

Time Study of the New TeMax Scoop vs. Manual Wheelbarrow for Moving Landscaping Mulch

Summary:

Temove USA has developed a new attachment for the TeMax electric materials transporter to reduce the time and human energy required to move free flowing materials like landscaping mulch. The Scoop bolts onto the front of the 300L barrow so that, with the barrow tipped forward, mulch can be pushed in rather than be lifted and shoveled in. A time study was completed to evaluate the amount of time and effort savings possible using the Scoop vs. a manual wheelbarrow. Two cubic yards of mulch were moved at a commercial nursery using the TeMax Scoop and a manual wheelbarrow. The time required to move each load was tallied until the full two cubic yards was moved using each device. The study showed that the Scoop took 40% less time to move the mulch than the wheelbarrow. Analysis of the data also showed that worker fatigue was significantly less with the Scoop than with the wheelbarrow as measured by the transport rates at the beginning of the test compared to transport rates at the end. That means that the Scoop not only saves time and labor in moving materials, but workers have more energy left to do additional work after the moving is done.

Objectives:

1. Determine how much time can be saved using the TeMax Scoop vs. a manual wheelbarrow in moving landscaping materials.
2. Verify that the TeMax Scoop is easy to use and rugged enough for commercial materials transport applications.
3. Identify design refinements that will make the Scoop more effective.

Conclusions:

1. The TeMax scoop moved two cubic feet of mulch in 40% less time than a manual wheelbarrow (16.1 minutes vs. 27.1 minutes).
2. The TeMax scoop was shown to reduce worker fatigue by 65% when compared with a manual wheelbarrow.
3. The TeMax Scoop was simple to use, requiring no special training to operate.
4. Even though it is constructed of lightweight aluminum, the TeMax Scoop is durable, with its steel blade preventing unwanted flexing and wear on the leading edge.
5. The addition of a shovel holder on the exterior of the barrow could further enhance the efficiency of the TeMax Scoop.

Background:

The TeMax electric materials transporter, with its 10.6 cubic foot capacity barrow body, is ideal for moving high quantities of bulky materials, especially when transporting those materials up and down hills or through narrow alleys or gates. Its efficient, high torque motor carries 550 pounds of payload at a time, and its batteries have enough capacity to operate the TeMax all day on a single charge.

But when moving landscaping materials (such as ground cover or topsoil) from one spot to another, the materials still need to be shoveled into the barrow body, a task that takes considerable time and effort.

Temove USA has designed and built an attachment to fit on the leading edge of the barrow body, transforming its shape to resemble the bucket on a front end loader. (See Figure 1.)



Figure 1.
The TeMax Scoop design compared with that of a front end loader.

Although the TeMax Scoop has plenty of power, it doesn't have sufficient weight to drive completely into a pile of ground cover without losing traction, so it can't simply scoop the materials like a front end loader. But the TeMax Scoop does allow the worker to push, rather than lift, the ground cover material into the barrow, which reduces the time and energy required to fill the TeMax.

By providing more efficient loading, along with its inherently fast, easy movement, the TeMax Scoop can significantly reduce labor costs for commercial landscapers. The purpose of this study is to determine how much time and energy can be saved with the new Scoop attachment.

Data Collection:

The time study was performed at Riverside Commercial Nursery in Fresno, California on June 7. The air temperature was approximately 95 degrees, making it a fairly typical late spring/early summer day in Central California. Tremove USA personnel performed all testing and data acquisition.

The study was designed to emphasize the differences of loading and unloading the TeMax Scoop, as compared with the manual wheelbarrow. A large (~50 cubic yards) pile of cedar mulch was used for filling the TeMax and manual wheelbarrow for the study. The time required to move two cubic yards of mulch approximately 35 feet was measured. The short distance that the mulch was moved minimized the advantage of the TeMax, since its larger barrow size greatly reduces the number of loads required and therefore the amount of transport time.

To fill the manual wheelbarrow, the normal technique is to tip the wheelbarrow on its side next to the pile and push as much material into the barrow as possible, then stand the wheelbarrow up and finish filling it with a shovel. The time required to fill, move, and dump each load of mulch was measured until a total of two cubic yards was moved.

To fill the TeMax Scoop, the barrow was tipped forward and driven into the edge of the pile as shown in Figure 2. Mulch was then pushed into the barrow with a shovel as shown in Figure 3. Once loaded, the barrow was raised and locked in its upright position. This technique filled the TeMax to about $\frac{3}{4}$ of its capacity (see Figure 4), and no further loading with a shovel was done. To dump the TeMax Scoop, the front edge of the scoop attachment was manually lifted and pivoted back onto the top of the barrow and pinned in place (see Figure 5). The TeMax barrow was then tipped forward and the contents dumped as the TeMax was driven slowly in reverse (see Figure 6). The time required to fill, move, and dump each load of mulch was measured until a total of two cubic yards was moved.



Figure 2.
TeMax Scoop ready to load.



Figure 3.
Loading the TeMax Scoop.



Figure 4.
TeMax Scoop loaded.



Figure 5.
Scoop attachment pivots to permit easy and complete unloading. Scoop is locked in the open position with a ball detent pin.



Figure 6.

TeMax Scoop is unloaded by tipping the barrow and slowly driving the TeMax in reverse until the contents have flowed out.

Results:

Table I shows the data collected during the time study. The TeMax Scoop required just six loads to move the two cubic yard test volume, while the wheelbarrow required 20 loads.

Figure 7 graphically shows the 40% improvement in total transport time the TeMax Scoop demonstrated vs. the manual wheelbarrow.

TeMax Scoop		Wheelbarrow	
Time	Total Vol.	Time	Total Vol.
0	0	0	0
2.25	9	0.88	2.7
4.75	18	1.97	5.4
7.35	27	3.17	8.1
10.25	36	4.38	10.8
13.05	45	5.67	13.5
16.08	54	6.93	16.2
		8.08	18.9
		9.37	21.6
		10.63	24.3
		12.08	27
		13.67	29.7
		15.13	32.4
		16.6	35.1
		18.22	37.8
		19.83	40.5
		21.22	43.2
		22.55	45.9
		24.03	48.6
		25.35	51.3
		27.12	54

Table I.
Time Study Data

Time Required to Move 2 cu. yd. of Mulch

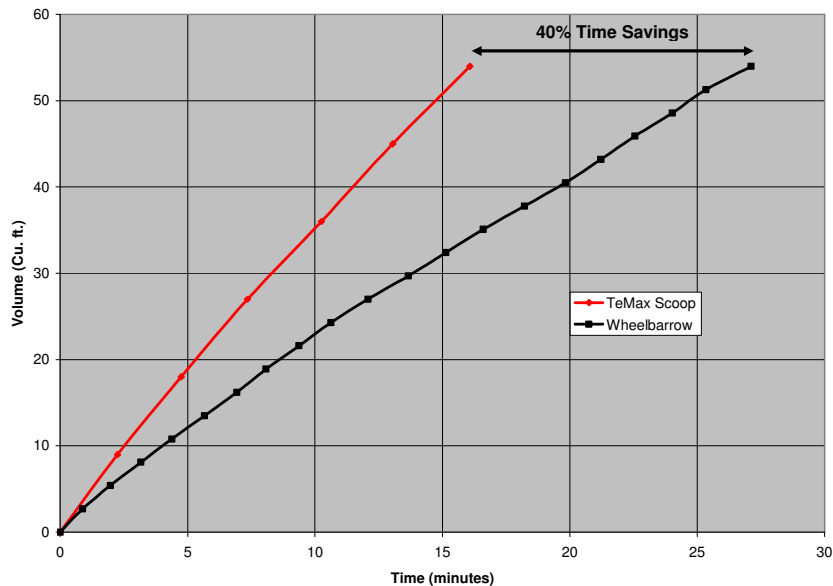


Figure 7.
TeMax Scoop and Manual Wheelbarrow: Total volume of mulch moved as a function of time.

Observations and Discussion:

The task of moving a pile of mulch can be looked upon as three steps:

1. Filling the transport device.
2. Moving the filled transport device.
3. Dumping the transport device.

Since the distance over which the transport device was moved was so short in this study (35 feet), the second step contributed little to the overall time. Similarly, the time required to dump the device was very short. So the step that contributed the most to the overall task was filling the transport device. Based on the results of this study, clearly it was much faster and easier to load mulch into the TeMax Scoop than to use a wheelbarrow.

It is important to note that even more time would be saved with the TeMax Scoop in applications that required transporting the mulch over longer distances or on hilly terrain. The large capacity of the TeMax and its ability to climb hills (and travel downhill at controlled speed) become huge advantages in such applications.

Since the TeMax Scoop used in this study was a prototype, the technique for loading was not well refined. Prior to the start of the time study it was found to be faster to load the TeMax only with as much mulch as could be pushed in with a shovel before the barrow was raised (i.e. no additional mulch was shoveled into the TeMax to get a completely full barrow). Therefore each TeMax load was only about 9 cubic feet of mulch. Over longer transport distances it may be more advantageous to fully load the TeMax by shoveling extra material in after the barrow is raised.

The graphs in Figure 7 show the cumulative volume of mulch moved as a function of time for both the TeMax Scoop and the manual wheelbarrow. For both devices, the slope of the curve decreases over time. This happens because it takes the worker longer to move each successive load of mulch due to fatigue. The effect of fatigue on worker efficiency can be measured by comparing the rate of material movement at the beginning of the test vs. at the end.

Figure 8 shows the time study data plotted for the TeMax Scoop along with a second line showing the average rate of material movement at the start of the test. (This average rate of transport was calculated by measuring the volume and time to move the first two loads.) If that initial rate had been maintained throughout the test it would have taken only 14.2 minutes or 13% less time to move the full two cubic yards of mulch. That 13% loss in efficiency occurred due to worker fatigue.

Fatigue Factor - TeMax Scoop

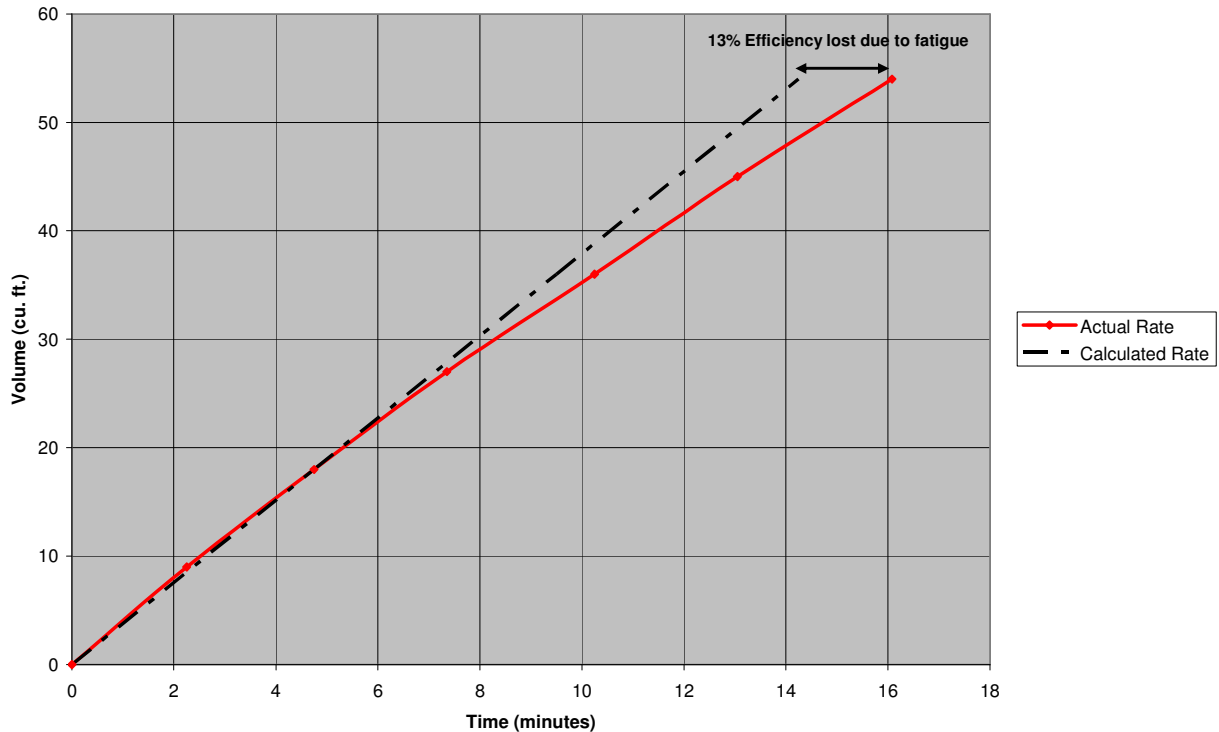


Figure 8.
Actual and calculated rates of material transport for the TeMax Scoop, showing the effect of worker fatigue on efficiency.

Figure 9 shows a similar plot for the manual wheelbarrow. The dashed line showing the initial rate of material movement was calculated by measuring the volume and time to move the first two loads using the wheelbarrow. If that same rate could have been maintained throughout the test, the two cubic yards of mulch could have been moved in just under 20 minutes, rather than the 27.1 minutes actually required. In this case worker fatigue resulted in a 38% loss in efficiency. So the TeMax Scoop not only reduced the time to transport material by 40% vs. the manual wheelbarrow, but it reduced fatigue by 65% compared with the manual wheelbarrow.

Fatigue Factor- Wheelbarrow

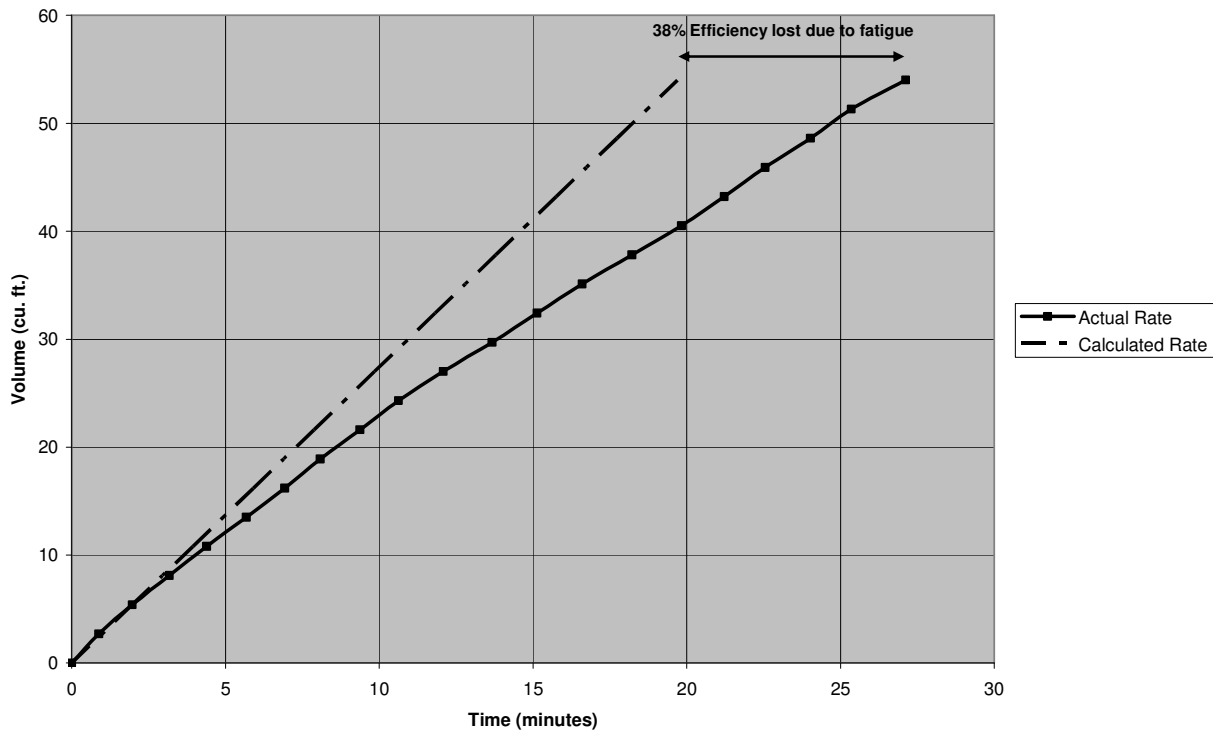


Figure 9.
Actual and calculated rates of material transport using a manual wheelbarrow, showing the effect of worker fatigue on efficiency.

Based on the results of this time study, and taking into account both the better efficiency of the TeMax Scoop and the effects of worker fatigue, one worker could move 56 cubic yards of mulch in a single day using the TeMax Scoop. That same worker could move just 34 cubic yards in a day using a manual wheelbarrow.

Taken another way; for a landscaping project that requires the movement of 30 cubic yards of mulch, the TeMax Scoop could transport the material in a little more than four hours, leaving almost half of a work day for completing other project tasks. It would take seven hours – nearly a full day – to move the same amount of material with a manual wheelbarrow, leaving little time (and a tired worker) to do other project tasks.

In the severely down economy that exists today, the TeMax Scoop can give a commercial landscaper the flexibility to take on bigger jobs without adding additional labor, and thereby avoiding the unpleasant task of releasing workers at the end of the job.

One of the objectives of this study was to see how robust the Scoop was in a commercial application. A time study is a perfect exercise to test the durability of the

Scoop. With an emphasis on speed and efficiency, a worker doesn't concentrate much on careful handling of the equipment.

Diamond plate aluminum was used as the primary construction material for the Scoop. This material was chosen not so much to match the barrow material, but to minimize the weight extending out past the pivot point on the barrow. The leading edge of the Scoop was reinforced with steel to reduce wear and to minimize flexing of the Scoop as material is loaded. Bronze bushings were pressed into the sides of the Scoop to permit easy pivoting and to minimize wear. Throughout the test the Scoop showed no signs of wear or deflection in any of the components.

As the time study was being conducted the equipment operator had no convenient place for the shovel as the TeMax was being moved. A shovel holder has since been designed which consists of a steel tube attached to the back wall of the barrow. The shovel holder will also provide extra leverage for the worker when loading heavier materials with the Scoop.

Temove USA personnel conducted this time study. Questions about objectivity are obviously raised when an equipment manufacturer sponsors or conducts such a test. Since the TeMax Scoop being tested was a prototype and not a commercially available attachment, it was in Temove USA's best interest to objectively run the time study before investing in the materials and manufacturing process to produce the Scoop. Temove USA will gladly support any potential customer who would like to conduct their own time study comparing the TeMax Scoop to their current transport device (manual wheelbarrow or other power equipment). A TeMax Scoop will be provided free of charge to conduct the study, provided the results of the study are shared with Temove USA.

Acknowledgment:

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