An attempt to use image analysis to capture growth dynamics in mixed crops stands

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Background

Demand for organically grown winter oilseed rape.

Problems with pests, nutrient supply and weeds

Growing winter oilseed rape in a living mulch of white clover

- To reduce the problems with pests
- To reduce the need for separate green manure crops
- To introduce a "friendly" weed competitor

Hypotheses on rape part of the project (short)

- Larger yields, N-yields
- Rotary strip seeding reduces variation
- "Brushing" increases rape biomass and yield
- Exist a LAI shifting point among species (image analysis)

Conventional ploughing and seed-bed preparation

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We would like to use image analysis to separate:

- Bare soil and plant debris
- Rape
- White clover
- Weeds

Frame:
\[ I(x,y) = R(x,y) + G(x,y) + B(x,y)/3 \]
\[ R, G, B = \text{red, green, blue} \]
Converts to grey. 0 = black, 255 = white, >170 = 1 = frame

Bare soil, plant debris:
\[ I_{IRG}(x,y) = g(x,y)/(r(x,y) + 1) \]
\[ r, g = \text{red, green divided by image intensity, } I. \]
Threshold \( I_{IRG} \), default 0.6.
Reducing \( I_{IRG} \) means less bare soil

Model assumption:
Clover coverage – clover leaves are larger and more circular than grass leaves.

Step 1
Transform to grey image by carrying out a PCA-analysis and retaining the first component.

Step 2
The edges are computed using the Sobel method with a user defined gradient threshold.
Clover = open areas, grass = many edges.

Step 3
Eroding (when many edges) and dilating (when few edges) the combined (with binary soil image) edge analysis.
User defined number of erosions.
The resulting area may also include weeds.

Step 4
Separate clover from weeds by using thresholds for smallest and largest weed area, respectively

Conclusions – image analysis
- Frame easily separated
- Bare soil and plant debris can be separated from living plants (few tests)
- Plant form is not a suitable parameter to use when trying to separate rape from dicot weeds and white clover