

Alternative crop factsheet: Pharmaceutical crops

OPPORTUNITIES FOR PHARMACEUTICAL CROPS

With developments in bioprocessing and a renewed interest in medicinal benefits of plants, there is increasing opportunity to expand pharmaceutical crop production in the UK.

Of particular attention at the moment is medicinal cannabis, which has begun to be prescribed under the NHS for various conditions in the last couple of years. One of the active substances in cannabis, cannaboid, can be to manage side-effects of chemotherapy, epilepsy and multiple sclerosis, and other uses are currently being investigated. Restrictions on cultivation of medicinal cannabis and hemp in the UK means that much of the CBD market is supplied by imported products, despite it being a viable crop to grow in the UK.

Since 1998, galanthamine has been an approved treatment of Alzheimer's disease, and other potential uses include treatment of fatigue disorders, ADHD, arthritis and use in perfume manufacture. Synthetic production is possible but expensive, and the chemical can be found naturally in several plants, such as daffodils. Research conducted with Harper Adams University and Aberystwyth University have shown that growing daffodils at altitudes

above 305m (1000ft) somehow 'stressed' the plants such that the levels of galanthamine increased significantly.

Another crop with potential to expand in the UK is opium poppies, with Macfarlane Smith establishing domestic production in 2006. The seedpods of opium poppies produce a latex containing codeine, morphine, narceine, narcotine, papaverine and thebaine, all valuable to medicine makers. Macfarlane Smith is the only registered producer of opium poppies in the UK, and control all production, harvest and processing; following an investigation into the monopoly by the Office for Fair Trading it was felt that interference might cause the company to stop producing in the UK (DBIS).

Finally, St John's Wort has been used as a herbal medicine for hundreds of years, and most recently has received more attention for its application in managing depression.

These are just some examples of the many pharmaceutical crops with potential for commercial production in the UK. Pharmaceutical production is a niche and discrete market, based primarily on direct contracts with pharmaceutical manufacturers.

GROSS MARGINS

Poppies

Source: Agricultural Budget Costing Book, Nov 2019

	/ha
Yield (t/ha)	2.2
Area payment	£ 100
Alkaloid bonus payment	£ 1,200
Output	£ 1,300
<i>Fertiliser</i>	£ 148
<i>Crop protection</i>	£ 190
<i>Sundries</i>	£ 15
Variable costs	£ 353
Gross margin	£ 947

Medicinal cannabis

Source: Agricultural Budget Costing Book, Nov 2019, and NNFC Hemp Factsheet, 2006

	/ha
Seed yield (t/ha)	1
Price per tonne	£ 500
Straw yield (t/ha)	5.5
Price per tonne	£ 110
Output	1102
<i>Seed</i>	£ 137
<i>Fertiliser</i>	£ 186
<i>Crop protection</i>	£ 20
<i>Sundries</i>	£ 171
Variable costs	£ 514
Gross margin	£ 588

CROP ESTABLISHMENT AND PRODUCTION

LAND, CLIMATE AND SOIL SUITABILITY

Daffodils can be produced in cooler upland areas, and given appropriate equipment, such as adapted quad bikes, can be grown on up to 20 degree slopes. Daffodils, St Johns Wort and poppies prefer well-drained, sandy or loamy soils. Poppies like more temperature climates, and St John's Wort is tolerant to acidic soils.

Hemp favours a deep humus soil but has been grown successfully on a wide range of soil types. Research has shown that hemp/marijuana can be very effective at improving soils, e.g. structure, water management, buffer strips, good break crop in arable rotations etc.

VARIETIES AND LEGISLATION

For galanthamine production, various commercial varieties of daffodils are suitable.

Papaver somniferum is the variety of poppy grown for medicinal use. Macfarlane Smith is the only company licensed to produce medicinal poppies in the UK; licenses and seed can be obtained in agreement with them, and they harvest and process the crop.

Different varieties of cannabis are required for indoor or outdoor systems. Dual purpose varieties such as Finola can be grown for seed production and a smaller amount of straw (as they are usually dwarf varieties). Hemp and cannabis are regulated and licenses provided by the Home Office based on THC content (<0.2%) and the intended market. THC (tetrahydrocannabinol) and CBD (cannabidiol) content alters according to variety, and requirement for these will differ according to the buyer; it is recommended to consult with the buyer on recommended varieties and obtaining a license. Samples of the crop must be taken and tested ahead of harvesting.

CROPPING SYSTEMS

Daffodil bulbs are a perennial crop and can last up to 4 years of harvest before replanting, providing harvest is well-managed. Bulbs left undisturbed for 1st full year. In second spring flowering the flowers can be handpicked for floral market. In second summer the bulbs are lifted and dropped onto the soil surface along with leaves and allowed to dry, the leaves artificially desiccated by a burner and the bulbs lifted for indoor drying. Due to nematode risk the bulbs should not be established in soil used for potatoes.

Medicinal cannabis can be grown outdoors although temperatures <15°C restrict productivity; protected growing would produce higher yields in temperatures of between 24 and 30°C. Hemp and cannabis are low input crops, with dense canopy cover suppressing weeds.

PROCESSING AND SUPPLY CHAINS

Pharmaceutical crops are usually grown in contract with a pharmaceutical company that deals with processing the crop. Crop requirements should be discussed with the buyer.

For licensed and restricted crops, such as cannabis and poppies, perimeter farm security may need to be considered. Macfarlane Smith take care of harvesting of poppies for medicinal use, with the collection of latex from the opium pods being a labour intensive process taking several days, and pods maturing at different times.

TIMINGS

Daffodils are a perennial crop, with bulbs planted in August and September, and bulbs can last between 2 and 4 years. Ideally the biomass should be harvested with the majority of the plants at the 'goose neck' stage i.e. not all in full flower. The harvester would aim to collect above ground biomass and leave around 80mm to 100mm of daffodil 'stubble'. The daffodil season is January to April.

Hemp/cannabis is an annual crop, and spring sown, after frosts.

Sowing of poppies is usually in March or April, three months before flowering between July to September. Flowering lasts for two to three weeks during which time the seed pod containing the alkaloids develops.

St John's Wort perennial plant with total production of plant material of approximately 1.5 to 2 tonnes per hectare fresh weight. However, only around one third of the plant is harvested at any one time providing 0.5 to 0.7 tonnes per hectare per harvest. Two harvests per annum are possible. First harvesting should only take place one year after the plant's first flowering. In subsequent years the plant is harvested after flowering in June or July.

With restricted species, such as cannabis and poppies, seed may have to be bought under a contract from the agreed buyer. When growing for a specific pharmaceutical contract, specialist agronomic advice may be provided by the contractor.

MACHINERY AND EQUIPMENT

Less equipment is required for field cannabis crops, and protected production would require irrigation. Dual purpose hemp and cannabis crops can be grown using conventional farm machinery. The crop is harvested using a conventional combine harvester and the straw baled for fibre use. Seed should be dried to 9% moisture and cleaned to 2% admixture.

Daffodils can be planted with similar machinery and methods as potatoes. Commercially available planters would be needed for production on a commercial scale, but are potentially expensive (est. £7,000), especially if adapted for upland conditions. There are ongoing field experiments into the adaptation of quad-bikes for smaller-scale and upland production.

St John's Wort can be harvested with a reciprocating blade mower, aiming to harvest the top one third of the plant (where the active chemicals are concentrated), then the harvested material is dried after harvesting, before being pulverised for chemical and oil extraction.

Further information

- Agricultural Budgeting Costing Book
- The Horticulture Development Council's Narcissus Manual
- 'Yellow Gold': Innovative systems for sustainable daffodil-derived galanthamine production in the uplands. A presentation from Harper Adams University, Agroceutical Products Ltd and Aberystwyth University.
- Bioeconomy Consultants (NNFCC) Hemp (Cannabis sativa) Crop Factsheet.

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