COMPARISON OF ALTERNATIVE SAP LADDERS APPLIED RESEARCH IN ONTARIO

Submitted by:
Dave Chapeskie BSc(F), M.Sc(F),R.P.F.
and Angela Wheeler,B.Sc.

Background

Sap ladders have been developed, by maple producers, in response to the challenge of transferring sap over gradients in sugar bushes. A sap ladder is a simple, relatively inexpensive tubing system that allows for the transfer of sap over flat areas, up hills, or over obstacles such as roadways and trails. The only requirement is that the tubing be on a vacuum system. For the purposes of this paper, any system that is specifically designed to lift sap vertically is referred to as a sap ladder system.

Sap ladders can be useful where a section of bush is separated from the source of vacuum by a hill. In many such instances, the sap would simply be allowed to run by gravity to a tank at the bottom of the hill. By implementing a ladder system, labour used in gathering sap is reduced and the yield of good quality syrup may increase due to the introduction of vacuum to the affected areas. In some cases, the need for additional pumping stations may be eliminated and remote areas may be accessed that were left previously untapped due to the lack of electricity or other source of power. A sap ladder may also improve the effectiveness of tubing installations in areas where the bush is very flat or sloped upwards towards the sugar camp.

There are many different forms of sap ladders. There are those that use 5/16 inch lines as the vertical lift between upper and lower portions of mainline and others that use one or two sections of mainline tubing as the vertical lift. It may be possible to use a series of ladders to pull sap over greater heights if a single ladder is found to be inadequate. For example, three 8 foot ladders may be used in series, with small sections of downward sloping mainline in between to rise over a 24 foot incline.

Objectives

A need has been identified to compare a number of sap ladder configurations in an operational environment. It was recognized that there was much to be learned regarding the comparative efficiencies and limitations of the different ladders, as well as the mechanics involved. Specific aspects of the different ladders of interest include:

1. The amount of vacuum required for effective operation of the different ladders.
2. Freezing and thawing patterns associated with operation of the different ladders.
3. The efficiency of each ladder at lifting sap without significant losses due to fall-back or churning of the sap.
4. The comparative performance of the different sap ladders during low and high sap flow periods.
5. The number of taps which each type of sap ladder can accommodate for a pre-determined lift height.
6. The maximum effective height of lift for a ladder system.
7. The effectiveness of a series of sap ladders.

The main objectives of the present study are to learn more about sap ladders so that recommendations can be made regarding their comparative effectiveness. Alternative heights of sap ladders and the effectiveness of the ladders in series may be studied once a more basic comparison of the different types of ladders is carried out.

Methods:

A small-scale research project has been designed and was implemented at Wheelers Maple Products in Lanark County for the 2002 production season.

Five different sap ladder configurations are being evaluated in this project, along with a bypass serving as a control. The five types of sap ladders being evaluated are as follows:

1. A series of 6-way manifolds with 5/16 inch lines for a vertical lift
2. A single section of mainline as a vertical lift
3. Two pieces of mainline as a vertical lift, one for sap and one for vacuum
4. A single piece of mainline with a small diameter line contained within it as a vertical lift (diffuser)
5. A booster tank at the lowest point, with two vertical pieces of mainline, one for sap and one for vacuum

The five set-ups were established in a single location in the sugar bush to allow for controlled comparison between the sap ladders while gaining information on their individual performance. The sap ladder experiment is located in a portion of the sugar bush where a section of bush with 1200 taps is separated from the vacuum system by a flat section of land. The sap was previously collected on a tubing system that required the sap to be carried about 150 metres over a flat area before sloping downward to the pump house where the vacuum system is located. The sap ladder set-up will lift the sap 8 feet vertically before it enters a mainline which can now slope downwards over a flat section of land. The tapped section of sugar bush is adequately sloped downwards to the sap ladder set-up. The mainline tubing on both sides of the sap ladders is 1¼ inch black food grade polyethylene pipe.

Two large cedar posts were installed in the ground 16 feet apart with brace wire running between them. This set-up acts as support for the 5 different types of sap ladders as well as the control. All six systems work within the same 16 foot area. Ball valves are located at the bottom end and the top end of each ladder to turn them on or off, so that only one can be activated at a time. Each sap ladder can then run independently under the same circumstances. Vacuum gauges are attached to the 1¼ inch mainline at both ends of the sap ladders, so that performance of each sap ladder can be monitored individually. A vacuum of 18 inches of mercury will be maintained but may be altered somewhat to observe the effects on the performance of the sap ladders.

The vertical portion of each sap ladder is made of clear line so that both sap and air flow can be closely monitored as it passes through the sap ladders. This is very important in evaluating the effectiveness of each lift.

The items listed in the objectives section of this paper will be closely monitored.

Observations and Preliminary Results (2002 Season)

Observations were made while the sap was running during the 2002 season. 14 inches of mercury was all that could be maintained on the vacuum side of the sap ladder set-up. The set-

Illustration of a sap ladder.

up will be altered in 2003 in an attempt to achieve 18 inches of mercury. Vacuum was transferred across some of the ladders better than with others. Consequently, the lifting action of the sap also varied from ladder to ladder.

1. Star Ladder - This system may be the most expensive to install, depending on the number of taps. It was observed that some of the lines would remain clear of sap, permitting transfer of vacuum, while sap was lifted in the remaining lines. There were leaks in the system due to the way that it was installed with the clear PVC line, resulting in reductions in vacuum. This problem will be remedied in 2003. The ladder was reasonably effective in spite of problems with vacuum loss. The vacuum was 14 inches at the upper end and 12 inches at the lower end of the ladder but theoretically should be much better when the problem with leaks is eliminated. Leakage should not be a problem with a simple installation under normal circumstances.

2. Single Pipe Ladder - The single pipe lift was ruled out as an effective lift compared to the others due to a dramatic reduction in vacuum from the upper end (14 inches Hg) to the lower end (11 inches Hg) of the lift resulting in very inefficient lifting of sap. Sap was only lifted in very weak, turbulent gushes. This sap ladder option will not be re-evaluated unless there are design modifications to make it more effective.

3. Double Pipe Ladder - This system had a trap type elbow located between the two pipes at the bottom. There was no vacuum loss between the upper and lower ends of the lift. The pipe on the vacuum side of the lift would initially fill about halfway (about 4 feet) with sap and then would create a continuous pumping action which would vigorously push sap up the other line. The sap in the line closest to the vacuum would rapidly surge down the line while sap would simultaneously surge up the other line and into the mainline without falling back or churning. This occurred rapidly and continuously while the sap was running and the vacuum was on. Observations from the spring of 2002 suggest that the double pipe sap ladder was most effective at lifting sap. This sap ladder will receive further attention and study in the spring of 2003.

4. Diffuser Pipe Ladder - With this set-up it was observed that the sap and air did separate, with air confined to the inner pipe and sap staying on the outside of this pipe. The sap did rise rapidly with little vacuum loss (1 ½ to 2 inches Hg). However, by making some modifications at the base, separation may be more complete, resulting in even less vacuum loss.

5. Booster Tank Ladder - The boost-

er tank filled up with sap and the sap was slowly sucked up into the mainline. It may have been more effective with greater vacuum but it appears that the greatest improvement to the system may come from adding a second mainline located from the upper end of the ladder to the vacuum source. This would allow for separation of the sap and the vacuum so that vacuum can easily reach the booster chamber. This option uses the traditional booster method in a lift situation. A modified system will be tested in 2003.

6. Bypass (Control) - Vacuum was reduced in the control situation by 2½ to 3 inches Hg on the bush side of the experiment. Therefore, the bypass method was not an effective alternative. The single pipe ladder discussed under (2) above was even less effective.

The results from a single season of testing, as described above, are preliminary only. Further testing, taking into account observations and results from the 2002 season, will take place during the 2003 production season.

Maple producers who may have comments, suggestions, or questions regarding this applied research effort should contact Dave Chapeskie.

MAPLE PUMPKIN ICE CREAM PIE

1 cup mashed pumpkin
1/2 tsp. cinnamon
1/2 tsp. nutmeg
1/2 tsp. cloves
1/2 cup maple syrup
2 cups vanilla ice cream
500 ml cool whip
1 — 9" graham wafer crust

Combine pumpkin, spices and maple syrup. Stir in softened ice cream and fold in cool whip. Pour into crust and garnish with pecan or walnut halves. Freeze until firm, at least 4 hours. To serve, remove from freezer about 15 minutes before serving. Store leftovers in the freezer.

EXECUTIVE DIRECTOR POSITION AVAILABLE

Non-profit maple syrup organization seeks part-time Executive Director.

Duties to include planning and attending meeting, managing communications and overseeing projects specified by the organization. Bi-lingual French/English required. Salary Negotiable.

Send resume/inquiries to: Mary Douglass, 2611 Okemos Road, Mason, MI 48854. Telephone: 517-349-5185. E-mail: SBFarms@concentric.net.