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Effect of crop row spacing and environmental factors on weed development

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Crop stand structure can affect microclimate of crop and soil upper layers and so crop and weed development. A field experiment was carried out in 2006 in Central Bohemia, Czech Republic to study the effect of spring wheat (*Triticum aestivum* L.) row spacing on abiotic environmental factors and weed phytocoenoses.

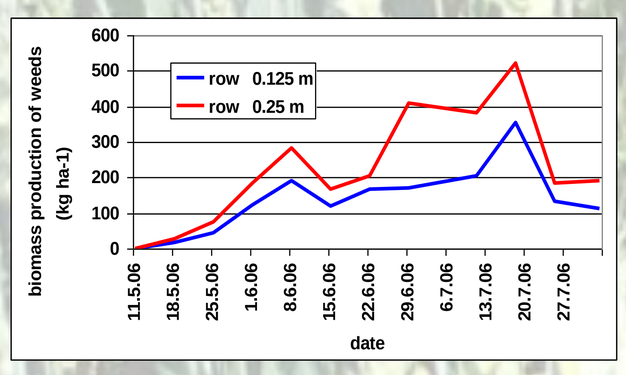
Using a randomized block experimental design with 4 replicates, spring wheat was sown on May 11 at 0.125 and 0.25 m row width. Samplings at weekly intervals were performed to determine crop and weed above-ground dry biomass, crop stages (BBCH scale). Photosyntheticaly active radiation (PAR, mol d^{-1}), air temperature (by Minikin QT sensor, EMS Brno, CZ) at 0.10 m height inside the crop, soil temperature (by Minikin TT, EMS Brno, CZ) at 0.05 and 0.10 m depth, soil water potential (SWP, MPa) at 0.05 - 0.072 m (by Microlog SP + Watermark 200SS-X, EMS Brno, + Irrometer, USA) were recorded at 15-minute intervals throughout the crop cycle; also rainfall (rain-gauge SR03 Fiedler, CZ, mm) was measured. The average daily values of the weather data between two biomass samplings were used for the statistical evaluation of the results.

Table 1: Biomass production of weeds and spring wheat, BBCH stages of the spring wheat and values of the abiotic factors

Date		18.5.2006	25.5.2006	1.6.2006	8.6.2006	15.6.2006	22.6.2006	29.6.2006	11.7.2006	18.7.2006	25.7.2006	2.8.2006
BBCH stage		21	23	29	31	37	49	59	73	77	87	91
Weeds (kg ha^{-1})	12.5 cm	17.8	43.3	122.1	190.7	119.7	168.2	171.2	203.7	353.4	134.6	111.2
	25 cm	25.8	74.9	183.0	282.1	166.5	203.1	**410.7**	383.5	520.3	183.0	191.0
	+/- Limits	*23.5*	*63.9*	*78.0*	*190.5*	*54.3*	*102.4*	*161.9*	*259.3*	*459.7*	*172.2*	*136.3*
Spring wheat (kg ha^{-1})	12.5 cm	**412.8**	544.4	**1283.2**	1948.4	**4712.0**	**8816.8**	**8893.6**	12818.8	15404.8	13982.8	13898.4
	25 cm	279.6	444.6	1020.6	1381.0	2899.0	6125.2	6128.8	11542.4	12521.8	10808.6	10732
	+/- Limits	*76.4*	*182.4*	*248.6*	*843.3*	*1183.7*	*2213.0*	*2107.1*	*4002.0*	*4189.0*	*3882.0*	*4450.8*
PAR (mol den^{-1})	12.5 cm	30.5	33.9	23.8	24.6	23.6	9.8	5.5	4.4	9.9	11.0	10.0
	25 cm	30.3	35.2	23.6	25.5	24.6	11.1	7.2	**7.0**	**12.9**	**14.4**	**13.5**
	+/- Limits	*11.2*	*14.4*	*7.8*	*6.0*	*6.8*	*2.7*	*2.7*	*1.4*	*2.7*	*2.0*	*2.9*
Air temperature (°C)	12.5 cm	15.7	13.4	10.6	11.4	18.6	20.9	20.6	20.5	21.5	25.6	23.1
	25 cm	16.0	13.6	10.8	11.3	18.5	20.7	20.4	20.2	21.2	25.0	21.4
	+/- Limits	*2.9*	*2.4*	*2.9*	*2.2*	*2.6*	*2.2*	*2.7*	*2.3*	*2.6*	*1.1*	*3.5*
Soil temperature in 0.05 m (°C)	12.5 cm	17.3	14.5	12.5	12.4	17.9	20.7	20.4	20.0	20.9	23.4	23.5
	25 cm	17.2	14.4	12.4	12.1	17.9	20.4	20.1	19.5	20.6	23.4	23.4
	+/- Limits	*2.8*	*1.7*	*2.1*	*1.3*	*1.9*	*1.4*	*1.3*	*1.3*	*1.8*	*0.7*	*1.7*
SWP (MPa)	12.5 cm	-0.064	-0.056	-0.021	-0.027	-0.102	_	-0.084	-0.073	-0.170	-0.242	_
	25 cm	-0.052	-0.045	-0.017	-0.032	-0.089	_	-0.106	-0.063	-0.149	-0.234	_
	+/- Limits	*0.023*	*0.035*	*0.039*	*0.024*	*0.016*	_	*0.044*	*0.038*	*0.036*	*0.015*	_
Precipitation (mm)		27.8	13.5	99.4	2.4	0	31.6	33.5	20.9	5.2	5.5	24.6

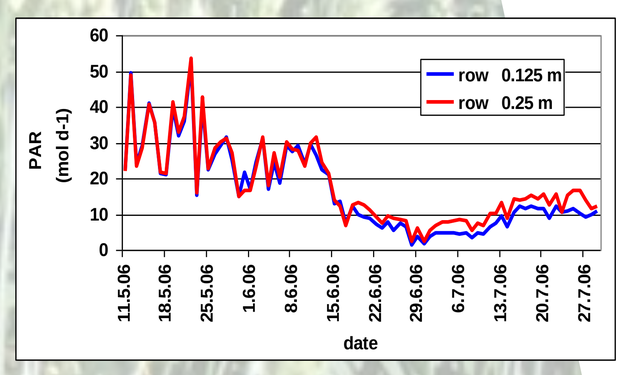
+/- Limits for α = 0.05 (ANOVA method, Tukey, STATGRAPHICS®Plus, ver. 4.0.)

Graph 1: Biomass production of weeds (kg ha^{-1})

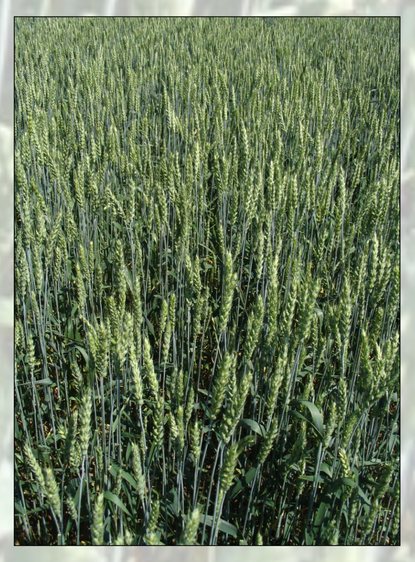


Crop row width affected weeds emergence and growth: weed biomass was higher in the crop sown at 0.25 m than at 0.125 m row width (e.g. at the end of crop heading, above-ground weed biomass was 410.7 kg ha^{-1} with wider rows and 171.2 kg ha^{-1} with narrower ones). On the contrary crop biomass was lower at 0.25 m than at 0.125 crop row width (Table 1). There was a highly significant linear relationship between PAR values at 0.1 m height above ground inside the crop canopy and wheat biomass (i.e. PAR = 30.37 - 0.00239*biomass production) observed from the beginning of tillering (i.e. 21 BBCH stage) to the early milk crop stage (i.e. 73 BBCH stage). Weed growth was positively correlated with the transmitted PAR through crop canopy. Row width did not affect air temperature inside crop canopy, soil temperature, and soil water potential. As a conclusion, since wider crop rows caused lower crop biomass production and higher transmitted PAR through crop canopy, and weed biomass production was mainly influenced by the PAR availability (Graphs 1 and 2), traditional wheat row spacing (i.e. 0.125 m) adopted in conventional agriculture systems was proved to be more competitive against weeds than wider row spacing (i.e. 0.25 m) proposed in organic systems.

Graph 2: Daily sums of PAR (mol d^{-1})



Spring wheat with rows of 0.25 m



Spring wheat with rows of 0.125 m

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