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Weed Management—Techniques

Temperature and Relative Humidity Affect Weed Response to Vinegar and Clove Oil

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Nonsynthetic herbicides offer a potentially useful addition to the suite of weed management tools available to organic growers, but limited information is available to guide the optimal use of these products. The objectives of this research were to (1) evaluate the efficacy of clove oil- and vinegar-based herbicides on weeds across multiple states, and (2) assess the potential role of temperature, relative humidity (RH), and cloud cover in explaining inter-state variations in results. From 2006 to 2008, a total of 20 field trials were conducted in seven states using an identical protocol. Seeds of brown mustard were sown and herbicides applied to both mustard and emerged weeds when mustard reached the three- to four-leaf stage. Treatments included clove oil at 2.5, 5, 7.5, and 10% v/v concentrations at 54 L ha⁻¹, and vinegar at 5, 10, 15, and 20% v/v concentrations at 107 L ha⁻¹. Results varied widely across trials. In general, concentrations of at least 7.5% for clove oil and 15% for vinegar were needed for adequate control of mustard. Both products were more effective at suppressing mustard than *Amaranthus* spp. or common lambsquarters. Poor control was observed for annual grasses. No significant effects of cloud cover on the efficacy of either product were detected. In contrast, RH was positively correlated with control of brown mustard by both clove oil and vinegar with improved control at higher RH. Temperature had no detectable effect on the efficacy of clove oil, but higher temperatures improved control of brown mustard by vinegar.

Nomenclature: Clove oil; vinegar; common lambsquarters, *Chenopodium album* L.; redroot pigweed, *Amaranthus retroflexus* L.; brown mustard, *Brassica juncea* L. Czerniak.

Key words: Acetic acid, cloud cover effects, eugenol, natural-product herbicides, organic weed management, weed control.

Herbicidas no-sintéticos ofrecen potencialmente una adición útil a la variedad de herramientas para el manejo de malezas, disponible para productores orgánicos. Sin embargo, hay poca información disponible para guiar el uso óptimo de estos productos. Los objetivos de esta investigación fueron (1) evaluar, en diferentes estados, la eficacia de herbicidas a base de aceite de trébol y de vinagre sobre malezas, y (2) evaluar el papel potencial de la temperatura, humedad relativa (RH), y la cobertura nubosa para explicar variaciones inter-estatales en los resultados. De 2006 a 2008, un total de 20 experimentos de campo fueron realizados en siete estados usando un protocolo idéntico. Semillas de mostaza (*Brassica juncea*) fueron sembradas y los herbicidas aplicados a la mostaza y malezas emergidas cuando la mostaza alcanzó el estado de desarrollo de tres a cuatro hojas. Los tratamientos incluyeron aceite de trébol a concentraciones de 2.5, 5, 7.5 y 10% v/v a 54 L ha⁻¹, y vinagre a concentraciones de 5, 10, 15 y 20% v/v a 107 L ha⁻¹. Los resultados variaron ampliamente entre experimentos. En general, concentraciones de al menos 7.5% para el aceite de trébol y 15% para el vinagre fueron necesarias para el control adecuado de la mostaza. Ambos productos fueron más efectivos para suprimir la mostaza que *Amaranthus* spp. o *Chenopodium album*. Se observó un control pobre de gramíneas anuales. No se detectaron efectos significativos de la cobertura nubosa sobre la eficacia de ninguno de los productos. En cambio, la RH estuvo positivamente correlacionada con el control de la mostaza por el aceite de trébol y el vinagre con un mejor control a RH más altas. La temperatura no tuvo efectos detectables sobre la eficacia del aceite de trébol, pero las temperaturas altas mejoraron el control de la mostaza con vinagre.

Surveys of organic growers and studies of organic farms indicate that weeds are often the most important constraint to successful organic production (Bond and Grundy 2001; MNDOA 2010; Walz 1999). Although organic farmers use many strategies to manage weeds, soil disturbance remains the primary approach on many farms, resulting in losses in soil quality as well as high energy and labor costs.

Nonsynthetic herbicides have the potential to play an important role on organic farms by reducing reliance on soil disturbance to manage weeds. However, limited information is available to guide the optimal use of these products. Two herbicides that have received attention from both the research and farming communities for weed control in organic crops are vinegar and clove oil; both are components of several herbicides approved by the Organic Materials Review

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