CONTROL OF GROUP B RESISTANT WILD RADISH IN WHEAT

Aik Cheam1, Siew Lee1, David Bowran2 and Abul Hashem3
Agriculture Western Australia
1 Locked Bag 4, Bentley Delivery Centre, WA 6983, Australia
2 PO Box 483, Northam, WA 6401, Australia
3 PO Box 432, Merredin, WA 6415, Australia

Abstract Wild radish (Raphanus raphanistrum L.) populations, resistant to Group B (acetolactate synthase, ALS, inhibitors) herbicides, were sprayed with a few selective herbicides in a wheat crop during the 1998 season at the Avondale Research Station in Western Australia. It was shown that Glean® (chlorsulfuron) on its own or followed by Eclipse® (metosulam), both are Group B herbicides, failed to control the highly resistant biotype, but gave reasonable kill of the partially-resistant biotype. 2,4-D amine (a Group I herbicide), as a follow-up treatment, killed most of the survivors from earlier Group B sprays. Jaguar®, a mixture of bromoxynil (Group C) and diflufenican (Group F), was the most effective in controlling the resistant populations resulting in almost two and a half fold increase in the final grain yield of wheat. The final grain yield was determined by the level of control and the resistance status of wild radish. It was further established that control of the early emerging wild radish was important because of their competitiveness and ability to produce abundant seeds.

INTRODUCTION

There is already widespread resistance of wild radish to the Group B herbicides within the Western Australian wheatbelt. To combat this problem, farmers have been advised to integrate various chemical and non-chemical methods of weed management to control the resistant populations. However, the majority of farmers still prefer the use of alternative herbicides because of their efficacy and flexibility and a number of such herbicides have been registered for removal of wild radish from cereal crops. Apart from the alternative herbicides, there are Group B products which are very effective against wild radish that have not developed resistance. Thus it is important for farmers to have prior knowledge of the resistance status of their wild radish, so that the right choice of herbicides can be made. To date, reports have been received of infestations being sprayed with two or even three applications of various Group B products in response to control failures simply because the farmers were unaware of the wild radish resistance status. Because of these reports, a field trial was carried out last season to assess some common herbicide practices on the control and demography of four resistant and partially resistant populations of wild radish based on the assumption of no prior knowledge or with a prior knowledge of resistance in the populations. The aim was to demonstrate to farmers the importance of matching resistance to herbicide choices and at the same time to identify the stages of wild radish growth that are most critical for regulation of the resistant populations.

MATERIALS AND METHODS

Four populations of wild radish that were resistant to Group B herbicides together with their respective susceptible populations collected from the same sites were grown in small plots within a wheat crop. Each of the radish plot was seeded with 200 seeds. The experiment was a split-plot design with the eight different radish populations as the sub-plots and the herbicide treatments as the main plots. The herbicide treatments included Glean® (chlorsulfuron) as the basic treatment (applied at Zadok’s growth scale point Z12) to which some of the wild radish biotypes selected for this study were either highly resistant to or partially resistant. The second treatment was Eclipse® (metosulam) (applied at Z14-15) as a follow-up to Glean to simulate the practice of spraying with two applications of Group B products, in response to control failures. The third treatment used 2,4-D amine, a Group I herbicide, to control the resistant survivors from earlier Group B applications. 2,4-D amine was applied at Z30. Jaguar® was the fourth herbicide treatment applied on its own at the Z12 stage of plant growth. Jaguar is a mixture of bromoxynil and diflufenican, belonging to herbicide Group C and F, respectively. Herbicide rates in g a.i./ha are shown in Table 1 and product rates are indicated in Figures 1 and 2. Cohorts of wild radish seedlings that survived and produced seeds were monitored to assess the effectiveness of the various treatments.
RESULTS AND DISCUSSION

The herbicide Glean on its own was found to be ineffective against the highly resistant biotype. A follow-up spray with Eclipse did not improve control significantly. This confirmed the futility of spraying with two applications of Group B products in response to control failures. Good control was achieved when 2,4-D was sprayed on the resistant survivors from earlier Group B applications. The use of Jaguar was however the most effective treatment (Figure 1).

Glean when sprayed on the partially resistant biotype was fairly effective. A follow-up spray with Eclipse significantly increased the kill of the partially resistant biotype. This was in contrast to the lack of kill of the highly resistant biotype. As expected, 2,4-D as a follow-up spray killed most of the survivors from earlier Group B sprays. Jaguar on its own was again the most effective treatment (Figure 2).

Although new germinations of wild radish occurred following Glean application at 6 weeks after crop sowing, survivors from these late germinations did not produce viable seed, were spindly in growth and consequently were of no importance. This was in agreement with the findings of Panetta et al. (1988) when they reported that no radish plants which emerged later than 21 days after crop emergence produced seeds. Wild radish survivors from early germinations before the application of Glean were highly competitive and produced abundant seeds. Production ranged from 100 to 1,000 seeds per plant. In an earlier study on seed production, Cheam (1986) also showed that seed production was highest from plants which emerged early, and there was a progressive reduction with later emergence. The pre-Glean radish emergence totalled 89% of the 1998 emergence and up to 70% of the highly resistant biotype survived after Glean application. In contrast, only 1.6% of the 11% post-Glean emergence survived but none produced seed. Most of the survivors from Glean and the later application of Eclipse were killed by the 2,4-D and Jaguar treatments. Despite the odd wild radish seedlings that emerged after 2,4-D application, none survived. New wild radish emergence after the Jaguar treatment averaged 6% of the initial seedbank, but the final survival was only 0.4%.

The best grain yield of wheat was obtained following the Jaguar treatment irrespective of the resistance status (Table 1). Although yield increase was obtained following control of the Glean and Eclipse survivors with 2,4-D, there was a significant increase in only the partially resistant population. The application of Eclipse following Glean also increased yield significantly in the partially resistant but not the highly resistant population.

![Figure 1. Survivorship of highly resistant and susceptible wild radish following various herbicide treatments](image-url)
Figure 2. Survivorship of partially resistant and susceptible wild radish following various herbicide treatments.

Table 1. The final wheat yield (t/ha) following the control of resistant and susceptible wild radish with some selected herbicides.

<table>
<thead>
<tr>
<th></th>
<th>Rate (g a.i.)</th>
<th>Radish collection 1</th>
<th>Radish collection 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Highly resistant</td>
<td>Susceptible</td>
</tr>
<tr>
<td>Unsprayed control</td>
<td></td>
<td>2.41</td>
<td>2.91</td>
</tr>
<tr>
<td>Glean</td>
<td>15</td>
<td>2.30</td>
<td>4.65</td>
</tr>
<tr>
<td>Glean, Eclipse</td>
<td>15, 5</td>
<td>2.51</td>
<td>5.28</td>
</tr>
<tr>
<td>Glean, Eclipse, 2,4-D</td>
<td>15, 5, 500</td>
<td>3.09</td>
<td>5.07</td>
</tr>
<tr>
<td>Jaguar (brom./diflu.)</td>
<td>150/15</td>
<td>5.34</td>
<td>5.38</td>
</tr>
<tr>
<td>LSD (P = 0.05)</td>
<td></td>
<td>1.09</td>
<td>1.39</td>
</tr>
</tbody>
</table>
The results have clearly demonstrated the importance of using another herbicide group with a different mode of action for effective control of Group B resistant wild radish. An almost two and a half times yield increase could be obtained by making the right herbicide decision. However, it is essential that integrated weed management is practised and no single herbicide group is relied upon. Control of the early emerging wild radish is also important because of their ability to compete and produce abundant seeds.

ACKNOWLEDGMENTS

This is a collaborative project by Agriculture Western Australia, Western Australian Herbicide Resistance Initiative and the CRC for Weed Management Systems. Z. Zulkifli, B. Roberts, F. Piesse, H. Singh and B. Thomas provided technical assistance.

Appreciation is also extended to staff of the Avondale Research Station for their assistance.

REFERENCES
