

Evaluating potential strategies for effective lucerne removal prior to cropping

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ABSTRACT

Lucerne was removed at four regrowth stages at four sites in northern and southern New South Wales. Five herbicide treatments were used in the study. Stage of regrowth had a significant effect on herbicide efficacy. Efficacy was maximised when lucerne was allowed to regrow for at least three weeks after complete defoliation. Improved efficacy is indicative of increased herbicide translocation to the crown and taproot. Immediately after defoliation the reserves of C and N in the crown and taproot are utilised in respiration and shoot regrowth. However, 2-3 weeks after defoliation there is sufficient shoot photosynthesis to enable the root reserves to be replenished and the timing of optimum kill using herbicides coincided with this period when the net direction of translocation was from the shoots to the roots. Results from this and other experiments in Western Australia indicate that the reliability of lucerne kill is improved when it is sprayed in early to mid spring compared with lucerne sprayed in late spring/early summer or autumn.

KEY WORDS

Lucerne, removal, timing, herbicide, regrowth.

INTRODUCTION

Difficulty with reliable lucerne removal using herbicides is a widespread problem that is becoming more prevalent as farmers adopt lucerne-based phase farming systems. In eastern Australia several surveys have been conducted which have questioned lucerne growers and agronomists about lucerne removal. In southeastern (SE) Australia, northern New South Wales (NSW), and southern Queensland most growers relied on combinations of chemical control with either heavy grazing or cultivation (7, A. Storrie, pers. comm.). Chemical control generally involved tank mixes of glyphosate with 2,4-D amine or ester; alternatively MCPA or clopyralid (Lontrel²) were used. These achieved up to 80% lucerne kill in SE Australia or up to 90% kill in northern NSW and southern Queensland with many growers considering this level of control unsatisfactory (7, A. Storrie, pers. comm.). Lucerne was generally removed in late summer or early autumn just prior to cropping in SE Australia (7) despite lucerne often being under considerable moisture stress at this time. In northern NSW lucerne was removed between spring and autumn (A. Storrie, pers. comm.). Several growers in SE Australia relied on heavy, usually continuous grazing for 12-18 months with mixed success achieving 60-100% kill. Cultivation with broad overlapping sweep points that sever the lucerne root 30-100 mm below the surface was generally effective but soil penetration with such broad sweeps can be difficult (7). These surveys and other studies (1) highlight the difficulty of removing lucerne reliably with a single operation and there is often a requirement for follow-up treatments to control surviving plants.

While cultivation and grazing remain options for some growers, many are restricted to using herbicides on lucerne should these other options be unsuitable or impractical in their farming system. Herbicide treatments invariably kill the lucerne shoots, but ineffective control becomes apparent when new shoots regrow from buds in the crown. This indicates that the crown, crown buds and taproot did not receive a lethal herbicide dose (8). The aim of these studies was to maximise herbicide efficacy by examining the importance of timing of herbicide application in relation to both period of regrowth and seasonal conditions and in so doing reduce the variability of results obtained.

MATERIALS AND METHODS

In 1999 field experiments were conducted which examined the efficacy of lucerne removal in relation to the length of the regrowth period after mowing. The study was conducted over four sites, two in northern (Spring Ridge and Tamworth) and two in southern (Junee and Grogan) NSW. At the northern NSW sites the plants were sprayed in early spring while at the southern sites there were two spraying times, early-mid spring (ES) and late spring (LS). In each experiment, lucerne plots were mown to crown height at different intervals prior to herbicide application so that at any spraying time there was a range of plants with different amounts of regrowth after mowing. The experiment utilised a number of herbicide treatments that had proven to be successful in previous trials or had been recommended/used by growers or agronomists. The 5 herbicide treatments used are shown below. Some were mixes containing more than one active ingredient.

1. 2,4-D isopropylamine (IPA) 225g/L (Surpass[?]) 3.0L/ha + glyphosate (450 g/L) 1.0L/ha
2. 2,4-D dimethylamine (DMA) 500g/L (Amicide[?] 500) 3.0L/ha
3. 2,4-D dimethylamine (DMA) 500g/L (Amicide[?] 500) 3.0L/ha + spraying oil (Uptake[?]) 0.5% v/v
4. MCPA amine 500g/L (MCPA[?] 500) 2.0L/ha + clopyralid (Lontrel[?]) 0.3L/ha
5. triclopyr + picloram (Grazon[?] DS) 0.5L/ha

(Note: None of these treatments are currently registered for lucerne removal prior to cropping. We the authors and the organisations we represent do not endorse their use.)

Timing of removal was further examined at two sites in WA (Borden and Jerramungup) and at one site in NSW (Temora) and the ACT (Ginninderra). For each treatment, lucerne plots were sprayed glyphosate and 2,4-D IPA mixtures when conditions were considered optimum. Efficacy at these spray times were then compared with that achieved in the ES and LS sprays above using treatment 1 after 3-4 weeks regrowth. For all of the experiments lucerne kill was assessed by measurements of basal (crown) area before and then 3-4 months after treatment.

RESULTS

Growth stage and herbicide efficacy

Generally 2,4-D DMA + spraying oil, MCPA + clopyralid and triclopyr + picloram were the best treatments (Fig 1a-f) however the MCPA + clopyralid mix was a less effective treatment in late spring (Fig. 1e,f). The 2,4-D DMA treatment performed poorly except in southern NSW in early spring after 4-5 weeks regrowth where every herbicide treatment gave good kill after 3-5 weeks regrowth (Fig 1c,d).

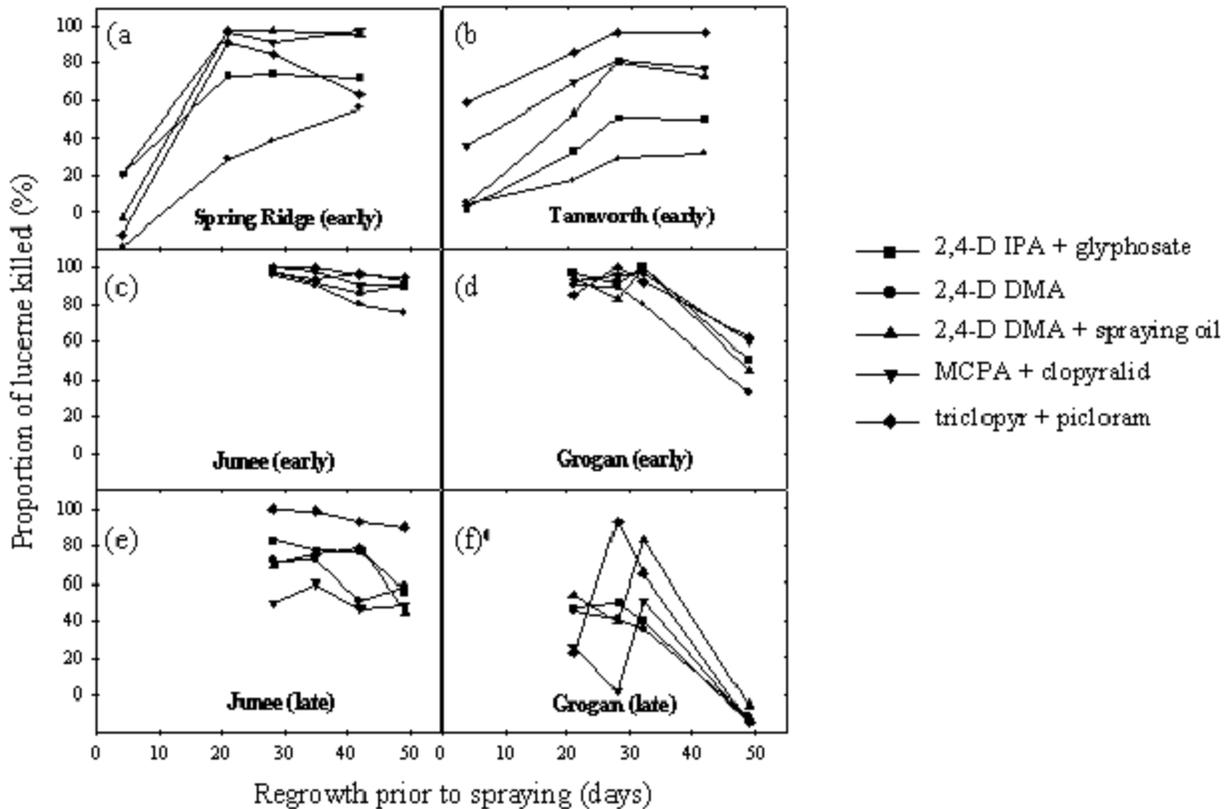


Figure 1. Proportion (%) of lucerne killed following best-bet herbicide application to lucerne plants of varying age after cutting at Spring Ridge (a), Tamworth (b), Junee (c), Grogan (d) in early spring and at Junee (e) and Grogan (f) in late spring.

In northern NSW treatment efficacy was dependent on the herbicide used and the amount of regrowth prior to spraying (Fig. 1a,b). Three treatments, Grazon DS², MCPA + Lontrel² and 2,4-D DMA + Uptake² were successful at these sites provided there had been at least three weeks regrowth. The least effective treatment was 2,4-D DMA on its own (Fig. 1a,b). At the southern sites the difference between herbicides was less marked for the ES spray so that the stage of plant development was the principal determinant of herbicide efficacy. Efficacy was greatest after 4-6 weeks regrowth with less than 20% of the lucerne stand remaining. In LS efficacy was greatly reduced regardless of which herbicide was used. Only Grazon DS² (treatment 5) at Junee after 3-5 weeks regrowth gave good kill in LS otherwise results were highly variable particularly at the Grogan site (Fig. 1e,f).

In this study the best kill was achieved when lucerne was growing actively in ES after 4-6 weeks (28-42 days) regrowth and was 20-30cm tall. After 6 weeks regrowth, when the plants were flowering, herbicide efficacy decreased. This may correspond to a shift in partitioning of sugars and proteins within the plant that favours reproductive development.

Timing of lucerne removal

Early or mid spring sprays have generally been found to be more effective than late spring/early summer or autumn (AUT) sprays across a range of sites and experiments in 1999 (Fig. 2). Only at the Ginninderra (ACT) site was the LS spray more effective than the early/mid spring spray while at Jerramungup in WA good lucerne control was achieved regardless of the timing of herbicide application. Autumn removal tended to be as effective as LS removal, except at Ginninderra where it proved less effective than the LS spray, the most effective treatment time. Across all the sites lucerne control in ES proved to be more

reliable ranging from 64 to 100% kill compared to the LS spray which ranged from 24-96% and the AUT spray which ranged from 29-85% kill (Fig.2).

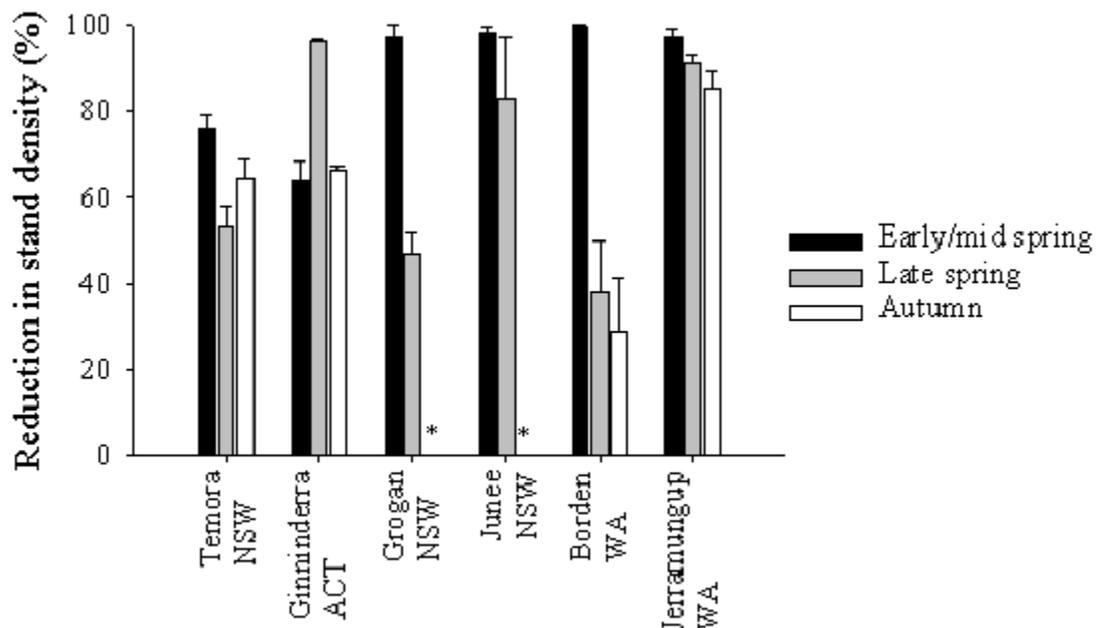


Figure 2. Reduction in lucerne stand density following herbicide application in early/mid spring versus late spring across a range of sites in NSW and WA in 1999. * There were no autumn treatments at Grogan and Junee. Bars represent one standard error of the mean of 4 replicates.

DISCUSSION

Systemic herbicides such as glyphosate and the auxin hormone-like herbicides, 2,4-D, MCPA, clopyralid and dicamba are sprayed onto the foliage, absorbed by the plant and then translocated in the phloem (4, 5). Phloem movement is primarily directed toward the strongest sinks, often the meristematic regions where active cell division is taking place. Hence systemic herbicides also accumulate in these regions (6). Therefore to achieve a lethal dose in the crown and root tissues it is critical that herbicides are applied when there is movement of sugars downwards into these tissues. While movement of sugars is always dynamic there are stages during regrowth when there is net movement of sugars and proteins either to or from the roots. In lucerne the crown, taproot and lateral roots also have a role as storage organs providing C and N for shoot regrowth after defoliation or winter dormancy (2). Generally, for the first 2-3 weeks after defoliation there is a net depletion of sugars and proteins from the crown and taproot which support shoot regrowth. Once the shoots are re-established they provide assimilates to replenish the storage reserves in the crown and taproot (2).

On the basis of these preliminary studies the success of herbicide treatments appears to be maximised when lucerne is actively growing. For this reason spraying in early or mid spring when there is adequate water and growth is rapid seems to increase the likelihood of getting a good kill. Furthermore it appears necessary that plants be allowed to regrow for approximately 3-4 weeks after grazing or cutting before applying herbicides. It is likely that this corresponds to the stage in the regrowth cycle when there is a net downward movement of assimilates into the crown and taproots to replenish the storage reserves in these organs.

These lucerne removal studies demonstrated the difficulties faced by growers when using herbicides to kill lucerne. In no circumstance, even under the best conditions, did we find a treatment that could effectively kill 100% of the lucerne stand reliably and follow-up treatments would be required. Further

research is currently being undertaken to confirm the optimum timing of lucerne removal in relation to the stage of plant growth in the regrowth cycle and to determine whether the improved efficacy is indeed a consequence of improved herbicide translocation to the crown and taproots.

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