Micro-spraying with one drop per weed plant

Micro-spraying is a herbicide application system, which is able to reduce the herbicide consumption in row crops a lot by placing only one or a few droplets of herbicide on single weed plants.

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Precision spraying by use of computerised variable dose technology for controlling the applied amount of herbicide according to the site-specific demands on the field has been used for several years and the potential for savings is well documented.

Micro-spraying is a new spraying concept for herbicide application. The idea of this system is to detect and target individual weed plants and thereby minimizing the contamination of the soil surface. The herbicide applications in the springtime are especially interesting because of the fact that the weed leaves’ surface covers only a few per cent of the soil surface.

Compared to a conventional broadcast application, the micro spray concept almost eliminates the deposition of herbicide on the soil surface and hence diminishes unwanted environmental site effects.

Micro-Sprayer Concept

The micro-spray concept combines weed recognition, micro-spraying and robot technology. A computer vision system recognises the position of the weed seedlings and a micro-sprayer applies herbicides according to a spray map while a RTK-GPS guided vehicle links it all together.

The micro-spray system is developed for row crops. The herbicide application for a conventional sprayer is often based on the generation of spray droplets in hydraulic nozzles, and the spray formation secures a good coverage on the plant. On the contrary, the micro spray system is developed to apply very small amounts of spray water by ejecting a jet through a hypodermic tube, which makes it easier to control the transport and the targeting of the pesticide on small weed plants. After the spray water has been deposited on the plant leaves as a small droplet, there is a demand for a redistribution to obtain a good coverage of the leaf. The redistribution is ensured by using specially formulated spray liquid.

The first prototype consisted of a 126-mm micro-boom with a line of 40 hypodermic tubes. The boom was separated into 8 sections and each section was opened and closed by use of solenoid valves. A new prototype with a higher resolution was developed with the purpose of getting a higher accuracy. This boom was 100 mm and consisted of 20 individually controlled tubes. This made it possible to apply herbicides in 5x5-mm cells in the field.

Figure 1. Effects of glyphosate applied as single droplets on plant biomass of Brassica napus.
**Doses of glyphosate in a field situation**

Test on the biological efficacy when applying single droplets was conducted at the Department of Integrated Pest Control. For *Solanum nigrum* L preliminary laboratory tests showed that it was possible to obtain a 95% reduction in the biomass compared to an untreated control when 1 µg glyphosate was applied per plant (Graglia E. 2004).

Field test was conducted by applying single droplet on *Brassica napus*. Different combinations of glyphosate (Clinic, 360 g a.i. L⁻¹, Nufarm GmbH & Co KG) in the range of 0.125 – 4.0 µg per plant were applied to the base of lamina.

The reduction in the biomass compared to the untreated control was analysed 19 days after the herbicide was applied and the results can be seen in figure 1.

The biomass was reduced by 80 per cent when 2 µg per plant was applied.

**Obtainable precision for the micro-spray system**

Investigations of the precision in targeting small objects with the robotic micro spray system were conducted by laboratory tests (Søgaard et al., 2005).

White PVC (total length 6 metres) sheets were used as the spraying surface. The objects to be recognised on the sheets were black circles. The circles were placed randomly at different densities from 50 circles to 400 circles per m².

Figure 2 shows the results from spraying 305 circles with the first prototype of the micro-sprayer.

The dots show the position of the centroids of the spray liquid relative to the centres of the corresponding target circles. Each of the eight sprayer nozzles covers 15.8 mm in cross travel direction and this sets a lower limit for the precision. As a measure of the scattering the mean distance between the liquid centroids and the target circles (the mean error) can be computed. For the experimental data the mean error was found to be 2.8 mm.

To obtain a higher precision a new prototype was designed with 5 mm distance between each separate tube.

**Field test with the micro-sprayer**

Preliminary tests were conducted in the field by applying herbicide on a “test weed” (*Brassica napus*).

The test weed was seeded in rows with different densities from 50 plants to 400 plants per m².

The spray consists of a mixture of 2 µg glyphosate (Clinic, 360 g a.i. L⁻¹, Nufarm GmbH & Co KG) pr. µl liquid. Each ”shot” emitted 2.5 µl of spray mixture. The plants were evaluated visually for biological efficacy after 19 days.

All the collected data is not yet evaluated, but so far a test series of 100 plants was evaluated and a treatment efficacy was calculated to be 84% when spraying all sizes of plants and 93% when only plants above 100 mm² were used in the data series. The average applied dose was 27 µg glyphosate per plant, which correspond to 27 g glyphosate per hectare in a field situation with 100 weed plants per m².

**Conclusion**

The results show that the micro sprayer has the capability to hit the single weed plants in the fields and were able to obtain a reasonable treatment efficacy. On the other hand there is a need for further system optimization in terms of vision recognition and the application unit.

**Literature**
