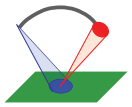

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Precision detection and spraying of volunteer potato plants in sugar beet fields

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Volunteer potato plants are a major weed problem in Western European cropping rotations. They are a source for the spread of disease, nematodes, and pests. For example they spread *Phytophthora infestans*, that causes late blight in potato crops. However, the control of Phytophthora infestans requires large amounts of pesticides that farmers, environmental groups, and politicians want to reduce. This is stressed by the framework directive on the sustainable use of pesticides, EU directive 2009/128/EC. Therefore, adequate control of volunteer potato plants and weeds is required. Volunteer plants are best controlled by application of glyphosate. This ensures control of haulm and tuber, and re-growth is inhibited. Currently available machines have a high risk of sugar beet crop injury and have a high labour demand, requiring a practical innovative solution. The stakeholders of the problem asked for a solution and an automated precision detection and spraying system was designed and tested.

With machine vision a plant specific detection system was made. Real time algorithms detect up to 1 m s^{-1} travel speed with a resolution of 1 cm^2 for three sugar beet rows where glyphosate has to be applied onto volunteer plants. After detection of individual potato plants in the sugar beet row, a micro sprayer applies targeted droplets of gel and glyphosate onto the weeds. A gel instead of water was used because no splash and drift to adjacent crop plants is allowed.

The prototype system that integrated real-time detection and targeted individual droplets at volunteer plants was tested in experimental fields. In one of the fields 96.6% volunteer potato classification and 8.0% sugar beet misclassification was achieved. In an experiment where also the sprayer was activated, over 80% of the weed potato plants were destroyed and only up to 2% of the sugar beet plants were destroyed, mainly due to incorrect detection, not as a result of spray drift. The precise positioning of droplets facilitates further developments into precision application of nutrients and pesticides on crops and weeds in agricultural fields.