THE ESSENTIAL ABOUT SUNFLOWER

Technical guide for succeed in your culture

A BRAND OF MAÏSADOUR

masseeds UNITED TO GROW

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GENERAL INFORMATION ABOUT THE SUNFLOWER

What is the market?

Why use hybrids?

THE SUNFLOWER MARKET

Sunflower seeds are basically destined for edible oil production (43% of the seed); ranking second behind rapeseed oil.

After extracting the oil, the seeds provide an oilseed cake (55% of the seed) used for animal feed which has a good food protein content (29 to 30%). The European Union of 25 uses around 8 million tonnes of oilseed cake, i.e.12% of the total of the oilseed consumed (2011).

There are two types of sunflower on the European market: linoleic and oleic.

The difference between these two types of sunflower is the oil's fatty acid composition. The oleic acid content is:

- between 15 and 25% for linoleic sunflower
- between 80 and 92% for oleic sunflower

The oil yield levels and richness of the two types of sunflower are approximately equivalent. The crop growing method is similar but greater care must be taken in the choice of variety and the sowing date for the oleic varieties due to the effect of low temperatures during flowering on the final fatty acid composition of the oil.

There must be at least 150 m between a plot of oleic sunflower and a plot of conventional sunflower to prevent cross-pollination.

Research is in progress to improve sunflower oil quality, particularly the Omega-6/Omega-3 ratio, to bring it close to that of rapeseed oil and improve its nutritional qualities.

GENERAL INFORMATION ABOUT THE SUNFLOWER

WHY USE HYBRIDS?

Yield potential

In most cases, sowing hybrids multiplies yields by 4.

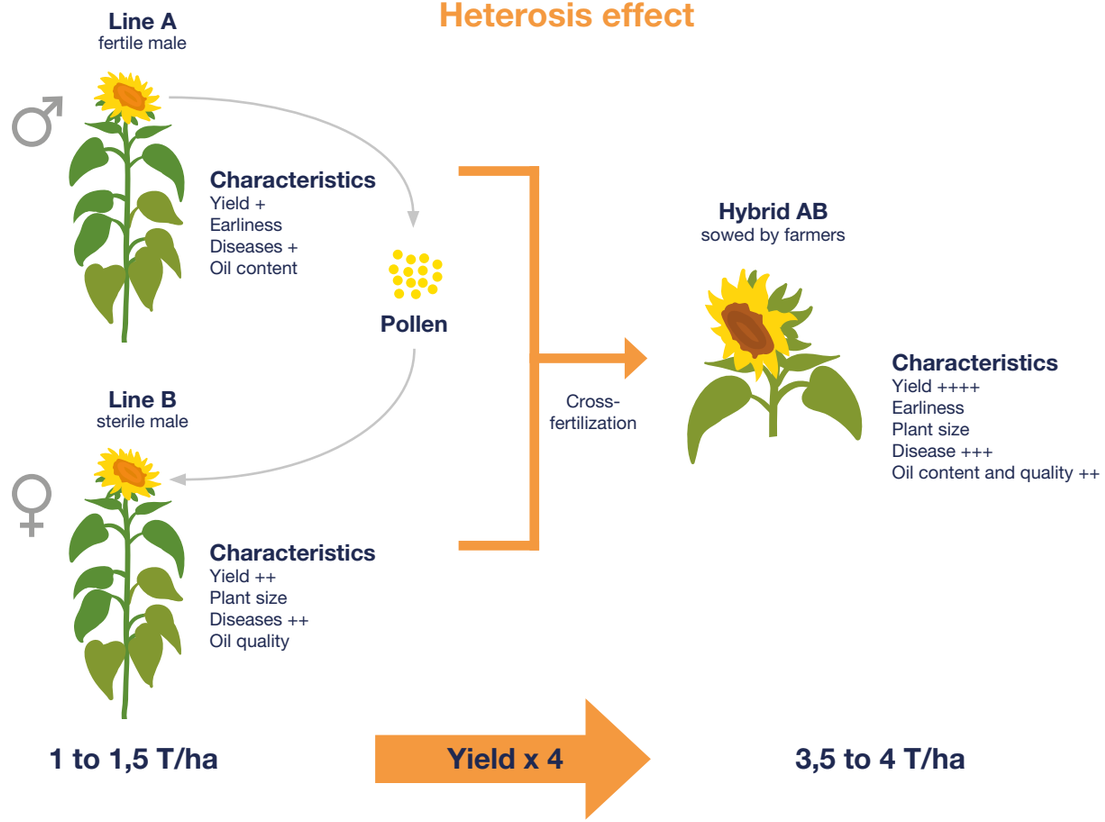
Stability and reliability

Advantages of hybrids:

- More regular yield
- Greater tolerance to diseases
- Better tolerance to stresses
- Higher oil yield

The heterosis effect, also called hybrid vigour, gives a performance gain. The hybrid exhibits the best features of both parents and a bonus with respect to many agronomic characteristics. The more genetically distant the initial populations, the greater the heterosis effect.

Heterosis effect



GENERAL INFORMATION ABOUT THE SUNFLOWER

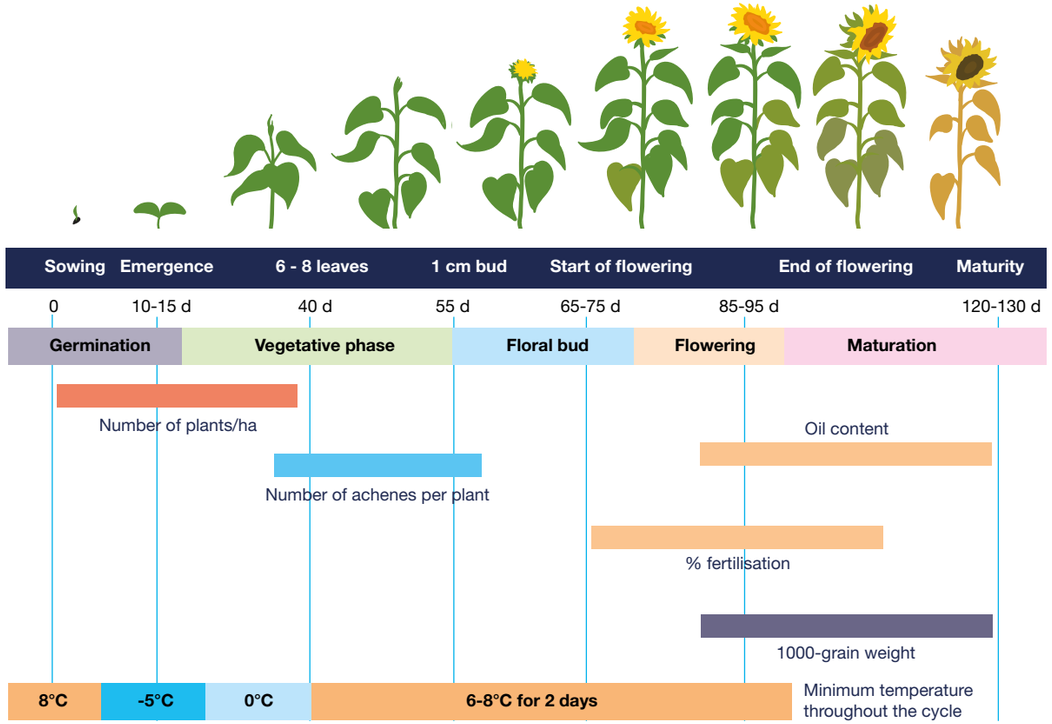
Notes

PHYSIOLOGY OF THE SUNFLOWER

What are the key stages of sunflower?

What are the yield components?

DEVELOPMENT OF SUNFLOWER YIELD



THE 5 KEY STAGES OF THE SUNFLOWER

1. Germination emergence

- Soil temperature over 8°C
- Sowing between 2 and 3 cm in fine and relatively moist soil

2. Vegetative phase

- Development of the aerial part of the taproot
- At the 8-leaf stage, start of initiation of the floral primordia
- Need for large amount of nutrients

3. Flower bud

- The number of ovules is final at the 1 cm bud stage
- The leaf area and the root system are almost at the maximum
- High growth phase: sensitive to lack of water or nitrogen
- But excess nitrogen will increase the leaf area, the water consumption and the development of diseases.

4. Flowering

- Flowering for one plant: 8 to 10 days
- Plants sensitive to contamination by Sclerotinia capitulum
- Sensitive to water stress: 30 to 35% of the yield can be lost

5. Maturing

- Seed fill
- Active synthesis of the fatty acids
- Physiological maturity is reached when the seeds reach 28% humidity

GROWING THE SUNFLOWER

Cultural intervention :
When and how ?

SOWING

The sunflower is a taproot, undemanding plant, except that it requires a certain amount of rigour in the cultivation process:

To maximize your yields :

- Emergence requires a soil temperature over 8°C.
- At the cotyledon stage, the sunflower withstands temperatures of -5°C to -7°C.
- From the appearance of the first true leaves, the negative temperatures cause necrosis which can be fatal for the crop.

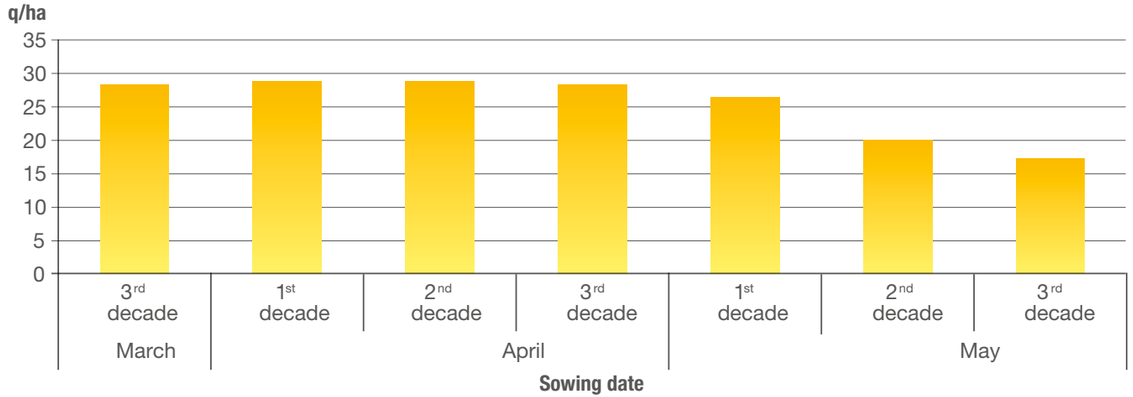
What makes good sowing?

- Respecting oil crop rotation: 1 year out of 3 at the minimum
- Having a good ground structure to improve rooting and development of the taproot

Sowing early means more quintals

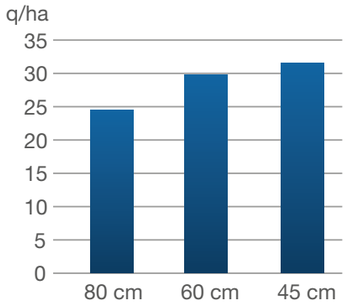
- Sunflower is sown early, as soon as the ground is sufficiently dried and warmed (> 8°C)
- Planting early brings better performance: flowering is offset to a period where water stress is lower.

Sunflower yield according to sowing dates



Source: MAS Seeds technosol program

Effect of row spacing on yield for a density of 65,000 plants/ha



Source: MAS Seeds technosol program

Optimise your spacing

The optimum spacing is 45 cm, but is little used for practical reasons.

A spacing of 60 cm is a good compromise.

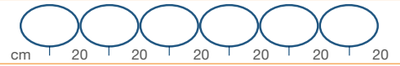
Avoid an 80 cm spacing because yield will be affected: insufficient ground cover which favours the development of adventives.

Get the population right

The optimum population is between 50,000 and 75,000 plants/ha, according to the soil type, sowing date and variety. To get the population right, a few rules must be respected:

- Population regularity is important because the sunflower cannot compensate for an uneven population which is responsible for losses which can exceed 5 q/ha.
- Limit density in humic or drying situations and for late sowing
- Sow 5 to 10 % above the desired plants/ha target
- Sow slowly (6 km/h) while checking each unit drill selector

Effect of an irregular population on final production

	% ground cover	Yield q/ha	Notes
	100%	***30 q/ha***	Good distribution
	75%	***26,5 q/ha***	Bad seed distribution during sowing. A more or less large number of plants have a more or less overlapping leaf area.
	83%	***26,3 q/ha***	
	66%	***21,3 q/ha***	
	50%	***22,8 q/ha***	

Source : MAS Seeds

WEED CONTROL

Weed control is a key point in the growing process. Large amounts of weeds create competition for water which can reduce the yield (by 10 to 20 % depending on the situation).

Mechanical weed control

Hoeing, while decompacting compacted soils is a useful complement to chemical weed control.

The synergy between chemical and mechanical weed control increases yield by an average of 9%. This can be done, according to the height of the crop, up to the 4-5 leaf pair stage.

Chemical weed control

In most cases, pre-emergence weed control programs combine a broad spectrum graminicide product with a broad-leaf herbicide product.

HERBICIDE TOLERANT VARIETIES OF MAS SEEDS

To manage weed control, MAS Seeds offers a range of herbicide tolerant hybrids.

Tolerance to Imidazolinones

Clearfield and Clearfield are trades from BASF. They symbolize the tolerance for imidazolinones present in different herbicide products.

- Clearfield varieties, which are tolerant to Pulsar and Eurolightning, are recognizable by their name which ends in IR (ex: Mas 80.IR). On the back of the bag, under the name of the variety, you will find the Clearfield logo.
- Clearfield+ hybrids, which are tolerant to Passat+ and Eurolightning+, are recognizable by their name which ends in CP (ex: Mas 92.CP). On the back of the bag, under the name of the variety, you will find the Clearfield+ logo.

Clearfield® Production System for sunflower

Clearfield® Plus Production System for sunflower

Tolerance to Tribenuron-Methyl

Tribenuron-methyl is the active ingredient in Express SX herbicide.

The varieties of our Tribenuron - Methyl tolerant range are recognizable by their name which ends in SU (ex: Mas 85.SU).

On the back of the bag, under the name of the variety, you will find the mention TRIBENURONMETHYL TOLERANT.

EXPRESS® SX® HERBICIDE

Herbicide tolerant technologies

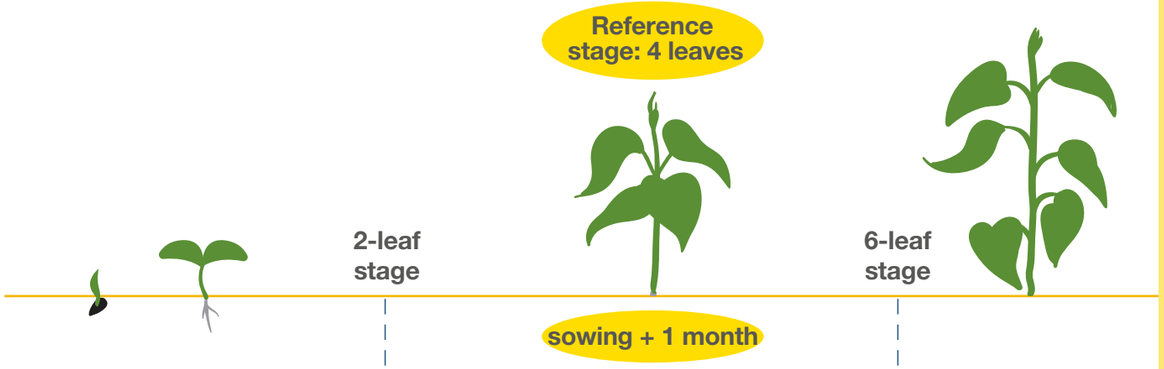
Efficacy: A wide spectrum of action to control grasses and dicots
Simplicity: A post-emergence phase
Safety: Treatment when weeds are sensitive

COMPARISON OF HERBICIDES

	Ambrosia	Datura	Bindweed hedges	Bidens	Xanthium	Sunflower wild	Thistle	Broomrape
Pulsar	++	+++	++	+++	+++	++	-	+
Passat+	++	+++	++	+++	+++	++	-	++
Express SX	++	+++	+++	+++	+	++	++	-

Source : Terres Inovia (CETIOM)

Any application error will be fatal:
- Variety confusion
- Drift/classic sunflower
- Bad rinsing



Pulsar 40 1 to 1.25 l/ha
or Eurolightning 1.2 l/ha

Clearfield® Production System for sunflower

Passat+ 1,6-2 l/ha
or Eurolightning Plus

Clearfield® Plus Production System for sunflower

Express SX (50% tribenuron methyle) 45g/ha + TREND 90 0.25 l/ha

FERTILISER

Phospho-potassic amendments

For a yield objective of 40 q/ha, the sunflower requires little phosphorus (40 units) a moderate amount of potash (40 to 60 units). Management of these mineral elements is based on multi-year soil analyses.

Over 80% of the phosphorus and potash used by the plant come from the soil's reserves.

Nitrogen: an indispensable element which must be used with care

- The sunflower needs 4 to 4.5 kg of absorbed nitrogen per quintal produced
- Over fertilising by 50 units means losing 50€/ha
- Under fertilising means losing 4 to 6 q/ha

Consequences of nitrogen excess

- Lush growth
- Development of diseases (sclerotinia, phomopsis)
- Maturity is retarded

Consequences of nitrogen deficiency

- Loss of yield by a reduction in achenes per capitulum and a reduction in photosynthesis activity

Some benchmarks

	Phosphorus (P205)		Potash (K20)	
Yield objective	**25 q/ha**	**40 q/ha**	**25 q/ha**	**40 q/ha**
Poor soil	40	60 -80	40	60 -80
Well-supplied soil	30	40 - 50	30	40 - 50
Very well-supplied soil	0	0	0	0

	Nitrogen (N)	
Yield objective	**25 q/ha**	**40 q/ha**
Topsoil poor in OM (<1,5%)	40 - 80	Over 90
Soil moderately fertile (% MO >2% and <5%)	Less than 40	60 - 90
Fertile soil rich in OM (>5%)	0	Less than 40

OLIGO-ELEMENTS

Boron

The sunflower absorbs over 400 g/ha of boron, of which 80 % between the «5 leaf pairs» and «flower bud» stages. A deficiency can greatly reduce yield and the oil content of the sunflower seeds (-5 to -7 points).

The main deficiency risk factors are:

- Short rotation land
- Thermal shocks (over 30° C),
- Light soils from the 10-leaf stage to the start of flowering
- Sandy or very calcareous soils (pH >8)
- Very dry conditions from the 10-leaf stage to the start of flowering

In these situations, provide an input of boron preventively for the soil or by leaf fertilisation. It is pointless to take action after the appearance of the symptoms. To assess the risk a soil analysis is the safest solution. The deficiency threshold is evaluated at 0.3 ppm for acidic soils and 0.8 ppm for calcareous soils.

Other oligo-elements

Molybdenum and magnesia deficiencies can be observed in very acidic soils (pH < 6). The pH of the plots must be checked where necessary: if the soil is found to be acidic, add a basic amendment.

The symptoms of a boron deficiency can be seen as crinkling of the leaves then a discolouration and a burn at the base of the limb (intermediate zone).

Source : CETIOM

Input	Stage	Form	Boron dosage
On ground	Before sowing incorporated or not, like a weed control product	• Solid, incorporated in the conventional fertiliser • Liquid	1,2 kg/ha
Applied to leaves	Between the 10-leaf and the flower bud stages	Liquid: apply at least 200 l/ha of mixture	300 to 500 g/ha

GROWING THE SUNFLOWER

IRRIGATION

Sunflower is on one of the spring crops which is best adapted to dry conditions. Its root system enables it to extract water from the ground better than other crops.

It is sensitive to water stress from the flower bud stage to the end of flowering and consumes an average of 230 mm of water for a yield of over the 40 q.

During this period, the irrigation water in light soils is well used. 2 applications of 35 to 40 mm of water (1 before flowering and the 2nd after flowering) can bring an additional 8 to 10 q/ha and 2 points of oil.

Some rules to be respected:

- Water just before flowering (1st yield factor)
- Watering too early can result in the development of lush vegetation
- Avoid watering on the flower, particularly in wet weather: the irrigation may increase the risk of sclerotinia of the capitulum
- Stop the irrigation when the back of the capitulum changes from green to lemon-yellow

HARVEST: NEITHER TOO LATE, NOR TOO DRY

TOO EARLY

Harvesting at this stage increases the level of impurities and the drying cost. Threshing is difficult and harvesting speed is slower.
14-15% d'H2O

RIGHT STAGE

The leaves at the base and middle of the stem are dry. Some top leaves are still slightly green. The florets fall by themselves.
8-9% d'H2O

TOO LATE

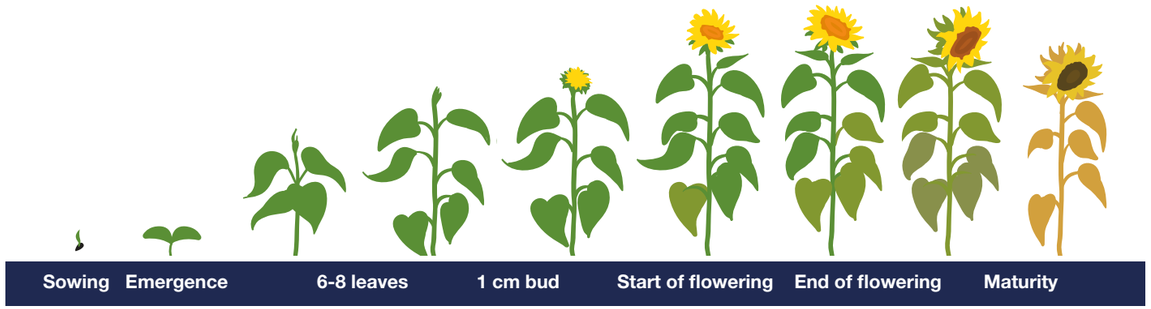
The capitulum is brownish black and the stems are brown. The losses will be high due to lodging (loss of capitula) and seed loss due to wind, birds and diseases (botrytis).
6% d'H2O

Notes

PESTS AND DISEASES

What are the pests and the most common diseases of sunflower?

SUNFLOWER INSECT PEST CALENDAR



SLUGS

Germination to 4-leaf stage

Larvae on grains

WIREWORMS

Sowing to 8-leaf stage

Larvae and plants damaged

BIRDS, RABBITS AND WILD BOARS

Sowing to 6 to 8-leaf stage

APHIDS
Germination at the 8 leaf stage

Aphid attacks on young plants

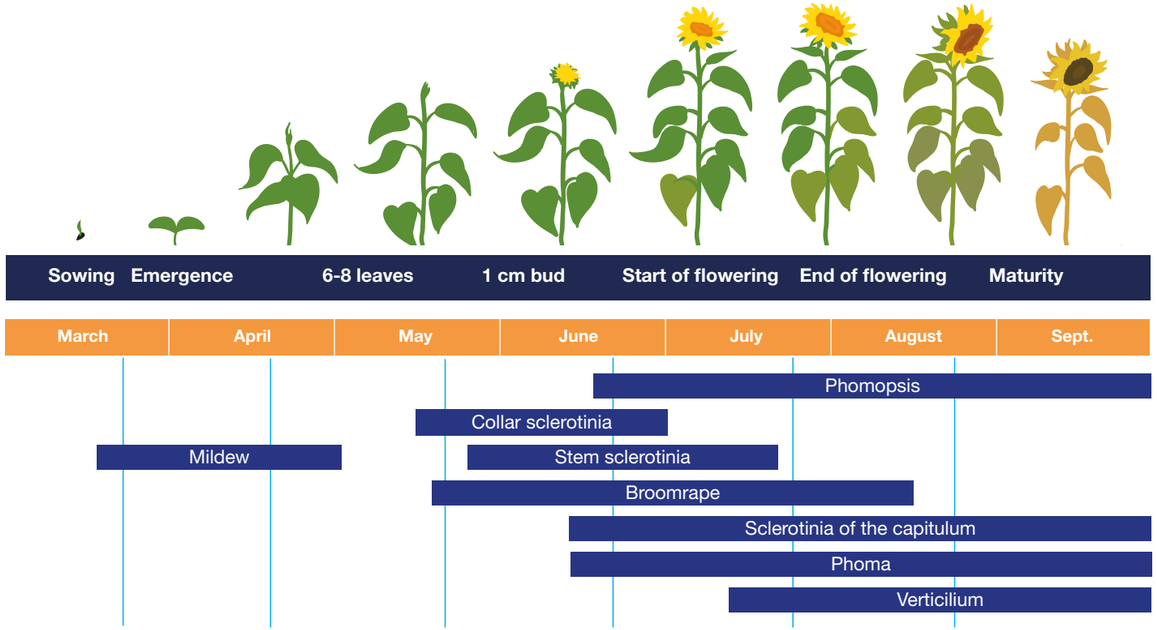
CUTWORMS
Sowing to 8-leaf stage

Black cutworm

Dingy cutworm

Bronzed cutworm

SUNFLOWER DISEASE CALENDAR



MILDEW
Germination

SCLEROTINIA STEM ROT
From the 1 cm bud stage to harvest

BROOMRAPE
8 leaves to maturity

PHOMOPSIS
From the 1 cm bud stage to harvest

DEFICIENCY SYMPTOMS

Boron deficiency

Potash deficiency

IN ACIDIC SOIL

Molybdenum deficiency

Magnesia deficiency

VERTICILIUM
Flowering to maturity

PHOMOPSIS
From the 1 cm bud stage to harvest

THE BROOMRAPE IN DETAIL

Broomrape (Orobanche Cumana) is probably the factor that has the most impact on yield for sunflower crop. This parasitic plant is very established around the Black Sea but also in the south of Spain and in some French regions. **Its spreading continues to increase across Europe and new populations appear regularly.**

Fortunately there are today a wide range of solutions to manage this spread and reduce its impact on yield sunflower:

- Tolerant hybrids based on imidazolinone herbicides (Clearfield and Clearfield Plus hybrids)
- Genetically tolerant hybrids to races E, F or G
- Respect for certain agronomic practices

MAS Seeds offers all solutions today for an effective fight against this parasitic plant.

Source : Shutterstock

A GENERAL PROBLEM IN EUROPE AND VERY SCALABLE

The first reports of broomrape in Europe date back to the 90s. The plants reported were populations with a race E. The spread of this parasite has been very rapid around the Black Sea and in southern Spain.

In the early 2000s, we observe the broomrape from the western facade of Turkey to the Volga region in Russia, as well as throughout Spain.

It is only in 2010 that we discover the first virulence broomrape qualified as «race F», still around the Black Sea and in Andalusia in Spain.

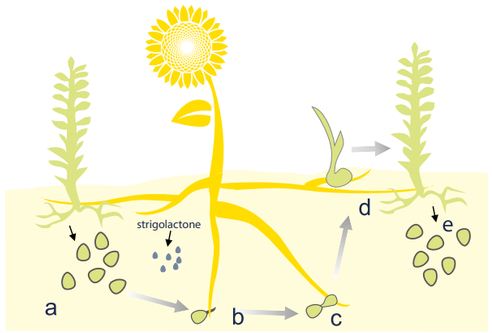
Today, broomrape is known to spread throughout Europe, from Spain to Turkey, including France, Hungary, Serbia, Bulgaria, Romania, Ukraine and Russia. **Since the mid-2010s, the number of cases of “race G” population also increase.**

Source : MAS Seeds

A VERY AGGRESSIVE PARASITE PLANT WITH STRONG SPREADING CAPACITY

Each broomrape plant is capable of disseminating thousands of spores as small as a few micrometers. Their size and their weight offer them a **very great capacity of propagation** (wind, animal, agricultural material, human activity). Broomrape seeds have **the ability to remain dormant in the soil for years** before attacking their host plant (a).

To attack the sunflower, the broomrape present in the ground uses the root system of its host to feed and germinate (b, c, d). It is important to **limit the number of sprouted broomrape plants to reduce the seed stock in the soil.**



Source : MAS Seeds

The consequences of a broomrape attack on a plot of sunflower with no genetic tolerance can be disastrous as it would result in total destruction of the plot. The agronomic solutions must be respected to reduce the damage and above all to limit its spread.

ESSENTIAL AGRONOMIC SOLUTIONS

The good agricultural practices to fight against broomrape, even before sowing sunflowers:

- **Identify the plots at risk** to adapt its varietal choice and thus select varieties with the tolerance more suited to the situation.
- Respect a certain **minimum duration between the cultivation of two sunflowers on the same plot.** Before we can sow again a variety of sunflower in a plot already infected with broomrape, we have to wait at least 3 years.

There are also several crop growing practices that help limit the impact of the broomrape :

- Sow a **variety adapted to the situation** that has a sufficient level of tolerance (race E, F or G)
- Choose a **Clearfield or Clearfield Plus variety** because they **give an additional level of protection.** The sunflower herbicide used will have a direct action on broomrape plants during the early stages of development of sunflower plants.
- Avoid phosphorus deficiencies in order to limit the number of grips of broomrape seeds
- To destroy the first emergence of broomrape **and avoid late sowing** to limit the spread of seeds and the impact on yield.

The good harvesting practices also play an important role:

- **Finish harvesting with infected plots** in order to limit the spread of broomrape seeds from one plot to the other
- **Thoroughly clean the harvesting equipment** once it is finished.
- **Do not crush** sunflower stems, but rather bury them

Notes

Notes

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