

Effect of Seeding density on Plant Interactions in Cereal Systems with Associated Cover Crop

Baresel JP¹, Köckeis M¹ & Weiner J²

Keywords: living mulch, subterranean clover, wheat, seeding density.

Abstract

The success of the establishment of living mulch systems in cereals depends, among other factors, on the seeding density of the main crop and the associated crop. A series of experiments with 6 seeding densities of subterranean clover and 2 seeding densities of wheat was performed in southern Germany in order to assess the role of this factor using model systems with wheat and subterranean clover. Increased seeding densities of subterranean clover increased subterranean clover biomass, reduced wheat tiller density, but improved N supply to wheat in the stem elongation stage.

Introduction and objectives

Associated crops (living mulches) may improve the sustainability of cropping systems, but competition by the associated crop often reduces productivity. Among many other factors, competition by an associated crop is influenced by the seeding densities of the main crop and the associated crop. Aim of this study was, to investigate the effect of both factors on competition between wheat and subterranean clover associated as living mulch, in order to optimize the balance between both crops.

Methods

A series of experiments with 6 different seeding densities of subterranean clover cv. 'Campeada' and 2 seeding densities of wheat cv. 'Achat' was performed in 2012 and 2013 at Freising, southern Germany, in order to assess the role of these factors using model systems with wheat and subterranean clover. Row distance was 15 cm, clover and wheat were mixed within the row. Seed density of wheat was 400 and 600 grains/m². Seven different densities of clover were applied, ranging from 0 to 1600 seeds/m² in a geometrical series. Clover biomass, wheat tiller density, grain yield and chlorophyll content were determined. In 2012, leaf chlorophyll content of wheat was determined indirectly by digital image analysis, using the red/green ratio as proxy, in 2013, the leaf chlorophyll content was measured using the Minolta SPAD chlorophyll meter. Data analysis was based on rank correlation analysis, because the linearity of the relations was not always given and not in the focus of this study.

¹ Technische Universität München, Lehrstuhl für Pflanzenernährung Emil-Rahmann-Str.2, 85354 Freising, Germany; baresel@wzw.tum.de

² Department of Plant & Environmental Sciences, Rolighedsvej 21 DK-1958 Frederiksberg Denmark

Results and discussion

The effects of seeding density on grain yield, tiller density, clover biomass and leaf chlorophyll content are depicted in Figure 1.

Independently from the seeding density of wheat, higher clover densities resulted in higher clover biomass at harvest and in lower wheat densities. The effect on wheat yield is not clearly evident, because lower stand densities can be compensated by other yield components. A general tendency towards lower yields with high clover density is however to be expected (Higher clover biomass resulted in lower yields in 2013)

Remarkable is the pronounced effect of higher clover densities on leaf chlorophyll content during stem elongation; this could be confirmed also by several other experiments performed in this research program and presented in this conference. Higher protein contents could be due to an improved availability of nitrogen in the presence of N-fixing legumes or due to a concentration effect in sparse canopies. In our case, the latter hypothesis seems to be less plausible, because the overall density of plants was very high, and also clover plants may be competitors for soil nitrogen.

Competition in living mulch systems depends considerably on seeding densities, which are one of the principle means for its regulation. Both negatives (e. g. on tiller density) and positive effects (e. g. improvement of N availability) have to be taken into account when determining the optimum seeding densities. A medium density of approx. 400 seeds/m² produced a reasonable canopy of subterranean clover without strong gain yield reduction in wheat; however, further studies in a broader range of environments are necessary in order to make practical suggestions to farmers.

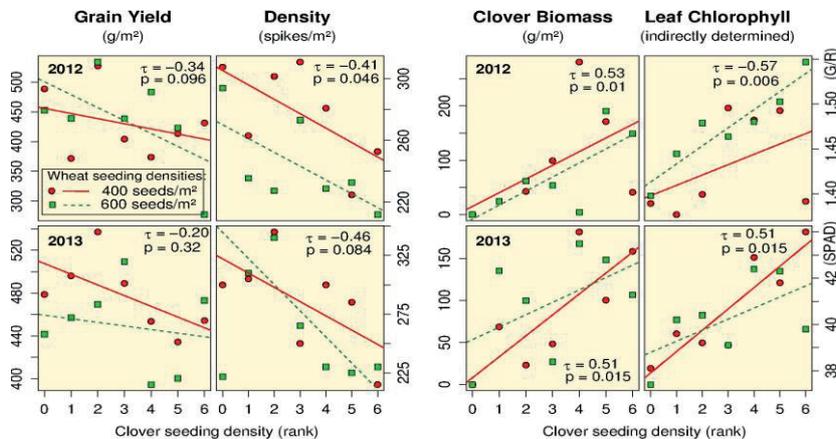


Figure 1: Effect of seeding densities of wheat and clover on clover biomass, leaf chlorophyll content, grain yield and wheat tiller density. “p” denotes spearman’s rank correlation coefficient, “τ” refers to “ρ”.

This research was funded by the European Commission in the frame of the cooperative Project “OSCAR” (www.oscar-covercrops.eu).