

Intercropping wheat with pea for improved wheat baking quality

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Introduction Achieving high quality bread wheat (*Triticum sativum* L.) is important to increase the consumption of organic bread products. Bread-making quality of wheat is mainly related to the protein and gluten content of the grain and flour (Waagepetersen et al., 2001). Pea (*Pisum sativum* L.) and wheat can complement each other in the use of N sources (Ghaley et al., 2005) possibly raising grain N percentage like shown for barley when intercropped with pea (e.g. Jensen, 1996). It has been shown how the degree of interspecies resource complementarity is determined by both inter- and intraspecific competition, which is influenced by the relative frequency of the species and density (Hauggaard-Nielsen et al., 2006).

Objective The aim of this study was to determine the effects of wheat-pea intercropping on wheat baking quality parameters using near infrared spectroscopy analyzer as a function of 1) the relative frequency of pea and wheat and 2) the population density

Materials and methods The experiments were carried out in 2003 on a sandy loam soil in Denmark (55°40'N, 12°18'E; 28 m above MSL; mean annual precipitation (25 yr) 600 mm; growth period of 210 days). Spring wheat (cv. Vinjett) and field pea (cv. Agadir) were grown as sole crops and in dual mixed intercrops. The crops were grown in a complete design with all combinations of five relative proportions, five density levels (Table 1) and four replicates. After harvest and threshing the grain dry matter yield were determined and assessments of wheat quality parameters were conducted using a near-infrared spectroscopy analyzer (Foss Tecator, Infratec 1241). The near-infrared spectroscopy analyzer was calibrated and linked to the Danish NIT network (Buscman et al. 2001).

Table 1. Relative crop proportions (%) of wheat and pea sole cropping and mixed dual intercrops according to recommended density¹

Wheat-pea intercropping relative proportions				
0	0:25	0:50	0:100	0:200
25:0	25:25	25:50	25:100	25:200
50:0	50:25	50:50	50:100	50:200
100:0	100:25	100:50	100:100	100:200
200:0	200:25	200:50	200:100	200:200

¹wheat = 300 plants m⁻² and pea = 100 plants m⁻²

Table 2. Wheat grain baking quality measured by protein and gluten content as well as specific weight when sole and intercropped with pea. Values are mean (n=4)¹

Wheat-pea IC frequency	Protein (% of dry matter)	Gluten (% of dry matter)	Spec. weight (kg hl ⁻¹)
100:0	10.7 ^A	22.7 ^A	78.3 ^{BC}
50:0	10.8 ^A	22.8 ^A	78.0 ^C
100:50	11.1 ^A	23.5 ^A	78.3 ^{BC}
50:50	12.8 ^B	27.8 ^B	78.9 ^{AB}
50:100	12.8 ^B	28.0 ^B	78.8 ^{AB}
25:100	13.9 ^B	29.7 ^B	79.3 ^A

¹Values followed by the same letter are not significantly different (P<0.05)

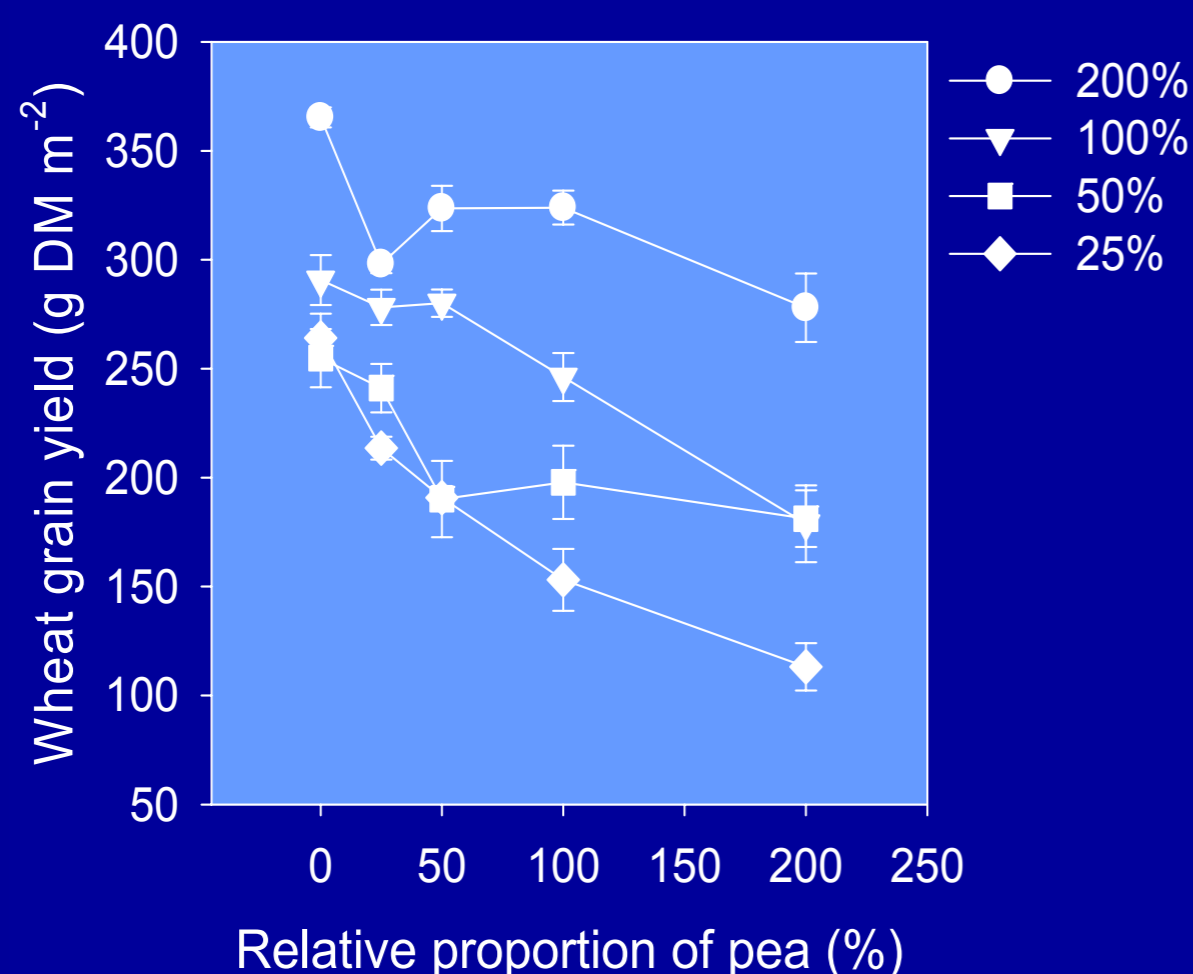


Figure 1. Wheat grain dry matter (DM) yield as a function of relative proportion of pea (%). The symbols indicate the four relative densities sown for wheat

Results and discussion Interspecific competition from pea decline wheat grain yield (Fig. 1). However, sowing intercropped wheat at recommended density (RD) there was no significant difference whether pea was sown up to 50% RD as compared to the respective wheat sole crop. Reducing wheat sole crop RD with 50% did not change the grain quality parameters, whereas protein, gluten and specific weight was raised when intercropped with pea (Table 2). However, it seems like the use of wheat RD (100%) leaves too little space for pea to develop (Fig. 1). As a rule of thumb a relative proportion of intercropped pea around 40-50% is suggested in order to achieve an appropriate level of intraspecific competition.

A protein yield ranging 11-14% for intercropped wheat, and with a medium to high (27-30%) gluten content extraordinary wheat baking quality is shown (Table 2). On an individual plant basis intercropped wheat had access to a greater pool of plant available soil N than sole cropped wheat. This increased supply of N in conjunction with the competition with pea for factors such as light and water results in a relatively larger increase in wheat protein content than dry matter production without reducing other important quality parameters.

Before such intercropping approach can be adapted by farmers a better understanding of the underlying interspecies dynamics that shape the final outcome are needed including standard baking tests of the flour. Another challenge is efficient separation of pea from the wheat grains and also a change of attitude by the seed companies according to general logistics towards receiving mixed grains.

Conclusion Pea interspecific competitive ability for factors such as light and water results in an increase in wheat protein content without reducing other important quality parameters. Density and relative crop frequency can be used as “regulators” when specific objectives such as bread making quality are wanted.

References Buchmann et al. (2001). Cereal Chem. 78:572–577; Ghaley et al. (2005). Nutr. Cycl. Agroecosys. 73:201-212; Hauggaard-Nielsen et al. (2006) Field Crop. Res. 95:256-267; Jensen. E.S. (1996). Plant Soil 182:25-38. Waagepetersen et al. (2001). Danish Institute of Agricultural Sciences, Denmark.

Acknowledgements This work was partly funded by the Danish Research Centre for Organic Farming.