STUDIES OF THE BIOLOGY AND CONTROL OF ITALIAN ARUM

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Summary

The growth of Italian arum (*Arum italicum*) is described and three classes of tubers distinguished. Herbicide trials have shown the plant to be highly resistant to bromacil and karbutilate each at 10 kg/ha and resistant to picloram 1.5 kg/ha plus 2,4-D 6 kg/ha. Repeat application of diquat 3 kg/ha, amitrole 4 kg/ha and asulam up to 10 kg/ha mainly affected actively growing tubers but glyphosate repeated at rates up to 4 kg/ha greatly reduced numbers of both active and dormant tubers.

INTRODUCTION

The Araceae family to which Italian arum (*Arum italicum*) belongs is widespread in tropical regions and comprises about 1,500 different species in upwards of one hundred genera. Many are cultivated as ornamentals and a few such as taro (*Colocasia antiquorum*) yield important food products from the underground parts. About a dozen species of arum including Italian arum are known in Eurasia, North Africa and around the Mediterranean (Bailey 1951). Introduced into New Zealand as an ornamental, Italian arum was first recorded as a garden escape by Mason *et al* (1950).

Apart from that by Gunning (1967) no trial work on Italian arum has been reported in the New Zealand literature. Gunning found the plant to be resistant to a fairly wide range of herbicides including 2,4-D, 2,3,6-TBA, 2,2-DPA, paraquat, diquat, dicamba and dichlobenil and considered only picloram to be worth further trial. In 1972 a project was initiated to study the biology of Italian arum and to investigate further herbicidal control. The results of this work are given in this paper.

BIOLOGY

Italian arum is a summer dormant perennial, the persistence of which in New Zealand is mainly dependant on its tuberous root stock. The mature root stock is a horizontally developing tuber with three or four segments produced in annual succession, i.e., the oldest part dies each summer and new growth is added to the apical end during the following winter growing period. This annual growth is only 1-3 cm so that mature tubers seldom exceed 6-8 cm in length and are usually considerably smaller. Tubers are defined as mature when they begin vegetative reproduction. Extensive vegetative reproduction occurs from the numerous buds on the surface of mature tubers which support up to 30 new tubers at various stages of development. These are successively released to separate existence as the rear section of the parent tuber dies each summer. Immature tubers separated from the parent are capable of survival and normal development from an early stage. Dormant buds on all parts of

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the mature tuber, but particularly the younger parts, can be activated at any time during the growing season to replace immature tubers which have been removed.

As soil temperatures decline in early autumn leaf shoots and feeding roots develop from the apical end of the tuber. The large hastate leaves from mature tubers have the characteristic glossy light and dark green variegated colouring of the arum family. Leaves from immature tubers and seedlings are much smaller, lanceolate and lack the variegated colouring of the mature foliage. A dense infestation of Italian arum can have 200 or more mature and several thousand immature tubers/m² distributed through the top 10-15 cm of soil. Most of the mature tubers make active growth during the winter but a high proportion of the immature ones remain dormant. Neither foliage nor roots are produced by immature tubers while they remain attached to the parent. In established infestations the dense canopy of mature foliage usually smothers leaf growth from immature tubers which then die. Although the rate of increase in tuber numbers is high, populations are kept reasonably stable by this suppression of immature growth and by losses of dormant tubers through disease attack. Vegetative spread is very slow as it is limited to the 1-3 cm of new growth made by tubers each winter.

Flowering is confined to mature tubers and in a dense infestation only a small proportion of these will flower. Flowering commences in early spring with the development of a stem up to 50 cm high topped by a spadix bearing minute crowded yellow flowers partly enclosed by a papery green spathe or sheath. The bright red berries which develop during the summer contain 3-5 hard seeds and each spadix can produce up to 500 seeds which germinate during the late autumn and winter. Growth of the seedlings is slow and they can establish only where competition is limited. As soon as flowering is initiated foliage from both mature and immature tubers begins to die and by late spring has entirely disappeared leaving only the berry topped flower stems to mark the plants' presence.

In common with most members of the Araceae the acrid juice of all parts of Italian arum contains an irritant poison which causes painful burning of sensitive tissues and if swallowed can result in death through convulsions and shock (Stewart 1971). However, the berries and tubers are readily eaten by domestic poultry, particularly turkeys, with no apparent harm.

HERBICIDE TRIALS — METHOD

Trials were conducted at Tamahere near Hamilton on a long established infestation of Italian arum growing in Horotiu sandy loam under a moderate canopy of deciduous robinia (*Robinia pseudoaccacia*). Each plot was a separate clump of plants 1-2 m in diameter. Herbicide treatments were applied in 1000 litres/ha and replicated four times.

In May, August and October 1972, when Italian arum was at the early vegetative, full vegetative and pre-dormancy stages of growth, respectively, single treatments of bromacil 10 kg/ha and karbutilate 10 kg/ha were made, as were single and repeat applications of picloram 1.5 kg/ha plus 2,4-D 6 kg/ha, diquat 3 kg/ha and amitrole 4 kg/ha. Single treatments of glyphosate 2 kg/ha and asulam 5 kg/ha were incorporated into the August and October treatments.

As glyphosate and asulam appeared the most promising materials in these initial trials they were used for further studies in which glyphosate 1, 2 and 4 kg/ha and asulam 2.5, 5 and 10 kg/ha were applied to early flowering stage Italian arum in October 1973. Treatments were repeated on surviving plants of the same clumps in October 1974.

Weed Biology

Results were assessed in all cases 12 months after treatment either by simple observation of foliage regrowth where treatment had been ineffective or by determining tuber survival on two 20 x 20 cm sample areas on each treated and control plot.

RESULTS

The soil sterilant herbicides bromacil and karbutilate were totally ineffective. Single applications of the picloram plus 2,4-D combination were also ineffective and repeat treatments relatively so, reducing mature tubers by about 50% with little effect on immature and dormant tubers. As single applications, diquat caused complete foliage desiccation but subsequent recovery was normal. Although repeated diquat treatment destroyed over 80% of mature tubers, immature and dormant numbers were not adequately reduced. The effects of amitrole application were fairly similar to those of diquat.

In the initial trials glyphosate appreciably reduced survival of mature and immature tubers, while asulam caused a total inhibition of regrowth throughout the winter after treatment, except for the appearance of some immature foliage. None of the herbicides showed significant seasonal differences in effect. Assessment of tuber survival in the more detailed trials with glyphosate and asulam are given in Table 1.

TABLE 1: PERCENT TUBER SURVIVAL AFTER SINGLE AND REPEAT HERBICIDE APPLICATIONS

<i>Treatment (kg/ha)</i> <i>Applications</i>	<i>Mature tubers</i>		<i>Immature tubers</i>		<i>Dormant tubers</i>	
	<i>Single</i>	<i>Repeat</i>	<i>Single</i>	<i>Repeat</i>	<i>Single</i>	<i>Repeat</i>
glyphosate 1.0	22	10	63	27	30	15
glyphosate 2.0	5	0	49	13	31	6
glyphosate 4.0	2	1	10	5	25	2
asulam 2.5	39	26	47	42	69	56
asulam 5.0	20	17	44	21	59	25
asulam 10.0	7	5	23	15	63	20
control	100	100	100	100	100	100
control: tubers/m ²	215		1100		2600	

Treatment dates: Initial application — 2.10.73; Repeat application — 4.10.74

Assessment dates: Initial application — 7.10.74; Repeat application — 6.10.75

Italian arum seedlings were noted to be establishing freely in the bare ground created around clumps by all treatments except picloram plus 2,4-D and the lowest rate of asulam.

DISCUSSION

As Gunning has noted, in terms of area occupied or rapidity of spread, Italian arum is not an important weed in New Zealand. Its problem status derives from the highly developed reproductive capacity of the tubers, the toxic nature of all parts of the plant and its relative immunity to a wide range of herbicides. Because mature tubers can increase numbers by a factor of about ten each year, a new clump rapidly develops a dense canopy of foliage which completely excludes competing growth. Although domestic stock, such as pigs and cattle, avoid

Italian arum if sufficient other food is available they may be poisoned if confined to clean up growth in areas infested with the plant. The vegetative spread of undisturbed clumps is very slow, amounting to only a few centimetres a year for individual tubers. The use of herbicides which are ineffective in controlling Italian arum and open the pasture sward may accelerate the spread of infestations by allowing seedlings to survive.

In pasture situations where the seedling is a poor competitor the chance of establishment is slight as the seed, although highly viable, is slow to germinate and does not produce a plant until autumn pasture recovery is well advanced. The proportion of Italian arum seed which survives passage through the digestive tract of domestic poultry or other birds is not known but the distribution of clumps suggests that these could be important vectors where plant competition is limited.

The great numbers of dormant tubers present in an established infestation are a powerful insurance of survival against most herbicides. Repeat applications of diquat and amitrole, and more especially asulam as indicated by Table 1, were able to destroy a high proportion of the mature and actively growing tubers, but penetration of these materials into dormant immature tubers was limited. Because of its greater capacity to translate into dormant tubers, glyphosate was appreciably superior to any other material tested. However, the difficulty of eradicating this persistent plant is indicated in Table 1, which shows that even after two annual applications of glyphosate at 4 kg\$ha, approximately two vegetatively reproducing mature tubers, plus 50 active and 50 dormant immature tubers remained in each square metre of the heavily infested trial clumps.

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