Reverse 1/128th Method for Calibrating Multiple Nozzle "boom" sprayers

Since we've already established that 18.5 x 18.5 represents approx. 1/128th of an acre, and that 1 oz represents 1/128th of a gallon, we can use this method for boom sprayers with a few quick conversions and a little bit of math:

1. We need to convert 1/128th of an acre into a shape that is measured in both feet and inches (length and width), since we are dealing with nozzles that are spaced apart in inches:
    a. 1 acre = 43,560 ft². So 43,560 ft² divided by 128 is **340.32 ft² (the area of 1/128th of an acre, regardless of the shape..)**
    b. We want to know how to make 1/128th of an acre (**340.32 ft²), into a shape that is measured in feet for length, and inches for width.** so we multiply by 12, which = **4084**
    c. So, now we know that **4084 is a constant that allows us to measure length in feet (the distance to travel), and a width in inches (the spacing between nozzles).** Remember, as long as we just change the shape, and not the area, we can again just count the number of oz's that are sprayed on 1/128th of an acre, and that number will be the same as gallons per acre.

Example

John has a 100 gallon tractor-mounted boom-sprayer with 12 nozzles spaced evenly **18 inches apart.** He wants to calibrate his tractor so he can spray his entire 20 acre field in two tanks. His pump pressure is set at 40 psi. with the booms turned off and the pump circulating.

A. The first thing John does is read the herbicide label to see what the minimum water volume is for that product. **He sees that the minimum is 10 gal/acre**.
B. John already sees that if he can calibrate his sprayer at 10 gal/acre, his 100 gallon tank would treat 10 acres of land, so two tanks would treat his 20 acres.

1. John needs to select a speed at which he wants to travel while spraying. Typically this is anywhere from 3 to 5 mph. He selects 5 mph, so now he just needs to figure out how far to travel to cover 1/128th of an acre.
2. **Since 4084 is a constant, he can just divide 4084 by 18 in. (the nozzle spacing) to get the distance he must travel to cover 1/128th of acre.** (*4084/18in* ***= 226.89 ft***.) All he is doing is taking an 18.5 x 18.5 area and turning it into a rectangle that is 18 inches wide and 226.89 ft. in length. ***The area of the rectangle is still 1/128th of an acre, just like the 18.5 ft² area used in the single nozzle method. Same area, just different shape.***
3. Now he has a couple of options:
    a. **Option 1:** Measure 226.89 ft. out in the field, and drive the tractor at 5 mph along the measured distance, timing how long it takes. Once he has his time, he parks the tractor and places a bucket under one nozzle to capture the water sprayed out of that one nozzle for the same amount of time it took to travel the 226.89 ft at 5 mph.
    Once he has collected the water, he pours the water from the bucket into a measure cup. The oz's in the bucket are the same as the gallons per acre. He knows he want to capture 10 oz's of water (10 gal/acre) so if his water volume is more or less during the time frame he can either change pressure, tractor speed, or nozzle size to adjust the volume to fit is needs. If he changes speed, he just drives the distance again at the new speed to acquire a new time for collecting water in the bucket.
    b. **Option 2:** Knowing that there are 5,280 ft in a mile, and 3,600 seconds in an hour (60min x 60 seconds), we know that **1 mile an hour is the same speed as 1.47 ft/second**. We know this by dividing 5,280 ft by 3,600 sec.
    Since John wants to travel 5 mph, he can just multiply 1.47ft/sec x 5 **= 7.35 ft/second. So 7.35 ft/sec. is the same speed as 5 mph.**
    c. Now he just take the distance he needs to travel and divides it by his speed**. (226.89 ft. / 7.35 ft/sec.=30.87 seconds.) This is how long it would take the tractor to travel the distance of 226.89ft. at 5 mph. So, it is also how long he needs to collect the water from one nozzle, then measure the water in ounces.**

Using this method means you don't even need to take the tractor out of the shop. Just figure out the time it takes to travel the distance (which is 4084 divided by the spacing between nozzles) and turn the sprayer on, with a bucket under just one nozzle, for that amount of time.

4. So now that John knows he doesn't need to move the tractor, he measured his nozzle width between all the nozzles to make sure it is the same. It is 18 inches. He divided 4084 by 18 to get a distance of 226.89 ft. He figured out that traveling at 5 mph (or 7.35 ft/sec) it would take him 30.87 seconds to cover his distance.
5. He fired up his tractor and put water in the tank, then placed the bucket under one nozzle and turned it on for 30.87 (or 31) seconds.
6. He measured the water in the bucket using a measure cup and found that he captured 15 oz's of water. So currently, John's tractor traveling at 5 mph with a pump pressure of 40 psi, is calibrated to spray 15 gallons per acre.
7. John has a choice now. He can either divide his 100 gallon tank by 15 to figure out that he would cover 6.67 acres per tank (which is a weird fraction making herbicide mixing difficult) Or…
8. John can speed up to 6 mph, or 7 mph, until he arrives at a collection time that only catches 10 oz's in the bucket. In **changing his speed, he simply takes the new speed multiplied by 1.47 ft/sec and then divides the 226.89ft distance by the new number.** (so for 6 mph he takes 1.47 ft/sec x 6 = 8.82ft/sec.) He would then divide his known distance of 226.89 by 8.82, which is 25.73 seconds. John has now reduced the time he needs to collect water in the bucket by over 5 seconds by increasing his tractor speed. So, he likely going to be much closer to collecting 10 oz's in the bucket instead of 15.
9. Once John does arrive at 10 oz's in the bucket, he knows that his sprayer is calibrated at 10 gal/acre. He will want to write down the speed he chose, the pump pressure he chose, and the nozzle size he is using so he can remain at this calibration from year to year, regardless of who is operating his sprayer.

Because the "oz's collected equal the gallons per acre" using the 1/128th method, John knows his tractor is calibrated to spray 10 gallons of water per acre as long as he is traveling at 6 mph. He also knows that his 100 gallon tank will cover 10 acres, and he will be able to cover his 20 acre field by the time he sprays two tanks of product.

If John only wants to mix 2 acres of herbicide in his tank and "spot treat" his field, he would simply put 20 gallons of water in the tank (remember he calibrated at 10 gal/acre) and he would mix two acres of product in that 20 gallons, based on the rate per acre found in the label. His tractor speed, pump pressure, and nozzle size always remaining the same..