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SPOT-TREATMENTS FOR YELLOW NUTSEDGE (*CYPERUS ESCULENTUS*) CONTROL

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ABSTRACT

Succesful eradication of Yellow nutsedge (*Cyperus esculentus L*) relies heavily on spot-treatments with herbicides of remaining light infestations after initial intensive whole field treatments. We investigated possibilities of tank-mixing the soil-residual herbicides benfuresate, metolachlor or metazachlor with either glyphosate or bentazon. Four experiments are described and we conclude that spot-treatments with glyphosate only fit best in eradication systems for yellow nutsedge.

INTRODUCTION

Yellow nutsedge (*Cyperus esculentus*) is a weed throughout the world from the sub-tropics to temperate climates, and has great agricultural importance (BENDIXEN & NANDIHALLI, 1987).
In North-Western Europe the weed did not occur until the mid-seventies. From that time onward it invaded the Netherlands, where, in 1981, it was found to be locally well established after introduction via gladiolus cormlets from the USA (NABER & ROTTEVEEL, 1986a). In the Netherlands the weed was soon recognised as a very aggressive invader, worth an eradication campaign, taking into consideration the initially small infested acreage (NABER & ROTTEVEEL, 1986b).

In eradication programmes for annual weeds prevention of seed formation is the most important factor. This leads to an exponential decline of the number of plants. Stimulating germination of the seeds in the soil by repeated soil cultivations within one season gives an even quicker decline (ROBERTS, 1983).

Prevention of tuber formation is of primary importance in any eradication campaign of the perennial yellow nutsedge. Propagation through seed does not seem to occur in the Netherlands and the plant itself and its rhizomes do not survive winter. The population dynamics of the weed has been studied by several workers (CLOUTIER *et al.*, 1988; VAN GROENENDAEL & H-ABEKOTTE, 1988). Their models show that even very few surviving tubers may rebuild a population very quickly under favorable circumstances, due to the high propagation capacity of the species (SCHIPPERS & TER BORG 1993)

Prevention of tuber formation is possible by regularly killing all primary sprouts (-THULLEN & KEELEY, 1975). Glyphosate was shown to be an effective leaf applied herbicide on *C. esculentus* (PERREIRA *et al.* 1987). However, after chemical treatment sprouting from tubers occurs and therefore more foliar treatments are needed within one season. The time newly emerged plants need until the first tubers are produced, depends on such factors as temperature and daylength, but a period shorter than 3 weeks has not been observed in the Netherlands.

In this paper we present results of four short-term field experiments in which we investigated the retarding effect of soil residual herbicides in combination with leaf herbicides on resprouting of Yellow nutsedge. These experiments simulated the control of patches of remaining yellow nutsedge plants in an eradication program. We reported related eradication studies, under cropped and uncropped conditions, earlier (ROTTEVEEL & NABER, 1993a and 1993b).

MATERIALS AND METHODS

From 1987-1990 four field experiments simulating spot-treatments of yellow nutsedge were carried out in silage-maize. The goal of these experiments was to find a system of chemical control preventing tuber formation of yellow nutsedge completely and which requires as few treatments as possible. Glyphosate is a herbicide against *C.esculentus* with a high efficacy, but since it has no soil activity it must be applied repeatedly on regrowth before any new tubers are formed. Therefore we studied the addition of the soil-acting herbicides benfuresate, metolachlor and metazachlor to the first glyphosate treatment in the expectation that fewer re-treatments with glyphosate only would be needed.

Since the treatments were intended as spot-treatments in which crop-damage or residual damage on the next crop was considered to be non-important, all herbicides were applied at rates higher than normal. The treatments examined are given in Table 1.

The experiments consisted of a randomised block design with a plot size of 4 m² and 5 replications. Between the plots a bufferzone of 1m wide was kept weedfree. Sprayings were carried out over whole plots with an AZO propane sprayer at 2.5 bar and 400 l/ha water. Other weeds than nutsedge were controlled by atrazine + mineral oil.

In all experiments the first treatment was carried out as soon as the nutsedge plants started to produce rhizomes. This moment is situated in the Netherlands around the longest day. We re-treated with glyphosate when the above mentioned growth stage was reached again in newly emerged plants.

Before every spray the number of nutsedge plants present on the plots was counted. After the last treatment of the season, when regrowth could be seen, shoot numbers were counted also. The final observation was carried out in the following year in June at the time of full primary shoot emergence.

Table 1 Chemical treatments used in different years. Sequential application of 2.88 kg/ha glyphosate were applied when necessary

Dosage in kg/ha a.i.	1987	1988	1989
A. 2.88 kg glyphosate	x	x	x
B. 2 kg benfuresate + 2,88 kg bentazon/oil	x	x	x
C. 2 kg benfuresate + 2.88 kg glyphosate	x	x	x
D. 4.32 kg metolachlor + 2.88 kg glyphosate	x	-	-
E 3 kg metazachlor + 2.88 kg glyphosate	x	-	-
F. 4,32 kg metolachlor + 2,88 kg bentazon/oil	-	x	x
G. 3 kg metazachlor + 2,88 kg bentazon/oil	-	x	x

oil= mineral oil, 6 l/ha.

The data of the experiments were statistically analysed with the computerprogram SPSS/PC+. From all experiments together the percentages of decline were screened in the non-parametric Test of Friedman.

All experiments were located on rather shallow sandy soils with a comparatively low (2-3%) organic matter content and a very high nutrient status due to years of very high gifts of manure. This is typical for the region, Noord-Brabant which has a large surplus of manure. All fields had a cropping history of practically continuous silage maize growing.

RESULTS

Within the individual experiments the initial number of shoots per plot was not significantly different between the treatments. (P = 0.788, 0.500, 0.473 and 0.257 respectively for Exp.1, 2, 3, and 4. In Table 2 the results are given for all experiments, one year after the first treatment, as percentages reduction in shoot numbers compared to the initial shoot density.

In experiment 1 there was a significant difference in efficacy between the herbicide treatments (P < 0.005). The reduction was highest (93%) in treatment C (benfuresate/glyphosate).

In experiment 2 (P=0.201), experiment 3 (P=0.200) and experiment 4 (P=0.217) there was no significant difference in efficacy between herbicide treatments. In experiment 2 the reduction of shoot numbers was highest (82%) in treatment B (benfuresate/bentazon/oil); in experiments 3 and 4 it was highest in treatment C (99 and 81% repectively).

To evaluate the results obtained from all the experiments together the treatments B and C (both benfuresate) were joined, and compared to D and F (both metolachlor) and to E and G (both metazachlor). The reduction of the number of yellow nutsedge shoots was significantly higher with benfuresate.

Table 2 Percentage of yellow nutsedge reduction in the year following treatment, compared with the initial shoot density

	exp1	exp2	exp3	exp4
A. glyphosate	48	36	99	81
B. benfuresate/bentazon/oil	88	82	96	53
C. benfuresate/glyphosate	93	67	99	81
D. metolachlor/glyphosate	88	-	-	-
E. metazachlor/glyphosate	69	-	-	-
F. metolachlor/bentazon/oil	-	67	87	79
G. metazachlor/bentazon/oil.	-	26	95	77

initial density of yellow nutsedge (shoots/m2)
1*exp. 1987-88, Hulten 17 (13-20)
2*exp. 1988-89, Hulten 11 (8-17)
3*exp. 1988-89, Sambeek 1220 (602-1660)
4*exp. 1989-90, Sambeek 94 (63-133)

The number of retreatments with glyphosate on regrowth was different from one experiment to another, and dependent on the density of yellow nutsedge plants and weather conditions. As a rough average it was experienced that glyphosate-only needed 3 additional sequence applications; metolachlor and metazachlor combinations needed 2 additional glyphosate sprays.

Benfuresate combinations needed on average one additional glyphosate spray during the season.

TER BORG *et al.*(1988) examined the *C.esculentus* varieties in these experiments and found var. *leptostachys* in Sambeek and var. *macrostachys* in Hulten. possible differences in susceptability to herbicides between these two varieties are unknown.

DISCUSSION

These experiments simulated spot-treatments for the control of individual plants, or small patches yellow nutsedge in a crop. Spot-treatments are meant to control such patches, eg. of last plants in an eradication program, or the first plants in case of new infestations. Sprays have to be repeated because sprouting occurs irregular as long as the season lasts or till the tubers are exhausted. Killing the primary shoots before ramification occurs prevents formation of new tubers. Primary shoots still appearing next spring are originating from the tuberbank, and were dormant, or not killed, the year before.

The accurate determination of tuber populations in the soil is always difficult (RANADE and BURNS, 1925) and, in case of very low numbers as in most of these experiments, practically impossible. Therefore the observations are based on shoot-counts which leaves the possibility open that the numbers of primary shoots do not reflect the size of the tuberbank. The amount of dormant tubers is not known, nor possible fluctuations in dormancy between years, which may have influenced our results.

The results show high reductions in shoot numbers, but comparatively small differences between treatments. Moreover, though the benfuresate treatments certainly show the best results, both in terms of efficacy and in terms of the number of treatments needed, we think that the practical applicability of these results is very limited. In spot-treatment-based eradication efforts one has to inspect and treat regrowth before ramification of the primary shoots starts. Inspection of the field takes far more time than the actual treatment. As long as it is not absolutely certain that soil acting herbicides prolong the effect of the first spray with a guaranteed period, the inspection remains necessary and little, if anything, is won. Glyphosate alone is therefore as suitable to this task as any of the combinations studied.

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