Environmental issues

14.1 Adverse effects on growth and development

There are many factors which can have an adverse effect on sunflower growth and development. These factors can influence yield by reducing the number of seeds set, the weight of each seed, the ratio of kernel to hull, as well as influencing oil content and quality. Several of these factors are discussed below. [1]

14.1.1 Frost

Sunflowers are reasonably tolerant of frost at certain growth stages. Newly emerged seedlings are frost tolerant (to –5°C) until the 6 to 8 leaf stage but are frost sensitive from the 6 leaf stage until the seed ripening stage. Sunflower buds are susceptible to frost damage and also a significant drop in air temperature can be detrimental at this stage.

Frosting during the bud development stage can result in distortion of the bud, failure to set seed and even a complete lack of flower production. This may also be seen as blackening or purpling around the edges of the head. Frosts of 2°C prevent flowers opening and subsequently reduce the seed set. Frosts of –2 °C to 0 °C during grainfill can significantly reduce yield. [2]

14.1.2 Hail

Hail may damage sunflowers in several ways, including plant death, physical injury to the stem or head and leaf defoliation. All of these may reduce yield.

The growth stage when hail damage occurs has a major impact on the effect on yield. Hail in the early vegetative stages can greatly reduce yield if the terminal bud is damaged, generally plants with damaged terminals will tiller and these tillers produce small heads. Defoliation from the stages of R1 (the terminal bud forms a miniature floral head rather than a cluster of leaves; when viewed from directly above, the immature bracts form a many-pointed star-like appearance) to R6 (flowering is complete and the ray flowers are wilting) appear to be most sensitive, since much of the photosynthate produced at this time is directed to head development.

Plant death is a common occurrence when plants are small. If the plant population is reduced significantly, the remaining plants will compensate if the damage occurs early in the growth stages (e.g 2–8 leaf stage). However beyond this stage the plants cannot compensate enough and yields may be reduced.

Injured plants may also suffer terminal bud damage or stem breakage or bruising. If plants are injured but unable to contribute to yield, they will still use water and nutrients, an unfavourable situation. [3]

MORE INFORMATION

GRDC Tips and Tactics: Managing frost risk - Northern Southern and Western Regions

1 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Plant Growth and Development https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=3

2 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Plant Growth and Development https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=3

3 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Plant Growth and Development https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=3

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MORE INFORMATION

http://www.australianoilseeds.com/conferences_workshops/sunflower_conferences/2003_Sunflower_Conference

http://www.australianoilseeds.com/__data/assets/file/0009/1215/Development_of_Drought_Tolerant_Sunflower.pdf

14.1.3 Drought

Dryland sunflowers have reasonable drought tolerance, particularly if planted into a full profile of moisture. Extreme drought will reduce the plant height, leaf area and head diameters, resulting in reduced yields. Additional information on drought can be found under moisture stress in the water use section in the agronomy module. [4]

14.1.4 Heat stress

High temperatures during flowering and seed set will reduce yields and oil contents. Head and seed temperatures usually are 5°C to 10°C higher than the air temperature. Yield is generally reduced due to a reduction in seed number and increase in small grains. In addition, sunscald can affect heads which are erect or semi erect as the angle of head inclination is directed at the sun, receiving high heat intensity under hot conditions. This causes brownish red seed hulls and undeveloped or non existent seeds.

The effect of temperature on fatty acid composition is most important during early stages of seed fill. Rondanini et al. (2005), found that high alternating day/night temperatures for 4 days or longer with a mean daily grain temperature greater than 35°C produced significant reductions in grain yield and quality. Yield was reduced due to lower seed weights resulting in an increase in the percentage of half full grains in all sections of the head (outside, inter, middle sections). Reductions were highest during early grain fill (10–12 days after anthesis) with reduced yield of 6% per degrees Celcius above a mean grain temperature of 29°C. Later heat stress (18–24 days after anthesis) resulted in yield reductions of 4% per degrees Celcius above 33°C, demonstrating that the timing of heat stress is critical to yield and quality responses.

This experiment also found that heat stress 10–18 days after anthesis resulted in lower final pericarp weight due to thinner cell walls and less cell layers. High temperatures (especially 10–12 days after anthesis) reduce both the rate and duration of oil deposition in the developing seed (Rondanini et al. 2005). Constantly higher temperatures reduce oil content when occurring in the grain fill oil deposition period, when compared to alternating high/low temperatures (Rondanini and Mantese, 2004). Temperatures greater than 35°C also affect other grain properties including fatty acid composition and hull to kernel ratio. [5]

14.1.5 Waterlogging

Waterlogging can have an impact on plant growth and development. Waterlogging involves the rapid reduction in the amount of oxygen available in the soil. This has a direct impact on water and nutrient uptake and also on physiological processes such as photosynthesis, respiration and leaf senescence.

The effects of waterlogging will vary depending on a number of factors including soil type, e.g. slow draining, length of inundation and crop growth stage. [6]

4 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Plant Growth and Development https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=3

5 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Plant Growth and Development https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=3

6 Australian Oilseeds Federation (2012), Better Sunflowers Agronomy Training Package (Big Yellow Sunflower Pack), Plant Growth and Development https://bettersunflowers.com.au/bysp/surveyinfo.aspx?sid=3