Ecology and management of weeds under no-till in southern Australia

Bhagirath Singh Chauhan

B.Sc. Agriculture (Hons.), M.Sc. (Agronomy)

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Table of Contents

Abstract

No-till systems have been widely adopted by farmers in Australia over the past decade to reduce soil erosion, improve soil physical and chemical properties, conserve soil moisture and save on fuel costs. These changes in tillage practices can have a major influence on the ecology and management of weeds. Studies were undertaken on the seed biology of six important Australian weed species to provide underpinning knowledge of their response to tillage. Field studies were also undertaken to investigate the effect of no-till on weed seedling emergence, seed bank persistence and herbicide behaviour.

Seed germination of threehorn bedstraw and wild turnip, the latter only at sub-optimal temperatures, was inhibited by light. In contrast, seed germination of common sowthistle and Indian hedge mustard was stimulated by light. Seed germination of small-flowered mallow was not influenced by the light conditions. Seedling emergence of threehorn bedstraw, wild turnip, small-flowered mallow and annual ryegrass was low on the soil surface but increased with shallow burial, which suggests that farming practices that achieve shallow burial of seeds are likely to promote greater seedling emergence of these weed species. In contrast, seedling emergence of common sowthistle and Indian hedge mustard was greatest for the seeds present on the soil surface and emergence decreased with increased burial depth.

In field experiments, low soil disturbance tillage systems left more seeds on the soil surface after crop sowing, whereas high soil disturbance systems buried most of the seeds. Seedling emergence of annual ryegrass, threehorn bedstraw and wild radish was greater under minimum tillage than no-till system. In contrast, seedling emergence of Indian hedge mustard, common sowthistle, silvergrass, small-flowered mallow and turnipweed was greater under the no-till system. Seedling emergence of wild oat and wild turnip was not influenced by the tillage system. Even though seedling emergence of annual ryegrass was much lower under no-till, the persistence of residual viable seeds of annual ryegrass from one season to the next was similar between the tillage systems. This was because of much greater seed decay under no-till (48 to 60%) than that recorded under minimum tillage (12 to 39%).

All dinitroaniline herbicides (trifluralin, pendimethalin and oryzalin) were more effective in reducing the number of plants, spikes, dry matter and seed production of annual ryegrass when incorporated at sowing with tines than with the discs. At Minlaton in 2004 and 2005, bioavailable trifluralin was greater under tillage systems with greater levels of soil disturbance than under lower soil disturbance systems. In the absence of the herbicide, annual ryegrass was less competitive with wheat under the disc-sown systems. The response of grain yield to herbicides was greater under the tine-sown systems than the disc-sown systems.

The performance of S-metolachlor on annual ryegrass control was investigated under no-till. The control of annual ryegrass was greater than 80% when S-metolachlor was applied at sowing (incorporated by sowing or post-sowing pre-emergence). However, application of the herbicide at sowing resulted in phytotoxic effects on crop emergence and grain yield of wheat. Application of S-metolachlor at 20 or 23 days before sowing not only provided effective control (74 to 83%) of annual ryegrass, it was also safe on wheat. Application of this herbicide at 40 or 46 days before sowing was relatively ineffective in controlling annual ryegrass (33 to 49% weed kill) but safe on wheat.

In conclusion, soil disturbance caused by tillage was found to have a major influence on the behaviour of the seed bank of different species including seedling emergence and decay rates of weed seeds. However, the response to tillage tended to be species-specific and was related to their seed biology. Tillage systems also had a major influence on the efficacy and bioavailability of trifluralin, which is prone to volatilisation losses. The findings of this research program are expected to contribute to the improvement in weed management under no-till systems.

Declaration

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent to this copy of my thesis, when deposited in the university libraries, being available for photocopying and loan.

Bhagirath Singh Chauhan Date:

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