.09	0.12	0.48	**0.07**	0.27	0.02	**42**	**44**	**653**	**103**	**6**	364
C	Slash	Control	1.29	0.10	0.20	0.52	**0.05**	0.30	0.04	**14**	**41**	**855**	**68**	**5**	268
	Slash	Axilo	1.55	0.10	0.18	0.59	**0.06**	0.29	0.03	**14**	**39**	**749**	**95**	**5**	274

- No foliar nutrient samples (nontreated and micronutrient treated) were found to be deficient in any nutrient measured

Results of 2018 Micronutrient Study

Foliar nutrient levels of
FoliarBlend-treated loblolly and slash pine seedlings measured in January 2019
nutrients in BOLD are in FoliarBlend product

Nursery	Species	Product	**N (%)**	S (%)	P (%)	K (%)	Mg (%)	Ca (%)	Na (%)	**B (ppm)**	**Zn (ppm)**	**Mn (ppm)**	Fe (ppm)	Cu (ppm)	Al (ppm)
		Deficient Levels	***<1.1***	*<0.1*	*<0.09*	*<0.4*	*<0.05*	*<0.12*		***<3***	***<5***	***135-1677***	*<30*	*<3*	185-2097
A	Loblolly Loblolly	Control Foliar Blend	**1.58** **1.51**	0.17 0.18	0.18 0.16	0.82 0.84	0.13 0.12	0.26 0.33	0.04 0.04	**23** **22**	**56** **58**	**458** **444**	275 379	12 15	433 511
B	Loblolly Loblolly	Control Foliar Blend	**1.64** **1.72**	0.12 0.12	0.15 0.15	0.66 0.66	0.07 0.07	0.27 0.29	0.01 0.02	**47** **49**	**60** **64**	**1197** **1162**	87 111	8 9	480 508
C	Loblolly Loblolly	Control Foliar Blend	**1.49** **1.52**	0.09 0.10	0.14 0.14	0.49 0.55	0.08 0.08	0.30 0.29	0.02 0.02	**42** **35**	**57** **48**	**802** **661**	105 146	7 6	437 340
C	Slash Slash	Control Foliar Blend	**1.29** **1.49**	0.10 0.11	0.20 0.16	0.52 0.59	0.05 0.06	0.30 0.28	0.04 0.03	**14** **15**	**41** **43**	**855** **716**	68 106	5 6	268 290

- No foliar nutrient samples (nontreated and micronutrient treated) were found to be deficient in any nutrient measured

Results of 2018 Micronutrient Study

Megafol-treated loblolly and slash pine seedlings foliar nutrient levels measured in January 2019

nutrients in BOLD are in Megafol product

Nursery	Species	Product	**N (%)**	S (%)	P (%)	**K (%)**	Mg (%)	Ca (%)	Na (%)	B (ppm)	Zn (ppm)	Mn (ppm)	Fe (ppm)	Cu (ppm)	Al (ppm)
		Deficient Levels	***<1.1***	*<0.1*	*<0.09*	***<0.4***	*<0.05*	*<0.12*		*<3*	*<5*	*135-1677*	*<30*	*<3*	185-2097
A	Loblolly	Control	**1.58**	0.17	0.18	**0.82**	0.13	0.26	0.04	23	56	458	275	12	433
	Loblolly	Megafol	**1.60**	0.17	0.17	**0.78**	0.13	0.29	0.04	24	57	524	46	7	280
B	Loblolly	Control	**1.64**	0.12	0.15	**0.66**	0.07	0.27	0.01	47	60	1197	87	8	480
	Loblolly	Megafol	**1.71**	0.13	0.14	**0.59**	0.09	0.27	0.01	47	59	1189	133	10	503
C	Loblolly	Control	**1.49**	0.09	0.14	**0.49**	0.08	0.30	0.02	42	57	802	105	7	437
	Loblolly	Megafol	**1.34**	0.09	0.12	**0.47**	0.07	0.27	0.02	32	46	704	82	6	319
C	Slash	Control	**1.29**	0.10	0.20	**0.52**	0.05	0.30	0.04	14	41	855	68	5	268
	Slash	Megafol	**1.44**	0.10	0.16	**0.44**	0.05	0.24	0.03	14	34	727	70	4	279

- No foliar nutrient samples (nontreated and micronutrient treated) were found to be deficient in any nutrient measured

- Micronutrient ***deficiencies*** must be quantified prior to selection and application of any new product

- Many other products are available on the market:

Potassium 2.0%
Sulphur 2.0%
Magnesium 1.0%
Iron 2.5%
Boron 0.02%
Manganese 0.05%
Zinc 0.05%

Magnesium 0.5%
Boron 0.025%
Copper 0.25%
Iron 0.25%
Manganese 2.5%
Zinc 1.25%

Calcium 1.0%
Magnesium 1.0%
Copper 0.5%
Iron 0.5%
Manganese 0.5%
Molybdenum 0.1%
Zinc 0.5%

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Ricky Sloan, Helena Agri-Enterprises

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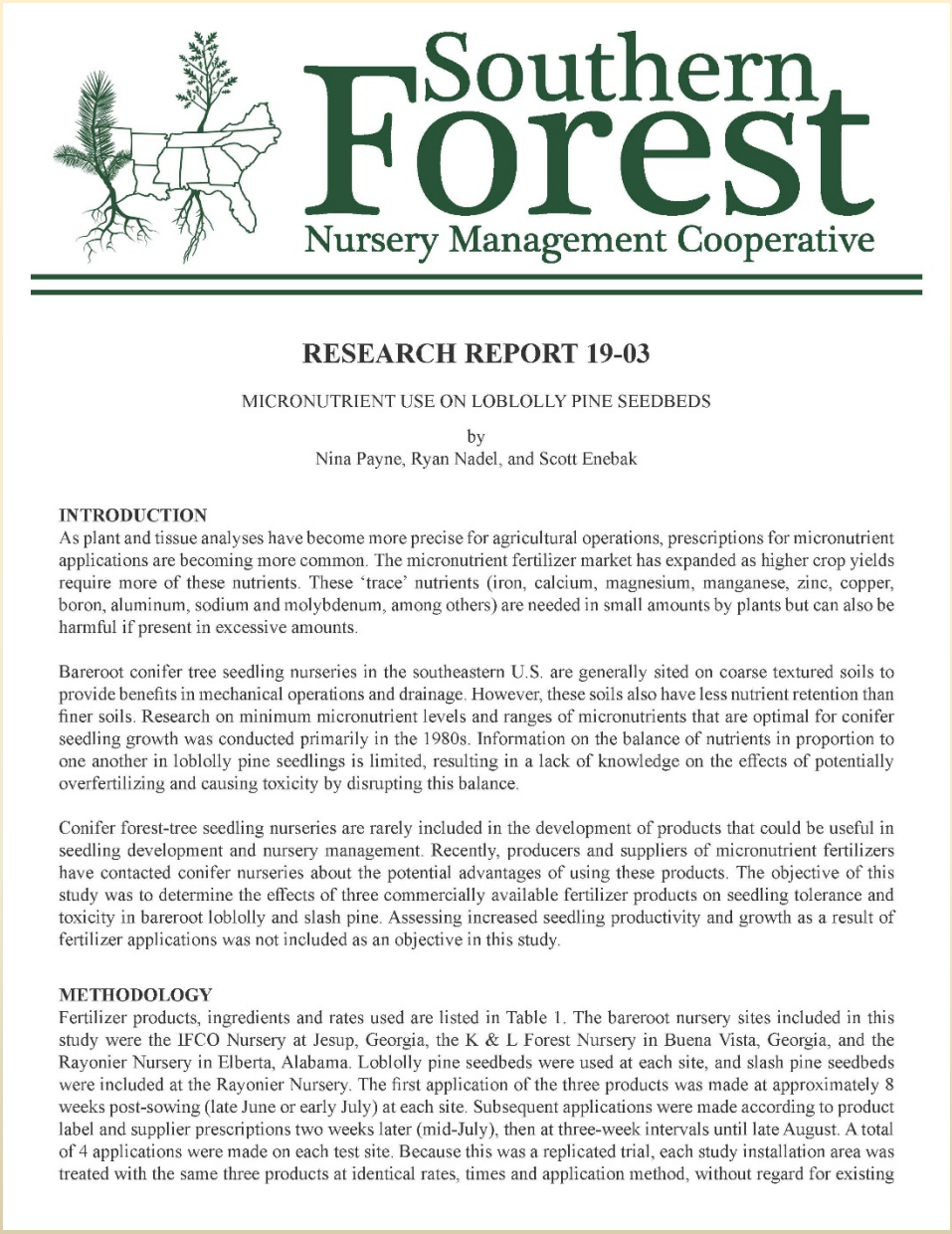
2018

Micronutrient Product Study RR 19-03



Southern Forest Nursery Management Cooperative

RESEARCH REPORT 19-03

MICRONUTRIENT USE ON LOBLOLLY PINE SEEDBEDS

by
Nina Payne, Ryan Nadel, and Scott Enebak

INTRODUCTION

As plant and tissue analyses have become more precise for agricultural operations, prescriptions for micronutrient applications are becoming more common. The micronutrient fertilizer market has expanded as higher crop yields require more of these nutrients. These 'trace' nutrients (iron, calcium, magnesium, manganese, zinc, copper, boron, aluminum, sodium and molybdenum, among others) are needed in small amounts by plants but can also be harmful if present in excessive amounts.

Bareroot conifer tree seedling nurseries in the southeastern U.S. are generally sited on coarse textured soils to provide benefits in mechanical operations and drainage. However, these soils also have less nutrient retention than finer soils. Research on minimum micronutrient levels and ranges of micronutrients that are optimal for conifer seedling growth was conducted primarily in the 1980s. Information on the balance of nutrients in proportion to one another in loblolly pine seedlings is limited, resulting in a lack of knowledge on the effects of potentially overfertilizing and causing toxicity by disrupting this balance.

Conifer forest-tree seedling nurseries are rarely included in the development of products that could be useful in seedling development and nursery management. Recently, producers and suppliers of micronutrient fertilizers have contacted conifer nurseries about the potential advantages of using these products. The objective of this study was to determine the effects of three commercially available fertilizer products on seedling tolerance and toxicity in bareroot loblolly and slash pine. Assessing increased seedling productivity and growth as a result of fertilizer applications was not included as an objective in this study.

METHODOLOGY

Fertilizer products, ingredients and rates used are listed in Table 1. The bareroot nursery sites included in this study were the IFCO Nursery at Jesup, Georgia, the K & L Forest Nursery in Buena Vista, Georgia, and the Rayonier Nursery in Elberta, Alabama. Loblolly pine seedbeds were used at each site, and slash pine seedbeds were included at the Rayonier Nursery. The first application of the three products was made at approximately 8 weeks post-sowing (late June or early July) at each site. Subsequent applications were made according to product label and supplier prescriptions two weeks later (mid-July), then at three-week intervals until late August. A total of 4 applications were made on each test site. Because this was a replicated trial, each study installation area was treated with the same three products at identical rates, times and application method, without regard for existing

Questions/comments?