MONITORING TRENDS IN PESTICIDE USE AND RESIDUES ON QUEENSLAND WOOL

Ward MP[1,2], Armstrong RTF[1]

[1]Department of Primary Industries, Animal Research Institute, Locked Mail Bag 4, Moorooka, Queensland, Australia 4105
[2]Present address: Department of Veterinary Pathobiology, School of Veterinary Medicine, Purdue University, West Lafayette, Indiana, U.S.A. 47907

Pesticides are applied to sheep during the wool-growing season to control louse infestation and blowfly strike. Pesticides used in Australia belong to organophosphorous (OP), synthetic pyrethroid (SP) or insect growth regulator (IGR) classes. To maintain market access, the Australian wool industry has resolved to reduce the amount of pesticide residues on wool by a strategy of best management practices that minimise the need for pesticide application late in the wool-growing season.[1,2] This paper reports the results of a program to monitor trends in pesticide use by Queensland woolgrowers and amounts of OP, SP and IGR pesticides on Queensland wool during the period 1993 to 1999.

Materials & Methods

Wool lots were selected randomly for testing in 3 surveys conducted in 1995/96, 1996/97 and 1998/99. Wool samples were tested for all OP, SP and IGR pesticides registered for use on sheep in Australia at the time of sampling. The total amount (mg/kg of greasy wool) of OP- and SP-class residue was used in analysis; trends in each IGR-class residue (cyromazine, diflubenzuron, triflumuron) were analysed separately. For analysis, results below the level of reporting (0.5, 0.2 and 1 mg/kg for OP, SP and IGR residues, respectively) were interpreted as nil residue detected.

A questionnaire was sent to all owners of wool samples tested, requesting information on flock and shearing characteristics, and pesticide use practices. The beginning of the wool-growing season for each wool sample tested was derived from questionnaire information and used in analysis. Residue amounts were transformed ($\sqrt{}$) to achieve normality, and the mean residue amount was calculated for each month during the study period. Trends in residue amounts were estimated using linear regression, weighted by the number of samples tested per month. Survey responses to questions on pesticide application practices were categorised by year. The year 1998/99 was not included because of insufficient sample size. The χ^2 test for linear trend was used to assess changes in application practices.

Results

A total of 819 wool samples were tested for pesticide residues between 1993 and 1999, representing approximately 31% of Queensland sheep flocks. Time of shearing and months of wool growth were available for 538 of these flocks. A significant ($P < 0.01$) reduction in both OP and SP residue amounts was observed during monitoring (Table 1). The annual decrease in OP and SP residue amounts was estimated to be 0.038 and 0.035 mg/kg, respectively. A significant ($P < 0.01$) increase in triflumuron amounts (0.298 mg/kg per annum) was estimated.

Table 1. Linear trends in the mean monthly amounts (√) of OP, SP and IGR pesticides on Queensland wool, July 1993 to April 1999.

Residue	Intercept	Month	F-statistic	P-value	Adjusted R^2
Organophosphorous	1.3841	-0.0163	21.66	<0.01	0.263
Synthetic pyrethroid	1.0083	-0.0157	29.59	<0.01	0.330
Cyromazine	0.8271	0.0205	2.23	0.14	0.021
Diflubenzuron	0.6060	0.0066	0.90	0.35	-0.002
Triflumuron	-0.0242	0.0455	17.21	<0.01	0.245

There was a significant decrease in the proportion of woolgrowers treating for lice infestation >4 months after shearing (36 to 11%; P <0.01) and treating twice or more (38 to 13%; P <0.01) during monitoring (Table 2). The proportion of woolgrowers who reported using IGR pesticides on the first (1 to 57%; P <0.01) and second (nil to 17%; P <0.01) occasions after shearing increased significantly. There was a significant increase in the proportion of woolgrowers treating for blowfly strike control twice or more (2 to 20%; P = 0.03), and using an IGR for flystrike control on the first occasion (5 to 80%; P <0.01) during the monitoring period (Table 3).

Table 2. Number of Queensland woolgrowers reporting pesticide application practices for louse control in 3 questionnaire surveys.

		Year of shearing					
Practice	Response	1993/94	1994/95	1995/96	1996/97	1997/98	P-value
Treatment	Yes	97	60	153	33	127	
	No	1	3	16	1	9	0.14
Frequency	≤1	61	46	137	287	116	
	≥2	37	15	31	7	17	<0.01
Pesticide	OP	28	24	47	9	27	
(1st treatment)	SP	58	25	48	10	28	
	IGR	1	4	51	15	72	<0.01
Pesticide	OP	33	11	16	3	13	
(2nd treatment)	SP	5	1	2	0	2	
	IGR	0	2	11	4	3	<0.01
Timing	≤4	59	41	123	28	113	
	>4	33	16	20	6	14	<0.01

Table 3. Number of Queensland woolgrowers reporting pesticide application practices for flystrike control in 3 questionnaire surveys.

		Year of shearing					
Practice	Response	1993/94	1994/95	1995/96	1996/97	1997/98	P-value
Treatment	Yes	53	43	120	21	70	
	No	41	21	49	14	62	0.26
Frequency	≤1	41	37	132	15	59	
	≥2	1	7	23	2	15	0.03
Pesticide	OP	21	14	48	2	13	
(1st treatment)	IGR	1	13	59	13	53	<0.01
Pesticide	OP	8	1	13	0	4	
(2nd treatment)	IGR	0	5	11	2	10	0.10
Timing	≤4	10	6	28	2	18	
	>4	47	33	79	15	52	0.26

Discussion

Between 1993 and 1999, the monitoring program demonstrated changing patterns in the use of pesticides to control louse infestations and blowfly strike, and corresponding changes in amounts of pesticide on Queensland wool. Considering both first and second pesticide applications, the use of OP and SP pesticides for louse control decreased by 43 and 58%, respectively. Since most pesticide detected on Queensland wool is the result of treatments for louse infestation,[3] reduced use of OP and SP pesticides for louse control is probably the cause of decreasing residue levels. Resistance of louse populations to both OP and SP pesticides, and blowfly populations to OP pesticides, is documented in Australia.[4,5] This may explain why Queensland woolgrowers are using OP and SP pesticides less frequently. The use of IGR pesticides to treat for both louse infestation and blowfly strike increased considerably during the study period. From negligible use in 1993/94, IGR pesticides were used by the majority of woolgrowers applying pesticides in 1997/98. Whilst the amount of IGR residues in most samples included in this study were <1 mg/kg, some samples contained amounts of cyromazine, diflubenzuron and triflumuron in excess of 100 mg/kg. To maintain market access the use of IGR pesticides, and factors associated with high residue levels, must continued to be monitored.

No trends were identified in the proportion of woolgrowers applying pesticides for either louse or blowfly control. However, the frequency of applications for louse control decreased, whereas for blowfly control increased. In addition, the proportion of woolgrowers applying pesticides late in the woolgrowing season (>4 months post-shearing) for louse control decreased. Results suggest that extension programs aimed at more effective control of louse infestations have had an impact: woolgrowers appear to be applying pesticides earlier and less frequently. Blowfly control poses a greater obstacle to reducing pesticide use in the wool industry. In Queensland, flystrike tends to occur in both spring and autumn,[6] so that late wool-growing season applications may be difficult to avoid for animal welfare reasons. Alternatives to pesticide use for late-season flystrike control are a priority area, if pesticide residues on Queensland wool are to be further reduced. Six years of monitoring has provided information useful for assessing progress made in extension campaigns aimed at more effective pesticide use, and identifying factors that may contribute to unacceptable pesticide residues on wool.

References

1 Shaw T. Wool as a "clean, green" fibre; the implications of pesticide residues in wool - a challenge for regulatory authorities, drug companies, wool processors, veterinarians and farmers. In: Allworth MB. Proceedings of the Fourth International Congress for Sheep Veterinarians. Australian Sheep Veterinary Society, Armidale, 1997: 98-105.

2 Russell IM, Campbell NJ, Hanrahan PD, Nunn CR, Smith GC. Reduction of pesticide residues in the Australian wool clip. In Cox J. Proceedings of the 9th International Wool Textile Research Conference, Biella, 1995.

3 Ward MP, Armstrong, RTF. Pesticide use and residues on Queensland wool. Australian Veterinary Journal 1998; 76: 739-742.

4 Levot GW. Insecticide resistance: new developments and future options for fly and lice control on sheep. Wool Technology and Sheep Breeding 1993; 41: 108-119.

5 Levot GW. Resistance and the control of sheep ectoparasites. International Journal of Parasitology 1995; 25: 1355-1362.

6 Ward MP, Armstrong RTF. Time-space clustering of reported blowfly strike in Queensland sheep flocks. Preventive Veterinary Medicine 2000; 43: 195-202.