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Strategic tillage in conservation agriculture consequences on weed communities and winter wheat productivity

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Agroécologie Dijon Unité de Recherche

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Conservation Agriculture :
No-tillage + Species diversification + Permanent soil organic cover

Frequency of occurrence and density of perennial and grass weeds increase
Weed seedbank is concentrated in the top soil horizon

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Perspective

Is Tillage a Suitable Option for Weed Management in Conservation Agriculture?

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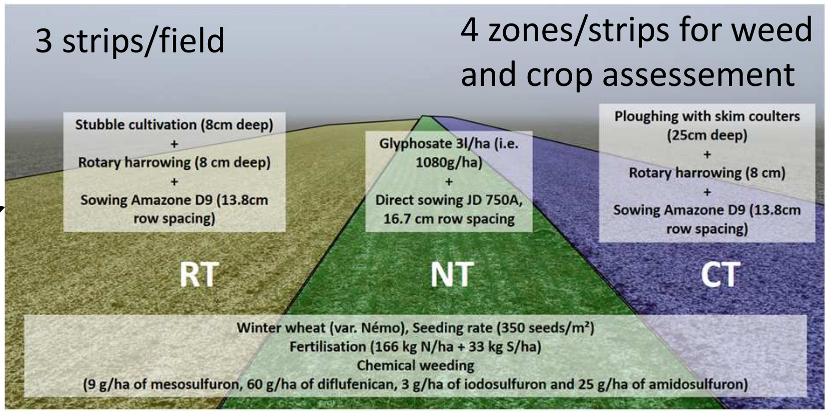
Methods

Dijon, France
Experimental Farm INRAE d'Epoisses

No-plow (2000-2010) + CA (2010-2017)
Tillage experiment in 2017-2018



Results

Table 1. Effect of tillage treatments (CT: conventional tillage, RT: reduced tillage, NT: no-till) implemented prior to winter wheat sowing in fields conducted under CA principles during 17 years, on weeds (density, richness, biomass), winter wheat yield and grain quality (least square mean ± standard error). Tillage systems sharing identical letters are not significantly different at $p < 0.05$ (bold). DM: dry matter.

			Tillage System		
Response Variable	χ^2	Pr(>χ^2)	CT	RT	NT
Weed density before weeding (plants/m²)	31.03	**<0.0001**	12 ± 4 b	33 ± 10 c	5 ± 2 a
Alopecurus myosuroides density before weeding (plants/m²)	9.14	**0.01**	2 ± 1 a	6 ± 2 b	2 ± 1 a
Weed density after weeding (plants/m²)	18.49	**<0.0001**	4 ± 1 a	13 ± 2 b	8 ± 2 b
Species richness before weeding (nb. species/16 m²)	27.51	**<0.0001**	7.4 ± 0.7 b	9.9 ± 0.8 c	4.9 ± 0.5 a
Species richness after weeding (nb. species/16 m²)	5.47	0.06	6.6 ± 0.6 a	6.6 ± 0.6 a	8.5 ± 0.7 a
Weed biomass at crop maturity (g DM/m²)	18.49	**<0.0001**	1 ± 0 a	15 ± 10 b	3 ± 2 ab
Crop density (nb. plants/m²)	5.66	0.06	190 ± 6 a	206 ± 6 a	209 ± 6 a
Number of ears per plant	0.10	0.95	2.5 ± 0.1 a	2.5 ± 0.1 a	2.5 ± 0.1 a
Number of grains per ear	51.73	**<0.0001**	40.1 ± 1.1 c	34.1 ± 0.9 b	30.7 ± 0.8 a
1000 kernel weight (g DM)	7.71	**0.02**	37.5 ± 0.9 a	35.6 ± 0.9 a	35.2 ± 0.9 a
Yield (t DM/ha)	16.87	**0.0002**	7.1 ± 0.4 b	6.1 ± 0.3 a	5.5 ± 0.3 a
Specific weight (g/L)	4.99	0.08	756 ± 5 a	751 ± 5 a	744 ± 5 a
Protein content (%)	0.14	0.93	12.5 ± 0.2 a	12.6 ± 0.2 a	12.6 ± 0.2 a

Tillage treatments significantly affected weed communities before weeding, increasing weed density and richness in comparison to no-till (including glyphosate application). These differences in species richness and abundance transcribed into a significant tillage effect on weed community composition before weeding, highlighting the importance of tillage in shaping weed communities, even after 17 years of similar farming practices. However, these significant effects observed before weeding were not visible after weeding, highlighting the tremendous potential of herbicides to homogenize initially contrasted weed flora and the difficulty to link agronomic practices and weed observations, when the latter are carried out after weeding. The highest crop yields were observed under CT, probably due to increased mineralisation of soil organic matter or enhanced soil structure, rather than lower weed:crop competition, as reflected by an overall low weed biomass after weeding.