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STØTTET AF

Promilleafgiftsfonden for landbrug

XI Effects of new adjuvants, N32 and pH of the spray solution on herbicide efficacy

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This chapter reports the results of pot experiments conducted to study the effect of new adjuvants, a liquid nitrogen fertiliser (N32) and pH of the spray liquid on herbicide activity. Each experiment was only conducted once and should be replicated or followed up by additional experiments.

Influence of pH and adjuvants on the efficacy of MaisTer

MaisTer is authorised for the control of broadleaved and grass weeds in forage maize. MaisTer contains foramsulfuron and iodosulfuron (300 + 10 g/kg) and is recommended applied in mixture with MaisOil. In this experiment we compared the efficacy of MaisTer + MaisOil (1.33 L/ha) with two new adjuvants – Fieldor Max (0.15%) and Gondor (0.15%). Fieldor Max is a penetration oil and Gondor is a non-ionic surfactant. Gondor is claimed to reduce drift and increase the rainfastness. We also examined the influence of pH of the spray solution on MaisTer efficacy. Previous studies have shown that the biological efficacy of some sulfonylureas is affected by pH (Green & Cahill, 2003). High pH increases the solubility of the sulfonylureas but is also expected to reduce uptake. In this experiment we reduced pH of spray solutions of MaisTer + MaisOil from 7.8 to 5 using K_2HPO_4 and enhanced pH to 9 using K_3PO_4 . We also tested MaisTer + MaisOil (1.3 L/ha) in mixture with pH Fix 5 (0.2%), which is an adjuvant adjusting pH to 5.

All spray solutions were prepared in tap water with a hardness of 18. Each treatment was applied at six MaisTer doses to pot-grown *Setaria viridis* at the 4-leaf stage. Adjustment of pH was made before MaisTer was added to the water. Plants were harvested 4 weeks after herbicide application and fresh and dry weights were recorded. A dose-response model was fitted to the data and ED_{50} doses were estimated.

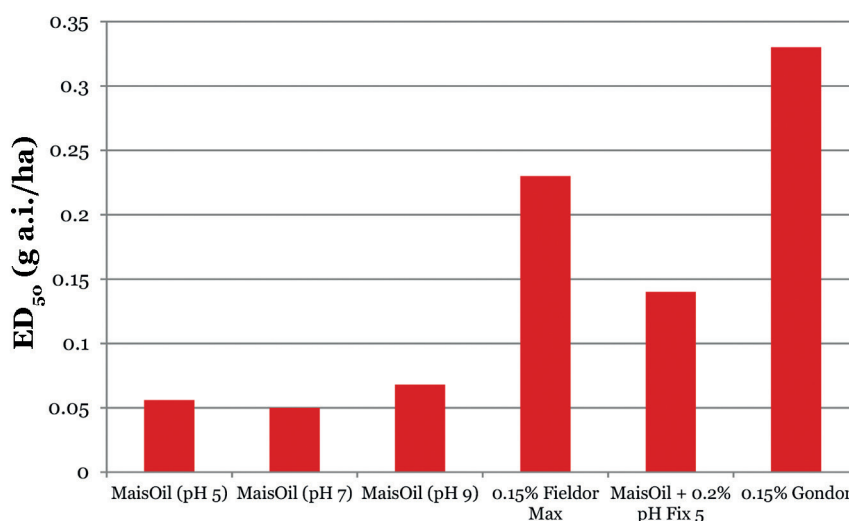


Figure 1. Activity of MaisTer (300 g/kg foramsulfuron + 10 g/kg iodosulfuron) on *S. viridis*. The columns show the dose of MaisTer (g a.i./ha) that was required to reduce fresh weight by 50% (ED_{50}). MaisOil was applied at 1.33 L/ha.

Adjustments of pH of spray solutions of MaisTer + Maisoil had no effect on herbicide activity (Figure 1). Significantly higher effects of MaisTer were obtained in mixture with MaisOil compared with pH Fix 5, Fieldor Max and Gondor.

Influence of pH and adjuvants on the efficacy of Monitor

Monitor contains 800 g/kg sulfosulfuron and is authorised for control of broadleaved and grass weed species, specifically *Bromus* species, *Apera spica-venti* and *Poa trivialis*. Currently, the maximum dose is 2 x 12.5 g/ha or 1 x 18.75 g/ha. However, these doses will most likely be reduced in future due to changes in the risk envelope. It is recommended to apply Monitor in mixture with 0.2% non-ionic surfactant. In this study we examined the effect of Monitor + 0.2% Agropol at different pH of the spray solution. In addition the effect of adding pH Fix 5 (0.2%) and NovaBalance (0.1%) to the spray water was examined. Both of these adjuvants reduce pH of the spray solutions to 5. Finally the effect of Gondor (0.15%) was tested.

All spray solutions were prepared in tap water with a hardness of 18. The pH of the spray solutions was reduced to 5 using K_2HPO_4 and increased to 9 using K_3PO_4 . Each treatment was applied at six Monitor doses to *A. spica-venti*. Adjustment of the pH of the water (including pH Fix 5 and NovaBalance) was made before Monitor was added to the water. Plants were harvested 4 weeks after herbicide application and fresh and dry weights were recorded. A dose-response model was fitted to the data and ED_{50} doses were estimated.

Overall, no significant differences in activity of the different treatments were obtained. Under the conditions tested neither adjustment of pH of the spray solutions nor addition of NovaBalance or pH Fix 5 had any significant effect on the activity of Monitor + Agropol (Figure 2). The activity of Monitor was similar in mixture with Gondor and Agropol.

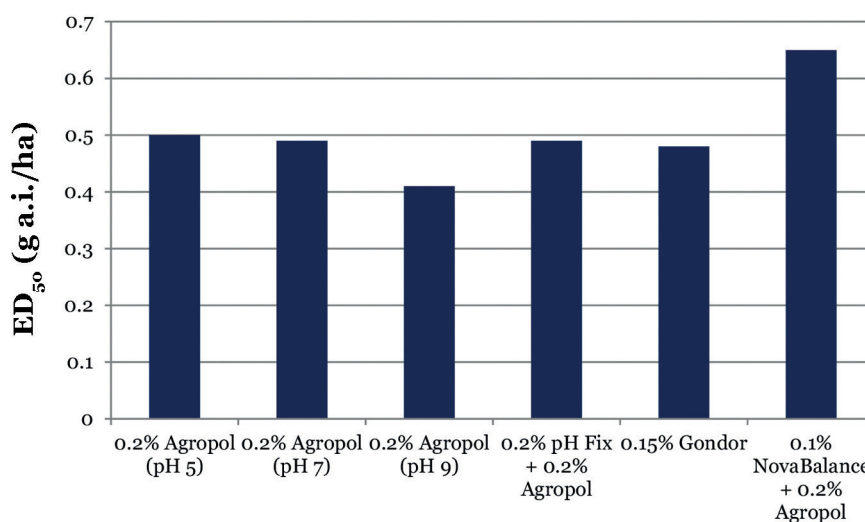


Figure 2. The effect of different adjuvants and pH of spray solutions on the activity of Monitor (800 g/kg sulfosulfuron) on *A. spica-venti*. The columns show the dose of Monitor (g a.i./ha) that is required for reducing fresh weight of plants by 50% (ED_{50}).

Influence of adjuvants on the activity of glyphosate formulations

The efficacy of Glyphogan (360 g/L glyphosate), Glyfonova 480 (480 g/L glyphosate) and Roundup Flex (480 g/L glyphosate) applied alone and in mixture with ammonium sulphate (AMS) + Contact (2 kg/ha + 0.2%) or NovaBalance + Contact (0.2 L/ha + 0.2%) was examined on *Elytrigia repens*. The plants were established in the spring 2015 by planting three one-node rhizomes in 2-L pots. The plants were grown outdoors until late autumn when they were moved to a cold glasshouse (min. temperature 2°C). In spring 2016 the plants were moved outdoors again. In June above-ground plant material was cut and

removed. Herbicide treatments were applied in mid-July when the plants had 4 leaves. Each treatment was applied at 4 glyphosate doses (135, 270, 540 and 1080 g/ha glyphosate). Spray solutions were prepared in tap water with a hardness of 18 and a pH of 7.8. Plants were cut at soil surface 4 weeks after treatments and the efficacy was assessed by recording leaf regrowth from the rhizomes.

Results of fresh weights of regrowth are shown in Figure 3. No significant differences in efficacy were found between formulations applied without adjuvants. The effects of all formulations were significantly increased in mixture with AMS + Contact and NovaBalance + Contact with no significant differences between the adjuvants.

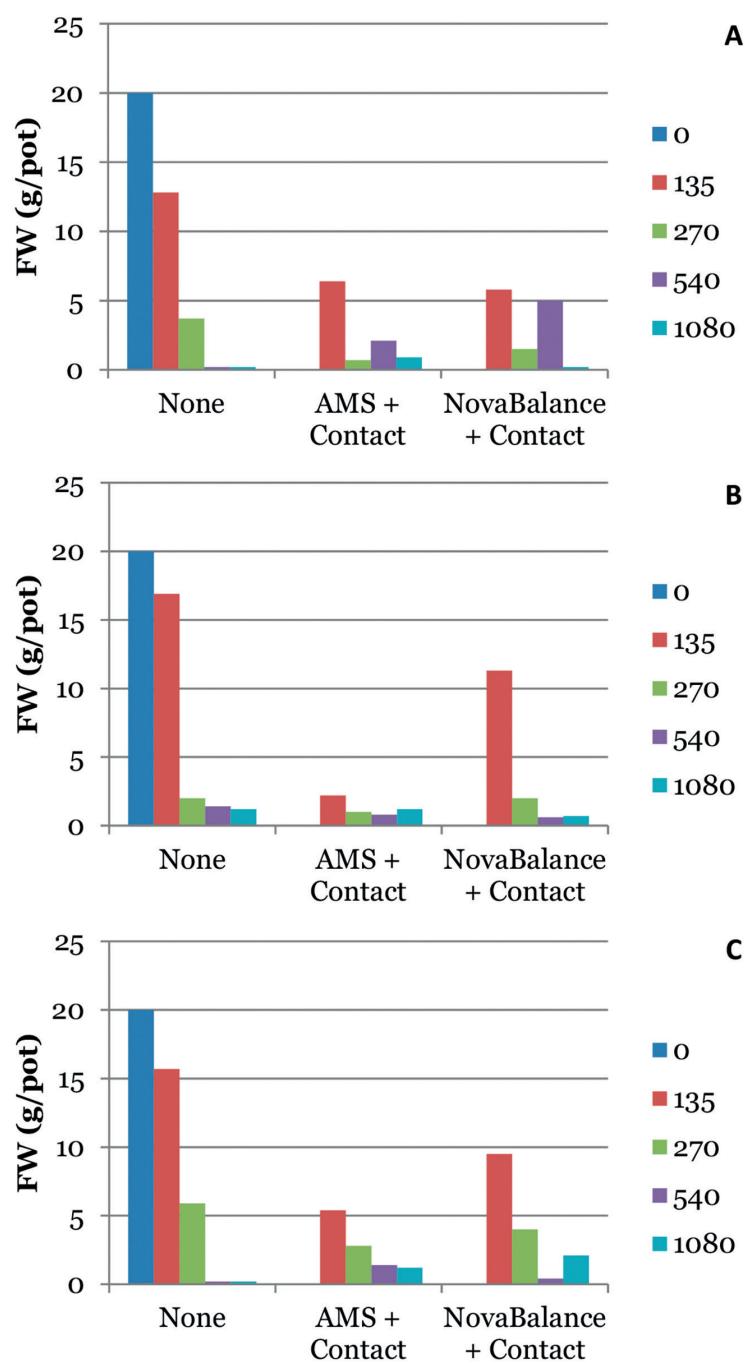


Figure 3. The efficacy of Glyphogon (A), Glyfonova 480 (B) and Roundup Flex (C) alone and in mixture with ammonium sulphate (AMS) + Contact (2 kg/ha + 0.2%) or NovaBalance + Contact (0.2 L/ha + 0.2%) on regrowth of *E. repens*.

Effect of Support Kip-R on the activity of Boxer and Kerb

Support Kip-R is specifically recommended as an adjuvant to herbicides with soil activity. According to the manufacturer Support Kip-R encapsulates the herbicide and induces an electrical charge at the herbicide surface, which prolongs the time that the active ingredient spends in the root zone. Support Kip-R is recommended at a dose of 0.2-0.4 L/ha.

We tested the effect of Boxer (800 g/L prosulfocarb) and Kerb (400 g/L propyzamide) alone and in mixture with 0.3 L/ha Support Kip-R on *Poa annua* and *Stellaria media*. Six doses of each herbicide were applied alone and in mixture with Support Kip-R two days after sowing. In order to distribute the herbicides evenly in the upper soil layer, 25 mL of water was added to the soil surface after spraying. The pots were placed in a glasshouse at a temperature of 10-15°C. The plants were harvested 8 weeks after herbicide application.

Support Kip-R had no significant effect on the activity of Kerb and Boxer on *P. annua* and *S. media* (Table 1).

Table 1. Influence of Support Kip-R on the effect of Boxer (800 g/L prosulfocarb) and Kerb (400 g/L propyzamide) on *P. annua* and *S. media*. ED₅₀ is the dose required for reducing fresh weight of the weed species by 50%.

| Herbicide | Weed species | Adjuvant | ED ₅₀ (g a.i./ha) |
|-----------|-----------------|---------------|------------------------------|
| Kerb | <i>P. annua</i> | None | 5.1 |
| | | Support Kip-R | 5.0 |
| | <i>S. media</i> | None | 43.7 |
| | | Support Kip-R | 42.8 |
| Boxer | <i>P. annua</i> | None | 142.3 |
| | | Support Kip-R | 145.2 |
| | <i>S. media</i> | None | 57.0 |
| | | Support Kip-R | 53.6 |

Effect of N32 on herbicide efficacy on *Vulpia myuros*

N32 is a liquid fertiliser containing 7.9% nitrogen as N-ammonium, 7.9% as N-nitrate and 15.9% as N-amide. The effect of applying Boxer (800 g/L prosulfocarb), Broadway (68.3 g/kg pyroxsulam + 22.8 g/kg florasulam) and Glyphomax (360 g/L glyphosate) in mixture with N32 was examined in a pot experiment using *Vulpia myuros* as test plant. The plants were grown outdoors.

Boxer was applied at the 3-4 leaf stage while Broadway and Glyphomax were applied at two growth stages - the 3-4 leaf stage and when plants had 6 leaves and 2 tillers. Each herbicide was applied at 5 doses. Boxer was applied alone and in mixture with N32 (30 L/ha). Glyphomax was applied in mixture with N32 (30 or 60 L/ha) and ammonium sulphate (AMS) + Contact (2 kg/ha + 0.1%). Broadway was applied in mixture with the recommended adjuvant PG26N (0.5 L/ha) and PG26N + N32 (0.5 L/ha + 30 L/ha).

The plants were harvested 4 weeks after treatment. Fresh and dry weight was recorded. A dose-response model was fitted to the data and ED₅₀ doses were estimated.

Table 2. Influence of N32 on the activity of Boxer (800 g/L prosulfocarb), Broadway (68.3 g/kg pyrox-sulam + 22.8 g/kg florasulam) and Glyphomax (360 g/L glyphosate) on *Vulpia myuros*. ED₅₀ is the dose required for reducing fresh weight of *V. myuros* by 50%.

| Herbicide | Growth stage | Adjuvant | ED ₅₀ (g a.i./ha) |
|----------------------------|--------------|------------------------------|------------------------------|
| Boxer | 3-4 leaves | None | 354 |
| | | 30 L/ha N32 | 515 |
| Broadway | 3-4 leaves | 0.5 L/ha PG26N | 11.9 |
| | | 0.5 L/ha PG26N + 30 L/ha N32 | 7.0 |
| | 2 tillers | 0.5 L/ha PG26N | 19.9 |
| | | 0.5 L/ha PG26N + 30 L/ha N32 | 11.1 |
| Glyphomax | 3-4 leaves | None | 65 |
| | | 30 L/ha N32 | 47 |
| | | 60 L/ha N32 | 34 |
| | | 2 kg/ha AMS + 0.1% Contact | < 30 |
| | 2 tillers | None | < 30 |
| 30 L/ha N32 | | < 30 | |
| 60 L/ha N32 | | < 30 | |
| 2 kg/ha AMS + 0.1% Contact | | < 30 | |

N32 had no effect on the activity of Boxer but improved the efficacy of Broadway and Glyphomax (Table 2). For Broadway + PG26N the ED₅₀ dose was reduced by 40% when N32 was added to the spray solution. The efficacy of Broadway was higher at the 3-4 leaf stage compared with the tillering stage. At the 3-4 leaf stage of *V. myuros* the effect of Glyphomax was significantly increased in mixture with N32. However, the efficacy in mixture with AMS + Contact was similar to the efficacy in the tank mix with 60 L/ha N32. Generally the efficacy of Glyphomax was higher at the tillering stage compared with the 3-4 leaf stage. The high efficacy in the mixture with N32 and AMS + Contact is suggested to be caused by a higher retention of spray liquid on the waxy leaves of *V. myuros* and/or increased uptake. *Vulpia myuros* is difficult to control and the possibility to improve the efficacy on this species is interesting. Additional trials are planned to examine crop selectivity of tank mixtures of herbicides and N32 and to study the effect on other weed species.



Field treated with 0.2 L/ha Cossack (10 g/L mesosulfuron + 2 g/L iodosulfuron) + 80 g/ha Broadway (68.3 g/kg pyrox-sulam + 22.8 g/kg florasulam) around 1 April. Two weeks later the field border was treated with 50 g/ha Broadway + 100 L/ha N32. (Photo: Lars Albrecht Karr).

References

Green, J. M. and W. R. Cahill (2003). Enhancing the Biological Activity of Nicosulfuron with pH Adjusters. *Weed Technology* 17: 338-345.