7th International Safflower Conference
WAGGA WAGGA AUSTRALIA

The effect of sowing depth on safflower germination and early growth in clay and sandy soils

Emma Mikkelsen[1], Asha Ponder[1], Kim Pickersgill[1], Nick Wachsmann[1]
[1]Longerenong College, Longerenong Rd, Longerenong 3401, Australia,
mous_04@hotmail.com, pondeas@hotmail.com.au, kpickersgill@longy.com.au,
nwachsmann@longy.com.au

Abstract
A glasshouse experiment was conducted to investigate the effect of seven sowing depths between 1 and 15 cm on the emergence and early growth of safflower (*Carthamus tinctorius*) in cracking clay and sandy soils. Sowing depths between 1 and 7 cm had no significant effect on the time taken by safflower to emerge, but exceeding 3 or 5 cm did reduce the number of plants that emerged and the amount of growth produced to 47 days after sowing. At least where topsoil is moist or post sowing rainfall is likely, these results support current grower practice where on average safflower is sown at a depth of 3.5 cm. Growers should be cautious of sowing below 5 or 7 cm depth, especially where soils are prone to crusting after rain.

Key words: Time to emergence - crop establishment - dry matter

Introduction

A survey (Wachsmann *et al.* 2001) established that most growers in south-eastern Australia plant safflower (*Carthamus tinctorius*) at depths between 1.5 and 7.5 cm (mean = 3.5 cm). However, anecdotal evidence suggests that some growers plant even deeper, especially when delaying sowing into spring in order to place seeds into moist soil as the surface dries with increasing temperatures and the decreasing chance of rainfall. The same survey also identified that poor establishment and seedling vigour are issues with safflower production and these aspects of crop agronomy can be associated with sowing depth, soil type and environmental conditions. Sowing depth recommendations for safflower vary between regions, being 1.5 to 4 cm in South Australia (Stanley *et al.* 1995) and 4 to 7 cm in New South Wales (Colton 1988). An experiment was undertaken to investigate the effect of sowing depth on the emergence and early growth of safflower in clay and sandy soils.

Materials and Methods

The experiment was conducted in a glasshouse without temperature control and the design was a factorial in randomised blocks with four replicates. Treatments were sowing depths of 1, 3, 5, 7, 10 and 15 cm, with each depth treatment sown in cracking grey clay and structureless brown sandy soils. The cultivar used was S-555 and a prior test indicated germination to be 94%. Pots were 9 cm in diameter and 35 cm in length. Sowing depths were achieved by filling pots with soil to slightly above the desired depth and tapping on a hard surface, before adjusting the soil level and sowing 6 seeds. Each pot was subsequently filled to the surface and packed again. This operation was completed on the 23rd July 2008 (mid-winter). Pots initially received an overhead irrigation until water drained freely from the base. Each pot was then placed in a shallow tray and subsequent watering occurred through capillary action, with the trays topped up as required. No fertiliser was applied. Weeds were controlled manually and no pest or disease control was necessary.

The date at which each plant emerged was recorded when the first true leaf reached 1 cm in length. Biomass (dry matter = DM) was measured 47 days after sowing (DAS) and 19 days after the last plant had emerged. At this time plants were cut at soil level and dried at 70^0C to constant mass and weighed. The time taken to reach emergence (DAS), plant establishment (%) and early growth (g DM/plant) were subsequently calculated and all data was statistically analysed using ANOVA or linear regression with Genstat 7.2.

Results

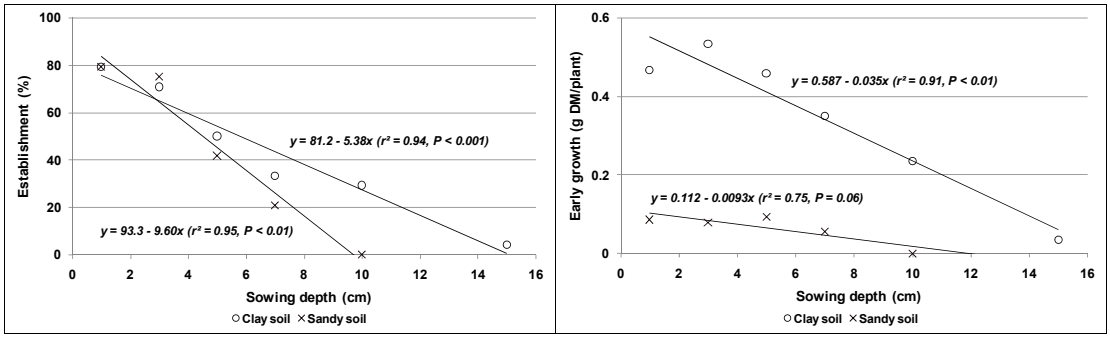
A few days after the initial surface watering it was noticed that the sandy soil had developed a surface crust. At least one plant emerged from all sowing depths tested in the clay soil, but no plants emerged from beyond 7 cm in the sandy soil (Table 1). Increasing sowing depth from 1 to 7 cm had no significant effect on the time taken to reach emergence in either soil, but compared to 5 cm, sowing at 10 or 15 cm depth did delay emergence in the clay soil by at least 10 days.

Table 1. Effect of sowing depth (cm) on safflower emergence (time in days after sowing) and establishment (% of seeds that emerged) in a cracking grey clay and sandy soil.

	Time to emergence			Plant establishment		
Soil type	Clay	Sand	Mean	Clay	Sand	Mean
Sowing depth						
1	20^{a}	24	22	79^{a}	79^{a}	79^{a}
3	22^{a}	23	22	71^{a}	75^{a}	73^{a}
5	22^{a}	24	23	50^{ab}	42^{b}	46^{bc}
7	25^{ab}	23	25	33^{bc}	21^{bc}	27^{cd}
10	32^{bc}	-	-	29^{bc}	0^{c}	15^{de}
15	35^{c}	-	-	4^{c}	0^{c}	2^{e}
LSD (P = 0.05)	7.6^{**}	n.s.	n.s.	30.4^{***}	31.0^{***}	20.0^{***}

^{a,b,c} means with the same script are not significantly different at P=0.05, $^{***}P$<0.001, $^{**}P$<0.01, $^{*}P$<0.05, n.s. = not significant at P=0.05.

Increasing sowing depth beyond 3 cm tended to progressively reduce plant establishment in both soils and compared to 3 cm, plant establishment was reduced by at least 54% when sowing occurred at or below 7 cm depth (Table 1 and Figure 1a). Similarly, increasing sowing depth below 5 cm tended to reduce the amount of growth produced by each plant to 47 DAS (Figure 1b). At this time all plants had produced significantly (P<0.001) more growth in the clay soil (mean = 0.35 g DM/plant) than the sandy soil (mean = 0.05 g DM/plant).



a) b)

Figure 1. Effect of sowing depth (cm) on safflower a) establishment (% of seeds that emerged) and b) early growth (g DM/plant 47 days after sowing) in a cracking grey clay and sandy soil.

Discussion

With adequate water supply in this experiment, there was little difference in the time taken for plants to emerge, establishment or early growth between sowing depths of 1 and 3 cm in either soil type. However, under drying surface soil conditions which might be experienced in the field, germinating seeds sown at 1 cm depth may be prone to desiccation, especially where sowing depth is uneven across the width of sowing equipment or where seed soil contact is poor. The mean sowing depth of 3.5 cm used by growers in south-eastern Australia is therefore appropriate and consistent with the sowing depth recommendations of Stanley *et al.* (1995).

Increasing sowing depth to 5 or 7 cm had little effect on the time taken for safflower to emerge, but it did reduce the number of plants that emerged and particularly on the clay soil, the amount of early growth produced. With fewer and smaller plants resulting from sowing at these depths, crops would offer less competition to weeds and any pests that occur may have a greater relative impact due to the presence of less crop biomass. Growers should therefore be cautious of sowing safflower below 5 or 7 cm depth, especially where soils are prone to crusting after rain. Further increasing sowing depth to 10 or 15 cm would exacerbate these problems and depending on sowing rate, may result in crop stands that are too light to produce economic yields. The limited early growth observed in the sandy soil in this experiment is attributed to low fertility highlighting the importance of appropriate nutrition to early crop growth.

Acknowledgements
The authors would like to thank John Goldsmith (Longerenong College) for his guidance in planning this experiment and the preparation of this manuscript.

References

Colton, R.T. 1988 Safflower growing. AGFACT P5.2.2. Department of Agriculture, New South Wales.

Stanley, M., Hannay, J. And Potter, T. 1995 Safflower – Agronomy. Factsheet Agdex 146/50, Primary Industries South Australia.

Wachsmann, N.G, Knights, S.E. and Norton, R.M. 2001 The potential role of safflower (*Carthamus tinctorius* L.) in Australia's southern farming systems. Proceedings of the Xth Australian Agronomy Conference, Hobart, Tasmania, Australia, January 28 - February 1, CD-ROM or, http://www.regional.org.au/au/asa/2001/4/a/wachsman.htm Accessed 28 June 2008.