Physical and Cultural Weed Control
Book of Abstracts

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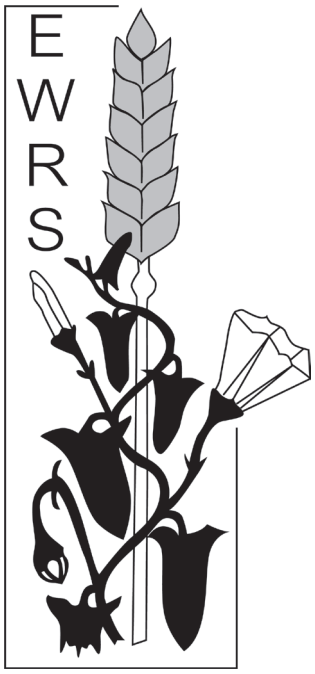

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Cover crops

Exploring the impact of strip cultivation on weed seed predation

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Oral

Strip cultivation is an intercrop system that enables the cultivation of multiple crop species on the same piece of land while utilizing existing farm equipment. Reductions in pest and disease infestation levels have been reported, but the implications for weed pressure have remained unexplored. We hypothesized that the increased spatial diversity following strip cropping might enhance weed seed predation, serving as an important preventative weed management approach. Therefore, the aim of this study was to determine the effect of the increased crop spatial diversity in strip cultivation on weed seed predation. Data was collected from a strip cropping experiment located on Droevendaal experimental farm, Wageningen University & Research, the Netherlands, during the 2023 cropping season. The experiment included fixed crop pairs, namely faba bean (*Vicia faba*) - pumpkin (*Cucurbita pepo*) and cabbage (*Brassica oleracea*) - oats (*Avena sativa*), which were grown in both a strip cropping setup with a strip width of 3 m and monoculture references. Seed exposures were regularly placed for 3-day periods in each crop/strip throughout August and October to mimic the normal period of seed shed of arable weeds. Seeds of *Chenopodium quinoa* were used as model weed seeds. Each sampling point consisted of both a caged and an uncaged seed exposure to differentiate between vertebrates and invertebrate seed predators. Cages had 1x1cm openings. Significant differences were observed between caged and non-caged seed exposures ($P < 0.001$). A significant interaction was observed between sampling period and crop ($P < 0.001$). Seed predation seems to decrease after harvesting. Consequently, the higher seed predation rates throughout the end of the season were observed in cabbage, as the only crop not being harvested at that moment. Particularly after harvest, a reduction in seed predation rate was observed in the monocultures, whereas in the strip cropping systems, weed seed predation was maintained. The findings highlight the potential of strip cropping to positively influence weed seed predation levels, particularly in those systems where crops in neighbouring strips are not harvested at the same time. Based on experiences gained in this first year, we discuss interesting insights and methodological reflections concerning weed seed predation research.

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A living mulch system for weed management in maize

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Oral

Current EU policies, such as the Farm to Fork strategy, aim to reduce the use of pesticides and fertilizers. The use of cover crops as living mulch allows weed suppression, leading to a potential reduction in herbicide use, and also preserves soil fertility. A field study on the use of living mulch in maize started in 2023 in north-west Italy. The aim of the trial was to reduce herbicide use in maize, by testing the combination of in-row chemical weed control and an inter-row living mulch. The cover crops were seeded one month before maize (mid-March) or at the same time (mid-April) and they were either mowed or not mowed during the cropping season. A chemical control and an untreated control with spontaneous weeds (either mowed or not mowed) were also included. Two cover crops were tested, *Secale cereale*(rye) and *Trifolium alexandrinum*(Egyptian clover), seeded at 180 kg/ha and 50 kg/ha, respectively. Cover crops and weeds were mowed in mid-June. The biomass of both weeds and cover crops was assessed, along with maize height, growth stage and vegetation indices. Maize was harvested in October and grain yield and plant biomass were assessed. Biomass produced by cover crops before mowing was 113.3 g/m^2 and 131.9 g/m^2 of dry matter for ryeand E. clover seeded a month before, respectively, while the same species seeded the same day as maize averaged 135.2 g/m^2 and 260.5 g/m^2 of biomass, respectively. Regarding weed biomass, all treatments were significantly different from the untreated control (217 g/m^2), except the treatment with rye seeded a month before maize and not mowed; the lowest weed biomass was achieved with E. clover seeded with maize, regardless of mowing (32.5 g/m^2). The crop was almost not affected by competition from cover crops, as only the height of maize grown with rye seeded the same day and mowed was significantly lower than the chemical control. In terms of yield, the chemical control and the clover seeded with maize treatment (regardless of mowing) showed the highest values (14.9 Mg/ha and 14.7 Mg/ha, respectively), which differed only from the mowed rye seeded the same day as maize (11.4 Mg/ha). Overall, spring sowing of the cover crop allowed to reduce the competition with the crop; Egyptian clover seems to be better suited to this technique, both for weed control and crop performance.

Tags: maize, cover crops, living mulch, weed management

Living mulch organic corn systems: Lessons learned in closing the yield gap in the Temperate US Regions

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Oral

Advancing soil health through management practices has remained a key component to developing climate resilient cropping systems. However, in minimal tillage organic corn systems, matching production levels of tillage-based corn remains elusive. Establishing corn in a living mulch is one method of reducing tillage in organic corn; however, previous experience at the Arlington Agricultural Research Station (AARS) in Arlington, WI observed yield reductions typically half of expected yields from tillage-based corn systems. Two successive experiments performed over 3 years at AARS have built knowledge on management practices that improve production of corn when planted into a red clover living mulch. From 2021-2022, a Management Tools experiment examined 3 factors of 1) pre-plant strip tillage vs no strip tillage, 2) Flaming vs no flaming at planting, and 3) Inter-row roller crimping (IRC), high residue cultivation (HRC), or IRC + HRC performed post planting. In 2023, a complementary experiment built off key lessons of the Management Tools experiment by exploring practices to manage competition from clover. Treatments included 1) an inter-row mower (IRM) to manage in-season clover growth, 2) Forage harvesting (FH) pre-plant, 3) FH + IRM, 4) No management, and 5) Cultivated control. Critical lessons learned are that performing pre-plant strip tillage is critical for success as grain yields increased in one year by up to 50 bu/ac reaching 134 bu/ac. In-season clover biomass was correlated to corn yield indicating that management of clover within the season can aid in promoting grain yields. Managing clover growth in-season with an IRM successfully improved plant vigor as measured through SPAD readings and corn grain yield by 27.8 bu/ac from 68.0 to 95.9 bu/ac as compared to no in-season management. Tillage-based plots yielded 170 bu/ac yields indicating the need for continued development to close yield gaps within reduced tillage organic living mulch systems.

Tags: organic agriculture, reduced tillage

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Rolled-crimped cover crops for organic no-till planted winter wheat (Triticum aestivum)

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Oral

Mulch from cover crops that have been mechanically terminated with a roller-crimper can suppress weeds and facilitate organic no-till corn and soybean production. However, research is lacking on no-till planting winter wheat (*Triticum aestivum*L.) into rolled-crimped cover crops. An experiment was conducted to test the effects of no-till planting winter wheat into five cover crops: 1) buckwheat (*Fagopyrum esculentum* Moench), 2) radish (*Raphanus sativus*L.), 3) sorghum sudangrass [*Sorghum bicolor* (L.) Moench x *S. sudanense*(Piper) Stapf.], 4) soybean [*Glycine max* (L.) Merr.], and 5) sunn hemp (*Crotalaria juncea*L.) that were planted in early-, mid-, and late-summer. Cover crops were terminated with a roller-crimper and winter wheat was simultaneously no-till planted into the cover crops in early fall. A 'no cover crop' control treatment was also included where wheat was planted into tilled soil. Cover crop and weed biomass at wheat planting, wheat seedling density, weed biomass at wheat harvest, and wheat grain yield were quantified. Cover crop and weed biomass at wheat planting varied by cover crop planting date and species. Early-summer planted sorghum sudangrass produced the most cover crop biomass and had among the lowest weed biomass at wheat planting and at wheat harvest. However, wheat density and grain yield was relatively low in the early-planted sorghum sudangrass treatment compared with the other cover crop treatments, indicating a tradeoff between weed suppression and wheat yield at the high end of the cover crop mulch biomass gradient. Early-planted buckwheat and early-planted soybean had among the highest wheat grain yields, but no cover crop treatments yielded more than the 'no cover crop' control. Results from this experiment indicate rolled-crimped cover crops can facilitate organic no-till winter wheat production, but more research is needed to overcome tradeoffs and optimize production.

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Winter-killing cover crops for organic no-till spring wheat production

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Oral

Organic farmers often depend on tillage to control weeds and prepare seedbeds before planting. This poses a particular challenge for spring wheat in the Northeastern United States. Windows for spring tillage are typically restricted by frequent precipitation, while fall tillage leaves soil vulnerable to erosion. This can delay planting and compromise weed management. This experiment tested cover crop-based no-till spring wheat production to manage weeds and contribute nitrogen to wheat. By shifting tillage to late summer and establishing a winter-killing cover crop, the soil is suitable for no-till drilling of spring wheat. The experiment compared seven cover crop treatments to precede spring wheat. Treatments included Tartary buckwheat (*Fagopyrum tataricum*), sorghum sudangrass (*Sorghum bicolor* × *S. sudanese*), oat (*Avena sativa*), field pea (*Pisum sativum*), oat and field pea, tillage radish (*Raphanus sativus*), Appin turnip (*Brassica rapa*)and a spring tillage-based control. Given the importance of high protein in spring wheat, the influence of additional fertilizer was also examined. The experiment was established in August 2022 at the Cornell Musgrave Research Farm (Aurora, NY, USA) and the Hudson Valley Farm Hub (Hurley, NY, USA) in a split-plot randomized complete block design with 4 blocks. Subplots had no fertilizer or 95 kg/ha Chilean nitrate (16-0-0) at the 4-5 leaf stage. It was hypothesized that weed suppression, grain yield, and grain quality would be greatest with legumes and brassicas. It was expected that Chilean nitrate would increase grain protein across treatments but also promote weeds. Cover crop and weed biomass were measured in late fall. At wheat harvest, wheat biomass, wheat grain yield, and weed biomass were measured. At both sites, weed biomass was similar to the tilled control except in buckwheat and sorghum sudangrass plots, where cover crops likely winter-killed too early for lasting weed suppression. Cover crop treatments also achieved similar yields as the tilled control except in buckwheat and sorghum sudangrass, which were lower. Oat and oat/pea performed best, yielding an adjusted mean of 3725 kg/ha at the Farm Hub and 2949 kg/ha at Musgrave respectively. Persistence of oat mulch likely improved weed suppression. Supplemental fertilizer at Musgrave increased weed biomass by 30% without improving yield, although grain had an additional 2.5% protein. No cover crops affected grain protein. Overall, results suggest that replacing spring tillage with a winter-killing cover crop reduces weeds and maintains grain yield. Additional fertilizer could improve grain protein, but effects on yield and weeds were site-specific.

Tags: wheat, organic, cover crop, no-till

Acknowledgement(s) / funding: Hudson Valley Farm Hub

Weed composition in three soil cover managements in almond orchards in a mountainous area of the Iberian system (NE Spain)

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Oral

Traditionally, in Mediterranean areas, sheep grazed almond orchards, olive groves and vineyards under rainfed conditions and tillage was occasional. The reduction of the livestock population has changed the habits and these environments are nowadays tilled several times a year, mainly to reduce competition for water. The CAPs eco-regimes propose maintaining a soil cover during several months reducing the tillage intensity to improve soil quality and other ecosystem services related to higher plant diversity.

In 2022, three soil cover regimes were compared in three almond orchards located close to each other and with similar soil characteristics (calcareous loamy soils) at the same municipality in 2022 (Valderrobres, Teruel, Spain): a) tilled once or twice a year, depending on the rainfall, b) spontaneous vegetation mowed once a year in spring and c) seeded cover crop (triticale-vetch-*Lolium multiflorum* mixture), periodically grazed by sheep. In 2023, three similar treatments to those were established in a field next to a sheep farm (Torrecilla de Alcañiz, Teruel, Spain) in a calcareous sandy-loam soil with the exception that b2) included spontaneous vegetation periodically grazed by sheep and c2) was seeded with a triticale-vetch mixture. Plant ground cover of each identified plant species was assessed in the interrow of the orchards several times and additionally recorded separately in the tree rows, except in 2022 in a) and b) because they received the same treatments than the rest of the plots.

In 2022, mean plant ground cover in the interrows was 20, 98 and 75% for a, b and c, respectively and in 2023-24 reached 17, 48 and 22% for a, b2 and c. In 2022, mean plant richness was 16, 44 and 29 in plots a, b and c and in 2023-24, it was 15, 24 and 16 for a, b2 and c2, respectively.

In the row, in 2022 mean ground cover was 95%, and richness reached 30; in 2023-24, cover was 70, 72 and 82% in a, b2 and c2, respectively, and richness was 21, 19 and 24. Despite these differences in cover, midday stem water potential of almond trees was similar among treatments.

As expected, more plant species grew in less disturbed environments in the tree rows, followed by spontaneous cover in the interrow, while less species emerged in the tilled plots or grew as weeds in the grazed cover crops. More data need to be collected to complete the picture from other points of view.

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Perennial weeds

Tackling yellow nutsedge with fallow periodes and cover crops

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Oral

Yellow nutsedge (*Cyperus esculentus*) is an invasive and troublesome weed that plagues arable and vegetable fields in Switzerland and other parts of Europe. The plant reproduces mainly vegetatively via tubers and is easily transported to new fields by machinery. Until now, the main focus has been on developing chemical strategies or combined chemical and mechanical approaches to control this noxious weed. However, organic fields have received less attention and there is an urgent need for effective control strategies without herbicides.

To this end, a four-year research project was launched in 2022 to evaluate and optimise a multi-year fallow technique to control yellow nutsedge in heavily infested areas. Three on-farm trials were established in the canton of Bern, Switzerland. The optimised fallow technique aims to reduce the tuber bank in the soil through a combination of repeated tillage and highly competitive cover crops. Young seedlings are mechanically destroyed at regular intervals, while the germination of tubers still present in the soil is stimulated. Tillage is repeated approximately every three to four weeks from the start of the yellow nutsedge growing season (May) until early October. Six treatments were compared including two tillage machines (rotary harrow and vibrocultivator) in combination with different cover crop mixtures (none, frost-sensitive and overwintering), sown by the end of July. Sowing competitive cover crops (fast-growing and competitive species) aims to inhibit the growth of yellow nutsedge and maintain soil organic carbon levels by returning fresh organic matter to the soil. To evaluate the effectiveness of the different treatments, the number of tubers per liter of soil was sampled at the start of the trial and after each growing season.

After one year, a reduction in the number of tubers was observed for all treatments tested. There were no major differences between the two machines, except in one plot where the rotary harrow was equipped with a packer roller. This roller tended to favour yellow nutsedge regrowth by compacting the worked area. On average, the relative reduction in tuber numbers after one year (7-10 passes) was 60% for tillage alone. For the combined tillage and cover crop methods, where the soil was only cultivated until the end of July (5 passes), the reduction was between 20 and 40%.The trials will continue until the end of 2025.

Tags: fallow, tillage, cover crop, yellow nutsedge

Impact of regular mowing, mowing height, and grass competition on tuber number and tuber size of yellow nutsedge clonal populations (Cyperus esculentus L.)

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Oral

Cyperus esculentus, a perennial sedge, is one of the most dangerous weeds in agriculture because of its high multiplication potential, its high risk of tuber spread and its low sensitivity to control measures. To diminish the risk of *C. esculentus* spread and incursion into adjacent crops by creeping rhizomes, control measures should also focus on non-cropped areas adjacent to these crop zones. Defoliation by mowing is an example of one of these control measures. The aim of this study was to identify the critical mowing interval and height required for preventing tuber formation and to assess the combined effect of mowing and competition exerted by the grassy vegetation on the growth and spread of *C. esculentus* in field margins. In two separate years we conducted an indoor container (11 L) experiment, under a worst-case scenario, in which genetically distinct clones, grown alone or in combination with *Lolium perenne*, were subjected to season-long mowing regimes that differed in mowing interval (1-, 2-, 4-, and 8-weeks) and/or mowing height (2 and 5 cm). Weekly and 2-weekly mowing at 5 cm within an 18-week period significantly reduced tuber production of *C. esculentus* grown with competition (up to 93 and 98% reduction in tuber number respectively) and without competition from *L. perenne* (both a 97% reduction), compared to the uncut control with and without competition, respectively. Compared to a mowing height of 5 cm, a mowing height of 2 cm resulted in better control of *C. esculentus*, with tuber numbers up to 32% lower and 5-65% lighter. 2-weekly mowing at 2 cm height can be an effective strategy for containing or reducing *C. esculentus* patches in field margins.

Tags: cutting, field margins, herbaceous strips, herbicide-free areas, Lolium perenne, mechanical weed control

Acknowledgement(s) / funding: No funding was received.

Impact of electrocution on shoot and tuber vitality of Cyperus esculentus

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Oral

Cyperus esculentus (yellow nutsedge) is an invasive perennial sedge that can cause huge losses in arable crops. Current control strategies are based on combinations of cultural, mechanical, and chemical measures, repeated over years. Recent commercial releases of safe innovative electric weeders, offer promising alternative opportunities for controlling perennial weeds with high energy/high frequency electricity. To evaluate the effect of a single electrocution application on the efficacy of *C. esculentus* control, field experiments were performed in two locations in Belgium. Two electric weeding devices were evaluated: Zasso XP300, delivering a high-frequency, phased direct current (maximum voltage of 7000 V and maximum power output of 2000 W per square meter of green biomass, driving speeds between 1.1 and 3.0 $km \cdot h^{-1}$), and Rootwave Pro, delivering high-frequency alternating current (maximum voltage of 5000 V and power output between 7.5 and 10 kVA, treatment duration of 2 s). The impact of various technical (driving speed and voltage), biotic (clone and growth stage), and abiotic parameters on electrocution efficacy was evaluated. Plant responses to electrocution were evaluated by examining the vitality of treated *C. esculentus* mother tubers and shoots. Both devices were ineffective in controlling mother tubers, regardless of their burial depth (−5 cm to −15 cm), but were highly effective against aboveground shoots with reductions of vitality of up to 91% and 100% after a single pass with Zasso XP300 and Rootwave Pro, respectively. Maximum reductions were obtained when electricity was delivered at low speed (1.1 to 1.5 $km \cdot h^{-1}$) and on 5-leaf shoots without heat or water stress. Remarkably, the lowest efficacies were found on water-stressed soils at the time of application. Voltage had no effect on the degree of *C. esculentus* control. The efficacy of electricity was not affected by clone, irrespective of electric weeding device. Electrocution is a useful and effective control method within any integrated control strategy for controlling emerged shoots. However, as *C. esculentus* mother tubers are not affected by a single treatment, season-long repeated treatments are needed to exhaust the mother tubers.

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Innovative disturbance techniques to control creeping perennial weeds through root cutting

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Oral

Creeping perennial weeds like *Cirsium arvense* (L.) Scop. strongly influence arable production, causing crop quantity and quality losses unless controlled. The common farming practices for controlling creeping perennial weeds of intensive inversion tillage and herbicide application (especially glyphosate) are not sustainable. Innovative and sustainable perennial weed control principles should utilize non-inversion mechanical control. This includes physical disturbance of the weeds growth specifically targeting their creeping root system. One example of an innovative approach to fulfill these demands is the use of new tillage machines (e.g. “Root-Cutter”). Root cutting enables belowground weed control without inversion tillage by horizontally cutting the roots and shoots, ultimately leading to a depletion of the roots storage reserves and therefore a destruction of the plant’s propagules. We conducted multi-year field trials in Germany, Norway and Finland. These trials focused on implementing and optimizing disturbance through root cutting while evaluating the efficacy in suppressing *C. arvense*, *E. repens* and *S. arvensis*. The effectiveness was compared to conventional farming practices, especially ploughing. Statistical analysis revealed no significant differences in the biomass reductions of *C. arvense*, *E. repens* and *S. arvensis* between ploughing and root cutting. The weed control effect of root cutting was further improved by adding competition through cover crops. We value the potential of the “Root-Cutter” in reducing perennial weed biomass with non-inversion disturbance as highly promising. We concluded that the combination of non-inversion disturbance and competition is a promising strategy to reduce the reliance on herbicides or inversion tillage in the management of perennial weeds.

Acknowledgement(s) / funding: European Union’s Horizon 2020 research and innovation programme under grant agreement No 771134. The project “AC/DC-weeds- Applying and Combining Disturbance and Competition for an agro-ecological management of creeping perennial weeds”

Root cutters: Novel tillage methods to control creeping perennial weeds with a low risk of soil erosion and nutrient leaching

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Oral

Perennial weeds are a major obstacle for reducing pesticides and tillage. Three multi-year experiments were conducted in Norway and Sweden to determine if a) the horizonal and vertical root/rhizome cutters (HRC and VRC, respectively) can provide effective non-chemical control of multiple perennial weed species comparable to more intensive tillage methods (Experiments 1-2), b) without increasing the risk of soil erosion and nutrient leaching (Experiment 3), and c) if integrating the VRC with the HRC, mowing or disc harrow can increase the efficacy against perennial weeds (Experiment 1). All treatments were spring plowed in Experiment 1 and 3, and autumn plowed in Experiment 2. In Experiment 1, the rotary tiller was the most suppressive against *Sonchus arvensis* and *Elymus repens* but increased *Stachys palustris* shoot numbers. HRC treatments were not signicantly worse than the rotary tiller and increased crop yield by 28%, reduced total perennial shoot biomass by 46-51% and reduced *S. arvensis* and *E. repens* shoot biomass by 52% and 80%, respectively, compared to an untreated control. In Experiment 2, HRC treatments reduced *Cirsium arvense* shoot numbers by 71% compared to the untreated control but failed to control *E. repens*. HRC treatment depth (7 vs. 15 cm) did not significantly affect control efficacy. Experiment 3 showed that HRC did not increase soil, water or nutrient losses compared to the untreated control and resulted in 60% less soil and 52% less phosphorous losses than disc harrowing. Treatments with VRC reduced the shoot biomass of *E. repens* by 40% and *S. arvensis* by 22%, compared to without VRC. Novelly, the results show that in plowed systems, HRC provides control of multiple perennial weed species that is comparable to more intensive tillage methods, but with little risk of soil and nutrient losses; and integrating VRC into control strategies improves perennial weed control efficacy.

Tags: Conservation agriculture; regenerative agriculture; organic agriculture; integrated pest management; Elytrigia repens

Acknowledgement(s) / funding: Norwegian Research Council, Kverneland Group, C.F. Lundström foundation, FORMAS

Different tillage methods for couch grass management in spring cereals

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Oral

Couch grass, *Elymus repens* (L.) Gould, is the most abundant weed species in arable crops in Finland. Couch grass thrives in spring cereals, which are the major crops in Finland. In conventional farming, couch grass is typically controlled with glyphosate, applied either on stubble after harvest or before direct drilling. The future of glyphosate has been unclear in the EU, and alternative management methods against couch grass are needed. Three field experiments in spring cereals were carried out in locations with different soil types and with high infestations of couch grass. A trial protocol with different mechanical methods was followed, with randomized complete block trial design with four replicates. Spring barley was grown in 2021, spring oats in 2022 and spring barley again in 2023. The idea was to repeat each tillage method yearly. The protocol included seven treatments: 1) (pre-drill glyphosate +) no-till, 2) (post-harvest glyphosate +) ploughing, 3) tine cultivation, 4) tine cultivation + ploughing, 5) ploughing, 6) KvickFinn cultivation, and 7) 2021 KvickFinn fallow + green manure (+ no-till 2022 and 2023). Glyphosate after harvest was applied in 2021 and 2022 and before drilling in 2022 and 2023. The coverage of couch grass was visually assessed, and the biomass of weeds and cereals measured from samples at harvest time each year. The grain yield quantity and quality of cereals were recorded. Finally, the trial results were used in cost-effectiveness comparisons. In 2021, the KvickFinn fallow reduced couch grass most effectively in all three locations. The KvickFinn fallow in 2021 provided a good subsequent efficacy on couch grass still in 2022, but not any more in 2023. Ploughing alone did not reduce the cover or biomass of couch grass in three years. Tine cultivation before ploughing improved the effect of ploughing clearly on all sites. Especially on heavy soils KvickFinn -cultivation reduced couch grass more than ploughing. The differences between treatments were the biggest in Siikajoki on highly organic soil with the highest couch grass pressure. The treatments with glyphosate were effective on couch grass on all sites and produced the highest cereal yields in 2022 and 2023. The yield quality was not affected by the treatments. The pre-drill glyphosate + direct-drilling was clearly the most profitable treatment, and KvickFinn cultivation the least profitable. The treatment 7 was economically competitive because of the subsidy to the green manure in 2021.

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Integrated weed management

Challenges and opportunities for integrated weed management in low-stem pome fruit

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Oral

Conventional pome fruit growers keep the area beneath their fruit trees (the 'black strip') nearly weed-free at a low cost through two to four applications comprising soil-acting and/or foliar herbicides per year. However, in line with the European Green Deal's objective to cut the use and risk of chemical pesticides by 50% by 2030 and promote Integrated Pest Management (IPM), there has been a phase-out of widely used herbicides, thereby increasing the demand for economically and technically viable integrated weed management systems.

Our current study aims to investigate the required treatment frequency and labour hours of distinct weed management systems, and their effects on weed flora, fruit yield and quality. Systems were applied in a well-established intensive pear (*Pyrus communis* L. cv. Conference) and apple (*Malus domestica* Borkh. cv. Golden) orchard, and included an untreated control, two benchmark systems (i.e., standard chemical system and a standard mechanical control system used by organic growers, based on hoeing followed by cord mowing) and three or four integrated systems (for respectively pear or apple) with no or reduced herbicide use and implementation of non-chemical tactics (cords mower, hot air). Weed flora was studied through three-weekly monitoring of weed coverage, species importance and composition. In the period from end of flowering until the fruit reaches 80% of its final size, individual treatments were applied whenever weed coverage in the black strip surpassed a 15% threshold. Fruit yield (weight, number) per tree and fruit quality (size distribution, mineral content) were analysed at the beginning of fruit ripening.

Yield differences between control systems were minimal. However, fruit N content was lower in plots managed with alternating use of the cord mower and hot air device than in plots with a standard chemical system. Systems with hot air effectively reduced grasses but were most labour-intensive. A trend towards an increase in perennial weeds, mainly common dandelion (*Taraxacum officinale* L.), was observed, except in the standard chemical system, indicating potential long-term management challenges. The roller hoe/finger weeder passes in the standard mechanical control system seem to foster nitrophilic dicotyledonous weeds. Integrated systems revealed up to threefold higher treatment frequency and labour use relative to the standard chemical system. The system combining mowing with limited chemical intervention effectively controlled common dandelion, suggesting that a smart combination of mechanical tactics and well-targeted herbicide applications can manage perennial weeds while reducing overall herbicide use. These initial findings highlight future challenges and opportunities of implementing non-chemical weed control tactics in conventional pome fruit orchards.This research was funded by Flanders Innovation and Entrepreneurship (VLAIO).

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Reducing tillage and herbicide use intensity while limiting weed-related wheat yield loss

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Oral

Integrated weed management (IWM) promotes the combination of non-chemical techniques to achieve sustainable weed control while reducing the reliance on herbicides. However, IWM strategies reducing both herbicide and tillage intensity remain unsatisfactory, leading to weed-induced yield loss. In this study, five IWM strategies were implemented for three years (2020–2022), aiming at reducing herbicide application under four tillage conditions while limiting weed-induced yield losses. These strategies were annual moldboard ploughing without herbicides (PL0H), annual moldboard ploughing with reduced herbicide use (PLHred), occasional moldboard ploughing with reduced herbicide use (PLredHred), shallow tillage with no herbicides (ST0H) and no-tillage with reduced herbicide use (NTHred). The effects of IWM strategies and years since implementation, on total weed and crop biomass, estimated weed and crop volume, weed density, weed species richness and grain yield were analysed in winter wheat. No differences in weed biomass, volume or species richness were observed between IWM strategies over the years. Weed density increase was highest in PL0H. No difference was identified in wheat grain yield between the strategies over the years. Moderate weed-related yield losses were observed only in 2020 without significative difference between strategies. Reducing tillage and herbicide use led to a greater use of non-chemical weed management techniques such as mechanical weeding. The feasibility and performances of such systems must be assessed over a long-term period to ensure their sustainability.

Camera-guided inter-row and in-row hoeing in cereals, sugar beet, sunflower and maize

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Oral

Robotic hoeing uses real-time row detection with an RGB-camera connected to a controller, which steered a 3 m and 6 m wide automatic side-shift system to guide the no-till sweeps in the center of the inter-row area with a distance of 25 mm to the crop rows (KULT Vision Control). This so-called first generation weeding robot improved mechanical weeding from 65 % weed control efficacy (WCE) to 80 % WCE without causing more crop damage. The driving speedcould be doubled. However, the problem of weed competition in the crop row remained. Therefore, selective in-row hoeing was included into the inter-row hoe. KULT-iSelect + University of Hohenheim in-row hoe is an extension of the KULT-Vison control hoe. Four in-row hoeing elements were mounted behind the inter-row hoe in a distance of 50 cm above the crop row. Multispectral cameras were placed in front of v-formed in-row blades with hydraulic opening and closing. Cameras were mounted vertically above the crop rows taking 30 x 20 cm pictures. Image processing and Artificial Intelligence (AI)-based classification was computed in real-time on a controller mounted on the tractor. Species were grouped into ‘crop’, ‘beneficial/rare weed’ and ‘problematic weed’ and a decision algorithm was computed to move the hoeing blades the crop row, where only problematic weeds were present. This system incereased WCE in sugar beet, sunflower and maize to 93 % with less than 5 % crop losses. However, speed was reduced from 10 to 1 km/h. Therefore, in-row robotic hoeing so far is adopted mostly in high-value crops.

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Portable walk-behind inter-row weeder for no-till cultivations

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Oral

Demands and interests are emerging for regenerative organic farming, where biological diversity, soil conservation and human health issues are additionally addressed. For that goal, we have been practicing under solar-sharing environment a no-till alternate production of *Glycine max* (soybean) as the main crop and winter cover crops as the material for soil cover. With narrow row spacing of 30 cm for early canopy cover and with the chopped straw on the soil surface at the early growth stage, weed control without herbicide is well-structured, yet grass weeds such as *Digitaria ciliaris* (crabgrass) or *Panicum dichotomiflorum* (fall panicum) eventually exceed the crop canopy without direct weeding action. Unlike conventional mechanical weeders based on uprooting of the weed plants and on covering them with soil, no-till cultivation only allows to act on above-ground portion of the weeds in the inter-row section of the crop. To cope with frequent surface weeding with less labor input, we have developed an inter-row weeder that contained three electrically driven hand mowers (bush cutters) on a hand-driven motor-assisted tricycle cart. The mower mounted a 21 cm- two-blade rotor that rotated at 4500-5000 rpm and was supported by a bowl-shaped stabilizer on the bottom. A plastic cover was added above the rotor to protect the crop. The machine test was carried out in a rice paddy field after the season, where voluntarily sprouted rice plant hills on a solid soil surface were imitated as grass weeds in a no-till field. At the operating speed of 0.4 m/s, less than 1% of the stems remained, whereas at 1.4 m/s, nearly 20%. This is because some stems were cut at a lower peripheral speed of the blade (close to its own center shaft) at such high operating speed. In the actual no-till cropland, the prototype covered 0.49 ha/h, whereas a single hand mower 0.21 ha/h. In 2022 under solar-sharing environment, for zero-, two- and three-time weeding at one week intervals, dry above-ground biomass of weeds at flowering stage were 336, 204, 141 g/m^2, and seed grain yields of the crop were 0.6, 1.4, 2.0 t/ha, respectively. Currently, trials are continually undertaken to increase the weeding efficacy at high operating speed, to widen the operation width of the blades that covers near intra-row area, and to further assist the operator at the headland for increasing field capacity of the machine.

Tags: no-till, inter-row weeding, field capacity, efficacy, solar-sharing, soybean, grain yield

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Seeding and interrow weeding

Better weed control by optimized seed pattern

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Oral

The aim of the project was to develop a seeding machine for winter wheat and to test the hypothesis that equal seed distances (triangular pattern) will improve both crop yield and competition against weeds. In this way, the amount of herbicides could be reduced compared to conventional drill sowing, thereby establishing a more sustainable cropping system. For organic farming systems, we test if harrowing could be more effective by this triangular seeding compared to row drilling. The project demonstrated that mechanical sowing of grain in triangular pattern is possible with sufficient accuracy. However, this places high demands on the seed and seedbed preparation. Cereals in equal sowing distances with significantly reduced seed rates are equal in terms of yield to conventional sowing rates. However, the hypothesis that the uniform sowing association with a low sowing rate of 150 grains/m² contributes to improved weed suppression and thus herbicide savings could not be confirmed. The results suggest that the sowing rate was too low to achieve sufficient soil cover and consequently high weed suppression at an early stage of crop development. Furthermore, we found that the phenotypic characteristics of the wheat cultivar will also effect crop yield and weed suppression. During the 2 years of field trials the interaction between crop cultivar and sowing pattern were highly significant. For the conditions of organic farming we also can conclude that such low sowing rates will result in too low competition against weeds. However, grain yield was positively affected by the triangular seed pattern as far as weeds could be sufficiently controlled by direct methods.

Tags: weed competition, winter wheat, seed pattern, grain yield, wheat cultivars

Acknowledgement(s) / funding: funded by the Deutsche Bundesstiftung (DBU)

The effect of row distance and plant spacing on weed competition and yield in spring barley

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Oral

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Seeders with large row distance give less opportunity to utilize the weed control effect of the plant population, through a poorer spatial distribution of the seeds. We studied how different row distance and plant spacing in the row, affected the crop's ability to suppress annual weeds and the yield in organic cultivation of two spring barley varieties (*Hordeum vulgare*), Irina and Planet. To evaluate how row distance affects weed competition and yield, we used a Väderstad Rapid Turf. The trials were carried out on a sandy loam at the SITES Lönnstorp Research Station, Lomma Sweden. Mechanical weed control was applied in the trials, as false seedbeds, blind harrowing and selective weed harrowing. In 2022 the weed control effect was better at 6.25 cm compared to 12.5 cm row distance, at seed rates > 230 per m² for Planet and > 300 per m² for Irina. The weed pressure outside the plots was high. Weed weight was 10 to 40 times lower inside the plots, which was an effect of the crop's weed competition. The yield increased at the narrow row distance and with an increased number of seeds per m². Blind harrowing before emergence and selective weed harrowing after emergence, resulted in a lower yield compared to if no mechanical weed control was carried out after seeding. Yields in 2022 sown at 6.25 cm compared to 12.5 cm row distance were 8-15% higher (0.5-1.0 ton/ha) for the narrow row distance, at a seed rate of 500 per m². Even at a seed rate of 300 per m², the yield was higher, 2-7% (0.1-0.4 ton/ha), for the narrow row distance. In Irina, in 2023, the yield increased at the narrow row distance and at the increased seed rates, on a soil that had a rather high water-holding capacity, even if we had a very dry early summer. However, we got a different yield result for Planet in 2023. Here, the yield was unaffected by the row distance. The yield decreased with an increased seed rate for both row distances, on a soil that had a rather low water holding capacity.When organic spring barley is sown with 6.25 cm row distance instead of 12.5 cm, at normal seed rates, better weed control and higher yields are obtained.

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Quantifying the mechanisms of weed suppression in cereal-legume intercrops

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Oral

Weeds pose a significant threat to crop yields. Combined with negative impacts of herbicidal control becoming gradually more apparent, this necessitates a re-evaluation of weed management practices that reduce reliance on herbicides. Intercropping systems offer a promising contribution to alternative strategies, demonstrating the potential to mitigate weed-related yield losses. A thorough analysis of intercropping literature suggested that selection, i.e. the dominance of one species, rather than complementarity, is the primary mechanism of enhanced weed suppression in intercropping systems. The mechanisms underpinning weed suppression within intercrops remain a subject of active investigation. We conducted three field experiments over 2022 and 2023, in which we aimed to quantify these mechanisms by exploring various aspects of cereal-legume intercropping systems compared to pure stands. We grew several cereal-legume intercropping configurations, varying in species composition, density, and spatial arrangement. Crop performance was represented by crop biomass and yield. Weed suppression was inversely represented by weed biomass. We examined canopy cover and light interception to gain insights into growth development of the cropping systems. Our findings confirmed the dominant role of selection as the primary mechanism behind enhanced weed suppression in cereal-legume intercropping systems. In 2023, we observed higher weed suppression than predicted. This can be explained by the delayed emergence of the weaker competitive crop species, thereby facilitating the amplified weed suppression of the stronger competitor. Furthermore, intercrop systems displayed canopy cover and light interception more similar to the pure stands of strong competitors, underscoring the impact of selection on these variables. Interestingly, replacing just one in every four rows of a faba bean (legume) with triticale (cereal) yielded substantial weed suppression, comparable to what was observed in triticale pure stands. These results highlight the potential for optimizing cereal–legume intercropping systems by strategically replacing a small portion of weaker competitive crop species with the stronger competitive species. Future research into plant traits and their variable expression within intercrop systems offers promising avenues for further enhancing our knowledge and identifying key breeding targets to optimize intercrop varieties. These insights pave the way for sustainable and environmentally friendly weed management practices in agriculture.

Tags: Intercropping, weed suppression, cereal, legume, selection

The integration of inter-row cultivation to an arable cropping system by combining with banded herbicide

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Oral

The necessity for alternative methods of effective weed control has become increasingly acute as the combined impact of herbicide resistance, tightening regulation and consumer demands is felt by growers. Considering the European Union's Farm to Fork policy, which aims to achieve a 50% reduction in pesticide use, we demonstrate that a combination of on-row banded herbicide and inter-row hoeing is capable of delivering control equal to that of current methods when controlling *Alopecurus myosuroides* (black-grass). Black-grass is one of Europe's most important weed species, which has developed wide-spread herbicide resistance and is present in every area of the UK making it a priority to ensure that sustainable control remains possible in the future. We present a set of field trials data where current control strategies (multiple herbicide passes) is compared to two strategies of reducing herbicide loading – cutting rates or reducing the area treated within a field and combining with a non-chemical method. This sets a direction of reduction whereby lower rates results in ineffective weed control and increased risk of herbicide resistance, whilst the combination of on-row banded herbicide and inter-row hoeing offers the opportunity to maintain high levels of weed control. These results are incorporated into a previously developed economic model to demonstrate that the uptake of this alternative control strategy may be effective but barriers remain in terms of a predicted reduction in economic returns and an increase in labour required to deliver it.

Interrow Mowing in Organic No-Till Planted Dry Bean

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Oral

Interrow Mowing in Organic No-Till Planted Dry Bean

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No-till planting organic dry bean (*Phaseolus vulgaris*L.) into rolled-crimped cereal rye (*Secale cereale* L.) can have several advantages over traditional tillage-based production. However, suboptimal cereal rye growth in fields with large populations of weeds may result in weed-crop competition and adds seeds to the soil weed seed bank. The R-Tech Interrow Mower, a front mounted interrow mower with five independent, hydraulically-powered rotary mower units offers potential for supplemental weed management in organic no-till field crop systems. Previous research examining multi-tactic weed management in organic no-till planted soybean demonstrated that interrow mowing reduced weed biomass ($P < 0.05$) compared to other tactics. In 2023, a field experiment was conducted across five sites in four statesto evaluate different interrow mowing strategies in organic no-till dry bean production to address weed-crop competition and weed population management. Interrow mowing treatments were: 1) interrow mowing early, 2) interrow mowing late, and 3) interrow mowing as-needed. A weed-free treatment and an untreated control treatment were also included.Surrogate weed microplots were established to ensure consistent weed densities across plots.We hypothesized that: 1) all interrow mowing treatments would decrease weed biomass compared to the untreated control, and 2) early and as-needed interrow mowing would enhance dry bean yield compared to the untreated control. Weed control varied by site, with late mowing showing the most consistent reduction in weed biomass across sites. Late mowing decreased weed biomass ($P < 0.05$) relative to all mowing treatments and the untreated control at one site, while reducing weed biomass ($P < 0.05$) relative to early mowing and the untreated control at another site. At two sites, late and as-needed mowing reduced weed biomass ($P < 0.05$) compared to the early mowing treatment. Dry bean yield differed by treatment in one site, where the early mowing treatment increased dry bean yield ($P < 0.05$) relative to all other treatments. This experiment will be repeated at all sites this year and will include an assessment on weed seed production. This research supports evidence for the use of interrow mowing to reduce weed biomass in organic no-till cropping systems. Future research should evaluate the effects of interrow mowing across different environmental conditions, crop cultivars, and even in tillage-based systems.

Tags: organic no-till, interrow mowing, weed seed production

Poster session

The European Oper8 project: Promoting alternative weed control options across multiple crops

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Poster

With the rise of herbicide resistance, withdrawal of chemicals and initiatives such as 'Farm to Fork' aiming to accelerate the transition to more sustainable food systems, developing alternative, effective options for weed control is imperative in European farming. The Oper8 project, funded by the Horizon 2021 program, stands as a collaborative thematic network aimed at fostering innovative solutions and facilitating knowledge exchange across stakeholders by leveraging the expertise of eight operational groups spanning seven partner countries. Now halfway into its three-year duration, data has been collated from surveys, a literature review, and assessments of current solutions to identify key needs, gaps, and barriers in alternative weed control across different farming systems and crops. The current focus of the project is taking these data to generate Weed National Action Plans (NAPs), tailored to each crop and country, with the overarching objective of formulating specific policy recommendations. Oper8 also prioritises widespread engagement through demonstrations, webinars, and media outreach, aiming to foster awareness and adoption of alternative weed control methods across all involved stakeholders. This presentation will spotlight the progress of the Oper8 project, particularly in relation to the development of the NAPs, and emphasise the importance of continuing widespread networking, collaboration and dissemination to sustain interest and uptake of alternative weed control.

Acknowledgement(s) / funding: I would like to thank my ADAS colleagues Lynn Tatnell, Kevin Godfrey and Eleanor Dearlove who have led the UK involvement in the Oper8 project as well as all other partners involved. Funding: The European Union Horizon 2021 Food, Bioeconomy Natural Resour

Effect of compost on weed emergence in sugar beet

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Poster

The germination of weeds can be reduced or delayed by compost and mulch materials. The same applies to the subsequent growth phase, so that field emergence and early development of weeds inhibited by decayed organic matter. In 2019 and 2020, 5 field tests and 4 pot experiments were carried out Germany, in which the effect of ready-made composts on the emergence of weeds was investigated. The two compost materials (organic compost and green-cut compost) were able to reduce the weeds emergence rate by approximately 50%. Neither the type of compost nor the layer thickness or the water content of the compost played a role, i.e. there were no significant differences between the treatments. In both years of the experiment, the inhibition effects caused by the compost materials were similarly strong. However, in the field tests, these effects did not appear so clearly, although they were statistically significant. The compost was spread manually in bands 80 mm wide and 23 mm thick in the row of beets immediately after the sowing. The field tests were carried out as a block system with 4 repetitions created. The plot size was 10 m x 1.35 m (corresponding to 3 beet rows) or 13.5 m².The effects in the field proved to be too weak for practical use of growing sugar beets. These investigations cannot explain why the effects in the pot experiments were so much stronger than in the field experiments. One reason could be that, for technical reasons, there was much less time in the pot trials between moving the soil and covering with compost than in the field trials. This could also affect germination induction or inhibition. Another reason could be that the concentration of biologically active inhibitors is higher in the pots than in the field due to the method used. The other conditions (type of compost, moisture of soil and compost, spectrum of weed species) were comparable. It is not clear from the literature whether biochemical processes are responsible for the effect, or whether the mere exclusion of light from the compost layer reduces the germination of weeds. The higher the degree of rotting of the compost, the lower the effects tended to be.

Tags: weed emergence, compost, organic matter, field experiments, pot experiments

New approach for physical weed control on railway tracks in Sweden

F. Fogelberg

RISE - Research Institutes of Sweden, UPPSALA, Sweden

Poster

Weed control on Swedish railway tracks are carried out by spraying with standard herbicides using glyphosate as active substance. This weed control is effective but has drawbacks; it does not control shrubs and small trees; some tracks or sections are not allowed for herbicide use and weather can postpone or cancel spraying. Thus, physical/thermal weed control methods are of interest for the Swedish railway maintenance companies and the National Transportation Administration.

Materials and methods

In 2022 and ongoing commercially available hoes used in agriculture and custom-made wing shaped shares were mounted on a railway maintenance machine normally used for snow removal. The tools were tested on railway tracks in western Sweden. The hoes were set to control weeds in a row about 60 cm wide perpendicular from the edge of the sleepers. We conducted block trials of a length of about 200-400 meters and general tests of the tools to measure fuel consumption and driving speed. These latter tests were carried out on 2-10 km of the tracks.

Results

Weed amount was assessed visually 1, 6 and 12 months after treatment. In general weeds were controlled regardless of design of the tools. Some differences in effect were observed as the duck-foot shapes agricultural shares were more effective against perennial weeds such as grasses, while the wing-shaped share was more effective against shrubs and small trees of pine, spruce and birch. Weed control effect decreased by time for grasses, perennials and annuals, while trees and shrubs in general still were controlled after 6 months.

Conclusions

We conclude that physical weed control on railway shoulders is possible to carry out by various types of duck-foot shares or wing-shaped shares. The method can be used on annuals, perennials and shrubs/small trees. The hoeing operations should be adapted to both weed type, weed cover and season.

Tags: railways, steam weeding, duck foot shares

Acknowledgement(s) / funding: Swedish Transportation Authority

Low-energy electrical weed control effectively controls small scentless mayweed (Tripleurospermum inodorum) and wild oat plants (Avena fatua)

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Poster

Most direct weed control methods are based on herbicides and tillage, both of which have serious negative environmental impacts and negative effects on soil and/or human health. Electrical weed control has been along for a long time without really taking off, but has been experiencing a resurgence in recent years. However, the solutions on the market use huge amounts of energy, move slowly, and are not 100% safe from a fire or health perspective. A low-energy electrical method (ELEC) was evaluated in a series of pot experiments in 2017 against 1) small *Tripleurospermum inodorum* (scentless mayweed) and *Avena fatua* (wild oats) plants, 2) large *T. inodorum* and *A. fatua* plants, and 3) established *Elymus repens* (couch grass) plants. Small plants were treated with four levels of voltage (5, 10, 15 and 20 kV) and four exposure periods (0.2, 0.4, 0.6 and 1.2 s), and large plants and *E. repens* at the same voltage levels, but with longer exposure periods (0.5, 1.5, 4.5 and 13.5 s); albeit no 10 kV treatment for *E. repens*. Data were analysed first as a one-way ANOVA (including the untreated control) and then as a two-way ANOVA (excluding the untreated control) with voltage, exposure time and the interaction as fixed effects. Small plants of *T. inodorum* and *A. fatua* (treated at 18 and 14 days after sowing, respectively) were killed or greatly reduced by the electrical treatments, while the effect was much lower against large plants (treated at 6 weeks after sowing) and *E. repens* plants (cut 34 days after emergence, and then treated 14 days after the cut). Many of the electrical treatment combinations killed 100% of small *T. inodorum* plants, and while small *A. fatua* plants were not quite dead, most electrical treatment combinations reduced the shoot biomass by more than 99%. In general, 5 kV was more effective than higher voltage levels. For small plants the shortest exposure time was sufficient to achieve full effect, while for larger plants a longer exposure time was more effective. In conclusion, the low-energy electrical control method can efficiently control small weed plants with low voltage a short exposure time, but is not effective against fully grown plants. The method will be evaluated further in potato, wheat and sugar beet within the WEEDZAPPING-project that will run between 2024-2026.

Tags: Electricution, IPM, non-chemical weed control

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Applicability of Nanocellulose to Weed Control

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Poster

Nanocellulose is a plant fiber that has been reduced to a nano-level. We found that cellulose nanofibers, which forms like a gel, physically inhibited weed emergence in the field. In this study, we prepared amphiphilic and hydrophilic nanocellulose produced by chemical defibration, mechanical defibration, and biological defibration, and investigated their weed emergence suppressing effects. Chemical defibration involves oxidation or esterification, mechanical defibration involves crushing or collision, and biological defibration involves microbial fermentation. We conducted three emergence experiments using seeds of *Trifolium repens* (white clover) and *Lolium multiflorum* (Italian ryegrass). In experiment (i), wet nanocellulose was layered directly on top of the seeds. In experiment (ii), seeds were scattered on the soil surface, covered with nanocellulose, and air-dried. In experiment (iii), nanocellulose was dried into sheets and placed on top of the seeds. After observing germination for four days, in order to monitor changes in the sheet due to humidity, the cell trays were covered with translucent plastic bags and maintained at high humidity by misting. Emergence experiments were conducted in an incubator at 20°C with a 12-hour photoperiod, and the number of emergent shoot was recorded daily for up to two weeks. In experiment (i), the final emergence percentage ranged from 0.8% to 73.2% (compared to 92.4% to 92.8% without treatment). Significant inhibition of Italian ryegrass emergence was observed for all types of nanocellulose. However, in experiment (ii), two types of nanocellulose were found to promote emergence. The degree of inhibition appeared to depend on the type of nanocellulose and the weed species. In experiment (iii), all sheets inhibited emergence, although some sheets broke, allowing sprouting under humid conditions. Overall, our findings suggest that nanocellulose can be effectively used as a physical weed-control material. Further research is warranted to optimize its application and explore its potential in agricultural practices.

Tags: nanocellulose, physical treatment

HOW DOES WEED ABUNDANCE AND DIVERSITY VARY WITH CROPPING PRACTICES?

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Poster

Weeds are a serious problem to farmers and cause great damage to food production. On the other hand, they can be ecologically important parts of the agro-ecosystem. Therefore, it is essential to measure the impacts of management on weeds across communities of weeds. We tested association of weed densities and diversities in major crops using a large scale survey of 7 common weeds across 485 fields in the UK over 3 years. During autumn 2006 and spring 2007, the survey visited upevery field and mapped the weeds present. Weed populations were enumerated up to two times each year when both weeds and crops were mature. Ordinal density structured scale was used, in which density states for every species were visually estimated.

The relationship between weed density and diversity with crop types and rotational complexity was assessed by linear mixed models. Shannon and Simpson indices which were evaluated to account for species richness and relative species abundances. Beta diversity was analyzed using the Bray Curtis dissimilarity which was calculated for each pair of fields, then categorized by crop types and rotation.

We show that there are clear impacts of crops and rotation on weeds, however these are species and crop-specific. Our results demonstrate the importance of understanding the ecological impacts of crop management but also highlight the complexity of the responses at a community scale.

Maize and weed development and spectral signature as affected by competition with cover crops

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Poster

Cover crops are widely used for multiple benefits but when grown together with the crop as living mulch they can compete with the main crop and cause some stresses.A pot trial was conducted in Italy in 2023 to assess the competition between four cover crops and maize and between the same cover crops and four weed species. The cover crops were two grasses, *Lolium multiflorum* and *Secale cereale*, and two legumes, *Vicia sativa* and *Trifolium alexandrinum*, seeded at the same rate of 10 seeds per 0.33 m diameter pot. The weed species were two monocots, *Echinochloa crus-galli*and *Digitaria sanguinalis*, and two dicots, *Amaranthus retroflexus* and *Chenopodium album*. Both weeds and maize were seeded at the rate of one seed per pot, placed in the center. Each combination of cover crop and maize or weed was replicated 5 times, as were the control pots, where the central plant was left to grow alone. Additional pots with only the cover crop completed the experimental set up. Throughout the season, development parameters such as height, growth stage and SPAD index of both the cover crops and the central plant were assessed twice. At the end of the trial, the spectral signatures of maize and weeds were assessed with a spectroradiometer, allowing the calculation of some vegetative indices. The dry biomass of both the cover crops and the central plants was then assessed. Maize biomass was reduced by 80.9% and 72.2% when growing with *S. cereale*and *L. multiflorum* respectively. However, it was enhanced by 10.8% when growing with *T. alexandrinum* and reduced by only 3.3% when growing with *V. sativa*. Also weed growth was mainly limited by grass cover crops, that reduced their biomass by at least 70%. Significant differences in NDVI were only found in *A. retroflexus*, that showed the higher value (0.788) when growing with *V. sativa*, while the lower value was reached with *L. multiflorum* (0.733). Also the NDWI, related to water content, was lower with *L. multiflorum* (0.025) and higher with *V. sativa* (0.055). *C. album* NDWI was higher with *V. sativa* (0.073) but lower when growing with *T. alexandrinum* (0.044), while this index calculated for maize showed opposite behaviour with grass species, being lower with *S. cereale* (0.036) and higher with *L. multiflorum*(0.049). Grass cover crops can effectively suppress weeds but also reduce maize development, compared to the legume cover crops at the same density.

Tags: cover crops, living mulch, spectral signature, competition, weeds

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