THE ROLE AND POSITION OF SUNFLOWER IN UK AGRICULTURE

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Summary
This paper summarises a review of the UK sunflower crop which provides comprehensive information pertainingrelating to sunflowers grown under UK conditions and identifies gaps in current knowledge and makes recommendations for further work.

There is a demand for UK produced sunflowers both for crushing for oil and for bird seed. At present no sunflower seed is crushed in the UK, the oil from an equivalent crush of 170,000t being imported. The current UK market value is therefore approximately £30 million, providing an established market for any home grown product. This demand for sunflower products could support a potential area in the UK of 40,000 ha, but in 1999 the crop was only grown on an estimated 300 ha. The UK is on the climatic fringe of the European growing area, but with the introduction of newer earlier ripening varieties the crop is becoming more viable, although yields can still be variable. At present only two major diseases Botrytis head rot (*Botrytis cinerea)* and head and stem rot (*Sclerotinia sclerotiorum)*, have been identified as potentially damaging to sunflower crops. UK sunflower oil is of very high quality and it has a good spectrum of polyunsaturates. The high content of linoleic acid and absence of linolenic acid makes sunflower oil superior to the oil from oilseed rape and soya bean from the industrial point of view. Sunflower oil produced in the UK can have up to 40% higher linoleic acid content compared to that produced on the continent. Comparing the gross margins of spring sown crops indicates that sunflowers can be attractive to the grower and provide stable returns now that oilseeds area payment support is available. The recent trend of hot and dry summers in the UK has led to ideal conditions for sunflowers and this trend could be long term as one of the results of global warming.

Introduction

Since the breeding of the first short-season hybrids in France in the late 1960s (McCartney & Church, 1999), the production of sunflowers has become a major industry in both Europe and the Americas. In the UK, sunflower has been grown successfully in the 1800s (Wilson, 1849), in the 1940s (Hurst, 1946) and with limited success in the 1970s (Bunting, 1974). Interest in the sunflower crop was renewed in the 1980s (Church & Rawlinson, 1991) and in 1994, the United Kingdom Sunflower Association (UKSA) was formed to promote the crop. At the present time, UK production is limited, being approximately 600 tonnes from 300 hectares. Most of the produce is used in pet-foods (UKSA, unpublished). During the past 10 years, market prices for seed have fluctuated between approximately £150 to £225 per tonne. In 1992 there was a major change with the reform of the Common Agricultural Policy when support was shifted from price to the Arable Area Payments Scheme. The area payment for sunflowers is the same as for oilseed rape and subject to fluctuations if base areas or tonnages for all oilseeds are exceeded. All this suggests an opportunity for producing a UK crop that is not in surplus and for which a market already exists. Pet and wild-bird food is a major niche market for sunflowers at the present time, mainly due to promotional work by the Royal Society for the Protection of Birds on all-the-year-feeding of garden birds with the softer shelled, black seeded varieties typical those produced in the UK. Most pet-food suppliers are happy to source from the UK, provided there is continuity of supply and quality is consistent. The crushing market will not be available until larger quantities, at least 2000 tonnes a day crush, are available.

Oil quality

As well as a higher level of oil in UK produced sunflower, up to 50%, compared to 44% on the continent, the proportion of linoleic fatty acid in sunflower oil has been shown to be greater than that of the source seed (Table 1; McCartney & Church, 1999). The levels of linoleic fatty acid increased between sown and harvested seed and the levels of oleic and erucic fatty acid decreased. This higher quantity of total oil and linoleic fatty acid (40%) have been attributed to the cooler growing conditions of the UK.

Table 1. Comparison of fatty acid profiles (% in oil) between planted (p) and harvested (h) seed in 1988 - IACR Rothamsted (%)

Variety	Seed	Palmitic	Stearic	Oleic	Linoleic	Erucic
Sunbred 246	*p*	5.5	5.3	24.3	60.6	0.91
	h	5.5	4.3	12.1	72.0	0.65
Avante	*p*	6.2	5.2	20.4	63.0	0.93
	h	6.6	4.8	11.4	72.0	0.73
Vincent	*p*	6.5	4.2	29.0	57.0	0.70
	h	5.8	3.9	15.0	72.0	0.68

Suitability of sunflower for UK conditions

There are two major constraints on production of a successful sunflower crops in the UK, both are related to heat availability. The first is the length of the growing season, as determined by the earliest date at which sowing is practicable and the latest date at which maturation ends and harvesting can no longer be delayed. The second is the amount of heat available for use by the crop during this growing season. The optimum date of drilling in the

UK falls between mid-April and mid-May when soil temperatures at 5 cm are around 7°C, this is equivalent to a temperature of 10°C at 30 cm, suitable areas are indicated in Fig. 1. The crop should be harvested by mid-September as a delay into October can lead to crop damage from heavy rain or frosts. The amount of heat needed to supply a semi-dwarf hybrid of the type `*très précoce'* is approximately 1400 degree days over a base of 6°C (Cook *et al*, 1998). Fig. 2 indicates the suitable production areas for a growing season between May and September.

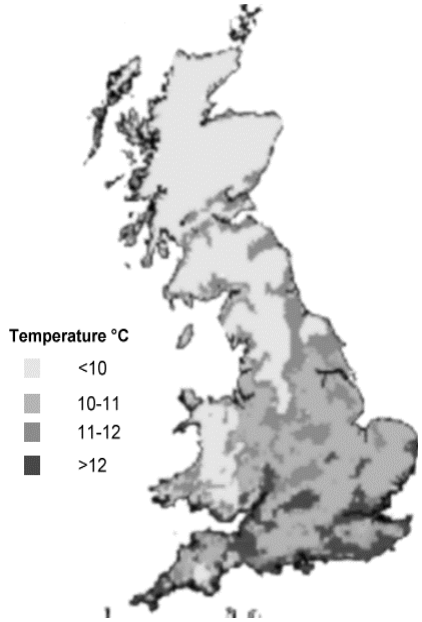

Fig 1. Average soil temperatures for 1 May

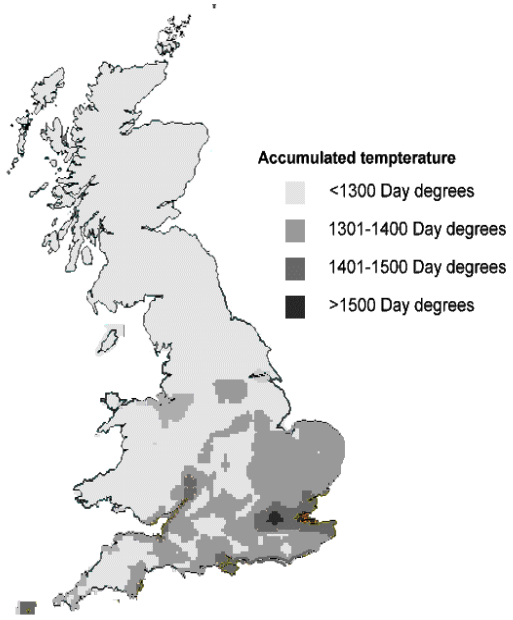

Fig 2. Mean accumulated temperatures (May to September >6°C)

General husbandry

In the UK, sunflower is a spring sown break crop. The late drilling date allows the preparation of a `stale seedbed' for control of difficult and resistant weeds. The seedbed is prepared and sowing is delayed until the first flush of weed seedlings have appeared and the soil disturbed as little as possible. The weeds are then killed using non-selective herbicides, few seedlings then emerge. Sunflower is best grown following cereals or fallow, not after crops that may increase the risk of *Sclerotinia sclerotiorum* such as oilseed rape or potatoes, or after crops which leave large residues of nitrogen in the soil e.g. kale, sugar beet or permanent pasture. The crop can be grown on almost any soil type, but as with most crops the best soil type is a well-drained loam that will warm up rapidly in spring, enabling plants to get off to a good start. The drought tolerance of the crop also makes it suitable for use on droughty soil.

Preparation for the seedbed should begin with autumn ploughing and sub-soiling should be done if necessary. Fertiliser applications of 40-60 kg/ha of potash and phosphate and up to 50 kg/ha nitrogen (UKSA, unpublished) should be made in late March/early April and followed by a light cultivation to remove wheelings. Alternatively fertilisers can be applied as an early top-dressing. There has been limited work done in the UK on sunflower nutrition. In general CETIOM information has been used (CETIOM, 1998). The crop is drilled using either a precision drill or a pneumatic cereal drill with alternate coulters blocked off. Recent studies

in the UK have indicated little difference in final yields between the two methods (Cook & Raw, 1993; McCartney & Church, 1999).

Variety choice is limited, for example, to only two semi-dwarf varieties were available for sowing in 2000. Potential varieties are trialled each year by the UKSA. The small number of available varieties reflects the small scale of the UK sunflower industry. Seed should be drilled between 16 April and 5 May if possible (Dixon & Lutman, 1992), with target plant populations between 80, 000 and 120,000 plants/ha for a 34 cm row spacing. Row spacings depend on the type of drill used and can be up to 50 cm.

Weed control in the UK sunflower crop is limited to cultural control through the use of a stale seedbed, or by one of the relatively few herbicides approved for use. Trifluralin and pendimethalin are approved for use pre-emergence of the crop and weeds, the weeds controlled are mainly broadleaved, but some grass weed control can also be achieved. Sethoxydim is approved for post-emergence control of cereals and grass weeds. For crops grown on wide rows a tractor mounted steerage hoe has been used successfully (R Brown, pers. comm.).

Although sunflower has been grown intermittently in the UK for many years, there is still relatively little experience of diseases on sunflowers under UK conditions. However, three fungal pathogens, *S. sclerotiorum, Botrytis cinerea* and *Verticillium dahliae,* have been reported in UK crops. Of these, *S. sclerotiorum* probably represents the biggest potential threat to the growing crop. For disease control there are no fungicides approved for use on the crop. Sclerotinia stem and head rot control is still best achieved by good rotation practice. Botrytis head rot appears to be less of a problem than initially thought and the use of a desiccant and early harvest may reduce damage caused by the pathogen.

The limited area of sunflower in the UK has lead to little information on observations of insect pests and the damage they cause. There have been reports of minor damage caused by tortrix larvae, leaf minors and looper caterpillars in Bedfordshire and thrips in Hampshire (Rawlinson & Dover, 1986). *Brachycaudus helichrysi, Aphis fabae* and *Myzus persicae* were recorded in Oxfordshire in 1986, but again caused little damage (Rawlinson & Dover, 1986). Insect fauna occurring on sunflower were recorded on crops in Hertfordshire between 1986 and 1991 (Anon, 1986, 1987, 1991). Aphids, including *B. helichrysi, A. fabae, M. persicae, Macrosiphum euphorbiae,* and other *Aphis* spp. were found. *B. Helichrysi* has also been found on crops in Cambridgeshire but caused little damage. Polyphagous lepidoptera larvae, mirid bugs, leaf hoppers, leaf miners (Diprea and Hymenoptera) and thrips have been recorded in small numbers, but have caused only minor damage. Large numbers (sometimes more than 300 per head) of pollen beetles, *Meligethes aeneus*, have been observed on sunflower heads in Hertfordshire. In 1996, silver Y moths (A*utographa gamma*) were observed feeding on flowers in Cambridgeshire, but no caterpillars were found. Finches (*Fringillidae*) have caused damage to nearly mature crop heads in Cambridgeshire, where up to 12% of seeds in the head were taken. Grazing of seedling crops by rabbits has been found, especially where crops are planted close to woodland areas, in Cambridgeshire. Mice and badger damage has been noted, with the latter the damage may be localised. Slugs (*Arion silvaticus)* have been observed to cause damage, especially at the seedling stage in many crops throughout the UK (Anon, 1987; McCartney unpublished; UKSA, unpublished).

Harvest should ideally take place during September. The crop can be harvested at 30% moisture content or below. However, it is more commonly harvested either when the seed has dried down naturally to 15-20% moisture, or after the application of a desiccant (diquat) at

30% seed moisture (Anon, 1997). A conventional cereal combine can be used with little modification, harvesting trays can be fitted and the reel tines covered to avoid impaling the flower heads. As the seed is typically harvested wet (15-30% moisture) the seed is commonly dried on a drying floor and blown with cold air down to 15% moisture then dried further using heat to 9% moisture. The crop is then cleaned to reduce admixture to 2% or less.

Economics

The financial performance of sunflower is compared with alternative spring crops for harvest 2000 - 2002 in Table 2. The price predicted for sunflowers is that for a commercial sunflower crop for sale as pet-food. Gross outputs are higher for the spring oats and lower for linseed and spring oilseed rape. By harvest 2002, when the changes are fully implemented, peas are likely to be the only break crop with a similar gross margin, based on harvest 1999 gross data and harvest 2002 Arable Area Payments. This assumes no penalty for overshoots on oilseeds with regard to acreage or production.

Variable costs for sunflowers are lower than most alternative crops (Table 2), due to low nitrogen, no fungicides, growth regulators and insecticide being applied. There is potential for a significant fall in the seed price, but a future increase in the area of sunflowers may mean that there will be greater pest and disease pressure and consequently these costs may increase and compensate for the possible fall in the seed cost.

Overall, the crop has the potential to compete well with the alternative broad-leaved spring crops. For example, in a six-course predominantly winter-sown rotation in the UK (wheat, wheat, winter oilseed rape, wheat, wheat and winter beans) the area allocated to the break crops could be partially replaced by sunflower. To minimise disease risk then sunflower should replace winter oilseed rape. If the price of sunflower remains at £170 /t, the gross margin of the crop will be similar to that of rape yielding 3.1 t/ha at £105-110 /t but the crop holds a greater risk of failure than the crop it would replace.

Conclusions

The review of the UK sunflower industry has indicated the main priority areas for concentration of research effort. Good crop establishment is critical for a profitable sunflower crop. Problems encountered during this phase are many and research is needed to establish the requirements for successful establishment so that `blueprints' for best practice can be provided. Further work is also needed to refine the husbandry of growing crops including potential pest and disease control. Technology transfer mechanisms are needed to guide the development of the crop through its formative years, there will be a need to establish and develop links with farmers, breeders, merchants and end users. This review is a source of information to build on and, with support from the UKSA sponsoring demonstration sites and promotional campaigns, growers can be made aware of the potential of sunflowers as an alternative spring break crop.

Table 2. Effect of Agenda 2000 proposals on gross margins

Crop	Sunflower	Spring Oats	Peas	Beans	Linseed	Spring oilseed rape
Output (£/ha)						
Price (£/mt)[1]	175	75	80	80	100	110

Yield (t/ha)	2.0	5.0	4.3	3.5	1.8	2.3
Output	**350**	**375**	**344**	**280**	**180**	**253**
Variable costs (£/ha)						
Seed	106	56	94	96	54	41
P/K Fertiliser	30	30	30	30	30	30
Nitrogen	-	44	-	-	30	44
Herbicides	32	20	62	25	40	45
Fungicides	-	20	25	20	-	13
Growth Reg.	-	7	-	-	-	-
Insecticide	-	-	10	10	-	13
Total variable cost	**168**	**177**	**221**	**181**	**154**	**186**
Area aid 2000[2] [3]	337	242	299	299	364	337
Gross Margin 2000	**519**	**440**	**422**	**398**	**390**	**404**
Area aid 2001[2] [3]	298	260	299	299	312	298
Gross Margin 2001	**480**	**458**	**422**	**398**	**338**	**365**
Area aid 2002[2] [3]	260	260	299	299	260	260
Gross Margin 2002	**442**	**458**	**422**	**398**	**286**	**327**

[1] Crop values shown are estimates of ex-farm prices

[2] Area aid for oilseed rape and sunflower could be affected by overshoot of reference price.

[3] Area aid values are best estimates as at 13/01/00 using green pound rate of 1 euro = 0.70p

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