POLYMERIA - TRYING TO STOP IT TAKING ALL

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Summary

Polymeria take-all is a native Australian plant which is particularly troublesome throughout the Australian cotton industry because it is difficult to control. For example, shallow chipping once per month for four months increased the dry weight production of Polymeria take-all shoots but not cotton production. Again, single applications of glyphosate and Starane®, while decreasing the shoot growth of Polymeria take-all, did not increase cotton yields. In contrast, repeated severe defoliation performed under non-irrigated conditions reduced the growth of shoots and rhizomes of Polymeria take-all in an uncultivated area trial. These results have been used to help develop best management practices for Polymeria take-all control which will include prevention, herbicide application, cultivation and field hygiene.

Background

Polymeria longifolia (Polymeria take-all or Peak Downs curse) is a native Australian plant. It has long narrow grey/green leaves with pink/mauve, yellow-centred flowers. It forms a dense rhizomatous root system which is largely resistant to many chemical and cultivation treatments (McMillan 1988).

Polymeria take-all was ranked as the tenth worst weed in New South Wales cotton growing areas in the 1988/89 season (Charles 1991). It appeared to be increasing in abundance at this time. Control measures for Polymeria take-all were far from satisfactory and progress towards such measures had been slow due to a lack of research effort (McMillan 1988). This paper discusses why some of these control methods against Polymeria take-all have failed. This knowledge is then used to suggest best management practice for this weed in cotton farming systems. This paper follows from an earlier paper which examined the distribution, biology and the potential for control of Polymeria take-all (Johnson *et al.* 1998).

What we learnt when control measures failed

Case study 1. Shallow defoliation may stimulate weed growth - the case against chipping

An experiment was conducted to determine whether hand chipping had any impact on Polymeria take-all growth and cotton yields at two locations: these were Auscott, Moree and Twynum North - Central, Collarenebri during the 1996/97 season. Although a range of six hand chipping and pulling treatments were undertaken, only the results for the treatment chipped once per month for four months (the most intensive treatment) and the unchipped control have been presented (Table 1). Hand chipping was performed with a hoe to a depth of 5 - 10 cm. Each treatment plot was one metre x one metre and there were four adjacent blocks or replicates at each location. The trials were started in late October and continued until mid March (just prior to cotton defoliation).

There was no difference in Polymeria take-all density between the chipped and unchipped treatments at harvest (Table 1). In contrast, the total above-ground dry weight of Polymeria take-all was increased by chipping. Importantly, chipping did not increase the total dry weight of cotton plants or the seed cotton yield. Chipping actually stimulated the growth of Polymeria take-all allowing sufficient recovery of the weed from its dense underground rhizome system and maintenance of stem density. Shallow, minimally disruptive defoliation by hand chipping, or for that matter inter-row cultivation, will promote the growth of Polymeria take-all without resulting in a cotton yield advantage.

Table 1. A summary of the density and yield of Polymeria take-all and cotton shoots between two treatments, an unchipped control and a treatment chipped once/month for four months. The total dry weight of Polymeria take-all was the total above-ground material removed throughout the trial. Results were analysed using an analysis of variance and differences assessed using the 5% least significant difference (l.s.d.). Means within a parameter marked with the same letter are not different.

Location and growth parameter	Unchipped	Chipped
Auscott		
Polymeria take-all density/m^2	113.3^a	121.5^a
Total Polymeria take-all dry weight (g/m^2)	121.8^a	477.0^b
Total cotton plant dry weight (g/m^2)	427.8^a	518.1^a
Seed cotton yield (g/plant)	20.2^a	21.0^a
Twynum North - Central		
Polymeria take-all density/m^2	165.3^a	202.5^a
Total Polymeria take-all dry weight (g/m^2)	33.5^a	316.0^b
Total cotton plant dry weight (g/m^2)	644.7^a	346.2^a
Seed cotton yield (g/plant)	31.4^a	23.2^a

Case study 2. Herbicides may reduce weed growth but do little else - the case against single applications of herbicides

An experiment was used to determine the effect that single applications of glyphosate or Starane® (currently two of the better herbicide control options) had on Polymeria take-all infestations and cotton growth at Auscott, Moree. There were four treatments in this trial - 2.5 L/ha of each of Roundup CT Xtra®, Starane® and water (a cotton/Polymeria take-all control) and an unsprayed treatment located outside the patch area (a cotton only control) (Table 2). Each plot was sprayed with the equivalent of 200L/ha water.

The spray treatments were allocated to one metre x one metre plots in four replicate blocks spaced in a large Polymeria take-all patch. The conditions at spraying included high soil moisture (just trafficable after irrigation), a temperature range of 17 - 36°C and relative humidity of 16 - 39% at 10 cm above the soil surface (with plant shading and slightly overcast conditions). The plots were sprayed using a small shielded spray unit over the cotton row but which avoided damage to the cotton. Spraying occurred on 27 November 1998 (46 days after cotton planting) with the growth of Polymeria take-all and yield of cotton evaluated prior to defoliation on 24 March 1999.

Both glyphosate and Starane® reduced the shoot density and dry weight of Polymeria take-all by almost half, in contrast to the water control. There was no difference between the two herbicides on Polymeria take-all growth. Cotton growth was reduced by 48% (total dry weight) and 37% (seed cotton) by Polymeria take-all in plots sprayed with water compared with outside the patch. There was no increase in either cotton dry weight or seed cotton yield in the herbicide-treated plots compared with the water controls.

Table 2. The effects of glyphosate and Starane® on Polymeria take-all and cotton growth at harvest. Results were analysed using an analysis of variance and differences assessed using the 5% least significant difference (l.s.d.). Means within a parameter marked with the same letter are not different.

Growth parameter	Water control	Glyphosate[1]	Starane®[2]	Control - outside patch
Polymeria take-all shoot density/m^2	377.5[b]	236.5[a]	217.5[a]	-
Polymeria take-all shoot dry weight (g/m^2)	300.6[b]	162.4[a]	161.5[a]	-
Total cotton plant dry weight (g/m^2)	492.8[a]	599.5[a]	447.0[a]	947.9[b]
Total seed cotton yield (g/m^2)	185.6[a]	184.6[a]	171.9[a]	294.5[b]

1. As Roundup CT Xtra® (Monsanto, 450 g/L glyphosate active ingredient).

2. Starane® (Dow AgroSciences, 300 g/L fluroxypyr active ingredient).

While the shoot growth of Polymeria take-all was reduced by these two herbicides, it is highly likely that rhizome growth and subsequent competition below ground was not. Excavation of rhizomes revealed that herbicide translocation was limited to the top 10 cm of the soil profile and that reshooting from the next lowest undamaged node occurred. While the application of herbicides through shielded spray units in the cotton crop may be of limited usefulness in that a cotton yield advantage is not achieved in that single season, a reduction in the growth of Polymeria take-all may occur. It is postulated that repeated herbicide applications may further reduce weed growth, particularly under fallow conditions where patches can be treated more easily.

What we learnt when control was more successful

Severe cultivation and absence of irrigation reduce Polymeria take-all growth

Another experiment evaluated the effect of severe cultivation and irrigation on shoot and rhizome growth of Polymeria take-all in an uncultivated area at Auscott, Moree. The original experiment was a 2 x 2 x 2 factorial examining the application, or not, of cultivation, irrigation and nitrogen fertiliser. The eight treatments were allocated randomly to two metre x two metre areas separated from each other in four blocks. Because nitrogen fertiliser had no effect on Polymeria take-all growth, only cultivation and irrigation results are presented, the timing of which roughly coincided with operations in cultivated fields.

After the trial began in mid February 1998, the first two cultivation events in April and October (late due to wet weather) were performed with a mattock to a depth of 10 - 15 cm and the final two events (November, December) with a rotary hoe, which cultivated to the same depth. There were three irrigation events in which 100 litres of water in total were applied to each plot area before the trial was harvested in mid April 1999. Rhizome material was collected to a depth of 10 cm from approximately 2% of the plot surface area. In other work, this depth potentially represented around 18% of rhizomes and roots in the top metre of the soil profile. The trial period encompassed the wet winter of 1998 and the subsequent wet summer somewhat reduced the need for irrigation.

Cultivation greatly reduced shoot density and both the shoot and rhizome dry weight of Polymeria take-all at harvest (Table 3). The application of irrigation water increased shoot density and rhizome dry weight but not shoot dry weight (data not shown) in cultivated plots but it led to decreases in these parameters in uncultivated plots, particularly rhizome dry weight (Table 4).

It appears that the intensity of cultivation damage on Polymeria take-all may have been more severe than that experienced in the nearby cultivated fields, where inter-row cultivation achieves little more than a severing of the shoots from the rhizomes and possibly the severing of some rhizome connections. Rapid shoot recruitment is usually observed after such events, and similarly after hand chipping (Table 1). These results suggest that when

Table 3. The effect of cultivation only on the growth of Polymeria take-all. Results were analysed using an analysis of variance and differences assessed using the 1% least significant difference (l.s.d.). Means within a parameter marked with the same letter are not different.

Parameter	**Cultivation mean**	
	C+	**C-**
Total shoot density/m^2	180.19[a]	276.88[b]
Total shoot dry weight (g/m^2)	71.81[a]	109.14[b]
Rhizome dry weight (g/m^2)	119.36[a]	193.92[b]

Table 4. The interaction effects of irrigation and cultivation on the growth of Polymeria take-all.

Parameter		**Irrigation**		**Interaction**
	Cultivation	**I+**	**I-**	**between C and I**
Total shoot density/m^2	C+	224.50	135.88	
	C-	264.63	289.13	Yes
Rhizome dry weight (g/m^2)	C+	141.67	97.05	
	C-	158.33	229.51	Yes

disruptive cultivation is performed under non-irrigated conditions, or simply a dry year, Polymeria take-all growth may be reduced. Luxuriant growth of grassy weed species in uncultivated plots preferentially using irrigation water was the most probable reason why Polymeria take-all growth was reduced in these plots.

The results indicate that to reduce the growth of Polymeria take-all, severely disruptive cultivation is needed, possibly under non-irrigated conditions. The effect of water on Polymeria take-all was confounded by the wet trial period and growth of other weeds. By only cultivating patches in which the weed occurs, machinery costs and soil disruption should be minimised. In addition, the successful transplant of plant fragments either within or outside the patch would be lessened, particularly under dry conditions (Johnson *et al.* 1998). Other work suggests that if transplanting does occur, defoliation within three weeks will virtually eliminate all new plants. Furthermore, anecdotal evidence suggests that herbicide application preceding severe defoliation may further reduce the growth of Polymeria take-all. These suggestions require further investigation.

Best management practice

Prevention

Polymeria take-all is present in many of the plant communities which have been, and continue to be developed for cotton production. Identifying Polymeria take-all infestations prior to land development is important. Care can then be taken to isolate large existing patches and implement some form of control to prevent fragments being spread over a wide field area. If control attempts fail, these areas may be left out of production until a successful control measure can be found.

While this advice has limited value in areas where extensive land development has already occurred, it should be heeded in areas of expanding production particularly around St. George/Dirranbandi, Walgett, Richmond (Queensland) and in parts of northern Australia where Polymeria take-all is known to also occur.

Herbicides

All herbicides which are commonly applied as either pre- or post-emergent applications in cotton for other weeds are ineffective on Polymeria take-all. This means that there is no herbicide that can safely be sprayed on cotton to control Polymeria take-all. Herbicides such as the phenoxy group, e.g. 2,4-D amine and 2,4-D ester, and Starane® are likely to be more effective against Polymeria take-all than other herbicides, but care is needed in the application of these herbicides under fallow conditions because of the potential for spray drift and the residual nature of Starane®. It is suggested that repeated applications of effective herbicides are needed to manage this weed. In addition, single applications of strongly residual herbicides such as imazapyr will not permanently reduce the size of Polymeria take-all infestations but may further compromise cotton production in sprayed areas.

Since herbicides are more likely to be effective when applied to actively growing Polymeria take-all, applications should be restricted to times after irrigation or rainfall. Repeated applications of effective herbicides have been shown to control other hard-to-control species and may hold some promise in the treatment of Polymeria take-all. In addition, target selectable spot spraying technology may allow specific areas of Polymeria take-all to be treated.

Cultivation

Severely disruptive cultivation of the upper soil profile, for example by a rotary hoe, where the rhizomes of Polymeria take-all are located, has reduced the growth of the weed in a small trial. Further research is needed to see if these results occur on a larger field scale. Likewise, cutting Polymeria take-all rhizomes and shoots into small pieces less than 10 cm long during cultivation can prevent fragment regrowth. The evidence so far indicates that persistent soil disturbance by cultivation may be a likely key to controlling Polymeria takecultivation for Polymeria take-all control should only be carried out within Polymeria take-all patches and, where possible, not before rainfall or irrigation, otherwise fragments may be successfully transplanted.

Field hygiene

Good field hygiene is essential to prevent the movement of vegetative fragments or seed from infested to uninfested areas. For example, mud should be removed from cultivation machinery used in infested fields and care taken to avoid moving infested soil in laser levelling operations.

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Acknowledgments

This work has been funded by the Cotton Research and Development Corporation.

The assistance of staff at Twynum North - Central, formerly Colly Farms, Collarenebri and Auscott, Moree is greatly appreciated.