

Creeping Thistle

Successful control in organic farming



Creeping thistle has become an increasing problem especially for organic arable farms with soils of higher organic matter content. Wherever it grows, it competes with the crops for water and nutrients. Once established, much patience is required to achieve a tolerable density of

the thistle. So far, there is no 'magic bullet' for its control on organic farms. However, by following certain rules of plant cultivation, in combination with direct methods, the thistle can be effectively controlled.

A Challenge for Arable Farmers

Creeping thistle (*Cirsium arvense*) is a persistent weed, which overwinters as a root and sprouts again in spring. In natural, undisturbed growing conditions, the thistle develops into a biennial plant. If disturbed in its development by agricultural interference, such as cutting and hoeing, it reacts by intensified production of roots and shoots.

Creeping thistle occurs on almost all soil types but finds optimal conditions on nutrient-rich, deep, clay soils with an adequate water supply. In light soils and dry locations, creeping thistle appears less frequently and only where it has access to water reserves in the subsoil.

Once established, mechanical removal of thistle plants is difficult. Energy reserves in the root enable creeping thistle to defy several years of mechanical control. Thus, measures should be taken early to prevent extensive spreading.



The creeping thistle flowers between June and September and forms both female (upper picture) and male flowers (lower picture). Pollination is by insects. The first seeds are ripe as early as 10 days after pollination.

Reasons for creeping thistle problems

- Crop rotation heavy on cereals and with little grass-clover or lucerne.
- A general tendency of short term one-year leys instead of perennial grass-clover leys.
- A trend towards favouring competitively weak crops with a high profit margin (e.g. field vegetables).
- Lack of deep-rooting crops in crop rotation (e.g. lucerne or fodder radish).
- Poor care of fallows.
- Fragmentary or weak plant stocks as a result of infestation with pests or disease, or an insufficient nutrient supply, which facilitates the thistle's spread and development.
- Slippage, smearing and the emergence of a plough sole by incorrect cultivation, and especially driving on wet ground, facilitate the spread of thistle.
- Seed production of thistles on waste ground, fallow and/or cultivated fields.
- No soil-turning tillage (plough).
- No complete undercutting given reduced tillage.



A creeping thistle that has sprouted from a piece of root during spring on a green fallow. A piece of root 5 cm long may form a plant fit for survival from a soil depth of 30 to 50 cm.

Basic rules for thistle prevention

- Restrict the proportion of cereals in the crop rotation to maximum 50%.
- Incorporate intensive 3-year grass-clover in your crop rotation, with a percentage of at least 20, better yet 30%.
- Incorporate root crops in your crop rotation, or hoe cereals instead of harrowing them.
- Immediately till and re-sow failed grass-clover- and grass-lucerne crops.
- Prevent the relocation of nitrogen into lower soil layers with the cultivation of catch crops or well-established winter crops. Till failed catch crops and apply bare fallow.
- Shift from winter to summer crops. Spring ploughing is significantly damaging to thistles.

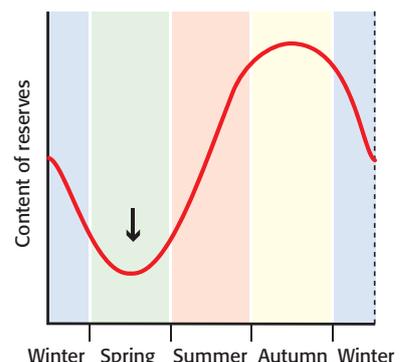
The cycle of reserves in thistle roots: The pacemaker for control measures

The regenerative potential of the thistle after disturbance depends on the nutrient reserves in the roots. The higher the amount of reserve material, the greater the re-sprouting potential.

The content of reserve material in thistle roots follows a seasonal cycle, with a low point in spring after sprouting. As soon as the thistles have formed sufficient leaf mass, the reserves in the roots are restocked. Given good weather and a fast development, the storage of reserve

material for flowering and seed formation is almost complete by June/July, at the latest in late summer (August/September). If development is not disturbed, sufficient reserves are available for overwintering and a re-sprouting in spring.

The reduced reserves in the roots at the beginning of April can be exploited for control. At that time, thistles react most sensitively to disturbance.



Three Steps from First Colonisation to Thistle Infestation

Step 1: First colonisation via seeds or pieces of root



Via seeds:

- › Reproduction via seeds mostly occurs in fallows.
- › Spreading is also possible via manure, straw or insufficiently sanitised compost.
- › Seeds germinate in late spring from May to June. Optimal germination temperature is 20 to 30°C.
- › The seedlings first form a rosette and usually do not flower until the subsequent year.
- › The seedlings develop slowly in the first 6 weeks (or until about 10 cm high). During this period they are sensitive to shade, dryness, competition, infestation with fungi and burial.
- › The seedlings rely on an adequate and sustained supply of water in the topsoil (accumulation area, high ground water level, soil with good water holding capacity).

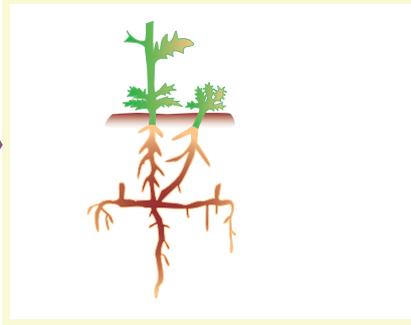
Via pieces of root:

- › Thistles are often introduced as root pieces via tillage machinery and tractor tyres.
- › Even very small root pieces (>5 mm) are capable of sprouting, although a length of 2,5cm is needed for further development into a plant.



The spread via seeds is secondary.

Step 2: Roots grow in length and width; first flowering stems



- › Once established, the thistle plant quickly forms an extensive, complex root system with roots running horizontally and vertically. Thanks to its vertical roots, it is capable of reaching more than 3m into the ground.
- › Root- and shoot damages (e.g. by tillage measures) stimulate the formation of secondary roots and root buds. The result is further sprouting of shoots from the root buds.
- › In contrast to couch grass, which grows horizontally with rhizomes, thistle colonizes the soil with roots which can produce root buds anywhere and grow 2 to 12m a year. On secondary roots, there are up to 16 root buds per meter.
- › The horizontal secondary roots run mostly at a soil depth of 20 to 30 cm.



Root sucker: Nutrient storage for quick re-sprouting.

Step 3: Formation of clusters



- › At the latest, the 3rd year sees the sprouting of many tillers from secondary roots. The typical thistle 'nest' (a cluster of numerous flowering shoots) appears in the summer months.
- › Depending on the location and environmental conditions, a plant forms 5000 to 40,000 seeds which can remain viable in the ground for up to 20 years.
- › Most seeds are deep-seated in the flower head and only weakly connected to the dispersal apparatus (pappus). This is why the flower components (pappi), seen blowing in great numbers over long distances, are mostly seedless.
- › Pappi with heavy seeds generally fall on the ground close to their mother plants. Seeds that are well connected to the pappus can however be transported up to 100m away.
- › A large proportion of the seeds are eaten by insects and birds. Nevertheless, the importance of seed dispersal for first colonisation should not be underestimated.



Creeping thistles only need 2 to max. 5 years from initial infiltration to extensive infestation in the form of nests.

Control: A Three-step Approach

1. Preventing thistles from establishing

The uncontrolled development of the creeping thistle must be prevented at all costs. Efficient mechanical control is no longer possible once the thistles have formed 'nests' with a deep, widely branched system of roots, as well as considerable reserves in their roots!

The first colonisation of a field with creeping thistle can most effectively be prevented by frequent competition for light, nutrients and water. The best conditions for this are supplied by balanced crop rotations, water-permeable soils, dense plant stocking, and frequent mowing for forage production. At the same time, invasion via root suckers and seeds from field edges and uncultivated areas, and via root pieces, must be prevented.

In early development stages, tillage measures are very effective against seedlings. Seedlings,



Thistle seedlings can be effectively controlled by mechanical means of hoeing during the first few weeks.

which sprout primarily from May to June, are sensitive to mechanical interference such as hoeing and to shading from early-emerging winter crops, up to an age of 6 weeks.

Unlike the seedlings, thistle plants with a shoot length of up to 10 cm sprouting from root pieces can only be weakened by repeated tillage measures.

Following actions have proven effective:

- › Deliberate planning of a tillage in the period from the beginning to the middle of April in crop rotation, e.g. before the sowing of peas or the planting of potatoes. In this way, the creeping thistle's growth suffers lasting disturbance. Plants re-sprouting after winter cannot restock the reserves in the roots that have been drained during winter, or can do so only to a limited extent.
- › Do not cultivate competitively weak crops for more than two years in a row (see chart below).
- › After competitively weak crops, make a high-density sowing with seeds that will quickly establish dense, tall growth (early canopy closure), e.g. grass-clover, lucerne or rye instead of winter wheat. For wheat, favour varieties which grow tall on soils low in nutrients.
- › Before primary inversion tillage, perform stubble tillage (stubble ploughing), in order to cut newly sprouting thistles and the still green thistle stubble of older plants, and to exhaust reserve material in the roots (see page 6 for details).
- › Prevent soil compaction. Loosen compacted soils or plough soles with deeper tillage reaching at least 5 cm deeper than the problem area. Carry out the tillage only while soil conditions are very dry and never when they are moist. The heavier the soil, the more important its condition. After loosening the soil, stabilise the measure by sowing a deep rooting and quickly growing green manure (e.g. fodder radish) or crop (e.g. lucerne, sunflower).
- › Mow or cut inflorescences in edge strips and nearby areas before seed formation.

Competitiveness of selected arable crops against the creeping thistle

Competitively weak:	Competitively strong:
› Sugar- and fodderbeet, beetroot	› Lucerne, grass-clover
› Soybeans, lupins, grain peas (threshing peas)	› Winter field beans, forage peas
› Malting barley, short-straw wheat	› Spelt, rye, triticale and long-straw wheat, oats
› Carrots, onions	› Potatoes
› Flax, buckwheat	› Maize, sunflowers, rape*

*moderate competitive strength (slow juvenile development)

2. Removing single plants and impeding new growth

If single thistle shoots or 'nests' protrude from a cultivation, seed formation must be prevented by thistle-cutting or thistle-pulling. Since these procedures have no impact on the store of reserve material in the roots, they can only be considered emergency measures.

The cultivation of fast-growing and cuttable catch crops impedes the spread of thistles.

Following measures have proven effective:

- › As a minimum measure, flower heads can be removed at the beginning of flowering. This should be done about 10 days after the flower buds open. The cut should be made as low as possible on the flowering stem. The topping enables fungal pathogens to enter.
- › A better method than topping is to pull or mow out the slightly lignified aboveground shoots of the thistle before flowering. Pulling them out has the advantage of partially damaging the root. Thistle-pulling on heavy soils is easier after substantial precipitation.
- › New growth must be removed again in the same year after a growth of 5 cm, in order to prevent a renewed storage of reserve material.
- › Fragmented grass-clover growth should be tilled and re-sown.

- › Sowing a lush secondary crop or a strong forage or green-manure mixture after meticulous ploughing and seed bed preparation has proven effective. Increased seed quantities (1,5 to 2 times more than usual) leads to faster establishment, and therefore to better weed control. Mixtures are generally more competitive than pure stands. Catch crops without legumes should be fertilised with farm manure.
- › Avoid cultivating competitively weak crops on thistle-infested land parcels.



Pulling thistles after each reoccurrence may be costly, but it can prevent further spreading of the root weed.

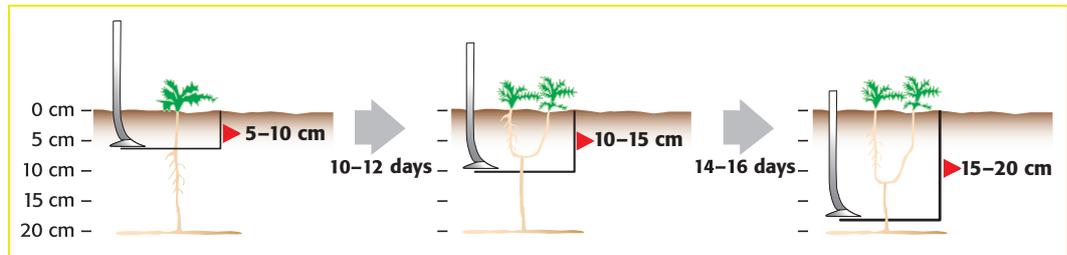
Green manures and catch crops with good thistle-controlling effects			
	Advantages	Restrictions	Cultivation advice (typical seed rate)
Vetch-rye mixture	<ul style="list-style-type: none"> › Usable as fodder 	<ul style="list-style-type: none"> › No vetches in pea-crop rotations. › Overwinters. 	<ul style="list-style-type: none"> › Sowing after ploughing in summer; silage in May; subsequent crop: maize. › Seed rate: 30–50 kg winter vetches and 50–80 kg rye per ha. › Cut high for re-sprouting of vetches.
Landsberger mixture (legume-grass mixture)	<ul style="list-style-type: none"> › Intensive rooting through the soil › Usable as fodder 	<ul style="list-style-type: none"> › No restrictions by virtue of crop rotation. › Overwinters. › Uncommon in arid regions. 	<ul style="list-style-type: none"> › Sowing until end of August. › Seed rate: 25 kg hairy vetch, 20 kg Westerworld/annual ryegrass, and 15 kg crimson clover. › Cut high for re-sprouting of vetches.
Pea-vetch-oats mixture	<ul style="list-style-type: none"> › Intensive rooting through the soil › Usable as fodder 	<ul style="list-style-type: none"> › No cultivation in cereal-intensive crop rotations and with peas as main crop. › No new sprouting after cutting. 	<ul style="list-style-type: none"> › Sowing until end of August; not overwintering. › Seed rate: 80–110 kg fodder peas and 30–40 kg summer vetches per ha, possible supplement of 60–80 kg oats; choose fodder peas over grain peas because of better growth.
Summer vetch-fodder radish-ryegrass mixture	<ul style="list-style-type: none"> › Usable as fodder 	<ul style="list-style-type: none"> › Ryegrass can overwinter and may complicate tillage. 	<ul style="list-style-type: none"> › Sowing until mid-August. › Seed rate: 40 kg summer vetch, 15 kg fodder radish, 10 kg one-year ryegrass per ha.
Fodder radish	<ul style="list-style-type: none"> › Dense growth › Deep-rooting plant › Usable as fodder 	<ul style="list-style-type: none"> › Can overwinter in mild weather conditions. 	<ul style="list-style-type: none"> › Sowing until end of August. › Tolerates organic fertilising. › Seed rate: depending on the variety 20–30 kg per ha.

3. Prioritising intensive mechanical control and intensive greening when facing extensive spread

Up until now, a single measure has proven effective in remedying an extensive infestation with thistles: Repeated, focused tillage in combination with the cultivation of densely growing, intensive-use- and ideally perennial crops. This procedure also corresponds to the so-called 'Johanni-Fallow', a

recommendation in older literature: The thistles are being starved from end of June, after a fast-establishing crop, until beginning of August, as they are depending on building up reserve substances in that period.

Stubble tillage in summer: Progressively grabbing the thistle at greater depths



Stubble tillage with a skin plough (Precilab). Only the upper 10 cm are being ploughed. The depth can be adjusted via support wheel. The root weeds are being severed and are lying on the top where they dry out.



The flat cultivator, undercutting the whole surface, can achieve a similarly efficient result against root weeds as the stubble-plane plough or the skin plough. Unlike the skin- or stubble plane ploughs, it does not turn the soil.

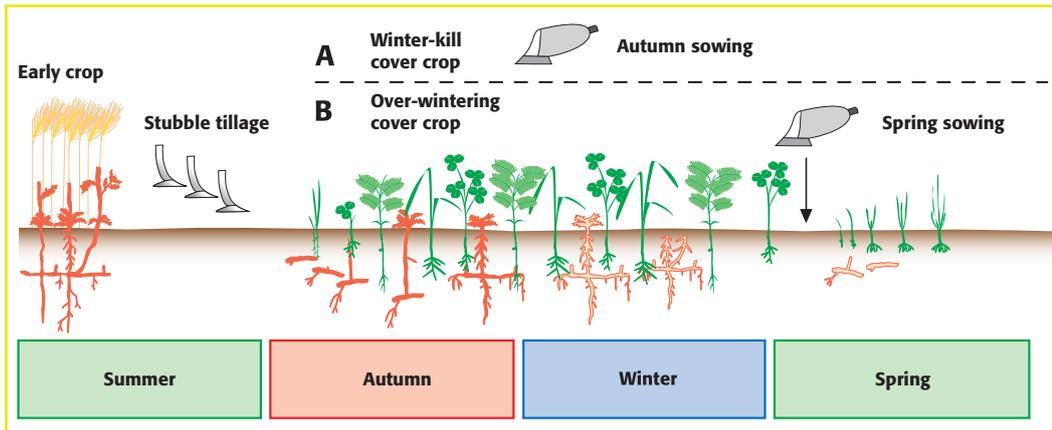
How it is done:

1. After cereal harvest, carry out stubble tillage at a working depth of 7–10 cm with a skimmer or a wing-share cultivator (cutting across the whole surface) with a share overlap of 10 cm.
2. Follow up the initial stubble tillage with 2–3 further rounds with a wing-share cultivator, increasing the working depth with each work step.

Worth knowing:

- This method does only work during heavy drought. It can lead to the opposite effect of thistle spread in the case of humidity sufficient for re-sprouting.
- The working intervals should be chosen such that the newly growing thistle plants do not grow higher than 10 cm. This way, storage of new reserve substance can be prevented.
- This procedure works best in combination with a catch crop. As soon as the thistles dried after tillage, sow a fast-growing greening. As a rule, all opportunity for cultivation of competitive catch crops should be exploited.
- This method is also suited for couch-grass- and bindweed control.

After stubble tillage: Disturbing and suppressing the thistle



How it is done:

1. After early crops, such as e.g. winter barley, disturb the thistle for the first time with stubble tillage (as described on page 6).
2. After stubble tillage (ploughing is a poor alternative, as rhizomes survive and re-sprout), sow a cover crop with good cover, such as summer vetch or fodder radish, as soon as possible in order to suppress thistle growth via competition for light.
3. After the cover crop, a further disturbance is made by ploughing for the winter crop or in spring for the summer crop.

Worth knowing:

- › Ploughing in spring weakens the thistle better than ploughing in autumn, as the reserves in the thistle's roots is all but exhausted in spring.
- › On lighter soils one should do without a ploughing in autumn and cultivate an overwintering catch crop instead of e.g. winter wheat, which is later being tilled in spring, to help retain nitrogen.

Perennial forage cultivation

Especially for livestock farms, the sowing of a perennial intensive-use forage-crop mixture is the most reliable measure against thistles. This method aims at the exhaustion of reserves via competition and trimming.

Worth knowing:

- › To exhaust the thistles, the cultivation of grass-clover or lucerne-grass over 2 or ideally 3 years is necessary. The crop should quickly grow a dense cover. The better the soil, the longer the period of fodder cropping should be.
- › The forage should be cut at least three times a year in order to weaken the thistles.
- › The cutting time should be in accordance with the development of forage-crop stock and thistles. The thistles should not protrude from the crop, so that they cannot build up reserves. Cutting must be done at the very latest when flowering starts.
- › A fragmentary forage-crop stock should be tilled and re-sown, as the thistle will use the absence of shading and a steady nutrient supply to spread unhindered.



Perennial grass-clover leys or lucerne-grass or pure lucerne-crop all have a double effect: They shade the thistle shoots, and deprive the thistle of water and nutrients even in deeper soil layers.

Power Mixture – an alternative for farms with little livestock

Farms with little or no livestock can grow a grain legumes-cereal mixture which is used as a WCS (whole crop silage with field beans and barley, or peas and oats) and cut at the point of lactic ripeness. After the WCS 1 to 2 primary soil tillage procedures follow. The subsequent sowing of a Power Mixture such as summer vetch with fodder radish (80 kg/20 kg) prevents the newly sprouting thistle plants from storing reserve material by maximising shading. The final ploughing for the winter crop can drain the thistles' last reserves.

Do not Forget about Control in Fallows!

Fallow fields, field margins, and fringe structures alongside hedges, bodies of water, and waysides are particularly exposed to colonisation with creeping thistles, as they are extensively cultivated or not cultivated at all, the soil never being tilled. Such surfaces need special observational focus, as tillage-measures for creeping-thistle control do not apply.

Near-natural surfaces within the farmland should have the possibility of unhindered development, so that they may fulfil their purpose as valuable habitat to birds, insects, and other inhabitants of the open field. This is why, as a rule, there should only be as many interventions as necessary.

The following procedure has proven effective:

1. **Observe:** Check fallow fields, marginal structures, and other near-natural surfaces for thistles



Fallows offer particularly favourable conditions for thistle development.

in regular intervals. This way, you can take action against spreading in a timely manner. Not only creeping thistles, but also other problem weeds, such as field bindweed, bitter dock, or couch grass may spread and cause great problems in neighbouring- or succeeding crops.

2. **Tear out, cut out, mow out:** So far, in extensively cultivated surfaces, organic farms dispose only of tearing out, cutting out, and mowing out as direct measures. These methods are very laborious. If applied consistently, they also lead to success. The expenditure of time is however very high, which is why a calculation of time expenditure for observation and care should always be included when planning near-natural surfaces.

3. **Restore fields with large thistle nests:** If a newly cultivated surface does show large thistle nests already in its first year, there must have been older thistle stocks, which can be tackled only with great expenditure. Heavily infested surfaces should be re-integrated into crop rotation and restored with a three-year cultivation of grass-clover or lucerne.

4. **Prevent re-establishment:** In order to prevent thistles from invading again, one needs to take care of new seedlings or re-sprouting root pieces, especially on restored surfaces.

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