THE UNIVERSITY OF MAINE Cooperative Extension

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Weed Mapping Using Your Smartphone

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Introduction

Weeds in wild blueberry fields occur in random patches amongst wild blueberry rhizomes. Unlike cultivated row crops planted in uniform patterns, wild blueberries form a natural groundcover and the weeds grow among them. Broadcast sulfur and herbicide applications are the standard materials used to manage these random weed patches. However, rising costs, concerns about herbicide resistance, and increasing environmental stewardship goals encourage growers to seek more targeted solutions (Nobre et al., 2023). One such targeted solution is spot spraying. Instead of spraying an entire field, spot spraying focuses on herbicide applications only where weeds are present, reducing chemical use and application costs (Esposito et al., 2021). Today, one of the simplest tools to begin spot spraying is already in your pocket: your smartphone.

Using Avenza Maps on a smartphone for weed mapping. Photo: Patrice Sison.

Targeted herbicide spraying starts with a weed map. To create a weed map using your smartphone, you can download apps like ArcGIS Field Maps, Fields Area Measure, and Google Earth, but the app we will be demonstrating here is "Avenza Maps". This app allows you to map weeds by walking the field and marking patches with pins or polygons. You can add photos, notes, and patch sizes to create a digital weed map for future management (Image 1). After making your weed map, you can use it as a guide for spot spraying. For larger-scale operations, you can export the map's data to a tractor-mounted boom sprayer that is capable of individual nozzle control or to a spray drone for autonomous spot spraying.

Steps to Create a Weed Map using Avenza

1. Download Avenza Maps from your App Store for free.

2. Open the base map icon. The blue circle on the map represents your real-time location.

3. Walk around your field and find a weed patch. Click the "draw and measure" option, which is the bottom-left icon on your basemap (see Figure 1-1). Once the "draw and measure" option is activated, use the blue circle (your location) to start creating your weed patch polygon. Your location will serve as a guide to create the vertices, or sides, of your polygon using the "add point" button can be found on the bottom right of the screen (see Figure 1-2).

4. Close your polygon by clicking the shaded rectangle icon (see Figure 1-3) and hitting the checkmark sign found on the bottom right of your screen. The weed patch area should automatically be calculated after you create your weed patch polygon. You can change the units of measurement in the settings.

5. Continue steps 3 to 5 until you hit all the weed patches you want to map.

6. To view the weed patch polygons on satellite imagery, you can export them to Google Earth by clicking the "map layers" icon at the bottom right corner of the basemap interface (see Figure 1-4). Click on the weed patch polygons that you just created. At the top of the map layers interface is the "export" icon (see Figure 1-5), which can export your weed patch polygons as KML files for Google Earth or any other GPS mapping program. These KML files may also be imported into the tractor or spray drone's GPS for spot spraying, but the file format depends on the tractor or drone's manufacturer and model. You can always convert these KML files to other file formats online or through GIS software.

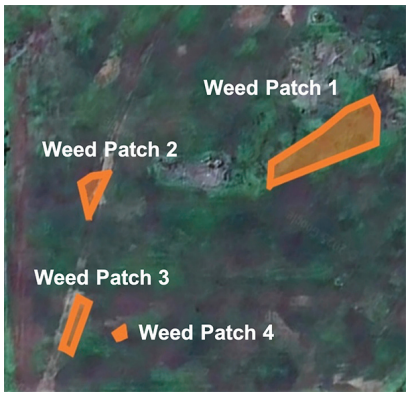
Note: Your location's accuracy depends on your smartphone's GPS. Typically, smartphones have 10-foot horizontal and vertical accuracies, meaning your points may not be as precise as those from a GNSS receiver with centimeter-level precision. Nevertheless, creating weed maps on your smartphone will give you an estimate of your weed coverage and help you calculate how much herbicide is required.

Figure 1.

Herbicide Calculations Using Weed Maps

Below is an example of herbicide calculations using a weed map.

Patch and Field Areas



Generated weed map in Hope, ME using Avenza Maps displayed on Google Earth. Photo: Patrice Sison.

Weed Patch Number	Weed Patch Acreage
1	0.0645
2	0.0092
3	0.0100
4	0.0008

The area of the entire field in this example, including all weed patches, is 1.6046 acres. Add the acreage of all weed patches to obtain the total weed area. The total area of Weed Patches 1-4 shown in Image 2 is 0.0845 acres. You can use these acreages and the herbicide rate listed on the product label to compare the cost of applying herbicide to the entire field versus applying it only to mapped weed patches.

Calculating Herbicide Costs

For this example, we will use the herbicide cost per oz and rate (oz/acre) listed in the table below.

Example Herbicide Cost ($/oz)	$0.46
Example Herbicide Rate (oz/acre)	8

Example Herbicide Cost for the Entire Field

To determine the cost to apply herbicide to the entire field, multiply your total field area (1.6046 acres) by the herbicide rate (8 oz) and the herbicide cost ($0.46).

1.6046 acres x 8 oz x $0.46 = $5.90

Example Herbicide Cost to Only Weed Patches

Next, we'll compare the herbicide cost when spot-applying to weed patches only. Determine the combined acreage of the weed patches in your field. In the section above, we determined that the total acreage of weed patches in the field was 0.0845 acres.

Multiply the weed patch acreage (0.0845) by the herbicide rate (8 oz) and the herbicide cost ($0.46) to obtain the total cost of herbicide required for just weed patches.

0.0845 acres x 8 oz x $0.46 = $0.31

The total cost of herbicide sprayed only to the weed patch areas is $0.31 compared to $5.90 for the entire field, resulting in a cost reduction of $5.59, or $3.48/acre. The limitation of weed mapping, however, is the spatial distribution of weeds (Hunter et al., 2020). If your weeds occur as small, evenly distributed patches in the field, weed mapping would be tedious and broadcast spraying would be the better option. However, if your weeds occur in large, clumped patches, it would be worth considering creating a weed map. Weed mapping is a good exercise to understand how much of your field(s) acreage is composed of weeds. The best time to make a weed map is in the spring, before weeds or wild blueberry plants have emerged, or around the same time you would apply pre-emergent herbicides (March-April).

Weed Map Links

- Avenza Maps store
  avenza.com/
- ArcGIS Field Maps
  esri.com/en-us/arcgis/products/arcgis-field-maps/overview
- Fields Area Measure
  fams.app/
- Google Earth
  google.com/intl/en/earth/versions/#earth-for-mobile

References

Esposito, M., Crimaldi, M., Cirillo, V., Sarghini, F., & Maggio, A. (2021). Drone and sensor technology for sustainable weed management: A review. *Chemical and Biological Technologies in Agriculture*, 8(18). https://doi.org/10.1186/s40538-021-00217-8

Hunter, J. E., III, Gannon, T. W., Richardson, R. J., Yelverton, F. H., & Leon, R. G. (2020). Integration of remote-weed mapping and an autonomous spraying unmanned aerial vehicle for site-specific weed management. *Pest Management Science*, 76, 1386–1392. https://doi.org/10.1002/ps.5651

Nobre, F. L. L., Santos, R. F., Herrera, J. L., Araújo, A. L., Johann, J. A., Gurgacz, F., Siqueira, J. A. C., & Prior, M. (2023). Use of drones in herbicide spot spraying: A systematic review. *Advances in Weed Science,* 41, e020230014. https://doi.org/10.51694/AdvWeedSci/2023;41:00014

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