was collected in 4 minutes, 31 seconds. To convert ml to gal, divide by 3,785 ml/gal. Then 92 ml = 92/3,785 = 0.0243 gal. To convert seconds to hours, divide by 3,600 sec/hr. Then 4 min, 31 sec = 271 sec, and 271/3,600 = 0.0753 hr. Finally, 0.0243 gal/0.0753 hr = 0.32 gal/hr.

For many injection methods, the injection pump calibration will change depending upon the pressure in the irrigation system. The actual injection rate will be less when injecting against pressure. Therefore, the above procedure can be used only as a first approximation of the final calibration setting, and the calibration will need to be finalized in the field during fertilizer injection into the irrigation system.

Finalizing calibrations in the field

To finalize the calibration of an injector, measure the rate of fertilizer depletion from the storage tank. Install a small graduated supply tank if the bulk storage tank is not graduated for accurate measurement of volumes injected.

It is a good idea to inject fertilizers from a small graduated supply tank rather than to pump directly from a large bulk storage tank. The small tank should be sized to contain the fertilizer solution needed for one application, and only the required amount of fertilizer solution should be placed in the small tank before the irrigation during which it will be injected. This procedure can improve the effectiveness of fertilizer injection because (1) only the amount of fertilizer in the small supply tank can be injected during irrigation, thus preventing excess applications from accidentally being made, (2) the amount of fertilizer injected can easily and accurately be read if the supply tank is relatively small and has graduations permanently marked on it, and (3) only the fertilizer in the small tank will be diluted if backflow from the irrigation system occurs because of failure of the injection pump and backflow prevention system.

For injection methods which use a suction tubing between the injection pump and the supply tank, the injection rate can be measured with a chemical flow meter or by connecting the tubing to a graduated cylinder. Measurements should be made while the injector is operating under normal conditions, including normal injection rates and normal irrigation system operating pressures. Then adjustments in the injection rate can be made as the injection system operates.

Calculating fertilizer injection rates

For all methods of injection, the required fertilizer injection rate must be known. The required injection rate can be calculated from the following equations for solid set (including sprinkler and micro systems), center pivot and traveling gun irrigation systems.

Solid set irrigation systems

Solid set systems include sprinkler and micro (drip and microsprinkler) irrigation systems. For solid set irrigation systems, the fertilizer injection rate in gallons per hour (gph) is calculated from:

$$\text{Rate} = [\,100 \cdot A \cdot F\,] / [\,P \cdot H \cdot W\,] \qquad (1)$$

where Rate = fertilizer injection rate (gph),

A = area to be irrigated (ac),

F = fertilizer amount to be applied per acre (lb/ac),

P = fertilizer fraction, percent of fertilizer per gallon of fluid injected (%),

H = fertilizer application time (hr), and

W = weight of fertilizer solution (lb/gal).

As an example of the use of Equation (1), assume that 20 lb of nitrogen (N) must be applied per acre on a 5-acre citrus nursery using sprinkler irrigation. The fertilizer to be used is a liquid solution of Ammonium Nitrate (21% N; 10.73 lb/gal)[1]. The normal irrigation cycle is 2 hr, and fertilizer injection begins immediately after the system has reached normal operating pressure. Fertilizer will be injected for 1.5 hr, leaving almost 0.5 hr to flush the fertilizer from the irrigation system and off of the plants. Using equation (1):

$$\text{Rate} = \frac{[100 \cdot 5\text{ ac} \cdot 20\text{ lb/ac}]}{[21\% \cdot 1.5\text{ hr} \cdot 10.73\text{ lb/gal}]}$$

Rate = 29.6 gph

Thus, the required 20 lb of N can be applied per acre by injecting 29.6 gal of Ammonium Nitrate per hour for the 1.5 hr injection time. The total volume to be injected would be 29.6 gal/hr times 1.5 hr = 44.4 gal.

[1] Because liquid fertilizer solutions are often custom mixed, the nutrient concentrations and weight of the fertilizer solution must be obtained from the fertilizer supplier. Common values are used in this publication.