

TOLERANCE OF ASPARAGUS TO BROMACIL — RESULTS AFTER FIVE YEARS

A. RAHMAN, P. SANDERS and J.E. WALLER

Ruakura Soil and Plant Research Station, MAF, Private Bag, Hamilton

SUMMARY

A long term project to study the effects of repeated annual applications of bromacil to asparagus (*Asparagus officinalis* cv NZ Beacon) was established with transplanted crowns on a Horotiu sandy loam soil in 1981. Rates between 1.2 and 3.2 kg ai/ha applied over the last 5 years have not had any detrimental effect so far on fern production, number of stems or spears, or the gross or marketable yield of spears. Limited observation on crowns and roots from plots treated with 2.8 and 3.2 kg ai/ha have indicated some possible reduction in their growth and development in the fifth year. The work is continuing.

INTRODUCTION

The herbicide bromacil has provided very good broad spectrum weed control in asparagus crops in many trials around New Zealand (Franklin *et al* 1980; Rahman and Sanders 1983; Stevenson 1979). It is widely used by growers in the Waikato at the start of the harvest season or at the close-up of the crop. There appears to be no record in the literature of the use of this herbicide in asparagus in any other part of the world, except Australia (Birkenhead and Morgan 1981). A related material, terbacil, is more widely used in this crop (Mullen 1977; Welker and Brogdon 1972).

Premature decline of asparagus production has affected some areas of commercial production in New Zealand. This decline has been attributed by most observers (eg. Moon 1977) primarily to varying degrees of crown and root rot caused by *Fusarium* spp. It has been suggested, however, that residual herbicides, such as bromacil, applied to the crop may also be involved. Short term tolerance of asparagus to bromacil is good (Rahman *et al* 1981; Rahman and Sanders 1983), but because of the persistence and relative mobility of this herbicide, there is a distinct possibility that repeated applications may cause injury to the crop, particularly on the light soil types of the Waikato region.

The objectives of the long term trial reported here are to study the effects of repeated annual applications of bromacil, at various rates, on the growth and production of asparagus. Any indirect ill effects are also being investigated by determining the incidence of disease which may be aggravated by chemical stress.

MATERIALS AND METHODS

Asparagus cv. New Zealand Beacon crowns were transplanted in rows 1.5 m apart into a Horotiu sandy loam soil (8.8% organic C) near Hamilton in September, 1981. Pre-emergence applications of bromacil (Hyvar X) at rates of 0, 1.2, 1.6, 1.8, 2.0, 2.2, 2.4, 2.8 and 3.2 kg ai/ha were applied 7 days later in 350 litres/ha water at 200 kPa. Each plot consisted of a single row 20 m in length and treatments were arranged in a systematic design with four replications. The use of this design eliminated the need for guard rows (except on either side of the untreated rows) as the extensive root system of asparagus could only grow into slightly lower or higher rates in the two adjacent plots.

During the growing season weeds in the untreated control plots, and where necessary in the treated plots, were controlled by hand weeding and/or spot spraying with glyphosate. This was to ensure that any effects measured could be attributed only to the bromacil treatment. At least two applications of captafol (Difolatan) were made during the fern stage each year to minimise the ingress and effects of *Stemphylium*. No

Proc. 39th N.Z. Weed and Pest Control Conf.

spears were harvested during the first two seasons while the crop was establishing but the number of stems in each plot was counted.

Asparagus ferns were cut at ground level and weighed at the end of each growing season (May/June). The ferns were removed from the trial area to minimise the level of *Stemphylium* inoculum. Winter cultivation was carried out each year to break down the mounds over the crown, to control any weeds and to mix in the fertilisers. The mounds over the asparagus crowns were rebuilt at the beginning of each growing season and this was followed by reapplication of the same bromacil treatments.

The harvesting of spears began in the third growing season and lasted for 38, 82 and 79 days in 1983, 84 and 85 respectively. All spears 180 mm or more in length were harvested from each plot at ground level every Monday, Wednesday and Friday. These were counted, weighed and trimmed to 180 mm length and reweighed.

Investigatory samplings of crown and root materials were made from several plots in the winters of 1984 and 1985. Soil samples 1 m x 1 m x 0.5 m deep were dug to extract three crowns with as many roots intact as possible and the soil was sieved to retrieve most of the fine rooting material. After washing the plant material, the number of new buds, empty shoot sockets and the roots originating from each crown were counted before dissection of the crowns to check for disease and determination of dry weight. Lengths of all live roots (>1 mm diameter) and dead (flaccid) roots were also measured before oven-drying them and recording weights.

RESULTS AND DISCUSSION

The stem counts made three times during the establishment phase of the crop (1981-83) and the number of spears harvested in the next three growing seasons are presented in Table 1. The only significant difference was recorded in the second count taken at the end of the first season which showed fewer stems in the hand weeded controls compared to all the bromacil treatments. This was attributed to some damage by hand weeding to spears just below ground level in the initial establishment stage. None of the rates of bromacil used in the trial had any detrimental effect on the total number of spears harvested in the first three harvesting seasons.

TABLE 1: Effect of bromacil treatments on asparagus stem and spear numbers ('000/ha).

bromacil (kg ai/ha)	Stem numbers			No. of spears harvested		
	9.11.81	15.2.82	9.3.83	1983	1984	1985
0	23.0	94.8	72.6	64.8	133.7	171.9
1.2	22.8	109.7	70.5	64.8	133.7	174.5
1.6	23.2	116.3	80.8	64.3	137.1	166.8
1.8	23.4	117.6	78.9	66.9	133.8	174.6
2.0	23.5	118.2	74.9	60.3	127.2	189.8
2.2	23.5	117.0	72.3	61.6	127.0	177.7
2.4	23.5	110.0	72.4	59.0	123.5	159.9
2.8	23.3	110.8	76.5	60.2	125.2	185.1
3.2	22.5	108.7	70.7	61.2	126.4	180.0
SEM	0.7	3.7	3.8	3.3	0.6	1.2
CV%	5.8	6.6	10.1	10.5	8.9	13.2

The weights of asparagus ferns measured at the end of each growing season are presented in Table 2. There was a trend for slightly higher fern yields at the middle rates of bromacil in each year. Reasons for this pattern are not clear. The gross yield of spears showed no significant differences between treatments in any of the three harvesting seasons. The marketable yield of spears (trimmed to 180 mm length) and the average weight of individual spears (not tabulated) also showed no significant differences between treatments. Thus, as for the stem counts, none of the rates of bromacil used have so far affected the fern production or the gross or marketable yield of spears in this trial.

TABLE 2: Effect of bromacil treatments on asparagus fern weights and gross spear yields.

bromacil (kg ai/ha)	Fern weight (t/ha)				Spear yield (t/ha)		
	1982	1983	1984	1985	1983	1984	1985
0	1.62	3.34	5.33	3.63	2.50	4.94	4.90
1.2	2.24	4.20	6.12	3.87	2.53	4.56	5.19
1.6	2.39	4.33	6.64	4.40	2.55	5.28	5.03
1.8	2.33	4.10	6.17	3.87	2.53	4.69	5.15
2.0	2.43	4.27	6.80	4.67	2.37	4.69	5.30
2.2	1.99	3.73	5.82	4.33	2.36	4.44	5.21
2.4	2.30	4.03	6.17	4.73	2.41	4.76	4.74
2.8	2.18	4.13	6.03	4.50	2.33	4.59	5.24
3.2	1.97	3.87	6.07	4.13	2.40	4.66	5.62
SEM	0.16	0.27	0.35	0.16	0.15	0.24	0.37
CV%	15.0	14.3	11.5	7.5	12.6	10.2	14.4

Measurements of crown and root materials have provided some interesting information but due to the limited number of samples these cannot be statistically analysed. Data from some of the plots treated with the two highest rates of bromacil and the untreated control were obtained in the fourth and fifth year of the crop. Crowns from plots treated with 2.8 and 3.2 kg ai/ha bromacil are not showing signs of disease, but they appear to have slightly lower number and length of roots, more dead roots, fewer shoot sockets and new buds, and weigh less than the crowns removed from the hand weeded plots (Table 3). Although these data are from a limited number of samples, they may indicate the beginnings of a decline in the asparagus in these plots.

TABLE 3: Effect of bromacil treatments on asparagus crowns and roots (all data/0.5 m³ sample; based on limited number of samples).

Year	bromacil (kg ai/ha)	Number			Length		Root DM (kg)	Crown DM (g)
		live* roots	dead* roots	new shoots	live roots (m)	dead roots (m)		
1984	0	790	0	138	553	7	2.0	159
	3.2	766	0	133	463	10	1.5	140
1985	0	1093	50	242	542	30	2.4	194
	2.8	684	85	170	401	52	1.5	137
	3.2	607	134	141	487	66	2.3	136

* Roots originating from crowns

Weed control in this trial has been commercially acceptable with very few weeds establishing in any of the chemical treatments during the growing season. The untreated control plots have required hand weeding once a month until January, when fern canopy completely covered the plots.

The results reported here show that asparagus has good crop tolerance to the recommended rate of bromacil (1.6 kg ai/ha) applied annually for the five growing seasons tested so far. Although annual applications of twice the recommended rate have not affected the crop growth and production yet, limited observations in the fifth year show some possible detrimental effects on the crown and root development. Further repeat applications are to continue.

ACKNOWLEDGEMENTS

Thanks are due to J. Mortimer for technical assistance.

REFERENCES

- Birkenhead, W. and Morgan, A.S., 1981. Asparagus — Weed control. *Agdex 266/640*, Agnote, Dept. of Agriculture, Govt. of Victoria, Melbourne.
- Franklin, S.J., Bussell, W.T., Cox, T.I. and Tate, K.G., 1980. Asparagus — establishment and management. *Aglink HPP 125*, Information Services, M.A.F., Wellington.
- Moon, D.M., 1977. Asparagus production and its problems. *N.Z. Commercial Grower* 32: 22.
- Mullen, B., 1977. Weed control in asparagus. *Proc. California Weed Conference* 29: 104-108.
- Rahman, A. and Sanders, P., 1983. Residual herbicides for weed control in established asparagus. *Proc. 36th N.Z. Weed and Pest Control Conf.*: 136-139.
- Rahman, A., Thompson, A. and Sanders, P., 1981. Weed control in newly transplanted asparagus. *Proc. 34th N.Z. Weed and Pest Control Conf.*: 63-66.
- Stevenson, M.R., 1979. Asparagus: Weed control. *N.Z. Commercial Grower* 33: 21.
- Welker, W.V. and Brogdon, J.L., 1972. Effects of continued use of herbicides in asparagus plantings. *Weed Science* 20: 428-432.