Intelligent Field Mapping Systems

Figure 1. Sunset during barley harvest at Fairfield, MT, photo by Lora Smith

With the advent of precision agriculture, the way we farm is changing. Through "mapping the farm," precision management strategies can be implemented such as: targeted herbicide application, targeted soil management, improved yield predictions, improved management of water, and other farm resources. These practices all require information that is not readily available to the small farm. Current field mapping technology has a financial and time commitment that puts it out of reach of most small farms. The aim of this project is to bring precision agriculture within reach of a farm of any size. With support from the Small Business Innovation Research Program (SBIR) grant no. 2017-33610-26744 from the USDA National Institute of Food and Agriculture[1], and a matching funds from the State of Montana we have begun our first steps toward making this project a reality. Our field mapping technology enables precision agriculture on the farm by augmenting existing farm activities where the farmer drives the whole field. These activities include but are not limited to: tilling the soil, seeding the crop, spraying for weeds or pests, and harvesting the crop.

The hardware of the system is comprised of a small durable GPS-enabled camera and an embed computer that controls camera acquisition. The hardware component of the system is placed on the farming equipment during existing activities to produce maps of the farm with minimal added work to the grower. The second part of the system is the software platform. This software will process the imagery collected by the cameras, historical imagery, crop information, and information from the grower to provide actionable management prescriptions for the field. The information from the grower can include desired management practices, production strategies, and crop rotation schedules. Within this software there is a trained computer vision platform. This software first identifies objects out of the norm in the field. Then classifies the objects in these sub-regions including: weed and species, cropping problems (green crop, lodged crop), and manufactured objects. During the next phase of development NWB Sensors will develop a web platform that will allow sharing of data between growers, algorithm developers, and service providers.

Example actions coming out of this software include: projected next-year losses based on mapped perennial weed distributions, optimized spray tracks based on weed locations, and cost benefit analysis of actions such as spraying.

On Farm Testing

Currently this technology is targeting detection of persistent weed patches in cereal grain harvest. Figure 1 shows the field mapping system in action with the detection and classification of two patches of milkweed during barley harvest. Harvest might seem like the wrong time to manage weeds, as damage is already done to this year's crop. However, harvest is the right time to assess your management practices and prevent damage to next year's crop. The weeds un-managed with current techniques are right there waiting to be observed, identified, and mapped. From these species-specific weed maps the following actions are possible.

- Perennial weeds, such as grasses, will come back at the same location next year. This allows early spring targeted spraying of these patches. Many grasses are still active in the fall allowing targeted site-specific herbicide application post-harvest to kill these weeds.

- Root propagating weeds will also come back at the same location, but many are not manageable in the fall. Targeted site-specific pre-emergence or a post emergence herbicide can be used early spring to get ahead.

- Deviation from cropping plans can enable management of a widespread weed. Selecting a different crop can enable new management options. The grower may select a crop that will out compete the infesting weed. Alternatively, the grower may select a different crop to enable a different herbicide to manage the weed during next year's growing season..

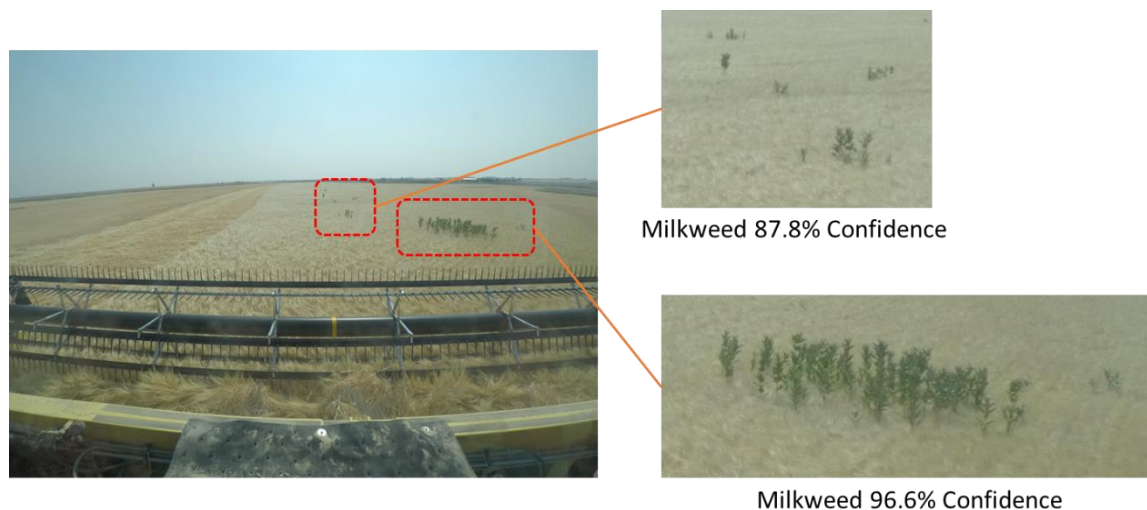Milkweed 87.8% Confidence

Milkweed 96.6% Confidence

Figure 2. Field mapping system in action showing the detection and classification of two patches of milkweed during barley harvest.