

# TREE CARE INDUSTRY

The Official Publication of the National Arborist Association

Volume IX, Number 5 - May 1998

## *Tree Chemistry for Fun & Profit With Dr. Alex L. Shigo*

\*\*\*\*\* 3-DIGIT 276  
DR. JAMES R. MCGRAW  
NC STATE UNIVERSITY \*\*  
BOX 8003 \*\*  
RALEIGH NC 27695-0001



INTRODUCING NAA'S NEW  
"Rigging for Removal VIDEO."  
See Page 65 for more  
details.





## WITH SOME OF THE LONGEST SERVICE INTERVALS IN THE BUSINESS, IT ONLY STOPS TO PICK UP AWARDS.

1997 J.D. Power and Associates Award recipient for "Best Medium-Duty Truck for Dealer Service."\* This award, based on attitude, quality, capabilities and timeliness says a lot about the 1000-plus International® dealers across North America. So on those occasions when an International truck actually requires maintenance, its owner can expect nothing less than top-ranking service. For more information about a truck that **works overtime** and **pays over time** and whose dealer service network earned a J.D. Power and Associates award, call 1-800-962-0119, ext. 310.  **INTERNATIONAL**

\*J.D. Power and Associates 1997 Medium-Duty Truck Customer Satisfaction Study.™ Medium-Duty Truck defined as Gross Vehicle Weight Class 5, 6 or 7 truck.

Please circle 46 on Reader Service Card



# Tree Chemistry for Fun & Profit

By Dr. Alex L. Shigo

## Introduction

The word "chemistry" sends chills down the spines of most people. Arborists say, "How dare he talk about that word. I got into the tree business so I could get out of chemistry class."

I want to examine chemistry in several ways—not only the chemistry involved in water, food and fertilizer ... but chemistry in a different sense. You have heard about the chemistry of love or business, which refers to the makeup of a business or relationship. The makeup is what chemistry is all about.

Let me start with a definition: Chemistry is all about arrangements and rearrangements of matter and the changes in properties of products. The problem we have had with this subject is in the way chemistry has been presented. There is no such thing as a complex understanding. What we need is to find simple ways to give simple meaning to complex subjects.

I will try to convince you not to be afraid of chemistry. If I change the words, you'll see that you use chemistry every day—every time you have a drink of water, you are drinking chemicals; every time you eat, you are eating chemicals. We have to remind people of that, because we will be in trouble as a profession if we do not start using chemistry.



**Actinorhizae on alder, collected from a swamp in midwinter in New Hampshire. Many beneficial soil organisms are active in very cold conditions. The organisms supercool when temperatures go very low. These actinorhizae benefit the host tree by fixing nitrogen.**





## The STIHL 020T... Elevated to a New Low

Those in the know agree, you can't top the STIHL 020T for dependability, balance or performance. And now you can't top the price. The manufacturer's suggested retail price for the incomparable 020T is now only \$449.95. Up to \$200 off its suggested 1997 retail price!

The ultimate chain saw with the features you expect at an unexpected low price. The 020T is designed for arborists and utility workers who require dependable power, low weight and optimum balance. It's the lightest weight STIHL

Now Only  
**\$449.95**

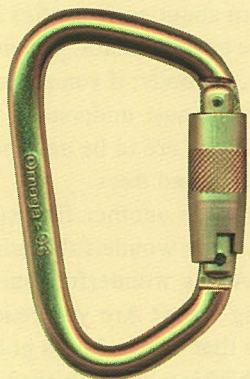
M.S.R.P.  
 At Participating Dealers

gasoline powered chain saw (only 7.9 lbs.) and has a 2.2 horsepower 35.2 cc engine. The saw is equipped with an attachment ring, Master Control Lever™, exclusive side access chain tensioner, anti-vibration system, and STIHL Quickstop® inertia chain brake.

All this performance and dependability at an unheard of \$200 savings. Quality products, designed for the way you work. For more information or for the name of your nearest STIHL dealer, visit our web site at [www.stihlusa.com](http://www.stihlusa.com) or call 1-800 GO STIHL (1-800-467-8445).



**You know what  
it takes to be  
the best...**



**Your  
reputation  
depends on it!**



**We make the  
best carabiners  
in the world...  
your life depends  
on it!**



**Omega Pacific, Inc.**  
The Carabiner People™

**P.O. Box 1780  
Airway Heights, WA 99001  
www.omegapac.com  
1.800.360.3990**

be banned. People signed a petition to ban water! Laugh, if you want, but these types of ignorant overreactions are around our corner.

I'm frightened when I see airline magazine articles about chemicals that we use every day. Some of these people do not understand the benefits of some of the chemicals we use, and, if someone starts a petition drive, life could become awfully difficult for us.

Some people have said that I am against fertilizer. I'm against pruning, too, when it's done incorrectly. I'm against watering, when a tree is over-watered, but I'm not against di-hydrogen oxide being used correctly. No treatment or product is failsafe. You can't go out and buy the very best hammers and screwdrivers and automatically make a nice house.

It's important to know about the products we use and employ them expertly. We'd better start fighting back against ignorance. One way to do that is to let people know that we understand a little bit about chemicals, and that we understand what fertilizers are and how to use them correctly, because I believe in the use of fertilizers.

## Fight back with knowledge

There are only six actors (C.H.O.N.P.S.) that make up 98 percent or more (by weight) of your body and of trees. I don't think it's asking too much for arborists to know just a little bit about those six. They can kill you, they can make you happy, they can give you lots of fun, and lots of profit, or they can make your life very miserable. There are only a few combinations of these we need to know.

We need to know what makes us run. Is it so difficult or irritating to know  $C_6H_{12}O_6$ ?

We need to understand our fuel, our glucose. One test I often give in my talks is to ask participants to name 30 general similarities between people and trees. Then, show me (or tell me) how those 30 similarities are different in their specifics. Start with glucose. Both trees and people use glucose as fuel. What's the specific difference? Trees make it, we get it ready made.

Let me give you another example. You are made up of bags of chemicals, and trees are made up of bags of chemicals. The difference is, our bags are in fatty little boundaries. Tree boundaries are made up of carbohydrates, mostly. People are primarily protein, whereas trees are primarily carbohydrates.

There is a long list of these similarities and differences. One of my favorites

## BEAUTY IS MORE THAN SKIN DEEP

Some people might be tempted to choose our high-end ropes for their vibrant colors alone. But for tree care experts, the real beauty of a Yale Cordage rope lies in its performance.

Every rope we create is manufactured to our stringent standards. We simply won't sell a rope with broken filaments, improper tensioning, or strands that are uneven, twisted or off-sheen. As a result, each Yale rope provides the strength and wear resistance arborists demand – for long-lasting performance that starts at the surface – and goes all the way to the core.

For more information and a free sample of our best selling XTC rope, write to the address below.

**YALE CORDAGE**  
26 Morin Street, Biddeford, ME 04005  
(207) 282-3396 fax (800) 255-9253



Photos courtesy Dr. Alex Shigo

**Mite galls on a birch leaf. Many insects "inject" chemicals into living cells and the cells alter their chemistry in ways that benefit the insects.**



## Good things come in threes

There are three important parts of your life. (You will notice how many things come in threes.)

- 1) Get something started;
- 2) Keep it running once it's started;
- 3) Do something productive once it's started and running.

For instance, if you start something but are headed in the wrong direction, you will have serious problems. It's not a matter of how fast you are going, but whether you are going in the right direction. It's not a matter of how many things

you know, but how many things you know that are correct. You can start your chain saw, but if you don't know which limb to cut you won't accomplish much that is positive.

I believe very strongly in the power of words. The way you can suddenly become a bigger, more powerful, more profitable, more fun-loving person is to define yourself. If you can't define who you are, that might be your first problem. And if you can't do it in 25 words or less, you may have a serious problem. Otherwise, you may get up in the morning and start, but you aren't going in the right direction.

## Motivators and stimulators

I have found that there are three motivators in life—faith, fear and fun. Faith motivates because we think something good will happen through our efforts.

Fear motivates because we are afraid something bad will happen if we don't act. As for fun, we say, "Oh the heck with it all, let's go fishing or hunting ... Let's have some fun."

There are also three major stimulators in life—pleasure, pain and curiosity. The reason I want to talk about the "S" word and the "M" word is because we get these words confused. The best I can hope to do is stimulate someone ... I cannot motivate anyone, however.

How can I stimulate you so that you will be motivated to pursue a greater understanding of chemistry? As I noted above, there are three possible ways I can stimulate you:

I can stimulate you through pleasure. I can tell you lots of nice things that will make you feel good.

I can irritate you and cause pain. Sometimes, pain is not a bad stimulator, because people repeat what you said

even though it may have hurt them. I hope I will not irritate you with this discussion, but if I do, it will be because I am pushing you to learn more about trees. If you are to be an engineer, you must learn about mathematics and rules; if you are to be a doctor, you must know the heart, the body; if you are to be a mechanic, you must understand motors. I believe if you are to be an arborist, you must understand trees.

Curiosity is another fine stimulator. The NAA has wonderful reading materials. ISA has wonderful journals. Are you using them? Are you reading? We all know that exercising is good for the body—thinking, through reading, is exercise of the mind. I don't mean you have to read every word, but you should at least flip the pages and know what's hot. One of the greatest fears I have is that something wonderful has happened and I don't know about it.

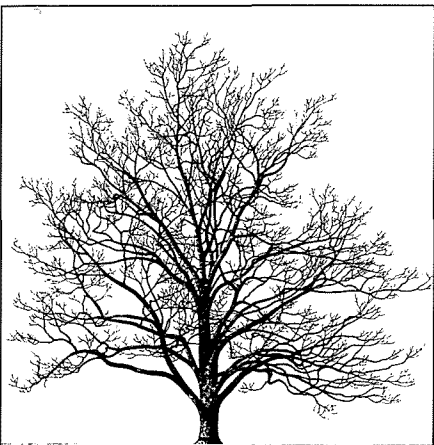
## Warning signs

You must be educated about tree chemistry and the products you use. People who are far removed from our industry are starting to get closer and closer. This is why I see the handwriting on the wall about chemistry. I'm getting a little worried, and you should be, too.

I was on a plane recently and read an essay by the CEO of an airline about fertilizers as pollutants. The CEO wrote about how our oceans and drinking water are starting to reach the limits of their capacity. He outlined some of the potential targets ... He was getting awfully close to us.

Let me give you another reason why I get frightened at where we are headed. As part of a high school science project, a student decided to show how little people understand about chemistry. He got a petition signed by hundreds of people to outlaw di-hydrogen oxide.

He described how di-hydrogen oxide has killed people; how people have been burned by di-hydrogen oxide; how cars have been known to slide off the road and people have been killed all because of di-hydrogen oxide. People signed the petition, figuring that anything that could be so bad that it could kill people should



# Getting to the root of trees' nutrient needs since 1941.



## THE DOGETT CORPORATION

The Tree Fertilizer Company

**800-448-1862**

*Call for more information on  
slow-release fertilizers, soil  
amendments, micro nutrients,  
organics, mycorrhizal spores  
and an index of research  
publications.*

TREE ILLUSTRATION: © 1994 THE MORTON ARBORETUM

is that when any living organism has its survival threatened, it will do something to continue to live. You do something when your survival is threatened, and a tree does something when its survival is threatened.

When threatened, a tree responds in many ways—and it responds the same way you must respond, both as an organism and as a business person.

When your business is threatened, you need some ready cash. You can tap into some of your profits you have kept in reserve. It's the same with your body, which stores reserve energy and it's the same for a tree.

The tree converts its profits into starch. The reserve energy for the tree is in the form of starch most of the time, and when the tree's profit begins to go down, bankruptcy comes in. The chemistry of the tree is no different than the chemistry of your business. The chemistry of business is called cash flow, and the chemistry of the tree is called energy flow. In your business, you call it money. In the chemistry tree business, we call it ATP.

In general, you better have some fuel when your survival is threatened. Those are the similarities. What about the specific differences?

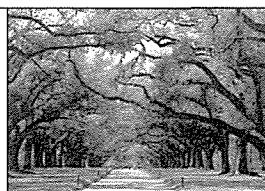
Your chemistry is such that you have

mobile units that will go to the injury. The way a tree responds is altogether different from the way an animal responds. A tree begins to form boundaries by walling off the injury. People are constantly dying and replacing the dying parts to stay alive. Trees can't do that, but trees have a better system. A tree is not a regenerating organism, it is a constantly generating system.

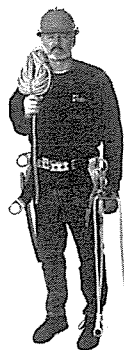
If you are in business, you'd better understand money. ATP is a universal currency in nature. Why do you require phosphorous? Because phosphorus in ATP is the major "money mover" in all living things. I'm not saying you have to understand the detailed chemistry of all this, but all arborists need to be aware, at least, of what ATP and glucose are and what they do.

If someone calls and asks what is happening to a tree, you can tell him or her if you know chemistry. You can turn a customer into a client. People come to you as customers, they should leave as clients. Customers come and go, clients come and stay.

How do you change a customer into a client? You become connected to a client. Look your clients in the eye. Call them by name. One of the best ways to achieve that conversion is to show (in a



# He prides himself on your success.



Dick Miller knows  
that having the right tools for the right  
job can make all the difference.

### Providing you with:

- Fast Reliable Service
- The Right Tools for the Job
- Expert Advice
- A Great (Free!) Catalog
- Professional Tools for the Tree-Care Industry: Hand Tools to Climbing Gear, Pruning Supplies to the Latest Diagnostic Equipment.

**Call Now! 800-441-8381**

or fax: 888-441-8382



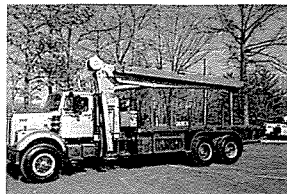
**AMERICAN ARBORIST<sup>®</sup>**  
SUPPLIES, INC.



# 140 SPECIALIZED TRUCKS IN STOCK!



1993 Ford LNT8000, 8.3 Diesel, 8 sp w/22-1/2 ton JLG crane. Model L 2250JBT, 95" Hook Height. \$94,500

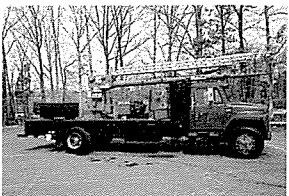


15-ton National crane Model 756 + 35 jib. 102' Hook Height. Mounted on white tandem 240 Cummins 10 sp., \$34,900



10+ Units - Just In!

10+ units. 1987-88-89 Chevy C60, 8.2 Diesel, 5sp/2sp. 30,000 GVW with 8 ton JLG cranes. 65' Hook Height. 16' bed. Starting at \$27,900



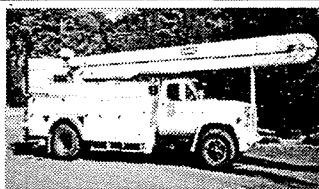
1987 Int'l 1854 DT466 5sp/2sp w/ Radocy 75' sign crane w/ladders. \$24,500



1980 GMC tandem V/8 with sky hook 130' sign crane. \$26,500



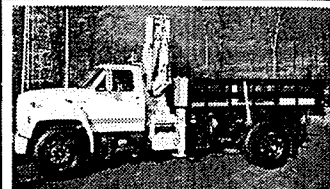
(6) Tree Trucks In Stock LR50 Asplundhs; Aerial Lift; Lift All; Holans; Etc.



1984 GMC; 8.2 Diesel; Auto.; A/B; w/ 52' HiRanger...\$29,500



1984 Int'l. S1954; 466; Auto.; A/B; 33 GVW; Dump; Power Angle Plow; 6-Ton Knuckleboom; 16' Side Reach.....\$16,500



(3) 1988-90 Ford Diesel K-Booms Just In; 3 to 6-Ton Cranes; Low Miles; 22 to 33K Miles; Super Nice!



(3) 1988-1989 Ford F350's; V-8; 4 Spd.; with Diesel Air Comp. and Gas Welders \$12,900 Each



1987 Ford F800; 7.8; Auto.; 12' Utility; Liftgate; NICE!.....\$18,900



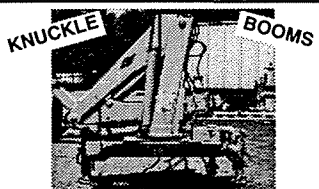
(4) Mack & Int'l Grapple Trucks; Prentice & Hawk With Diesel Pony Motors To Run Units.....\$7,500-\$19,500



1987 Ford F800; 8.2 Auto; 28,000 Miles; With Stelco HU2000 Sewer Rodder.....\$14,500



(15) Material Handling Buckets in Stock; 41', 42', 43', 50' & 55'; Holan, Asplundh; Telelect, Teco, Etc.....Call for List



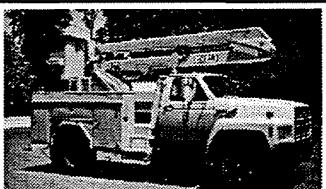
(10) HIAB; IMTCO; National; Etc. Knucklebooms Unmounted Or Mounted \$4,500 And Up



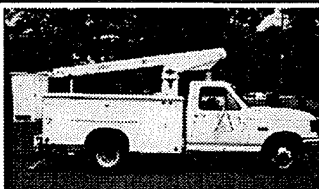
(8) Single Axle Knuckleboom Trucks - Ford, GMC, Internationals Call For List & Prices



SHEET ROCK LOADERS; BOUGHT AND SOLD - CALL FOR CURRENT INVENTORY.



(10) 32' to 42' Bucket Trucks; Gas & Diesel.....Call for Sale Price



(30) 1 Ton Buckets; 28' to 36' In Stock .....Call For Price List



(10) Digger Derricks In Stock! Single & Tandem.....Call for List



(10) Chip Body Dumps in Stock; Call For Prices & Descriptions

**Opdyke's**  
Truck & Equipment Sales

3123 Bethlehem Pike • Hatfield, PA (Phila. Area) 19440  
**(215) 721-4444**



## Cover Story

courteous way) that you have credentials. Don't be afraid to use the word chemistry in your conversations with them.

I have looked through hundreds of chemistry textbooks and I am convinced that I know why you ran (and I ran, too) from chemistry. I made fair grades in chemistry because I could memorize easily. Memorizing does not equal understanding, however. It was not until I started to write and talk about chemistry that I realized how little I really understood. Let's not be afraid of chemistry ... Let's give chemistry a chance ... It can be fun.

## The father of synthetic fertilizer

Anyone who fertilizes should know

this little story. I am going to leave it up to you to decide whether it has a happy or unhappy ending.

At the beginning of World War I, Ger-

many was having difficulty with its crops because their supplies of sodium nitrate for fertilizers came all the way from Chile. They gave this problem to a chem-



**Very slow release fertilizer. Acids produced by lichens slowly release elements from the rock that are essential for tree growth.**

## Is the Cut Resistance of **Your** Foot Protection **UL Classified?**

When you see the UL Classified mark, you can be sure that the foot protection you wear will meet the certification requirements of ASTM F1818<sup>†</sup> and the OSHA requirements for cut resistance.

OSHA\* requires that "... foot protection prevent the chain saw from cutting the employee before the employee is able to react, or before the protective material jams the chain saw. ..."

The UL Classified mark certifies that **SAWJAMMER®** products will meet these requirements. In fact, **SAWJAMMER®-PRO** and **SAWJAMMER® Slip-on** are the only UL Classified foot protectors.

**For more information call 1-800-969-9276, visit our website at [www.sawjammer.com](http://www.sawjammer.com), or send an e-mail to [trimmer@sawjammer.com](mailto:trimmer@sawjammer.com)**

### SAWJAMMER COMPANY, LLC

P.O. Box 11395 • Baltimore, Maryland 21239-0395  
Tel.: 410-325-6860 • Fax: 410-483-4066 • Toll Free Fax: 1-888-473-8008

**SAWJAMMER®-PRO** and **SAWJAMMER®** are registered trademarks of the **SAWJAMMER COMPANY, LLC**  
U.S. Patent Numbers: 5172493, 336972, 5251386, 5272822 • Canadian Patent Number: 2029921 • Other U.S. and foreign Patents Pending

<sup>†</sup>F1818 requires that a chain saw running at 50 feet per second must be stopped in less than 1.5 seconds. \*29CFR1910.266

Please circle 59 on Reader Service Card

TREE CARE INDUSTRY - MAY 1998



**SAWJAMMER®**  
P • R • O  
Chainsaw Protection for the Professional Logger™

**SAWJAMMER®-PRO**  
chain saw protection is permanently  
attached to your custom boots.



**SAWJAMMER®**  
Slip-on Foot Protection™

**SAWJAMMER® Slip-on  
Foot Protection™** is worn over  
your regular work shoes or boots.



# Convert...

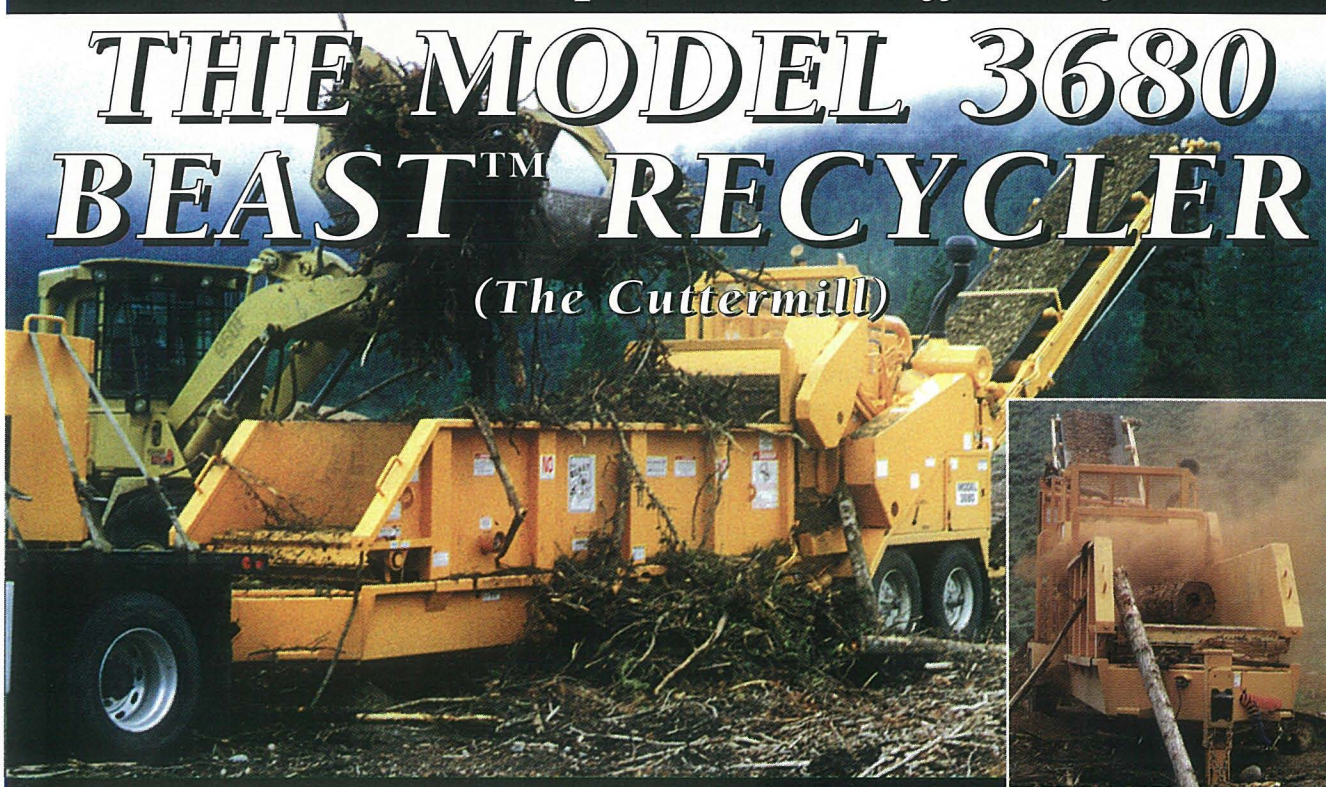
## BIG LOGS~STUMPS~GREEN WASTE

including Palm & Vines

to useable, saleable products, cost-effectively with

# THE MODEL 3680 BEAST<sup>TM</sup> RECYCLER

(The Cuttermill)



- Produce mulch in one pass
- Uniform product of almost any size
- Nothing processes green waste better
- Easy to transport - no permits
- The size reduction is contained inside of the cuttermill
- Reduce logs 30" in diameter and larger
- Unique cutting system limits fuel consumption and horsepower requirements
- Tough to hang up, tough to plug
- Wet material - stringy material - no problem

BEFORE PURCHASING A WASTE REDUCTION MACHINE, YOU MUST SEE...

## THE MODEL 3680 BEAST<sup>TM</sup>

BY SMORACY, INC.

Call Bandit today for a free video or  
to arrange a demonstration

# BANDIT INDUSTRIES, INCORPORATED

6750 MILLBROOK ROAD • REMUS, MI 49340

PHONE: (800) 952-0178 OR (517) 561-2270

FAX: (517) 561-2273

E-Mail: [brushbandit@worldnet.att.net](mailto:brushbandit@worldnet.att.net)

Website: [www.banditchippers.com](http://www.banditchippers.com)



pounds in your work with trees, and most are based on four actors: carbon, hydrogen, oxygen and nitrogen. Let me give you an example that's easy to understand:

Nitrogen exists in the air with triple bonds. ("Oh no," you're thinking. "Why does he have to start talking about bonds?") All bonding means is that nitrogen is held in the air by two "magnets" that are 300 pounds each. In other words, if you hold them, you can pick up a 300-pound block of steel. Now, people and trees are held together by "magnets" that will pick up *two* pounds. Why is this important? Well, if we were held together by 300 pound "magnets," we wouldn't fall apart. (The force is really not a magnetic one, but electrostatic attraction. I use "magnets" here just to make a simple point.)

Fertilizers, on the other hand, are soluble salts that are *essential* for life. They are held together with weak "magnets." Without delving too deeply into

---

*"Anyone who has not touched the inside of a tree should not be allowed to talk about trees."*

---

bonding theory, all you need to know is that life is made up of a whole bunch of stuff held together by "magnets." Some of them are weak, some strong.

Most of the water and all of the fuel that will open up the buds next year is already bound in the trees. The water that is in the tree right now is not free water, it's bound water. It is attached to cellulose, of course, but it is there. Take a chunk of wood and try to squeeze the water out of it. You can run a D5 tractor over it and you won't run any water out. And yet, that piece of wood

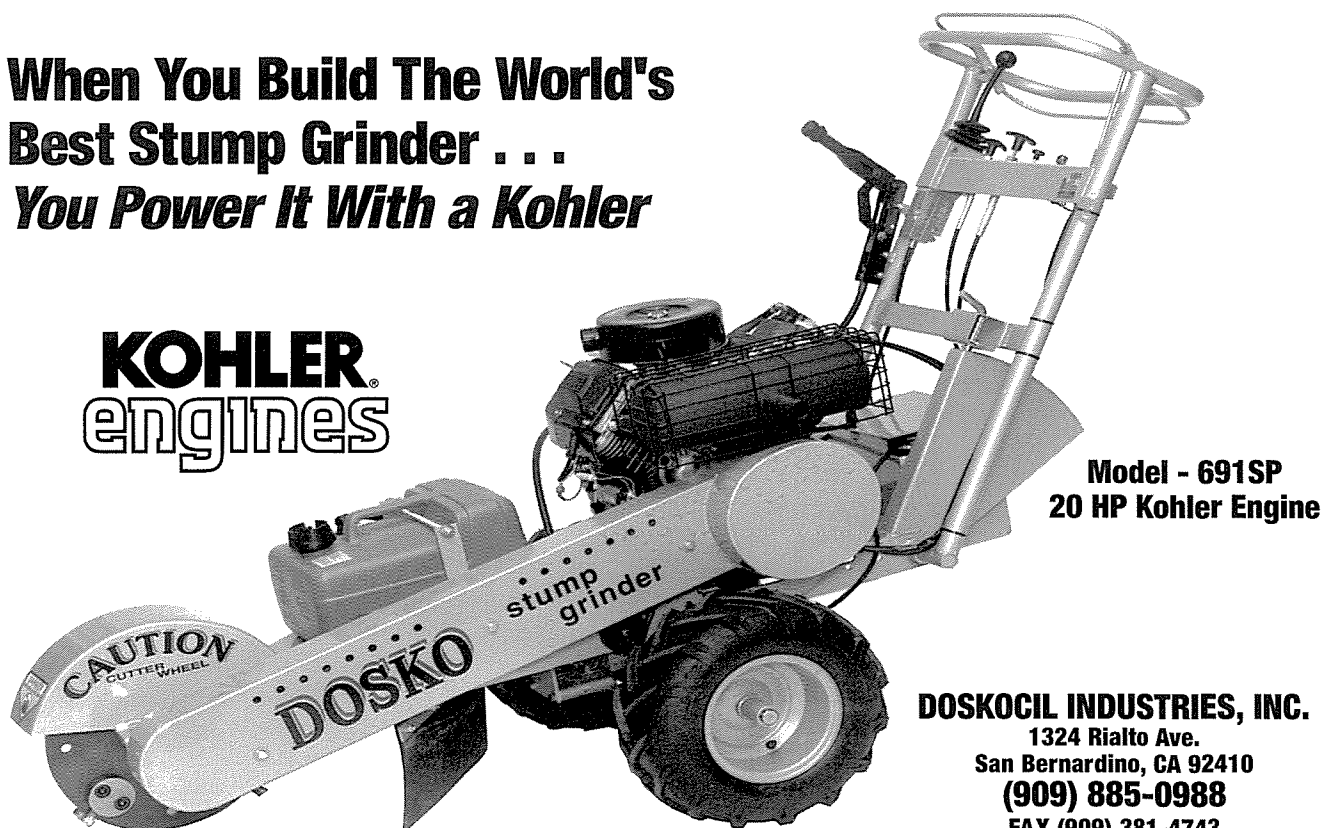
may be one-half water by weight. The water is bound to the cellulose.

Similarly, a tree has all of its glucose there for next year, but the glucose has been slightly altered so that it is not soluble in water. We call it starch. So, at the base of the bud, you have all the starch and all the glucose.

You don't have to understand all of the chemical processes involved in tree care, but everyone should know more, and, at the least, understand the most basic, most important processes.

**When You Build The World's  
Best Stump Grinder . . .  
You Power It With a Kohler**

**KOHLER**  
engines



**Model - 691SP  
20 HP Kohler Engine**

**DOSKOCIL INDUSTRIES, INC.**  
1324 Rialto Ave.  
San Bernardino, CA 92410  
**(909) 885-0988**  
FAX (909) 381-4743

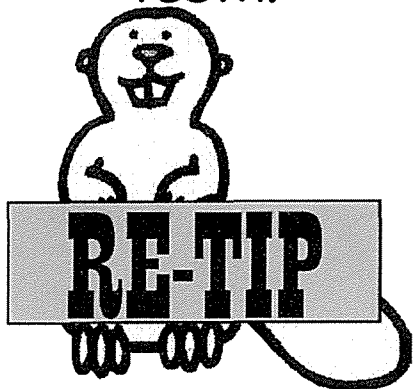


# Cover Story

## Be a leader

In your area, be a leader in introducing and talking about the chemistry of trees. Don't be afraid of chemistry. We have to bring this word into our vocabu-

**SAVE  
\$50 TO \$150  
every time  
you change  
stump grinder  
teeth.**



Our Re-tipping process replaces the **WORN** or **BROKEN** carbide on your used stump grinder teeth.

**You "wear 'em"  
We repair 'em!**

**CALL**

**1-888-GO-STUMP**

**1-888-467-8867**

**DISCOUNT  
STUMPCUTTERS**

Please circle 19 on Reader Service Card

lary ... We have to start learning ... We have to have some fun with chemistry.

What is a leader? My definition, which you don't have to accept, is this: "A leader is a person (or an animal) with a mission that is so important to them that they persevere in spite of constant attacks." Most leaders get beaten up and most leaders are often wrong, but they persevere. Show me a person who bleeds and stops the first time he gets hurt, and I'll show you a loser.

There's nothing wrong with making an honest profit while you are having fun with chemistry. Isn't that what our business is all about? The day it's no longer fun is the time to find something else. I refuse to go through the biggest part of my life without having some fun.

Remember, however, no one can learn for you. Nobody can really teach you to learn. You have to learn for yourself. I don't know how anyone can motivate you. I hope that I may be able to stimulate you, however, through pleasure, pain or curiosity.

What is a tree? What is a symplast? How does water really move up the tree? Why do we have certain declines? Why does this insect or fungus know a tree is very low in it's defense system? Be curious about the answers to these questions.

I have a definition for education: It is a race toward higher degrees of igno-

rance. Keep learning more and more until you reach a point where you do not know. If you pursue any natural science question, it will come eventually to the answer, "I don't know." But the pursuit is the fun part. Just as is hunting, the real fun is (or should be) the pursuit.

Someone once said, "Anyone who has not touched the inside of a tree should not be allowed to talk about trees." Boy, wouldn't I like to have that as a rule. Would you go to a doctor for a kidney operation if he had never touched one? Would you be first?

If we don't understand chemistry, I believe bad things will happen to our profession. Whether it be in the form of more regulations, laws or strings on everything we touch, it will happen. The message I am trying to communicate is that there is a whole new and wonderful layer coming to arboriculture, and this other layer is asking different questions. They are going to demand some different answers. There is faith, there is fear and there is fun. Let's not be afraid of chemistry, and make more honest money, and have lots of fun!

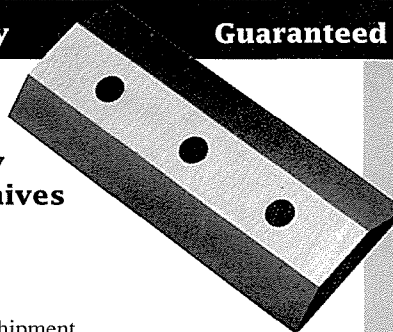
*This article was excerpted and adapted from the keynote address at TCI EXPO '97. Dr. Alex Shigo is the owner of Shigo & Trees, Associates in Durham, N.H. **TCI***

## ZENITH BRUSH CHIPPER KNIVES

**Highest Quality**

**Guaranteed Lowest Price**

**Move up to  
Zenith Cutter  
industrial quality  
brush chipper knives  
and save money.  
Guaranteed.**



- Guaranteed same-day shipment.
- Guaranteed selection. Available and in stock now.
- Guaranteed industrial quality.
- Guaranteed durability. Made from the best raw materials.
- Guaranteed lowest price. Call now for all the facts about our lowest price guarantee.

We've been making the highest quality industrial cutting tools for more than 70 years. Call for a price on your chipper knives.

**ZENITH CUTTER CO.**

**1-800-223-5202**

Zenith Cutter  
5200 Zenith Parkway  
P.O. Box 2252  
Rockford, IL 61131-0252

Please circle 77 on Reader Service Card