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Effect of landscape diversity in an agricultural environment on pesticide use and arthropod diversity in fruit crops in Quebec, Canada.

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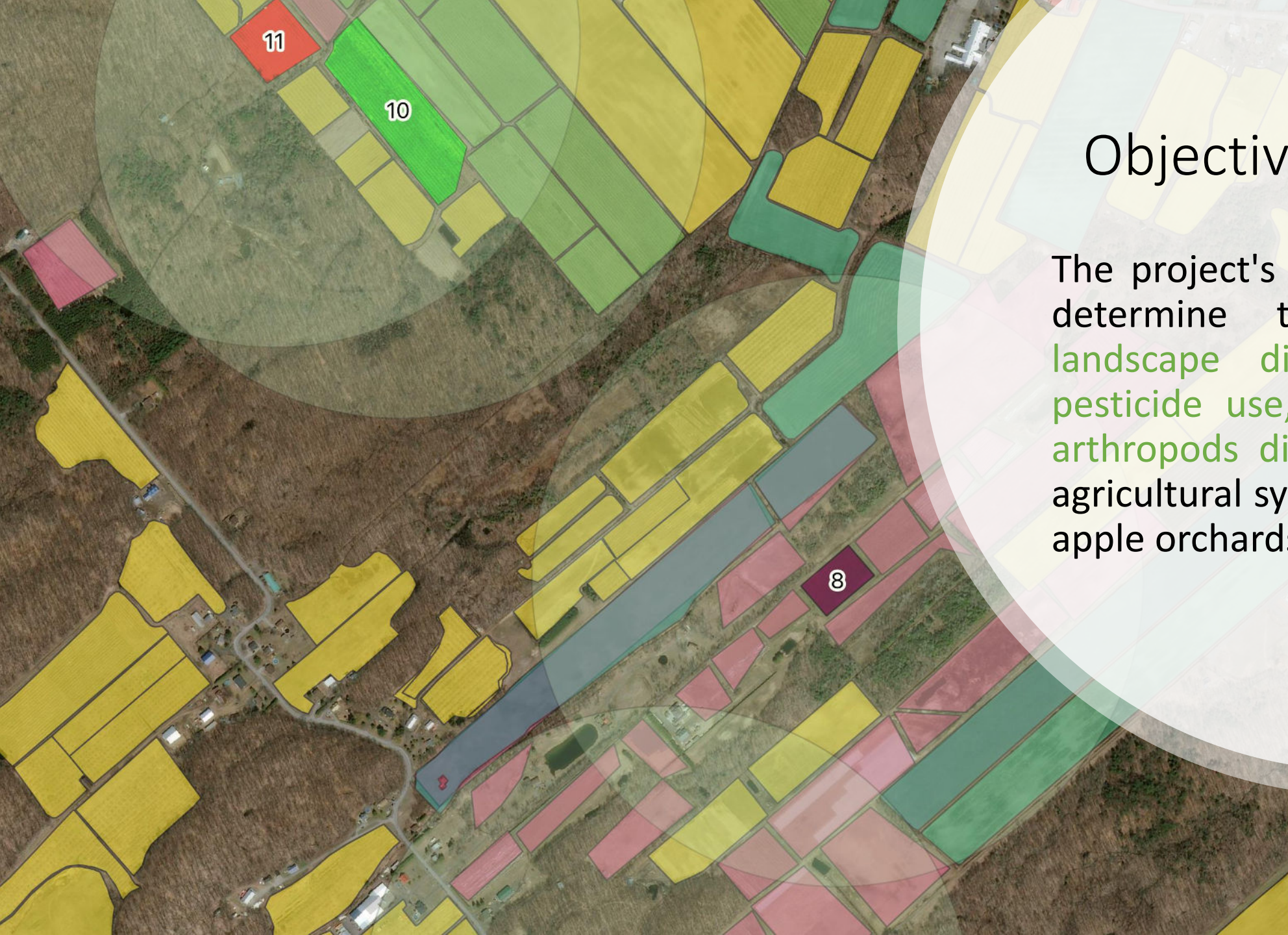
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Introduction

- In ecology, ecosystems composed of rich plant diversity are recognized to be more stable and more resilient in the face of varying conditions (Gunderson 2000; Matsushita et al. 2016; Walker et al. 2010). More diversified farms have equal or greater profitability than less diversified farms, and they use fewer chemical inputs (Davis et al. 2012). Environmental services are also improved in diversified facilities (Scheffer et al. 2001).
- Landscape modulates ecological services, pest populations, level of damage to crop and, ultimately, the use of pesticide (Tscharntke et al. 2005; Grab et al. 2018a, b).



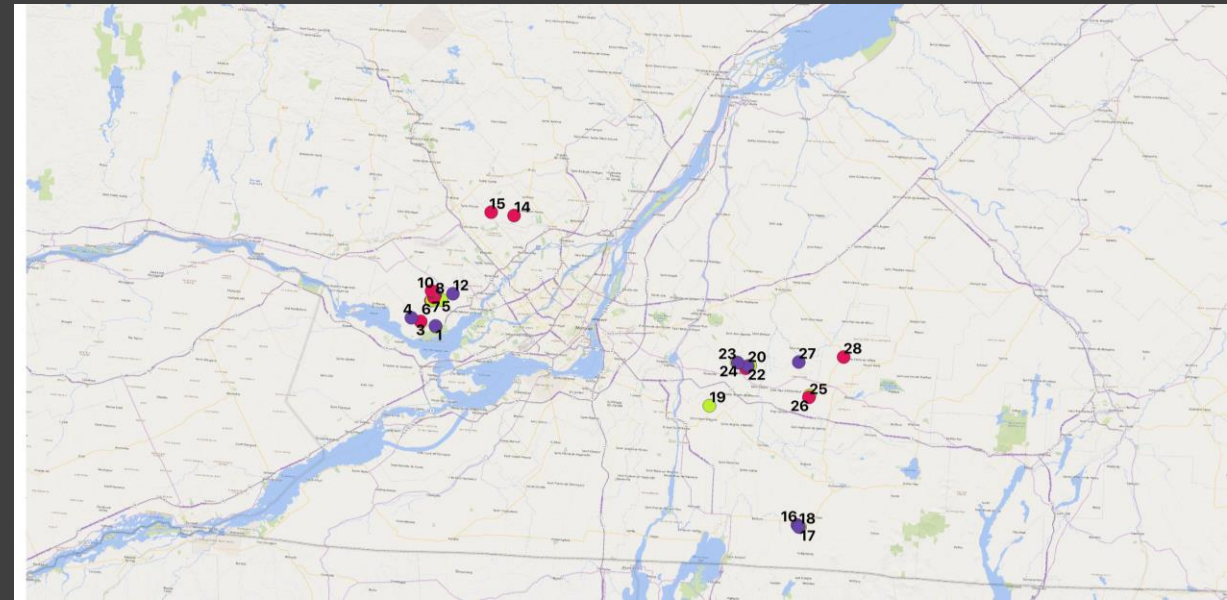


Objectives

The project's objective was to determine the impact of landscape diversity on the pesticide use, crop yield and arthropods diversity for three agricultural systems: vineyards, apple orchards, and raspberry.

Methods

- Nine sites for each crop were selected across two producing regions of Quebec, Canada.
- Landscape diversity was determined using Simpson index.
- Arthropod's sampling was done twice a month with several traps.
- Each pesticide application was recorded over the whole season.
- Yield was measured in apple orchards and vineyards.
- The register of pesticide treatments was also considered in the data analysis.



Results

- A significant variability was observed in the number of pesticide treatments related to seasonal climatic conditions.
- The mean number of products (pesticides) applied annually was higher in the apple orchard than in vineyard and raspberry (Fig. 1). This observation is mainly related to the number of fungicides.
- In the three fruit production, a higher number of pesticides treatments was observed with low landscape diversity (Fig.2).
- The number of products applied, and the number of treatments tend to be lower in the presence of medium landscape diversity.
- Yield was not significantly affected by landscape diversity in the vineyard, but higher variability was observed in the apple orchard (Fig. 3).

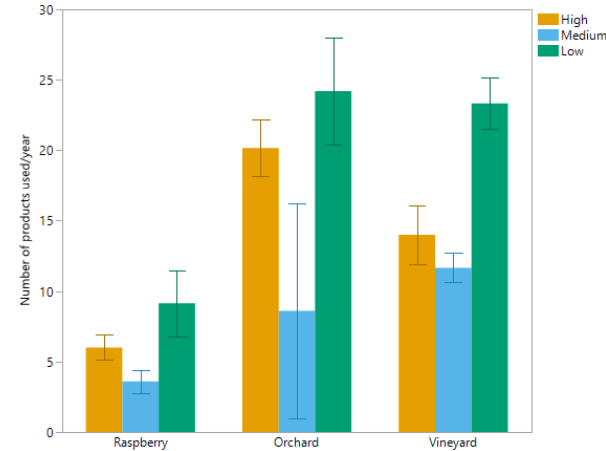


Figure 1: Number of products applied by year according to landscape diversity, 2019 and 2020.

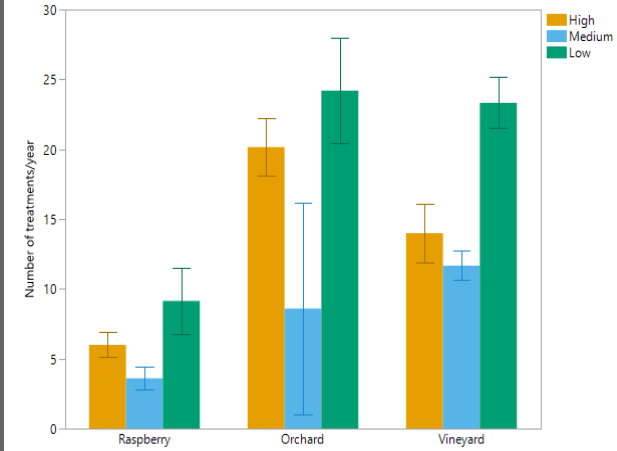


Figure 2: Number of treatments by year according to landscape diversity, 2019 and 2020

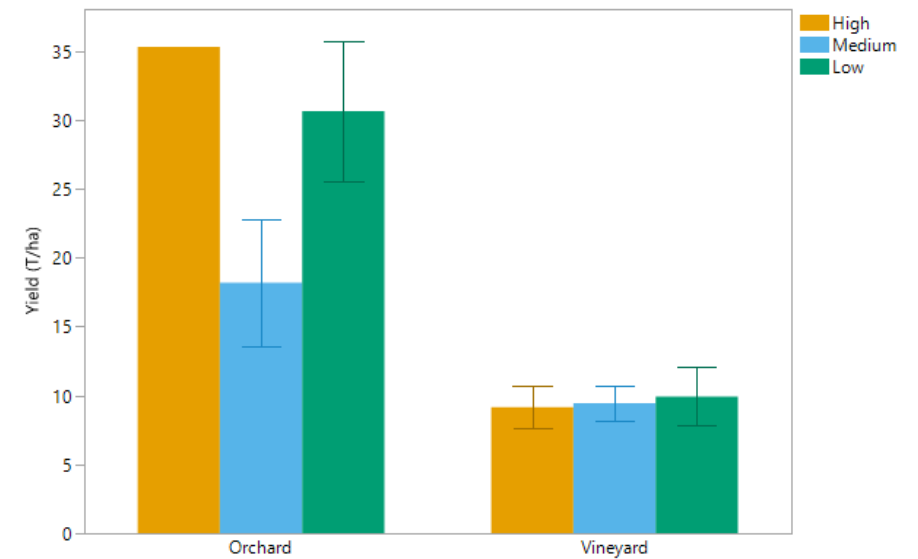


Figure 3: Yield according to landscape diversity, 2019.

Results

- Preliminary results of arthropods identification showed that we have a great diversity in all three fruits production (season 2019) (Fig. 4).
- Species richness is similar according to the three levels of landscape diversity.

Diversity:	Raspberry									Orchard									Vineyard									Total				
	Low			Medium			High			Low			Medium			High			Low			Medium			High							
	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3	1	2	3					
Order																																
Acarina	13	39	528	398	61	32	125	17	21	191	392	68	140	55	13	125	128	128	15	523	2	21	5	215	97	47	21					
Araneida	24	95	29	26	29	30	63	24	40	29	30	14	69	4	10	63	43	35	27	21	4	14	14	15	24	38	10					
Chilopoda		1		2		8	6		1	2	1	2	10			6	2	3	7			1	1		2		4					
Coleoptera	273	896	1092	922	855	231	1336	246	583	900	554	158	536	46	137	1336	396	1530	428	295	312	246	84	367	67	183	398					
Collembola	17	207	2893	2731	55	105	45	22	22	699	22	10	24	72	2	45	9	29	150	1798	226	687	25	29	1	281	368					
Dermaptera	6					8				2			1	1			85		6	89	1	2	3		18	2	3					
Diplopoda	6	58	1	18	2	27	26	9	1	8		1	43		2	26	13		49	59	1	23	2	9	1		1					
Diptera	116	847	913	235	860	224	734	471	616	246	431	254	559	75	64	734	733	634	163	408	171	230	141	234	187	177	305					
Hemiptera	13	34	194	14	103	82	47	50	167	28	155	36	150	20	29	47	104	67	85	54	35	208	36	89	25	122	61					
Hymenoptera	83	773	167	86	189	157	265	2115	80	373	253	134	139	11	107	265	1526	70	279	2073	76	165	29	1081	183	185	325					
Isopoda			2	2	1	22	1	4	1	5	7		27			1	5	1	2	7		1		1			1					
Lepidoptera	1	3	5	5	1	2	3	5	3	1	2	1	1	1		3		2	3	2		6		5	3	1	3					
Orthoptera	8	44	1609	4	9	31	11	1	3	48	2			3		11	1	2	26	119	2	21	2	72	1	1	4					
Phalangidae	1	4	10	1		9	4					3	1			4	1		7	1	3	16	5	1			1					
Siphonaptera		1	2								3						2															
Thysanoptera			1					1		1				1									1	3			1					
Total Abundancy	561	3002	7446	4444	2165	968	1899	2965	1538	2562	1852	683	1700	289	364	2666	3048	2501	1247	5449	833	1641	348	2121	609	1037	1506			55444		
Mean abundancy/trap	4,2	8,58	22,3	17,3	9,17	3,5	6,78	14,8	5,92	8,74	6,73	4,4	5,54	4,8	3,1	7,49	9,53	10,4	4,93	15,2	5,2	6,98	2,6	8,87	4	4,85	5,93			8,59		
Species richness	33	43	39	34	41	35	42	39	38	41	36	34	36	20	22	42	41	34	37	40	34	38	35	33	25	27	42			36		



Discussion

- Preliminary results showed that a significant variability was observed between farms, and actually, additional data is required to determine the impact of landscape diversity on pests control and fruit productivity.
- Several advantages can be obtained by promoting crop diversification within an agricultural enterprise, thereby contributing to agricultural enterprises' profitability.

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Canada

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