NORTHERN
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GRDC GROWNOTES™

GRDC
GRAINS RESEARCH & DEVELOPMENT CORPORATION

SAFFLOWER

SECTION 3

PLANTING

SEED TREATMENTS | TIME OF SOWING: YIELD LOSSES DUE TO DELAY, FROST-RISK TIMING | TARGETED PLANT POPULATION | CALCULATING SEED REQUIREMENTS | SOWING DEPTH | SOWING EQUIPMENT

Planting

3.1 Seed treatments

The fungicide thiram is commonly applied to safflower seed (Figure 1) to provide protection against seed-borne fungi that cause seed rot and seedling damping off. However, infections contained within the seed, such as *Alternaria carthami*, may still occur, even with a fungicidal dressing.

Figure 1: *Safflower seed.*

Photo: AM Photography

3.2 Time of sowing: yield losses due to delay, frost-risk timing

Safflower development is controlled by a combination of temperature and daylength. Large delays in the time of sowing therefore have a much smaller effect on the timing of flowering and provide for a flexible sowing window. This is because crops progress through the vegetative fill stages much more rapidly, with only a small effect on the period between flowering and maturity (Figure 2).

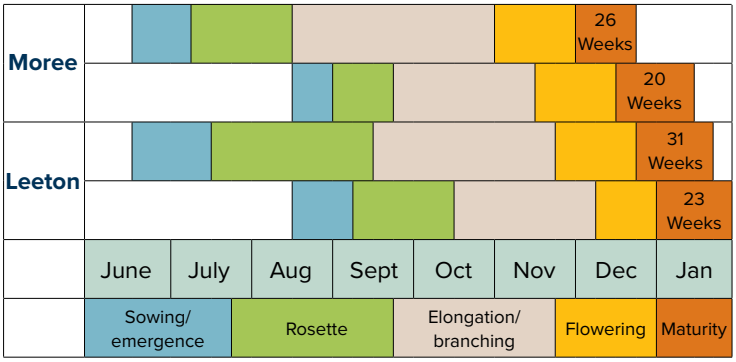

Figure 2: *Effect of sowing in mid-June and mid-August on safflower development at Moree and Leeton in NSW.*

Source: adapted from Colton 1988

The development of safflower is also hastened in seasons that are warm and dry; this is due to higher temperatures in the crop canopy (Figure 3).

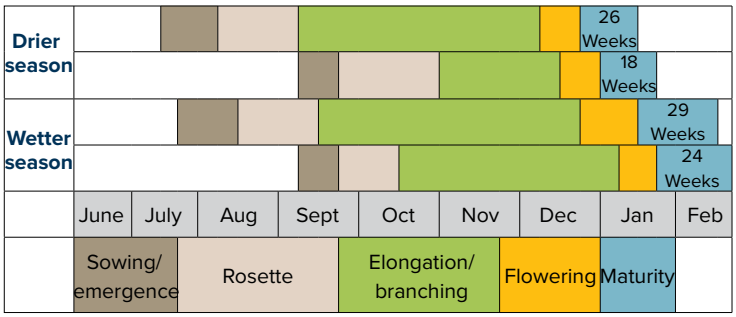

Figure 3: *Effect of sowing in mid-July and mid-September on safflower development in a wetter and drier season at the same location in the Victorian Wimmera.*

Sowing too early can result in frost damage during stem elongation, branching and even budding. Risk is greatest in northern areas because the generally warmer climate causes plants to begin stem elongation in winter.

Very early sowing followed by good early-season growing conditions may cause excessive vegetative growth, increasing crop water use, which may restrict seedfill if soil-water reserves are depleted.

Sowing too late reduces yield potential by shortening the duration of vegetative fill and pushing flowering and seedfill into late spring and summer, which often coincides with higher temperatures and the decreasing chance of rainfall. Late-sown crops may also be at greater risk of seed staining and sprouting in regions prone to significant summer rainfall events.

Generally, safflower should be sown in June or early July in central and northern NSW and during July in the southern regions of NSW, Victoria and South Australia (Figure 4). In the southern regions, sowing can be extended to mid-August, but this should be considered only if earlier sowing is not possible or if there are other reasons for growing safflower, such as the pre-sowing control of problem winter weeds. Spring sowing is possible in parts of Victoria and South Australia where, in cooler conditions

on a full profile of soil water, safflower can be sown between early September and early October and still produce economic yields.

The sowing time for safflower is quite flexible under favourable conditions in southern regions, or if it is included in cropping rotations as a strategic or opportunity crop. When safflower is grown as a cash crop, however, it should be sown at the optimum time to maximise yields, which is generally earlier in northern regions than southern regions (Figure 4).

Safflower yields are related to sowing time, and the yield of dryland and irrigated crops is most reliable when crops are sown in late June or early July. Each week of delayed sowing after mid-July usually results in a yield penalty of 5%, although under relatively cool growing conditions with adequate water supply, sowing can be delayed until mid-September without substantial yield reduction. [1]

	May				June				July				August				September				October			
Week	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**	**1**	**2**	**3**	**4**
Northern NSW			v	v	☺	☺	☺	☺	☺	☺	☺	w	w											
Central NSW					v	v	☺	☺	☺	☺	☺	w	w											
Southern NSW								v	v	☺	☺	☺	☺	☺	w	w								
Victoria								v	v	☺	☺	☺	☺	☺	w	w	w	w	w	w				
South Australia								v	v	☺	☺	☺	☺	☺	w	w	w	w	w	w	w	w		

Figure 4: *Recommended optimum (☺) and extended sowing window (v or w) for safflower in different regions.*

MORE INFORMATION

Optimum sowing time for rainfed safflower in southern Australia is affected by soil water availability

Effect of sowing time on the growth, yield and water use of safflower—some preliminary results

Two field experiments were undertaken in the Victorian Wimmera to assess the effect of sowing time on the development, growth and yield of safflower. Delayed sowing of safflower resulted in yield penalties similar to those of other winter crops (~5% per week), but the rate of decline is less where more soil water is available at sowing.

For low-rainfall areas, early sowing appears important to achieve good safflower yields, but where the soil profile is reasonably wet at sowing and/or where follow-up rains are likely, safflower can produce economic yields (>1 t/ha) when sown as late as mid-October in southern Australia. The common practice of sowing safflower in spring can lead to yield loss and growers should consider earlier sowing to achieve yields that are more reliable in drier environments. [2]

3.3 Targeted plant population

It is important to establish a consistent stand of safflower at a plant population suited to the expected growing conditions, as it is for all crops. Safflower compensates for low plant densities by producing additional branches, so the yield of early-sown crops in good growing conditions does not vary greatly over a wide range of sowing rates. However, very low sowing rates offer little competition to weeds and can produce very large individual plants with thick, woody stems. These plants are difficult to harvest and the volume of material passing through machinery may make it hard to obtain a clean sample.

Under drier conditions, sowing at too high a rate will create a dense crop canopy early in the season, increasing water use. If water in the soil profile is depleted too early in the season, there may be insufficient reserves for flowering and seedfill, resulting in reduced yield and quality.

1 N Wachsmann, T Potter, R Byrne, S Knights (2010) Raising the bar with better safflower agronomy. Agronomic information and safflower case studies. GRDC, http://www.grdc.com.au/BetterSafflowerAgronomy

2 N Wachsmann, R Norton, D Jochinke, S Knights (2004) Optimum sowing time for rainfed safflower in southern Australia is affected by soil water availability. The Regional Institute, http://www.regional.org.au/au/asa/2004/poster/1/4/1196_wachsmannn.htm

Sowing rates should be increased to compensate for the reduced duration of vegetative growth and branching where sowing later is delayed beyond the optimum time.

Target plant populations for safflower over a range of environments are provided in Table 1. Sowing is recommended at the lower end of the range provided when sowing early in June or July or where stored soil water or expected rainfall is less than ideal. Sowing rates should be increased for late sowing, after mid-July, or if subsoil moisture or seasonal rainfall is more assured.

Higher rates should also be used for irrigated crops, or where poor emergence is expected because of issues such as seed quality, cold temperatures, depth of sowing to reach moisture, or soil-surface crusting. In drier environments, such as lakebeds in the far west, lower seeding rates than normal may be justified. Consider 6–8 kg/ha in the northern regions and 10–12 kg/ha in the southern regions.

FAQ

Table 1: *Target plant populations (no. of plants/m^2) and sowing rates (kg/ha) assuming 90% germination and 25% establishment losses.*

Nutrient	Favourable conditions	Drier conditions	Irrigated crops
Northern and central NSW	20–25 plants/m^2 (12–15 kg/ha)	15 plants/m^2 (9 kg/ha)	40–50 plants/ m^2 (25–31 kg/ha)
Southern NSW	30–35 plants/m^2 (18–22 kg/ha)	25 plants/m^2 (15 kg/ha)	
Victoria and South Australia	30–40 plants/m^2 (18–24 kg/ha)	20–30 plants/m^2 (12–18 kg/ha)	

3.4 Calculating seed requirements

Sowing rates can be calculated by using the following formula and assuming ~25,000 safflower seeds per kg:

$$\text{Sowing rate (kg/ha)} = \frac{(\text{Target plant population/m}^2) \times 10{,}000 \times 10{,}000}{(\text{seeds/kg}) \times \text{germination\%} \times (100\text{-establishment loss})}$$

$$\text{For example, sowing rate (kg/ha)} = \frac{(20/\text{m}^2) \times 10{,}000 \times 10{,}000}{25{,}000 \times 90 \times (100\text{-}25)}$$

3.5 Sowing depth

Depth of sowing will vary according to soil characteristics, planting machinery and moisture levels. Unlike wheat, safflower has a hull and needs to be placed into good moisture to assist the seed in imbibing sufficient moisture to enable germination. For this reason, safflower is ideally sown into moist soil with equipment such as press-wheels to provide good seed–soil contact.

Sowing depth will vary with soil type and conditions but is normally between 2 and 5 cm. Sowing deeper can delay emergence and reduce early vigour (Figure 5), leaving crops more susceptible to pests, diseases and competition from weeds. Some growers extend sowing depth to 7 cm to place seed into moisture; however, this should be avoided if possible, especially where soils are prone to crusting.

Figure 5: *Seven-week-old safflower plants sown at depths of 1, 5 and 10 cm in clay soil.*

Photo: Nick Wachsmann

3.5.1 Row spacing

Safflower is normally planted with standard cereal-sowing equipment in rows 18–36 cm apart. Narrower rows allow greater suppression of weeds, whereas wider rows may facilitate better airflow for disease control.

Wider rows are also more suited to inter-row sowing, cultivation for weed control or band spraying. Low sowing rates and very wide rows to 50 cm may be preferable in very dry situations, but row spacings >36 cm have resulted in lower yields in more favourable growing conditions. Wider rows can also be used with row-crop equipment for planting irrigated safflower crops. Californian experience indicates that planting single rows on hills 75 cm apart, twin rows on 1 m raised beds, or several rows on raised beds 1.5–2 m can all be satisfactory. [3]

3.6 Sowing equipment

Generally, safflower is sown with standard wheat equipment. Press-wheels should be used to ensure good seed–soil contact, and the wheel width and pressure adjusted to sowing conditions. In dry soils or if soil-dwelling pests may be present, heavier pressure is usually required to achieve reasonable establishment. [4]

3 N Wachsmann, T Potter, R Byrne, S Knights (2010) Raising the bar with better safflower agronomy. Agronomic information and safflower case studies. GRDC, http://www.grdc.com.au/BetterSafflowerAgronomy

4 R Byrne (2009) Safflower. In Summer crop production guide 2009. (Eds L Serafin, L Jenkins, R Byrne) NSW Department of Primary Industries.