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Methode zur Berechnung und Optimierung der Mineraldünger-verteilung im Bereich eines rechtwinkligen Vorgewendes

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Summary

The consumption of organically produced foodstuffs in Germany and in the European Union has increased constantly within the past few years. The continued strong demand for organically produced foodstuff also comprises organically produced beet sugar for the processing industry and food retailing.
Mechanical weed control is of central importance for organic farming. Efforts of the European Union to reduce the application of chemical crop protection products will broaden the field of application of mechanical weed control also for conventional farming.
The sugar beet plant germinates at the same time during the main germination period of most weeds and therefore competes during the early growth stages for the growths factors light, water and nutrients. Until now mechanical (intra-row) weed control can only achieve unsatisfactory results. Therefore, organic production of sugar beet still requires much manpower hours per hectare within a short timeframe for removing weed manually from the space within rows of plants.
For this thesis extensive field tests of hoeing techniques currently available on the market were carried out. The objective was to decrease the time needed for manual weed control considering quality of work and yield.
During the two years of field trials on area under organic cultivation of Agrar und Umwelt AG Loberaue in Zschortau, Landkreis Nordsachsen, in Saxony, Germany, different hoeing techniques that work the area between (inter-row) and within (intra-row) rows of sugar plants have been tested. During the first year of trials two different inter-row hoes with 'A' and 'L' shares and intra-row implements were applied. In the second year, more emphasis was put on inter-row implements; modified hoeing tools as weIl as inter-row harrows were used. The quality of the inter-row hoeing techniques used was satisfactory for organic sugar beet cultivation. In both years, higher weed control success was realised during trials with a second type of implement, the Yetter Rotary hoe.
In both years there were no significant yield differences between the various implement types. The required man power hours per hectare of manual weed controllie in a range that is comparable to other

published studies investigating mechanical weed control of field vegetables and sugar beet.

Based on these field trials a hoe prototype for operating mechanical intra-row weed control was developed. The prototype includes a camera-based control system for operating the hoe, which is based on detecting the position of the sugar beet plant in front of the hoe implement in real time. The constructed hoe-prototype is driven hydraulically. The image acquisition is carried out with the help of a CCD-camera with daylight filter. The image recording does not take place continuously but is triggered when the implement rotation reaches a fixed point. The programme developed for detecting the plant position in the image works with a 2 GHz processor with an average processing time of 30 ms in real time. The detection rate of the first field tests was 88%. The first tests of the prototype also reached a working velocity of up to 1 m/s. The hoe implements work with a continuous implement rotation and are accelerated or slowed down according to the correction signal from the image analysis. Both investigated implement types work the space between plants but an optimization of the implement for reducing the untreated space within rows of plants is required.

Limiting the required manual work to the very close space around the sugar beet plant in organic sugar beet production is possible by using the developed intra-row hoe prototype. The prototype makes an effective intra-row weed control during the early growth stages possible. First trials have proven the functionality of the prototype considering the requirements for the system regarding the plant position detection for operating the hoe and the working velocity.