Many growing cover crops (CC) successfully suppress weeds. Weed control can be due to resource competition and/or allelopathy and is often associated to CC biomass development and subsequent shading, but for certain CC other factors might be implicated. We therefore studied the factors responsible for pigweed (Amaranthus retroflexus) growth suppression by different cover crops (CC).

Is CC biomass negatively correlated with pigweed growth suppression? Is shading the primary mechanism of pigweed growth suppression by CC?

**Method**
We examined the weed suppressive ability of 13 different CC on pigweed under high and low shading (figure 1C) in the field (Nyon, Switzerland) in 2014 and 2015.

**Results**
- Below 3 t/ha of CC biomass, pigweed growth suppression was negatively correlated with CC biomass (figure 1A).
- Brassicaceae and black oat effectively controlled pigweed even with a low biomass (figure 1A).
- CC strongly suppressed pigweed growth through mechanisms independent from shading (figure 1B).

Can we infer that the observed growth suppressive effects are due to allelopathy?

**Experiment 1**
In order to study growth repressive root interactions in the absence of competition for light, nutrients, water and space a pot experiment was conducted under controlled conditions.

**Method**

**Results**
- Significant growth reduction (p < 0.05) of pigweed when grown with buckwheat, black oat and forage radish (figure 3).
- Phacelia showed no growth repressive effect on pigweed (figure 3).
- 68, 41, and 62% pigweed growth suppression by BK, BO and FR when roots were directly interacting in the soil and 46, 37 and 49 % when roots were separated by a mesh allowing movement of molecules between the two plant species but no direct root contact.

**Conclusions**
- Weed suppression by cover crops (CC) is not always related with a high CC biomass development.
- With two shading levels, pigweed biomass was similar, demonstrating that light interception by CC was not the primary mechanism responsible for pigweed growth suppression.
- Below a threshold of 3 t/ha of CC biomass, pigweed growth suppression was negatively correlated with CC biomass.
- Brassicaceae and black oat did not follow this relation and effectively controlled pigweed even with a low biomass.
- Allelopathic root exudates can be studied independently from resource competition in soil.
- Forage radish, black oat and buckwheat suppressed pigweed growth by allelopathic root exudates.
- Buckwheat changed its root exudation profile after heterospecific neighbor recognition and induced pigweed root growth inhibition.

**Experiment 2**
By considering the theory on costs of plant defense in stressful environments, predicting that costs should increase when competition is intense, we further hypothesized that buckwheat changes its root exudation profile in the presence of weeds in order to suppress their growth.

**Method**
Biological activity (germination and root length after 5d of pigweed growth; figure 5A and B) and chemical activity was tested by diluting root exudates to 1%. Whetman paper in a petri dish (12 cm x 12 cm) was humidified with 4 ml of diluted root exudates. Measurements were performed after 5d on 24 pigweed seeds per petri-dish.

**Results**
- Root exudate extracts from BK-P caused a higher germination rate for pigweed and strongly reduced pigweed root growth (figure 5A and B).
- In total, a list of 3506 different markers was generated after analysis of root exudate extracts by UHPLC-HRMS. Principal component analysis (PCA) on descriptors obtained from the different root exudates from sand culture and separated by UHPLC-HRMS (C). Adapted from Gfeller et al. (2018).
- Updated from Gfeller et al. (2018).