CHOOSING AND MANAGING COVER CROPS IN ORGANIC AGRICULTURAL SYSTEMS

Camelina (S. Minette)

This document contains descriptions of 40 fallow-period cover crop species that are used in organic cropping systems.
It is a complementary resource associated with the technical guide *Choosing and managing cover crops in organic agricultural systems*, which was published in July 2012. The guide is available for download on the ITAB website: http://www.itab.asso.fr/publications/Cahier%20Couverts_ENG_2018.pdf.

These species descriptions are the result of literature reviews and discussions among the members of a national working group focused on cover crops in organic cropping systems. The working group was managed by ITAB and the national network of chambers of agriculture, which comprises agricultural advisors, coordinators, and other experts in organic agriculture.

SECTIONS:

Mustard (S. Minette)

CHOOSING A COVER CROP SPECIES

REMINDER

STEP 1: DEFINING CONSTRAINTS

I. Crop rotation/sequence

II. Sowing period

III. Fallow-period duration

IV. Soil type

STEP 2: RANKING THE OBJECTIVES (defining one or more management goals)

- Maintenance of soil organic matter
- Nitrogen release to the following cash crop
- Weed control
- Forage production
- Improvement of soil structure
- Pest control

STEP 3: DEFINING SOWING/TERMINATION DATES AND METHODS

FINAL CHOICE

This process will lead to a selection of species that are suited to a given situation. The farmer can then choose whether to utilise a single cover crop species or a species mixture. When making the final choice, other factors to consider include seed cost and seed availability (on the commercial market or as farm-saved seeds).

COMPOSING A MIXTURE

REMINDER

(approach recommended by the Meurthe and Moselle Chamber of Agriculture)

First, for cover crops to develop properly, it is necessary to choose species whose characteristics match with planned sowing and termination dates and methods. Second, it is also important to keep in mind the identity of the following cash crop and potential threats to plant health, even if risks are lower when mixtures are used instead of single species. Third, even if it is theoretically possible to mix seeds of all sizes, different seeds may have different sowing requirements. For example, planting depth may vary. Consequently, farmers may have to make two passes with the seed drill: once to sow seeds with deeper planting depths and once to sow seeds with shallower planting depths. This approach is used to plant mixtures of faba bean and mustard, for example.

All mixture types can lead to successful cover establishment and biomass production. However, following a few guidelines can ensure that farmers obtain optimal results:

- Combine plants with different, complementary development strategies that share space and do not compete for resources
- Combine plants with different morphologies (e.g., slender, bushy, low-lying, climbing)
- Use species with diverse root systems
- Use species that flower rapidly in the autumn to provide pollen and nectar to beneficial insects at a time of year when such resources are rare
- Adjust the sowing density of each species to limit overrepresentation by any one plant or excessive competition, both of which could prevent optimal, balanced cover crop growth

MANAGEMENT GOALS

If the goal is to improve soil structure, it is important to combine species with different root systems. If the goal is to retain nitrogen over the winter so that it can be passed along to the following cash crop, it is helpful to use mixtures of legumes and grasses or of legumes and brassicas. In both cases, cover, and thus weed suppression, can be maximised.

CALCULATING SOWING DENSITY

To calculate sowing rates for species mixtures, you must multiply the monoculture sowing rate for each species by the proportion desired in the mixture. *In some cases, the sowing rate can be increased by 20% to ensure proper cover development.*

Here is an sample calculation for a mixture of spring faba bean (50%), blue tansy (25%), and radish (25%):

faba bean = 100 kg * 0.5 = 50 kg/ha

blue tansy = 12 kg * 0.25 = 3 kg/ha

radish = 15 kg * 0.25 = 3.8 kg/ha

There are no established types of mixtures; many combinations are possible. The ultimate goal is to maximise the complementary benefits of different species.

When calculating sowing rates, it is crucial to take **regulatory standards** into account. The proportion of legumes allowed in mixtures varies by department. Farmers must check departmental regulations to verify maximum allowable proportions.

A FEW EXAMPLES

⇒ **buckwheat** (*40 kg/ha*) + blue tansy (*8 kg/ha*) or mustard (*8 kg/ha*)

⇒ blue tansy (*3 kg/ha*) + rye (*22 kg/ha*)

⇒ **winter oat** (*60 kg/ha*) + crimson clover (*10 kg*) or forage pea (*100 –120 kg/ha*)

⇒ **spring oat** (*60 kg/ha*) + forage pea (*50 kg/ha*), black medic (*8 kg/ha*), or white clover (*5 kg/ha*)

⇒ **Italian ryegrass** (*8–10 kg/ha*) + rye (*15 kg/ha*) or crimson clover (*12–18 kg/ha*)

⇒ vetch (*15 kg/ha*) + rye (*10 kg/ha*)

THE EXPERIENCE OF A FARMER IN AQUITAINE (DEPARTMENT OF LOT AND GARONNE)

To cover the soil and maintain soil organic matter after a faba bean/wheat sequence, Philippe Guichard stubble ploughed his field using a disc harrow and then broadcast sowed the following mixture:

faba bean *(200 kg/ha)* + daikon *(15 kg/ha)* + sunflower *(35 kg/ha)*

SPECIES DESCRIPTIONS

The following pages provide descriptions of the major fallow-period cover crop species used in organic cropping systems. The species are organised by taxonomic family, and their general characteristics are described (e.g., ability to capture and release nitrogen, biomass production, placement in the rotation). Recommendations related to species establishment and termination are provided, making easier to select and grow the cover crop of choice, whether alone or as part of a mixture.

Legumes

Grasses

Brassicas

Composites

Waterleafs

Buckwheat family

Linseeds

Use care with winter crops (e.g., rapeseed, radish, turnip rape, wheat, barley): they display varying degrees of cold tolerance.

LEGEND:

This image indicates that the species produces **NECTAR/POLLEN** and thus attracts both domesticated bees and wild pollinators.

Seed costs* are calculated in €/ha, which are indicated using the following scale:

- ●○○○○ < 30 €/ha
- ●●○○○ 30–60 €/ha
- ●●●○○ 60–90 €/ha
- ●●●●○ 90–120 €/ha
- ●●●●● > 120 €/ha

- **NITROGEN CAPTURE AND RELEASE:** low (0–20 u), intermediate (20–40 u), high (40–60 u)
- **FALLOW-PERIOD DURATION:** short (< 80 days), intermediate (80 < days < 120), long (> 120 days)

**cost of purchased seeds. Seed costs can be reduced by employing farm-saved seeds.*

TRY OUT SOME OTHER SPECIES THAT CAN BE USED AS COVER CROPS:

soybean, serradella, spinach, hemp, corn spurry, orchard grass, lupin, bromegrass, meadow fescue, mouse-ear hawkweed, English ryegrass, comfrey, rattlepod, tansies, quinoa, and many others...


L. Fourrié

Faba bean

Vicia faba

Legumes

General characteristics

Advantages

Strong growth

No risk of bolting

Easy to terminate

Fixes large amounts of atmospheric nitrogen

Disadvantages

Cannot serve as forage (except as part of immature mixed cover)

Successful seedling growth requires high sowing rate (susceptible to weed competition during early development)

Large seeds—tricky to sow and compose mixtures

Weed control: limited (erect plants provide little cover)

Growth features

Biomass	Soil nitrogen capture	Nitrogen release
intermediate to high	intermediate	high

To obtain proper cover development

Germination: slow to intermediate

Growth rate: intermediate to high

Fallow-period duration: intermediate to long (2–6 months)

Soil

Type: silty, clayey calcareous soils

Preparation: no specific requirements

Effect on structure: very positive (intermediate system—taproot and fibrous roots)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
Any	Row sowing highly recommended; narrow spacing Broadcast sowing—**cover ground well**	3–6 cm	180 kg/ha TKW = 300–600 g	●●●●●

Mixtures: can be used with grains (e.g., sorghum, oat), other legumes (e.g., vetch), or brassicas (e.g., rapeseed)

Termination

Freeze tolerance:
Hardy (winter variety) < -15°C
Sensitive (spring variety) ≤ -5°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing/shredding, stubble ploughing
2. Ploughing/tilling

Placement in rotation

Grains, sunflower

Avoid legumes

Faba bean

Nitrogen-demanding crops (e.g., maize)

Avoid legumes, protein crops, and other species susceptible to Sclerotinia diseases

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

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September 2013


L. Fourrié

Faba bean

Vicia faba

Legumes

Perspectives from the field

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« If you use faba bean, your sowing rate needs to be high enough. Establishment can fail if there are too few seeds on the ground. You also need to make sure the seed is buried deep enough. It is easy to incorporate faba bean into mixtures. It is better to use varieties with low TKW values, such as FEVITA®. »

Philippe Guichard, Farmer in Aquitaine, Lot and Garonne

« It is important to use the roller before sowing. This cover crop is easy to terminate via crushing. You can then sow your maize directly, without preparing the soil. »

Sébastien Minette, Poitou-Charentes, Chamber of Agriculture

« Faba bean is a hardy plant that produces lots of biomass and generates large amounts of nitrogen. Its sowing rate is rather high (90–100 kg/ha). The cover becomes thick at around 3 weeks to 1 month. Faba bean has a significant impact on soil structure. It is often mixed with either oat or mustard. Because of the large seed size, the logistics of mixtures may be tricky. However, the seeds can be planted separately (e.g., using slug pellet applicators and a centrifugal fertiliser spreader [DP12] on the front and back of the tractor, respectively, and then burying the seeds with a roller or a tine harrow). Faba bean is easy to eliminate: just shred it or crush winter-killed plants. »


A. Coulombel


L. Fontaine

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)


L. Fontaine

Fenugreek

Trigonella faenum-graecum

Legumes

General characteristics

Advantages

Can be used as forage (harvest before it bolts) or to produce seeds

Grown namely in southern France (hot, dry conditions)

Fixes large amounts of atmospheric nitrogen

Companion crop

Disadvantages

Bolts rapidly

Intermediate biomass production

Transmits root rot (*Aphanomyces*)

Weed control: intermediate to good

Pest control: poor to intermediate (pungent seeds repel insects)

Growth features

Germination: fast

Growth rate: intermediate

Fallow-period duration: intermediate (3 months)

Biomass	Soil nitrogen capture	Nitrogen release
low to intermediate	intermediate	intermediate to high

To obtain proper cover development

Soil

Type: clayey calcareous soils; does poorly on compacted and anoxic soils

Preparation: fine seedbed

Effect on structure: positive (taproot)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
February to October	Well suited to sowing during harvest Broadcast sowing —**cover ground well**	2–4 cm	40 kg/ha TKW = 25 g	●●●○○

Mixtures: good fit with grains (e.g., black oat, sorghum) or other legumes (e.g., vetch, clover)

Termination

Freeze tolerance:
Sensitive
≤ -2 to -8°C

Sensitivity depends on cover development stage

Most effective methods

1. Shredding/crushing (necessary if cover is allowed to develop)
2. Ploughing/tilling

Placement in rotation

Small-grain crops → **Fenugreek** → Nitrogen-demanding crops (e.g., maize, wheat, barley)
Avoid legumes and protein crops

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September 2013


S. Minette

Grass pea

Lathyrus sativus L.

Legumes

General characteristics

Advantages

Excellent forage for sheep

Drought tolerant

Grows to a height of 60 cm

Fixes large amounts of atmospheric nitrogen

Disadvantages

Seeds are toxic if consumed in large quantities

Large seeds—tricky to sow and compose mixtures

Transmits root rot (*Aphanomyces*)

Weed control: intermediate

Pest control: DU

Biomass	Soil nitrogen capture	Nitrogen release
intermediate	intermediate	intermediate

To obtain proper cover development

Growth features

Germination: intermediate

Growth rate: intermediate over an extended period

Fallow-period duration: short to long

Soil

Type: does best on somewhat clayey soils; tolerates sandy or calcareous soils

Preparation: no specific requirements

Effect on structure: positive (taproot)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
Until mid-September	Broadcast sowing during stubble ploughing—**cover ground well**	3–4 cm	40–60 kg/ha TKW = 200 g	●●●●○

Mixtures: can be used with grains (e.g., oat, sorghum, barley)

Termination

Freeze tolerance:
Sensitive
≤ -5°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing/shredding/stubble ploughing
2. Ploughing

Placement in rotation

Avoid legumes → **Grass pea** → Nitrogen-demanding crops (e.g., maize, wheat, barley, beet, potato)
Avoid legumes, protein crops, and species that host

DU: data unavailable

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J. Bayle

Forage lentil

Lens nigricans

Legumes

General characteristics

Advantages

Easy addition to mixtures (small seeds)

Generates good soil cover—bushy growth form

Produces large amounts of biomass

Drought tolerant

Fixes large amounts of atmospheric nitrogen

Disadvantages

Afflicted by/transmits root rot (*Aphanomyces*)

Generates very low-lying cover

Weed control: good

Pest control: DU

Biomass	Soil nitrogen capture	Nitrogen release
low to intermediate	low to intermediate	intermediate

To obtain proper cover development

Growth features

Germination: fast

Growth rate: high

Fallow-period duration: long (4–5 months)

Soil

Type: all

Preparation: no specific requirements

Effect on structure: positive (taproot)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
September/ October	Can be sown during harvesting Broadcast sowing—**cover ground well**	2–3 cm	40 kg/ha TKW = 20–30 g	●●●○○

Mixtures: can be used with grains (e.g., oat, barley, rye)

Termination

Freeze tolerance:
Sensitive
≤ -6°C

Sensitivity depends on cover development stage

Most effective methods

1. Shredding/crushing (if cover is allowed to develop)
2. Tilling/stubble ploughing

Placement in rotation

Avoid legumes	**Forage Lentil**	Nitrogen-demanding crops (e.g., maize, wheat, barley, beet, potato) *Avoid legumes, protein crops, and species that host*

DU: data unavailable

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J. Bayle

Forage lentil

Lens nigricans

Legumes

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Perspectives from the field

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« Forage lentil produces a rather large amount of biomass. It grows close to the ground. This can cause problems when it comes to weed removal. The lentil is therefore commonly used in mixtures with complementary species, such as mustard or oat, which grow tall and remain erect. »

Philippe Guichard, Farmer in Aquitaine, Lot and Garonne

« Freezing temperatures do not always kill the lentil. They need to hit -7 or -8°C and stay there for 3–4 days. As a result, I often have to plough it under. However, I do not plough too deeply because I then plant maize. »


J. Bayle


J. Bayle


J. Bayle


L. Fontaine

Bird's-foot trefoil

Lotus corniculatus

Legumes

General characteristics

Advantages

Tolerant of extreme climatic conditions (cold, drought)

No risk of bolting

Can serve as forage (bloat safe)

Fixes large amounts of atmospheric nitrogen

Weed control: poor (short plants)

Pest control: DU

Disadvantages

Slow growth

Low level of soil cover (height: 10–40 cm)

Sensitive to high levels of winter precipitation

Transmits root rot (*Aphanomyces*)

Biomass	Soil nitrogen capture	Nitrogen release
low to intermediate	low	intermediate

To obtain proper cover development

Growth features

Germination: slow (2–3 weeks)

Growth rate: low

Fallow-period duration: long

Soil

Type: all except waterlogged soils

Preparation: fine seedbed

In wet soils, **greater bird's–foot trefoil** is a better choice.

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
Spring, autumn	Row sowing Broadcast sowing possible if seeds are buried, pass with roller	1–2 cm	10–15 kg/ha TKW = 1–1.5 g	●●●●●

Mixtures: can be used with grains (e.g., oat, barley, tall fescue, bromegrass)

Termination

Freeze tolerance:
Hardy < -15°C*

Sensitivity depends on cover development stage

Most effective methods

1. Shredding (if allowed to develop)
2. Tilling (stubble plough with winged shanks)

Placement in rotation

Avoid legumes → **Bird's-foot trefoil** → Nitrogen-demanding crops (e.g., maize, wheat, barley, sorghum)

*the Mediterranean variety is not cold tolerant

DU: data unavailable

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Yellow lupin

Lupinus luteus

Legumes

General characteristics

Advantages

Hardy and resistant

Can serve as forage (high protein content)

Improves low-fertility soils

Roots release an acid enzyme that facilitates mineral assimilation (e.g., phosphorus)

Does not transmit *Aphanomyces*

Fixes large amounts of atmospheric nitrogen

Weed control: poor

Pest control: vulnerable to anthracnose

Disadvantages

Higher temperature requirements

Seeds can be toxic

Susceptible to weed competition (e.g., docks and sorrels or thistles)

Biomass	Soil nitrogen capture	Nitrogen release
intermediate to high	low	intermediate to high

To obtain proper cover development

Growth features

Germination: slow

Growth rate: high

Fallow-period duration: intermediate to long (100–180 days)

Soil

Type: shallow, sandy soils; best used in acidic soils

Preparation: one or two methods—loosen upper soil layer

Effect on structure: positive (extensive root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
September/October	Broadcast or row sowing	3–5 cm	100–150 kg/ha TKW = 120–450 g	●●●●●

Mixtures: can be used with spring oat

Termination

Freeze tolerance:
Sensitive (spring variety) to very hardy (winter variety) < -15°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing/shredding/stubble ploughing
2. Ploughing/tilling

Placement in rotation

Avoid legumes → **Yellow lupin** → Nitrogen-demanding crops (e.g., wheat, Italian ryegrass, rye)

DU: data unavailable

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L. Fontaine

Lucerne

Medicago sativa

Legumes

General characteristics

Advantages

Can serve as forage

Vigorous growth and dense cover

Can interrupt cyclical disease transmission in grains

Fixes large amounts of atmospheric nitrogen

Mediterranean variety: drought tolerant but frost sensitive (suited to south)
Flemish variety: frost sensitive (suited to north)

Disadvantages

Termination is complicated

Self toxic (do not plant lucerne as the following cash crop or undersow a lucerne in a lucerne) and causes bloat in livestock

Exerts strong competitive pressure on other species in mixtures

Sensitive to soil compaction, saturation, and trampling

Afflicted by/transmits root rot (*Aphanomyces*)

Seeds must be inoculated (southern France)

Weed control: intermediate

Pest control: intermediate, increases risk of *Sitona* weevils

Growth features

Germination: fast

Growth rate: low to intermediate

Fallow-period duration: long

Biomass	Soil nitrogen capture	Nitrogen release
low to intermediate	intermediate	low to intermediate

To obtain proper cover development

Soil

Type: all except waterlogged, acidic soils (can apply lime)

Preparation: fine seedbed

Effect on structure: positive (strong fibrous root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
Spring, early autumn	Can be undersown in the spring Broadcast sowing, pass with a roller/harrow Row sowing	1 cm max	20–25 kg/ha TKW = 2–2.5 g	●●●●○

Mixtures: small quantities can be mixed with grains (e.g., sorghum, oat)

Termination

Freeze tolerance:
Hardy < -15°C

Sensitivity depends on cover development stage

Most effective methods

1. Shredding
2. Ploughing/tilling

Placement in rotation

Small-grain crops or end-of-rotation crops	**Lucerne**	Nitrogen-demanding crops (e.g., maize, wheat, barley, sorghum)

DU: data unavailable

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September 2013


L. Fourrié

Water medic

Medicago littoralis

Legumes

General characteristics

Advantages

Can serve as forage

Very vigorous growth, dense cover, competitive and aggressive plant

Rapid production (60–75 days)

Fixes large amounts of atmospheric nitrogen

Disadvantages

Self toxic (do not plant water medic as the following cash crop or undersow a water medic in a water medic)

In mixtures, exerts strong competitive pressure on other species

Just after sowing, vulnerable to drought and competitive pressure from grains (wheat, bluegrass, ryegrass)

Responds negatively to soil compaction and trampling

Afflicted by/transmits root rot (*Aphanomyces)*

Weed control: good (suppressive effect)

Pest control: intermediate

Biomass	Soil nitrogen capture	Nitrogen release
intermediate	intermediate	high

To obtain proper cover development

Growth features

Germination: fast

Growth rate: intermediate (if undersown) to high

Fallow-period duration: intermediate to long

Soil

Type: all except waterlogged, acidic soils

Preparation: fine seedbed

Effect on structure: positive (strong taproot system; can extend as far down as 2 m)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
Spring, early autumn	Can be undersown in the spring Broadcast sowing, pass with roller/ harrow	1 cm max	20–25 kg/ha TKW = 2–2.5 g	●●●●○

Mixtures: small quantities can be mixed with grains (e.g., millet, oat)

Termination

Freeze tolerance:
Sensitive
≤ -3°C

Sensitivity depends on cover development stage

Most effective methods

1. Shredding (if allowed to develop)
2. Ploughing/tilling

Placement in rotation

Small-grain crops or end-of-rotation crops	**Water medic**	Nitrogen-demanding crops (e.g., maize, wheat, barley, sorghum)

DU: data unavailable

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September 2013


L. Fourrié

Water medic

Medicago littoralis

Legumes

Perspectives from the field

Gille Salitot, Picardie Chamber of Agriculture

« It is best to undersow water medic in spring barley or plant it immediately after the harvest. It is not very useful when the fallow period is long because of its annual life cycle and its establishment costs. In Picardie, you often get disappointing results if you undersow water medic in a winter grain during the spring. »

Alain Lecat, Nord-Pas de Calais Chamber of Agriculture

« It is a difficult cover crop to terminate. It must be cut at the very base of the stem during an efficient tillage operation. »


J. Leroyer

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)


C. Glachant

White/yellow sweet clover

Melilotus alba/arvensis

Legumes

General characteristics

Advantages

Can serve as forage

Produces large amounts of biomass (grows as tall as 2 m)

Can grow on soils that are poor in organic matter

Fixes large amounts of atmospheric nitrogen

Disadvantages

Biennial

Termination is complicated

If terminated improperly, can produce thick cover and become invasive (bushy growth form)

Terminate before bolting

Transmits root rot (*Aphanomyces*)

Weed control: intermediate

Pest control: DU

Biomass	Soil nitrogen capture	Nitrogen release
high	high	high

To obtain proper cover development

Growth features

Germination: DU

Growth rate: high

Fallow-period duration: intermediate to long (80–100

Yellow sweet clover may provide better quality green manure. It is shorter and bushier; it also provides more extensive cover.

Soil

Type: deals well with calcareous soils

Preparation: no specific requirements

Effect on structure: very positive (extremely strong, deep root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
Spring, late summer	Can be undersown in the spring Broadcast sowing, pass with roller/harrow Row sowing	1–3 cm	20 kg/ha TKW = 1–2 g	●●●○○

Mixtures: can be used with grains (e.g., sorghum, oat, millet, rye)

Termination

Freeze tolerance:
Hardy < -15°C

Sensitivity depends on cover development stage

Most effective methods

1. Shredding
2. Ploughing/tilling using discs/tines

Placement in rotation

Avoid legumes → **Sweet clover** → Nitrogen-demanding crops (e.g., wheat, Italian ryegrass, rye)

DU: data unavailable

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C. Glachant

White/yellow sweet clover

Melilotus alba/arvensis

Legumes

Perspectives from the field

Gille Salitot, Picardie Chamber of Agriculture

« Depending on the conditions the year the cover is established, biomass levels may be rather modest going into the winter. If you plant sweet clover, be careful to properly manage it. Because it is a biennial plant, the following year's regrowth can end up competing with the cash crop. »

Alain Lecat, Nord-Pas de Calais Chamber of Agriculture

« It is a great cover crop if you want to increase soil nitrogen content. However, it is hard to terminate unless you are not going to farm the field or you are planting roots and tubers in the late spring. »


G. Salitot


C. Glachant

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)


G. Salitot

Black medic

Legumes

General characteristics

Advantages

Hardy

Drought tolerant

Can be undersown in grains

Deals well with light competition

Fixes large amounts of atmospheric nitrogen

Disadvantages

Biennial

Transmits root rot (*Aphanomyces*)

Weed control: good (creates extensive cover)

Pest control: DU

Biomass	Soil nitrogen capture	Nitrogen release
intermediate	intermediate	intermediate

To obtain proper cover development

Growth features

Germination: fast

Growth rate: intermediate (during fallow period, summer) to high (in mixtures)

Fallow-period duration: intermediate to long

Soil

Type: all, especially calcareous soils

Preparation: no specific requirements

Effect on structure: positive (small taproot with fibrous branches; can extend as far down as 50 cm)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
Spring to autumn	Broadcast sowing Use of roller or harrow recommended	3 cm	10–15 kg/ha TKW = 1.8 g	●●●○○ ●●●●○

Mixtures: can be used with grains (oat, rye, maize), composites (sunflower, nyger), or

Termination

Freeze tolerance:
Hardy < -15°C

Sensitivity depends on cover development stage

Most effective methods

1. Shredding
2. Ploughing/tilling

Placement in rotation

Avoid legumes → **Black medic** → Nitrogen-demanding crops (e.g., wheat, rye, sorghum, maize)

DU: data unavailable

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

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September 2013


G. Salitot

Black medic

Medicago lupulina

Legumes

Perspectives from the field

Gille Salitot, Picardie Chamber of Agriculture

« Compared to Haifa white clover, Virgo black medic displays more limited development. The sowing rate is higher, which means establishment costs are higher as well. It generates low-lying cover. »

Alain Lecat, Nord-Pas de Calais Chamber of Agriculture

« It is a cover you can use on calcareous soils. It can easily be reproduced year after year. Black medic can grow on poor-quality soils and tolerates drought conditions. However, it is more expensive than other cover crops. It can do a good job suppressing weeds after grain crops are harvested. »

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« I am a big fan of black medic, when it is sown in April or May, because it yields lots of biomass, and a bit more nitrogen than white clover. If it is undersown in a grain crop, there are not any issues at harvest time because it produces low-lying cover. »


G. Salitot


L. Fontaine


L. Fontaine

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

Field pea

Pisum arvense

Legumes

General characteristics

Advantages

Easy to terminate

Can serve as forage

Fixes large amounts of atmospheric nitrogen

Disadvantages

Large seeds—some mixtures may be complicated

Low level of growth

Afflicted by/transmits root rot (*Aphanomyces*)

Drought intolerant

Weed control: poor

Pest control: vulnerable to parasites and anthracnose

Growth features

Germination: fast

Growth rate: intermediate

Fallow-period duration: intermediate

Biomass	Soil nitrogen capture	Nitrogen release
low to intermediate	low	low to intermediate

To obtain proper cover development

Soil

Type: all except waterlogged soils

Preparation: no specific requirements, but performs poorly if ploughpans are present

Effect on structure: positive (fibrous root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
Before early October	Broadcast sowing while stubble ploughing Use of roller or harrow recommended	2–3 cm	100–250 kg/ha TKW = 220–280 g	●●●●○ ●●●●●

Mixtures: can be used with grains (e.g., oat) or brassicas (mustard)

Termination

Freeze tolerance:
Extremely sensitive (spring variety) to hardy (winter variety)
≤ -10°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing
2. Ploughing/tilling

Placement in rotation

Avoid legumes	**Field pea**	Nitrogen-demanding crops (e.g., wheat, rye, sorghum, maize, sunflower) *Avoid using peas as cover crops in rotations with peas*

DU: data unavailable

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

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September 2013

Field pea

Pisum arvense

Legumes

Perspectives from the field

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« The field pea stands tall thanks to its erect form and tendrils. It works extremely well in cover crop mixtures. »

Field pea-barley mixture
A. Roinsard

Forage pea

Pisum sativum

Legumes

General characteristics

Advantages

Fairly easy to establish

Produces large amounts of biomass in the autumn

Fixes large amounts of atmospheric nitrogen

Disadvantages

Not easily winter killed

Seedlings are drought intolerant

Afflicted by/transmits root rot (*Aphanomyces*)

Very vulnerable to eyespot

Weed control: poor

Pest control: DU

Growth features

Germination: fast

Growth rate: intermediate to high

Fallow-period duration: intermediate to long

Biomass	Soil nitrogen capture	Nitrogen release
intermediate to high	intermediate	intermediate

To obtain proper cover development

Soil

Type: all

Preparation: no specific requirements

Effect on structure: intermediate (somewhat deep fibrous root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
Before early October	Broadcast sowing while stubble ploughing Use of roller or harrow recommended	1–2 cm	40–60 kg/ha TKW = 100–300 g	●●●○○ ●●●●○

Mixtures: can be used with grains (e.g., sorghum, spring oat, millet, rye)

Termination

Freeze tolerance:
Hardy
< -15°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing/shredding
2. Ploughing

Placement in rotation

Avoid legumes	**Forage pea**	Nitrogen-demanding crops (e.g., wheat, rye, sorghum, barley) *Avoid using peas as cover crops in rotations with peas*

DU: data unavailable

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

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September 2013


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Forage pea

Pisum sativum

Legumes

Perspectives from the field

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« On the forage pea, leaves are found lower down than on the field pea. When the forage pea is used as a cover crop, weeds may be more prevalent. The species also needs to be grown with a companion crop because it can grow tall but lacks tendrils. »


A. Roinsard


A. Roinsard

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)


L. Fontaine

Sweetvetch

Hedysarum species

Legumes

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

General characteristics

Advantages

Provides good cover and grows rapidly

Can serve as forage (palatable and bloat safe)

Drought tolerant (hardy)

Fixes large amounts of atmospheric nitrogen

Disadvantages

Exerts only intermediate competitive pressure on weeds during early growth

Perennial

Performs poorly under wet conditions

Availability of organic seeds is limited in France

Transmits root rot (*Aphanomyces*)

Weed control: good

Pest control: DU

Biomass	Soil nitrogen capture	Nitrogen release
intermediate	low	intermediate to high

To obtain proper cover development

In southern France, **common sainfoin** (*Onobrychis viciifolia*; an annual) can be used as a potential replacement.

Growth features

Germination: intermediate

Growth rate: intermediate

Fallow-period duration: intermediate to long

Soil

Type: nutrient-poor, dry calcareous soils

Preparation: no specific requirements

Effect on structure: very positive (deep taproot)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
Late summer Early autumn	Can be undersown in the spring Broadcast sowing Use of roller recommended	2–3 cm	40–45 kg/ha* TKW = 20–22 g	●●●○○

Mixtures: can be used with grains (e.g., sorghum, oat, millet, rye) or lucerne

Termination

Freeze tolerance:
Hardy
≤ -15°C

Sensitivity depends on cover development stage

Most effective methods

1. Shredding
2. Ploughing/tilling

Placement in rotation

Avoid legumes → **Sweetvetch** → Nitrogen-demanding crops (e.g., wheat, rye, sorghum, maize)

*40–50 kg of hulled seeds or 150–180 kg/ha of unhulled seeds

DU: data unavailable

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September 2013


G. Salitot

White clover

Trifolum repens

(intermediate variety)

Legumes

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

General characteristics

Advantages

- More persistent and robust than other clovers
- Tolerates drought once established
- Can serve as forage
- Provides good soil cover (propagates using stolons)
- Fixes large amounts of atmospheric nitrogen

Disadvantages

- Perennial
- Slow, potentially difficult establishment (water stress)
- Transmits root rot (*Aphanomyces*)
- Attracts mice and other rodents
- Causes bloat in livestock
- Susceptible to competitive pressures when undersown

Weed control: intermediate

Pest control: DU

Growth features

Biomass	Soil nitrogen capture	Nitrogen release
intermediate	intermediate	intermediate

To obtain proper cover development

Germination: slow

Growth rate: intermediate

Fallow-period duration: long

Soil

Type: all

Preparation: very fine seedbed

Effect on structure: positive (well-developed fibrous root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
February to October	Can be undersown Broadcast sowing Use of roller recommended	1 cm	4–5 kg/ha TKW = 0.60–0.70 g	●●●○○

Mixtures: can be used with mustard or rye

Termination

Freeze tolerance:
Hardy < -15°C

Sensitivity depends on cover development stage

Most effective methods

1. Ploughing
2. Tilling

Placement in rotation

Spring grains (e.g., barley, maize)	**White clover**	Nitrogen-demanding crops (e.g., wheat, rye, sorghum, maize) Undersown in a winter grain in the spring

DU: data unavailable

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September 2013


G. Salitot

White clover

Trifolum repens

Legumes

Perspectives from the field

Gille Salitot, Picardie Chamber of Agriculture

« If used over several years, Haifa white clover displays a similar degree of development to that of red clover. There are differences between varieties. If the cover crop is undersown, white clover causes fewer problems than red clover because it does not grow up through the following cash crop. Furthermore, white clover propagates via stolons, which helps fill in post-harvest gaps in the cover. »

Alain Lecat, Nord-Pas de Calais Chamber of Agriculture

« It is a cover you can use everywhere, and it can easily be reproduced year after year. Although white clover can be sown at any time of year, it is best done in early spring (undersown in grain crops in the full tillering stage). »

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« This cover crop produces significant biomass and has a rather low-lying growth form. It is a good compromise species for undersowing in a pre-existing cash crop. However, it tends to attract field mice. »

Philippe Guichard, Farmer in Aquitaine, Lot and Garonne

« It is a good cover crop to use when employing direct drilling. While it works well, it must be properly established because it will allow weeds to grow if it is too sparse. »


G. Salitot


G. Salitot

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)


A. Lecat

Berseem clover

Trifolium alexandrinum

Legumes

General characteristics

Advantages

Drought tolerance and frost sensitivity vary for different varieties

Provides good cover

Can serve as forage (palatable and bloat safe)

Disadvantages

Appeals to slugs

Transmits root rot (*Aphanomyces*)

Difficult to establish

Susceptible to competitive pressures when undersown

Weed control: intermediate to good

Pest control: DU

Growth features

Germination: rather fast

Growth rate: high

Fallow-period duration: short to intermediate

Biomass	Soil nitrogen capture	Nitrogen release
intermediate to high	low to intermediate	intermediate

To obtain proper cover development

The **Egyptian variety** of berseem clover stops growing after it has been cut.

Soil

Type: all; can be grown in acidic soils

Preparation: stubble ploughing, establishment of a fine seedbed

Effect on structure: positive (intermediate system—taproot and fibrous roots)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
Spring, summer, autumn	Can be undersown in the spring Broadcast sowing, pass with roller	1–2 cm	20–25 kg/ha TKW = 2–3 g	●●○○○

Mixtures: can be used with grasses (e.g., ryegrass) or spring brassicas

Termination

Freeze tolerance:
Sensitive
≤ -5°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing/shredding
2. Ploughing

Placement in rotation

Avoid legumes	**Berseem clover**	Nitrogen-demanding crops (e.g., wheat, rye, sorghum, maize)

DU: data unavailable

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

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September 2013


A. Lecat

Berseem clover

Trifolium alexandrinum

Legumes

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

Perspectives from the field

Gille Salitot, Picardie Chamber of Agriculture

« In Picardie, you get disappointing results if you undersow berseem clover in a winter grain during the spring. Some varieties are not capable of repeat flowering. After the harvest, they do not grow back at all or only a little. In the summer, berseem clover must be planted early (before the end of July) to have any hope of heading into the winter with significant amounts of biomass. »

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« Berseem clover should be undersown later in the season because of its long, slender growth form and its ability to grow tall very quickly (can compete with grain crop in place). »


G. Salitot


G. Salitot


S. Minette

Crimson clover

Trifolium incarnatum

Legumes

General characteristics

Advantages

Very hardy
Provides good cover
Easy to put into place
Can serve as forage
Fixes large amounts of atmospheric nitrogen

Disadvantages

Hard to terminate
Tricky to establish
Susceptible to competitive pressures when undersown
Develops poorly if temperatures are very cold
Transmits root rot (*Aphanomyces*)

Weed control: intermediate

Pest control: DU

Growth features

Germination: fast

Growth rate: low to intermediate

Fallow-period duration: intermediate to long

Biomass	Soil nitrogen capture	Nitrogen release
high	intermediate to high	intermediate to high

To obtain proper cover development

Soil

Type: all

Preparation: stubble ploughing, establishment of a fine seedbed

Effect on structure: positive (fibrous root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
February to October	Can be undersown in the spring Broadcast sowing, pass with roller	1–2 cm	20–25 kg/ha TKW = 2–3 g	●●○○○

Mixtures: can be used with grains (e.g., sorghum, oat, millet, rye)

Termination

Freeze tolerance:
Hardy
≤ -15°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing/shredding
2. Ploughing

Placement in rotation

Avoid legumes	**Crimson clover**	Nitrogen-demanding crops (e.g., wheat, rye, sorghum, maize)

DU: data unavailable

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

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September 2013


L. Fontaine

Red clover

Trifolium pratense

Legumes

General characteristics

Advantages

Good-quality establishment

Can serve as forage

Produces large amounts of biomass in mixtures and during the fallow period

Fixes large amounts of atmospheric nitrogen

Disadvantages

Tricky to establish

Causes bloat in livestock

Susceptible to competitive pressures when undersown

Transmits root rot (*Aphanomyces*)

Weed control: excellent

Pest control: DU

Growth features

Germination: fast

Growth rate: good to high

Fallow-period duration: long

Biomass	Soil nitrogen capture	Nitrogen release
intermediate to high	intermediate	high

To obtain proper cover development

Soil

Type: all

Preparation: somewhat fine seedbed

Effect on structure: positive (fibrous root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
February to October	Can be undersown in the spring Broadcast sowing, pass with roller/harrow	1–2 cm	20–25 kg/ha TKW = 1.8 g	●●○○○

Mixtures: can be used with grains (e.g., sorghum, oat, barley, millet, ryegrass)

Termination

Freeze tolerance:
Hardy < -15°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing/shredding
2. Ploughing

Placement in rotation

Avoid legumes	**Red clover**	Nitrogen-demanding crops (e.g., wheat, rye, sorghum, maize)

DU: data unavailable

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September 2013


L. Fontaine

Red clover

Trifolium pratense

Legumes

Perspectives from the field

Gille Salitot, Picardie Chamber of Agriculture

« Red clover generally produces large amounts of biomass. Varieties differ in their vulnerability to powdery mildew, limiting potential changes in autumn cover crops. After a period of freezing temperatures, this cover crop is easy to terminate via ploughing. »

Alain Lecat, Nord-Pas de Calais Chamber of Agriculture

« If undersown, red clover displays an intermediate level of aggressiveness and provides an average amount of cover. The sowing date can be used as a tool for limiting its degree of aggressiveness. »

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« Red clover gets first place for its biomass and nitrogen production! It provides excellent cover and grows sufficiently high. However, be careful because it can be a rather intense competitor when it has been undersown. »

Philippe Guichard, Farmer in Aquitaine, Lot and Garonne

« Red clover has a greater seedling density and provides more extensive cover than white clover. My red clover cover crop is followed by maize or sunflower. However, it must be shredded before the sunflower is planted. »

Arnaud Schmitt, Farmer in Meuse, Lorraine

« Planted between wheat and spring barley, red clover can be used to break up the crop rotation and suppress weeds. Either I undersow it, or I sow it directly in the autumn. However, when it is undersown, it grows through the cash crop in place! The advantage that red clover has over other cover crops is that it produces a lot of biomass and nitrogen for the following cash crop. »


L. Fontaine


A. Lecat


G. Salitot


A. Lecat

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

Persian clover

Trifolium resupinatum

Legumes

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

General characteristics

Advantages

Grows more quickly than crimson clover in the summer

Can be used as a relay crop

Rather drought tolerant

Fixes large amounts of atmospheric nitrogen

Disadvantages

Tricky to establish

Provides average level of cover

Transmits root rot (*Aphanomyces*)

Susceptible to competitive pressures when undersown

Weed control: intermediate

Pest control: DU

Growth features

Germination: intermediate

Growth rate: intermediate

Fallow-period duration: intermediate to long

Biomass	Soil nitrogen capture	Nitrogen release
intermediate to high	low	intermediate to high

To obtain proper cover development

Soil

Type: all, including heavy, waterlogged, and non-acidic soils (pH>6)

Preparation: fine seedbed

Effect on structure: positive (intermediate system—taproot and fibrous roots; can extend down 25 cm)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
February to October	Can be undersown in the spring Broadcast sowing, pass with roller	1–2 cm	10–15 kg/ha TKW = 2–3 g	●●○○○

Mixtures: can be used with grains (e.g., sorghum, oat, millet)

Termination

Freeze tolerance:
Hardy < -15°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing
2. Ploughing/tilling

Placement in rotation

Avoid legumes	**Persian clover**	Nitrogen-demanding crops (e.g., wheat, rye, sorghum, maize)

DU: data unavailable

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September 2013


S. Minette

Vetch

Vicia sativa

Legumes

General characteristics

Advantages

Easy to establish

Produces large amounts of biomass

Should be used as part of a mixture

Fixes large amounts of atmospheric nitrogen

Disadvantages

Transmits root rot (*Aphanomyces*)

Drought intolerant

Has trouble growing in nutrient-poor soils

Slow growth rate

Droops if grown as a single cover crop; needs a companion crop

Weed control: intermediate

Pest control: DU

Growth features

Germination: fast

Growth rate: low to intermediate

Fallow-period duration: intermediate

Biomass	Soil nitrogen capture	Nitrogen release
intermediate to high	intermediate	intermediate to high

To obtain proper cover development

Soil

Type: all

Preparation: no specific requirements

Effect on structure: positive (intermediate system—taproot and fibrous roots)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
Before early October	Can be sown as part of a mixture Broadcast sowing, pass with roller	2 cm	30–50 kg/ha TKW = 45–75 g	●●●○○

Mixtures: can be grown with grains (e.g., sorghum, oat, barley, rye, wheat, triticale)

Termination

Freeze tolerance:
Sensitive (spring variety)
to hardy (winter variety)
≤ -15°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing
2. Ploughing/tilling

Placement in rotation

Avoid legumes and spring barley → **Vetch** → Nitrogen-demanding crops (e.g., wheat, rye, sorghum, maize)

DU: data unavailable

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September 2013


S. Minette

Vetch

Vicia sativa

Legumes

Perspectives from the field

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« Vetch cannot really be used during the summer fallow period in Lorraine because its timing is a bit late. However, it does produce abundant biomass if it is properly established. It can be mixed with oat, for example. »

David Hypolite, Farmer in Meurthe and Moselle

« It is helpful to use vetch as part of a mixture. For example, before a grain cash crop (spring wheat), I employ a cover crop mixture of oat, vetch, and sunflower. It functions like a nitrogen factory if planted early, before August 1 in northeastern France. It allows serves as an alternative legume because organic crop rotations tend to be legume heavy. »


ARVALIS

J. Arino

A. Roinsard

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

Hairy vetch

Vicia villosa

Legumes

General characteristics

Advantages

Very cold tolerant

Pest resistant (allelopathic activity)

Semi-erect growth form; less vulnerable to eyespot than common vetch

Fixes large amounts of atmospheric nitrogen

Weed control: good

Pest control: DU

Disadvantages

Transmits root rot (*Aphanomyces*)

Growth features

Germination: fast

Growth rate: intermediate

Fallow-period duration: intermediate

Biomass	Soil nitrogen capture	Nitrogen release
intermediate to high	intermediate	intermediate to high

To obtain proper cover development

Soil

Type: all

Preparation: no specific requirements

Effect on structure: positive (fibrous root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
Before early October	Can be sown as part of a mixture Broadcast sowing, pass with roller	2–3 cm	30–50 kg/ha TKW = 32 g	●●●○○

Mixtures: can be used with grains (e.g., sorghum, oat, barley, millet)

Termination

Freeze tolerance:
Hardy < -15°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing
2. Ploughing/tilling

Placement in rotation

Avoid legumes and spring barley → **Hairy vetch** → Nitrogen-demanding crops (e.g., wheat, rye, sorghum, maize)

DU: data unavailable

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

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September 2013


J. Arino

Spring oat

Avena sativa

Grasses

General characteristics

Advantages

Rapid growth

Tolerant of warm, dry conditions

Strong allelopathic activity

Positive effect on soil structure (0–25 cm)

Can serve as forage

More frost sensitive than winter oat

Weed control: intermediate to good

Pest control: susceptible to crown rust and BYD

Disadvantages

Somewhat susceptible to crown rust in nitrogen-poor soils (more resistant than winter oat)

Host plant for aphids that vector barley yellow dwarf (BYD)

Growth features

Germination: fast

Growth rate: high

Fallow-period duration: intermediate to long

Biomass	Soil nitrogen capture	Nitrogen release
intermediate	intermediate	low

To obtain proper cover development

Oat regrowth can be used as a cover crop.

Soil

Type: all

Preparation: no specific requirements

Effect on structure: positive (deep fibrous root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
July to early October	Row sowing Broadcast sowing, pass with roller	2–3 cm	100–120 kg/ha TKW = 35–50 g	●●○○○

Mixtures: can be used with vetch, forage lentil, forage pea, or faba bean, etc.

Termination

Freeze tolerance:
Sensitive
≤ -3°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing
2. Ploughing/light tilling

Placement in rotation

Avoid grasses	**Spring oat**	Spring legumes (e.g., pea, lentil, vetch), maize, sunflower, etc. *Avoid grains*

DU: data unavailable

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

Written by:
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(ITAB)

With assistance from:
P. Guichard (farmer), J. Bayle (Meurthe and Moselle Chamber of Agriculture), J. Arino (Gers Chamber of Agriculture)

September 2013


L. Fontaine

Winter oat

Avena sativa

Grasses

General characteristics

Advantages

Rapid growth

Strong allelopathic activity

Positive effect on soil structure (0-15 cm)

Can serve as forage

Disadvantages

Very susceptible to crown rust in nitrogen-poor soils

Host plant for aphids vectoring barley yellow dwarf (BYD)

Weed control: intermediate to good

Pest control: susceptible to crown rust and BYD

Growth features

Germination: fast

Growth rate: high

Fallow-period duration: long

Biomass	Soil nitrogen capture	Nitrogen release
intermediate to high	intermediate	low

To obtain proper cover development

Soil

Type: all

Preparation: no specific requirements

Effect on structure: positive (fibrous root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
July to October	Row sowing Broadcast sowing, pass with roller	2–3 cm	100–120 kg/ha TKW = 35–50 g	●●○○○

Mixtures: can be used with vetch, forage lentil, etc.

Termination

Freeze tolerance:
Hardy
≤ -13°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing
2. Ploughing/light tilling

Placement in rotation

Avoid grasses	**Winter oat**	Spring legumes (e.g., pea, lentil, vetch), maize, sunflower, etc. *Avoid grains*

DU: data unavailable

Written by:
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With assistance from:
J. Arino (Gers Chamber of Agriculture)

September 2013


L. Fontaine

Winter oat

Avena sativa

Grasses

Perspectives from the field

David Hypolite, Farmer in Meurthe and Moselle

« Winter oat does a good job of catching nitrogen left in the soil by the preceding cash crop. I plant it before wheat or spring barley, and do so rather late, because there is a significant risk of crown rust otherwise. Oat is also the companion crop in my vetch-oat-sunflower mixture. »


L. Fontaine


L. Fontaine

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)


S. Minette

Black oat

Avena strigosa

Grasses

General characteristics

Advantages

Resistant to crown rust and barley yellow dwarf (BYD)

Tolerates dry conditions in the late summer

Displays significant allelopathic activity

Can serve as forage

Disadvantages

Development is slow if seedlings experience hot temperatures

Host plant for aphids

Weed control: DU

Pest control: intermediate

Growth features

Germination: fast

Growth rate: high

Fallow-period duration: long

Biomass	Soil nitrogen capture	Nitrogen release
intermediate to high	intermediate to high	low to intermediate

To obtain proper cover development

Soil

Type: all

Preparation: no specific requirements

Effect on structure: positive (fibrous root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
July to early October	Row sowing recommended, then pass with roller Broadcast sowing—**covers ground well**	2 cm	30–40 kg/ha TKW = 35–50 g	●●○○○

Mixtures: can be used with vetch, clover, faba bean, etc.

Termination

Freeze tolerance:
Sensitive
≤ -2 to -3°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing
2. Ploughing/light tilling

Placement in rotation

Avoid grasses	**Black oat**	Spring legumes (e.g., pea, lentil, vetch), maize, sunflower, etc. *Avoid grains*

DU: data unavailable

Written by:
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September 2013


S. Minette

Black oat

Avena strigosa

Grasses

Perspectives from the field

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« Black oat is much more resistant to crown rust than spring white oat is. However, the cover crop can fail if planted in nitrogen-poor soil. This species, which has a low TKW, is recommended for use in mixtures. Black oat seeds display a high level of dormancy, so watch out for the re-emergence of previously planted seeds. »

Jérôme Labreuche, ARVALIS Plant Institute

« Black oat comes from Europe. However, it was bred in South America to produce more biomass and forage. It goes under different names, including diploid oat, Brazilian oat, forage oat, and Avena strigosa. It grows more rapidly than our spring oats. It is often still growing in the winter, and its stems freeze easily. However, growth can take off again in the spring from new tillers that sprout at the plant's base. It is more resistant than common oat is to viral diseases and crown rust. It has a low TKW. »


S. Minette


S. Minette

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)


S. Minette

Foxtail millet

Panicum germanicum

Grasses

General characteristics

Advantages

Tolerates heat

No regrowth

Positive effect on soil structure

Disadvantages

Susceptible to water stress during early development

Seedling growth will be complicated if weeds or re-growth present

Weed control: good

Pest control: DU

Growth features

Germination: fast

Growth rate: high

Fallow-period duration: intermediate

Biomass	Soil nitrogen capture	Nitrogen release
low	low to intermediate	low

To obtain proper cover development

Soil

Type: all; grows well on nutrient-poor calcareous soils

Preparation: no specific requirements

Effect on structure: positive (deep fibrous root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
July-August	Row sowing recommended, then pass with roller Broadcast sowing—**covers ground well**	1 cm	20–30 kg/ha TKW = 2–3 g	●●○○○

Mixtures: can be used with legumes (e.g., berseem clover, Persian clover, forage lentil)

Termination

Freeze tolerance:
Very sensitive
≤ 0°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing
2. Ploughing/tilling

Placement in rotation

Avoid grasses → **Foxtail millet** → Spring legumes (e.g., pea, lentil, vetch), sunflower, etc.

DU: data unavailable

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

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September 2013


S. Minette

Foxtail millet

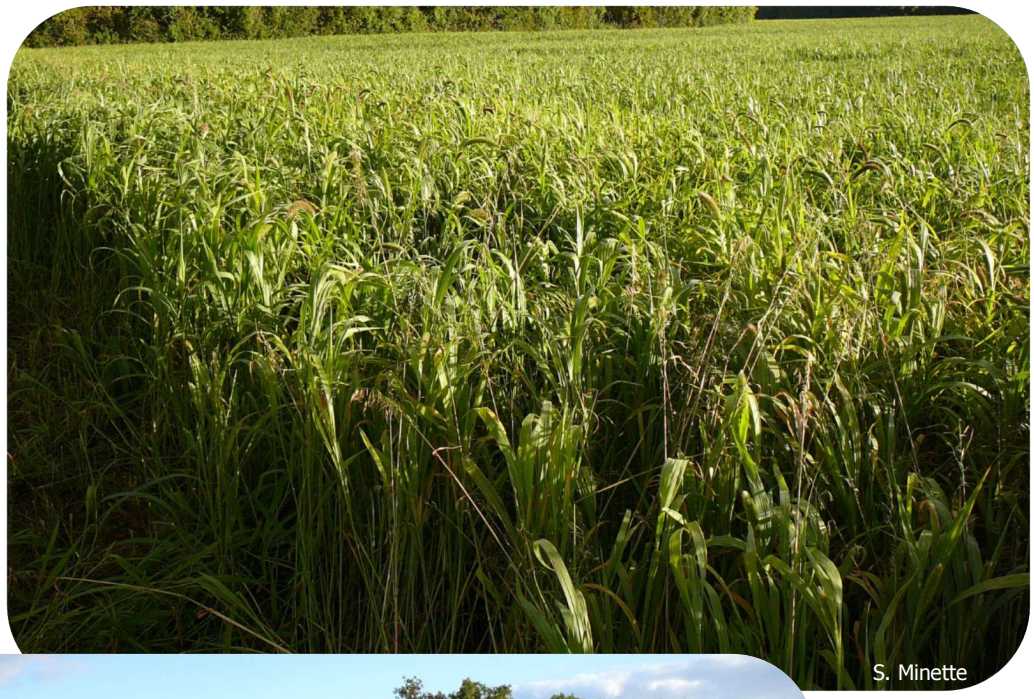
Panicum germanicum

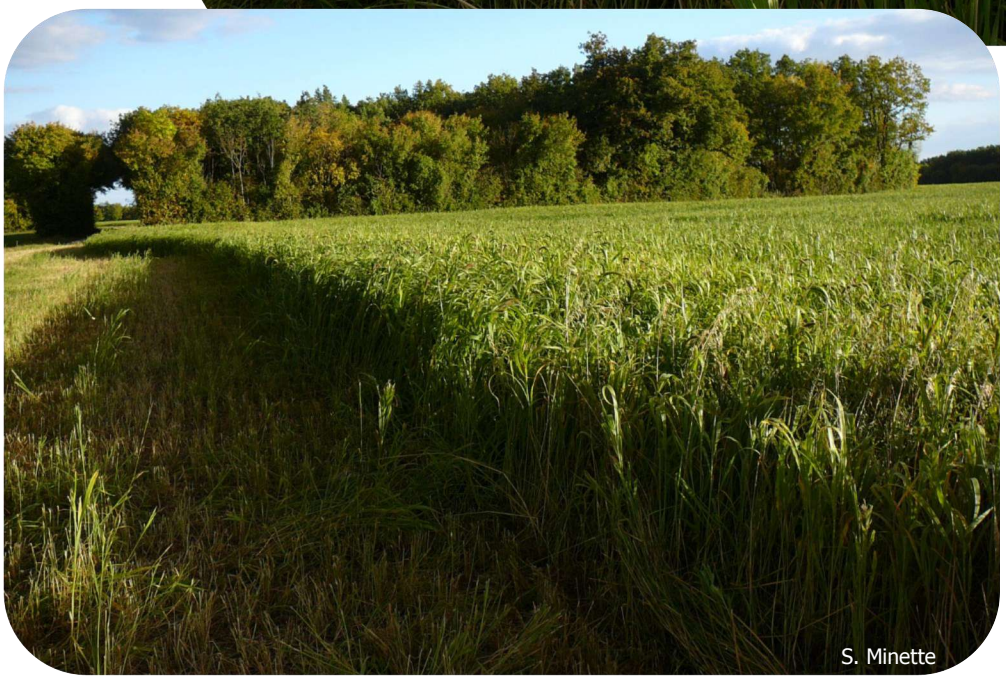
Grasses

Perspectives from the field

Jérôme Labreuche, ARVALIS Plant Institute

« This summer grass can be sown in late spring or early summer to obtain a second harvest of forage. It is cold intolerant and frost sensitive. »


S. Minette


S. Minette

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

Proso millet

Panicum miliaceum

Grasses

General characteristics

Advantages

Can serve as forage

Rapid growth

Tolerates drought and heat

Quickly adds soil organic matter

Disadvantages

Frost sensitive

Seedlings are susceptible to slug herbivory

Weed control: good

Pest control: DU

Biomass	Soil nitrogen capture	Nitrogen release
low	intermediate	low

To obtain proper cover development

Growth features

Germination: fast

Growth rate: high

Fallow-period duration: short to intermediate

Soil

Type: all

Preparation: fine, packed seedbed

Effect on structure: positive (extremely strong root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
Late April to late July	Broadcast sowing, pass with roller	1–2 cm	10 kg/ha* TKW = 5 g	●●○○○

Mixtures: can be used with legumes (e.g., forage lentil, berseem clover, Persian clover)

Termination

Freeze tolerance:
Sensitive
≤ 0 to -1°C

Sensitivity depends on cover development stage

Most effective methods

1. Crushing
2. Tilling

Placement in rotation

Anything, can come after barley → **Proso millet** → Spring legumes (e.g., pea, lentil, vetch), maize, sunflower, etc.

*of hulled seeds

DU: data unavailable

Written by:
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September 2013


A. Roinsard

Italian ryegrass

Lolium multiforum

Grasses

General characteristics

Advantages

Can serve as forage

Excellent, early growth

Disadvantages

biennial

Host plant for aphids

Can reduce water availability in soil if left in place too long

Can flower or bolt if not terminated quickly enough

Weed control: intermediate

Pest control: encourages presence of the corn ground beetle

Growth features

Biomass	Soil nitrogen capture	Nitrogen release
intermediate to high	intermediate to high	Very low to low

To obtain proper cover development

Germination: fast

Growth rate: high

Fallow-period duration: short to intermediate

Soil

Type: all

Preparation: fine seedbed

Effect on structure: positive (dense fibrous root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
August to mid-October	Row sowing Broadcast sowing, pass with roller	1 cm max	12–20 kg/ha TKW = 3.5 g	●●○○○

Mixtures: can be used with legumes (e.g., vetch, forage lentil)

Termination

Freeze tolerance:
Hardy < -15°C

Most effective methods

1. Shredding
2. Tilling

Sensitivity depends on cover development stage

Placement in rotation

Avoid grasses	**Italian ryegrass**	Spring legumes (e.g., pea, lentil, vetch), sunflower, etc.

DU: data unavailable

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

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With assistance from:
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September 2013


A. Roinsard

Italian ryegrass

Lolium multiforum

Grasses

Perspectives from the field

Jérôme Labreuche, ARVALIS Plant Institute

« It is easy to establish but more complicated to terminate. Italian ryegrass is very risky to grain growers (has negative effects on the following cash crop, can enhance presence of weeds). Alternative varieties, with short life spans, establish themselves quickly but last no longer than 6 months. »


A. Roinsard

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)


A. Roinsard

Italian ryegrass

(alternative variety)

Lolium multiflorum

Grasses

General characteristics

Advantages

Rapid growth

Can be grown as a relay crop to produce forage

Disadvantages

Host plant for aphids

Weed control: intermediate (good soil cover)

Pest control: host plant for aphids

Growth features

Germination: fast

Growth rate: intermediate to high

Fallow-period duration: short to intermediate

Biomass	Soil nitrogen capture	Nitrogen release
intermediate	intermediate to high	low

To obtain proper cover development

Soil

Type: all

Preparation: fine seedbed

Effect on structure: positive (dense fibrous root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
August to mid-October	Row sowing Broadcast sowing, pass with roller	2 cm	20 kg/ha TKW = 1.8 g	●●○○○

Mixtures: can be used with legumes (e.g., vetch, forage lentil)

Termination

Freeze tolerance:
Sensitive
≤ -8°C

Sensitivity depends on cover development stage

Most effective methods

1. Shredding
2. Ploughing/tilling

Placement in rotation

Avoid grasses	**Italian ryegrass (alt)**	Spring legumes (e.g., pea, lentil, vetch), maize, sunflower, etc.

DU: data unavailable

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September 2013


S. Minette

Rye

Secale cerale

Grasses

General characteristics

Advantages

Good soil cover

No risk of flowering or bolting

Positive effect on soil structure (0–25 cm)

More disease resistant than barley or common oat

Disadvantages

Host plant for aphids

Late sowing date

Weed control: good

Pest control: DU

Growth features

Germination: fast

Growth rate: low to intermediate

Fallow-period duration: long

Biomass	Soil nitrogen capture	Nitrogen release
low to intermediate	intermediate	low

To obtain proper cover development

Soil

Type: all; prefers acidic soils

Preparation: fine seedbed

Effect on structure: positive (rather deep fibrous root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
July to September	Row sowing Broadcast sowing, pass with roller	1–2 cm	25–80 kg/ha TKW = 40–50 g	●●●○○

Mixtures: can be used with legumes (e.g., pea, vetch, faba bean)

Termination

Freeze tolerance:
Hardy < -15 °C

Most effective methods

1. Winter killing + crushing/shredding
2. Ploughing/tilling

Sensitivity depends on cover development stage

Placement in rotation

Avoid grasses	**Rye**	Spring legumes (e.g., pea, lentil, vetch), maize, sunflower, etc.

DU: data unavailable

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September 2013


S. Minette

Rye

Secale cerale

Grasses

Perspectives from the field

Jérôme Labreuche, ARVALIS Plant Institute

« Rye is a cold-tolerant grain that yields long-lasting cover. It is also relatively easy to establish. It is a little bit harder to terminate than other grains though. Slugs can cause damage to young plants. »


A. Roinsard


S. Minette

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)


S. Minette

Sudan grass

Grasses

General characteristics

Advantages

Produces large amounts of biomass

No risk of bolting

Tolerates drought and heat

Can serve as forage

Very cold sensitive

Weed control: intermediate to good

Pest control: poor, susceptible to wireworms

Disadvantages

Seedlings need long, warm days to grow

Must be mature when used as forage (height > 70 cm; otherwise potential for cyanogenic glycoside poisoning) and cannot be consumed if freezes

Growth features

Germination: fast

Growth rate: high

Fallow-period duration: intermediate

Biomass	Soil nitrogen capture	Nitrogen release
intermediate	high	low

To obtain proper cover development

Soil

Type: all

Preparation: fine seedbed

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
July to September	Row sowing Broadcast sowing, pass with roller	2 cm	15–25 kg/ha TKW = 25–35 g	●●○○○

Mixtures: can be used with legumes (e.g., pea, vetch, berseem clover, Persian clover)

Termination

Freeze tolerance:
Sensitive
≤ 0 to -1°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing
2. Tilling

Placement in rotation

Avoid grasses → **Sudan grass** → Spring legumes (e.g., pea, lentil, vetch), sunflower, etc.

DU: data unavailable

Written by:
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September 2013


S. Minette

Sudan grass

Sorghum sudanense

Grasses

Perspectives from the field

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« In Lorraine, it is best to sow Sudan grass before July 10 if it is being used in the summer fallow period. Otherwise, it will not build enough biomass to provide effective cover. »


S. Minette

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)


L. Fontaine

Winter barley

Hordeum vulgare

Grasses

General characteristics

Advantages

Rather rapid seedling growth

Susceptible to spring diseases

Disadvantages

Deals poorly with waterlogged and anoxic soils

Susceptible to barley yellow dwarf virus

Appeals to grey field slugs

Weed control: intermediate

Pest control: poor, encourages presence of the corn ground beetle

Growth features

Biomass	Soil nitrogen capture	Nitrogen release
intermediate	intermediate to high	low

To obtain proper cover development

Germination: fast

Growth rate: intermediate to high

Fallow-period duration: intermediate

Soil

Type: all

Preparation: no specific requirements

Effect on structure: positive (fibrous root system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
July to early September	Row sowing Broadcast sowing, pass with roller	2–3 cm	80–100 kg/ha TKW = 40 to 50 g	●○○○○

Mixtures: can be used with legumes (e.g., pea, vetch, clover)

Termination

Freeze tolerance:
Hardy
≤ -8°C

Sensitivity depends on cover development stage

Most effective methods

1. Shredding
2. Ploughing/tilling

Placement in rotation

Late-harvest crops: maize, forage brassicas *Avoid grasses*	**Winter barley**	Spring legumes (e.g., pea, lentil, vetch), maize, sunflower, etc.

DU: data unavailable

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

Written by:
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September 2013


S. Minette

Camelina

Cameline sativa

Brassicas

A complementa- resource to the technical guide: "Choosing and managing cover crops in organic agricultural sys- (www.itab.asso.fr)

General characteristics

Advantages

Hardy

Strong allelopathic activity (suppressive effect)

Positive effect on soil structure

Strong growth

Disadvantages

Drought intolerant during early development

Risk of bolting if sown too early

Weed control: intermediate to good

Pest control: DU

Growth features

Germination: fast

Growth rate: high

Fallow-period duration: long

Biomass	Soil nitrogen capture	Nitrogen release
low to intermediate	intermediate to high	low to intermediate

To obtain proper cover development

Soil

Type: all

Preparation: fine seedbed

Effect on structure: positive (taproot)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
July to late September	Broadcast sowing, pass with roller	1 cm max	2–5 kg/ha TKW = 1.5–2 g	●○○○○

Mixtures: can be used with spring grains or other spring crops (pea, buckwheat)

Termination

Freeze tolerance:
Sensitive to hardy
≤ -10°C

Sensitivity depends on cover development stage

Most effective methods

1. Shredding
2. Tilling

Placement in rotation

Anything	**Camelina**	Anything
Avoid sunflower and rapeseed		*Avoid rapeseed and maize*

DU: data unavailable

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September 2013


S. Minette

Camelina

Cameline sativa

Brassicas

Perspectives from the field

Sébastien Minette, Project leader, Poitou-Charentes Chamber of Agriculture

« It provides excellent cover, similar to that of mustard, but produces less biomass. Sowing is simple, and the plant germinates easily. Camelina displays strong allelopathic activity towards other plants, which means it does not work well in mixtures. Watch out for bolting! Do not sow too early, and be sure to terminate quickly, in mid-November or mid-December by the latest. »

Jérôme Labreuche, ARVALIS Plant Institute

« This brassica is one of the latest intermediate crops to be commercialised. It produces less biomass than other brassicas (e.g., mustard, radish). Its growth cycle is very short. Consequently, if it is sown early, it is important to terminate it before it bolts. »


S. Minette


S. Minette

A complementary resource to the technical guide: "Choosing and managing cover crops in organic agricultural systems" (www.itab.asso.fr)


L. Fontaine

Winter rapeseed

Brassica napus

Brassicas

General characteristics

Advantages

Provides good cover

Produces large quantities of biomass

Late flowering

Disadvantages

Intolerant of water stress

At significant risk of parasitism and disease

Difficult to terminate and fully prevent regrowth

Weed control: good

Pest control: DU

Growth features

Germination: fast

Growth rate: good

Fallow-period duration: intermediate

Biomass	Soil nitrogen capture	Nitrogen release
intermediate to high	high	intermediate

To obtain proper cover development

Rapeseed regrowth can be used as an intermediate crop.

Soil

Type: all

Preparation: fine seedbed

Effect on structure: positive (taproot)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
August to September	Broadcast sowing, pass with roller	1 cm	8 kg/ha TKW = 6 g	●○○○○

Mixtures: can be used with legumes (e.g., vetch, pea, faba bean) or grasses (ryegrass)

Termination

Freeze tolerance:
Hardy < -15°C

Sensitivity depends on cover development stage

Most effective methods

1. Shredding
2. Tilling

Placement in rotation

Anything	**Winter rapeseed**	Anything
Avoid use in rotations with rapeseed		*Avoid sunflower, maize; avoid use in rotations with*

DU: data unavailable

A complementa- resource to the technical guide: "Choosing and managing cover crops in organic agricultural sys- (www.itab.asso.fr)

Written by:
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With assistance from:
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September 2013


L. Fontaine

Forage rapeseed

Brassica napus

Brassicas

General characteristics

Advantages

Strong growth

Good soil cover

Can serve as forage

Late flowering

Disadvantages

At significant risk of parasitism and disease

Difficult to terminate and fully prevent regrowth

Weed control: good

Pest control: DU

Growth features

Germination: fast

Growth rate: high

Fallow-period duration: short

Biomass	Soil nitrogen capture	Nitrogen release
high to very high	very high	intermediate

To obtain proper cover development

Rapeseed regrowth can be used as a cover crop.

Soil

Type: all

Preparation: fine seedbed

Effect on structure: positive (strong taproot system)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
before late August or early September	Row sowing Broadcast sowing, pass with roller	1 cm	5–8 kg/ha TKW = 3.5–7 g	●○○○○

Mixtures: can be used with legumes (e.g., vetch, pea, faba bean) or grasses (ryegrass)

Termination

Freeze tolerance:
Hardy < -15°C

Sensitivity depends on cover development stage

Most effective methods

1. Shredding (in the month after flowering)
2. Tilling

Placement in rotation

Anything	**Winter forage rapeseed**	Anything
Avoid use in rotations with rapeseed		*Avoid sunflower, beet; avoid use in rotations with rapeseed*

DU: data unavailable

A complementary resource to the technical guide: "Choosing and managing cover crops in organic agricultural systems" (www.itab.asso.fr)

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September 2013


L. Fontaine

Forage rapeseed (winter)

Brassica napus

Brassicas

Perspectives from the field

Jérôme Labreuche, ARVALIS Plant Institute

« Rapeseed regrowth serves as a good catch crop. Rapeseed varieties, whether for oilseed or forage production, can be used as intermediate crops or as relay forage crops. »


L. Fontaine


L. Fontaine

A complementa- resource to the technical guide: "Choosing and managing cover crops in organic agricultural sys- (www.itab.asso.fr)


S. Minette

White mustard

Sinapsis alba

Brassicas

General characteristics

Advantages

Easy and fast to establish

Positive effect on soil structure

Highly tolerant of warm, dry conditions

Mobilises phosphorus

Disadvantages

Flowers rapidly (50–60 days) and thus risk of bolting

Intolerant of water stress (and nitrogen scarcity); speeds up time to bolting

Weed control: good

Pest control: susceptible to pests such as sawflies (larvae), grain weevils, and flea beetles.

Growth features

Germination: fast

Growth rate: high

Fallow-period duration: short

Biomass	Soil nitrogen capture	Nitrogen release
intermediate to high	high	intermediate

[1]To obtain proper cover development

Soil

Type: all

Preparation: stubble ploughing

Effect on structure: positive (taproot)

Anti-beet nematode variety of white mustard: €2.50/kg

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
July to September	Broadcast sowing, pass with roller	1 cm	8–10 kg/ha TKW = 6–8 g	●○○○○

Mixtures: can be used with legumes (e.g., crimson clover, lentil, vetch) or grasses

Termination

Freeze tolerance:
Sensitive
≤ -7°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing
2. Shredding

Placement in rotation

Anything	White mustard	Anything
Avoid use in rotations with rapeseed and sunflower		*Avoid brassicas (rapeseed, beet), sunflower, and maize*

DU: data unavailable

A complementa- resource to the technical guide: "Choosing and managing cover crops in organic agricultural sys- (www.itab.asso.fr)

Written by:
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With assistance from:
M. Mangin (ARVALIS), J. Bayle (Meurthe and Moselle Chamber of Agriculture), J. Champion (Drôme Chamber of Agriculture), J. Arino (Gers Chamber of Agriculture)

September 2013


S. Minette

White mustard

Sinapsis alba

Brassicas

Perspectives from the field

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« White mustard cover can either have amazing benefits or catastrophic effects! It can be sown until late in the year. Vegetative growth is extremely rapid. It is a good indicator of soil function because it is sensitive to compaction and nitrogen levels. »

Sébastien Minette, Project leader, Poitou-Charentes Chamber of Agriculture

« It is easy to sow and comes up without a problem. It is the simplest cover crop species to use! It produces large amounts of biomass. It suppresses weeds and has a positive effect on soil structure. If white mustard is sown too early (August 15 to September 15), there is a risk of bolting. The cover must be terminated when it flowers. When it is included in mixtures, it competes with legumes, unless the sowing rate has been adapted. »

Jérôme Labreuche, ARVALIS Plant Institute

« White mustard has trouble with water stress and heat when it is sown too early. It is easy to establish and terminate. If the cover is well developed, it will be difficult to plough under. It must be shredded, or first flattened by replacing the jointer with a taut chain. Its ease of establishment is an advantage. It is a good cover crop for breaking up grain-based rotations. It is not recommended for use in rapeseed-heavy rotations. »


J. Bayle


J. Arino

A complementa- resource to the technical guide: "Choosing and managing cover crops in organic agricultural sys- (www.itab.asso.fr)


S. Minette

Brown mustard

Brassica juncea

Brassicas

A complementa- resource to the technical guide: "Choosing and managing cover crops in organic agricultural sys- (www.itab.asso.fr)

General characteristics

Advantages

Strong allelopathic activity targeting certain fungi and parasites

Helps control certain grain diseases

Better growth and nitrogen uptake than white mustard

Disadvantages

Flowers rapidly (50–60 days) and thus risk of bolting

Few varieties available

Weed control: good (suppressive effect)

Pest control: good (e.g., take-all disease, root rot [*Rhizoctonia solani*], Fusarium wilt)

Growth features

Germination: fast

Growth rate: high

Fallow-period duration: short

Biomass	Soil nitrogen capture	Nitrogen release
intermediate to high	intermediate to high	low to intermediate

To obtain proper cover development

Soil

Type: all

Preparation: stubble ploughing

Effect on structure: positive (taproot)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
July to early September	Broadcast sowing, pass with roller	1 cm	3–4 kg/ha TKW = 3 g	●●○○○

Mixtures: can be used with legumes (e.g., crimson clover, lentil, vetch) or grasses

Termination

Freeze tolerance:
Sensitive
≤ -5 to -10°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing/shredding
2. Ploughing

Placement in rotation

Anything	**Brown mustard**	Anything
Avoid use in rotations with brassicas or sunflower		*Avoid brassicas (rapeseed, beet), sunflower, and maize*

DU: data unavailable

Written by:
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September 2013


S. Minette

Brown mustard

Brassica juncea

Brassicas

Perspectives from the field

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« The TKW of brown mustard is much lower than that of white mustard. The species can be sown until late in the year. Vegetative growth is extremely rapid. It is a good indicator of soil function because it is sensitive to compaction and nitrogen levels. »

Jérôme Labreuche, ARVALIS Plant Institute

« Because brown mustard has higher glucosinolate levels than other brassicas, it may have stronger allelopathic effects on certain fungi, such as take-all disease in wheat on wheat rotations or *Rhizoctonia solani*. It produces a bit more biomass than white mustard. »


J. Bayle

A complementa- resource to the technical guide: "Choosing and managing cover crops in organic agricultural sys- (www.itab.asso.fr)


S. Minette

Winter turnip rape

Brassica rapa oleifera

Brassicas

General characteristics

Advantages

Does not flower in winter

Helps control certain grain diseases

Can be used to produce forage

Very similar to forage rapeseed

Disadvantages

Tricky to terminate if taproot is well developed

Sensitive to water stress, which provokes flowering

Risk of bolting after a freeze

Weed control: good (suppressive effect)

Pest control: DU

Growth features

Germination: fast

Growth rate: high

Fallow-period duration: short

Biomass	Soil nitrogen capture	Nitrogen release
intermediate to high	high	intermediate

To obtain proper cover development

Soil

Type: all

Preparation: stubble ploughing and establishment of fine seedbed

Effect on structure: positive (taproot)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
August-September	Broadcast sowing, pass with roller	2 cm	5–8 kg/ha TKW = 4–6 g	●○○○○

Mixtures: Plant as single-species cover crop or with a legume (e.g., vetch, pea)

Termination

Freeze tolerance:
Sensitive
≤ -8 to -10°C

Sensitivity depends on cover development stage

Most effective methods

1. Shredding
2. Ploughing/tilling

Placement in rotation

Anything	**Winter turnip rape**	Anything
Avoid sunflower; avoid use in rotations with		*Avoid sunflower, maize, beet; avoid use in rotations with rapeseed*

DU: data unavailable

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

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Winter turnip rape

Brassica rapa oleifera

Brassicas

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab-asso.fr)

Perspectives from the field

Sébastien Minette, Project leader, Poitou-Charentes Chamber of Agriculture

« Turnip rape starts as a rosette of leaves close to the ground. It can be tricky to terminate, especially via shredding, but its cover is among the most extensive. This species is often used as part of a mixture, sown after a grain-legume crop. Compared to mustard, it has a greater impact on soil structure. »

Jérôme Labreuche, ARVALIS Plant Institute

« This species has the benefit of rarely flowering before the winter (if the winter variety is used), even when it is sown early. This brassica is easy to establish but more difficult to terminate. »


Turnip rape-oat mixture
S. Minette


S. Minette

Forage radish

Raphanus sativus

Brassicas

General characteristics

Advantages

Rapid growth

Can serve as forage

Disadvantages

Termination is very tricky if the taproot is well developed (the vestige of the root can reinitiate growth)

Requires high levels of nitrogen

Risk of bolting

Very cold tolerant

Weed control: good (suppressive effect)

Pest control: anti-nematode varieties exist

Biomass	Soil nitrogen capture	Nitrogen release
high to very high	high	intermediate

To obtain proper cover development

Daikon is easier to terminate than most other forage radishes, and it flowers later. However, its seeds cost more.

Growth features

Germination: fast

Growth rate: high

Fallow-period duration: intermediate

Soil

Type: all

Preparation: stubble ploughing and establishment of fine seedbed

Effect on structure: positive (taproot)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
July-August	Row sowing Broadcast sowing, pass with roller	1–2 cm	8–12 kg/ha TKW = 8–10 g	●●○○○

Mixtures: radish growth (cover and biomass) can be enhanced by either a legume or a vetch (e.g., provide nitrogen)

Termination

Freeze tolerance:

Hardy < -15°C

Sensitivity depends on cover development stage

Most effective methods

1. Shredding
2. Ploughing

Placement in rotation

Anything	**Forage radish**	Anything
Avoid use in rotations with brassicas		*Avoid use in rotations with brassicas (rapeseed, beet)*

DU: data unavailable

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September 2013

Forage radish

Raphanus sativus

Brassicas

Perspectives from the field

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« This cover crop needs lots of nitrogen and grows very rapidly. It is one of a few species to strongly restructure the soil. »

Sébastien Minette, Project leader, Poitou-Charentes Chamber of Agriculture

« The forage radish is a brassica and thus shares certain characteristics with mustard. However, it produces a bit less biomass. It is often used as part of a mixture, sown after a grain-legume crop. »

Jérôme Labreuche, ARVALIS Plant Institute

« Forage radish is less sensitive to water stress than mustard is. It is also better suited to early sowing. Farmers like this species because it is easy to establish and it grows fast. It is rather hard to terminate mechanically, but the process can be facilitated by winter killing, notably when plants are well-developed. »

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)


J. Bayle

Nyger

Guizota abyssinica

Composites

General characteristics

Advantages

Heat and drought tolerant

Very cold sensitive

Flowers relatively late

Strong growth

Positive effect on soil structure

Weed control: intermediate

Pest control: DU

Disadvantages

Allelopathic activity directed towards other plants (produces compound that inhibits germination of seeds other than its own)

Strongly appeals to slugs

Provides limited soil cover (erect growth form)

Requires high accumulated temperatures

Growth features

Germination: fast

Growth rate: intermediate

Fallow-period duration: short

Biomass	Soil nitrogen capture	Nitrogen release
low to intermediate	low	low

To obtain proper cover development

Soil

Type: all

Preparation: no specific requirements

Effect on structure: positive (taproot)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
July-August	Broadcast sowing, pass with roller Should ideally occur just after harvest of preceding crop	1 cm	8–10 kg/ha TKW = 2.9–3.2 g	●●○○○

Mixtures: not recommended for use in mixtures (allelopathic activity)

Termination

Freeze tolerance:
Very sensitive
≤ 0°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing
2. Shredding/ploughing

Placement in rotation

Anything *Avoid using in rotations with sunflower*	**Nyger**	Anything *Avoid using in rotations with sunflower*

DU: data unavailable

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September 2013


J. Bayle

Nyger

Guizota abyssinica

Composites

Perspectives from the field

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« Nyger is difficult to establish. It is also susceptible to slug damage. »

Sébastien Minette, Project leader, Poitou-Charentes Chamber of Agriculture

« It is drought resistant but very frost sensitive. It has small seeds that are easy to plant. Cover development varies greatly from year to year. However, it can be useful in mixtures. »

Jérôme Labreuche, ARVALIS Plant Institute

« Nyger shows strong growth if established early. However, getting it going can be complicated. Its temperature needs and extreme frost sensitivity—it should be terminated after the first freeze—are the reasons why nyger frequently fails when sown late. Its high degree of frost sensitivity is an advantage, even if its regrowth shows limited competitive ability. Nyger also seems to appeal to slugs. »


S. Minette


S. Minette

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)


S. Minette

Sunflower

Helianthus annuus

Composites

General characteristics

Advantages

Heat and drought tolerant

Hardy

Good soil cover

Helpful in mixtures (good companion crop)

Late flowering (depending on variety)

Weed control: poor to intermediate

Pest control: DU

Disadvantages

Strongly appeals to slugs

Cold sensitive

Strict temperature requirements

Growth features

Germination: intermediate

Growth rate: high

Fallow-period duration: short

Biomass	Soil nitrogen capture	Nitrogen release
high	intermediate to high	intermediate

To obtain proper cover development

Soil

Type: all

Preparation: no specific requirements

Effect on structure: positive (deep taproot)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
August	Broadcast sowing, pass with roller	2–3 cm	40 kg/ha TKW = 40–55 g	●○○○○

Mixtures: can be used with oat, pea, lentil, etc.

Termination

Freeze tolerance:
Sensitive
≤ 0 to -2°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing
2. Shredding/ploughing

Placement in rotation

Anything	**Sunflower**	Anything
Avoid using in rotations with sunflower or Sclerotinia host species		*Avoid using in rotations with brassicas, sunflower, or Sclerotinia host species*

DU: data unavailable

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September 2013


S. Minette

Sunflower

Helianthus annuus

Composites

Perspectives from the field

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« Sunflower can be very useful in mixtures. It will be the tallest plant of the group. It has a taproot, which improves soil structure. It can also be used as a single-species cover crop and will produce abundant biomass. However, it should not be planted before a grain. »

Sébastien Minette, Project leader, Poitou-Charentes Chamber of Agriculture

« Sunflower seeds need to be planted deep into the soil to ensure rapid growth and to limit bird predation. It is a drought tolerant species, and its taproot can come in handy. It should not be used in rotations with sunflower. »

Jérôme Labreuche, ARVALIS Plant Institute

« In the summer, sunflower develops well when sown early. It is very frost sensitive, which makes it easier to terminate. However, that same trait makes late sowing problematic. It should not be used as a fallow-period cover crop in fields in which sunflower is farmed for commercial purposes because of disease risks (Phoma black stem, mildew, Phomopsis stem canker). »

David Hypolite, Farmer in Meurthe and Moselle

« The sunflower's root system extends down deep, and I use the species as a companion crop in the oat-vetch-sunflower mixture that I plant before my grass cash crops. »


S. Minette


S. Minette

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)


S. Minette

Blue tansy

Phacelia tanacetifolia

Waterleafs

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

General characteristics

Advantages

Rapid development (flowering after two months; bolting after three months)

Comes from a rarely cultivated taxonomic family; provides a true break in the rotation

Positive effect on soil structure

Disadvantages

Necessary to prevent bolting; can lead to resowing

Sowing can be tricky

Weed control: good (suppressive effect)

Pest control: repels flea beetles and aphids

Growth features

Germination: slow

Growth rate: high

Fallow-period duration: intermediate

Biomass	Soil nitrogen capture	Nitrogen release
intermediate	high	intermediate

To obtain proper cover development

Soil

Type: all

Preparation: fine seedbed

Effect on structure: positive (intermediate system—taproot and fibrous roots)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
July-August	Row sowing Broadcast sowing possible—**covers ground well**	2–3 cm	8–12 kg/ha TKW = 1.8 g	●●○○○

Mixtures: can be used with buckwheat, for example

Termination

Freeze tolerance:
Sensitive
≤ -7 to -10°C

Sensitivity depends on cover development stage

Most effective methods

1. Ploughing
2. Shredding/winter killing + crushing

Placement in rotation

Anything *Avoid brassicas, sunflower, and soybean*	**Blue tansy**	Anything *Avoid brassicas, sunflower, and soybean*

DU: data unavailable

Written by:
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September 2013


S. Minette

Blue tansy

Phacelia tanacetifolia

Waterleafs

Perspectives from the field

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« Blue tansy is a great cover crop for breaking up the rotation. If you sow carefully, biomass levels should be good. It should also have a highly suppressive effect on weeds. Additionally, blue tansy appeals to bees. »

Sébastien Minette, Project leader, Poitou-Charentes Chamber of Agriculture

« Blue tansy has an intermediate root system, with both a taproot and fibrous roots, which really improves soil structure. Make sure that the seeds are well covered during the sowing process. You want to ensure that seedling emergence is homogeneous and maximised. It provides great cover and attracts pollinators. It can be used to break the cycle of certain diseases and insects because it comes from a family of non-crops and is not very susceptible to pests. One disadvantage is the cost of its seeds, but it is a helpful addition to mixtures. Watch out for bolting if it is sown too early. »

Jérôme Labreuche, ARVALIS Plant Institute

« This plant is tricky to establish. It needs fine soils to maximise the level of seed-soil contact. It is a useful species because it grows fast and provides good soil cover. Blue tansy is a member of the waterleaf family. Generally, it can fit in any type of rotation, although it should not be used before vegetable crops destined for commercial canning (industry concerns over Sclerotinia risk). »


S. Minette


J. Bayle


S. Minette


J. Bayle

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)


J. Bayle

Buckwheat

Fagopyrum esculentum

Buckwheat family

General characteristics

Advantages

Rapid development

Tolerant of late-summer drought

Allelopathic activity

Comes from a rarely cultivated taxonomic family; provides a true break in the rotation

Disadvantages

Average level of soil cover

Risk of (rapid) flowering and bolting

Weed control: intermediate

Pest control: DU

Growth features

Germination: intermediate

Growth rate: good

Fallow-period duration: short to intermediate

Biomass	Soil nitrogen capture	Nitrogen release
intermediate	intermediate	low to intermediate

To obtain proper cover development

Soil

Type: all

Preparation: stubble ploughing and establishment of fine seedbed

Effect on structure: positive (taproot)

Sowing

Period	Method	Depth	Rate	Cost (€/ha)
Right after harvest until mid-September	Broadcast sowing, pass with roller Row sowing possible	2–3 cm	30–40 kg/ha TKW = 20–30 g	●●●○○

Mixtures: can be used with mustard, blue tansy, and legumes

Termination

Freeze tolerance:
Sensitive
≤ -2°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing
2. Shredding/ploughing

Placement in rotation

Anything → **Buckwheat** → Anything

DU: data unavailable

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September 2013


J. Bayle

Buckwheat

Fagopyrum esculentum

Buckwheat family

Perspectives from the field

Frédéric Arnaud, Meurthe and Moselle Chamber of Agriculture

« Buckwheat is a good cover crop that allows a break in the rotation. However, it is a sensitive plant, and weeds can emerge when buckwheat is planted on its own. It is easy to terminate because it is very frost sensitive. It should always be used as part of a mixture. »

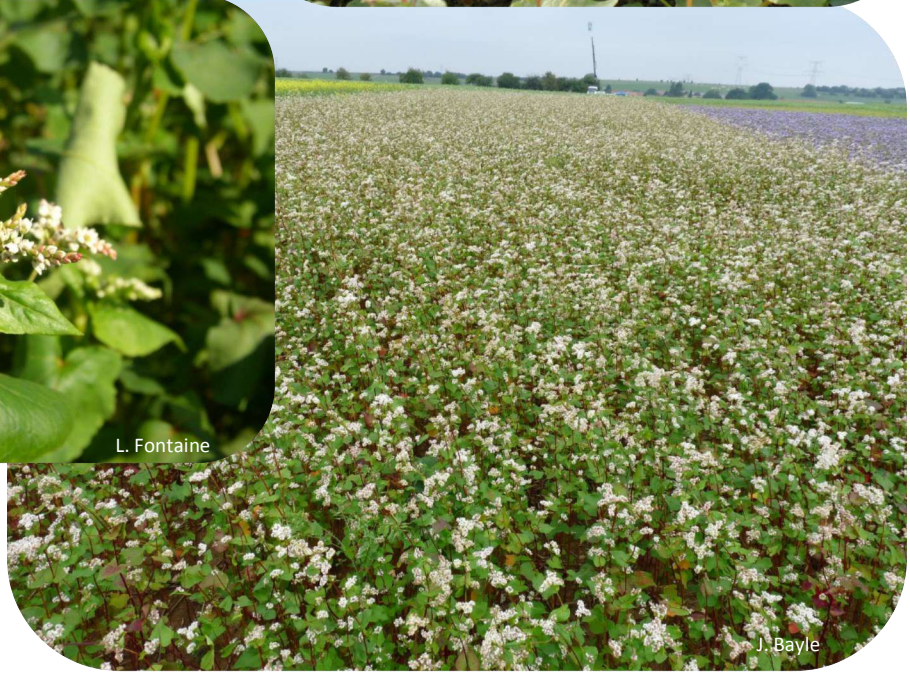
Jérôme Labreuche, ARVALIS Plant Institute

« This species absolutely needs to be established in early summer to allow time for proper development. Buckwheat is sometimes planted to produce a second harvest. It bolts rather easily and can become a weed in the following cash crop (it is a knotweed). »


J. Bayle


J. Bayle


L. Fontaine


J. Bayle

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)


S. Minette

Linseed

Linum usitatissimum

Linseeds

General characteristics

Advantages

Tolerant of late-summer drought

Easy to terminate

From a rarely cultivated taxonomic family

Disadvantages

Woody stems will be difficult to shred and take time to decompose if plant is well developed

Limited soil cover

Weed control: poor

Pest control: effects on rapeseed broomrape and the Colorado potato beetle remain to be quantified

Growth features

Germination: fast

Growth rate: intermediate

Fallow-period duration: intermediate

Biomass	Soil nitrogen capture	Nitrogen release
low to intermediate	low to intermediate	low to intermediate

To obtain proper cover development

Soil

Type: all

Preparation: fine, packed seedbed

Effect on structure: positive (deep taproot)

Sowing

Period	Technique	Depth	Rate	Cost (€/ha)
mid-July to mid-August	Broadcast sowing, pass with roller	1 cm	20–50 kg/ha TKW = 4–7 g	●●○○○

Mixtures: can be used with legumes, grasses, brassicas, etc.

Termination

Freeze tolerance:
Hardy (winter variety) ≤ -7 to -13°C
Sensitive (spring variety) < 0°C

Sensitivity depends on cover development stage

Most effective methods

1. Winter killing + crushing
2. Shredding/ploughing

Placement in rotation

Anything *Avoid linseed*	**Winter and spring**	Anything *Avoid linseed*

DU: data unavailable

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Written by:
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With assistance from:

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September 2013


S. Minette

Linseed

Linum usitatissimum

Linseeds

Perspectives from the field

Jérôme Labreuche, ARVALIS Plant Institute

« Linseed is sometimes included in certain cover crop mixtures. Its use as a stand-alone intermediate crop is less common, but it appears to develop just fine in such situations. However, if linseed is allowed to grow for too long, its stems become woody. They can interfere with the use of certain farm machinery and have trouble decomposing. »


S. Minette


S. Minette

A complementary resource to the technical guide: "Choosing and managing cover crops in organic cropping systems" (www.itab.asso.fr)

FINAL THOUGHTS FROM THE EXPERTS

- **Legumes** should not be used when nitrogen availability is high (e.g., significant organic amendment). However, they are indispensable when nitrogen is lacking.
- **Sowing techniques** vary and should be chosen based on the farming equipment available. Although any technique can be used, efficacy will vary. The most common and straightforward technique for sowing cover crops is broadcast sowing.

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ITAB Institut Technique de l'Agriculture Biologique

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MINISTÈRE DE L'ALIMENTATION DE L'AGRICULTURE ET DE LA PÊCHE
Avec la contribution financière du compte d'affectation spéciale «Développement agricole et rural»