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The Bioeconomy Consultants



Non-Food Crop Options for Jersey

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Executive Summary

The production of Jersey Royal potatoes has been a major contributor to the Jersey economy for many years. Due to their superior value when compared with alternative enterprises, they have commonly been cropped continuously on the same land, or as part of a very short crop rotation. This has led to the build-up of potato cyst nematode (PCN) which is a persistent pest with no limited or no effective and approved chemical treatment – the best method of control is breaking their production cycle by adopting a longer (up to 5 year) crop rotation.

The Jersey Royal acreage has declined by around 500ha in recent years and is expected to decline further in the short-term in an attempt to extend rotations and control the PCN problem. The island is therefore seeking alternative crop opportunities, to integrate into the crop rotations whilst remaining competitive, benefiting the local economy and ideally raising the profile of Jersey to in turn increase tourist visitor numbers year on year.

As an initial market scoping exercise, NNFCC have identified and reviewed a vast range of non-food crop opportunities across a number of sectors, including: medicinal herbs, pharmaceuticals, oleochemicals and novel oils, speciality food, bioenergy and algae. In order to qualitatively assess each opportunity the 26 showing the greatest promise in terms of production, manufacture and use were reviewed against a number of criteria, including: climatic conditions, agronomy, salt tolerance, market situation, value, potential for local use and ultimately their ability to improve the current PCN issue in the Jersey Royal potato crop.

Although resulting in high value outputs, the medicinal herb and pharmaceutical crops offered little opportunity for three main reasons: firstly, the crops are typically herbaceous perennials and therefore cannot be integrated into existing crop rotations; secondly, these herbaceous crops often require specialist planting and harvesting equipment which is not available on the island and would not be well used if introduced due to the small acreages involved; and thirdly, as these industries are highly regulated, there is no opportunity for local production and use, so it would not be possible to retain any additional value on the island.

The greatest market opportunity is apparent in novel oils for manufacture of personal care products. Within this sector, six crop species were identified as being highly suitable in terms of climate, agronomy, market, branding and local use potential, these were:

- AhiFlower
- Borage
- Evening Primrose
- Camelina
- Calendula
- Hemp

Each of these six crops is grown on an annual production cycle with most being spring-sown and early autumn-harvested, therefore integrating well with potato production as a means to extending existing crop rotations. They also use conventional planting and harvesting methods, for which equipment should already be available on Jersey, with capacity available at key times.

Within this market sector, there is also strong potential for local primary processing which in this case would be cold-pressing of oilseeds to extract unrefined oils – this process is simple and scalable from 10's to 100's of kilograms of seeds per hour. Equipment is widely available and relatively low-cost – a primary processing facility capable of pressing and filtering around 100kg per hour would cost less than £50k, with options to bottle, label and market cold-pressed oil for culinary use locally for an additional £30 – 50k (for bottling, capping and labelling equipment).

However, a higher value non-food opportunity is apparent in personal care products; whilst primary processing could still be undertaken on the island, filtered oils would be shipped to the mainland for further processing, product formulation and manufacture before being distributed and retailed nationally, globally or even returned to Jersey for local sale to the tourist sector, thus retaining maximum value within the islands economy.

In order to pursue this opportunity further work is required to explore the commercial potential, develop a business case and to identify specific gaps and investment needs for equipment, technology, skills and expertise.

Although opportunities were identified in other sectors, they were not scored as highly in the assessment phase primarily due to limited opportunities to deliver local benefits and less mature or lower value markets. Additional opportunities showing potential were speciality food (incl. samphire, truffles and asparagus) and bioenergy crops; although the former were excluded from the scope of this project (focus on non-food) and the latter were long-term perennial crops and thus were unable to assist directly with the PCN issue. These opportunities could potentially be considered alongside the speciality oils, to further extend crop rotations, to offer benefits to inland crops or to improve overall island self-sufficiency and sustainability.

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1 Introduction

The production of Jersey Royal potatoes is an important industry for the island of Jersey. The value of the crop compared to alternatives means that it has commonly been cropped on the same land continually, or on a very short rotation basis. This has led to the build-up of potato cyst nematodes (PCN) (*Globodera pallida* and *G. rostochiensis*). Prevention of these pests occurs through careful crop rotation and control traditionally relies on the use of nematicides. However, these products have gradually been withdrawn from use and / or are being phased out.

PCN is now a widespread problem through the island, to varying degrees and is resulting in both cosmetic potato skin damage and yield penalties affecting grower returns. Adopting an adequate rotational period (of 5 years or more) helps to reduce PCN incidence as part of a set of integrated control measures.

The Jersey Royal acreage stood at 3,500ha in 1997, but has declined to around 3,000ha now and could decline further to 2,000ha if 1,000ha of the worst effected land is taken out of production (300ha Category 4 and 1,000ha Category 3).

In addition to the reduction in area due to PCN occurrence, 2013 was a difficult season for the Jersey Royal industry with one of the worst winters on record, made worse by the exceptional snow in March. Delayed planting, additional costs and yield penalties resulted in slightly lower exports of 28,417 tonnes (171 tonnes lower than 2012) though a higher total gross return of £27.5M (£969/t) was achieved from the market¹.

In 2013, the total area of outdoor fruit and vegetables saw a reduction from 3,734 to 3,603ha mainly due to the fall in area of Jersey Royal potatoes from 3,235 to 2,949ha. Other fruit and vegetables fell by 20ha though the area of fruit and vegetables in organic production remained more or less static at 84ha. However, maincrop and other potatoes increased by 176ha (a 156% rise).

The States of Jersey Department of Environment wishes to identify other high value crops that could be included in the rotation to help improve the rotational practices while helping to offset the high land rents (by UK standards) and to reduce the financial impact of simply removing land from production.

Other crops including high value vegetables have been examined as alternatives, but economies of scale and the costs of shipping to the mainland have proven to be a hurdle.

The States of Jersey Department of Environment are therefore looking to examine what other alternative opportunities might be available from the non-food sector, recognising that

¹ Agricultural Statistics for 2013, Economic Development Department - <http://www.gov.je/Government/Pages/StatesReports.aspx?ReportID=1113>

there could also be opportunities for some on-island processing, to help reduce transport costs and retain value on the island.

The average size of holding in Jersey is around 70 vergées² (ca. 13ha); almost 50% of holdings have 0 – 10 vergées (ca. 2ha); 85% of holdings are less than 50 vergées (ca. 10ha) and less than 10% of holdings have 100 vergées or more (ca. 20 ha).

1.1.1 Project Aims

Traditional non-food crop markets tend to be characterised by small volumes of production and volatile prices, particularly in ‘uncontrolled’ markets where cheaper sources (e.g. China) can swamp markets and depress prices. There are a number of examples of this (e.g. Chamomile, Evening Primrose) or where alternative markets have depressed use (e.g. much Borage (Starflower Oil) has been replaced by algal products). However, market opportunities remain where provenance and local traceable supply chains are important factors.

Where markets have been tightly controlled (e.g. morphine poppy production) strong markets have developed and long-term relationships can be built. Unfortunately, there are very few examples of such controlled pharmaceutical crops. While many pharmaceuticals are based originally on plant-derived chemicals most of these can be synthesised chemically at lower cost.

Due to the infrastructure existing on the island of Jersey, although it may be difficult to identify successful examples of alternative enterprises, the potential for on-island processing and the ability to add the cachet of branding as a ‘Product of Jersey’ some interesting opportunities may become apparent.

The aims of this project are to undertake a primary scoping study to review the current position with regard to non-food crops and to discuss areas of interest with current end users and other industry stakeholders. The work will identify specific needs and / or opportunities in the non-food sector and link these with potential opportunities for crops in Jersey that could be taken forward in more a more detailed appraisal.

1.1.2 Project Methodology

Through a combination of existing knowledge, web-based research and discussions with industrial stakeholders, we have identified a vast range of novel crops options. The crops identified are primarily focussed on non-food opportunities, but there is some unavoidable cross-over into speciality food products. Furthermore, due to the main reason of this work being to address the PCN problem by extending the crop-rotation the focus is mostly on annual crops which can be integrated within existing arable rotations. A small number of perennial crop options have been considered, where particular indirect benefits are apparent – each will be explained in turn below.

² 1 vergées = 19,360 square feet (1,798.6 m²) = 0.444444 acres; 1 ha = 2.471 acres

Due to the problems with PCN this research has carefully considered a number of factors, to ensure new crop alternatives not only thrive on the island, but also improve the growing conditions for Jersey Royal production.

Being a small island, Jersey has limited land area and shipping costs are an important addition to production. Therefore, crops with high value and low volume outputs were prioritised. Islands are also typically reliant on significant imports of energy in the form of both fuel and food. Therefore crops which could improve sustainability and reduce reliance on imports were also considered.

Having an extensive coastline is a major factor to consider, as crops adjacent to the coast will suffer from salt spray and wind damage, and crops inland may also be subject to saline soils, with winds carrying the salt water. However, a number of crops have tolerance to salt and some even thrive in saline soils, and therefore would be well suited to growing on Jersey.

Protection of agricultural land using buffer crops such as evergreen salt tolerant trees and shrubs could be a possibility, to extend the range of crop options and to ensure greater productivity of niche inland crops. The coastline may also be exploited by the expansion of aquaculture.

Another major consideration is identifying crops which will complement potato production. Regular crop rotations bring many benefits, by improving soil fertility and reducing certain pests, disease, and weeds. It is extremely important to rotate crops from different plant families, as specific families are often targeted by the same pests and diseases, and have similar nutritional requirements. Potatoes are in the Solanaceae plant family; therefore break crops should not be from the Solanaceae family, as they would exacerbate the health problems faced currently. In particular, tomatoes are closely related to potato and suffer from the same nematode infestations (*Globodera rostochiensis*). Other Solanaceae crops to avoid include peppers, chilli and aubergine. In addition, certain crops increase potatoes susceptibility to blight, which should be avoided, including sunflowers, raspberries, pumpkins and squash.

Fortunately, there are a number of crops which complement potato production, by deterring pests and disease, such as marigolds, tansy, nasturtium, and asparagus. Other crops enhance potato flavour and growth, including beans, cabbage, and horseradish. Integrated pest management and good rotational practice, could be a vital tool in combating potato production decline in Jersey, where chemical alternatives are not performing.

In order to qualitatively assess each option for its suitability to Jersey and ability to address the challenges in question, a set of pre-defined criteria were developed; these included:

- **Climatic suitability** – based on published climate data for Jersey; incl. rainfall, daylight hours, average temperatures, max/min. temperatures and frost free days.

- **Market situation** – incl. level of maturity, scale of current market and future potential; also considered competitiveness against synthetic alternatives.
- **Value** – revenue potential for Jersey; incl. value of raw material, processing / manufacturing activities, and / or end product.
- **Branding opportunities** – potential for on-island processing, conversion or manufacture, to enable outputs to be branded 'Product of Jersey'.
- **Potential for local use** – considering the extent of tourism on Jersey and the resultant revenue potential or the possibility of displacing imports through local use.
- **Salt tolerance** – due to the location, climate and topography of Jersey, saline conditions are widespread, therefore a degree of salt tolerance would be favourable.
- **Addressing PCN issue** – ability to integrate within existing crop rotations on potato growing land, to break the PCN cycle or inhibit its spread.

2 Results

The following summarises the findings of our research, focussing primarily on non-food crop opportunities. However a limited number of speciality food crop options of notable interest have been included.

2.1 Medicinal Herbs

There is a large and growing demand worldwide for medicines from plants. Around 90% of plant medicines are still wild harvested, with a range of associated problems that impact on users' safety and the environment. New regulation for production and supply of mixed herbal extracts is in place and has created an opportunity for cultivation of endangered species in the UK, potentially. However, the introduction of the Traditional Herbal Medicines Directive in April 2011 meant unlicensed suppliers were no longer permitted on the market, and this reduced the scale of opportunity for local production.

Seventy percent of the 40-50,000 plant species used in herbal remedies worldwide are wild-crafted (20-30,000 tonnes pa from Europe, alone). 4,000 of these species are on the brink of extinction (WWF, 2004). 130 plant species are cultivated in Europe (between 70,000 and 100,000 ha), less than 500 species are cultivated world-wide.

Herbal medicines include raw herb (dried or fresh), tinctures (an infusion of herbs in alcohol), and extracts (solvent-extracted products). Herbal medicines are produced by direct extraction from whole plant material without further purification other than filtration. They generally contain a large number of constituents and active compounds possibly working in conjunction with each other, rather than a single, isolated active compound. Legislation has been introduced to control the sale of herbal products such as these; including Echinacea spp., Valerian and hops.

The range of plant materials used in herbal medicines includes all types of plant materials, including flowers, fruits, seeds, bark, gums exuded from trunks, roots and leaves. Generally traded material is dried and chopped/milled to some degree, usually by the producer.

The principal markets for medicinal herb raw materials are food and healthcare industries that manufacture:

- Dried herb products, incl. tablets and capsules
- Liquid extracts and tinctures
- Herbal teas
- Concentrated soft extracts (for further industrial application)
- Concentrated dry extracts (for further industrial application)

There are a number of key manufacturers in the UK, including:

- Seven Seas Ltd

- Neal’s Yard Remedies
- Boots plc
- Revital Ltd
- Brunel Healthcare (part of Elder Pharmaceuticals)
- Vifor Pharma UK Ltd (Potters Herbals)
- Ransom Naturals Ltd (part of William Ransom & Son)

Most of the manufacturers listed above were contacted as part of this research; although some were not able to discuss their supply chains or sourcing strategies, those whom were willing to engage in discussion provided some useful insight. In brief, discussions suggested the herbal extract industry continues to grow and is predicted to continue to grow, despite increasingly stringent regulations. Opportunities remain for the UK where provenance and local supply chains are important to manufacturers and suppliers, despite competition from India, China and EU countries. The smaller family-owned companies generally expressed the greatest interest in local supplies; however they stated that generally their sourcing strategies are influenced by their customers’ requirements, quality and price which can often restrict the opportunity for UK and EU suppliers.

Previous research led by NNFCC on UK medicinal crops concluded there are opportunities for R&D and production in the UK of between 14 and 36 species at least, highlighted due to the endangered, in-demand or suitability for production status. These include a large proportion of field-grown species, some of which may be suited to specific regions and others increasingly suited as a result of climate change. Specific crops showing strong potential, suited to UK conditions and cultivated in-field are summarised in the table below, further details can be found in the full report³.

| Common name (Spp) | Plant part used | Growth habits | Demand / Potential |
|---|--------------------------------|--|--|
| Bearberry (<i>Archostaphylos uva-ursi</i>) | Leaves, berries | Low-lying evergreen shrub. Prefers damp conditions | Limited potential, slow market growth. Competition from US. |
| Deadly nightshade (<i>Atropa Belladonna</i>) | Leaves, fresh/dried root | Perennial. Thrives in chalky soils. Leaves harvested in summer, roots in autumn. | Difficult to obtain; difficult to meet quality standards. Limited potential, slow market growth. |
| Wild indigo (<i>Baptisia tinctorum</i>) | Rhizome and root | Perennial herbaceous plant; grows to 3 metres. Needs good drainage. | Growing demand as immune system herb. Cultivation techniques require improvement. |
| Iceland moss | Whole | Yellow-green lichen, likes | Endangered medicinal plant – |

³ Investigation into the Potential Market and Feasibility of Introducing New Medicinal Plant Crops into the UK and Europe, 2007 (<http://www.nnfcc.co.uk/tools/investigation-into-the-potential-market-and-feasibility-of-introducing-new-medicinal-plant-crops-into-the-uk-and-europe-nnfcc-07-015>)

| | | | |
|---|---|--|---|
| <i>Cetraria islandica</i> | plant | alpine areas – not in-field. | strong market growth. |
| Hawthorn (<i>Crataegus oxyacantha</i>) | Dried flowers, berries | Deciduous thorny tree / shrub; grows to 8 metres tall. | Strong and growing market demand, high value. Further research on optimum varieties required. |
| Yellow Gentian (<i>Gentiana lutea</i>) | Fresh and dried root | Perennial herb; needs loamy soil and sheltered site – requires protection from windy conditions. | Top selling German prescription herbal; strong demand. |
| Goldenseal (<i>Hydrastis Canadensis</i>) | Rhizome | Herbaceous perennial | Demand strong and growing; supply limited. |
| Cowslip (<i>Primula veris</i>) | Flowers, leaves, root | Hairy perennial herb, growing 10-15cm only. | Low but growing demand. |
| Butcher's Broom (<i>Ruscus aculeatus</i>) | Aerial parts, rhizomes; collected when in fruit | Perennial shrub. | Relatively low, but growing demand. |
| White Soapwort (<i>Saponaria officinalis</i>) | Root, aerial parts | Perennial herb; gathered while in flower, roots gathered in autumn. | Medium demand; strong competition from overseas suppliers. |
| Baical Skullcap (<i>Scutellaria baicalensis</i>) | Root – from 3-4 year old plants | Perennial shrub. | Anti-nausea and AIDS treatment; growing demand. |
| Sweet Violet (<i>Viola odorata</i>) | Aerial parts | Perennial shrub; native to the UK. | Increasing demand for dried aerial parts; fragrance product. |

To exploit current opportunities, seed must be sourced from reputable suppliers, of which there are a few in the UK (CN Seeds, National Herb Centre). A list of registered herbalists is available from the trade associations' website (www.associationofmasterherbalists.co.uk). Although the companies contacted above may be able to supply lists of the most in-demand herbs, a warning should be made that by the time a grower has sourced seed, grown and harvested the crop and got it ready for market – the list may have changed. It is therefore best to confine activities in the early years of production to traditional herbals – such as ***Echinacea, Valerian, Skullcap, St John's Wort, milk thistle, feverfew, etc.***

It is evident from the research that all of the species which are potentially suited to the growing conditions on Jersey have a perennial growth cycle, so although they may become an integral part of a larger opportunity in the future, their ability to address the PCN issue is limited and hence these opportunities will not be explored further at this stage.

2.2 Pharmaceutical Crops

In plant derived single molecule pharmaceuticals, 'bioactives' are extracted on a commercial scale by large multinational companies. Extraction and purification is very expensive due to the complexity of plant materials extracted via the primary extraction step. The production of phytochemicals from plant biomass is largely dominated in the UK by MacFarlan-Smith (Johnson Matthey Plc) in opiates (from poppies), with expertise and facilities also at Ineos Fluor.

Farm gate price is for crude biomass (dried), with the most expensive parts of the process still to be undertaken – extraction (circa £10/kg biomass) and purification (circa £1000/kg active). Production and processing costs for field-based crops could be circa £2,000/ha, depending on price of seed and nature of crop establishment (direct drilling or seedling), however protected and high security crops would be much higher (circa 10-fold). Crop yields typically vary from 1-5 dried tonnes/ha. Negotiations for contracts need to take all these issues on board, with commensurate prices/kg biomass being offered. Target figures for dry material ex-farm gate vary from £2/kg for field grown crops, and £10/kg for protected crops, but could also be 10-20 times higher than this in some cases, at least.

Crops destined for the pharmaceutical industry need to be maintained, often without access to pesticides and herbicides due to lack of approvals and potential for contamination with residues. This could be a problem in Jersey soils, if heavy pesticide use is required for crop survival, unless nematode resistant crops and varieties are selected. The crop must be harvested optimally for bioactive, washed (in some cases), dried, milled and stored/transported. Rigorous health and safety management will be required due to the complex chemistry in the raw material. Processing will require food-grade standards at the least and due to this complexity and the associated costs, is unlikely to be carried out in new extraction and processing facilities on Jersey. This opportunity is therefore likely to be limited to on-island cultivation, followed potentially by washing, drying and milling before being exported to the mainland for further processing and bioactive extraction.

Some examples of pharmaceutical crops that could be suitable for cultivation on Jersey are included below.

2.2.1 Daffodils

Daffodils produce a range of useful secondary metabolites, including Galanthamine, which is extracted from the bulbs and approved by the National Institute for Health and Clinical Excellence in the UK as a treatment of early stage and moderate Alzheimer's dementia.

Alzheimer's currently affects at least 600,000 people in the UK and as many as 35 million people worldwide, and incidences will increase dramatically as average life expectancies increase. There is large potential in the market since patents on Galanthamine, marketed as

Reminyl by pharmaceutical company Shire Pharmaceuticals, have recently expired and it is reportedly difficult to synthesise artificially.

Agroceutical Products in Brecon in mid-Wales are leading scientific work, discovering that chemical levels can be enhanced by certain stresses, and have developed highly specialised fertiliser treatments, unique harvesting and processing equipment. Daffodils grow well in the UK and European climates and some varieties show high levels of salt tolerance.

This could be a significant opportunity, but further research is required to determine the agronomic suitability to Jersey. Although daffodils are perennial plants, as Galanthamine is extracted from the bulb the whole plants are harvested, making this an annual crop when cultivated for this market. Involvement is likely to be limited to cultivation and drying prior to export. Land area requirements are likely to extend to 10's of hectares per year as opposed to hundreds or thousands and therefore overall value potential for the island is limited.

2.2.2 *Artemisia annua*

Artemisia annua, or sweet wormwood, is a shrub which contains the drug Artemisinin, which is used for anti-malarial combination therapy. Global demand rapidly outstripped production in 2004, leading to the World Health Organisation taking action to help farmers reduce costs and increase efficiency to ensure sufficient supply.

Sanofi created a synthetic alternative in 2013 using genetically-engineered yeast, costing £230-260 per kilogram, which is similar to the botanical source, and this may become cheaper in future. However, Sanofi currently only have the capacity to meet a third of the demand, equating to around 50-60 tonnes per year.

Artemisia is a fast growing annual, which thrives in sandy/loam, well drained, fertile soils, and in sunny temperate climates. *Artemisia annua* is extremely vigorous and essentially disease and pest free. However, it may not be suitable to grow on Jersey, as the growing season may not be long enough to accumulate high levels of Artemisinin.

Cultivation is in the relatively early stages in the UK and therefore further research would be required to more accurately determine suitability for cultivation on Jersey. Post-harvest options would also be limited, as *Artemisia* would likely need to be shipped fresh to the mainland, potentially incurring significant costs.

2.2.3 *Rosemary*

Market research indicates that there is a demand for rosemary extract as an antioxidant and the estimate of the worldwide value of the market was between £70-90 million in 2006. This market would require the production of 60,000 ha of rosemary assuming a price of £30/kg for 4% extract and a content of carnosic acid of 2.5%, 50kg/ha. The carnosic acid content of selected accessions grown in the UK is typically 4% and above, much higher than those

traditionally imported from Spain and North Africa which have carnosic acid concentrations of just 1%.

There are already a number of companies in Europe and the US extracting, marketing and using rosemary antioxidants in food, animal food, nutraceuticals and cosmetics. In addition there is a potentially large market for natural antioxidants in the plastics and biolubricants markets especially within food packaging and high value pharmaceutical plastics for prosthetics.

Rosemary is mildly salt tolerant and suited to the mild Jersey climate, but would need to be sheltered from the wind. However, Rosemary is a perennial herb and so would not integrate within typical annual crop rotations on Jersey and would not aid the issue with PCN persistence, unless a longer-term break crop was required to eliminate the issue on some of the more highly contaminated land.

2.2.4 Poppies

Poppies are grown commercially for the extraction of morphine and other valuable opiate drugs. Growing opium poppies requires a license from the UK government, and is illegal in many parts of the world including the USA and Germany, therefore limiting production but having large potential in global markets.

Poppies are a spring sown break crop and are well suited to the UK climate. They also have some tolerance to salt, growing in coastal areas, making them suitable for Jersey. Johnson Matthey Macfarlan Smith has ownership of the only UK poppy growing business, managing morphine supply from both UK and Portugal. Macfarlan Smith manages the agronomy as well as the harvesting of the crop, using specialist equipment. Growers are selected for their professionalism, location, soil type and their facilities including an on floor drying system, and are currently located in Dorset, Hampshire, Oxfordshire and Lincolnshire.

Having discussed opportunities for Jersey with Macfarlan Smith, they currently have no plans to expand production outside of the current growing areas on mainland UK, so this option will not be pursued; however if market dynamics and demand change in the future, it could be something to reconsider due to its climatic and agronomic compatibility.

2.3 Oleochemicals and novel oils

The largest application for oleochemicals, about 30% of market share for fatty acids and 55% for fatty alcohols, is for making soaps and detergents. Other applications of oleochemicals include the production of lubricants, solvents, biodiesel and bioplastics. Novel oils can also include those used in cosmetics, toiletries, healthcare products and even culinary applications for flavours, fragrances, dyes and nutritional benefits.

The cosmetics market in the UK is currently worth over £6 billion; a 3% market growth was reported in 2014. Plant derived oils and essential oils are used in cosmetics production but data is difficult to obtain from industry on volumes and market size. Similarly the market for natural healthcare products and food supplements, such as Omega -3 and -6 fatty acids, is expanding as health awareness improves and the population increases.

Natural oils are typically extracted in one of two ways; CO₂ extraction or cold pressing. The former requires highly specialised facilities; however the latter is a simpler option which can be carried out on relatively small-scales, whilst achieving good quality oil products. This option could be suitable for Jersey, where primary processing of relatively small-volumes of oilseeds is required prior to product manufacture. Cold-pressing is also suitable for batch-processing, so a range of oilseeds could be pressed through the same system in small batches, maximising the use and value of the equipment.

Subsequently oils could be exported for further processing and product manufacture, and potentially returned to Jersey and / or sold on mainland UK or more widely whilst still carrying the 'Product of Jersey' brand.

Refined oils require more complex processing but have odour and colour removed and have a longer shelf-life, of 24 months as opposed to 12-months. Refining is typically carried out in larger centralised facilities, due to the greater complexity and the higher cost of processing and handling equipment.

One particular company in the UK that focusses on production, processing and manufacture of speciality oil crops, oils and products is Statfold Seed Oils. They have been consulted as part of this research; they offer a multitude of opportunities for Jersey to consider, and further consultation should help to refine the list of opportunities and the benefits they may offer.

Statfold Seed Oils - Producer/Supplier of:

- Bulk Oils – globally sourced and supplied
- Essential Oils & Natural Fragrances – supplies over 200 oils, working with UK and global suppliers
- Nutritional Oils – grown and sourced in the UK/locally
- Extracts & Infused Oils – botanical extracts from flowers, leaves, bark, roots, fruit, berries, gums, whole plants and herbs
- Bulk Skin Care Bases – washes, gels, creams and lotions

Statfold Seed Oils - Services offered include:

- Contract Bottling – medium-sized and automated bottling and labelling facilities, to bottle small or large batches of oils or products.
- Cold Pressing – operating 20 cold pressing expellers with capacity to process 80 tonnes of seed per month
- Refining & Deodorising – ideal for high quality cosmetic grade oils
- Personal Care Manufacture – formulating and packaging products to suit unique brand requirements.

The following section summarises some of the key novel oil crops that meet some or all of the requirements for production on Jersey.

2.3.1 AhiFlower

The AhiFlower is an innovative crop, bred to have seeds rich in fish oils. Technology Crops International (TCI) developed the crop from *Buglossoides arvensis*, with seed oil exceptionally rich in plant-based source of omega-3 and omega-6 fatty acids, specifically, stearidonic acid (SDA) and gamma-linolenic acid (GLA). These are important nutrients for health, but mainly come from fish in the human diet, as they are naturally low in most plants, but overfishing and expense makes alternative sources an attractive lucrative market. *B. arvensis* is native to Europe, and can be annual or perennial, making it a suitable break crop.

AhiFlower is still becoming established in the UK, so suppliers and manufacturers are actively seeking growers. However, although mainland UK is the primary target, opportunities for wider sourcing may become apparent in the short- to medium-term.

2.3.2 Borage

Borage produces oil from the seed which is used in dietary supplements, baby foods, veterinary and personal care products. Borage seed oil is very high in gamma-linolenic acid (GLA) and valuable fatty acids, and is medicinally used to improve circulation and target blood disorders. It is also used to treat skin disorders such as Eczema, Rosacea, Atopic Dermatitis and Cradle Cap in infants; there is even an application pending for borage oil as a non-dairy creamer.

According to the UK's largest producer of Borage, it is the most profitable arable spring sown crop available, with opportunities to earn over £900 per hectare gross margin.

Borage uptakes salts from the ground, which gives the stems and leaves a salty flavour, which is good for remediating saline soils but can harm the plant if salt concentration is too high. It is also claimed to be a good companion plant, attracting bees and pollinators, and repels the tomato hornworm, leaving mulch high in potassium and calcium.

Borage is easy to grow, likes full to partial sun exposure, and grows well in Europe. This is a significant opportunity for Jersey, as growing conditions are highly suitable, it is an annual spring sown crop that would substitute potatoes in a rotation well and the market and product range is established; offering opportunities for local production, processing prior to export to the mainland for product formulation.

2.3.3 Evening Primrose

Evening Primrose is an annual or biennial (maturing over 14 -20 months) – its seeds are a rich source of gamma linolenic acid (GLA) which is used in health & nutritional supplements as well as cosmetics and skincare treatments. Yields are typically low (<1t/ha), although potential in optimum conditions is greater (2.5t/ha). It is a spring sown crop, but is sensitive to drought so requires rain after sowing to aid establishment.

Lowland areas are preferred and shelter is essential due to risk of seed loss at maturity. The crop requires warm, sunny conditions and dislikes shady areas – the north of the UK is unsuitable due to average annual temperatures being too low.

Historically significant areas of Evening Primrose were cultivated in the UK; however cheaper production in China, India and Asia caused production levels to fall in the late 90's. Opportunities still remain where local processing, manufacture, product branding and marketing is undertaken, making this an ideal opportunity for Jersey.

2.3.4 Camelina Oil (Gold of Pleasure)

Camelina Oil is cold-pressed from the seeds of the Brassicaceae annual plant *Camelina sativa*, also known as false flax or Gold of Pleasure. Camelina is mildly salt tolerant, so could be grown inland as a break crop. The oil content of the seed, on a dry weight basis, is typically between 30 and 40 percent.

Camelina oil can be used in both edible and industrial products. More recently camelina is being grown as a source of vegetable oil high in omega-3 fatty acids. The oil has been used successfully as an adjuvant in agricultural spraying applications, as a biodiesel, and it has been approved for use in cattle, chicken, and pig feed. Camelina meal, the product remaining after the oil has been extracted from the seed, is similar to soybean and canola meal and contains more than 40% protein and has a moderately-low glucosinolate content.

Camelina Oil is a very rich source of Polyunsaturated Fatty Acids (PUFA's) which makes it an excellent choice for nutraceutical use. Due to its high EFA (essential fatty acid) and linoleic acid content, Camelina Oil has very good effects on the skin, acting as an anti-age and emollient agent to improve skin elasticity and suppleness. Camelina Oil may be used in cosmetics, toiletries, soaps, pharmaceuticals, sun care and nutraceuticals.

Camelina seems to perform well as a companion crop and is considered a weed in many areas, due to its ability to survive in a diverse range of habitats, which enables it to be

introduced fairly easily into new environments. Camelina is often grown on marginal land and it responds well under drought stress conditions but may be better suited to low rainfall regions than most other oilseed crops. Camelina is highly sensitive to residual soil herbicides imidazolinones and sulfentrazone, so the field's history is important.

Camelina offers a significant opportunity for Jersey as a spring sown annual crop with proven benefits in personal care products. There would be an opportunity to extract the oil on-island and potentially export to the mainland for product formulation, branding and distribution.

2.3.5 Calendula (Pot Marigold)

Calendula is an annual (or perennial) companion plant which attracts pollen beetles and repels nematodes from the soil, which could be very beneficial to Jersey Royal production. Marigolds have some tolerance to salt, but would grow better inland.

Calendula, also known as Pot Marigold, has been an important medicine in folk healing in Ancient Greece, Rome and Arabia. Calendula preparations are used for treating e.g. minor wounds, callouses, eczema, itches, burns, insect bites and stings. The carotenes in Calendula promote the renewal of surface tissue and its antibacterial properties prevent infections. The power of Calendula has also been harnessed in beauty therapy, and it is used in lotions, creams and other cosmetics. Calendula has also been used to dye textiles yellow. The plant has many essential oils and so it has been used as an ingredient in perfumes.

Calendula leaves can be made into a pleasant tea or eaten in salads, and the flowers suit different kinds of food. It is also used as a substitute for saffron. Field marigold is quite common species in Central and South Europe.

Calendula, in a similar way to Camelina, offers significant opportunities for cultivation and primary processing on Jersey, with the added benefit of deterring nematodes.

2.3.6 Linseed/Flax

Linseed, also known as Flax, is a winter or spring sown annual crop. The crop is a rich source of Alpha-Linolenic Acid (ALA), omega-3 fatty acids and is widely grown on mainland UK and across Europe. Linseed oil or flax oil is widely used in healthcare supplements and personal care products. Flax is also grown for its fibre, which is used in composite manufacture due to its lightweight but high strength properties.

Linseed is easy to grow, with low input costs and a relatively short growing season meaning it integrates well into existing rotations as a spring-sown break crop and offers attractive returns. It is sown using conventional cereal or oilseed drilling equipment and harvested with a conventional combine harvester. The crop is either grown for its oil (linseed) or fibre (flax) but not both due to different varieties, agronomy and harvesting requirements.

The seeds harvested from linseed are tiny and overall yields are low, thus making this a viable option for production and export from Jersey to mainland UK for processing, extraction, formulation and product manufacture. Linseed can be cold-pressed, so primary processing could be undertaken on Jersey prior to shipping oil to the mainland for product formulation, manufacture and distribution.

2.3.7 Hemp

Hemp is a 4m tall, multifunctional, break crop, which produces fibre, oils, seeds, and valuable chemicals. Hemp fibre are six times as strong as cotton, and used to make paper, pulp, rope, cloth, furnishings, animal bedding, and building materials such as loft insulation and hempcrete, which has a lower carbon intensity than concrete.

Hemp oils are rich in omega-3 & -6 fatty acids, and are used in many applications including creams, cooking, plastics, and fuels. The seeds can also be eaten raw, and leaves used in teas. In some varieties, cannaboids can be extracted for use in multiple sclerosis treatment. In recent years breeding and selection has resulted in cultivars low in THC, the recreational drug, and hemp is once again being considered by governments as a useful crop. However, you need a Home Office licence to grow hemp in the UK.

Hemp grows fast, is very adaptable to soil and climatic conditions and is undemanding on resources such as artificial fertilisers and pesticides. It provides a good break crop for the farmer, giving the land a rest from other crops and helping to prevent disease. Hemp would be a useful crop to integrate into the existing rotation on Jersey, but it requires speciality harvesting equipment and would be a bulk product to export for processing as there is currently no small-scale equipment suitable for processing and fibre-extraction.

2.3.8 Sunflower

Sunflower oil is generally considered a premium oil because of its light colour, high level of unsaturated fatty acids and lack of linolenic acid, bland flavour and high smoke points. The primary fatty acids in the oil are oleic and linoleic (typically 90% unsaturated), with the remainder consisting of palmitic and stearic saturated fatty acids. The primary use is as a salad and cooking oil or in margarine but it is also commonly used in personal care products such as creams, gels, lotions and washes. Seeds are also widely used in foods, animal feeds and bird feed mixes.

Sunflower is an annual spring sown crop with a relatively short growing season, although seeds mature early harvest can sometimes be quite late in comparison to other oilseeds, as the seeds must be dry when collected. It is planted and harvested using conventional drilling and combining equipment. Although good drainage is required the crop is not drought tolerant and requires access to water at critical growth periods – it may require irrigation in drier climates. Sunflower has low tolerance to salt.

Although Sunflower suits the Jersey climate; the saline growing conditions and the scale of global competition make the opportunity for Jersey more challenging to exploit. This may form part of a wider package of speciality oilseeds cultivated on the island but is unlikely to be a major contributor. It is also known to increase potatoes susceptibility to blight and would therefore not be a good companion crop in rotation with Jersey Royal potatoes.

2.3.9 Bog Myrtle (*Myrica gale*)

Bog Myrtle, also known as Myrcia gale, is a deciduous shrub native to north-west Europe, so could grow well on Jersey. Bog Myrtle is grown for its essential oils, dried bog myrtle, antibacterial and insect repellent properties. It thrives in Bogs, marshes, fens and wet heathland in acid soils but plants are occasionally found in calcareous fens. Although this is not suitable for addressing rotational issues experienced on Jersey, it could form part of an integral speciality oil product range.

There are around eight producers in the UK, including in south west England. Products are exported to Canada, Australia, USA, and within the UK.

2.3.10 Sea Buckthorn

Sea Buckthorn is a hardy drought and salt tolerant shrub, which produces orange 'superfruits'. The fruits contain oils rich in carotenes, omega 3 and 6, serotonin, vitamins A, B, C, and E, which are used for nutraceuticals health products and skin healing applications, such as facial cream and shampoo or for burns and eczema. The fruits are also sold as juice, oil, jam, carbonated and alcoholic beverages, toffees, biscuits, fruit chews, and nutritional ingredients. Leaves can also be used as tea. Many drugs have also been developed from sea buckthorn in Russia and China in different forms.

Sea buckthorn can control soil erosion and water loss effectively, and increase land reclamation in coastal areas. It would very suited to the climatic conditions of Jersey, and provide high value health products. However, as a shrub it is not a solution to the rotational issue but could form part of a wider package of speciality personal care products.

2.3.11 Samphire

Marsh Samphire is an increasingly popular health product which grows naturally in coastal areas, and loves saline conditions. It can be sold as a speciality vegetable which goes very well with fish and could complement Jerseys fishing industry, or used in high quality body and hand lotions, for its high levels of vitamin C and A, and minerals iron, calcium and magnesium which have antioxidant and regenerative actions on the skin.

Marsh samphire is currently used in high value UK brands such as Molton Brown and Noble Isle cosmetics and toiletries. Marsh samphire could be grown on Jersey's coastal areas, but the crop is unlikely to offer any benefit in terms of addressing PCN issues. Again, it could form part of a wider package of speciality outputs, but should not be a major future focus.

2.4 Speciality food crops

Although the focus of this project is specifically non-food crops, two specific speciality food opportunities with of particular interest were identified during this research. Although these opportunities may not address the Jersey Royal issue directly, they could be considered as part of a broader package of opportunities with potential for branding or local use on Jersey.

2.4.1 Truffles

Truffles are a very high value product and have great branding potential. Jersey's sunny, mild and wet climate makes it the only place suitable for Black Summer Truffle cultivation in the UK, and with droughts in the south of Europe causing yield decline, there is plenty of room in the market. Summer Truffles would also grow well on Jersey.

The UK market price for Black Truffles is currently ~ £1000 /kg and ~£400/kg for Summer Truffles. Damaged truffles can also be used for flavourings, oils, and value added to other products, including vodka and gin.

Mycorrhizal Systems who lead cultivation of summer and winter truffles in the UK provide plantation expertise, and guidance on harvesting, and can help with distribution if required.

Only 1-5 hectares of land would be needed and plantations can be made to look like natural forests, as truffles grow on the roots of trees including Hazel, Oak, Birch, and Quercus ilex (a salt tolerant evergreen suited to Jersey climate).

Preparation is the main work, only weeding is required for maintenance. Truffles are then harvested after 4 years using trained dogs to located them and humans to extract and clean them prior to them being shipped to the UK by courier for packaging and distribution.

Despite climatic conditions on Jersey being ideal, this opportunity would clearly not be suitable for production on existing arable land and would not directly address the current potato crop issue. However, the high value, low volume nature of production could add significant value to the Jersey crop industry, whilst offering opportunities for branding as a 'Product of Jersey'. There is also the potential for using damaged truffles as flavourings or for their truffle oil which could be used in cosmetics, skincare treatments and toiletries, for example.

2.4.2 Asparagus

Asparagus is a luxury health food, which thrives in salty conditions. Asparagus in the UK comes mostly from Peru, shipped in out of season. However, fresh British seasonal asparagus is highly sought after. Since asparagus often originates in maritime habitats, it thrives in soils that are too saline for normal weeds to grow.

Most importantly, Asparagus is said to be a useful companion plant for tomatoes and potatoes as it repels some harmful root nematodes so this could be a viable option for Jersey to consider, specifically addressing the current pest problem.

2.5 Salt tolerant trees and tall grasses

In order to protect the inland arable areas and to increase the range of crop options available for cultivation on Jersey, there are a number of suitable tree species, such as *Quercus ilex* (oak) and *Pinus nigra* (black pine), which could form a coastline buffer in the most exposed areas; however such species are likely to significantly change the landscape and result in the conversion of land from agricultural to forestry production which is likely an undesirable outcome for Jersey. Other salt tolerant grasses and woody biomass, such as *Miscanthus* and Willow, could be planted to offer a more temporary layer of protection; these crops would be harvested for bioenergy production, to improve sustainable heat and power generation on the island and to reduce fuel imports.

2.5.1 *Quercus ilex*

This salt tolerant evergreen oak tree would be ideal for sheltering crops further inland from salt spray and wind, having leaves all year round and being an attractive looking tree. It can be used in conjunction with truffle production, but the truffles may need to be grown further inland to limit salt exposure. The wood can be used in construction and furniture production for example and the acorns are edible.

2.5.2 *Miscanthus x giganteus*

Miscanthus is a 3 metre tall perennial bioenergy grass which grows well on salty soils, and could act as a buffer to salt spray and wind protecting crops further inland. The strong rhizome system deeply penetrates soil and can stabilise it, which prevents erosion and the crop is also used to regenerate damaged or contaminated soils. *Miscanthus* rhizomes are sown using potato planters, which Jersey already have the infrastructure for. It is generally harvested using a forage harvester, which may currently be present on Jersey, or alternatively a grass mower and baler could be used to cut and collect the biomass.

Once matured after 2-3 years *Miscanthus* is harvested annually, yielding around 10 – 12 tonnes per hectare. *Miscanthus* can be burned for heat and electricity production, so could make Jersey more energy independent, reducing energy imports onto the island.

2.5.3 Willow

Willow (*Salix* spp.) are fast growing moderately salt tolerant trees which are typically coppiced every three years. Willow trees could be used as a buffer to protect less salt and wind tolerant crops inland.

Aqueous extracts of the bark are said to have analgesic, antiseptic, astringent, anti-pyretic, and anti-inflammatory properties when ingested. The bark extract salicin is excellent for the skin, with antibacterial properties, aroma, and beta-hydroxy acid dry skin alleviation. This could be combined with some of the novel oil opportunities, to extend a skincare or cosmetics range carrying the Jersey brand. Furthermore the woody biomass is a good energy source; when harvested the trees are chipped and burned to generate heat and/or electricity – this could make Jersey more energy independent and less reliant on imports.

Willow typically yields around 25 – 30 tonnes of biomass when harvested every three years; averaging around 10 tonnes per year equivalent and the calorific value of the fuel is similar to or slightly higher than *Miscanthus*. Conventionally Willow is harvested using modified sugar cane harvesters, so this opportunity would only be successful on a small-scale on Jersey, avoiding the need to transport a harvester over, focussing on manual harvesting only.

2.6 Algae

Algae, including seaweed and microalgae, are used for an impressive range of high value products, including nutraceuticals, pharmaceuticals, cosmeceuticals, biopolymers, bioplastics, fermentation products, feed, oils, biofuels, hydrogen, and biogas. They do not compete for arable land or fresh water, and are widely considered as advanced feedstocks for biofuels and high value chemicals.

Growing seaweed could complement land production systems, using the material as a traditional fertiliser to enhance potato flavour, opening up new high value markets in seaweed extracts and oils, for cosmetics, toiletries, and skincare and healthcare products.

NNFCC are the pioneers and coordinators of the EnAlgae project, to facilitate collaboration between algae research and industry. The EnAlgae project could potentially link Jersey with algae scale up facilities, researchers or algae companies willing to invest or share expertise. The closest research partners to Jersey are Plymouth Marine Laboratory in SW England and the Centre d'Etude et de Valorisation des Algues in NW France who specialise in extracting algae proteins.

2.6.1 Seaweeds

Seaweed (macroalgae) can be grown on lines in seawater and therefore reducing pressure on freshwater sources. Seaweed is still used traditionally in Jersey Royal production for flavour by hand harvesting from the beach. If production was increased, valuable oils and chemicals could be extracted and sold, including alginate, and the remaining biomass used as a fertiliser. This would reduce any current dependence on imported fertiliser and create more high value products, while remaining with traditions.

2.6.2 Sea Oak Seaweed

Sea Oak (*Fucus vesiculosus*) is a form of kelp that has long been celebrated for its soothing effects on the skin, thanks to its abundance of minerals including iodine, calcium, magnesium and potassium. It can be used to make high quality hand lotion and hand wash. Sea Oak grown on lines in the sea would not compete with land crops, and does not require fresh water or fertilisers.

2.6.3 Microalgae

Microalgae (tiny sea plants) can be used to treat waste water and have applications in bioenergy and fuels, or can be grown in fresh water to produce higher value chemicals, pharmaceuticals, and cosmetics. This opportunity is more limited on Jersey and so has not been explored further.

Table 1: Results matrix, showing findings from qualitative analysis of opportunities

| OVERALL RATING | Crop | Medicinal Herbs | Pharmaceutials | Oleochemicals & Novel Oils | Health & Wellbeing | Fibre | Energy | Speciality Food | Lifecycle | Climate | Market | Value | Branding | Local use | Salt tolerance | PCN Issue | TOTAL |
|----------------|------------------|-----------------|----------------|----------------------------|--------------------|-------|--------|-----------------|-----------|---------|--------|-------|----------|-----------|----------------|-----------|-------|
| ● | Echinacea | ✓ | ✗ | ✗ | ✓ | ✗ | ✗ | ✗ | Perennial | 3 | 3 | 4 | 1 | 1 | 2 | 1 | ● 15 |
| ● | Valerian | ✓ | ✗ | ✗ | ✓ | ✗ | ✗ | ✗ | Perennial | 4 | 3 | 4 | 1 | 1 | 3 | 1 | ● 17 |
| ● | Skullcap | ✓ | ✗ | ✗ | ✓ | ✗ | ✗ | ✗ | Perennial | 3 | 2 | 3 | 1 | 1 | 2 | 1 | ● 13 |
| ● | St Johns Wort | ✓ | ✗ | ✗ | ✓ | ✗ | ✗ | ✗ | Perennial | 3 | 3 | 4 | 1 | 1 | 2 | 1 | ● 15 |
| ● | Milkthistle | ✓ | ✗ | ✗ | ✓ | ✗ | ✗ | ✗ | Perennial | 4 | 3 | 3 | 1 | 1 | 2 | 1 | ● 15 |
| ● | Feverfew | ✓ | ✗ | ✗ | ✓ | ✗ | ✗ | ✗ | Perennial | 3 | 2 | 3 | 1 | 1 | 3 | 1 | ● 14 |
| ● | Daffodil | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ | Annual | 3 | 2 | 4 | 1 | 1 | 4 | 1 | ● 16 |
| ● | Artemisia annua | ✗ | ✓ | ✗ | ✓ | ✗ | ✗ | ✗ | Annual | 2 | 4 | 4 | 1 | 1 | 3 | 3 | ● 18 |
| ● | Rosemary | ✓ | ✓ | ✗ | ✓ | ✗ | ✗ | ✓ | Perennial | 4 | 3 | 4 | 4 | 2 | 3 | 2 | ● 22 |
| ● | Opium Poppy | ✗ | ✓ | ✗ | ✗ | ✗ | ✗ | ✗ | Annual | 3 | 4 | 4 | 1 | 1 | 3 | 4 | ● 20 |
| ● | AhiFlower | ✗ | ✗ | ✓ | ✓ | ✗ | ✗ | ✓ | Annual | 4 | 2 | 4 | 4 | 3 | 3 | 4 | ● 24 |
| ● | Borage | ✗ | ✓ | ✓ | ✓ | ✗ | ✗ | ✓ | Annual | 4 | 4 | 4 | 4 | 2 | 3 | 4 | ● 25 |
| ● | Evening Primrose | ✗ | ✓ | ✓ | ✓ | ✗ | ✗ | ✗ | Annual | 4 | 4 | 4 | 4 | 2 | 3 | 4 | ● 25 |
| ● | Camelina Sativa | ✗ | ✓ | ✓ | ✓ | ✗ | ✗ | ✗ | Annual | 4 | 4 | 4 | 4 | 2 | 3 | 4 | ● 25 |
| ● | Calendula | ✗ | ✗ | ✓ | ✓ | ✗ | ✗ | ✓ | Annual | 4 | 4 | 4 | 5 | 2 | 3 | 5 | ● 27 |
| ● | Flax | ✗ | ✗ | ✓ | ✓ | ✓ | ✗ | ✓ | Annual | 4 | 5 | 3 | 4 | 2 | 4 | 3 | ● 25 |
| ● | Hemp | ✗ | ✓ | ✗ | ✓ | ✓ | ✓ | ✓ | Annual | 4 | 3 | 3 | 4 | 4 | 3 | 4 | ● 25 |
| ● | Sunflower | ✗ | ✗ | ✓ | ✓ | ✗ | ✓ | ✓ | Annual | 4 | 4 | 3 | 4 | 4 | 4 | 4 | ● 27 |
| ● | Bog Myrtle | ✗ | ✓ | ✗ | ✓ | ✗ | ✗ | ✗ | Perennial | 4 | 4 | 4 | 4 | 2 | 3 | 1 | ● 22 |
| ● | Sea Buckthorn | ✗ | ✗ | ✓ | ✓ | ✗ | ✗ | ✓ | Perennial | 4 | 3 | 4 | 3 | 2 | 4 | 1 | ● 21 |
| ● | Samphire | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ | ✓ | Annual | 3 | 3 | 3 | 3 | 3 | 4 | 3 | ● 22 |
| ● | Truffles | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ | ✓ | Perennial | 5 | 5 | 5 | 4 | 2 | 3 | 1 | ● 25 |
| ● | Asparagus | ✗ | ✗ | ✗ | ✓ | ✗ | ✗ | ✓ | Perennial | 4 | 5 | 2 | 4 | 3 | 4 | 2 | ● 24 |
| ● | Miscanthus | ✗ | ✗ | ✗ | ✗ | ✓ | ✓ | ✗ | Perennial | 4 | 5 | 2 | 2 | 5 | 5 | 1 | ● 24 |
| ● | Willow | ✗ | ✗ | ✗ | ✓ | ✓ | ✓ | ✗ | Perennial | 4 | 5 | 2 | 2 | 5 | 5 | 1 | ● 24 |
| ● | Algae | ✗ | ✓ | ✗ | ✓ | ✗ | ✓ | ✗ | Annual | 4 | 2 | 5 | 2 | 2 | 5 | 1 | ● 21 |

3 Conclusion

A vast number of opportunities have been explored for their potential on Jersey. To address the current pest problem in the potato industry and avoid the need for specialist planting and harvesting equipment whilst maximising value to the island, the greatest opportunity appears collectively in the novel oils sector.

In order for Jersey to benefit from these new opportunities and to retain as much value as possible for the island, the focus should be on high-value personal care products including cosmetics, toiletries and skincare treatments, such as creams, gels, lotions and washes. Such products would also lend themselves to branding as 'Product of Jersey' thus recognising the provenance of the material, increasing recognition and visitor numbers, and retaining as much value as possible for the islands economy.

A Jersey-branded personal care range comprising products made from and fragranced with Borage, Evening Primrose, Hemp, Camelina and Calendula for example could be an attractive proposition; offering opportunities for on-island sales to the tourism industry and potentially global sales, increasing the global recognition of Jersey as a raw material supplier.

A range of spring-sown annual novel oil crops could be cultivated as part of the existing crop rotation; spring sowing allows for land to be cleared of the previous crop and prepared for timely planting, and the typically short growing seasons of most novel oil crops lead to early autumn harvesting, allowing timely land preparation for the subsequent crop.

Most oil crops can be planted and harvested using conventional equipment; yielding low quantities of relatively high value outputs, meaning storage and transport requirements are simple and costs are kept low. There are also opportunities for primarily processing to be undertaken on-site or locally, using simple cold-pressing equipment to retain added value on the island. Small-scale equipment for this purpose is widely available and relatively cheap to purchase, install and operate – primary processing facility capable of pressing and filtering around 100kg per hour would cost less than £50k, with options to bottle, label and market cold-pressed oil for culinary use locally for an additional £30 – 50k (for bottling, capping and labelling equipment). Such equipment can be used on a range of oilseeds as opposed to a single seed type and is scalable from 10's to 100's of kilograms of seeds per hour. From this processing unit quality oil could be produced, which in low volumes could be shipped to mainland UK for further processing, formulation and product manufacture.

As illustrated in Table 1 crops suitable for cultivation on Jersey and of particular interest for this market include: AhiFlower, Borage, Evening Primrose, Camelina, Calendula and Hemp.

In order to establish a successful personal care products supply chain, the following stages would need to be considered:



Additional opportunities for Jersey, illustrated in Table 1 as having strong potential are bioenergy crops and specialty food crops. These options however do not directly fit within the purpose or scope of this project.

Bioenergy opportunities such as Miscanthus and SRC willow are perennial crops and are typically produced on non-prime arable land. There may be opportunities to remove small areas of land worst effected or at highest risk from PCN infestation, to cultivate perennial energy crops to generate renewable heat and / or power locally. As SRC Willow is a woody crop it requires specialist planting and harvesting equipment, unless grown on a very small-scale such that these operations could be undertaken manually. As stated in the results, SRC willow could also be cultivated towards coastal areas with a secondary purpose, as a moderately salt tolerant species, to protect inland crops from prevailing winds and salt spray.

Similarly, Miscanthus is a tall salt tolerant grass which could be used to protect inland crops with the resultant biomass being used for local heat generation. Miscanthus is planted using potato planters and harvested with grass mowers, so availability of suitable machinery is less of a concern; however the harvested material would likely need to be pelleted prior to being burned in suitable pellet boilers to generate heat.

Finally, speciality food crops are out of scope of this work; however during our research of salt tolerant crops suited to the Jersey climate, specific opportunities were identified in Asparagus and Truffles. Each opportunity is described in the main section of the report.

The opportunities are relatively widespread and several should be taken forward together as an integrated solution to the problems currently being experienced. There is a real opportunity to establish new crops and to develop an entire new product range from Jersey which would benefit the local economy, improve recognition and potentially attract more tourists, and if combined with bioenergy options identified could enable the island to become more self-sufficient in energy terms and less reliant on imports.

3.1 Recommendation for further work

In order to further validate the case for production of novel oil crops on Jersey, a more in-depth economic review is necessary. This would require commercial discussions with growers, contractors, processors, manufactures, equipment suppliers and retailers and a more detailed exploration of the scale and value of opportunity to Jersey.

4 Useful Contacts

The following is a list of organisations or resources that have been consulted as part of this research.

4.1 Technology Crops international

- Global speciality seed supplier and producer; focussing on speciality oil crop production
- Crops include: AhiFlower , Myrica gale, Camelina, Echium, Cuphea, Borage, Laboulet, Semences, Sunflowers
- Technology Crops Limited, Gowers Farm, Tumblers Green, Braintree, Essex, CM77 8AZ
- <http://www.techcrops.com/>

4.2 Premium Crops

- Leading UK speciality crop producer
- Crops include: Borage, Linseed, AhiFlower, Lupins, Millet, Red Wheat
- <http://www.premiumcrops.com/>

4.3 InCrops

- Innovation in crops, offering business support and commercialisation opportunities to SMEs in the alternative and non-food crops sector
- Specialising in: bio-based materials (flax, hemp), bio-based chemicals, bioenergy and fuels, algal biotechnology, sustainable agriculture, food health and well-being (e.g. sea buckthorn)
- <http://www.incropsproject.co.uk/>

4.4 EnAlgae

- EU INTERREG project to link algae producers and researchers, to facilitate scale up of innovative uses of algae.
- Many research and industry partners in North West Europe, including:
 - Plymouth Marine Laboratory
 - Centre d'Etude et de Valorisation des Algues in NW France
- <http://www.enalgae.eu/partners.htm>

4.5 Mycorrhizal Systems Ltd

- Tree plantations inoculated with truffle spores. Mycorrhizal Systems Ltd provides plantation services, expertise, and guidance on harvesting, and can help with distribution if required.
- <http://www.plantationsystems.com>

4.6 New Energy Farms

- Energy crop growers, including Miscanthus
- <http://www.newenergyfarms.com/>

4.7 Agroceutical Products Limited

- Daffodils - Scaling up galanthamine production with BEACON, based in Wales.
- <http://www.agroceutical.com/growers.html>

4.8 Statfold Seed Oils

- Stockist of 200 essential oils from natural extracts
- Major UK producer; offering a range of products and services of interest to this project
- <http://www.statfold-oils.co.uk/essential-oils>

4.9 NIAB Innovation Farm

- NIAB Innovation Farm is a pioneering knowledge transfer initiative supporting the translation on plant science discoveries into practical application; linking the science base and industry
- NIAB, Huntingdon Road, Cambridge, CB3 0LE, UK
- <https://www.innovationfarm.co.uk/>

4.10 Frontier Agriculture Ltd

- Frontier is the UK's leading crop inputs and grain marketing business, recognised for its close customer relationships with farmers and grain consumers and its successful management of the arable supply chain.
- Actively engaged in projects on Artemisia and Rosemary antioxidants
- <http://www.frontierag.co.uk/products-and-services/seed.aspx>

4.11 National Herb Centre

- Sourcing and supplying speciality herbs for medicinal, culinary and healthcare products
- <http://www.herbcentre.co.uk/>

4.12 Johnson Matthey Macfarlan Smith

- UK morphine poppy growing business
- Macfarlan Smith manages the agronomy of the crop as well as the harvesting of the crop, using specialist equipment. All crops are authorised by the home office.
- <http://www.macsmith.com/services/growing-morphine-poppies>

4.13 Crop Innovations

- Crop-Innovations is a charity in the UK, aiming to improve food security, nutritional status and the economic welfare of humans by promoting crop species that are currently not used to their full potential. Using a wider variety of crop species, that are able to grow in different climates or on marginal lands, creates more robust yields and farming communities better able to cope with climate change. Crop-Innovations partners agricultural development organisations to identify ways of maximising benefit from currently un-commercialised crops. Adapting scientific technology and methods to create devices and protocols that help farmers increase their yield and income.
- <http://crop-innovations.org/>

4.14 Molton Brown

- Made in England brand, using the finest natural extracts and essential oils for hair and body
- <http://www.moltonbrown.co.uk/>

4.15 Croda

- Speciality chemicals manufacturer and supplier
- Personal care, healthcare and industrial markets
- <http://www.croda.com/>

4.16 GW Pharmaceuticals

- Sourcing UK and EU grown hemp for Cannaboid drug development and manufacture
- <http://www.gwpharm.com/>

4.17 UK medicinal herbal product manufacturers

- Seven Seas Ltd - <http://www.seven-seas.com/>
- Neal's Yard Remedies - <http://www.nealsyardremedies.com/>
- Boots plc - <http://www.boots.com/>
- Revital Ltd - <https://www.revital.co.uk/>
- Brunel Healthcare (part of Elder Pharmaceuticals) - <http://www.brunelhealthcare.co.uk/>
- Potters Herbals (part of Vifor Pharma UK Ltd) - <http://www.pottersherbals.co.uk/>
- Ransom Naturals Ltd (part of William Ransom & Son) - <http://ransomnaturals.com/about>

NNFCC

NNFCC is a leading international consultancy with expertise on the conversion of biomass to bioenergy, biofuels and bio-based products.



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