

## 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, as a vigorous weed it competes with the crops for water and nutrients. Most farmers underestimate the creeping thistle’s competitiveness and the economic impact of an infestation.

Once established, much patience is required to reduce its density and obtain a tolerable density of the thistle. So far, there is no ‘magic bullet’ for its control on organic farms. However, with sound cultivation methods in combination with direct methods, the thistle can be effectively controlled. Adequate preventive measures and early interventions when thistles occur can spare immense trouble by avoiding intensive control measures.

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## A widespread, challenging weed for arable farmers

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

Creeping thistle occurs on almost all soil types but finds optimal conditions on nutrient-rich, deep clay soils with good water retention capacity. Under such conditions, cereal-based crop rotations favour the thistle occurrence especially. In light soils and dry locations, creeping thistle appears less frequently and only where it has access to water reserves in the subsoil.



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 thistle plant from a soil depth of 30 to 50 cm.



### Reasons for creeping thistle occurrence

- An increasing number of organic farms operate with little or no livestock and a crop rotation heavy on cereals.
- The general tendency of short term one-year leys instead of perennial grass-clover or alfalfa leys over three years.
- A trend towards favouring short-strawed types of cereals and competitively weak crops with a high profit margin (e. g. field vegetables).
- Inappropriate management of fields after harvest, fallows and surrounding land.
- Fragmentary or weak plant stocks as a result of infestation with pests or diseases, or an insufficient nutrient supply, which facilitate the thistle's spread and development.
- Slippage, smearing and the emergence of a plough sole by incorrect cultivation, and especially driving on wet ground.
- Seed production of thistles on waste ground, fallow and/or cultivated fields.

Once thistles plants are established, their mechanical removal is difficult, as the energy reserves in the roots enable the plants to defy several years of mechanical treatment. Thus, preventive measures and early interventions are critical to prevent extensive spreading!



Creeping thistle flowers between June and September. Thistle forms both female (left) and male flowers (right). Pollination takes place by insects. The first seeds are ripe as early as 10 days after pollination.

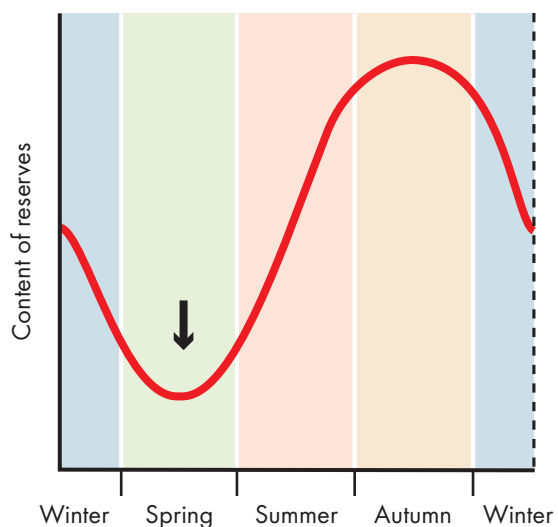
### Geographical impact on control strategies

While north-western and central Europe is mainly characterised by a humid temperate climate, the eastern and southern regions of Europe are often subject to very hot and dry summers. While humid conditions in summer provide suitable conditions for successful suppression of thistles in their early stages with competitive cover and forage crops, dry summer conditions in continental zones are more favourable to desiccation of thistle roots by mechanical control measures.

#### Box 1: The cycle of reserve material in thistle roots – the pacemaker for control measures

The regenerative potential of the thistle after disturbance depends on the reserve material 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 then built up for overwintering to then foster re-sprouting in spring.



The low level of reserves in the roots in spring is the entry point for effective thistle control. In this period, thistles react most sensitively to mechanical disturbance.



Tall-growing and dense crops like this protein pea-triticale mixture can significantly help prevent thistle problems.

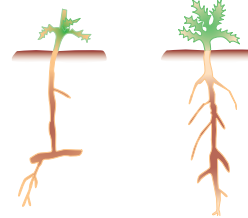
### Box 2: Basic recommendations for thistle prevention

Regardless of climatic and other conditions that affect the development of thistles, there are some basic measures that help prevent their spread:

- Restrict the proportion of cereals in the crop rotation to ideally less than 50%.
- Keep at least 15 to 20% perennial clover or lucerne-grass leys in the crop rotation.
- Plough and re-sow unsuccessful grass-clover and lucerne-grass leys.
- Prevent the relocation of nitrogen into lower soil layers with the cultivation of catch crops or well-established winter crops.
- Shift from winter to summer crops. Spring ploughing damages thistles more effectively, thus allowing the subsequent summer crop to compete more successfully with thistle growth.

## Development: Three stages from

### Stage 1: First colonisation via seeds and pieces of root



#### Via seeds

- Reproduction via seeds mostly occurs in and through fallows.
- Spreading is also possible via manure, straw, immature compost or infested own crop seeds.
- Thistle seeds germinate in late spring from May to June, with an optimal germination temperature between 20 and 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 (up to a height of 10 cm), being sensitive to shade, dryness, competition, burial, and infestation with fungi.
- The seedlings rely on a good continuous water supply in the topsoil.



Bare, well-moistured soil favours the germination and growth of thistle seeds.

#### Via root pieces

- 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 minimum length of 2,5 cm is needed for further development into a viable plant.



## first colonisation to infestation

### Stage 2: Growth of the roots and first flowering stems

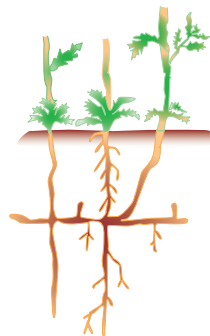


- Once seedlings are established, further growth quickly leads to an extensive, complex root system with roots running horizontally and vertically. Thanks to its vertical roots, the thistle is capable of reaching 3 m (sometimes even up to 5 m) into the ground. Root and shoot damage (e. g. by tillage measures) stimulate the formation of secondary roots and root buds. This leads to 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, while growing 2 to 12 m 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.



Already small plants build so called 'root suckers', special roots that store nutrients for quick re-sprouting.

### Stage 3: Formation of clusters



- At the latest 3 years after initial sprouting, typical thistle «nests» (clusters of numerous flowering shoots) start to appear in the summer months, stimulated by the sprouting of secondary roots.
- Depending on the location and environmental conditions, a plant forms 5,000 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 100 m away.
- A large proportion of the seeds are eaten by insects and birds. Nevertheless, seed dispersal for first colonisation remains of critical importance.



After 2 to 5 years, initial infiltration has led to extensive infestation in the form of nests.

## Control: A three-step approach

### Step 1. Preventing thistle invasion and growth

The first colonisation of a field with creeping thistle can most effectively be prevented by competing the plants for light, nutrients and water. This is best guaranteed through sound crop rotations, water-permeable soils, dense plant stocking, and frequent mowing of forage crops. At the same time, invasions must be prevented, which may occur via root suckers and root pieces, and seeds from field edges and uncultivated areas (i. e. fallow land).

In early development stages, tillage and hoeing are highly effective against seedlings. Seedlings which sprout primarily from May to June are up to an age of 6 weeks very sensitive to mechanical interference and to shading from early-emerging (winter) crops.

Thanks to available root reserves – unlike plants that develop from seeds – thistle plants sprouting from root pieces having a height of 10 cm and more can only be weakened by repeated mechanical control measures. Yet, such measures are much more effective in spring than in autumn, when the thistle will have built up already a great amount of reserve material in the roots to support re-sprouting in spring.



Thistle seedlings in maize seeding: repeated hoeing destroys the weed seedlings and encourages germination of new seeds.

#### The following actions have proven effective

- Deliberate planning of tillage and/or mechanical weed control measures in spring as part of crop rotation management.
- Not cultivating rather weak crops for more than two years in a row (see table 1).
- After competitively weak crops, sowing of high-density crops that favour early canopy closure and a densely growing crop (e. g. grass-clover, lucerne, mixture of peas and cereals).
- Cultivation of cereals that grow densely or tall (e. g. spelt instead of winter wheat). For wheat, varieties are to be favoured that grow relatively tall on soils low in nutrients.
- Stubble tillage prior to ploughing, in order to harm more effectively the old and newly sprouting thistles, i. e. successfully exhausting the reserves stored in the roots (see page 9 for details).
- Only when the soil is dry: prevention of soil compaction by loosening it with deeper tillage or subsoiler, reaching at least 5 cm deeper than the compacted layer. After loosening the soil, ideal is the sowing of a deep rooting and quickly growing crop, as green manure (e.g. fodder radish), for fodder (e. g. lucerne) or for cash (e. g. sunflower).
- Mowing or cutting inflorescences in edge strips and nearby areas prior to seed formation.

#### Important to know

The uncontrolled development of creeping thistle must be prevented at all costs. Efficient mechanical control is no longer possible once the thistles have formed clusters with a deep, widely branched system of roots storing considerable reserves for further spreading.



**Table 1: Competitiveness of selected arable crops against the creeping thistle**

Weak competitiveness
<ul style="list-style-type: none"> <li>• Sugar- and fodderbeet, beetroot</li> <li>• Soybeans, lupins, grain peas</li> <li>• Short-straw cereals</li> <li>• Vegetables in general</li> </ul>
Strong competitiveness
<ul style="list-style-type: none"> <li>• Lucerne, grass-clover</li> <li>• Faba beans, forage peas intercropped with barley</li> <li>• Spelt, rye, triticale and long-straw wheat, oats</li> <li>• Maize, sunflowers</li> <li>• Flax, buckwheat, hemp, millet, rape *</li> </ul>

\* moderate competitiveness in case of slow juvenile development

## Step 2. Removing single plants and impeding new growth

If single thistle shoots or ‘nests’ protrude in a growing crop, seed formation must be inhibited by cutting or pulling the thistles. Yet, since these procedures have only little impact on the stored root reserves, they need to be complemented with measures after the harvest to obtain more long-lasting results by depleting the root reserves over time.

Moreover, the cultivation of fast-growing and cuttable catch crops can effectively hamper the spread of thistles.

The following measures have proven effective:

- As a minimum measure, flower heads are 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. Pulling on heavy soils is easier after substantial rains.
- New sprouts must be removed continuously, 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.



A dense stand of tall wheat, well supplied with nutrients, helps to suppress thistles.

- Sowing a lush secondary crop or a strong forage or green-manure mixture after meticulous ploughing and seedbed preparation has proven effective. Increased seed quantities with 1,5 to 2 times more seeds than usual lead to faster establishment, and therefore to better weed control. Mixtures are generally more competitive than pure stands. Cover crops not involving legumes should be fertilised with farm manure, if available, to promote an early and fast canopy establishment to effectively suppress thistle growth.
- Avoid cultivating competitively weak crops on thistle-infested land plots.



Nip it in the bud with thistle-pulling if single plants start occurring. Pulling thistles after each reoccurrence may be costly, but it can prevent further spreading of the root weed.

**Table 2: Green manures and catch crops with good thistle-controlling effects**

	Advantages	Restrictions	Cultivation advices
<b>Vetch-rye mixture</b>	<ul style="list-style-type: none"> <li>Fodder source</li> </ul>	<ul style="list-style-type: none"> <li>No vetches in pea-crop rotations</li> <li>Overwinters.</li> </ul>	<ul style="list-style-type: none"> <li>Sowing after sub-soiling in September; silage in May; subsequent crop: maize</li> <li>Seed rate: 30–50 kg winter vetches and 50–80 kg rye per ha</li> <li>Cut high for re-sprouting of vetches.</li> </ul>
<b>Legume-grass mixture</b>	<ul style="list-style-type: none"> <li>Intensive rooting through the soil</li> <li>Fodder source</li> </ul>	<ul style="list-style-type: none"> <li>No restrictions by virtue of crop rotation</li> <li>Overwinters.</li> <li>Uncommon in arid regions</li> </ul>	<ul style="list-style-type: none"> <li>Sowing possible until September</li> <li>Cut high for re-sprouting of vetches.</li> </ul>
<b>Pea-vetch-oats mixture</b>	<ul style="list-style-type: none"> <li>Intensive rooting through the soil</li> <li>Fodder source</li> </ul>	<ul style="list-style-type: none"> <li>No cultivation in cereal-intensive crop rotations and with peas as main crop</li> <li>Single-cut crop (i.e. no regrowth)</li> </ul>	<ul style="list-style-type: none"> <li>Sowing until end of August; not overwintering</li> <li>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.</li> </ul>
<b>Sudan grass</b>	<ul style="list-style-type: none"> <li>Usable as a multi-cut fodder</li> <li>Very frost sensitive</li> </ul>	<ul style="list-style-type: none"> <li>The biomass can be difficult to manage, if not used as forage or pasture.</li> <li>Requires high temperatures to develop well.</li> </ul>	<ul style="list-style-type: none"> <li>Sow after the 20<sup>th</sup> of May</li> <li>Seed rate: 20–25 kg per ha</li> <li>Cut from a plant height of 45 cm for fodder</li> </ul>
<b>Fodder radish</b>	<ul style="list-style-type: none"> <li>Dense growth</li> <li>Deep-rooting plant</li> <li>Fodder source</li> </ul>	<ul style="list-style-type: none"> <li>Can overwinter in mild weather conditions.</li> </ul>	<ul style="list-style-type: none"> <li>Sowing possible until September</li> <li>Tolerates organic fertilising.</li> <li>Seed rate: depending on the variety 20–30 kg per ha</li> </ul>



Given an early intervention, thistles can be controlled without drastic measures. In dry, heavy soil, the stubble planer is best suited for full surface stubble cultivation.

**Box 3: Thistle-cutting on St John's Day**

Some farmers regard 24<sup>th</sup> June (Feast Day of Saint John the Baptist), often taken as the last day for cutting asparagus, as a promising period for thistle control. Asparagus sprouts, like thistles, should not be cut after St John's day, as they need to gather resources for the following year, just like the creeping thistle. The more often and earlier the thistle is bothered by trimming and cutting after St John's day, the less time remains for it to restock its roots with vital energy reserves.

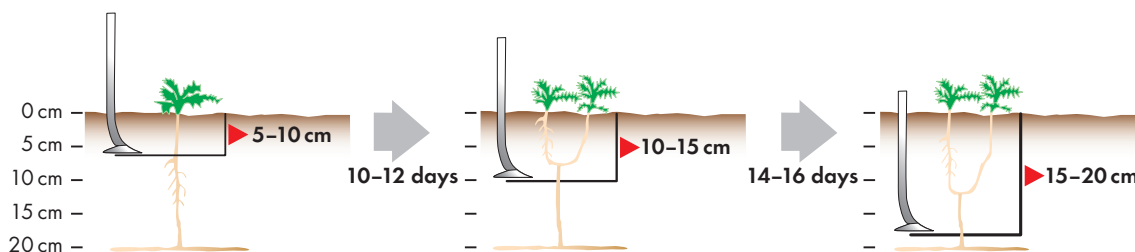


### Step 3. Prioritising intensive mechanical control when facing extensive spread

Until now, only one intervention strategy has proven effective in remedying an extensive infestation with thistles: Repeated focused tillage in combination with the cultivation of densely growing inten-

sively used perennial crops. This intervention logic relates to the so-called 'Johanni-Fallow', which is recommended for this purpose in older literature: by sowing a fast-establishing crop that is highly competitive for nutrients, the thistles are being starved from end of June until beginning of August, when thistles rely on building up reserves in the roots for their future development and proliferation.

**Figure 1: Stubble tillage in summer: Progressively grabbing the thistle at greater depths**



#### How it is done

1. After cereal harvest, carry out stubble tillage with a skimmer or a flat-cutting wing share cultivator (cutting across the whole surface) with a slight share overlap.
2. When regrown thistle plants reach 8 to 10 cm height, follow up the initial stubble tillage with 2 to 3 further rounds with a wing-share cultivator, increasing the working depth with each work step.

#### Important to know

This method only works during heavy droughts. In humid conditions, it can lead to the opposite effect, i. e. promoting thistle spreading through re-sprouting of not dried-off roots.

Young thistle shoots should be controlled repetitively to deplete the root reserves. This procedure works best when establishing additionally a cover crop. Such green manure should be sown timely, when thistles are dried off.

A 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. The rear-mounted discs help expose bare roots to the sun.

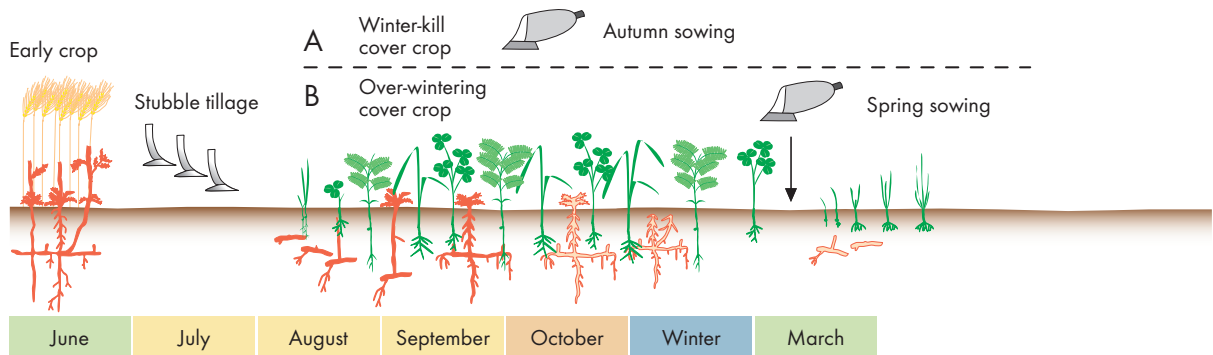


Overall, the use of the plough is essential when dealing with an extensive infestation of thistles. During stubble tillage, one should work intensively with machines which are able to cut the soil across the whole working width in varying depths. The picture shows a Precilab skin plough where the working depth can be adjusted via the support wheel. The root weeds are being severed and are lying on the top where they dry out.



## Thistle control under humid temperate conditions

**Figure 2: Overall strategy: After stubble tillage, disturbing and suppressing the thistle**



### How it is done

1. After early crops (e. g. winter barley, winter peas, Whole Crop Silage), disturb the thistle for the first time in July by applying stubble tillage.
2. Sow a cover crop with good soil coverage (e. g. summer vetch or fodder radish) to suppress thistle growth.

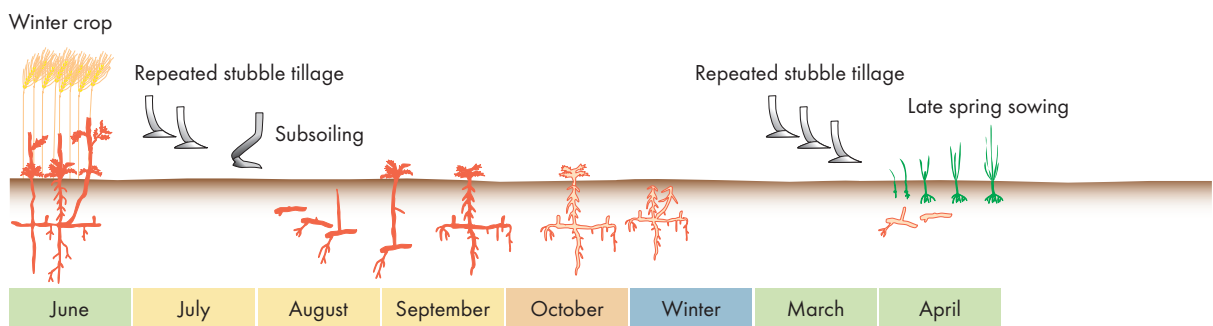
3. After the cover crop, further disturb the thistles by ploughing as part of seedbed preparation for a winter or spring crop.

### Important to know

Tilling in spring weakens the thistle more than ploughing in autumn, as the reserves in the thistle's roots are faster depleted in spring.

## Thistle control under semi-arid conditions

**Figure 3: Overall strategy: Disturb mechanically the thistles to deplete and dry off the roots in spring and summer**



### How it is done

1. After harvesting the main crop, ideally a winter crop with an early harvest (e. g. cereals, peas, faba beans), use the summer's dry conditions to deplete the thistles' root reserves by applying several soil tillage operations. Plan operations such that they are repeated at the 6 to 8 leaf stage of regrown thistle plants. Conclude the tillage phase with a subsoiling.

2. After winter, when soil conditions allow tillage activities, cultivate the soil 2 to 3 times with a skim plough or a completely flat-cutting wing share cultivator at a depth of 7 to 10 cm to disturb the thistle population. If the field is heavily infested in spring, aim to multiply the passes between the thistle regrowths and possibly sow a fast-growing crop soonest possible (e. g. millet, early sunflower or buckwheat).



### Important to know

Spring ploughing is not recommended on the most clay-rich soils (>30% clay). The wet conditions following winter hamper good seedbed preparation and involve the risk of creating a plough sole. On such soils, subsoiling during the previous summer helps to loosen the soil for the coming crop while promoting the drying up of thistle roots. Sunflower or millet are ideal crops to be sown after such intervention, around mid-May. As a general rule, it is better to grow a main crop later – on a clean(er) field – than having the crop grown earlier with a higher thistle infestation.

### Practitioner's tip: Deprive the thistle of light with WCS and a Power Mixture

A grain-legumes-cereal mixture may be grown in spring or autumn as a WCS (Whole Crop Silage) to actively compete against thistles. Such mixtures involve field beans and barley, or peas and oats, and are cut at the point of lactic ripeness. After harvest of the WCS, 1 to 2 primary soil tillage procedures are performed. 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 then drain the thistles' last reserves.

## Perennial forage cultivation

Especially for livestock farms, the sowing of perennial intensive-use forage-crop mixtures is the most reliable measure against thistles. They tend to exhaust the reserve materials via competition and trimming. On farms without livestock, lucerne or clover leys may be introduced into the rotation to regenerate soil fertility while having the advantage to suppress thistles at the same time.



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

### Important to know

- To exhaust the thistles, the cultivation of grass-clover or lucerne-grass over 2 or ideally 3 years is necessary. Good cultivation practices should promote quick growth and a dense cover. Lucerne performs best in soils with a pH above 6.5. In soils with a lower pH, mixtures involving red and white clover combined with different grasses may be used to optimise growth and biomass production.
- The forage should be cut at least three times a year in order to weaken thistle development. The cutting time should be in accordance with the development of forage-crop stock and thistles. The thistles should not protrude from the crop to avoid that they build up reserves. Cutting must be done latest when thistle flowering starts.
- A fragmentary forage-crop stock should be tilled and re-sown. Otherwise, the thistle will find new bare soil for its further spreading.
- If a crop fails to establish well in spring (i.e. low density), instead of re-sowing, repetitive thistle control measures should be implemented in this field to weaken the thistle population, before growing a fast maturing crop by end of May or June (e.g. millet, buckwheat, very early sunflower). After the harvest of these crops, the re-sowing of the forage or ley-crop should be done in autumn.

## Do not forget to control thistles in fallows!

Fallow fields, field margins, and fringe structures alongside hedges, water bodies and waysides are particularly exposed to colonisation with creeping thistles, as they are only extensively cultivated or not cultivated at all. Thus, they merit special attention, even more so as tillage measures cannot be applied to control thistle infestations.

### Appropriate measures in fallows

The following measures have proven effective in monitoring and controlling creeping thistles on fallow and not used land:

1. Constantly observe the development of flora on fallow fields and not used nearby surfaces. By doing so, you can take timely action against the establishment and spreading not only of creeping thistles, but also other problem weeds such as field bindweed, bitter dock or couch grass.
2. When observing thistle infestations on field borders, plan and implement special measures for these surfaces. If possible, start cultivating this land, ideally by installing a long-lasting cover crop (i. e. 'power mixture') after multiple passes of tillage measures.
3. Tear out, cut out, mow out if thistle infestations are very limited to a few spots or above-mentioned cultivation practices cannot be implemented. Because chemical solutions are strictly prohibited on organic farms, these very laborious interventions become necessary to prevent further spreading, which will cause bigger damage.

4. Fields with large thistle nests need special attention. If a newly cultivated surface develops large thistle nests in a fallow period. This indicates that there must have been older stock of thistle roots, which can be tackled only with long-term measures. Such surfaces should ideally be re-integrated into crop rotation and restored by cultivating dense multi-annual fodder crops (i. e. grass - clover or lucerne mixtures).
5. Prevent re-establishment of thistles by making sure that you only use clean new seeds and apply crop rotation and tillage measures that hinder the re-establishment of thistles.

#### Box 4: Thistle control in pasture and temporary grassland

The following measures have proven effective to prevent thistle establishment in pasture and temporary grassland:

- Avoid excessive grazing as it favours compaction and insufficient soil cover and, as a result, thistle establishment.
- If the infestation is only in its early stages with a few isolated plants, the thistles can be removed manually, if the procedure is repeated several times during the season.
- Frequent grazing followed by mowing of the refusals can contain, if not depleting the nests. Adequate organic fertilisation optimises grass growth and increases its ability to outgrow thistles.
- Donkeys, ponies, sheep and goats eat the flower buds and thus help reduce the thistle population.

### Imprint

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