RURAL MECHANICAL TREE TRIMMING[1]

by Jim Seitz

Abstract. Maintaining power line right-of-way is a never ending task. Utilities working to provide their customers reliable power, at as low a rate as possible, are turning to mechanical tree trimmers to augment their present tree trimming systems. These machines, utilized primarily in rural areas, are helping right-of-way managers to significantly reduce the cost to side trim trees.

Timberjack is a large manufacturer of off-highway vehicles used in the logging, mining and utility industries. We have shipped 28,000 vehicles to 78 different countries around the world. Our main plant facility is located in Woodstock, Ontario, Canada. A large portion of each Timberjack built is American made, such as the engines, transmissions, and hydraulic componentry. I would like to share with you some ideas about rural mechanical tree trimming on transmission and distribution power line rights-of-way and offer some specific options based on cost effectiveness as researched at Timberjack.

First, let me define rural tree trimming. You are probably more familiar with tree trimming to obtain line clearance in urban settings. That is generally where the bulk of trimming dollars are spent. Rural rights-of-way are along the sides of back roads or busy highways, while some are cross country (Fig. 1). Generally, these rural areas are where there are more trees and fewer people.

Techniques

Climbing crews. According to an EPRI study, climbing crews still trim about 40% of all trees trimmed, both urban and rural. These men work hard in a dangerous environment. In certain applications they are the only solution to tree trimming problems.

Lift equipment. Lift equipment available to work these rural settings has for the most part been lift equipment designed for use in urban sites. Four-wheel drive trucks and off-highway vehicles do a good job of transporting these lifts for trimming in rural settings. The limiting factor is still the man in the tree. He presents time, safety and cost factor problems.

Chemical application. Some chemical side trimming is being accomplished with helicopters. This aerial method of total vegetation control is cost effective but is on the decline due to fear of chemical drift. Generally, chemical application is moving from a helicopter application to more controllable ground application systems. To date, these ground applications are directed more to ground plant control and not to side trimming.

Cutting Methods

Flush cutting. Flush cutting is the most widely accepted method of tree limb pruning today. In recent years, there has been some change of ideas on how to accomplish flush cutting. A major concern is the tree's ability to seal itself off naturally from insects and infection after pruning.

In a paper titled "Branches," published in the Journal of Arboriculture 6 (11): November 1980, Dr. Alex Shigo covers in depth how trees respond to dead or dying branches. He states in this paper that, "trees effectively wall off dying and dead branches most of the time. As the growth rate of the branch wood decreases and the trunk wood surrounding the branch continues to grow, a swollen collar forms. This collar is trunk wood. On living, dying, or dead branches, the collar should not be removed."

Swath cutting. With a mechanical tree trimmer a swath-type cut results. Power line clearance is the objective, rather than the individual pruning of each limb. The machine cuts a straight line parallel to the power line and edge of the right-of-way. Some limbs are cut fairly close to the trunk and some are cut farther out from the trunk. The site of cut is determined by where the tree is located in relation to the edge of the right-of-way. Systems utilizing this method instruct the operator to get the maximum amount of line clearance possible, being careful not to damage the trunk of the tree. With this method the branch bark collar is left intact so it can perform its natural function in the

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event that the cut limb dies back to the trunk. A similar situation occurs if the limb is broken or damaged by an act of God.

It is interesting to note that close inspection of many flush cut right-of-way areas also have a certain percentage of limbs cut in the swath cut manner. Trees on the edge of the right-of-way are flush cut and trees several feet off the edge of the right-of-way are swath cut.

Tree Health Concern

Questions raised by swath type-cutting include those about branch regrowth and long-term tree health. It is often believed that swath cutting a branch results in a multi-sprouting of limbs which quickly grow horizontally toward the powerline. Test plots established by Timberjack in the spring of 1983 indicate that this is not the case. Of course different species react in different ways, but as a rule, regrowth is very minimal. Generally more line clearance is lost from the growth of residual side limbs. These limbs, seeking sunlight, grow to the now open, newly trimmed area.

Most rural right-of-way has 15 to 20 feet on each side of the power line available for trimming. With the minimal amount of regrowth associated with swath-type cutting, a very manageable retrim cycle can be established. If all the trees in our test plot area had been flush-cut, the retrim cycle would not be lengthened.

In the spring of 1984, I made a field trip with Dr. Charles Gilliam, a member of the Horticulture Department at Auburn University. He received his Doctorate in Horticulture from Virginia Tech. I asked him to give me an objective comparison of two cutting methods, flush cut and swath cut, with regard to regrowth and potential long-term tree damage. Dr. Gilliam indicated the pruned branches associated with swath cutting should pose little or no problem to the trees themselves. Regrowth characteristics are very similar to those of flush cutting. Exceptions to the swath method based on aesthetics probably would occur in urban areas, but in rural areas swath cutting is a viable method.

In the Southern United States there are several rural electric systems with over two years of swath-type cutting experience. Inspection of these areas further substantiates our test plot results.

In some states swath-type cutting is discouraged by law. However, on a recent visit to one of these states, I noticed that the State Department of Transportation used a very popular machine that, in effect, swath cuts. The vehicle is a farm-type tractor with a boom mounted rotary mower. It is used to mow horizontally on highway rights-of-way and sometimes is rotated to a vertical position to side trim bushes and lower limbs on trees. The rotary mower does not have conventional saw blades like a mechanical tree trimmer. Its rotating, flat blades, beat, chew, and tear wherever they are applied. I call this a whacker. It does not produce a clean cut, and after a pass, it looks like the trail of the Tasmanian Devil. This type of vehicle is widely used in most states today with little or no complaint. I have reviewed this machine and its performance to stimulate your thinking about regrowth, tree health, and residual site appearance. This machine is used because it is fast, efficient, and cost effective with no apparent public outcry or long-term detrimental site damage.

Mechanical Tree Trimmer

If the mechanical tree trimmer's swath cut does not cause long-term damage to the trees, and generally does not produce more regrowth, and one man and one machine can average one mile of continuous cutting per day, then it, properly applied, will be a very cost effective tool to address

Figure 1.

rural tree trimming.

Early mechanical tree trimmers were developed on the concept of cutting a limb as if you were in a bucket or climbing the tree. The methods were a single saw, a telescoping-type boom and a turntable for positioning. They effectively cut limbs, some actually holding them, but the productivity was not much better than a man in the tree. Also, the early rubber-tired carriers were not effective in the rural, rough terrain. Later on, some mechanical tree trimmers incorporated a knuckle boom and a multi-saw design. These two innovations greatly increased the machines' productivity.

Timberjack mechanical tree trimmer. The term "swath-cut" pretty well describes the result of a Timberjack Mechanical Tree Trimmer (Fig. 2). The effect it has on a right-of-way is much like what you would have if you could get the Jolly Green Giant to cut your system with a Jolly-Green-Giant-size hedge trimmer. We don't have a hedge trimmer on our boom, but we do have five 18" conventional saws rotating at high speed on a very unique wand assembly. The cut it produces is 5-feet long, and it cuts equally well going up or down. The wand will rotate the saws 180 degrees and will pivot on the end of the boom 85 degrees left and 85 degrees right of center. It quickly positions for a topping motion or proper limb cutting angle. The cut it produces is clean and fast.

In addition to the multi-saw wand and knuckle boom design, a key feature of the Timberjack Mechanical Tree Trimmer is the placement of the trimming assembly (booms) on the rough terrain carrier. The inventor, Mr. Bronk Dixon, felt it important to keep the swath trimming motion, the power line and the face of the right-of-way parallel at all times. The trimming assembly is pin mounted onto the right front corner of the machine. The boom pivot point is actually forward of the right front tire and to the side of the machine. Any angle adjustment needed for a cut is made at the wand on the end of the boom rather than the boom itself. This is the key reason why the machine trims as fast as it does.

The area of cutting available measures from ground level to 57 feet with a width of approximately 40 feet from left to right. Benefits of this design are (a) no turntable, (b) most cutting is forward of the machine, (c) booms are continuously parallel to the face of the right-of-way, and (d) there is much less maintenance due to simplicity of the hardware and hydraulics.

The tree trimmer utilizes a power frame of the very popular 350 Timberjack log skidder. It has a proven power train with hundreds in operation worldwide. It comes equipped with 28.1 x 26 high flotation tires. It utilizes no outriggers. The operator simply drops the quick moving heavy-duty dozer blade to give the machine the stability it requires. The dozer blade is also a valuable tool for light dozing work and a great help to a power saw operator during tree removal, helping to direct the fall of the tree away from the power line.

The conventional power train offers years of trouble-free service. Power is transmitted from the economical 3-53 turbo Detroit Diesel engine through a heavy duty 28,000 series Clark power-shift transmission. The axles are equipped with outboard, industrial type, planetaries providing

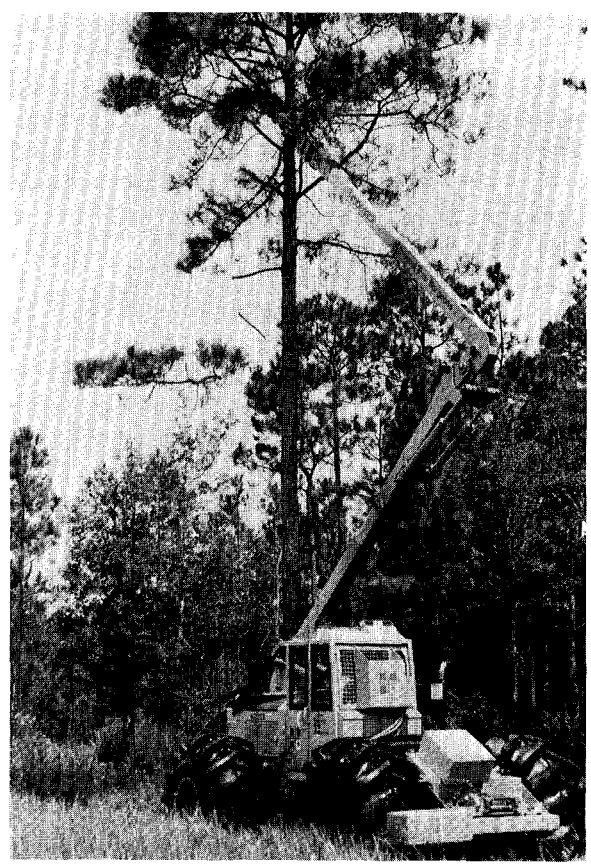

Figure 2.

final reduction at the wheel. This type power train does not incorporate any high pressure hydraulic pumps, hydraulic hoses, or hydraulic motors to propel the vehicle.

The operator's cab is completely enclosed. It is heated and air conditioned. A special dome is provided to allow the operator to see above the machine. This cab and dome are certified to ANSI specifications in regard to falling objects and roll over requirements.

The operator's controls for the carrier are located on the forward bulkhead of the operator's compartment. The trimmer controls are on each side of the seat. These controls link directly to the control valves for minimal wear, hydraulic circuitry and maintenance. Since most trimming operations are completed forward of the machine, the man sits in a comfortable upright position while operating.

The machine is equipped with a rear mounted hydraulic recovery winch to aid the operator if the machine becomes stuck. It also has a counterweight on the left rear corner of the machine to offset the weight of the trimming assembly on the right front corner. The upper and lower booms incorporate insulating fiberglass inserts certified to 69KV. The link between the upper and lower boom allows some minimal over-center operation.

Operator skills. In trimming distribution line, an occasional problem to deal with is overhanging limbs. It is not always easy to deal with this situation, but it is not an impossible task. Early schools of design for mechanical tree trimmers planned for the machine to hold the limb, cut it and lower it to the ground. Hardware to accomplish this was designed and used. This is a helpful capability, a small percentage of the time. However, experience has proven this to be much too time consuming. In dealing with the bulk of overhang situations, a better system is to sever the limb into small pieces and let them fall, similar to what you would do in a hand cutting situation. In a short time, an operator develops the necessary skills to direct the fall of a severed limb. For example, if you cut upward, the piece will generally move to the left enough to clear the line as it falls. In working on 3-phase line with overhang, several small quick cuts may be required. Dealing with overhang is not an unmanageable problem, but occasionally a skip will occur.

With a competent operator, a mechanical tree trimmer will damage very few lines, certainly no more than are damaged by conventional trim methods.

Productivity. Timberjack has a customer operating in East Texas that has run a machine for over two years. They average one and one-half miles of total cutting per day, working both single-phase and three-phase distribution line. The area is known as the "big thicket." It has a high stand density of both pine and hardwood. Ground conditions are generally flat and wet. Timberjack has operated a machine in north central North Carolina. The stand density is not as heavy as East Texas, but the terrain is very rough, steep and wet. After two days of operator training on the machine, an employee of the system was averaging about one mile per day. It is doubtful he will ever average one and one-half miles per day in the steep rugged terrain, but he will improve.

Cost effectiveness. Let's assume you could average one mile of trimming per day on your system with a mechanical tree trimmer. How would its cost compare to what you are doing n o w ?

Trim methods labor cost comparison for 200 miles (Table 1) contains four basic assumptions:

1. Production. One mile per day @ 200 working days would equal 200 miles per day.
2. Equipment. For comparison sake, use new equipment and depreciate it totally in one year.
3. Labor. One man will cost $7.00 per hour plus 50% for fringes and contractor profit, or a total of $10.50 per hour @ 2,000 hours per year. This would cost $21,000 per man per year. The 50% is used because it is a standard condition in most cost-plus type contracts.
4. Parity. These assumptions are based on information requested from power companies and contractors. The various inputs were averaged to produce these numbers.

Reading across the chart, one sees quickly that manpower is the big cost factor in any method. Utilizing the method with the least amount of men will reduce the cost per mile. The note at the bottom points out that manpower cost per mile will go from $1,575 for a 15-man climbing crew to $210 per mile for the mechanical tree trimmer crew.

With a mechanical tree trimming system, your manhour productivity will be much greater. Also, remember in the assumption that we totally depreciated the equipment over 12 months; this is not realistic. If the equipment is depreciated over four or five years, the equipment cost will further reduce the total cost per mile.

To realize the full benefit of low-cost mechanical tree trimming one needs to consider the following:

1. To save on manpower cost, use specialized mechanical equipment wherever possible.
2. To save on specialized mechanical equipment, a contractor will need a long-term machine commitment, or he will need to have it furnished to him. A contractor may lay off manpower at the end of a contract, but equipment purchasing costs go on. Therefore, a contractor will generally depreciate specialized equipment cost over the life of the contract he is working. Remember the cost per mile is substantially reduced with longer depreciation periods.

The mechanical tree trimmer will substantially reduce side trimming cost. Compare this machine and its manpower savings to the manpower sav-

Table 1.

Trim Method Labor Cost Comparison

ASSUMPTIONS:

PRODUCTION - 1 Mile per day @ 200 days equals 200 miles per year.

EQUIPMENT - All new equipment depreciated totally in one year.

LABOR - One man will cost $7.00 plus 50% or $10.50 per hour
- @ 2,000 hours per year. $21,000 per man per year.

PARITY - As indicated*

METHOD	EQUIP. COST	MANPOWER	COST	TOTAL
* 15 Man Climbing Crew.	0	15	$315,000	$315,000
* 3 Bucket Trucks @ $55,000 ea.	$165,000	6	$126,000	$291,000
* 2 Buckets Mounted on Rough Terrain Vehicles @ $70,000 ea.	$140,000	4	$84,000	$224,000
* 1 Timberjack Mechanical Tree Trimmer	$132,000	2	$42,000	$174,000

NOTE:

Manpower cost per mile goes from $1,575 per mile to $210 per mile. This fixed labor cost will occur every year.

If equipment cost is depreciated over 4 or 5 years, the cost of equipment per mile substantially reduces.

ings received years ago when switching to a mechanical mowing system. Is there anyone today who would trade their tractor/mowers for a crew of men using hand-cutting tools? I doubt it.

Conclusion

I do not want to leave you with the idea that if you buy or contract for a mechanical tree trimmer it will solve all your trimming problems. A mechanical tree trimmer is not the total answer. Every system has many variables, and I doubt that any mechanical machine will ever be developed that will properly address every situation. What I am challenging you to do is look over your thousands of miles of trees and trim what you can with this low cost method. Then, supplement what this method will not do with a different method. This will allow the maximum number of miles of side trimming for the budgeted dollars available. It takes work on your part to set up a cost effective program. Do not be like a man I recently talked to who said, "No, we can't use one of those things. Our entire 30,000 miles of rural line is too rough, steep and wet. We have to use all climbing crews."

I urge you to remember, a large portion of your system was built with mechanical equipment. The average production of a mechanical tree trimmer is 200 miles per year. Identify 600 miles that can be mechanically trimmed on your system and put a machine on for three years. You will be amazed at the cost savings.

The mechanical tree trimming industry is here today. Go visit a user, and check it out for yourself.

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ABSTRACT

HEISLER, GORDON M. and DAVID R. DE WALLE. 1985. **Plants that save energy.** Am. Forests 90(9): 13-16.

Recent studies have shown that selective, well-planned landscape plantings can significantly reduce wind velocity and heat loss from homes, thereby saving you money on fuel costs. Trees can also help you save air-conditioning costs by cooling your home in the summer. One of the most sensible and attractive plantings to conserve energy is the windbreak. The location of a windbreak is essential to its ability to shelter the house and thereby cut fuel consumption. Since in most of the U.S. prevailing winter winds come from the north and west, windbreaks are usually most effective on these sides of a house. We suggest that, where possible, windbreaks on the east or west be planted about 50 feet from a house. Any conifer will provide effective wind protection, but in general, choose fast-growing, visually dense species with stiff branches. The spacing of trees within a windbreak depends in part upon the species used. For narrow windbreaks, pine and spruce should be placed about six feet part in the rows. If you home is not air conditioned, do not block the direction from which come most of the summer breezes. You'll want to increase ventilation through open windows. If you have air conditioning, the placement of shrubs on the eastern, southern, and western sides of the outdoor condenser can save on energy bills.