Developments in physical weed control in Northwest Europe

Entwicklungen in der mechanischen Unkrautbekämpfung in Nordwest-Europa

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Abstract

In North West Europe there is an increasing need for advanced weed control methods. This paper gives an overview of the developments in physical weed control methods. Current innovations in interrow weeding focus on systems that take over the steering function of the driver in order to make them more precise and reduce crop losses. The latest developments in intrarow weeding techniques involve technologies that automatically detect and classify crop and weed plants and use this information to guide a weeding device. Several commercially available examples are presented.

Keywords: Mechanical weeding, physical weed control, thermal weeding

Zusammenfassung

In Nord-Europa besteht ein wachsender Bedarf nach hochentwickelten Unkrautbekämpfungsmöglichkeiten. Dieser Beitrag bietet einen Überblick über die derzeitigen Entwicklungen im Bereich der mechanischen Unkrautbekämpfung. Neue Innovationen im Bereich der Unkrautbekämpfung zwischen den Reihen der Kulturpflanzen zielen auf eine automatische Steuerung der Geräte ab um die Präzision der Bekämpfung zu erhöhen und Schäden an der Kultur zu vermindern. Im Bereich der mechanischen Unkrautbekämpfung innerhalb der Kulturpflanzenreihe sind in der letzten Zeit unter anderem Technologien entwickelt worden, die eine Detektion der Unkräuter bzw. eine Unterscheidung der Unkräuter von den Kulturpflanzen ermöglichen und diese Informationen an ein Gerät zur mechanischen Bekämpfung weitergeben. Kommerziell erwerbliche Beispiele der jeweiligen Technologie werden in diesem Beitrag vorgestellt.

Stickwörter: Mechanische Unkrautbekämpfung, physikalische Unkrautbekämpfung, thermische Unkrautbekämpfung

Introduction

In North West Europe there is an increasing need for advanced weed control methods. Due to stricter regulations the possibilities to use herbicides have been reduced and the implementation of IPM principles is mandatory (EU Directive 2009/128/EC). This need resulted in the development of advanced physical weed control tactics, of which some have reached the stage of commercially available equipment. This paper gives an overview of the developments in physical weed control methods.

Mechanical control

Weeds can be controlled through mechanical methods that are generally based on three mechanisms: cutting, uprooting and burying weeds. Mechanical weed control methods have a high capacity, are widely applicable and have in general a low cost which makes them attractive. However, they are also not very selective, which can cause severe crop losses in early crop stages. Timing and intensity of the operation determines their selectivity, together with crop and weed species and growth stage. Two main categories can be distinguished: interrow weeding tools and intrarow weeding tools.

Interrow weeding

Interrow weeding with mechanical tools is relatively simple. Most common is the use of tines with hoe blades. However, the method do not distinguish between crop and weed plants and depends on the accuracy of the driver to avoid crop losses. Current innovations in interrow weeding

therefore focus on systems that take over the steering function of the driver. Vision based systems that can follow crop crops while maintaining a high capacity and weed control results are the subject of several developments.

Intrarow weeding

Different implements have been especially designed and manufactured to control weeds in the crop rows. Successful developments are the torsion and finger weeder and a weeder using compressed air (Pneumat). The possibilities for using these weeding machines vary according to crop type, crop growth stage and field and weather conditions and depend on their selectivity. This selectivity is based on differences between weed and crop plants, for example in root anchorage forces, leaf area and/or plant height.

A new development for intrarow weeding is the use of technologies that automatically detect and classify crop and weed plants and use this information to guide a weeding device. This increases the selectivity of the weed control and reduces crop injuries. At the moment three robotic weeders are commercially available in Europe: the Garford Robocrop from the UK (www.garford.com), the Steketee IC from the Netherlands (www.steketee.com) and the Robovator from Denmark (www.visionweeding.com). They are all vision based systems that are capable of analysing images real time. The Robocrop has a rotating horizontal disc with a cut-out sector. After the machine vision, the disc is moved into the row in such a way that the cut out sector allows the disc to pass the crop plant and remove the weed plant by cutting or burying. The Steketee IC uses high resolution cameras that recognise crop plants based on shape, colour and location. Weeding takes place with two pneumatically guided hoes.

Another example of a vision based system that is still under development is "Ruud", a machine that uses textural analysis to detect broad-leaved weeds (*Rumex obtusifolius* L.) in grassland, and cuts the dock plant after detection (VAN EVERT et al., 2011).

Thermal weeding

Methods that increase temperatures temporarily (minimum temperatures ranging from 55 to 95 °C, depending on species, and plant parts) can be used as a weeding device (ASCARD et al., 2007). Examples are the use of fire, flaming, infrared radiation, hot water, microwave radiation, ultraviolet radiation, lasers, steam and electrical energy. Commercially, systems based on flaming, hot water and steam are used for weeding in horticulture, greenhouses and on hard surfaces. In general, these methods are energy demanding and have relatively low work rates. The selectivity for thermal weed control depends on the difference in sensitivity to temporary temperature increases between (the larger) crop and (smaller) weed plants. A commercially available selective weed control machine is the Poulsen machine (www.visionweeding.com). This machine uses cameras to detect the crop plants and switches off the flames in their presence. Hoaf Infrared technologies (www.hoaf.nl) manufactures a machine that combines flaming and infrared technologies to control weeds full field or interrow.

Future

New technologies such as vision based recognition and automatic actuation will increase the precision of physical weed control equipment and therefore broaden their possible application window. To be able to replace the current herbicide-based systems with integrated weed management systems, these physical weed control techniques need to be combined with preventive, cultural and breeding techniques.

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