

# 2011 UPDATE OF MAPLE TUBING AND TAPHOLE SANITATION RESEARCH AT CORNELL

*Stephen Childs, New York State Maple Specialist*

During the 2011 maple sap season a variety of research trials were conducted at the Arnot Forest of Cornell University and in the woods of a number of cooperators both with vacuum and gravity systems. This research was primarily funded by the New York State Farm Viability Institute. Research conducted over the last five years has shown that significant increases in sap yield can be obtained by keeping the tap hole from contamination by bacteria and yeast. This contamination usually comes from an old spout or an old drop line. By replacing the spout and the 20 to 30 inch drop line in a tubing system, experiments have shown significant increase in yield each year regardless of seasonal conditions. These experiments were conducted with tubing that had been in place for 5 or more years. This condition of using aging tubing systems represents the current status of over 65% of the maple tubing systems in New York. Testing in 2007 and 2008 were only conducted on gravity systems.

In 2009 tests were again run on gravity systems where new spouts and drops were compared to old spouts and drops. The new spouts and drops produced 88% more sap for the season than the old spouts and drops. Old spouts and drops averaged 6.4 gallons of sap per tap while the new spouts and drops averaged 12 gallons of sap per tap. In 2009, check valves were installed into drop lines where both treatments had new spouts, then a check valve followed by either a new drop line or an old drop line. In this case the check valve seemed to keep the tap hole from contamination and both treatments had the same yield of about 10 gallons of sap per tap but two gallons less than where a new spout and drop were used. Also in 2009 a larger study was done with Breezie Maples Farm in Otsego County. Here about 2700 spouts and drops were replaced in one woods to compare with older spouts and drops in woods nearby on the same farm where vacuum held at about 21 inches and with the vacuum being shut off when sap in the system became frozen. In this case the updated woods out yielded neighbor woods in the same area on the same farm by producing 2.4 times more sap. When compared with the yield in the same woods the year before, the new spouts and drops produced 2.2 times more sap. In 2009 the updated woods produced 22 gallons of sap per tap while surrounding woods with old spouts and drops produced just 10.5 gallons of sap per tap. Records were also kept on the material and labor cost involved in updating the woods resulting in a total cost of about \$2.12 cost to install each new tap and drop. Though this cost may seem high, the additional sap resulted in the production of an extra quart of syrup per tap or a retail value of between \$10 to \$18 per tap depending on sale price.

In 2010 replicated studies were done with both vacuum and gravity systems using drop and spout replacement, Leader Evaporator check valve spouts and imbedded silver spouts. With vacuum operating at about 15 inches Hg at the lateral line, a new spout and drop out produced old spouts and drops by 151%. Old spouts and drops averaging about 7.9 gallons of sap per tap while new spouts and drops averaged 19.8 gallons of sap per tap. Tests with a new check valve spout on an old drop verses an old spout on an old drop showed the check valve producing 114% more sap than an old spout and drop. Check valve treatments averaged 15.6 gallons of sap per tap while the old tap and drop averaged 7.9 gallons. Where a new silver spout on and old drop was compared to an old

spout and drop the difference was 13.7 gallons of sap with the silver spout and 8.1 gallons from the old spout for an increase of 69% in sap yield. The final test was to compare a Leader check valve spout that had been used the previous year and then rinsed in water as a cleaning and compared with an old spout and drop. In this case only a 38% increase in yield was observed.

In 2010 replicated tests were also conducted on gravity systems. When a new check valve spout on an old drop line was compared to a new check valve on a new drop line the difference was a 18% yield improvement where the new drop was used. This would indicate that on the gravity system the check valve is giving the tap hole a lot of protection but the protection is not perfect. With a new drop line the check valve produced 5.9 gallons of sap per tap while the check valve on an old drop line produced just 5 gallons per tap. Where a new spout and drop were compared to old spout and drop the result was 76% more sap. The new spout and drop yielded 6 gallons of sap per tap vs. the old spout and drop which produced 3.4 gallons of sap per tap. Where a silver spout on a new drop was compared with a silver spout and old drop the difference was just 13% indicating that the silver spout provided significant protections against taphole contamination from the old drop line. The new drop with silver spout resulted in 4.6 gallons of sap per tap while the old drop with a silver spout yielded 5.2 gallons of sap.

The replicated tests run in 2011 used the same system of two taps per tree each tap with a different treatment used in prior years. The following picture shows a typical tapping set up, in this case a new spout and drop next to an old spout and drop located 8" to 10" apart to keep the orientation of the two taps about the same.



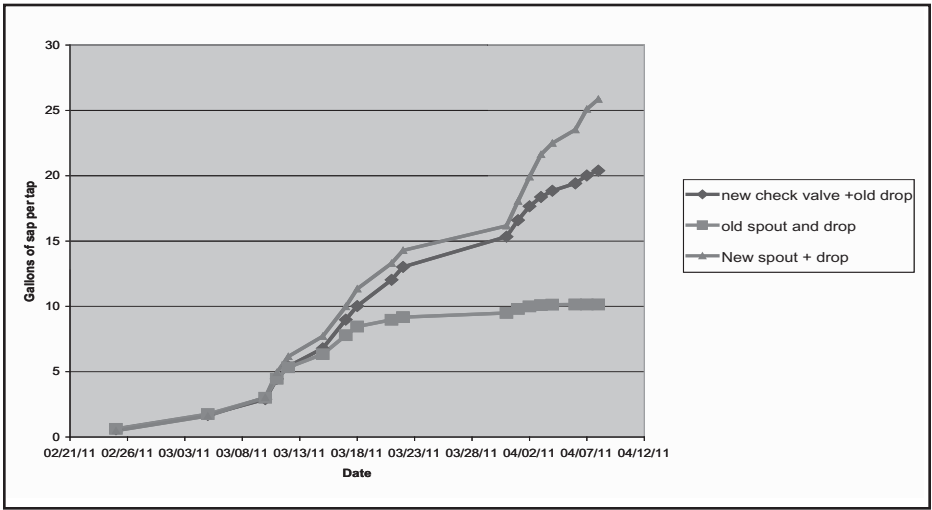
With vacuum held at about 16" to 17" Hg at the lateral line the following results were measured. Where the test was new spouts and new drops vs. old spouts and old drops, the new spout and drop out yielded the old by 120% or 2.2 times or 14.1 more gallons of sap per tap than the old spout and drops.

Where the test was a new check valve spout and old drop compared with an old spout and old drop, the check valve treatment produced 101% or 2 times or 10.2 more gallons of sap per tap than the old spout and drop.

For the sake of a broader comparison, the new spout and drop produced more than the new check valve on an old drop as reflected in Figure 1.

In 2010 a treatment was set up using a new silver spout on an old drop compared to

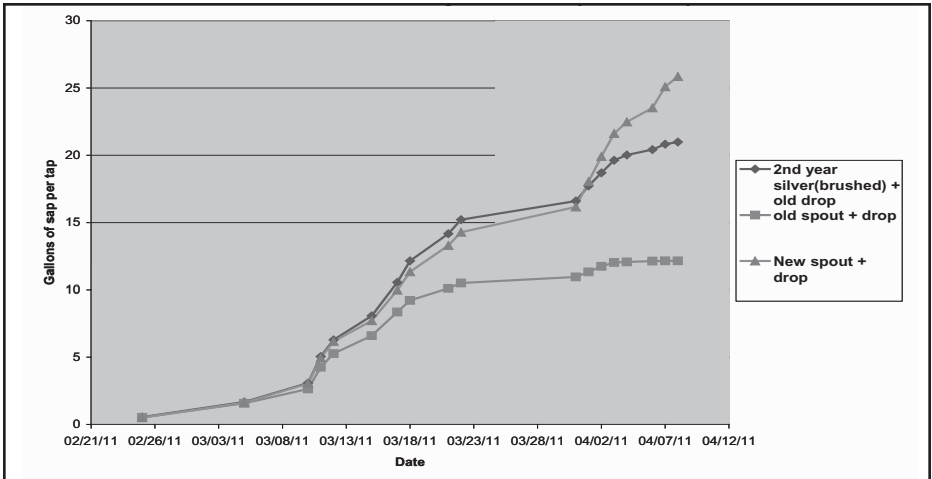
**Figure 1. Vacuum: Check valve vs. old vs. new**



an old spout and drop with the result showing a 69% increase in sap flow over the season where the silver spout was used. In 2011 the same systems were used only a stiff 5/16" brush was scrubbed into the silver spout. So the silver spouts were being used for the second year with the same old droplines that were used in 2010 still in place. In this case the second season brushed silver spouts and old drops produced 72% or 1.7 times or 8.8 more gallons of sap per tap than the old spout and old drops.

Again for the sake of comparison the results of new spouts and new drops are added to the graph for comparison. See Figure 2.

**Figure 2. Vacuum: new vs. 2nd year silver (brushed) vs. old**

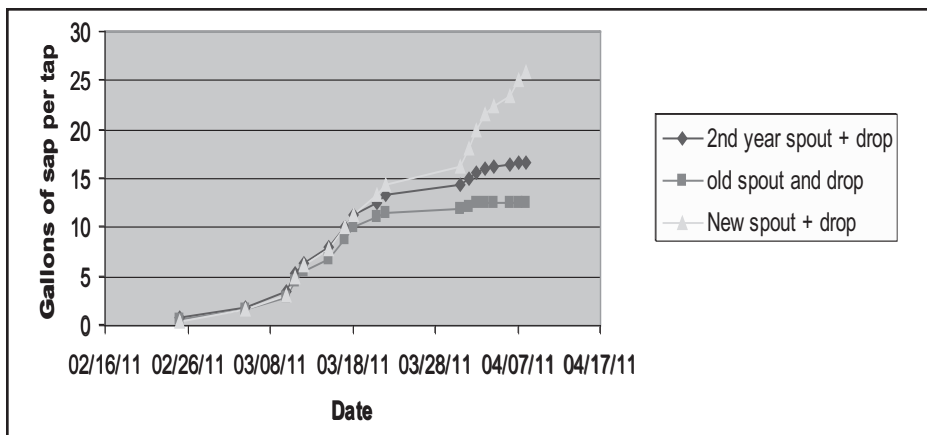


Once a maple producer has updated his tubing system by replacing spouts and drops the key question is how soon does that need to be done again to maintain the highest profitability of that tubing system. For how many years is there a production benefit and

how big is that benefit? In 2011 under vacuum a treatment of old spouts and drops was compared with spouts and drops in their second season. The second year spout and drops produced just 31% or 1.3 times or 3.9 gallons of sap more than the old spout and drops.

When compared to the new spout and drop results from nearby tests we see that the second year spouts and drops have lost significant productivity in just the second season of use. See Figure 3.

**Figure 3. Vacuum 2nd year vs. old vs. new**



In the 2010 season this same test was run. Only in the gravity treatments were results more disappointing for those looking for lasting results. However, a similar treatment was conducted with one replication on one of the cooperator sites with interesting results. At this cooperator the vacuum was held at 22" Hg and second season spouts and drops were compared with a treatment of new spouts and new drops. In this case the second year spout and drops slightly outperformed the new spout and drops.

In 2011 tests were conducted comparing a new silver extender spout on old drops vs new spout and new drops. In this case the new spouts produced 28% or 1.3 times or 4.7 more gallons of sap per tap than the silver extender spout on old drops. When compared to the average of old spouts and old drops in the same area the silver extender would fall a little better than half way between new spout and drop and old spouts and drops as seen in Figures 4A and 4B.

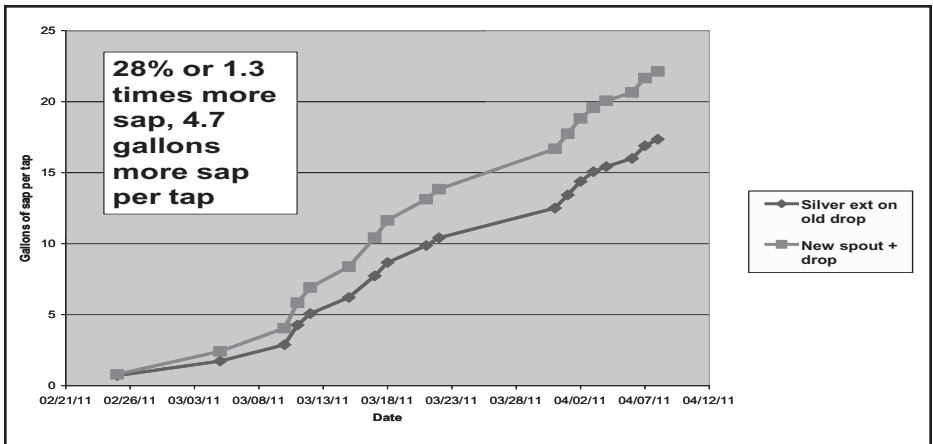
A general conclusion to the tests with the various spout and drop combinations is that most any action taken to protect the tap hole from bacteria and yeast being pulled back in during freezing weather when the tree is experiencing internal negative or vacuum pressure results in significant production increases. Figuring out which system pays best under given conditions is the maple producer's challenge. See Figure 5.

A new check valve on old drop lines was tested against a new spout and drop line. The new spout and drops yielded 21% or 1.8 times or 1.8 more gallons of sap per tap than a check valve with old drops.

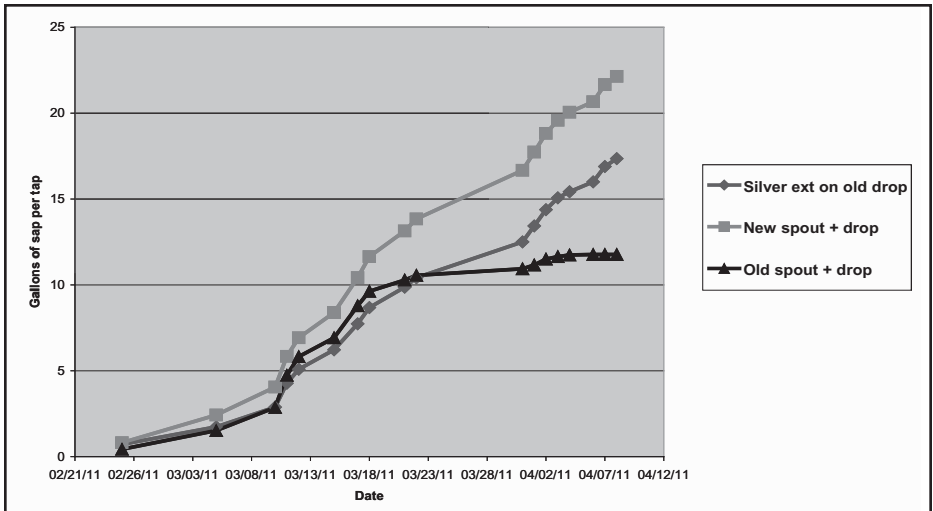
This would actually represent fairly good protection of the tap hole on the part of the check valve spout. This is fairly easy to see if we include the average of yield from old spouts and drops from the replications in the same area. See Figure 6.

Spouts and drops that were new in 2010 were used for the second year in 2011 and

**Figure 4A. Vacuum: Silver extender = old drop vs. new spout + drop**



**Figure 4B. Vacuum: Silver extender + old drop vs. new vs. old**

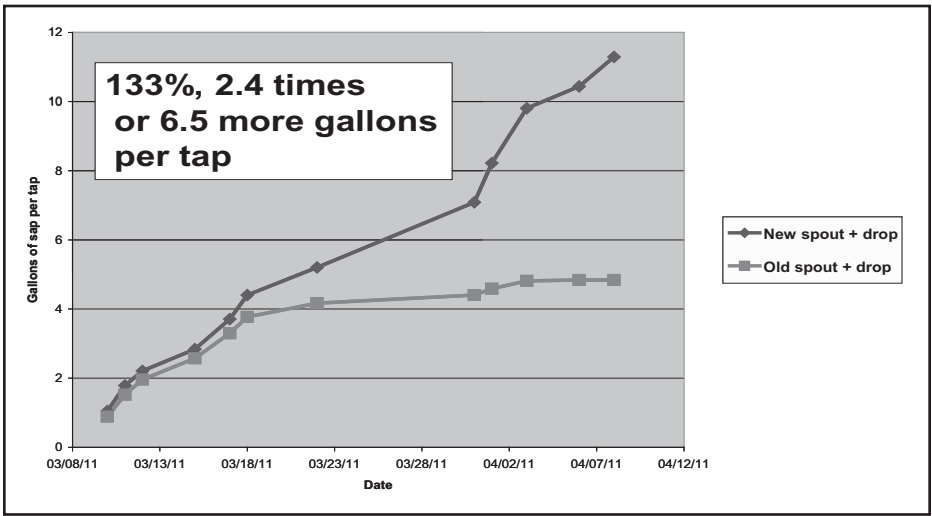


compared with old spouts and drops. In this case the second year spout and drops yielded 100% or 2 times or 4 gallons more sap than the old spouts and drops did as is reflected in Figure 7.

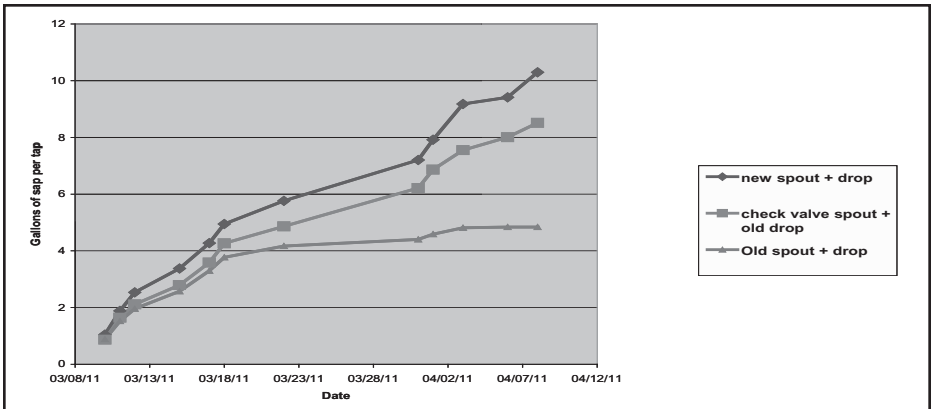
This seems like an excellent result except when we compare it with the yield result experienced with new spout and new drop from nearby replicates. By adding that data to the chart below it is easy to see that the two year old spout and drops was just a little better than half the yield improvement experienced with the new spout and drop. See Figure 8.

The performance of the second year spout and drop was much better in 2011 than what was recorded in 2010 as reflected in Figure 9. The weather in 2010 warmed into the 50's and above much earlier than it did in 2011. That may be a key factor in the kind of results one could expect experience with second year collection equipment. See Figure 9.

**Figure 5. Gravity: New spout + drop vs. old spout + drop**



**Figure 6. Gravity: New vs. check valve vs. old**



Silver spouts were tested on a gravity system where a second year silver spout on a second year drop was compared with a new silver spout on old drops. From Figure 10 it is clear that the second year silver spout and second year drop yield was comparable to a new spout and drop. In this case the second year silver spout was not brushed or cleaned in any way. A new silver spout on an old drop yielded about two gallons or 22% less sap per tap than a new spout and drop did but 2.2 times or 125% more sap than an old spout and drop.

As was observed in the vacuum tests, with gravity systems all attempts to protect the tap from contamination on old spouts or sap flowing back from contaminated spouts and drops resulted in significant improvements to sap production. The challenge is for the maple producer to determine which practice is most cost effective for them and implement a taphole sanitation practice.

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Figure 7. Gravity 2nd year spout + drop vs. old spout + drop

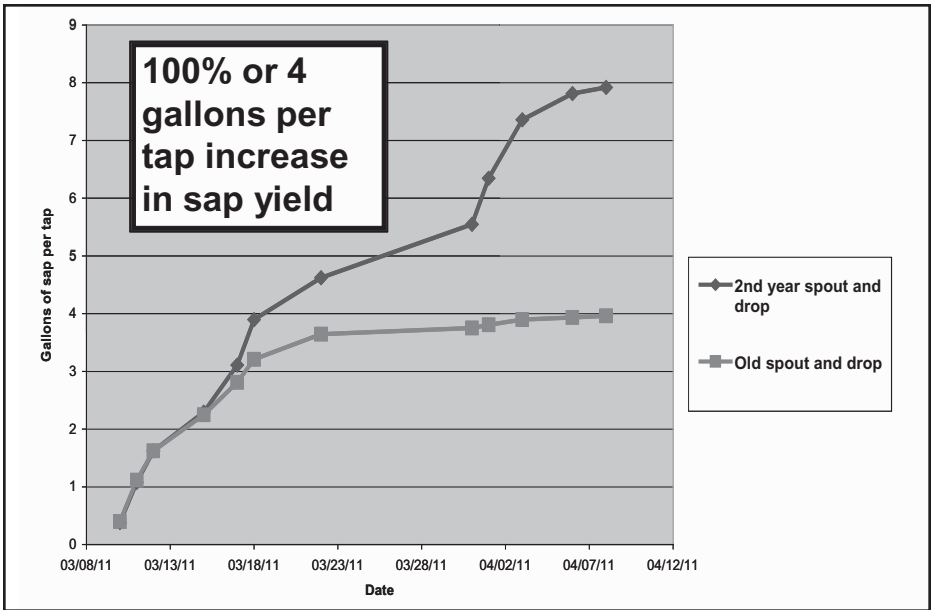
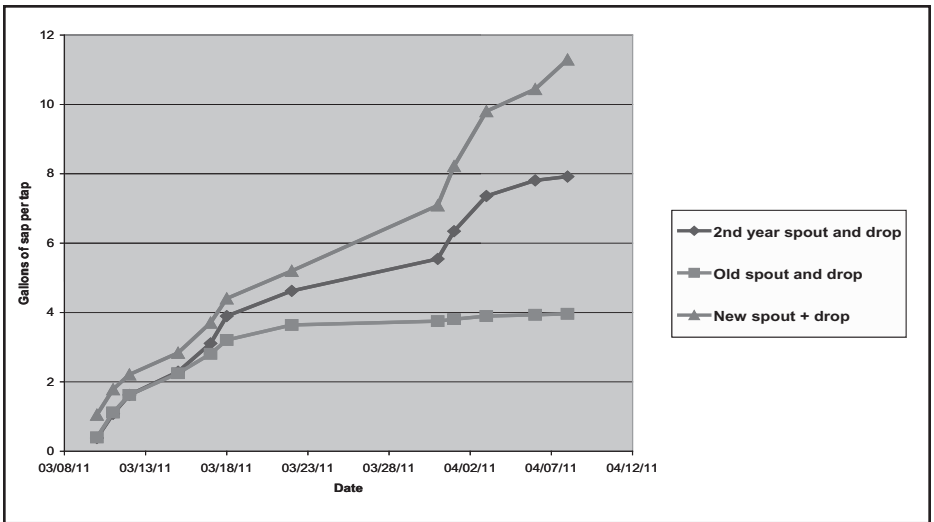


Figure 8. Gravity: 2nd year vs. old vs. new



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Figure 9. 2 year old spout and tap vs. old tap and drop - gravity

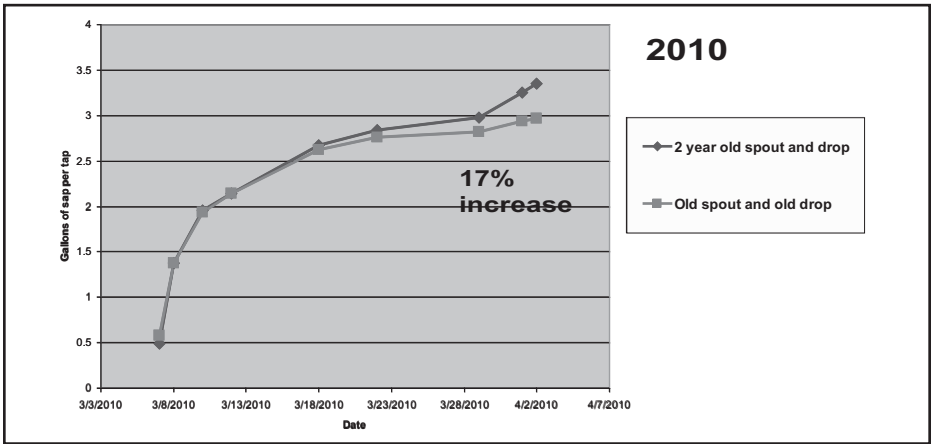
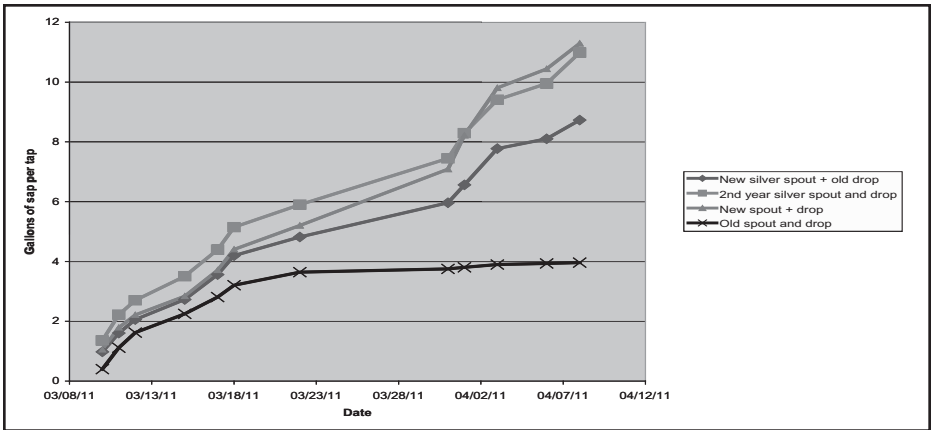


Figure 10. Gravity: Silver spout comparison



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