Pioneer Technical Bulletin

Sunflower crop development stages and yield determinants.

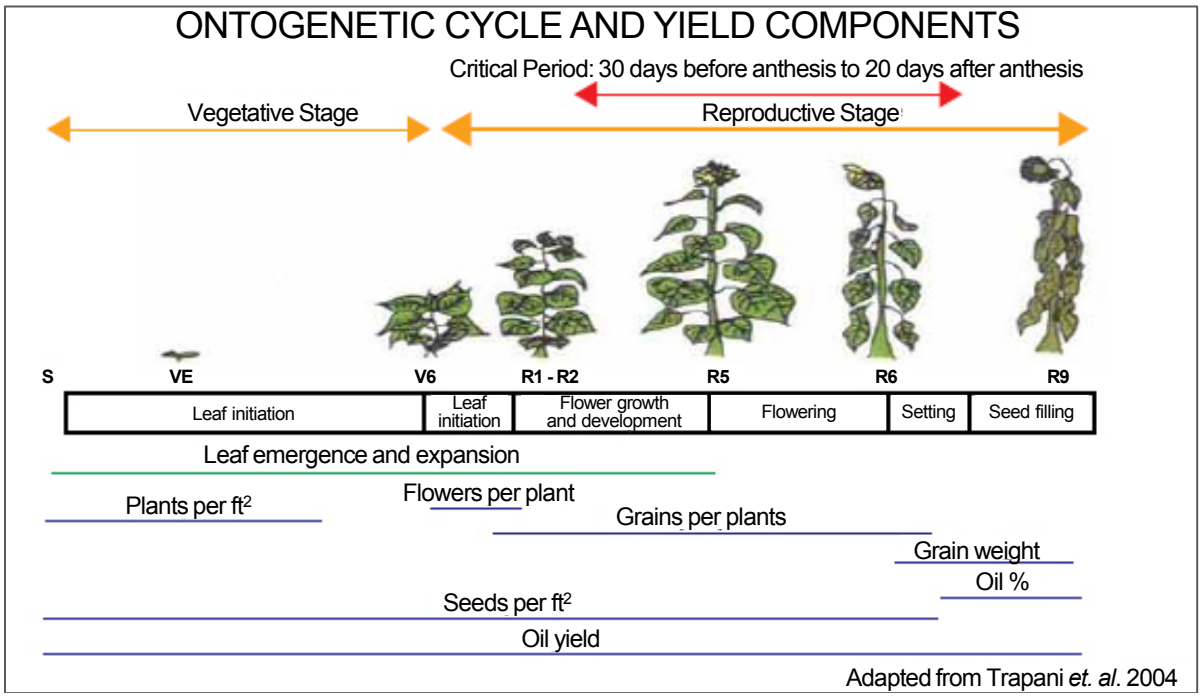
Introduction

Sunflower is a crop grown in various regions of North America, and across a wide range of agro-ecological environments.

As the plant grows, physiological and morphological changes that determine what is called phenological stages of the plant take place. These processes are genetically determined and are influenced by the environment.

The description of these phenological stages, commonly called growth stages, makes it possible to correlate them with the time different environmental factors and management issues take place, and thus better understand an observed crop response.

The most commonly used growth stage scale in sunflower, proposed by Schneiter and Miller (1981), is presented here along with corresponding management tips to obtain the best yield potential.



Seeding - Emergence Stage (S-VE)

Planting is one of the most important moments for a sunflower crop, since a proper seeding is the basis for development of phenotypic uniformity of the plants. This defines the number of plants produced per unit area (1st. yield component).

For proper germination, the most influential factors are proper seed to soil contact, water and temperature. While moisture requirements are low at this time, ensuring uniform seed imbibition to start the germination process is essential. Excess water during this stage limits the availability of oxygen and affects seed germination, having an impact on both the number of plants as well as the speed of emergence.

Seeding in low soil temperature extends the period from planting to emergence and allows more time for detrimental insect activity and soil fungi to develop. The result can be significant loss of established plants and/or non-uniformity of the crop.

First seedling emergence. First true leaf at least 1.5 inches long. The number of plants is defined.

Management Considerations:

- Plant in good seed zone moisture with the soil temperature above 50° F.
- Monitor and control soil insects. Use seed treated with systemic insecticides.
- Monitor and control wireworm.
- Manage other pests such as doves, crows, rabbits, ground squirrels, etc.
- Break the surface crust if soil compaction occurs.
- Due to the sensitivity of the seed to soluble salts, do not apply more than 10 pounds of nitrogen (N) and potash (K2O) fertilizer in the seed row (for optimal results apply it at least 2 inches to the side of the seed row).

Emergence - Floral Initiation Stage (VE-V6)

This stage begins with the emergence of the seedling and ends when the terminal bud begins to differentiate inflorescences. The length of this period depends on the hybrid genetics, the temperature and the photoperiod or the ratio of day length to darkness.

This vegetative growth phase is characterized by active root growth, significantly greater than the aerial part of the plant.

It is determined by counting the number of true leaves larger than 1.5 inches in length. For example: V4: four leaves larger than 1.5 inches.

This period ends with the terminal buds' change from the vegetative to the reproductive process, which takes place 20 to 30 days after sowing, when the plants have about 6 expanded leaves. The first 2 or 3 pairs of leaves can be seen arranged as opposites, and the following pairs are alternately arranged.

When this meristematic or growing point change occurs, the number of leaves that the plant will have is determined. Under high temperature conditions, high radiation and long days, this period tends to be shortened, thereby reducing the final number of leaves per plant.

Tolerance to low temperatures	
Cotyledon stage seedlings	Down to 23° F
1st pair of leaves	Down to 30° F
4th pair of leaves	Down to 32° F

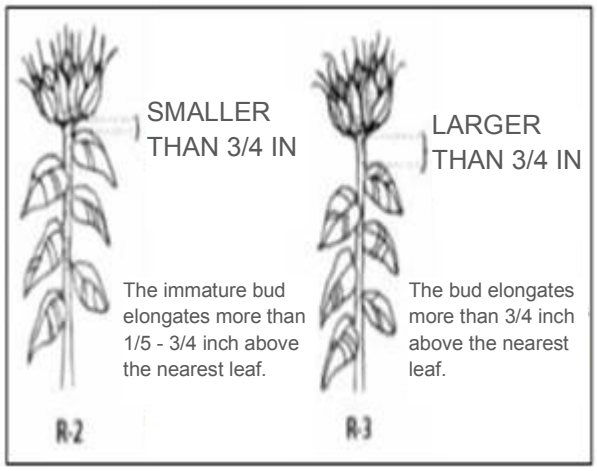
Table 1. Sunflower tolerance to low temperatures according to stage of development

Management Considerations:

- Keep the crop weed-free for at least 30-40 days after planting.
- Protect the crop from insects, birds, rabbits, etc.
- Ensure an adequate supply of nutrients, especially phosphorus. A low level of N and P negatively affects growth.

Floral Initiation – Flowering Stage (V6-R5)

Inflorescence starts being visible, surrounded by immature bracts, resembling a star.



At this stage, flowers differentiate and the potential number of seeds that the flower head will have is defined. The period ends at the start of the flowering (at the start of flower anthesis or pollination on the outer flower head).

During this stage active root development continues and leaf expansion occurs, and its length is also defined by the hybrid, temperature and photo-period. At higher temperatures, the rate of flower differentiation increases, but the period during which this process occurs shortens.

Management Considerations:

- It is essential to get to this point with a clean weed-free crop, the result of a good job in the previous stage.
- During this period, the highest rate of absorption of nutrients occurs, and in those cases requiring it, N should be applied at V6 – V8.
- Between R3 and R4, active growth takes place, reaching 95% of folial area development and continued root growth.
- The occurrence of severe water stress during this stage would influence the yield by affecting the potential number of seeds and and leaf expansion.
- Periodically scout and monitor the crop for the presence of insect pests such as defoliating caterpillars, sunflower beetles, and stem weevils.
- Scout and monitor the crop for the development of diseases such as Verticillium wilt, White mold, and rust. Verticillium wilt is a vascular disease that mostly affects folial expansion and in some cases the number of differentiated flowers.

Inflorescence begins to open

Flowering - Physiological Maturity Stage (R5-R9)

During the flowering period or reproductive growth stages (R5 and R6), which lasts 7 to 10 days, the number of set seeds is determined (2nd yield component). And between R6 and R9, carbohydrates, fatty acids and proteins are accumulated in the seeds, determining their weight and the percentage of oil.

Flowering. It is divided in sub-stages dependent upon the % of the head area that has flowered. Ex: if 30% of the head area is in anthesis R5.3

Flowering has been completed, and the ray flowers are wilted.

Management Considerations:

- Extended periods of cloudy days and rain during flowering can cause lower flower fertilization (fewer set seeds) by washing out pollen and / or reduced the activity of pollinators.
- Drought stress during flowering or early seed fill leads to fewer set seeds or lower seed weight and oil content.
- Damp, cool days during flowering are favorable for the development of white mold head rot (*Sclerotinia sclerotiorum*) as well as Alternaria and Phoma which cause early senescence of the plants. Prolonged high temperatures and high humidity are condusive to the development of Phomopsis stem canker.

The underside of the flower head starts turning a pale yellow

- Continue to scout and monitor for the presence of insect pests such as defoliating caterpillars, sunflower beetles, and stem weevils. Seed weevil, sunflower midge, and sunflower moths are additional insect pests that must be monitored during this time.
- Rhizopus head rot is often associated with sunflower moth larva and midge damage. Their feeding activity, or wounds from hail or bird damage allow an entry point for the disease to develop and spread.
- Dry weather conditions after reaching physiological maturity (30-32% seed moisture) accelerate the drying of the crop until it reaches harvest maturity. A desiccant herbicide can be used to accelerate the drying time even more and advance the threshing time. The greatest benefit of this practice is in situations with high humidity levels, a presence of disease or risk of damage by birds.

Left: The underside of the flower is yellow, the bracts remain green.

Right: The bracts are turning yellow and brown. Physiological maturity is reached.

Conclusions

Knowledge of sunflower ontogenetic cycle and the events that occur during growth and development of the crop make it possible to adjust management practices to maximize seed and oil yield.

For maximum yield, it is essential to manage and match the crop's resource demands with the environmental and supplemented supply at different times of its growth and development cycle.

Bibliography

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