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Weed control with frequent laser treatment as an alternative to herbicides

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1 Introduction

Technological advances enable new approaches for precise weeding in row crops. This paper evaluates the inhibition of weed growth through blue light laser treatment during the sensitive growth stages of the crop.

2 Method Overview

- Three randomly selected areas in a soy row were manually treated by a laser to remove weeds, six areas were left untreated. The treatment was performed seven times in a time period of 25 days until row closure (BBCH 10-24).
- At row closure, 10 days after the last treatment, the weeds inside the areas were cut and dried. They were identified, counted and weighted. The crops were counted, and the height measured.
- 4 weeks later (BBCH 82), the same procedure was performed to identify the long-term effect. All weeds were removed for counting in the first measurement; therefore, no large weeds were able to develop.

Figure 1: Topview of an untreated (left) and treated (right) area.

3 Materials

- 9 aluminum frames [0,53 m^2] in a row marked the experiment.
- The soy fields were treated with glyphosate, plowed and treated with a power harrow before the experiment start.
- A blue light laser [445nm, 5W] was manually targeted for a treatment duration of 3-5 seconds per weed.

Figure 2: Field at the start of the experiment (left) and after the second measurement of weed numbers [right].

4 Results and Discussion

The untreated areas had more and older weeds, while the treated areas only had single, juvenile weeds. At row closure, the untreated areas had an average of 143.5 weeds per frame. In comparison, the untreated areas had an average of 1.3 weeds per frame. There were no surviving monocotyledones in treated areas at row closure and a month later.

Weeds per 0,53 m^2	BBCH 24		BBCH 82	
	Untreated areas	Treated areas	Untreated areas	Treated areas
Monocotyledone	89.2 ± 15.7 a	0.0 b	5.2 ± 3.8 a	0.0 b
Dicotyledone	54.3 ± 21.4 a	1.3 ± 1.2 b	26.7 ± 4.0 a	2.0 ± 1.4 b
Total	143.5 ± 18.0 a	1.3 ± 1.2 b	31.8 ± 4.2 a	2.0 ± 1.4 b
Dry weight [g]	21.6 ± 7.0 a	0.0 b	-	-

Table 1: Monocotyledone and dicotyledone weeds on treated and untreated areas at row closure (13.07.21) and four weeks later (09.08.21). Statistically relevant differences were marked with letters [a/b].

There was no statistically significant difference of the soy plant performance between treated and untreated areas. Not in number, height or amount of soybean pods.

5 Conclusion

- The results show, that continuous blue light laser treatment during the crop growth phase has a long-lasting effect on the number of weeds in proximity of the crops.
- The laser treatment has shown no negative influence on the growth of the crop. This must be further investigated in a separate experiment with more samples and including quality measurement of the soybeans.
- Frequent treatment prevents weeds to reach a size that is more difficult to treat with a laser. The ideal treatment frequency (weekly, biweekly, …) is not clear yet.
- A high throughput can only be reached if the system is fully automated. It performs weakly if there is exceptional high weed pressure.
- Legal limitations of laser use on autonomous vehicles are an interesting topic for future research.

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