Organic Farming Innovations Network Europe

OH-FINE

Technical Document

Ridge cultivation for organic cropping systems

Enhancing organic crop performance through improved soil conditions

Ridge cultivation (or ridge tillage) is a soil management strategy intended to influence crop performance by affecting microclimate, soil structure, and root zone conditions. By altering the spatial arrangement of the soil profile, this technique can enhance water infiltration, aeration, and root development, while also contributing to improved weed and pest management. This document provides an overview of the principles, benefits, and implementation strategies of ridge cultivation.

Introduction

Ridge cultivation is an ancient method of soil management. Nowadays it is mainly used for root vegetables. Variations of ridge systems have been developed across South and Central America, Africa, and Southeast Asia. The technique has its roots in tropical and subtropical environments, where soils are typically shallow, less fertile, and subject to extensive or limited rainfall. Although ridge cultivation takes various forms, all systems aim to elevate the seedbed above the natural soil surface[1].

The Turiel ridge tillage system, a non-inversion, conservation-oriented cultivation practice, is named after Julian Turiel, who developed and built the device used to form dams (figure 1). The method was developed in Germany for organic and reduced-tillage farming, drawing on traditional techniques and local knowledge from Spain. The Turiel ridge tillage system is suitable for a wide variety of crops, including cereals, grasses, legumes, oil plants, vegetables, herbs and special crops.

The technique offers solutions for modern sustainable agriculture and provides agronomic, environmental, and economic benefits. By concentrating planting zones on elevated ridges and managing plant residues in inter-row areas, ridge tillage improves soil structure, promotes efficient water infiltration and drainage, and supports early-season soil warming. Compared with conventional ploughing, it avoids deep inversion and emphasises the preservation of soil structure.

Soil health challenges addressed by ridge tillage

The Turiel ridge tillage system mitigates several soil health risks related to soil structure, compaction, water dynamics, and nutrient efficiency. By loosening the subsoil without inversion, it improves porosity, aeration, and root penetration, particularly in compacted or heavy-textured soils. Raised ridges enhance drainage and oxygen availability in the root zone, reducing waterlogging and disease risk, while also warming faster in spring and improving early crop establishment. On sloped land, contour-oriented ridges can reduce runoff, erosion, and nutrient loss by slowing water flow and increasing infiltration. Up-down slope ridging on gentle slopes, using the Turiel ridge device, might help reduce runoff velocity by shifting stones and clods of earth into inter-row areas. Ridge cultivation improves seedbed structure, germination, and seedling emergence, especially on crust-prone soils. Concentration of organic matter and root activity in the ridge promotes localised microbial activity, while banded nutrient placement near the root zone increases nutrient use efficiency and reduces losses. Repeated re-ridging can also disrupt perennial weeds and suppress weed pressure.

Table 1: Soil health challenges addressed by ridge tillage

Soil health challenge	Ridge tillage effect
Compaction	Subsoil loosening, better porosity
Waterlogging	Raised planting bed, improved drainage
Erosion	Contour ridging reduces runoff
Soil crusting	Looser ridge tops = better emergence
Cold soil	Ridge crests warm faster in spring
Low microbial activity	Enhanced biomass in ridge zone
Nutrient losses	Banded fertilisation in ridges improves efficiency
Weed pressure	Perennial weeds disrupted by ridge reshaping

System operation in Turiel ridge tillage

1. Non-inversion ridge building: The system relies on a specially designed ridge device ("Turiel Dammgerät") that gently aerates soil layers without complete inversion. Instead of turning the soil, the upper humus layer is pulled into raised ridges – typically 60/75 or 90 cm wide, depending on machinery and tractor track width (e.g. 1.5 m or 1.8 m). These ridges are shaped using dedicated spurs ('Grindel'), that create fixed tracks in the furrows, helping guide subsequent passes precisely.
2. Subsoil loosening and soil aeration: The device loosens compacted layers to a depth of 15–35 cm without turning the soil. It opens pores in the subsoil, improving drainage and root penetration while preserving soil structure and microorganisms.
3. Seeding and mechanical weed control: Turiel machines can be equipped with seed attachments for precision sowing on ridge crests – either single-row, twin-row, or band-sowing setups. The same "self-guidance" spurs in furrows (the Grindel) act like rails to keep the machine in the correct row position during mechanical weeding. This allows precise and cost-effective hoeing without GPS or camera-based guidance, even on slopes above 30%.
4. During the crop cycle, the ridges can be re-shaped, the inter-rows can be tilled or weeded, using adapted frames. This keeps the ridges loose, suppresses root weeds (e.g. thistle, couch grass), and sustains soil structure and aeration throughout the season.

Figure 1, Turiel ridge device with spurs ('Grindel') (www.turiel-dammkultur.com)

Table 2: Technical components and dimensions of the Turiel ridge device

Machine Component	Description
Spurs	Soil-guiding tines in furrows to self-align the frame across operations
Ridge widths	Available in 60/75 cm or 90 cm, compatible with tractor tracks of 1.5–1.8 m; working widths 1.2–6.3 m, transport ≤ 3 m
Tool attachments	Subsoiler blades, seeding units, inter-row cultivation/ shallow hoe tools, residue incorporation tools
Tractor requirements	~75 PS tractors can operate 3 m width units on most soils

Field trial

Objectives and research question

In ridge tillage, seed density can often be reduced due to earlier sowing, wider row spacing, and improved crop development on ridges, especially for cereals. However, the effects of reduced seed density on other crops, such as soybean, remain unclear. Soybean is a key cash crop in the trial region for food and feed. In organic systems, it is typically grown as a wide-row crop, which requires intensive weed and water management, making it well-suited to ridge tillage. This raises the research question of whether soybean seed density can be reduced under ridge tillage without compromising crop establishment and yield.

Experimental set-up

The trial was conducted as a participatory field trial for demonstration purposes on an organic farm in eastern Austria. In a co-creative process, the farmer selected the research topic and determined the trial design and treatments. All field operations, including sowing, weeding, and harvesting, were carried out by the farmer, who has many years of experience with the ridge tillage system. The researchers provided guidance and technical support throughout the process and were responsible for data collection, documentation, analysis, and reporting.

Table 3: Experimental set-up

Parameter	Description
Type of trial	Demo strip trial at two fields, each trial with three treatments. No replication in one trial. Trial 1: 1,577 m² per strip, 7.2 m width per strip Trial 2: 1,723 m² per strip, 14.4 m width per strip
Trial treatments	Reduction in seed density for soybeans from 100% (standard practice, 65 seeds per m²) to 80%, 65%, and 50%. Treatments trial 1: 100%, 80%, 65% seed density Treatments trial 2: 80%, 65%, 50% seed density
Location	Kobersdorf in Central Burgenland, 333m a.s.l., eastern Austria
Climate	786 mm MAP, 9.8°C mean annual temperature (https://de.climate-data.org)
Soil	Relict pseudogley or pseudogley, sandy loam, acidic soil, low to medium quality arable farmland. Very similar soil conditions on both test fields.
Preceding crop 2024	Winter wheat with a following catch crop
Experimental crop 2025	Soybeans (Variety: Aurelina, early maturing; pre-inoculated seeds and additional treatment of the soil with a proper Rhizobium granulate, which was incorporated into the soil before sowing)
Field operations	Soybean sowing on May 19, 2025, 90 cm ridges, 2 soybean rows per ridge 4 hoeing passes, undersowing during the last hoeing pass Soybean harvest on October 3, 2025
Surveys	Plant height, height of pods, number of plants, grain yield
Participating farmer	Wolfgang Binder-Laki

Results

The trial results showed that, across all treatments in both trials, only 51% (with a range of 42-58%) of the sown plants had emerged and continued to develop. In trial one, the average germination rate was 50% and in trial two, 52%. The height of the soybean plants ranged from 69 to 84 cm, with plant height tending to increase with higher seed density. In trial one, the average plant height was 81 cm, and in trial two, it was 70 cm. The average pod height (the distance of the first pods from the soil surface) was 10.7 cm, with small differences (9.5-11.3 cm) across treatments and seed densities. No influence of the measured plant density on the height of pod formation could be determined. The average grain yield across both trials and all treatments was 1,822 kg/ha. Seeding rate and yield showed a significant correlation, with yield increasing from 1,498 to 2,086 kg/ha as plant density increased (Figure 2).

Weed pressure was low in both trials, except for the 50% seed density treatment in trial two, where clusters of Creeping Thistle (Cirsium Arvense) were more prevalent. The undersown crop developed very poorly in both trials and was visible only in isolated patches before harvesting in mid-September.

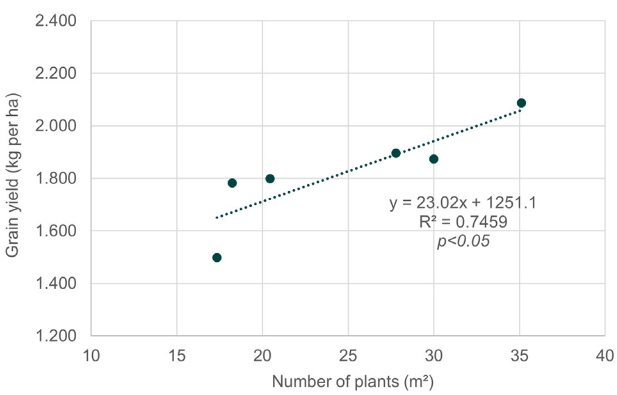

Figure 2. Correlation between stand density and grain yield

Figure 3. Preparation of the ridges with the Turiel Dammsystem

Conclusions

One reason for the poor emergence could be the cool and mostly dry conditions during and after sowing. In addition, the seeds were placed in the loose ridges, so soil contact may not have been optimal. Despite the difficult germination conditions, the subsequent development of the soybeans in both trials in the ridge cultivation system was assessed positively. Improved weather conditions, with higher temperatures and precipitation in June and especially in July, also contributed to this.

The weed control measures were effective. In conclusion, however, reducing seed density negatively affected soybean yield. When growing soybeans in a ridge tillage system, it is therefore advisable to use at least the usual recommended seed rate.

As field emergence was low in both trials, a further increase in seed density should also be considered to achieve the desired crop density. This could have the added benefit of causing the first soybean pods to form higher up on the plant due to increased competition among the plants, which in turn could reduce grain loss during harvest. Further research is needed to determine optimal seed density in ridge tillage systems.

In 2025, three soybean demo strip trials on organic farms in eastern Austria produced yields of 1,113–3,349 kg ha^{-1} (mean: 2,585 kg ha^{-1}) under standard cultivation with seed rates of 55-60 seeds m^{-2}. As ridge cultivation is not yet widely used, comparative yield data are unavailable. Recommended seed rates range from 50–70 seeds m^{-2}, depending on variety maturity.

Challenges of ridge cultivation

Turiel ridge tillage offers agronomic and ecological benefits, especially for water management, soil structure, and weed control, but it also comes with disadvantages that farmers and land managers must consider. These drawbacks vary by soil type, climate, availability of machinery, and crop system.

1. Labour and management intensity

- Ridge construction, maintenance, re-ridging and inter-row cultivation require more passes than conventional tillage or no-till systems.
- Precise timing and frequent field monitoring are necessary.

2. Specialised equipment requirements

- Ridge tillage requires custom or ridge-specific implements, such as ridge formers or subsoiler blades.
- Initial equipment cost and learning curve can be challenging for beginners.

3. Increased soil drying

- Moisture loss, due to a larger surface area exposed to sun and wind, is a key concern during germination and early growth stages.
- If not managed with mulching or irrigation, seedling establishment can suffer.

4. Yield variability in transition years

- In the first 1–2 seasons, ridge systems may underperform compared to plough systems, especially under spring drought (dry ridges), poor ridge formation, and weed pressure during transition.
- Studies showed initial yield reductions of ~15–23% in dry springs[3].

5. Humus supply

- Due to more frequent tillage and soil loosening, mineralisation and thus humus mineralisation might be stimulated.

Key benefits of ridge cultivation

- Improves soil structure and porosity without deep inversion, protecting biological activity in combination with adapted and more intensive intercropping and/or undersowing.
- Supports natural ridging microclimates for faster warming, root respiration, and microbial activity.[3]
- Water-managed ridges with high water infiltration and storage capacity, reducing runoff and drainage issues.
- Efficient weed control: self-guided mechanical hoeing works on slopes without electronic guidance systems.[4]
- Modular and low-tech: soil preparation, seeding, and cultivation handled by one frame; cost-effective for small/family organic farms.
- Operational flexibility: Ridge width customisation (75 – 90 cm, up to 7.2 m working width), subsoiling approach, suitable for diverse crop rotations.

Conclusion

Turiel's ridge tillage system combines traditional ridge cultivation with modern machine design. The Turiel ridge device is modular and can simultaneously perform soil loosening, ridge formation, and precision seeding and weeding, with minimal soil inversion and simplified equipment. This creates a more porous, biologically active soil environment while supporting effective mechanical weed control and is well-suited to both vegetable and arable cropping in organic and regenerative farming contexts. Despite the potential disadvantages of ridge cultivation, many organic farmers use the technique with good results.

Figure 4. Trial field in September 2025 before the soybean harvest

References

[1] Müller, E. Das Dammkultur-System Nach Turiel. Untersuchungen Auf Hess. Staatsdomäne Frankenhausen Zugl Kassel Univ Diss 2009.

[2] Li, H.; Shen, H.; Wang, Y.; Wang, Y.; Gao, Q. Effects of Ridge Tillage and Straw Returning on Runoff and Soil Loss under Simulated Rainfall in the Mollisol Region of Northeast China. Sustainability 2021, 13 (19). https://doi.org/10.3390/su131910614.

[3] Zikeli, S.; Gruber, S. Reduced Tillage and No-Till in Organic Farming Systems, Germany—Status Quo, Potentials and Challenges. Agriculture 2017, 7 (4). https://doi.org/10.3390/agriculture7040035.

[4] Alagbo, O.; Spaeth, M.; Saile, M.; Schumacher, M.; Gerhards, R. Weed Management in Ridge Tillage Systems—A Review. Agronomy 2022, 12 (4). https://doi.org/10.3390/agronomy12040910.

Further information

- **[German]** Turiel-Dammkultur. (2026). Turiel-Dammkultur. Landbau mit einer Maschine: Ökologisch und wirtschaftlich. https://www.turiel-dammkultur.com/
- **[German]** Bio-Net.at. (n.d.). https://www.bio-net.at
- **[German]** Schmidt, H. Ackern Ohne Pflug; Wissenschaftliche Schriftenreihe Ökologischer Landbau: Berlin, Germany, 2010; p. 285.
- **[Subtitles in multiple languages]** OH-FINE. (2026, April 25). Deutsch: Die Dammkultur [Video]. YouTube. https://youtu.be/QMc9lbLwtps

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