

FINAL REPORT



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Putting WormBoss into Practice



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Executive Summary

Awareness of WormBoss among sheep producers is very high, but adoption of WormBoss best management practices requires continued effort.

This project aimed to test whether extension of two key WormBoss practices could be accelerated when done through a coordinated producer-group program where members of two producer groups: Monaro Farming Systems (MFS) and ASHEEP Esperance, were directly encouraged and assisted by their group staff and they were provided with full or partial subsidies to undertake the nominated practices.

The groups intended to

- Increase the number of worm egg counts and drench tests (both for helminth worms and liver fluke) done by participants so that both the participants, as well as other members and others, would better understand the value of these practices and would be more likely to use them.
- Use their normal group processes: events and field days, web site, Facebook page, email notices, to promote participation, provide results and present best practice worm management.
- Generate local drench resistance test datasets that would also inform other members and local producers on the extent and type of drench resistance found locally.
- Develop a central database to hold Drench Test and WEC results that can be used to identify trends in the region and alerts of rising egg counts or changing worm types.

The samples collected during the drench tests were also to be used by Dawbutts in a parallel project to validate the Mini Flotac worm egg counting methodology.

The project ran from late 2017 to the end of 2019 and demonstrated that financially supporting producer groups to adopt beneficial practices can be a successful method to achieve increased adoption and at the same time provide data and information of local relevance.

Twenty-five subsidized helminth drench resistance tests, one liver fluke drench resistance test and approximately 800 worm egg count tests were carried out during the project.

These allowed the participants to gain results they may not have otherwise accessed and to personally identify the value of these practices for their farms.

The participating groups: Monaro Farming Systems and ASHEEP Esperance, both conducted extension and communication activities (using events or field days, their websites, facebook pages, newsletters and direct emails to members) to solicit membership involvement in the project activities and to promote the benefits of WEC testing and drench testing practices.

The Monaro Farming Systems group developed a display of real time results on their website, which highlighted the current worm status based on recent WEC results. ParaBoss developed a project proposal for a bigger more comprehensive national Drench Tests Database.

Each group created a dataset of drench tests results highlighting some regional trends, but importantly, demonstrating that there can be considerable variation in results across farms within a region and therefore each farm should conduct its own drench test.

The MFS group indicated the potential to have achieved a 5–10% increase in farm profit per hectare through increased weaner survival by making better worm management decisions using WEC tests and using effective drenches based on drench resistance tests.

Introduction/Hypothesis

Awareness of WormBoss among sheep producers is very high, but adoption of WormBoss best management practices requires continued effort.

This project aimed to test whether extension of two key WormBoss practices could be accelerated when done through a coordinated producer-group program where group members were directly encouraged and assisted by their group staff and they were provided with full or partial subsidies to undertake the nominated practices.

Two producer groups from different climatic and regional locations participated in the project. The first was Monaro Farming Systems (MFS), located in the Monaro region of south-eastern NSW. The second was ASHEEP Esperance (ASHEEP), located in the southern coastal region of Western Australia near Esperance. MFS group was the initiator of the project, whereas ASHEEP were later requested to participate.

The outcomes for woolgrowers involved in the project were expected to include:

- a) Adoption of WormBoss practices of WEC and Drench Tests that will improve worm (and liver fluke for NSW) control decisions on pasture management/rotations, drench choice and drench programs.
- b) Access to a comprehensive, district-specific, dataset that provides material for local discussions and planning.
- c) Access to local alerts and an early warning system from WEC and Drench Tests that will help to avoid risks from clinical worm infections.
- d) Protection of new and emerging drench technologies.
- e) 5–10% increases in overall farm profit per hectare due to increased weaner survival.
- f) Better understanding of the barriers to WEC and Drench Tests informing ParaBoss extension and adoption activities.

Literature Review

Not applicable.

Project Objectives

The project objectives, while similar for both groups, had some variations to accommodate differences in region and in the groups. These were to be delivered by December 2019.

Monaro Farming Systems (MFS)

- a) Grow the number of WEC tests and increase engagement of farm businesses undertaking regular worm test monitoring from 244 to 800 (an increase of 556), and farm business from 28 to 40.
- b) Design, develop and maintain a simple database to improve the recording of WEC results i.e. property location, WEC, class of sheep, drench history and worm type.
- c) Document/quantify the status of drench resistance to the ML, levamisole, closantel, monepantel, BZ chemical groups by conducting drench resistance tests (drench tests) on 15 farms with a good representation of the district climate, soil and pasture types. Testing from late 2018 will include these drench groups/actives: albendazole, levamisole, closantel, moxidectin, monepantel, abamectin, derquantel + abamectin. (Later changed to 22 tests in place of liver fluke trials)

- d) Document/quantify the status of liver fluke resistance in sheep to triclabendazole by conducting drench tests on 3 farms. (Later reduced to 1 and replaced by helminth trials)
- e) Document all trial data and results into the database to record status and changes in WEC and worm types.
- f) Assist in the validation (with Dawbutts) of the sensitive drench test to provide a cheaper and more practical way of testing drench resistance in sheep.
- g) Promote best practice worm management for south-east NSW Monaro via monthly “worm alert updates” giving forecasts, latest test results, recommendations, etc. available from group websites and via ParaBoss monthly State Outlooks.
- h) Deliver a series of educational, training and information activities to show case the initiative to core farm businesses and observer producers to increase confidence, awareness and capacity to integrate regular worm management protocols into their farm enterprise. Four events to 65 core businesses and 200 observers show casing “Worm Club” initiative.

ASHEEP

- a) Increase WEC tests carried out by farm businesses by 50% (base level to be determined in March 2018 census)
- b) Contribute to the design and development of, and have responsibility for the data entry into, a simple database to improve the recording of WEC results i.e. property location, WEC, class of sheep, drench history and worm type.
- c) Document/quantify the status of drench resistance to the ML, levamisole, closantel, monepantel, BZ, monepantel/abamectin chemical groups by conducting drench resistance tests (drench tests) on 15 farms with a good representation of the district climate, soil and pasture types.
- d) Document all trial data and results into the database to record status and changes in WEC and worm types.
- e) Assist in the validation (with Dawbutts) of the sensitive drench test to provide a cheaper and more practical way of testing drench resistance in sheep.
- f) Promote best practice worm management for southern Western Australian districts via at least 2-monthly "worm alert updates" giving forecasts, latest test results, recommendations, etc. available from group websites and via ParaBoss monthly State Outlooks.
- g) Deliver a series of educational, training and information activities to show case the initiative to core farm businesses and observer producers to increase confidence, awareness and capacity to integrate regular worm management protocols into their farm enterprise. Two events to 30 core businesses and 100 observers.

Success in Achieving Objectives

The objectives were largely achieved by the Monaro Farming Systems group, which carried out 757 additional Worm Egg Count (WEC) tests, 22 roundworm drench resistance tests and one liver fluke drench resistance test. They developed their own database for results that displays a live summary on their website. They also carried out extension activities to promote worm management best practice.

ASHEEP completed approximately one fifth of their initially planned drench tests. Their WEC test numbers were low, but were likely to be 50% more than would otherwise have been done at the time. The dry

seasonal conditions were largely responsible for the reduced number of tests. They did also conduct extension and promotion activities.

A national database was not developed; however, a study was conducted by ParaBoss that has created a project proposal for a national Drench Test Database.

Methodology

Two producer groups were enlisted and provided with funds to support their implementation of two key WormBoss recommendations:

- a) Use worm egg counts to regularly monitor the worm burden of sheep mobs to make informed drenching decisions.
- b) Conduct drench resistance tests each 2–3 years to inform the use of appropriate drench choices.

Each group were tasked with the following activities (principally carried out/organised by their executive officer or project officer):

- Promote the opportunity for subsidised WEC tests and access to WEC kits to their group members.
- Purchase and deliver to members the required number of WEC kits and offer a credit to each farm business member for subsidised worm testing.
- Send regular reminders to members to facilitate collection of samples and submission to laboratories.
- Select farms to undertake the drench tests (aiming to gain representation of climates, soil and pasture types). The cost of the kits and testing for the 'sensitive drench test' covered by Dawbut's. The project and the individual producers covered the costs of supplying any required drenches, postage of kits and tags (individual producer host contributions were decided by the group).
- Coordinate and conduct drench tests (ASHEEP 15, MFS 15—increased to 22 once fluke trials were not possible) as per Dawbut's/WormBoss drench test protocols: (<http://www.wormboss.com.au/sheep-goats/tests-tools/tests/testing-drench-effectiveness-with-a-drenchtest.php>) (supply kits, drench packs, protocols and labour assistance and technical guidance) for the following chemical groups: control, BZ, lev, moxidectin, closantel, monepantel, abamectin, Startect® (derquantel + abamectin) (not all done on all properties).
- Coordinate and conduct 3 drench tests as per WormBoss drench test protocols for liver fluke in sheep to triclabendazole (MFS only, as ASHEEP not in a fluke area).
- Samples for the sensitive drench test to be taken in parallel with the conventional test and submitted to the Dawbut's laboratory for analysis (only one set of samples required). Dawbut's to supply 15 x drench test kits for new protocol tests. All test costs associated with the sensitive drench test to be covered by separate Dawbut's/AWI project.
- Dawbut's to undertake statistical analysis of the results to show basic statistics as well as concordance to compare validity of new protocol test.
- In conjunction with ParaBoss, contribute to the design and set up an applicable database program that can record the desired information, run queries, generate individual property reports detailing worm test histories and allow on-line website access.
- Enter all data into the database including worm test analysis and trial information.
- Plan, coordinate and deliver educational activities (ASHEEP 2, MFS 4) to the membership detailing local trial results, database updates and best practice worm management.

- Deliver regular update (via email / website / face book) alerts every two months on current WEC and likely hot-spots to provide an early warning system to sheep producers.

Results

Monaro Farming Systems

- a) Grow the number of WEC tests and increase engagement of farm businesses undertaking regular worm test monitoring from 244 to 800 (an increase of 556), and farm business from 28 to 40.
 - 757 WEC tests and engaged 57 businesses.
- b) Design, develop and maintain a simple database to improve the recording of WEC results i.e. property location, WEC, class of sheep, drench history and worm type.
 - The MFS website homepage hosts a live graphic showing the average WEC test result for the month as well as showing bar graph results for the previous 12 months with a “comment” area. It is linked to a google sheet meaning the graphic automatically updates as results are added in.
 - Initial investigation of a collaboration with ParaBoss on the development of a national database showed the activity would cost considerably more than budgeted. Instead ParaBoss undertook a feasibility study and developed a funding proposal for a future activity to develop such a database.
- c) Document/quantify the status of drench resistance to the ML, levamisole, closantel, monepantel, BZ chemical groups by conducting drench resistance tests (drench tests) on 15 farms with a good representation of the district climate, soil and pasture types. Testing from late 2018 will include these drench groups/actives: albendazole, levamisole, closantel, moxidectin, monepantel, abamectin, derquantel + abamectin. (Later changed to 22 tests in place of liver fluke trials)
 - Monaro Farming Systems carried out 22 successful drench resistance tests against helminths. This was 7 more than planned, but group demand was strong and funds from the lack of liver fluke trials were used here.

Drench Resistance Tests Results Tables

The following drench abbreviations apply to tables 1, 2 and 3:

Drench abbreviations: BZ=benzimidazole; LV=levamisole; MX=moxidectin; CL=closantel; MP=monepantel; DQ=derquantel; AB=abamectin; BZ/LV=benzimidazole/levamisole; BZ/CL=benzimidazole/closantel benzimidazole, AB/CL=abamectin/closantel benzimidazole, BZ/AB=benzimidazole/abamectin; LV/AB=levamisole, abamectin; BZ/LV/MX= benzimidazole, levamisole, moxidectin; BZ/LV/AB= benzimidazole, levamisole, abamectin; BZ/LV/AB/CL= benzimidazole, levamisole, abamectin, closantel.

Table 1. The percent efficacy of drench actives or groups to *Haemonchus contortus*. Blank spaces indicate either a test was not carried out or the test was not considered valid due to limited data (that is, the proportion of the particular worm was very low).

Farm	BZ	LV	MX	CL	MP	DQ/ AB	AB	BZ/ LV	BZ/ CL	AB/ CL	BZ/ AB	LV/ AB	BZ/L V/MX	BZ/L V/AB	BZ/L V/AB /CL
1	100	100	100	100	100			100					100		
2	88	100	78	100	100			100					100		
3								0							
4	100	100	100	100	100			100					100		
5	67	100	59	42	100			100					100		
6	51	100	35	100	100			100					100		
7	81	99	69	94	100			100					100		
8	82	100	100	87	100			100					100		
9	79	100	93	100	100			100					100		
10	89	100	100	100	100			100					100		
11	100	100	100		100	100	100	100			100	100	100	100	
12	70	99	33	99			0	100			70	99	100	100	100
13	77	100	97	100	100	100	61	100		100	100	99	100	100	100
14	81	84	85	13	100	100	46	97			90	91	100	98	99
15	90	98	58	99	100	0		99	100				100		
16	87	100	85	98	100	100	0	100			87	100	100	98	100
17															
18	67	99	59	95	100	100	15	100			72	99	100	100	100
19	85	100	19	98	100	100	35	100			90	100	100	100	100
20	78	100	70	92	100		0	100			78	100	100	100	100
21	0	97	0	0	100	100	25	97			0	97	97	97	97
22	62	100	0	80	100	99	0	100	92	80	62	100	100	100	100

Table 2. The percent efficacy of drench actives or groups to *Trichostrongylus spp.* Blank spaces indicate either a test was not carried out or the test was not considered valid due to limited data (that is, the proportion of the particular worm was very low).

Farm	BZ	LV	MX	CL	MP	DQ/ AB	AB	BZ/ LV	BZ/ CL	AB/ CL	BZ/ AB	LV/ AB	BZ/L V/MX	BZ/L V/AB	BZ/LV/ AB/CL
1	100	83	100	2	100			100					100		
2	27	67	100	0	100			76					100		
3	79	100	100	4 2	100			100					100		
4	52	100	100	4 3	100			100					100		
5	31	84	100	2 0	100			89					100		
6	72	0	100	0	100			72					100		
7	83	72	100	7 1	100			95					100		
8	100	100	100	1 3	100			100					100		
9	0	86	100	0	100			100					100		
10	77	0	100	0	100			77					100		
11	91	100	100		100	100	100	100		100	100	100	100	100	100
12															
13	95	99	99	4 2	100	100	100	100		98	100	100	100	100	100
14	85	88	100		100	100	100	98			100	100	100	100	100
15	100	94	100	5 5	100			100	100	0	0	0	100	0	0
16	100	100	100		100	100	100	100	0	0	100	100	100	100	100
17	29	93	100		98	97	100	92	0	0	100	100	100	100	100
18															
19															
20															
21	0	18	0		100	98	0	18			25	39	18	39	18
22															

Table 3. The percent efficacy of drench actives or groups to *Teladorsagia circumcincta*. Blank spaces indicate either a test was not carried out or the test was not considered valid due to limited data (that is, the proportion of the particular worm was very low).

Farm	BZ	LV	MX	CL	MP	DQ /AB	AB	BZ/ LV	BZ/ CL	AB/ CL	BZ/ AB	LV/ AB	BZ/L V/MX	BZ/L V/AB	BZ/LV/ AB/CL
1	26	76	57	1 1	100			82					92		
2	30	92	67	0	100			94					98		
3	28	100	100	8 7	100			100					100		
4	83	100	100	1 2	100			100					100		
5	56	83	81	8 7	100			93					94		
6	62	0	96	0	100			62					98		
7	5	85	100	7 0	100			86					100		
8	100	100	100	3	100			100					100		
9	0	96	90	1 6	100			96					100		
10	56	48	100	0	100			77					100		
11	81	98	100		100	100	100	100			100	100	100	100	100
12	93	75	100				100	98			98	100	100	100	100
13	56	89	98	6 8	100	100	95	95		98	98	99	100	100	100
14	69	19	100		100	100	100	75			100	100	100	100	100
15	94	94	100	6 5	100			100	98				100		
16	100	100	76		100	96	100	100			100	100	100	100	100
17	22	86	80		97	98	96	89			97	99	98	100	100
18															
19	51	95	100		100	100	100	98			100	100	99	100	100
20	12	47	71		100		100	53			100	100	86	100	100
21															
22	0	61	100		100	99	100	61	65	100	100	100	100	100	100

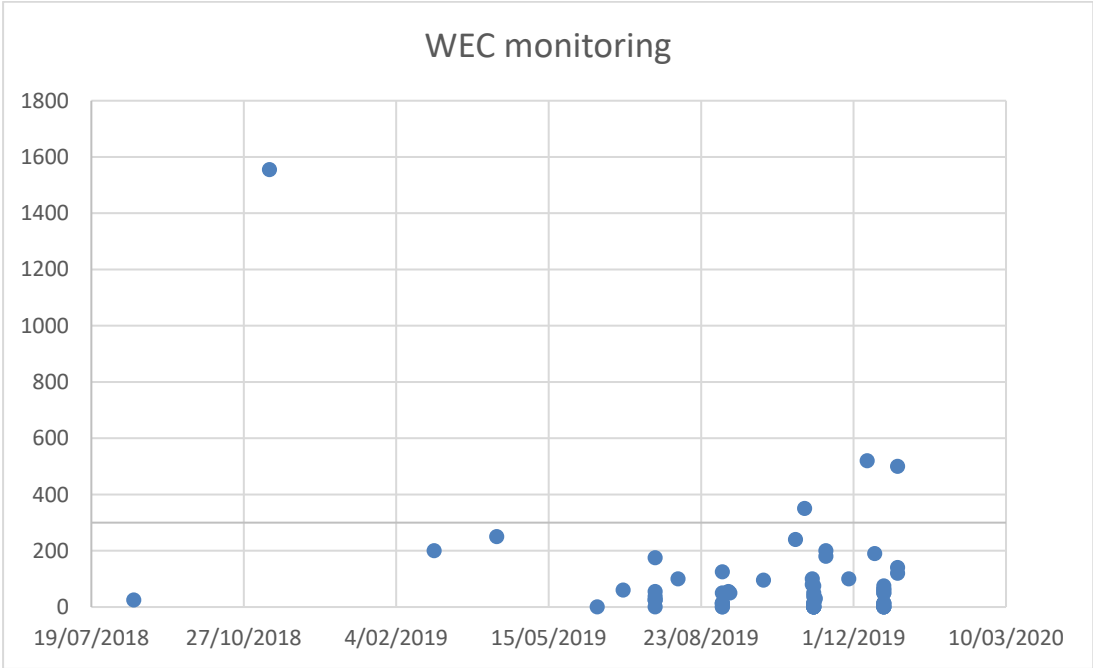
- d) Document/quantify the status of liver fluke resistance in sheep to triclabendazole by conducting drench tests on 3 farms.
- Only one farm was able to successfully test for drench resistance in liver fluke. Triclabendazole was tested and it was found to be completely ineffective.
 - A further two farms had positive counts, but the level was considered insufficient to carry out a meaningful egg count reduction test. No other properties were found with fluke counts.
- e) Document all trial data and results into the database to record status and changes in WEC and worm types.
- Trial data was collected and provided, and worm egg counts were added to the group database, with a summary of results displayed on their website.

- f) Assist in the validation (with Dawbutts) of the sensitive drench test to provide a cheaper and more practical way of testing drench resistance in sheep.
 - All samples used in the Drench Resistance Tests were tested through Dawbutts and used in the Mini Flotac trial.
- g) Promote best practice worm management for south-east NSW Monaro via monthly “worm alert updates” giving forecasts, latest test results, recommendations, etc. available from group websites and via ParaBoss monthly State Outlooks.
 - Worm alert updates were live on the MFS website using ongoing test results.
- h) Deliver a series of educational, training and information activities to show case the initiative to core farm businesses and observer producers to increase confidence, awareness and capacity to integrate regular worm management protocols into their farm enterprise. Four events to 65 core businesses and 200 observers show casing “Worm Club” initiative
 - MFS delivered three main presentations at field days showcasing updates and then final results. Each of these field days were attended by approximately 45-55 producers.
 - Field Day presentations over the life of the project included
 - 6 April 2018 – Update (Richard Taylor, Chair MFS)
 - 10 April 2019 – Update (Dr Matt Playford, Dawbutts)
 - 11 September 2019 – Final Results (Richard Taylor, Chair MFS)
 - AGM report – 2019: War on Worms Project Page
 - MFS Website – Project page <https://www.monarofarmingsystems.com.au/waging-the-war-on-worms/>

ASHEEP

- a) Increase WEC tests carried out by farm businesses by 50% (base level to be determined in March 2018 census)
 - Sixty-one worm egg counts were conducted across eight properties throughout the year to monitor for worms with the following being the number of tests for each of the eight properties: 1, 1, 1, 1, 4, 6, 9, 38; the latter was a large corporate farm over 20,000 hectares running many more sheep than other properties. A further two properties, encouraged by the project, conducted their own tests on-farm, but did not provide the number of tests done.
 - Initial and follow up surveys to determine level of WEC use was included in the annual ASHEEP survey, see Table 8. The responses to the question: Do you conduct regular worm egg counts? indicated a small increase in WEC use over the project starting at 46% of members in 2017, 50% in 2018, and 53% in 2019. By national standards, this would already be considered as a fairly high rate of adoption.
 - Far fewer WEC tests were collected than anticipated as the very dry seasonal conditions in the region resulted in very unfavourable conditions for worms, and therefore a much-reduced need to even WormTest. The following graph shows the tests that were conducted. Very few results were above the drenching threshold of 300 epg, further supporting that seasonal conditions did not indicate a strong need for testing.

Table 4. Worm egg count results from participating properties during the project.



- b) Contribute to the design and development, and have responsibility for the data entry into, a simple database to improve the recording of WEC results i.e. property location, WEC, class of sheep, drench history and worm type.
 - Data from monitoring WEC were collated into an excel database.
 - Initial investigation of a collaboration with ParaBoss on the development of a national database showed the activity would cost considerably more than budgeted. Instead ParaBoss undertook a feasibility study and developed a funding proposal for a future activity to develop such a database.
- c) Document / quantify the status of drench resistance to the ML, levamisole, closantel, monepantel, BZ, monepantel/abamectin chemical groups by conducting drench resistance tests (drench tests) on 15 farms with a good representation of the district climate, soil and pasture types.
 - ASHEEP carried out 3 successful drench resistance tests against helminths.

Table 5. The percent efficacy of drench actives or groups to *Haemonchus contortus*. Blank spaces indicate either a test was not carried out or the test was not considered valid due to limited data (that is the proportion of the particular worm was very low).

Farm	BZ	LV	MX	CL	MP	DQ/AB	AB
1							
2	100	100	100	100	100		100
3							

Table 6. The percent efficacy of drench actives or groups to *Trichostrongylus spp.* Blank spaces indicate either a test was not carried out or the test was not considered valid due to limited data (that is the proportion of the particular worm was very low).

Farm	BZ	LV	MX	CL	MP	DQ/AB	AB
1	54	0	100		99	100	100
2	89	96	100		100		100
3	4	0	100		100		100

Table 7. The percent efficacy of drench actives or groups to *Teladorsagia circumcincta.* Blank spaces indicate either a test was not carried out or the test was not considered valid due to limited data (that is the proportion of the particular worm was very low).

Farm	BZ	LV	MX	CL	MP	DQ/AB	AB
1	11	12	2		100	89	0
2	43	74	88		100		100
3	23	63	100		100		100

- d) Document all trial data and results into the database to record status and changes in WEC and worm types.
 - All data was added to the group excel database.
- e) Assist in the validation (with Dawbutts) of the sensitive drench test to provide a cheaper and more practical way of testing drench resistance in sheep.
 - All samples used in the Drench Resistance Tests were tested through Dawbutts and used in the Mini Flotac trial.
- f) Promote best practice worm management for southern Western Australian districts via at least 2-monthly "worm alert updates" giving forecasts, latest test results, recommendations, etc. available from group websites and via ParaBoss monthly State Outlooks.
 - Worm alerts were minimal as seasonal conditions indicated a limited need for both testing and drenching. Instead these topics were presented at the regular ASHEEP meetings.
- g) Deliver a series of educational, training and information activities to showcase the initiative to core farm businesses and observer producers to increase confidence, awareness and capacity to integrate regular worm management protocols into their farm enterprise. Two events to 30 core businesses and 100 observers
 - Extension was delivered at field days throughout 2019 based on results from 2018. Delivery was conducted by ASHEEP and representatives from Elanco gave further information regarding drench resistance with a wider industry perspective.
 - A direct email was sent to 175 members in early 2018 advertising the project and seeking participants.
 - 4 Facebook posts were posted highlighting activities in the project. (Reach 1128, engagements 120).

- In 2018, presentations and updates were given at meetings March 2018, (~40 attendees), June 2018, (~60 attendees), September 2018, (~70 attendees). Topics covered: Information about the project and invitation to participate, importance of knowing your drench resistance status, the impact of a drench group with 80% effectiveness—long- and short-term implications.
- ASHEEP intends to include final project results in the annual Autumn Sheep Field Day in March 2020. The group were unable to conduct resistance tests until December 2019 when the project finished. Plans for the field day include paddock walks and guest speakers as well as a detailed review of the resistance tests conducted through this project and key findings. Average attendance is between 30 and 50 people.
- There has been an information page on the ASHEEP website dedicated to this project <https://www.asheep.org.au/wormboss-drench-resistance-project>.
- ASHEEP runs an annual census of its members. This table shows the questions asked in relation to worm control in 2017, 2018 and 2019, and the results.

Table 8. ASHEEP Survey (worm questions and responses) 2017, 2018, 2019.

	2017 Census	2018 Census	2019 Survey
Number of respondents	18 online	17 online	17 online
How would you rate your knowledge of worm control?	Average rating of 60 (on scale of 0 - 100, 0 = Poor, 50 = Average, 100 = High)	Average rating of 60 (on scale of 0 - 100, 0 = Poor, 50 = Average, 100 = High)	Good = 58.2%, Average = 35.29%, Below Average = 5.88% (note change of scale)
Do you conduct regular worm egg counts?	46% Yes, 46% No, 8% Other (as required with other husbandry observations)	50% Yes, 43% No, 7% Other	52.94% yes, 47.06% no
Do you currently rotate your drenches based on the chemical group?	77% Yes, 23% No (one 'no' was planning to)	85% Yes, 14% No	76.47% yes, 23.53% no

Table 9. Additional worm questions and responses included in the 2019 survey.

Question	Farmer's response
<i>Q. Did you experience issues with drench resistance in 2019?</i>	100% of respondents answered No
<i>Q. What worm topics / areas would you like to know more on?</i>	<ul style="list-style-type: none"> • Barber's pole on perennials • I would just like to expand my knowledge of worms in sheep and in particular best times for drenching • Refugia • There is a new school of thought on when the product you are on is still working well, then stay on it. I think this applies mainly to combination products. Might be worth a look • Best drench rotation options • Identify worms under microscope for DIY FWEC • Drench resistance including whether any resistance to barber's pole in WA

Discussion

Did this project accelerate adoption, will that adoption be sustained and were the desired outcomes for farmers (as described in the introduction) achieved?

Overall the Monaro Farming Systems group achieved a high rate of adoption, exceeding their project aim. Conversely, adoption of testing, both WEC and Drench Tests in the ASHEEP group was much lower than their project aim.

To understand the disparity and to assess whether investments should be made in similar projects, key elements and impacts on the project need to be considered, in particular:

- Use of subsidies in achieving initial adoption
- Direct support from group staff and pre-existing motivation by producers
- Relevance of local results
- Seasonal conditions during the project

Subsidies

As full or part subsidies were provided for WEC and drench testing costs for both groups, these alone were not enough to achieve adoption in the ASHEEP group. However, in conjunction with other factors they appear to have been useful in the MFS group. The cost of testing is considered to be one (but not the only) impediment to its uptake and that without uptake the users have not yet seen the value of the practice. Therefore, the use of subsidies aims to overcome this issue and allow the user to enjoy the benefit of the practice at a low cost so that they are in a position to weigh up the value of continuing the practice.

In this project, it was up to each group to identify and provide supporting information through publications or presentations. Being provided with free tests will not automatically provide the insight and knowledge required to make best use of them in the future. In this instance it is not known whether the information they have received, combined with direct participation, has allowed the participants to recognise the full value of the practices to their enterprise, however activities were completed and the following feedback was received from the MFS board:

“MFS has demonstrated an increased awareness of resistance testing on farm, with a desire from producers to determine their flock resistance status, and proactively manage this into the future.”

Further projects might not leave this to chance, but determine what specific information/presentations and other support (e.g. personal advice) would be required to ensure participants gain a full understanding of the benefits of the practice to their business so that initial adoption momentum is continued.

Group support and producer motivation

Both groups had staff to liaise with their members, and to arrange and assist with testing, however, the pre-existing motivation varied considerably. Monaro Farming Systems group was the initiator of this project; they already were a large active group, had a Worm Club, and an Executive Officer and members who were already driving worm-related activities before the project.

In contrast, the ASHEEP group were requested to participate with no lead time, the group previously did not have a particular focus on worm management, the staff had no special knowledge of or special interest in the topic at the start of the project, and members had not been specifically requesting worm management activities. They did, however, have a supportive local veterinary clinic: Swan’s Veterinary Services, able to provide WEC tests and who was already a contributor to the ParaBoss monthly news reports and the project.

Both groups had project and executive officers who did a good deal to become familiar with the requirements of the project so as to support it.

In agriculture, adoption projects initiated by producers themselves appear to be favoured by research organisations on the basis that the motivation of the initiators drives the project. With this in mind the two groups in this project had a clear contrast. ASHEEP staff have done their best under the circumstances, but may have been less likely to achieve the aims as the group members themselves had not driven a process to seek participation in the project.

Local relevance

Local adoption projects promise regional relevance in regard to the specific outcomes. But they also offer familiarity and collegiality. If it is your group or your friend, neighbour or local business participating, people tend to value the results more highly. In this project, the author’s opinion is that the data from the MFS drench resistance trials is particularly locally relevant. While there are national trends regarding drench resistance, there are also regional differences. In particular, the Monaro region has some unique conditions regarding worms—a much higher incidence of barber’s pole worm than other inland regions in southern Australia—and therefore the drench resistance picture for them provides very useful data, not just for participants, but for other group members, and indeed, non-group members in the region.

Unfortunately, there were only three drench tests for ASHEEP, however, this group also has some climatic and regional uniqueness—further drench test results likely would have been very useful to all producers in the region.

On the downside, local projects run by producer groups have limitations on their rigour, due to time, cost and expertise restraints. Data outputs may not be reliable. In this case, with the assistance of farmers by the groups’ officers and testing occurring through Dawbuts, a good level of reliability would have been achieved with the drench tests results. However, other data collected to support the value of the practices would be limited, likely be biased and could not be relied upon.

The author believes that local trials conducted by groups are a useful means to increase the relevance of results, but are not ideal for the collection of reliable objective production and economic data.

Seasonal conditions

What happens on farms is heavily dependent on seasonal conditions. While these were reasonable when the project commenced, they declined rapidly with widespread drought in Australia. MFS were able to conduct many of their tests while there was still residual worm contamination of pastures; a prerequisite for sheep to be infected, driving both monitoring tests and a minimum level of infection for a drench resistance test.

ASHEEP started later and there was already a much lower threat from worms. The ASHEEP graph of WEC tests shows that the tests completed had relatively low worm egg counts. The seasonal conditions around Esperance in both 2018 and 2019 shows many months of rainfall very much lower than historic monthly rainfall averages; as such, there was a much lower need for monitoring WEC tests and this has been the most likely cause of lesser interest and adoption of subsidised tests by group members. It has also meant that prerequisite minimum egg counts required for drench tests were not being met, and so tests could not proceed.

MFS were also supposed to conduct 10 drench tests for fluke, but only conducted one. This was also partly seasonal, because conditions did not favour fluke, but may well have been based on an overestimation of the likely incidence of fluke on farms in the region, because real incidence was unknown. No testing of fluke was planned for ASHEEP as it is known they do not occur in their region.

As such, projects of this nature that are heavily dependent on seasonal conditions can expect poor results when the seasonal conditions are not conducive to the planned activities; in the author's experience, these are real and frequent issues. Provided funders are prepared to review and alter project plans accordingly or have contingencies built in from the beginning to account for possible seasonal changes, then the best use of funds can still occur. In this project funds to carry out fluke tests by MFS were transferred to more helminth tests with agreement by the funder. Later milestone payments by ASHEEP have not been invoiced and will be returned to AWI.

Whether initial adoption in this project will lead to continued use of the practices cannot be gauged as it is a short-term project. Subsequent follow up after at least one or two years would be required, although it is difficult to build such follow up evaluation into projects of this nature. Nevertheless, funders might consider how it may be done in future.

Considering the factors above, were the desired outcomes for farmers achieved?

Some of the outcomes have been successfully achieved, but as described above, a short-term demonstration project cannot reliably assess the desired longer-term adoption outcomes that are influenced by many factors. The participants in this project will still need to weigh up the benefits they saw against costs and workload, particularly in varying seasonal conditions. They will also need to learn how to best implement the practices into their system, which, with the worm egg counts, may take a year or two to refine.

While the author and many others consider these practices of high value, the complexity of worm management is such that it is often a longer journey to this realisation, rather than a day-trip. If worm management was easy, there would not be the need for such projects.

Let's look at each desired outcome

- a) Adoption of WormBoss practices of WEC and Drench Tests will improve worm (and liver fluke for NSW) control decisions on pasture management / rotations, drench choice and drench programs;
 - With the strong group ethos and staff and financial support under suitable seasonal conditions, combined with multiple presentations and communications, it is likely that a reasonable number of both participating and onlooking MFS members will adopt these practices to assist them to make sound worm management decisions than if the project

had not occurred. Feedback from the MFS board supports this:

“Through continued field day analysis of WEC and larval differentiation results, growers have reported greater uptake in routine worm testing within flock, and the increased utilisation of tools such as ParaBoss for control and risk mitigation advice. MFS has demonstrated an increased awareness of resistance testing on farm, with a desire from producers to determine their flock resistance status, and proactively manage this into the future.”

- Considering the contrasting situation of the ASHEEP group, as described earlier in this document, this project is likely to have a lower impact on adoption there.
- b) Access to a comprehensive, district specific, data set will provide material for local discussions and planning.
- This has been fully realized by MFS, but unsuitable seasonal conditions have resulted in a limited dataset for ASHEEP.
- c) Access to local alerts and an early warning system from WEC and Drench Tests will help to avoid risks from clinical worm infections;
- Again, this has already been fully achieved by MFS. In conjunction with a proactive group who were already investigating such a database and display of results before the project, the project has helped them toward this aim. ASHEEP, by virtue of poor seasonal conditions, but also because they did not have an already established desire to do this, have not attained this goal and the financial incentives were of no use when there were significant seasonal obstacles.
- d) Protection of new and emerging drench technologies;
- This outcome cannot be properly evaluated within the life of this project. Nevertheless, presentations within each group have highlighted the issues and so these groups are better informed as a result of the project. MFS members have the benefit of a drench test dataset that identifies (specifically for the individual participant, but also broadly for onlookers) the efficacy of drench groups and actives in their region and this gives them a head start over others without this data in making the right drench choices to protect new and emerging drench technologies. Feedback from the MFS board supports this:
“MFS has demonstrated an increased awareness of resistance testing on farm, with a desire from producers to determine their flock resistance status, and proactively manage this into the future.”
- e) 5–10% increases in overall farm profit per hectare due to increased weaner survival;
- This project did not have the monitoring structure or technical rigour in place to widely assess this, however the MFS board provided the following feedback for those participants:
“Due to timely testing and identification of worm burdens in weaners, particularly black scour and barber’s pole, it is estimated weaner deaths have decreased by 5–10% across flock. In a reported scenario of 1100 lambs on a 490 HA farm, this resulted in an estimated 55–110 more saleable and shearable lambs. The direct benefit of this to gross margin is estimated to be \$5,000–\$8000 per annum based on an average of \$150 revenue per head in 2018/19. This combined with increased animal performance and feed efficiency equated to a 5–10% profitability increase across the lamb enterprise.”
- f) Better understanding of the barriers to WEC and Drench Tests informing ParaBoss extension and adoption activities.

- This project has highlighted that when seasonal conditions are suitable and the participants have driven the process, activities that support farmers to adopt practices (specifically in this project financial assistance and organisation and management to assist people to conduct drench tests) do result in increased adoption and understanding of management practices.
- The author has conducted a similar project through another funder, which had similar results and supports the conclusions and recommendations from this project.

Impact on Wool Industry – Now & in 5 years’ time

This project will have a reasonable beneficial impact on the MFS group members, but it is unlikely there will be as significant an impact on the ASHEEP members due to poor seasonal conditions that occurred during the project making use of the intended technologies inappropriate or not possible. The activities included limited extension and communication to wider audiences, so it is expected to have an equally limited impact on other producers. However, the nature of the project is that it is aiming to predominantly impact those in the immediate region. With that and the seasonal conditions in mind, it should be considered successful in providing a long-term beneficial impact for the MFS group.

Conclusions and Recommendations

Project

This project has demonstrated that supporting producer groups to adopt beneficial practices can be a successful method to achieve increased adoption and at the same time provide data and information of local relevance. However, various factors should be considered to maximise the likelihood of success.

- When providing direct financial subsidies for adoption of practices to farmers, ensure that other co-requirements, such as specific information and other support (e.g. personal advice) are provided so that participants gain a full understanding of the benefits of the practice to their business and have the skills and knowledge to continue the initial adoption momentum.
- Ensure that the activities are achievable and realistic for farmers, particularly in regard to collection of data to demonstrate levels of adoption and farm outcomes.
- Projects that may be affected by seasonal conditions should include flexibility to adjust or delay activities, and may, from the start, detail such contingencies.
- Performance indicators should be realistic in terms of short-term adoption, and funders might consider how to collect longer-term adoption data beyond the life of the project.

Technical

The project results have confirmed the long-held WormBoss message that while the results of drench resistance tests do have some common regional or national trends, there can be considerable differences in efficacy of the older actives, particularly against barber’s pole worm.

In particular, for the MFS group, these conclusions were made:

- All farms had some drench resistant worms.
- Results are farm-specific; to really understand the status on a property, a drench resistance test there is critical.
- Barber’s pole worm was present on almost all farms tested in the Monaro and accounted for 60% of the overall egg output. Barber’s pole is the major worm issue for producers in the Monaro district.

- Barber's pole worm has the most control options, but there is a high level of resistance to the mectins. Levamisole is still effective on a large proportion of farms (>90%) and closantel was still effective on 60% of farms.
- The newer Zolvix® and Startect® drenches are working on all farms that were involved in the trials.
- Triple (BZ/Lev/ML) combination drenches were effective on most, but not all of the farms.
- BZ/Levamisole combination resistance was very prevalent.

The Drench Resistance tests carried out by ASHEEP, although much fewer, also confirms that all farms have some drench resistant worms and results are very farm specific. However, with only three properties included, it is best not to draw regional conclusions.

Bibliography

Not applicable.

List of Abbreviations and/or Glossary

WEC: worm egg count

Abbreviations used for drenches:

- BZ: benzimidazole
- LV or LEV: levamisole
- Ab or Aba: abamectin
- Cl or clos: closantel
- Moxi: moxidectin
- Mon: monepantel
- Der: derquantel
- ML: macrocyclic lactone