

CONTROL OF NUT GRASS (*CYPERUS ROTUNDUS*) IN ASPARAGUS

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ABSTRACT

Several herbicides were tested for selective control of nut grass in asparagus (*Asparagus officinalis*) over two growing seasons. The soil residual herbicides terbutylazine, terbumeton, hexazinone, diuron or their mixtures had little effect against nut grass when applied pre-emergence. EPTC delayed emergence of nut grass for up to 8 weeks, with no suppressive effect after that. Norflurazon caused considerable phytotoxic damage on the leaves but gave only a small reduction in plant numbers. Bromacil reduced plant numbers and tuber production to low levels. The addition of glyphosate or imazapyr at the end of the asparagus harvest season improved control of nut grass compared with bromacil pre-emergence used alone. Not all herbicides tested are registered on asparagus.

Keywords: asparagus, chemical control, *Cyperus rotundus*, nut grass, nutsedge

INTRODUCTION

Described by Holm *et al.* (1977) as the world's worst weed, nut grass (*Cyperus rotundus*) has not had a big impact on cropping in New Zealand until recently. This weed is a sedge, native to India, and is often known by names of nutsedge or purple nutsedge. The plant has dark green leaves and a triangular stem that carries the terminal loose umbel inflorescence which is reddish to purple brown in colour. The fibrous root system with its extensively branching slender rhizomes gives rise to the important characteristic feature of the plant viz. the many tubers that develop at 5 - 25 cm intervals along the rhizomes. The tubers are usually found in the top 15 cm of the soil profile but can be as deep as 40 cm. Seed production can occur but is thought to be very rarely responsible for the spread of the weed.

Nut grass was first recorded in New Zealand by Cheeseman in 1883 and is now distributed throughout most of the North Island from Northland to Wellington and also Nelson and Motueka (Healy and Edgar 1980). Hilgendorf (1948) described some early North Auckland orchards as being ruined by this weed. In recent years nut grass has spread into the arable lands of the Bay of Plenty, particularly affecting maize crops, and in some asparagus crops in the Hawkes Bay and Waikato. The spread is associated with the movement of tubers and appears to have been abetted by the use of contract growing of field crops with large machines travelling from site to site. Nut grass is capable of vigorous competition in all crops resulting in large losses of yield (Holm *et al.* 1977). Nut grass has demonstrated allelopathic properties in some trials, but these have not been widely observed in the field (Parsons and Cuthbertson 1992).

Residual herbicides such as bromacil, EPTC and norflurazon are known to provide some control of nut grass (Parsons and Cuthbertson 1992; Sheinbaum 1985). New Zealand is one of the few asparagus production areas world wide using bromacil as a selective herbicide (Rahman and Sanders 1983). Several other selective and non-selective herbicides have been used overseas with varying success for control of nut grass (Hawton *et al.* 1992; Paxman *et al.* 1985; Siriwardana and Nishimoto 1987). This paper describes our results with some promising herbicide treatments for control of nut grass in asparagus over the last two growing seasons

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MATERIALS AND METHODS

The trial site was in a 10 year old block of asparagus cv. UC157 located near Matamata. A severe infestation of nut grass had developed over the entire block, possibly originating from an earlier infested maize crop. Winter cultivation to bury asparagus fern trash and for general weed control (and inadvertent spread of nut grass) had been done each year for the life of the crop except for the winter of 1994. Thus soil disturbance which may have affected weeds and tuber distribution within the soil profile, did not take place during the trial period.

Selective herbicides available for use in asparagus were reviewed and, from this list, potential treatments were selected for comparison with standard residual herbicides (Table 1) viz. bromacil (Hyvar), bromacil + diuron (Krovar 1), terbuthylazine + terbumeton (Caragard) and terbuthylazine + diuron (Fenican). Additional treatments were EPTC, (Eradicane Super), hexazinone (Velpar), imazapyr (Arsenal), glyphosate (Roundup) and norflurazon (Solicam). Treatments were applied either as crop pre-emergence only (first week of September 1993 and 1994) or as a close up treatment (end of asparagus harvesting and beginning of fern stage) in December 1993 and 1994. All treatments applied at close up had a pre-emergence application of bromacil at 1.6 kg/ha for general weed control at the start of each harvesting season.

Herbicides were applied with a precision plot sprayer in 300 litres/ha water at a pressure of 215 kPa. Plot size was 6 x 6 m and there were four replicates in a randomised block design. Regular assessments were made of phytotoxic damage to nut grass shoots, ground cover and initiation of flowering. Plant density of plots was determined by plant counts in 0.1 m² quadrats at two randomly selected sites. At the end of the season, fern stems were counted (three rows of 2 m each) to assess treatment effects on the asparagus. After the nut grass foliage had died back and the ferns were mulched, two soil samples were collected (31.5.94) from each plot to a depth of 300 mm using a 75 mm diameter corer. The numbers and dry weight of tubers were measured from the washed samples.

Other competitive weeds present in the trial area were controlled with herbicides known to have no significant effect on either nut grass or asparagus.

RESULTS AND DISCUSSION

The terbuthylazine/diuron mixture showed little or no effect on the growth of nut grass (Table 1), and is used in this trial for comparative purposes as the treatment that provided the least control.

TABLE 1: Number of nut grass plants/m² counted at various times in the two growing seasons of the trial.

Treatment (Pre-E)	Rate (kg ai/ha)	First growing season			Second growing season		
		30.11.93	12.1.94	5.4.94	17.11.94	13.1.95	14.3.95
terbuthylazine/ diuron	2.6/2.6	550	2000	1241	1649	1013	1994
norflurazon	4.0	283	1625	916	804	796	1163
EPTC	6.0	72	1500	968	869	305	465
bromacil/diuron	2.4/2.4	370	538	603	320	351	389
bromacil	1.6	222	243	343	235	388	581
bromacil	4.0	237	328	364	134	85	104
bromacil/ glyphosate ^a	1.6/2.16	267	105	244	138	93	108
bromacil/imazapyr ^a	1.6/0.25	277	48	143	119	131	15
imazapyr	0.6	32	58	94	114	368	734
SED		122	179	150	200	113	152

^a Treatment applied at close up (December).

Hexazinone, the low rate of norflurazon (2 kg/ha) and the mixture of terbuthylazine plus terbuteton also had little effect on nut grass and are not tabulated. Norflurazon, which has provided satisfactory control of yellow nutsedge (*C. esculentus*) in asparagus in USA (Agamalian 1995), gave only a minor reduction in the growth of nut grass resulting in plant numbers of about 50% of the terbuthylazine/diuron mixture (Table 1) and ground cover approaching 100% towards the end of both growing seasons (Table 2). Norflurazon in mixture with a low rate of glyphosate (1.44 kg/ha) applied at close up (not tabulated) also did not provide long term control. EPTC restricted plant establishment until the beginning of November, but its effects disappeared afterwards, resulting in complete ground cover by the end of the season (Table 2). Poor weed control by the EPTC treatment combined with its poor activity against nut grass resulted in a serious weed problem and high numbers of nut grass. Application of EPTC at close up was also evaluated (not tabulated). It resulted in a small reduction in plant numbers, ground cover and tuber numbers, but the mechanical process of incorporating the EPTC was impractical and also caused some crop damage.

TABLE 2: Ground cover (%) of nut grass at various times in the two growing seasons and the numbers and dry weight of tubers from soil samples.

Treatment (Pre-E)	Rate (kg ai/ha)	Nut grass ground cover (%)				Tuber (No./m ²) (g/m ²)	
		First season 23.12.93 5.4.94		Second season 12.12.94 14.3.95		31.5.94	31.5.94
terbuthylazine/ diuron	2.6/2.6	86	100	94	100	4980	1117
norflurazon	4.0	55	98	73	100	2490	550
EPTC	6.0	38	100	70	100	4103	877
bromacil/diuron	2.4/2.4	45	76	40	68	2688	515
bromacil	1.6	25	45	40	75	2066	429
bromacil	4.0	28	35	17	16	1839	306
bromacil/ glyphosate ^a	1.6/2.16	8	38	26	15	1302	218
bromacil/ imazapyr ^a	1.6/0.25	15	23	25	1	1669	342
imazapyr	0.6	2	8	15	96	2094	447
SED		10	15	10	11	930	195

^a Treatment applied at close up (December).

Imazapyr applied pre-emergence reduced nut grass plant numbers and ground cover in the first season to about 10% of that recorded in the terbuthylazine/diuron treatment, but tuber numbers at the end of the season were still relatively high (Table 2). Efficacy of this treatment was much lower in the second season as shown by plant numbers (Table 1) and ground cover (Table 2) data recorded on 14.3.95. However, use of imazapyr at close up over bromacil treatment applied pre-emergence was very effective in reducing the plant density and ground cover of nut grass. It must be mentioned here that imazapyr is not registered for use in any food crop as yet and is known to kill asparagus plants on contact with the foliage.

Bromacil as a pre-emergence treatment showed a good level of suppressive activity against nut grass during the season, reducing plant numbers to less than half that of the terbuthylazine/diuron mixture. The highest rate of 4.0 kg/ha provided the best results overall. Control of nut grass by bromacil was augmented with the post emergence use of glyphosate at close up. A single application of glyphosate at 2.16 kg/ha applied in December was better than split applications at 1.44 kg/ha applied in November and again in December (not tabulated). However a few new plants continued to emerge after each application. The treatments that provided good control

of nut grass were even more effective in the second season after the repeat treatment application. Number and dry weight of tubers in winter were strongly correlated ($R=0.92$) between the two parameters. There was also a high correlation of tuber weights with plant numbers counted on 17.11.94 ($R=0.72$) and with the nut grass ground cover assessment made on 12.12.94 ($R=0.72$).

The time at which nut grass flowering starts is indicative of the stress the plants are under. Flowering had not started by 12.1.94 in plots treated with imazapyr or in 31 of the 32 plots which received pre-emergence treatment of bromacil. In the second season also, flowering was delayed by the highest rate of bromacil (4.0 kg/ha) and the two treatments in which glyphosate had been applied post-emergence. Leaf damage varied over the season with plant density, age and cold weather. There were effects following application of treatments which were usually short lived until new plants established. Only the norflurazon treatments caused damage in the form of yellowing of the leaves which lasted for the season, although it did not seriously affect the growth of nut grass (Table 3).

TABLE 3: Percentage of nut grass leaf damage at various times and the numbers of asparagus fern stems counted/10 m of row length.

Treatment (Pre-E)	Rate (kg ai/ha)	Nut grass damage (%)				Ferns (No./10 m)	
		First season		Second season		30.5.94 3.5.95	
		30.11.93	12.1.94	12.12.94	13.1.95	30.5.94	3.5.95
terbuthylazine/ diuron	2.6/2.6	1	0	25	53	112	153
norflurazon	4.0	65	18	78	63	144	166
EPTC	6.0	1	0	35	89	99	119
bromacil/diuron	2.4/2.4	23	0	55	16	163	209
bromacil	1.6	30	0	26	8	163	164
bromacil	4.0	46	10	75	18	170	245
bromacil/ glyphosate ^a	1.6/2.16	26	0	31	65	190	164
bromacil/ imazapyr ^a	1.6/0.25	28	23	23	79	171	177
imazapyr	0.6	5	4	23	0	208	181
SED		7	11	10	9	29	32

^a Treatment applied at close up (December).

Fern stem counts were made near the end of each season to check the effects of treatments on the asparagus crop (Table 3). The combination of poor control of nut grass and poor overall weed control by EPTC affected the crop to give the lowest fern counts. High fern numbers on 30.5.94 were recorded in treatments that had good weed control, eg. the two high rates of bromacil which were quite effective on nut grass. Fern numbers (30.5.94) were highly negatively correlated with the nut grass ground cover ($R = -0.67$) and plant numbers ($R = -0.61$) (5.4.94).

Results from this study show good activity on nut grass by some of the herbicides registered for use in asparagus in New Zealand. The combination of bromacil applied pre-emergence followed by glyphosate at close up provided a satisfactory control of nut grass using products with which growers are familiar. With commitment and a fastidious follow up programme of spot spraying, it may be possible to reduce the weed infestation to low levels. Eradication of nut grass in asparagus will depend on how deep the tubers are present in the soil, their longevity and dormancy characteristics.

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