

Precision Cultivating Technologies for Improved Weed Control

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In 2018, we conducted a survey to assess current use and potential for adoption of automated technologies in vegetable crops. Many of you participated. The results are summarized in Tourte and Siemens (2018). One of the perhaps surprising results was that only 30% of growers currently use automated weeding machines. Although most growers had tried automated weeding machines, over 75% were either somewhat satisfied or not satisfied with the technology. The top concern and barrier to adoption was reliability. Commercialized automated weeders utilize metal blades that move in and out of the crop row to cultivate weeds between individual crop plants as the machine moves through the field. The high number of moving parts and complexity of operation limits their reliability.

As an alternative, we have been investigating the use of updated versions of older, simpler, “proven” technologies for weed control. These are camera-guided cultivators and mechanical in-row weeding tools. Camera-guided cultivator’s use a forward-looking camera to identify crop plant rows. Image processing techniques for differentiating between green, living plants and a brown, soil background are well known and robust. The cultivator’s tools are attached to a toolbar that is able to move relative to the tractor via actuation of a hydraulic cylinder or steerable coulter. Camera-guided cultivators have been commercially available from several manufacturers for decades.

The in-row weeding tool we have been experimenting with is termed a “finger weeder”. Finger weeders are fingered wheels made from flexible rubber. Pairs of the ground driven wheels are positioned over the crop row such that the fingers on adjacent pairs overlap slightly. In this configuration, small in-row weeds are uprooted while well rooted crop plants remain anchored to the soil and unharmed. These types of devices were first commercialized about 70 years ago and there are several European and domestic made models currently available in the U.S.

We evaluated the use of a camera-guided cultivator and finger weeders with the aim of providing an improved and alternative method of controlling herbicide resistant weeds in cotton. Results of the 2-year study showed that finger weeders could be used in small cotton (1-2 leaf) without causing crop injury. Finger weeders were found to be effective at controlling small broadleaf weeds (less than ~1.5” in diameter). In experimental trials with heavy weed pressure, better than 50% of the in-row broadleaf weeds were controlled using the device. Larger broadleaf and well-rooted grassy weeds were not well controlled. This was expected as the devices are not designed for this purpose. Timing is critical for good performance.

Self-steering, camera-guided cultivators were found to be highly accurate and allowed cultivating tools to be positioned within 1.75” of the seed row (3.5” uncultivated band). Utilizing the technology improved weed control by 60% as compared to conventional cultivation (Lillistons). This is an impressive, and logical result. The uncultivated band was reduced from 10” to 3.5”, or 65% and weed control efficacy was directly proportional to the decrease in the width of the uncultivated band. Use of finger weeders in combination with the camera-guided cultivator was highly effective. In 2019, plots had about 1/3rd as many weeds as compared to conventional (66% weed reduction) and in 2018, weed control was 85% for all weeds and about 93% for broadleaf weeds.

A link to an action video of the devices in action and trial results is provided below. It is not unreasonable to think that similar type results may be achievable in vegetable crops such as broccoli, cauliflower and cabbage that also have stems or stalks and are upright in nature. The devices have been tried and may have utility in most vegetable crops, including lettuce, and is an aim of future research. These technologies are readily available from dealers in Yuma, AZ and Salinas, CA.

Precision Cultivation Technologies for Improved Weed Control in Cotton Action Video Link –

<https://youtu.be/iDnEH2-vsdc>

References

Tourte, L. & Siemens, M.C. 2018. Assessing use of automated (mechanized) technologies in vegetable crops. Salinas Valley Agriculture - ANR Blogs. 4 pp. Davis, Calif.: University of California Davis.

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