Weed species present in cereal crops in southern New South Wales

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Summary A field survey of 192 cereal crops in southern New South Wales collected data on the weed species present and their levels of infestation. Fourteen of the 192 paddocks had no weeds present, while 30 had only one species recorded. Two weed species were recorded in 52 paddocks, three in 35, four in 28, five in 20 and six in ten paddocks while three of the paddocks contained seven weed species. The species most commonly found were annual ryegrass and wild oats, in 66% and 63% of paddocks respectively. No other species of grass weed were present in more than 20% of paddocks. The most common broadleaf weed species was milk thistle (*Sonchus oleraceus*) which was present in 23% of the surveyed paddocks, capeweed (*Arctotheca calendula*), wireweed (*Polygonum aviculare*) and paterson's curse (*Echium plantagineum*) were the only other species found in more than ten percent of the paddocks.

Keywords Weed species, survey, annual ryegrass, wild oats.

INTRODUCTION

Weeds have a major impact on crop and pasture production in Australia. The impact can be through direct costs of control such as herbicides, cultivation or labour, or indirectly through yield losses from decreases in production or quality (Sinden *et al*. 2003).

The level of losses in Australian crops and pastures as a result of weeds was estimated to be approximately $3 billion of which approximately $2 billion was due to indirect losses (Combellack 1989). This had increased by $3.5 billion in 2003 of which about $1 billion was in direct costs to crops (Sinden *et al.* 2003).

Jones *et al*. (2005) estimated yield losses to weeds remaining after control totaled $280 million. Three weed species were responsible for about 90% of these yield losses: annual ryegrass (*Lolium rigidum* gaud.), wild oats (*Avena* spp.) and wild radish (*Raphanus raphanistrum*). However the importance of these weeds varied depending upon the region with wild oats most important in the north, wild oats and annual ryegrass in the south and annual ryegrass and wild radish in the east (Jones *et al*. 2005).

Knowledge of which weed species are present in a region enables both the research conducted and extension messages to be better targeted for that area. With the last weed species survey in southern New South Wales conducted in 1993 (Lemerle *et al*. 1996) and with changes in management practices (D'Emden *et al*. 2006) and herbicide resistance levels (Broster *et al*. 2011a; b) the relative importance of some weed species may have changed.

MATERIALS AND METHODS

Survey Cereal crop paddocks in southern New South Wales were surveyed in November and December of 2010 prior to the commencement of harvest. Paddocks were randomly selected at ten kilometre intervals, alternating left and right hand side of the survey transects where possible. This resulted in 192 paddocks being visited, of these 154 were wheat, 37 were barley and one triticale. The location of all sites was recorded using a GPS unit.

The paddocks were surveyed by two people walking across them for a ten to fifteen minute period. While the main aim of the survey was to collect samples of annual ryegrass and wild oat seed for herbicide resistance screening, the incidence and density of these species and any other species was recorded. In total 192 paddocks were visited, of which fourteen had no weeds present.

The density of weeds in the sampling area was visually assessed by the samplers along their sampling path. Upon leaving the paddock an estimated average density for the area was agreed upon using similar categories to Llewellyn *et al*. (2009) for annual ryegrass. In addition to the four classes used by Llewellyn *et al*. (2009) of: Low (<1 plant m^{-2}), Medium (1–10 plants m^{-2}), High (>10 plants m^{-2}) and Very High (>10 plants m^{-2} and dominating crop) this survey used an additional class: Very Low (occasional plant).

The classes were modified according to average mature biomass production per plant for each species. Species larger than annual ryegrass had lower thresholds for each class while those smaller had higher thresholds. This was to allow for the difference

in competition between populations of equal densities but difference mature size (e.g. wild oats and toad rush (*Juncus bufonius*)).

RESULTS

A total of 27 different weed species were identified in the paddocks visited. Of these eleven were grass and 16 were broadleaf species. Fourteen of the 192 paddocks had no weeds present, while 30 had only one species recorded. Two weed species were recorded in 52 paddocks, three in 35, four in 28, five in 20 and six in ten paddocks while three of the paddocks contained seven weed species (Figure 1).

The most common species were annual ryegrass and wild oats being found in 66% and 63% of paddocks respectively. No other species of grass weed were present in more than 20% of paddocks and only two of these [toad rush and barley grass (*Hordeum* spp.)] were present in more than ten percent of surveyed paddocks (Table 1).

The most common broadleaf weed species was milk thistle (*Sonchus oleraceus*) which was present in 23% of the surveyed paddocks, capeweed (*Arctotheca calendula*), wireweed (*Polygonum aviculare*) and paterson's curse (*Echium plantagineum*) were the only other broadleaf species found in more than ten percent of the paddocks (Table 2).

The majority of weed infestations of any species were classed as very low or low, 17% and 56% respectively. Only 3% of infestations were classed as very high, while 9% were classed as high and 15% as medium level infestations. Fourteen species were found in more than five (2.6%) of paddocks. For most of these species the majority of infestations were classed as low or very low (Table 3). Silver grass (*Vulpia* spp.) and toad rush were the species with highest percentage of samples classed as high or very high, 50% and 55% respectively.

DISCUSSION

Annual ryegrass and wild oats were the most common weed species found in this survey, found in 66% and 63% of paddocks respectively. This is similar to the findings of Lemerle *et al*. (1996) who found these two species in 69% and 72% of paddocks. They found the most common species to be capeweed being present in 76% of paddocks compared to only 14% in this survey. However while the areas investigated by these two surveys overlap there are still significant areas specific to each survey, this could explain some of the difference in capeweed infestation.

That annual ryegrass and wild oats were the dominant species in this survey also agrees with the economic analysis done by Jones *et al*. (2005). These two species were each responsible for about one third of the economic losses due to residual weeds in the Southern cropping region.

These two species are also the most commonly screened for herbicide resistance at Charles Sturt

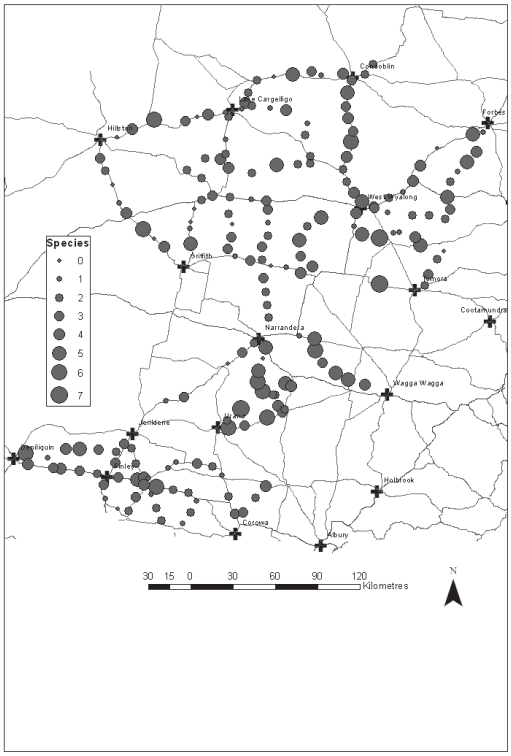

Figure 1. Number of weed species identified in surveyed paddocks.

Table 1. Grass weed species found in surveyed paddocks.

Species	Common name	Number of paddocks	% of paddocks
Lolium rigidum	Annual ryegrass	126	65.6
Hordeum spp.	Barley grass	33	17.2
Bromus diandrus	Brome grass	18	9.4
Phalaris spp.	Phalaris	1	0.5
Bromus catharticus	Prairie grass	1	0.5
Vulpia spp.	Silver grass	12	6.3
Bromus hordeaceus	Soft brome	1	0.5
Austrostipa spp.	Spear grass	2	1
Juncus bufonius	Toad rush	27	14.1
Avena spp.	Wild oats	121	63.0
Chloris truncata	Windmill grass	4	2.1

University (J. Broster unpublished data). Significant levels of resistance to several herbicides were found in the annual ryegrass samples collected during this survey (J. Broster unpublished data). Herbicide resistant populations of two of the three next most commonly found grass species, barley grass and brome grass (*Bromus diandrus*), have also been found in southern New South Wales.

The majority of both annual ryegrass and wild oats populations were of very low or low density. This is despite significant levels of herbicide resistance in the annual ryegrass populations (wild oats yet to be screened). Fifty-six percent of the annual ryegrass populations were resistant to diclofop-methyl, 53% to chlorsulfuron and 32% to tralkoxydim (J. Broster unpublished data). This is a similar finding to that of Llewellyn *et al*. (2009) who found that despite high levels of herbicide resistance in a 2003 survey over half the annual ryegrass populations were rated a low density (<1 plant m^{-2}).

Wild radish (*Raphanus raphanistrum*) was found in a similar proportion of paddocks (3.5%) as compared to the 1996 survey (Lemerle *et al.* 1996). This was despite it being ranked by agronomists in 1996 only behind annual ryegrass as a serious problem in the future (Lemerle *et al*. 1996).

This survey was undertaken during a very wet spring, with portions of many surveyed paddocks underwater. This may have influenced both: what species were present and their level of infestation. However, while some species may be less common in drier seasons, the potential was there for large increases in seed bank levels enabling these species to still be present in future years when conditions again become favourable.

Both this survey and the Lemerle *et al*. (1996) survey were done late in the growing season after most, if not all, herbicide applications. Any weeds present have therefore either germinated after the herbicide applications or are survivors of the herbicide application (escapes or resistant). Several

Table 2. Broadleaf weed species found in surveyed paddocks.

Species	Common name	Number of paddocks	% of paddocks
Xanthium spinosum	Bathurst burr	1	0.5
Arctotheca calendula	Capeweed	27	14.1
Fallopia convolvulus	Climbing bindweed	1	0.5
Rumex spp.	Docks	4	2.1
Fumaria spp.	Fumitory	1	0.5
Sisymbrium orientale	Indian hedge mustard	15	7.8
Lythrum hyssopifoli	Lesser loosestrife	10	5.2
Sonchus oleraceus	Milk thistle	44	22.9
Echium plantagineum	Paterson's curse	22	11.5
Lactuca serriola	Prickly lettuce	3	1.6
Carthamus lanatus	Saffron thistle	3	1.6
Capsella bursa-pastoris	Shepherds purse	3	1.6
Chondrilla juncea	Skeleton weed	19	9.9
Emex australis	Threecornered Jack	3	1.6
Raphanus raphanistrum	Wild radish	7	3.6
Polygonum aviculare	Wireweed	23	12.0

Table 3. Level of infestation for 14 weed species.

	Percentage of samples				
Species	V Low	Low	Med	High	V High
Annual ryegrass	28	44	13	7	7
Barley grass	21	70	9	0	0
Brome grass	6	50	22	17	6
Silver grass	17	25	8	33	17
Toad rush	0	11	33	44	11
Wild oats	21	58	15	5	1
Capeweed	7	89	4	0	0
Indian hedge mustard	13	53	13	20	0
Lesser loosestrife	0	30	30	30	10
Milk thistle	9	75	16	0	0
Paterson's curse	9	77	14	0	0
Skeleton weed	16	84	0	0	0
Wild radish	29	57	14	0	0
Wireweed	9	61	13	17	0

species may be therefore under-estimated as they may be present in large numbers early but are well controlled by herbicides.

Species present in higher numbers before herbicide application will have more individuals exposed to herbicides and therefore the risk of herbicide resistance is greater in these species than in a species with low numbers throughout the growing season. It is therefore important to also undertake these surveys prior to post-emergent herbicide application to see if any of the species less prevalent in this survey are present in higher numbers at that time.

ACKNOWLEDGMENTS

The survey was conducted as part of a research project funded by the Grains Research and Development Corporation.

REFERENCES

Broster, J.C., Koetz, E.A. and Wu, H. (2011a). Herbicide resistance in wild oats (*Avena* spp.) in southern New South Wales. *Plant Protection Quarterly* 26, 106-110.

Broster, J.C., Koetz, E.A. and Wu, H. (2011b). Herbicide resistance levels in annual ryegrass (*Lolium rigidum* Gaud.) in southern New South Wales. *Plant Protection Quarterly* 26, 22-28.

Combellack, J.H. (1989). Resource allocations for future weed control activities. In, 42nd New Zealand Weed and Pest Control Conference. New Plymouth. (Ed) A.I. Popay pp. 15-31. (New Zealand Plant Protection Society).

D'Emden, F.H., Llewellyn, R.S. and Burton, M.P. (2006). Adoption of conservation tillage in Australian cropping regions: An application of duration analysis. *Technological Forecasting and Social Change* 73, 630-647.

Jones, R.E., Vere, D.T., Alemseged, Y. and Medd, R.W. (2005). Estimating the economic cost of weeds in Australian annual winter crops. *Agricultural Economics* 32, 253-265.

Lemerle, D., Tang, H., Murray, G. and Morris, S. (1996). Survey of weeds and diseases in cereal crops in the southern wheat belt of New South Wales. *Australian Journal of Experimental Agriculture* 36, 545-554.

Llewellyn, R.S., D'Emden, F.H., Owen, M.J. and Powles, S.B. (2009). Herbicide resistance in rigid ryegrass (*Lolium rigidum*) has not led to higher weed densities in Western Australian cropping fields. *Weed Science* 57, 61-65.

Sinden, J., Jones, R., Hester, S., Odom, D., Kalisch, C., James R. and Cacho, O. (2003). 'The economic of impact of weeds in Australia.' CRC for Australian Weed Management, Adelaide.