Benefits and limits of farm animals to control herbage mass, pests and weeds in orchards: a review



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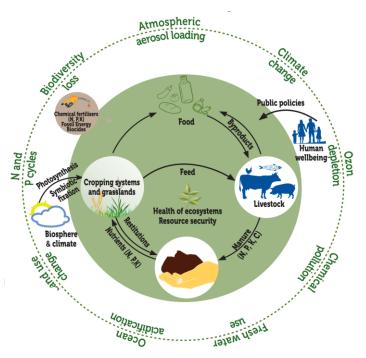






Background of the study

- Exploring synergies between livestock and crop sectors is seen as a promising way towards a more sustainable and circular European agriculture (ATF and Plant ETP, 2019, 2020)
- Initiatives aimed at reconnecting livestock and crop production at different scales are emerging, but remain scattered, making it difficult to assess and disseminate them
- The four GIS on agricultural sectors led by INRAE (Avenir Elevages, Grandes Cultures, Fruits et PIClég), in collaboration with ACTA and the thematic network on mixed-crop farming (RMT SPICEE), have joined forces to carry out a project focusing on the reconnection between crops and livestock (https://www.gis-avenir-elevages.org/Livestock-Farming-Future-Who-are-we/REVE-REconnexion-Vegetal-Elevage)

















Context and objectives

- One of the levers of the agroecological transition is the diversification of systems, in particular by reintroducing animals into systems specialized in field crops or arboriculture
- In this study, we focus on the introduction of animals into fruit and vineyard plots
- One of the assumed benefits of introducing animals into the plots is the control of herbage mass and weeds and the management of pests through biological regulation
- But animals can also cause damages on soil and vegetation

→ Make a comparative synthesis of the benefits and limits of different animals (small and large herbivores, poultry, pigs) to control herbage mass, weeds and pests in vineyards and orchards















Methods: 66 documents collected

23 Scientific publications



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« Chickens in orchards ». MIRAD project



« Rabbits in orchards ». LAPOESIE project



Photos: © INRAE - Sara Bosshardt



- 18 Technical publications or deliverables from R&D projects
- 23 Testimonies in in professional journals and in social media
- 2 Interviews conducted with ongoing experimental projects
- → Geographical distribution : France (40), EU (9), Rest of the world (17)













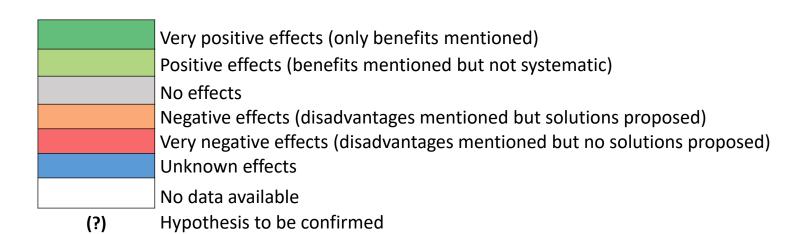


Methods: analysis of the documents

Construction of a matrix of the effects of animal species on orchards and vineyards:

- Ruminants (sheep, cows, goats)
- Poultry (chickens, geese, guinea fowl, ducks)
- Pigs
- Rabbits
- Equines (horses, donkeys)

- Herbage mass and grass cover
- Pests (rodents, insects and other invertebrates)
- Pathogens
- Auxiliary species
- Risks of damages to trees and soil



Numbers correspond to the number of documents

















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	- Grass consumption	37	7	11	14	9	(?) 5	(?) 1	(?) 2	10	5	1
Grass cover / soil fertility	- Exploring the plot	37	7	11	14	9	(?) 5	1	(?) 2	10	5	1
	- Appearance of refusals	14		1	3	3	(?) 2	(?) 1	(?) 2		1	
	Changes in plant diversity	3			2	2						
	-Thinning out the leaves	2										
	- Improvement in soil fertility (looser, more aerated soil) by scraping or trampling	1			3							
Pests	- Destruction of galleries by trampling	5		1						(?) 2		
	- Destroying galleries by excavating the ground									(?) 2		
	- Rodent consumption									(?) 2		
	- Reduction in the vegetation cover that protects rodents from natural predation	2		1						(?) 1		
	- Reduction of natural predation by rodents through the use of fences restricting access to plots of land				1							
	- Bio ogical regulation of plant pathogenic nematodes by other nematode species	1										
	- Cor sumption of insects, larvae or molluscs			2	(?) 13	4	4		2	(?) 1	1	
	- Cor sumption of infested fruit that has fallen to the ground	(?) 9		2	(?) 8	(?) 6	(?) 2	(?) 1	1	(?) 4		
	- Disturbance of insects by rubbing against trunks	2										
	- Disturbance to insect habitat and microclimate as a result of reduced grass cover				1	1	1					
	- Appearance of insect pests living in animal dung			1								
Auxiliary species	- Reappearance of auxiliary species (unknown mechanisms)	1										
	- Consumption of auxiliary species				(?) 2							
	- Changes in auxiliary species due to changes in flora	(?) 1										
Pathogens	-Reducing inoculum by trampling or eating dead leaves or fruit that has fallen to the ground	(?) 9			(?) 3	(?) 2				(?) 4	(?) 2	
	Reduction of inoculum by the degradation of dead leaves that have fallen to the ground thanks to urine (droppings in the case of poultry).	(?) 1			(?) 1	(?) 1				(?) 1	(?) 1	
	- Improving the microclimate by removing low branches	5										
	- Reduced risk of ascospore projection due to removal of low branches	2										
	- Improving the microclimate by removing the leaves from the vine shoots	1										
	- Root damage caused by "ploughing" the soil or scratching the surface				(?) 3		1			7		
	- Degradation of the tree by barking or pecking	17	3	2	(?) 6	3	3	1	2		2	
Risk of damages	- Damage to low branches caused by consumption, rubbing or leaning against the tree	18	5	4	3	3	2	1	2			
	- Consumption of buds, leaves or fruit	20	5	4	(?) 7	3	2	1	2	2		1
	- Damage to the trunk by pressure or friction	4		2	(?) 4	2	1	1	1			
	- Damage to the tree by perching				2		1					
Misk of dalliages	- Damage to vine shoots	1	1							1		
	- Soil degradation through compaction or the creation of ruts	13	2	4	2	1	1			7		
	- Appearance of bare soil	2			(?) 4							
	- Damage to fruit	1			(?) 2		(?) 1					
	- Damage to young plants	5	1	1	3	2	2	1	1			
'	- Degradation of trees through local over-fertilisation	2										

Grass cover management

Sheep, cows, geese, chickens, rabbits, are interesting species for herbage management

- Sheep: a traditional and effective solution, provided that the risk of damage is kept under control
- Cows: animals traditionally used in high-stem orchards or coconut plantations
- Geese: herbivorous poultry that are easy to introduce
- Chickens or guinea fowl: a possible solution, but may result in bare soil
- Rabbits: an innovative way of managing grass cover in orchards

Goats and pigs: not recommended animals for managing grass cover because of the damage they cause to trees and soil respectively



















Benefits for pest and disease management

Rodent management

Destruction of rodent galleries by trampling: the most frequently reported mechanism

Direct or indirect action by animals on insects or other invertebrates

• Some animals (poultry) are heavy consumers of larvae, insects or mollusks

The introduction of animals into orchards also plays a prophylactic role

- The consumption or trampling of dead leaves or fruit that has fallen to the ground helps to reduce scab inoculum
- Eating low branches or pruning them limits the spread of disease.















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	- Appearance of refusals	14		1	3	3	(?) 2	(?) 1	(?) 2		1	
	- Changes in plant diversity	3			2	2						
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	- Destroying galleries by excavating the ground									(?) 2		
	- Rodent consumption									(?) 2		
	- Reduction in the vegetation cover that protects rodents from natural predation	2		1						(?) 1		
Pests	- Reduction of natural predation by rodents through the use of fences restricting access to plots of land				1							
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	- Consumption of insects, larvae or molluscs			2	(?) 13	4	4		2	(?) 1	1	
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	- Disturbance of insects by rubbing against trunks	2										
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Major knowledge gaps

Animal species that have not been studied much, yet seem interesting

- Poultry: some knowledge of hens, chickens and geese, but very little is known about other species (guinea fowl, ducks, turkeys).
- Rabbits: could be an avenue, but what about outlets in the industry
- Equine ?

Mechanisms that are still poorly studied or understood

- Little is known about the impact on diseases, which is difficult to assess and quantify. Yet farmers are asking real questions on this subject.
- Impact on auxiliary species is unknown















Conclusion

- Many fruit and wine growers are motivated to introduce animals, but are concerned about damage on trees and soil
- Introducing animals can be a solution for managing weed, pest and diseases and lead to reduction of chemical treatments
- However, not all species can be equally used and mechanisms of pest and disease control remain largely unknown
- The use of animals to maintain perennial (or annual) crops requires skills in animal management and raises a number of organizational issues between livestock farmers and crop producers















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