Geophysical Research Abstracts
Vol. 13, EGU2011-11496, 2011
EGU General Assembly 2011

Constraints on cover-cropping as a greenhouse gas abatement action: The importance of species selection

Dru Marsh (1) and Bruce Osborne (2)

(1) School of Biology and Environmental Science, University College Dublin (dru.marsh@ucd.ie), (2) School of Biology and Environmental Science, University College Dublin (bruce.osborne@ucd.ie)

Winter cover-cropping, the practice of replacing bare fallow with plant cover in arable systems, represents one potential greenhouse gas (GHG) abatement action for the agricultural sector. Abatement is achieved if increased photosynthetic carbon assimilation in the cover crop can, over its life span, result in long term increases in soil organic matter. Cover-cropping may be an attractive option for farmers given its negligible disruption to existing food production. The practice is also widely recognised as providing other fertility and management benefits, including reduced nitrate leaching and the nitrogen recycling, which itself may achieve carbon savings by avoiding the indirect emissions associated with fertiliser production and distribution. Successful GHG abatement from cover-cropping, however, is dependent on the maintenance of plant productivity during often sub-optimal growing conditions. The beneficial effects are constrained by a relatively short growing season, which is determined by both management practices (e.g. sowing and ploughing dates) and inter-annual climatic variation.

This research examines the importance of *species selection* in addressing the constraints on biomass accumulation of winter cover crops. We established five cover crop treatments in a spring barley (*Hordeum vulgare*)-based cropping system following harvest in late summer. The treatments, arranged in a random block design with four replications, comprised volunteer barley seedlings left over after harvesting, mustard (*Sinapsis alba*), hairy vetch (*Vicia villosa*), a biculture of Winter rye (*Secale cereale*) and hairy vetch and a new variety of radish (*Raphanus sativa*), the latter crop having been bred specifically for cover-cropping purposes. These species were selected on the basis that they covered a range of desirable traits (e.g. cold-tolerance, rapid growth, nitrogen-fixation). Crop development was monitored over a three-month period leading up until late November, when an extreme weather event occurred.

Species selection, prior to the onset of extreme cold, was found to be important in maximising biomass accumulation. The standing biomass accumulation was greatest in the mustard (2,147 kg DM ha $^{-1}$), comprising 858 kg ha $^{-1}$ of carbon and 42 kg ha $^{-1}$ of nitrogen, followed by the radish (1,798 kg DM ha^{-1}, 679 kg C ha^{-1} and 41 kg N ha^{-1}) and the rye/vetch biculture (1,458 kg DM ha^{-1}, 580 kg C ha^{-1} and 32 kg N ha^{-1}). The level of inter-plot variation, however, meant that the mustard biomass did not differ significantly from the radish and rye. By contrast, the proportion of belowground biomass in each of the mustard, radish and rye, showed significant differences at 17%, 68% and 25% of the aboveground biomass, respectively. Relying on volunteer cover yielded relatively poor results with an accumulation of only 416 kg DM ha^{-1}, or 165 kg C ha^{-1} and 9.6 N kg ha^{-1}. The hairy vetch, at 198 kg DM ha^{-1} (75 kg C ha^{-1} and 7 kg N ha^{-1}), performed relatively poorly in terms of biomass accumulation, although it contributed almost twice the nitrogen per unit biomass compared to the other cover crops, making it a useful companion with the rye.

The importance of species selection was also confirmed by the effect of the extreme weather. Of the five cover crops, only the rye and vetch treatments survived through the freezing conditions, allowing both to continue to accumulate biomass following the thaw. Accordingly, the effect of inter-annual climatic variability may be better managed by selecting cold-tolerant species for cover cropping.

Accordingly, species selection and different species mixes, can assist in maximising biomass accumulation rates as well as insuring against the effect of extreme weather. Adopting this selective approach may, in turn, improve the GHG abatement potential of the practice.