O.37 - Physical control of weeds, pests and diseases

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Abstract

Reduction of the number of approved and effective pesticides, especially in minor crops, and drawbacks to the control of weeds, pests and diseases in organic production, triggers innovation in physical control. In weed control recent developments aim at increasing capacity and accuracy in mechanical inter-row and intra-row weed control. Other possibilities include the prevention of weeds by soil covers or by applying clean compost in the crop rows. For insect control the “Beetle Eater” a Canadian “vacuum cleaner”, developed to suck up Colorado beetles, is tested for use against the carrot fly and adult cabbage white flies. Reflecting soil covers or coverage of the soil between the crops with other plants can be also quite effective. For disease control the usage of UVc light is used for the control of *Botrytis* in greenhouses. The effectiveness of a specifically designed machine of Cleanlight and Dubex is investigated for phythophthora in potatoes and downy mildew in onions. Hot water treatment of the onion sets is another solution developed for downy mildew. The innovations in sensing and ways of actuation in f.e. physical weed control can be made valuable for pest and disease control. Innovation in burners increases the possibilities for selective usage not only for weeds but also for selectively controlled diseased plant material. Usage herb covers to confuse insects can be made more applicable for practice with the no till weed control machinery. Interaction between specialists in several disciplines and further research is needed and can further boost the possibilities for physical control.

Introduction

The awareness of government, consumers and farmers of possible adverse side-effects of chemicals has increased over recent decades and has resulted in regulations and the wish to reduce usage of pesticides. Reduction in the number of approved and effective pesticides especially in minor crops and drawbacks to control weeds, pests and diseases in organic production triggers innovation in physical control.

Physical weed control

A recent review of non-chemical weed management (Upadhyaya and Blackshaw, 2007) addresses as the main physical control methods use of cultural weed management, cover crops and non-living mulches, tillage and mechanical weed control, thermal weed control and soil solarisation. In mechanical weed control recent developments aim at increasing capacity and accuracy in inter-row and intra-row weed control. Pictures and more information on harrows, brush weeders, torsion weeders, finger weeders, tools using compressed air and recently developed cultivators and tools for mechanical intra-row weed control can be found on the website of the Physical and Cultural Weed Control Working Group of the European Weed Research Society (www.ewrs.org/pwc) and in publications by Van der Schans et al. (2006), Cloutier et al. (2007b) and Van der Weide et al. (2008). With appropriate machine adjustments, the machinery have made intra-row control of small weeds possible in many crops and in several growth stages (Van der Schans et al. 2006). In slow germinating, small seeded and low-competative crops like carrots, direct-sown leeks and onions, intra-row weeding remains difficult. In this case research is focusing on f.e. strip steaming or applying clean compost in the crop rows.

Currently, advanced technologies such as sensing crop and weed plants and robotics (Gerhards and Christensen, 2003; van Evert et al., 2006; van der Weide et al., 2008) are regarded as an important way to improve mechanical weed control in existing cropping systems. However, the adjustment of cropping systems to new developments and technologies may be equally important. One of those developments is societal pressure to reduce the energy consumption of plant production, which may lead to reduced ploughing and no-till systems (Kropff et al. 2008). The disadvantages of those systems are the higher weed densities, and sometimes less workable soil structure, and therefore the higher demand for weed control. Despite these disadvantages, two types of no or reduced tillage cropping systems using mechanical weed control have been developed and are being applied in practice in North America (Cloutier et al. 2007a).

Physical insect control

A review on physical control methods of insects has been published by Vincent et. al. (2003). Physical controls can be classified as passive (e.g. traps, trenches, fences, organic and artificial mulches, inert dusts) or active (e.g. mechanical, pneumatic, ultrasound, thermal). Vincent et al. (2003) report positive experiences with blown or aspirated air on *Lygus* spp. on strawberry, Colorado potato beetle, *Liriomyza* pp. on celery and *Bemisia tabaci* on melons. Recent research in the Nethelands test the 'Beetle Eater' a Canadian 'vacuum cleaner', developed to suck up Colorado beetles, against caterpillars diamondback moth (*Plutella xylostella*) and adult cabbage whiteflies (*Aleyrodes proletella*) in cabbage crops (Sukkel, 2008). Reflecting soil covers (Greer and Dole, 2003) or coverage of the soil between the crops with other organic mulch or other plants can be also quite effective. Straw mulch indirectly affects Colerado beetle populations by favoring predators and significantly reduces damage (Zehnder and Hough-Goldstein, 1990).

Physical disease control

Examples of physical disease control are reviewed in Vincent et al. (2001). In physical disease control passive control options with artificial and organic mulches are important. Dependent from disease and kind mulch of material effect are positive of negative (e.g. more cereal diseases in case of straw mulch and less *botrytis* in strawberries). Agrios (1997) states as active physical agents temperature (high or low), dry air, unfavourable light wavelengths and various types of radiation. Frequently used control options are steaming, solarisation and burning. Furthermore tillage and crop residue management are important for disease management. In the Netherlands recently for disease control the usage of UVc light is used for the control of Botrytis in greenhouses. The effectiveness of a specifically designed machine of Cleanlight and Dubex is investigated for phythophthora in potatoes and downy mildew in onions (Sukkel, 2008). Hot water treatment of the onion sets is another solution decreasing downy mildew.

Challenges for interaction

The innovations in sensing and ways of actuation in f.e. physical weed control can be made valuable for pest and disease control. Innovation in burners increase the possibilities for selective usage not only for weeds but also for selectively control diseased plant material. Weed blowers can be combined with vacuum cleaners to increase the efficiency of insect control. Usage herb covers to confuse insects can be made more applicable for practice with the no till weed control machinery. Interaction between specialists in several disciplines and further research is needed and can further boost the possibilities for physical control.

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