Società Italiana di Agronomia
XLV Convegno Nazionale
Sassari 20-22 settembre 2016

Mechanical weed control in organic winter wheat

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Direct weed control methods

Mechanical

Thermal

Biological

Organic farming

Chemical

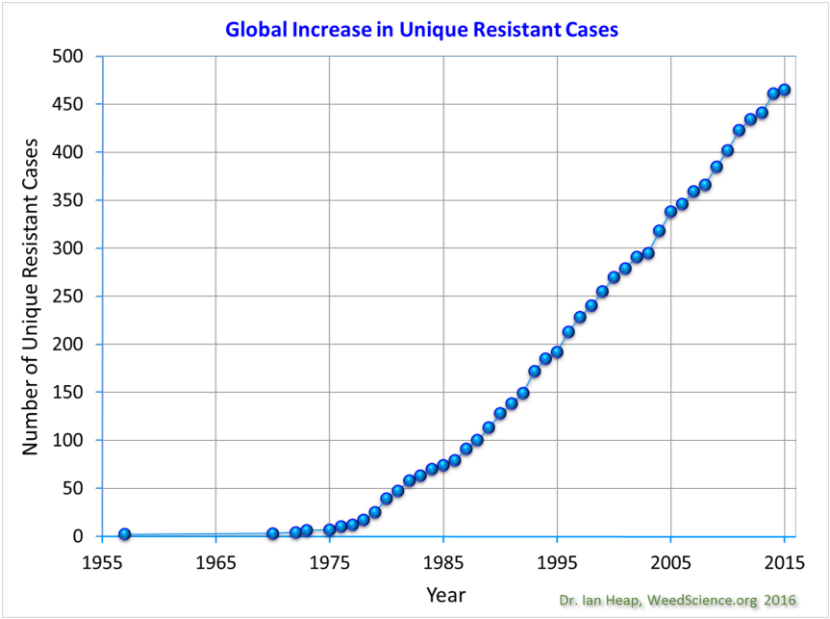
Conventional and integrated farming








Mechanical weed control



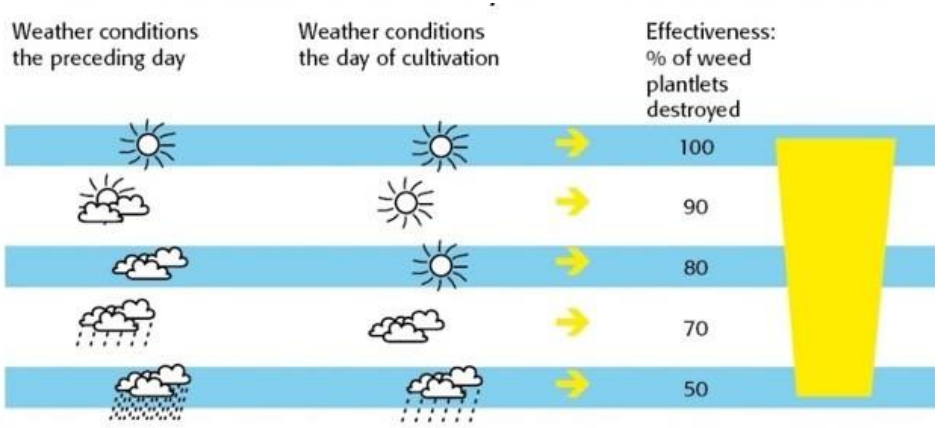
- good efficacy
- large application
- environmentally friendly
- managing herbicide-resistant weeds
- use of innovation and technologies




Mechanical weed control

- **efficacy depends on 'site-specific' factors:**
  - **weather conditions**
  - **soil characteristics**
  - **types and growth stage of weeds**

- **difficulties for intra-row weed control**
- **stimulation of weed emergence**
- **promptness not guaranteed**



Mechanical weed control strategies in wheat

Narrow rows spacing → higher wheat competitiveness (traditional 0.125-0.15 m)

Spring-tine harrowing →

- Intra and inter-rows weed control
- Effective only against small weeds
- Risk of wheat damages

Wider rows spacing → lower wheat competitiveness (0.25-0.30 m)

Precision hoeing:

- Split-hoeing
- Finger-weeding

→

- Inter-rows weed control
- Increased efficacy against weeds
- Reduced risk of wheat damages

Materials and methods

Sowing	Mechanical weed control treatments
Narrow row spacing (0.15 m)	Spring-tine harrowing (1 passage at the time T1)
	Spring-tine harrowing (2 passages at T1)
	Spring-tine harrowing (1 passage at T1 + 1 passage at T1+14 days)
	Untreated control
Wider row spacing (0.30 m)	Split-hoeing (1 passage at T1)
	Finger-weeding (1 passage at T1)
	Split-hoeing + Finger-weeding (1 passage at T1)
	Untreated control

T1: wheat at tillering stage
weeds at cotyledons-2 true leaves stage

Materials and methods

Mechanical tools

Spring-tine harrowing

Split-hoeing

Finger-weeding

Type	Cultivation depth (mm)	Driving speed (km h^{-1})
SF-30 Faza Italy	10-20	6
Asperg Germany	30-40	3
Kress & Co Germany	20-30	3

Materials and methods

- 3 field experiments: 3 years (Exp. 1, Exp. 2, Exp. 3)
- Site: central Italy (42°57' N - 12°22' E, 165 m a.s.l.)
- Soil texture: clay-loam
- Crop: winter wheat (cv. Bilancia)
- Wheat seeding density: 450 seeds m^{-2}
- Experimental design: split-plot with 4 replicates

Materials and methods

Measurements

Weeds (6 weeks after treatments)

- Ground cover (%)
- Weed density
- Weed dry weight

Wheat (at harvest)

- Grain yield
- Ears density
- Weight of 1000 seeds
- Hectolitre weight

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Results

Weed flora

Anagallis arvensis

Fallopia convolvulus

Papaver rhoeas

Polygonum aviculare

Stachys annua

Veronica hederifolia

Main weed species	Exp. 1	Exp. 2	Exp. 3
Anagallis arvensis L.		✓	
Fallopia convolvulus (L.) Á. Löve	✓		✓
Papaver rhoeas L.			✓
Polygonum aviculare L.	✓	✓	
Stachys annua (L.) L.	✓		
Veronica hederifolia L.			✓
Total weed density (n. m^{-2})	*31*	*16*	*54*
Infestation level	*Medium*	*Low*	*Medium*

Results

Experiment 1

Sowing	Mechanical treatments	Total weeds			Wheat			
		Ground cover (%)	Density (n. m^{-2})	Dry weight (g m^{-2})	Ears density (n. m^{-2})	Hectolitre weight (kg hl^{-1})	1000 seeds (g)	Grain yield (t ha^{-1})
Narrow row	S.-tine harrowing (T1)	22	19.3	5.9	510	84.1	37.1	5.27
	S.-tine harrowing (T1→T1)	4	6.3	2.1	559	83.8	38.1	4.93
	S.-tine harrowing (T1 →T1+14 d)	6	5.3	1.2	518	83.9	39.1	4.92
	Untreated control	41	22.7	7.0	487	84.1	38.8	5.39
	LSD (P=0.05)	*12*	*9.7*	*3.8*	*n.s.*	*n.s.*	*n.s.*	*n.s.*
Wider row	Split-hoeing (T1)	7	10.7	8.4	466	84.3	41.0	4.81
	Finger-weeding (T1)	5	8.7	2.6	485	84.4	39.3	4.67
	Split-h. + Finger-w. (T1)	3	6.3	4.0	414	84.1	39.2	4.44
	Untreated control	57	39.3	13.8	445	84.5	39.1	4.74
	LSD (P=0.05)	*11*	*10.9*	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*
	Average narrow row	*18*	*13.4*	*4.1*	*519*	*84.0*	*38.3*	*5.13*
	Average wider row	*18*	*16.3*	*7.2*	*453*	*84.3*	*39.6*	*4.67*
	Narrow row vs. wider row	*n.s.*	*n.s.*	*n.s.*	**	*	*	**

Results

Experiment 2

Sowing	Mechanical treatments	Total weeds		Wheat		
		Density (n. m^{-2})	Dry weight (g m^{-2})	Ears density (n. m^{-2})	Hectolitre weight (kg hl^{-1})	Grain yield (t ha^{-1})
Narrow row	S.-tine harrowing (T1)	17.1	1.1	512	79.1	6.60
	S.-tine harrowing (T1→T1)	5.8	0.3	447	79.4	6.32
	S.-tine harrowing (T1 →T1+14 d)	7.1	2.3	497	79.7	6.56
	Untreated control	15.0	2.5	505	79.6	6.79
	LSD (P=0.05)	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*
Wider row	Split-hoeing (T1)	8.8	4.3	473	79.7	6.25
	Finger-weeding (T1)	19.2	3.4	458	79.2	6.30
	Split-h. + Finger-w. (T1)	19.6	4.0	484	79.5	6.21
	Untreated control	17.5	4.5	473	79.4	6.31
	LSD (P=0.05)	*n.s.*	*n.s.*	*n.s.*	*n.s.*	*n.s.*
Average narrow row		*11.3*	*1.5*	*490*	*79.4*	*6.57*
Average wider row		*16.3*	*4.1*	*472*	*79.5*	*6.27*
Narrow row vs. wider row		*	*	*n.s.*	*n.s.*	*n.s.*

Results

Experiment 3

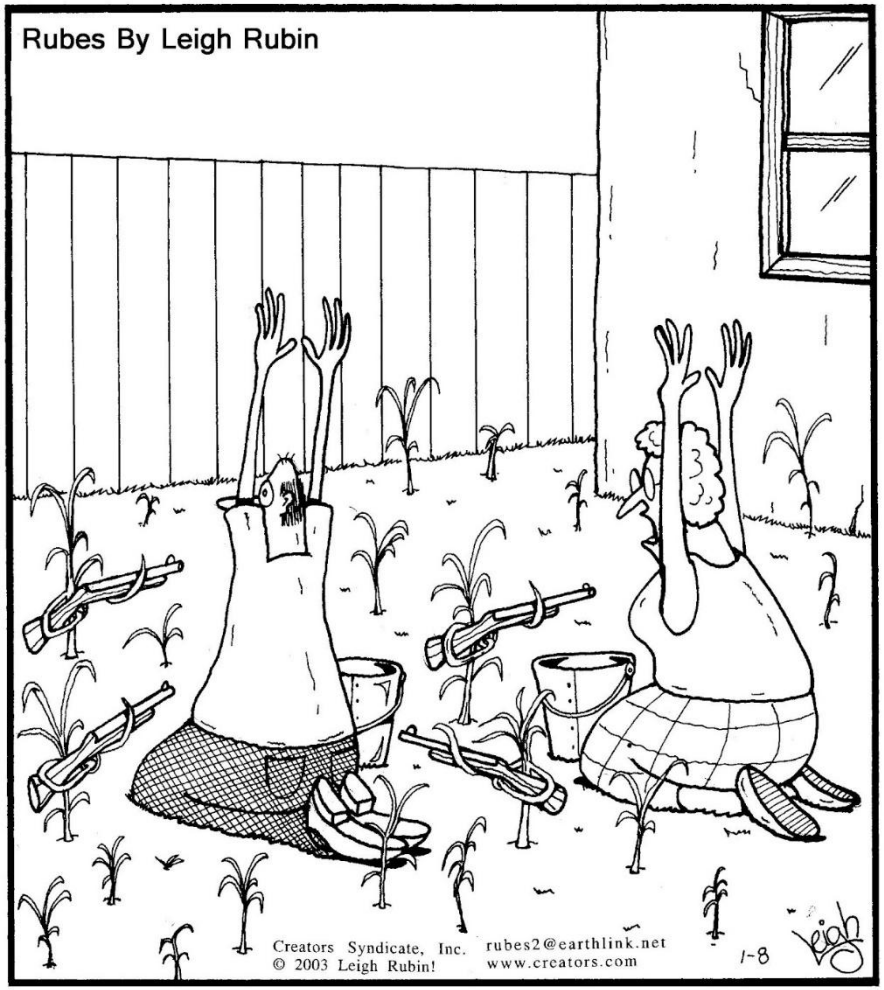
Sowing	Mechanical treatments	Total weeds	Wheat			
		Density (n. m^{-2})	Ears density (n. m^{-2})	Hectolitre weight (kg hl^{-1})	1000 seeds (g)	Grain yield (t ha^{-1})
Narrow row	S.-tine harrowing (T1)	29.7	500	80.0	36.5	6.89
	S.-tine harrowing (T1→T1)	18.2	534	80.1	38.0	6.88
	S.-tine harrowing (T1 →T1+14 d)	20.7	510	80.3	38.7	6.67
	Untreated control	46.0	523	80.4	39.0	6.81
	LSD (P=0.05)	*19.8*	*n.s.*	*n.s.*	*1.8*	*n.s.*
Wider row	Split-hoeing (T1)	10.7	496	80.1	37.8	6.25
	Finger-weeding (T1)	21.0	526	80.2	38.5	6.56
	Split-h. + Finger-w. (T1)	6.0	500	79.8	38.3	6.32
	Untreated control	61.9	498	80.2	37.7	6.27
	LSD (P=0.05)	*7.5*	*n.s.*	*0.3*	*n.s.*	*n.s.*
Average narrow row		*28.6*	*517*	*80.2*	*38.1*	*6.81*
Average wider row		*24.9*	*505*	*80.1*	*38.1*	*6.35*
Narrow row vs. wider row		*n.s.*	*n.s.*	*n.s.*	*n.s.*	*

Conclusions

- **Weed control in narrow row spacing with spring-tine harrowing**
  - ✓ **the best option → 2 passages**

- **Weed control in wider row spacing with precision hoeing**
  - ✓ **the best option → split-hoeing + finger-weeding**
  - ✓ **in case of high infestation (grasses or difficult to uproot weeds)**

- **Grain yield**
  - ✓ **Not differences among mechanical treatments**
  - ✓ **On average, 10% higher in narrow row spacing**



"We never should have waited this long ...
Now the weeds have *completely*
taken over."

Thank you for your attention

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dsa3
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Materials and methods

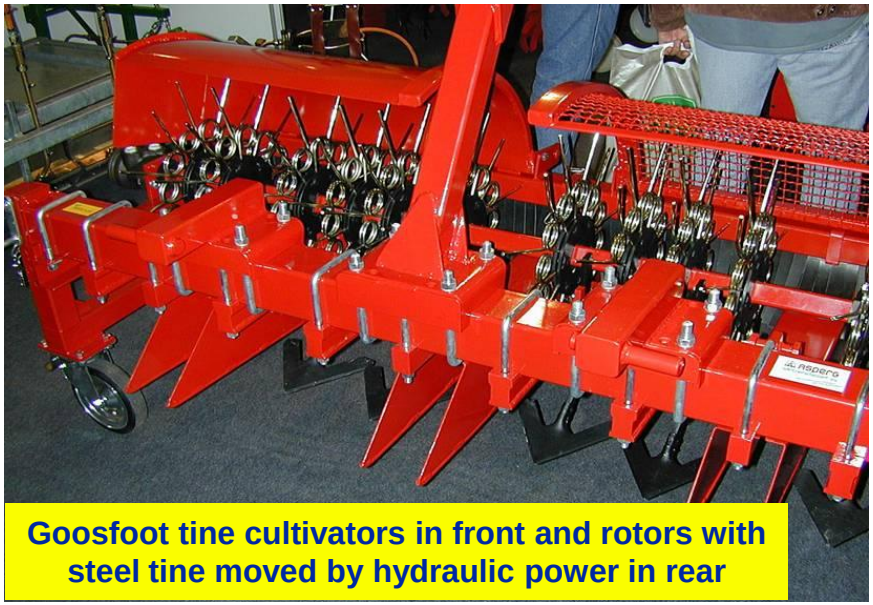
Spring-tine harrowing

- **type: SF-30, Faza, Italy**
- **flexible tines diameter: 7 mm**
- **cultivation depth: 10-20 mm**
- **driving speed: 6 km h^{-1}**

Materials and methods

Split-hoeing

- **type: Asperg Gartnereibedarf, Germany**
- **cultivation depth: 30-40 mm**
- **driving speed: 3 km h^{-1}**



Goosfoot tine cultivators in front and rotors with steel tine moved by hydraulic power in rear

Materials and methods

Finger-weeding

- **type: Kress & Co., Germany**
- **cultivation depth: 20-30 mm**
- **driving speed: 3 km h^{-1}**

Special-flat share inter-row and rubber fingers intra-row.