



THE UNIVERSITY OF
WESTERN AUSTRALIA
Achieving International Excellence

SCHOOL OF AGRICULTURAL &
RESOURCE ECONOMICS

Economics of controlling blackberry in agriculture

Morteza Chalak and David Pannell



Invasive species and agriculture

- Weeds dramatically reduce agricultural productivity

Costs to Australian farmers

\$1.5 billion a year in weed control activities

\$2.5 billion in lost agricultural production .





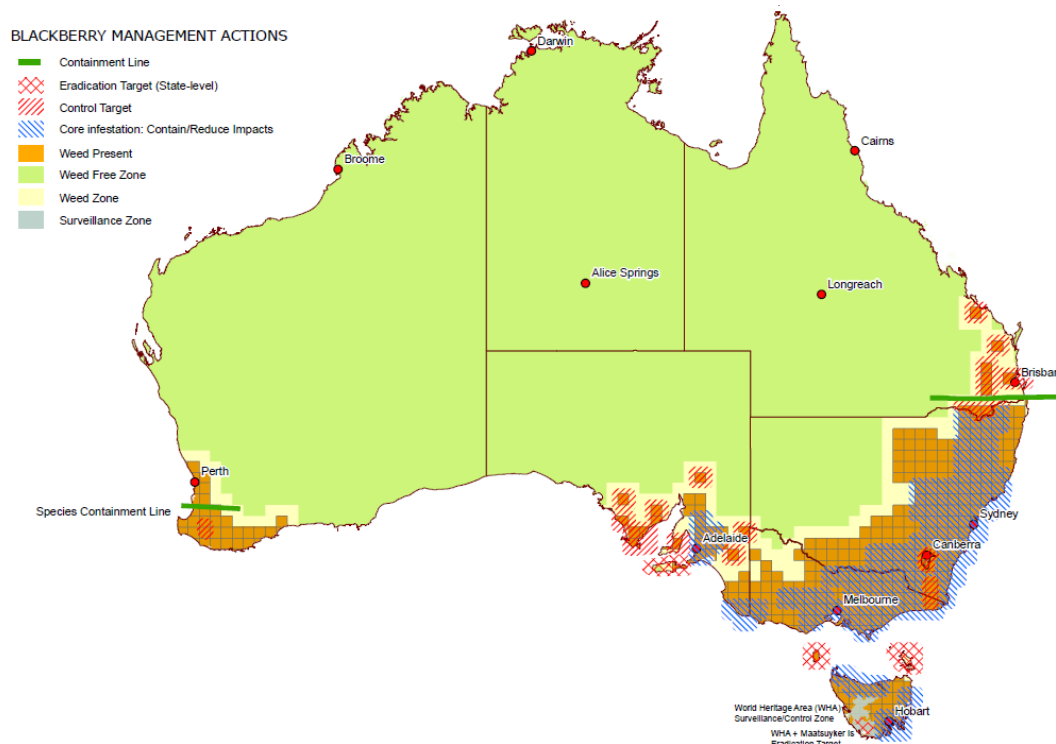
Blackberry

- Blackberry is considered a significant weed in Australia because of the extent of its negative impacts.
- The annual production losses and control costs are estimated at least \$70 million.



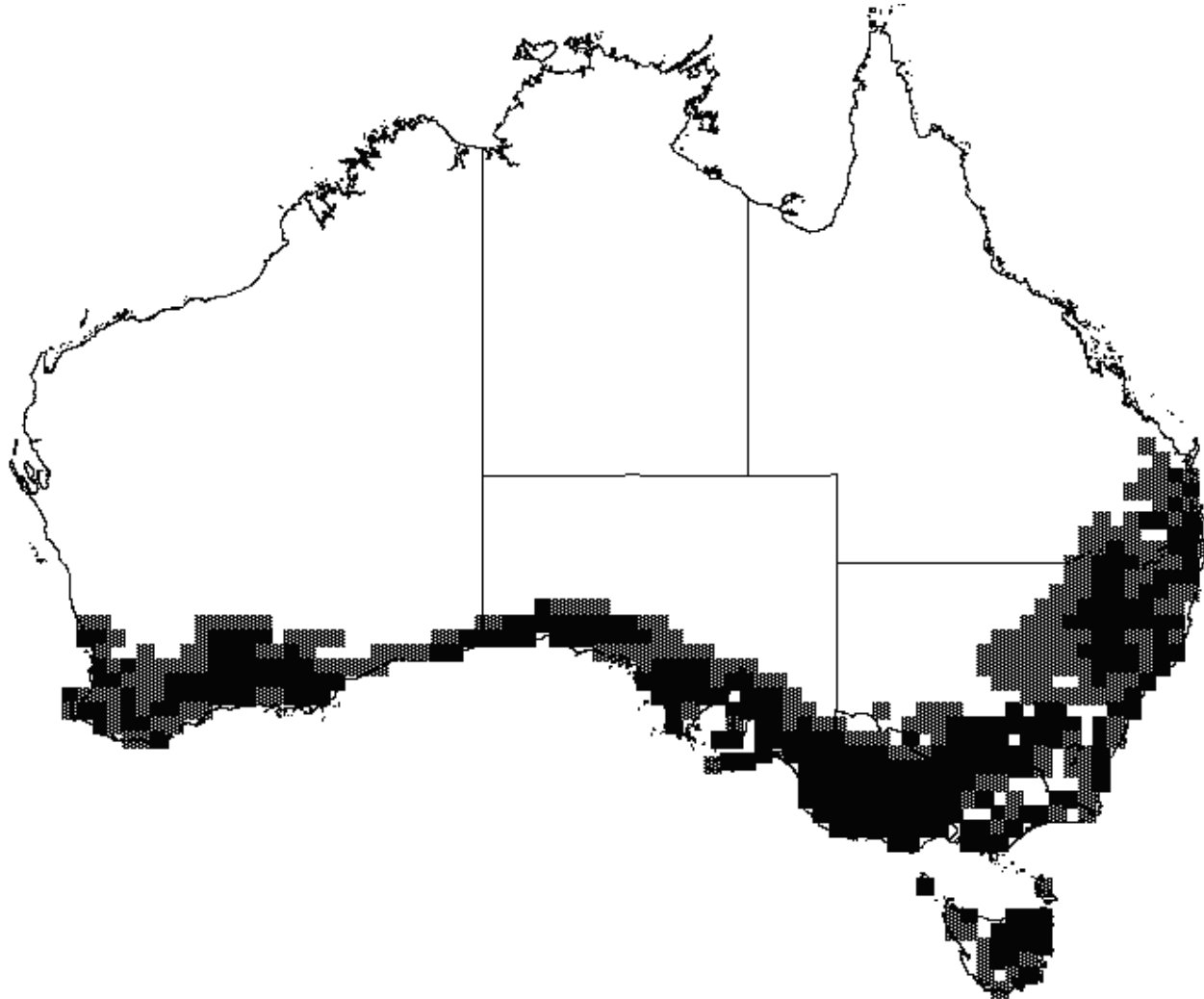


Blackberry weed spread in Australia





Potential distribution of blackberry





Blackberry in agriculture

Reduce ... *for example*

- Animal production



- Crop production





Blackberry control occurs in

Different bio-physical
conditions

Different accessibility
& different labour costs

Different forage production

Different levels of
infestation



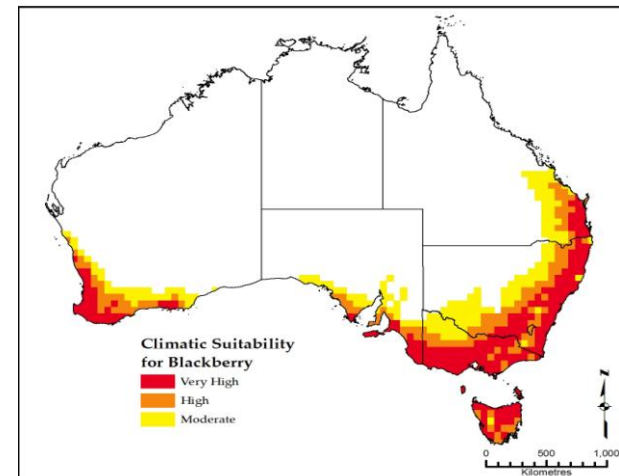
Questions:

What are the optimal strategies for the control of blackberry in sheep production pasture with different

Forage production

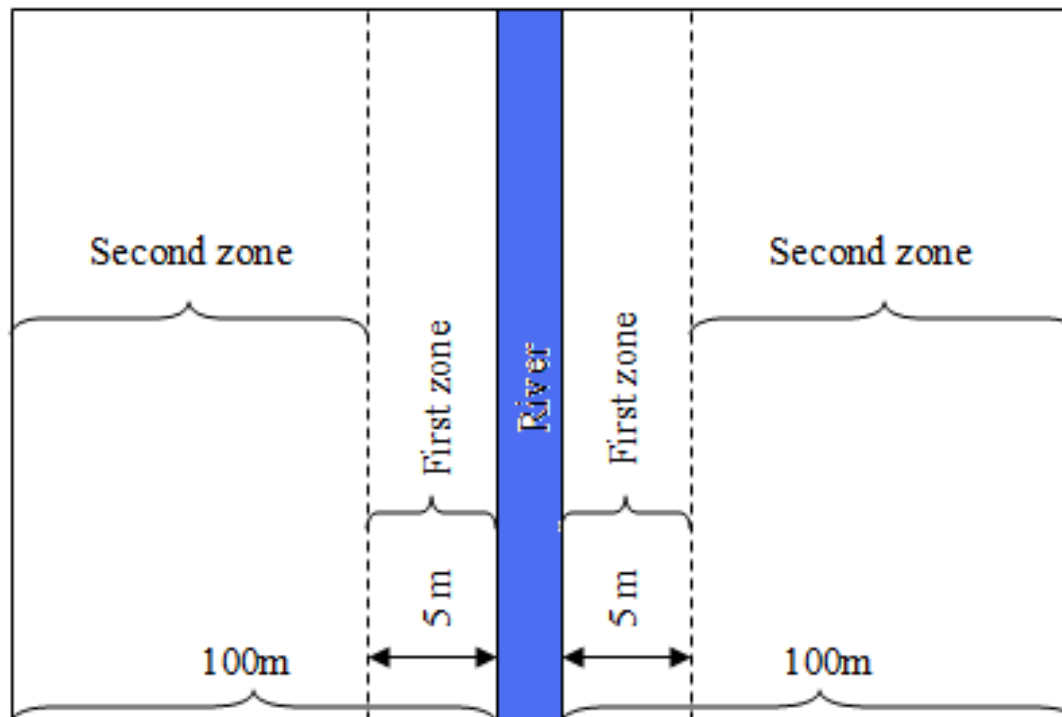
Labour costs

Weed densities



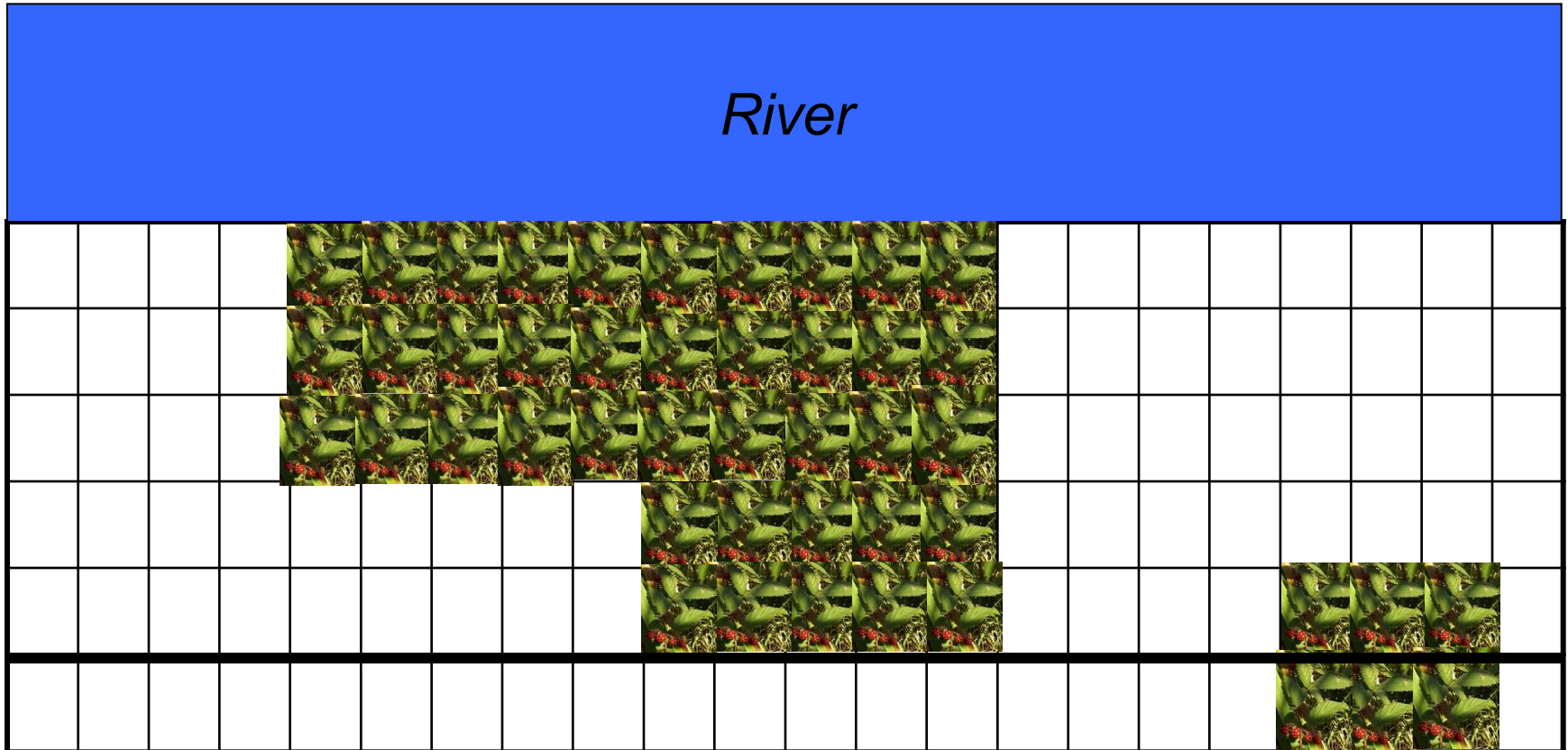


Weed dynamics





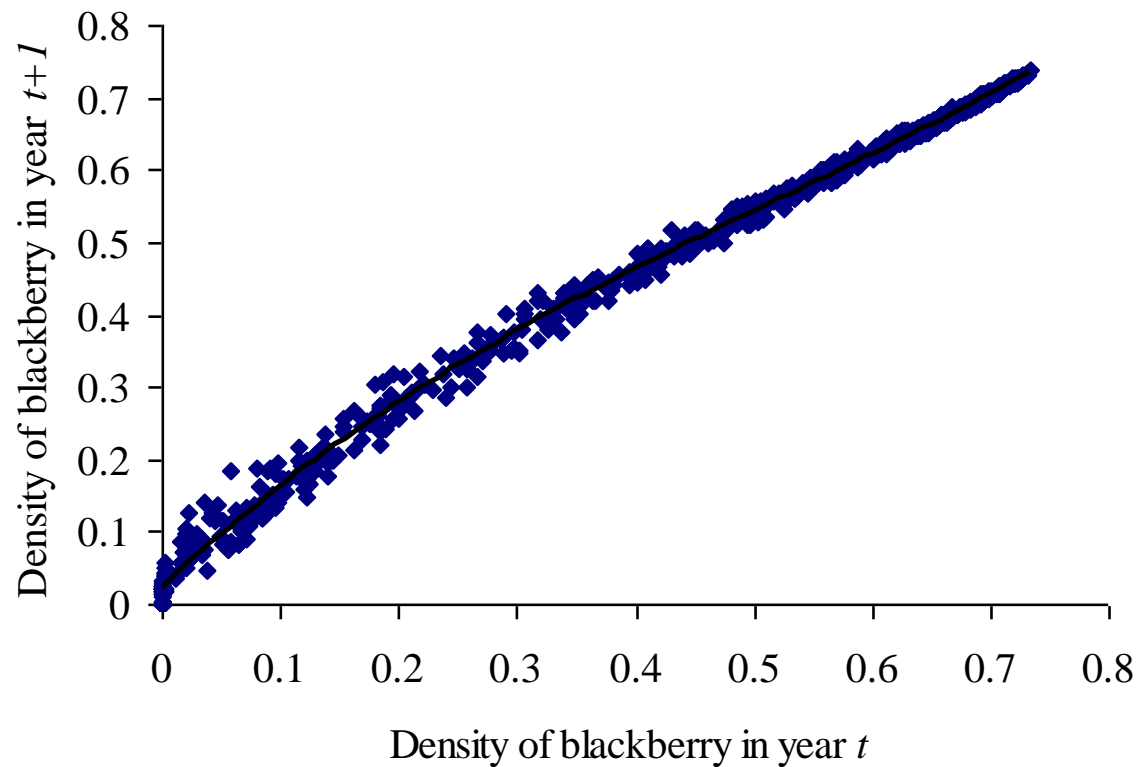
Agricultural weed



10 new infestations in 1000m X 100



Weed growth



$$w_{t+1} = (0.945w_t^3 - 1.46w_t^2 + 1.53w_t + 0.023) \cdot M(u_t)$$



Control options for blackberry

- Rust



- Triclopyr



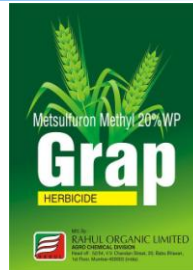
- Glyphosate



- Triclopyr plus picloram



- Metsulfuron-methyle



- Mowing



- Glyphosate plus Metsulfuron methyle



- Goat





Optimisation model

$$V_t(W_t) = \max_{u_t} \left[\beta_t(W_t, u_t) + \delta V_{t+1}(W_{t+1}) \right]$$

Subject to

$$w_{t+1} = (0.945w_t^3 - 1.46w_t^2 + 1.53w_t + 0.023) \cdot M(u_t)$$



Biological agent for blackberry:

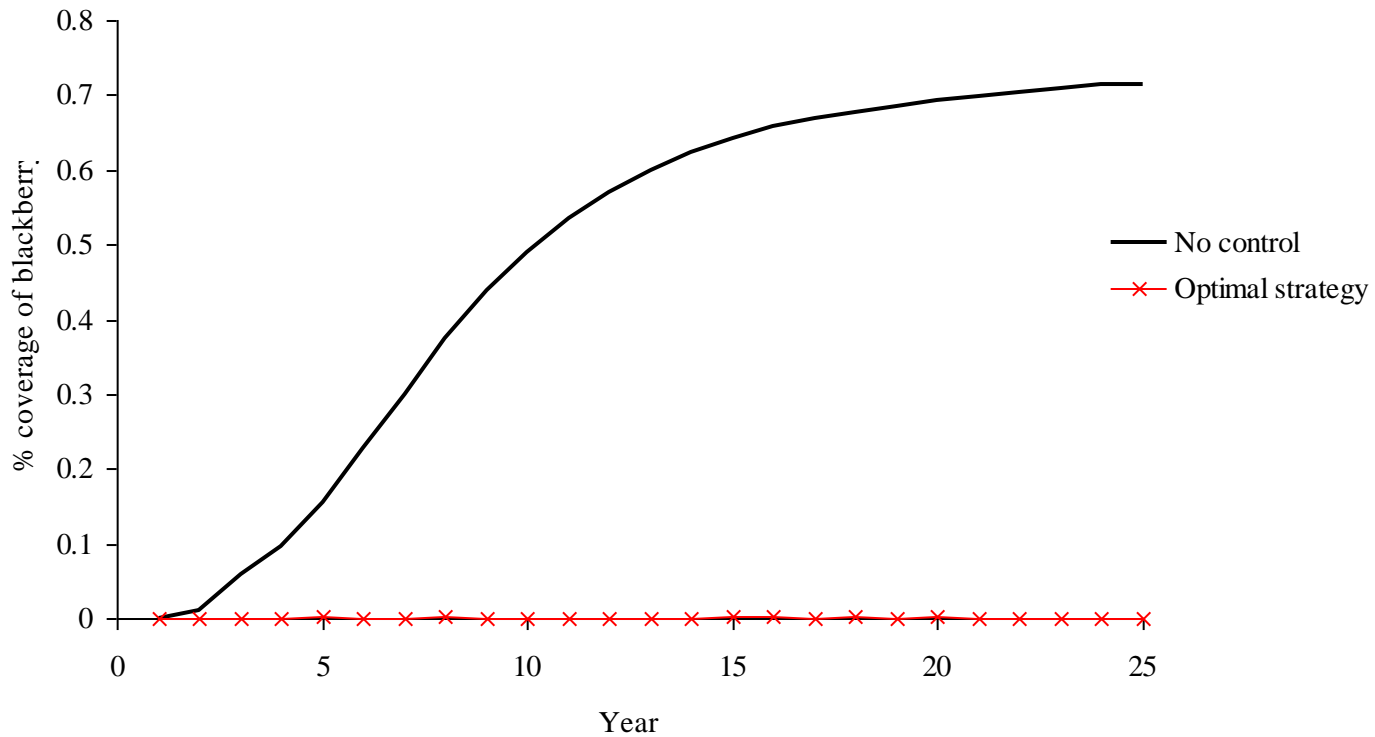
Looking at biological agent

- Rust has a very low effect on blackberry density (Mahr et al. 1998).
- Introducing rust only marginally increases NPV.





Weed density under optimal strategy and “no control”.





Optimal strategies

Table 1 Optimal strategies for different levels of potential forage production (λ) and initial weed densities (w , % cover of weed). The labour costs for chemicals are set at \$1500 ha⁻¹.

Annual yield of dry matter in the absence of weed, λ , (kg ha ⁻¹ yr ⁻¹).	Strategy 3	Strategy 8	Strategy 1
1000	0 < w < 8	8 < w < 15	15 < w
2000	0 < w < 10	10 < w < 41	41 < w
3000	0 < w < 13	13 < w < 70	70 < w
4000	0 < w < 15	15 < w	
5000	0 < w < 18	18 < w	
6000	0 < w < 20	20 < w	
7000	0 < w < 24	24 < w	
8000	0 < w < 26	26 < w	
9000	0 < w < 29	29 < w	
10,000	0 < w < 31	31 < w	

Strategy 1 and 8 are no control and mowing respectively. Strategy 3 is application of glyphosate plus metsulfuron methyle.



Optimal strategies

EF12>EF3>EF4>EF8

C12>C3>C4>C8

Table2: The optimal control strategies for Scenario 1 where there are no restrictions for the use of metsulfuron and picloram.

Initial weed density (% land infested)	Labour costs for spray 700 \$ ha ⁻¹			Labour costs for spray 2500 \$ ha ⁻¹		
	Chemical efficacies			Chemical efficacies		
	-20%	Base case	+20%	-20%	Base case	+20%
0-7	12	3	4	12	3	4
7-10	3	3	4	8	3	4
>10	3	3	4	8	8	8

St 3 glyphosate plus metsulfuron

St 4 metsulfuron methyle

St 8



St 12

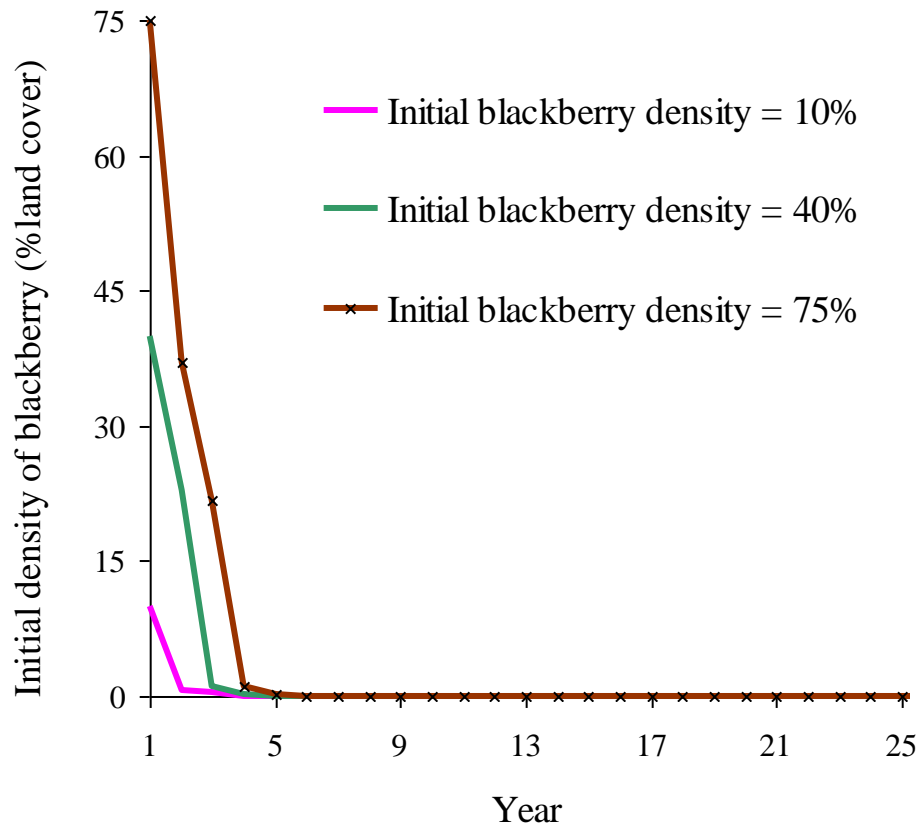
glyphosate plus metsulfuron

+





Trajectory of weed under optimal strategy





Conclusions

- Rust has a low impact on NPV.
- When the potential productivity of pasture is lower than 3000 kg ha⁻¹ for high weed densities the best strategy is “no control”
- With or without the rust option included, for a wide range of parameter values, glyphosate plus metsulfuron is optimal.
- When efficacy of chemicals increases, less effective and cheaper options become optimal.
- Labour costs, pasture productivity and weed density are important factors affecting optimal control strategies.



Thank you for your attention