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An Evaluation of Two Novel Cultivation Tools

Glenn J. Evans, Robin R. Bellinder, and Russell R. Hahn*

Cultivation is a critical component of organic weed management and has relevance in conventional farming. Limitations with current cultivation tools include high costs, limited efficacy, and marginal applicability across a range of crops, soil types, soil moisture conditions, and weed growth stages. The objectives of this research were to compare the weed control potential of two novel tools, a block cultivator and a stirrup cultivator, with that of a conventional S-tine cultivator, and to evaluate crop response when each tool was used in pepper and broccoli. Block and stirrup cultivators were mounted on a toolbar with an S-tine sweep. In 2008, the tripart cultivator was tested in 20 independently replicated noncrop field events. Weed survival and reemergence data were collected from the cultivated area of each of the three tools. Environmental data were also collected. A multivariable model was created to assess the importance of cultivator design and environmental and operational variables on postcultivation weed survival. Additional trials in 2009 evaluated the yield response of pepper and broccoli to interrow cultivations with each tool. Cultivator design significantly influenced postcultivation weed survival ($P < 0.0001$). When weed survival was viewed collectively across all 20 cultivations, both novel cultivators significantly increased control. Relative to the S-tine sweep, the stirrup cultivator reduced weed survival by about one-third and the block cultivator reduced weed survival by greater than two-thirds. Of the 11 individually assessed environmental and operational parameters, 7 had significant implications for weed control with the sweep; 5 impacted control with the stirrup cultivator, and only 1 (surface weed cover at the time of cultivation) influenced control with the block cultivator. Crop response to each cultivator was identical. The block cultivator, because of its increased effectiveness and operational flexibility, has the potential to improve interrow mechanical weed management.
Nomenclature: Broccoli, *Brassica oeracea* L.; pepper, *Capsicum annuum* L.
Key words: Block cultivator, cultivation, interrow weed control, mechanical weed control, stirrup cultivator, S-tine sweep.

La labranza es un componente crítico del manejo orgánico de malezas y tiene relevancia en la agricultura convencional. Las limitaciones de las herramientas de labranza actuales incluyen: altos costos, eficacia limitada y aplicabilidad marginal entre una variedad de cultivos, tipos y condiciones de humedad del suelo y las etapas de crecimiento de las malezas. Los objetivos de esta investigación fueron: 1) comparar el control potencial de malezas de dos nuevas herramientas (un cultivador de bloque y un cultivador de estribo), con un cultivador convencional de dientes pequeños y 2) evaluar la respuesta del cultivo cuando cada herramienta fue usada en pimiento y brócoli. Cultivadores de bloque y de estribo se instalaron en una barra de herramientas con una barredora de dientes pequeños. En 2008, este cultivador de tres partes se probó en campos sin cultivo, con 20 eventos/réplicas independientes. Los datos de supervivencia y re-emergencia de la maleza se recolectaron para cada una de las tres herramientas y también se recolectó información ambiental. Se creó un modelo multivariado para evaluar la importancia del diseño del cultivador, así como las variables ambientales y operacionales, en la supervivencia de las malezas después de la labranza. Ensayos adicionales en 2009 evaluaron la respuesta del rendimiento del pimiento y brócoli a la labranza entre-líneas con cada herramienta. El diseño de la herramienta de labranza impactó significativamente la supervivencia de la maleza ($P<0.0001$). Cuando la supervivencia de la maleza fue observada colectivamente entre todos los 20 eventos, los dos nuevos cultivadores mejoraron significativamente el control. En comparación con la barredora de dientes pequeños, el cultivador de estribo redujo la supervivencia de la maleza en cerca de un tercio, y el de bloque, redujo la supervivencia de las malezas en más de dos tercios. De los once parámetros ambientales y operacionales evaluados individualmente, siete tuvieron implicaciones significativas para el control de malezas con el barrido; cinco impactaron el control con el cultivador de estribo, y solamente uno (cobertura de la superficie con malezas al momento del cultivo), influyó en el control con el cultivador de bloque. La respuesta del cultivo a cada cultivador fue idéntica. Debido al aumento en la eficacia y flexibilidad operativa, el cultivador de bloque tiene potencial para mejorar el manejo mecánico de malezas entre líneas.

Cultivation can effectively manage weeds, and is a mainstay of many organic weed management programs (Ryan et al. 2007). Cultivation has also been successfully integrated with the use of herbicides on conventional farms. Weeds are controlled by burial, uprooting, root desiccation, and/or a physical separation or crushing of plant parts (Toukura et al. 2006). A number of papers have been published regarding the use of various cultivation implements within a wide range of cropping systems (Colquhoun et al. 1999; Mohler 2001; Pullen and Cowell 1997; Rasmussen 1992).

Limitations with current cultivation tools include high purchase and maintenance costs; marginal efficacy; excessive soil disturbance; stimulation of latent weed seed germination; and narrow applicability across a range of soil types, soil moisture conditions, and weed growth stages. There is a need for a cultivation implement that can address some of the limitations of current tools. The objective of this research was to evaluate whether two new tool designs (block and stirrup cultivators. G. Evans, Cornell University, Ithaca, NY 14853)

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* First and second authors: Research Support Specialist and Professor, Department of Horticulture, Cornell University, Ithaca, NY 14853; third author: Professor, Department of Crop and Soil Science, Cornell University. Corresponding author's E-mail: gje2@cornell.edu