

**Long-term application of mineral fertilizer affects weed flora in winter wheat
monoculture (*Triticum aestivum* L.)**

This supplemental section contains 5 pages and 6 tables.

Supplementary Table S1. Summary of herbicides applications over the past decade (with commercial names redacted).

Year	Application month	Herbicides
2012	April	Product 5 (200gr) + Product 6 (200gr) + Product 7 (0.4L) + Product 4 (1L)
	September	Product 2 (5L/ha) + Product 10 (2L/ha) + Product 4 (0.5L/ha)
2013	April	Product 5 (200gr) + Product 6 (200gr) + Product 11 (80mL/ha) + Product 4 (1L/ha)
	Août	Product 10 (3L/ha)
	September	Product 2 (6L/ha) + Product 4 (0.5L/ha)
2014	April	Product 5 (200g/ha) + Product 6 (200g/ha) + Product 11 (80mL/ha) + Product 4 (1L/ha)
2015	March	Product 5 (300g/ha) + Product 8 (250g/ha) + Product 11 (1L/ha)
2016	April	Product 5 (300g/ha) + Product 8 (250g/ha) + Product 12 (1L/ha)
2017	May	Product 8 (265gr/ha) + Product 9 (300gr/ha) + Product 4 (1L/ha)
2018	April	Product 5 (300gr/ha) + Product 6 (200gr/ha) + Product 3 (20gr/ha) + Product 4 (1L/ha)
2019	April	Product 1 (300gr/ha) + Product 3 (30gr/ha) + Product 4 (1L/ha)
	September	Product 2 (5L/ha) + Product 4 (1L/ha)
2020	Avril	Product 1 (300gr/ha) + Product 4 (1L/ha)
	September	Product 2 (5L/ha)
2021	April	Product 1 (300gr/ha) + Product 4 (1L/ha)

Supplementary Table S2. Active ingredients of the herbicides applied in the trial over the past decade (with commercial names redacted).

Herbicides	Active substance
Product 1	9 g/kg iodosulfuron-methyl-sodium
	47 g/kg mesosulfuron-methyl-sodium (45 g/kg mesosulfuron-methyl)
	23.7 g/kg thiencarbazone-methyl-sodium (22.5 g/kg thiencarbazone-methyl)
	135 g/kg mefenpyr-diethyl (Safener)
Product 2	441 g/L glyphosate, potassium salt (360 g/L glyphosate)
Product 3	750 g/kg amidosulfuron
Product 4	842 g/L esterified rapeseed oil
Product 5	10 g/kg iodosulfuron-methyl-sodium
	31.3 g/kg mesosulfuron-methyl-sodium (30 g/kg mesosulfuron-methyl)
	90 g/kg mefenpyr-diethyl (Safener)
Product 6	75 g/kg pyroxsulam
	75 g/kg cloquintocet-mexyl (Safener)
Product 7	2.5 g/L florasulam
	144.1 g/L fluroxypyr-meptyl (100 g/L fluroxypyr)
Product 8	14.2 g/kg florasulam
	70.8 g/kg pyroxsulam
	70.8 g/kg cloquintocet-mexyl (Safener)
Product 9	6 g/kg iodosulfuron-methyl-sodium
	31.3 g/kg mesosulfuron-methyl-sodium (30 g/kg mesosulfuron-methyl)
	90 g/kg mefenpyr-diethyl (Safener)
Product 10	918.6 g/L MCPA, dimethylamine salt (750 g/L MCPA)
Product 11	50g/L florasulam
Product 12	842 g/L esterified rapeseed oil

Supplemental Table S3. Realized flora weed species density under different fertilization treatments (individuals m⁻²) surveyed before the first weeding operation expressed as the mean $\pm$ standard deviation.

			Fertilization treatment				
Botanical family	Weed species	EPPO code	NK	NP	NPK	PK	Control
Asteraceae	<i>Matricaria chamomilla</i> L.	MATCH	53.8 $\pm$ 17.9	39.6 $\pm$ 17.9	40.0 $\pm$ 19.8	33.3 $\pm$ 10.8	19.1 $\pm$ 5.6
	<i>Cirsium arvense</i> (L.) Scop.	CIRAR	0	0	0	0	0.4 $\pm$ 1.3
	<i>Sonchus asper</i> (L.) Hill.	SONAS	0	0	0.9 $\pm$ 2.7	0	0
Brassicaceae	<i>Raphanus raphanistrum</i> L.	RAPRA	0	0.9 $\pm$ 1.8	0	0	0
	<i>Thlaspi arvense</i> L.	THLAR	0	0	0.4 $\pm$ 1.3	0	0
	<i>Capsella bursa-pastoris</i> (L.) Med.	CAPBP	0	0	0.4 $\pm$ 1.3	0	0
Equisetaceae	<i>Equisetum arvense</i> L.	EQUAR	5.8 $\pm$ 10.4	1.3 $\pm$ 2.0	2.2 $\pm$ 5.3	17.8 $\pm$ 30.6	91.1 $\pm$ 30.8
Papaveraceae	<i>Papaver rhoeas</i> L.	PAPRH	24.9 $\pm$ 19.1	13.3 $\pm$ 10.8	19.6 $\pm$ 8.8	32.0 $\pm$ 65.0	31.6 $\pm$ 38.0
	<i>Fumaria officinalis</i> L.	FUMOF	0	0	0	0.889 $\pm$ 1.8	0.9 $\pm$ 2.7
Plantaginaceae	<i>Veronica hederifolia</i> L.	VERHE	5.3 $\pm$ 5.3	11.1 $\pm$ 10.3	8.4 $\pm$ 10.5	24.9 $\pm$ 17.5	33.8 $\pm$ 16.5
Poaceae	<i>Poa annua</i> L.	POAAN	8.4 $\pm$ 5.1	10.7 $\pm$ 9.8	14.2 $\pm$ 11.5	14.7 $\pm$ 13.3	4.4 $\pm$ 4.2
Polygonaceae	<i>Polygonum aviculare</i> L.	POLAV	26.7 $\pm$ 28.3	24.9 $\pm$ 25.0	33.8 $\pm$ 29.1	76.0 $\pm$ 24.1	83.1 $\pm$ 47.4

Supplemental Table S4. Potential flora weed species density under different fertilization treatments (individuals m⁻²) expressed as the mean ± standard deviation.

			Fertilization treatment				
Botanical family	Weed species	EPPO code	NK	NP	NPK	PK	T
Apiaceae	<i>Petroselinum segetum</i> (L.) Koch	PARSE	88.4±265.3	0	0	0	0
Asteraceae	<i>Lapsana communis</i> L.	LAPCO	176.8±530.5	88.4±265.3	0	0	0
	<i>Taraxacum officinale</i> F.H. Wigg.	TAROF	176.9±350.9	2122.1±1258.2	2475.7±2467.0	1768.4±1476.9	884.2±1346.0
	<i>Matricaria chamomilla</i> L.	MATCH	2298.9±2159.0	1326.3±1258.2	1856.8±1591.5	1237.9±1061.0	795.8±795.8
	<i>Galinsoga quadriradiata</i> Ruiz et Pav.	GASCI	176.8±350.9	0	0	0	0
	<i>Senecio vulgaris</i> L.	SENVU	0	88.4±265.3	0	0	0
	<i>Erigeron canadensis</i> L.	ERICA	0	0	0	88.4±265.3	0
	<i>Gnaphalium uliginosum</i> L.	GNAUL	0	88.4±265.3	353.7±578.1	176.8±350.9	265.3±562.7
	<i>Sonchus asper</i> (L.) Hill.	SONAS	0	0	0	88.4±265.3	0
Brassicaceae	<i>Capsella bursa-pastoris</i> (L.) Med.	CAPBP	88.4±265.3	0	88.4±265.3	88.4±265.3	0
	<i>Thlaspi arvense</i> L.	THLAR	0	176.8±350.9	0	0	0
Caryophyllaceae	<i>Stellaria media</i> (L.) Vill.	STEME	88.4±265.3	0	0	88.4±265.3	0
Convolvulaceae	<i>Convolvulus arvensis</i> L.	CONAR	0	176.8±530.5	0	0	88.4±265.3
Equisetaceae	<i>Equisetum arvense</i> L.	EQUAR	88.4±265.3	0	88.4±265.3	442.1±1326.3	1856.8±2320.1
Euphorbiaceae	<i>Mercurialis annua</i> L.	MERAN	0	530.5±689.2	707.4±1085.6	88.4±265.3	176.838±350.9
Lamiaceae	<i>Lamium amplexicaule</i> L.	LAMAM	0	0	0	0	88.419±265.257

Supplemental Table S4 (Continued).

Onagraceae	<i>Epilobium ciliatum</i> Raf.	EPICT	0	176.8±530.5	88.4±265.3	265.3±562.7	88.4±265.3
	<i>Epilobium parviflorum</i> Schreb.	EPIPF	0	88.4±265.3	88.4±265.3	88.4±265.3	0
Papaveraceae	<i>Papaver rhoeas</i> L.	PAPRH	1149.4±1326.3	1061.0±2896.7	176.8±530.5	353.7±1061.0	1326.3±1434.6
Plantaginaceae	<i>Veronica hederifolia</i> L.	VERHE	353.7±578.1	176.8±530.5	0	88.4±265.3	88.4±265.3
	<i>Plantago lanceolata</i> L.	PLALA	265.3±397.9	353.7±806.7	265.3±397.9	265.3±795.8	618.9±869.7
Poaceae	<i>Echinochloa crus-galli</i> (L.) Beauv.	ECHCG	4421.0±3283.7	4244.1±3753.6	6012.5±5235.1	2475.7±2368.8	2387.3±2387.3
	<i>Vulpia myuros</i> (L.) C.C.Gmel.	VLPMY	0	88.4±265.3	353.7±1061.0	618.9±773.4	353.7±578.1
	<i>Poa annua</i> L.	POAAN	88.4±265.3	442.1±578.1	884.191±1563.7	353.7±701.8	442.1±578.1
Polygonaceae	<i>Polygonum aviculare</i> L.	POLAV	795.8±397.9	618.9±773.4	972.6±1109.7	1945.2±2423.9	1945.2±1871.0
Primulaceae	<i>Anagallis arvensis</i> L.	ANGAR	265.3±562.7	88.4±265.3	0	795.8±289.2	1591.5±1779.4
Rosaceae	<i>Geum urbanum</i> L.	GEUUR	0	176.8±350.9	0	0	0
Scrophulariaceae	<i>Verbascum pulverulentum</i> Vill.	VESPU	88.419±265.257	0	88.4±265.3	0	0
Solanaceae	<i>Solanum nigrum</i> L.	SOLNI	176.9±530.5	265.3±562.7	88.4±265.3	88.4±265.3	176.8±530.5
Urticaceae	<i>Urtica dioica</i> L.	URTDI	0	0	0	0	88.4±265.3

Supplemental Table S5. Weed density (individuals m⁻²) and species richness of the realized flora under different fertilization treatments surveyed before the first weeding operation, expressed as mean ± standard deviation and range.

Fertilization traitement	Mean species richness ± standard deviation	Range of species richness [Min – Max]	Mean weed density ± standard deviation	Range of weed density [Min – Max]
NK	4.8 ± 1.2	[3 – 6]	124.9 ± 47.0	[80 – 228]
NP	4.9 ± 1.2	[3 – 6]	101.8 ± 22.7	[80 – 132]
NPK	4.9 ± 1.1	[3 – 7]	120.0 ± 54.7	[52 – 244]
PK	5.3 ± 1	[4 – 7]	199.6 ± 67.6	[108 – 360]
Control	5.7 ± 0.9	[5 – 7]	264.4 ± 52.1	[212 – 348]

Supplemental Table S6. Weed density (individuals m⁻²) and species richness of the potential flora under different fertilization treatments, expressed as mean ± standard deviation and range.

Fertilization treatment	Mean species richness ± standard deviation	Range of species richness [Min – Max]	Mean weed density ± standard deviation	Range of weed density [Min – Max]
NK	5.4 ± 1.9	[2 – 7]	10787.1 ± 6113.9	[1591.5 – 21485.8]
NP	6.0 ± 2.3	[3 – 11]	12378.7 ± 7868.8	[5570.4 – 32626.7]
NPK	5.9 ± 2.3	[2 – 9]	14589.2 ± 7117.6	[6366.2 – 27852.0]
PK	5.9 ± 2.5	[3 – 11]	11406.1 ± 6764.1	[3183.1 – 27056.2]
Control	7 ± 2.5	[5 – 13]	13262.9 ± 4192.0	[5570.4 – 19894.3]