ROW SPACING AND CATCH CROP ESTABLISHMENT IN ORGANIC ARABLE SYSTEMS: A WAY TO INCREASE BIOLOGICAL N FIXATION

Chiara DE NOTARIS [1] – Peter SØRENSEN [1] – Jim RASMUSSEN [1] – Jørgen E. OLESEN [1]*

[1] Department of Agroecology, Aarhus University, Blichers Allé 20, Tjele, Denmark, Email*: cdn@agro.au.dk

Introduction

The global market of organic products had a fivefold increase in the last fifteen years, and it will continue to grow (Willer and Lernoud, 2015), but productivity of organic systems is restricted by nitrogen (N) availability and weeds proliferation (Doltra *et al*., 2011). In order to increase arable systems´ efficiency, alternatives to the import of conventionally produced manure are required (Brozyna *et al*., 2013). Biological N fixation (BNF) in legume-based catch crops (CC) can represent a valuable source of N. BNF is determined by dry matter (DM) yield of the legume, N content in the legume biomass, and the fixed-N proportion of total N content (Nesheim and Boller, 1991). Undersowing before harvest of the main crop is required for good establishment of CC and an increased row space of the main crop can benefit their growth by allowing more light for undersown CC. In this way, a wider row space in organic arable systems is expected to increase CC DM yield, thus increasing BNF. The aim of this study was to investigate catch crop development as affected by main crop row space, sowing time and manure application.

Materials and Methods

Set up: Foulum, Denmark (56° 30 N, 9° 34 E); sandy loam soil; March-November 2015. Spring wheat was grown as main crop, with a constant seeding density, while a mixture of red clover, white clover, ryegrass and chicory was used as CC. Investigated treatment factors: a) row spacing: 12, 18 and 24 cm; b) manure: with and without; c) catch crops: 9th May sowing, 21st May sowing and without a CC. At 18 and 24 cm row spacing the wheat crop was hoed before CC sowing. The design was factorial completely randomized with four replicates. Measurements: weekly spectral reflectance measurements to assess Ratio Vegetation Index (RVI); wheat total DM sampled by hand clipping in July; wheat grain yield from combined harvesting; CC sampled by hand clipping in early November. Intercepted fraction of Photosynthetic Active Radiation (fPAR) and Intercepted PAR (IPAR) of the main crop were calculated based on RVI as an indication of its growth, following the model by Christensen & Goudriaan (1993).

Results and Discussion

Wheat DM yield was in average 4.3 t ha^{-1}, with manure application being the only factor with a significant effect (P<0.001). Main crop´s RVI, fPAR and cumulative IPAR data show a significant effect of both manure and row space (P<0.001) (Figure 1). Tukey HSD tests highlighted a significant difference between 12–24 cm treatments, while RVI and fPAR development in time show that row space effect was significant during the first part of wheat´s growing season. Clover was the dominant CC, and its yield (Table 1) was significantly affected by manure (P<0.001) and row space (P<0.01), while not by sowing time (data not shown). Space effect is significant, in particular, when manure is applied, due to a space-manure interaction.

Table 1. Clover dry matter yield (t ha^{-1}).

Treatment	Row Space	Clover DM
Manure	12 cm	0.20 (0.06)
	18 cm	0.60 (0.12)
	24 cm	0.49 (0.13)
No Manure	12 cm	1.37 (0.15)
	18 cm	1.09 (0.13)
	24 cm	1.50 (0.09)

Standard errors are shown in parentheses (n=4).

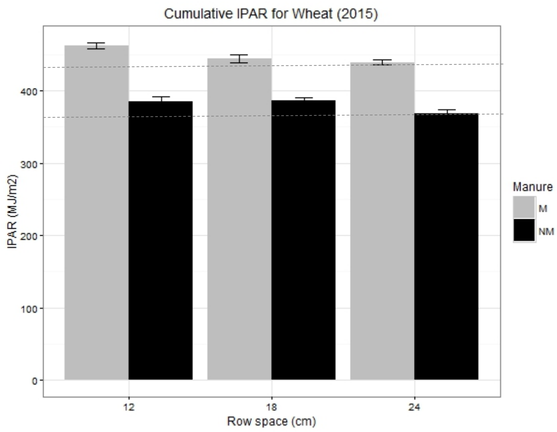

Figure 1. Cumulative Intercepted PAR (MJ m^{-2}) during wheat growing season.

The lower light interception by the wheat canopy in wider space treatments during the first part of the growing season can explain the higher clover yield in those plots. Row space, though, didn´t affect wheat´s grain yield, thanks to a higher intra-row density.

Conclusions

An increased row space in organic arable systems can increase legume-based catch crops DM yield, thus BNF, which is a valuable source of N for the following crop.

Acknowledgements

Acknowledgments go to the skilled technical support of Erling Nielsen and the staff in Foulumgåard. The study was part of the RowCrop project funded under Organic RDD2 by Ministry of Environment and Food.

References

Brozyna M.A. – Petersen S.O. – Chirinda N. – Olesen J.E.: 2013. Effects Of Grass-Clover Management And Cover Crops On Nitrogen Cycling And Nitrous Oxide Emissions In A Stockless Organic Crop Rotation. *Agriculture Ecosystems & Environment,* **181**:115–126.

Christensen S. – Goudriaan J.: 1993. Deriving Light Interception And Biomass From Spectral Reflectance Ratio. *Remote Sensing Of Environment,* **43**:87–95.

Doltra J. – Laegdsmand M. – Olesen J.E.: 2011. Cereal Yield And Quality As Affected By Nitrogen Availability In Organic And Conventional Arable Crop Rotations: A Combined Modeling And Experimental Approach. *European Journal Of Agronomy*, **34**:83–95.

Nesheim L. – Boller B.C.: 1991. Nitrogen-Fixation By White Clover When Competing With Grasses At Moderately Low-Temperatures. *Plant And Soil,* **133**:47–56.

Willer H. – Lernoud J.: 2015. The World Of Organic Agriculture. Statistics And Emerging Trends 2015. *Fibl-Ifoam Report.* Bonn: Organics International.