



STUDENTPROJEKT PÅ EKHAGA FÖRSÖKSGÅRD • 2001

VEGAN FOOD ON 800 m²

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Studentprojekt på Ekhaga försöksgård • 2001

Vegan food on 800 m²

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ABSTRACT

The sustainable production of foods is the larger topic of a set of projects run at the Ekhaga Experimental Farm at Funbo, Lövsta in Sweden. Two field experiments have been set up to investigate possibilities for self sufficiency based on an adjusted traditional diet and alternatively based on a vegan diet. The project focuses on the respective land requirements, an adapted choice of crops and the appropriate ecological production methods based on human labour.

This report analyses the experiences and results from this year's vegan food plot. Space requirements for self-sufficient production based on a vegan diet are considerably lower than for any diet, which consists of a lot of meat. When plants are consumed directly such energy, which would be lost though further transformation within the food chain can be used directly¹. It is assumed that under the given conditions sufficient food security can be achieved on a plot of 800 m².

The planning process and farming techniques were very much guided by the concept of permaculture. Permaculture seeks to create highly diverse, productive, and resilient agro-ecological systems, by imitating the patterns and features of natural ecosystems. The results have not been entirely analysed, since not all crops could be harvested, but a preliminary conclusion is given.

¹Under extreme climatic conditions, that make it impossible to grow sufficient vegetables and potatoes or cereals, this does not hold true and animals might then be a more adequate source of nutrients.

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Preface

I am a student of agricultural sciences and I have been studying at SLU since last August as an exchange student. In Berlin I have studied general agricultural sciences for the past three years. My initial motivation for taking up my studies was my special interest in ecological farming. I strongly believe that we need a change in agriculture and I have high hopes for a new development towards ecological and more sustainable agricultural systems. I would like to find an alternative to avoid the waste of energy, when transporting foods from one end of the world to the other. And I am also concerned about the negative effects that the unfair trade of commodities and the production of goods for export has on many countries of the South.

This is why I became interested in the idea of developing a system of food self sufficiency for the North, and decided to get involved in the student project at Ekhaga. I also have a personal interest in working with such a system, since I hope to be part of a farm or ecological community later on. I wanted to find out more about the traditional crops in Northern Europe and the also the possible uses of wild herbs and plants within a small scale agricultural system, for food and other purposes.

In 1996/97 I had the chance to work on an ecological farming project in Ecuador. This work with the Fundación Golondrinas deeply fascinated me, as the association offered practical solutions to small farmers in the rural areas of Northern Ecuador. Through a

combination of practical work on the farm, community work with the villagers and environmental education for the children, this project has a strong impact on the way people work with their environment. The association applied the principles of Permaculture, which were developed by Bill Mollison in order to create highly diverse, productive, and resilient agro-ecological systems. I have tried to apply some of the principles of permaculture in my system.

In this project it is hard to find a balance between pure theory and the methods and crops valid for use in current Sweden. A nutritionally sound diet is not enough, but I also tried to take into account, that we need some variety in our diet and enough herbs to make it tasty and interesting all year around. I tried to keep the outside inputs as low as possible. If I did use external materials I tried to look for re-usable or recycled material, such as re-usable and recyclable bird nets, and re-usable "fiber duk".

Introduction

Veganism, why go vegan..... some reasons and then the land question...

Whether we will be able to produce enough food and how to go about it is an ever-important question. Today it is widely assumed that the quantity of food we produce is enough and will be sufficient to sustain the world's population for quite some time. The question of food security is about more than simply the produced amounts though. It is about distribution of food, about growing the adequate types of food in the right places and it is also about poverty and ability to pay for the food available. These questions are widely discussed in different fora and the scope of this issue goes far beyond this essay. Here I am concerned with the production side of the food security issue. There are again different aspect to the food production and its sustainability. It is important to look at the environmental impact and the energy requirements for production and transport as well as at the types of food grown for an adequate nutrition. These have to be adapted to the cultural food habits of the respective population. Food in Sweden is to a large extend imported from other European countries and from overseas. This implies high energy costs for transporting the food to the consumer. When looking at reports about our energy reserves, it becomes quite obvious, that we will have to rethink our energy use for the future, if we want to be able to sustain our societies without the excessive use of fossil fuels. Alternative energies are and will be developed, but part of the solution

will also be to reduce energy consumption. Local production of locally adapted crops can be one way in Agriculture, on the one hand to avoid large inputs into agriculture, and on the other to avoid the transport costs. When dividing all agricultural land in Sweden today, it comes to ...m² per person. And at the same time the average Sweden consumes food, which has been grown on approximately 3200m² today. A person living on an adjusted traditional Swedish diet with only regional foods will need about 2500 m² with an additional 600m² pasture.

Space requirements for self-sufficient production based on a vegan diet are considerably lower than for any diet, which consists of a lot of meat. When plants are consumed directly such energy, which would be lost though further transformation within the food chain can be used directly². The land necessary to sustain one person every year will vary greatly in different climates and on different soils. One suggestion by Jeavons(1995) is that to sustain one person in the United States based on a vegan diet within a bio intensive system will be 4000 sq feet. The ecology action group has developed a system which can sustain one person on 1000 sq feet. These numbers show how much the space requirements vary in different environments and also within different production systems catering to different food habits. It is therefore interesting to look at

² Under extreme climatic conditions, that make it impossible to grow sufficient vegetables and potatoes or cereals, this does not hold true and animals might then be a more adequate source of nutrients.

the case of Sweden individually to draw valid conclusions for the situation here. It is assumed that under the given conditions at Ekhaga sufficient food security can be achieved on a plot of 800 m².

Background

The project is set on the Ekhaga Experimental Farm in Uppsala, Sweden and it is running in its fourth year now. It was started by Helena Ullmark in 1998. She had a strong interest in permaculture and include some of the ideas and concepts in the initial project. In the same year the first student projects were run at the Ekhaga experimental farm. These projects give students the possibility to explore a research topic in practice for one summer. The themes have been very diverse in the past years ranging from an investigation on the role of animals in an ecological farming system (e.g. weed management, nutrition on pasture), to work with biodiversity in the farming landscape. The vegan food plot became a student project in 1999. The reports from previous years are available through the Centre of Sustainable Agriculture (CUL) at the Swedish University Of Agricultural Sciences, Uppsala.

Vegan nutrition

The most important nutrients for a healthy diet are Carbohydrates - Protein - Fats - Vitamins - Minerals - Fibre - Water.

In vegan nutrition these are found in four main food groups:

- Cereals
- Vegetables
- Fruit
- Pulses

The diet needs to be varied in order to fulfil the body's needs. Some of all four food groups should be eaten every day.

Important nutrients in human diet and their specific importance in vegan nutrition:

Calcium

Calcium is important for healthy bones and teeth.

Important sources of calcium in a vegan diet include tofu³, green leafy vegetables (especially kale and parsley) seeds and nuts as well as oats and black molasses.

Essential fatty acids

The main components of fats are the fatty acids. There are two essential fatty acids, i.e. two fatty acids which can not be assembled by the body itself. These are linoleic acid and alpha-linolenic acid. These are important for maintaining the membranes of all cells, to help regulate many body processes which include inflammation and blood clotting. It regulates the body cholesterol

metabolism. Fat is also important in the diet because it enables the body to absorb the fat-soluble vitamins A, D, E and K from food.

Important sources of the essential fatty acids for the vegan diet include seeds and the oils made from sunflower, pumpkin, mustard and rapeseed, as well as corn, soya, evening primrose, and wheatgerm. They are also found in walnuts, green leafy vegetables and grains.

Vitamin B12

Vitamin B12 is an essential vitamin. It is used to make red blood cells and DNA and B12 is also required for making a protective layer around nerve cells in the nervous system.

It is a vitamin which is not produced by neither animals nor plants. It is produced by micro organisms in the intestinal tract of animals. It is therefore not available from plant sources, unless the plants are not washed properly and still contain micro organisms. This might be a common source of Vitamin B12, since even a washed lettuce for example still contains 1.000-100.000 microorganisms. Bacteria in the human intestinal tract make vitamin B12. However, the majority of these bacteria are found in the large intestine. Vitamin B12 does not appear to be absorbed from the large intestine.[...] Some bacteria in the small intestine apparently produce vitamin B12 which can be absorbed. This is one possible explanation for why so few cases of vitamin B12 deficiency are reported. Perhaps our bacteria are making vitamin B12 for us (Wassermann, 1991).

³ Foods in small print are currently not or can not at all be produced in Sweden.

The New Zealand Vegetarian Society states that Mushrooms cultivated on manure-enriched compost will contain vitamin B12. If the mushrooms are not over washed before use they will contain some B12. There is 0.26ug of vitamin B12 in 100g of mushrooms. A serving of 4-6 mushrooms weighs 75g (New Zealand Vegetarian Society, 2001).

Vitamin B12 is stored by the body over a very long period and it can be assumed that when grown ups switch to a vegan diet, their body will have sufficiently large B12 stores to last for another 20 years or more. The supply with vitamin B12 might not as serious a problem as was assumed for a long time. Research on the topic is still continuing.

Vitamin B12 deficiencies can be quite seriously though and lead to irreversible nerve-damage. It has therefore been recommended by a number of organizations for example by the International Association of Hygienic Physicians (IAHP) and physicians and nutritional scientists. Vitamin B12 can be supplied by yeast for example.

Essential proteins in the vegan diet

The main protein foods in a vegan diet are the pulses (27% protein of over all calories), grains (12% protein), nuts and seeds (13% protein). Proteins play an important role within the body and it is important to get all 8 essential amino acids. Complete proteins, which contain all 8 essential amino acids are found in potatoes (2%), in green leaves and in Soybeans (40%) and soy products. But it is

not necessary to take in all eight at the same time. The essential amino acids can also be supplied by a combination of different foods. Such combinations are found in the traditional dishes of most regions: beans and corn as is South America, Tofu and rice as in China and Japan, or chickpeas and couscous as is eaten around the Mediterranean are such examples. Therefore a brought variety of foods is important in the vegan diet.

Iron

The main functions of iron are to help supply oxygen to the blood, to help the body resist disease, to promote red blood cell formation, and to maintain proper metabolism.

Iron in plants is less readily absorbed than from meat products. But in a varied vegan diet adequate iron intake does not pose any problems. Sources of iron in a vegan diet include chick peas, liquorices (avoid the sugar!), muesli, spinach, silver beet, haricot beans, molasses, dried apricots, figs, brewers yeast, fresh wheat germ.

Note that vitamin C increases the body's ability to absorb iron, while tea and coffee inhibit it.

The Vegan Food Plot

Preconditions

The foundation of a farming system is the habitat. There are fixed and variable preconditions, which determine the possible use and the special requirements of a site. The experimental plot is situated on the land of the Ekhaga experimental farm. The local climate out on the farm is different from the climate in Uppsala city about 10 km Westwards. Temperatures are more extreme here. The winds are also stronger since the surroundings is farmland without any protective trees. These extreme temperature changes and the influence of wind are factors which can be buffered by the right set up and choice of species. The plot is situated at the foot of a hill to the North and cold air flows down towards the plot area causing earlier frosts in autumn and later frosts in spring. The area suffers from early summer draughts. The soil is a heavy clay. The site for the plot has been changed this year, so I started on a

completely empty, freshly ploughed plot of 16 by 50 meters (Apprndix 1.). In the past years cereals and vegetables was grown on the field.

The set up of the system

When dividing the planting space between the different crops I was guided by the report from the previous year and some additional literature on vegan nutrition. While in the previous years mainly root crops and vegetables had been grown, a recommendation in the literature included a lot more cereals and oil crops than what had been previously grown for this project. This is a very important issue. Cereals and oil crops reduce the bulk of food that needs to be consumed by a vegan in order to fulfil the nutritional requirements. On the other hand, the experience of the past years shows that these crops have not been very space efficient on the Ekhaga site, giving quite low yields per m².

The table below shows different possible divisions for an 800m² plot:

Division of the plot according to food groups:

Food Groups	Plot in 2000	From literature	planned for 2001	my plot in 2001
Cereals	66	269	104	*
root crops	198	78	143	
beans and peas	116	304	137	
Brassica	15	16	16	
vegetables	41	260	220	
Fruit	82	0	6	
Sugar	2	?	2	
Oils	84	207	100	
companions, green manure	58		40	

- Because of the damage the birds did to the cereals, I could not harvest any cereals and have now planted winter varieties of wheat and oat for the next season on the cereal plots.

Pattern understanding

There is a great variety of patterns in nature while other patterns have been imposed by humans. Natural patterns are a vital resource for planning and their understanding is important. The square field boundaries, which exist on the farm now, suit the surveying instruments and the machines. But it needs to be questioned to what extent they suit a small subsistence farming system.

In a small-scale intensive system, which is based on manual labour and creativity as the main external inputs, it is important to reconsider the existing patterns. There are a variety of aspects, which can guide the special planning of that system. In appendix 1 one could see the design of the plot. The plot must be easy to be worked by one person, the layout must suit the needs of the different crops and at the same time it should be pleasant to work in the field. I found that long straight rows are very tiring to work, while smaller round spaces are more easily accessed. While they divide the plot into smaller sheltered spaces, they also divide the work into smaller bits, which is very encouraging in practice. Edges are another important aspect of patterns. Edges in nature, as the transition areas between different ecosystems, are often the

most productive spaces since they combine a number of features of both ecosystems. A forest edge for example is a protected space with a lot of light while the larger trees, which also influence the water balance, nurture the soils. It is a place where species of both systems come together. In other words edges are much more than just the space where the machines don't reach properly, or where monocultures mix and the harvest is difficult. On the edges of this plot perennial plants have been planted such as fruit trees and bushes, herbs and willow. In some part it was also green manure, which can make for a low wind shelter.

The plot is now laid out as a set of half-circles, opening to the North, which is facing the hill leading up to the farm buildings. Narrow paths divide the curved seedbeds.

A shelter hedge for protection against the winds from the Southwest has been started with perennial fruit bushes and small trees as well as herbs. Two apple trees have been planted together with smaller perennial fruit bushes.

My design includes roughly 40 different species with all together about 60 varieties, including the main crops and their companion plants and herbs and the trees and bushes (Appendix 1.).

Farming techniques

In a small intensive system such as this there are little external outputs, therefore the system has to be planned in a way that ensures its sustainability and maintains soil fertility and a healthy environment for the crops.

Plant companions

Plants in a system have a positive, negative or neutral influence on each other. These influences are important for the functioning of the system and especially important in a small and intense system such as the subsistence plot. The limited space needs to be used as efficient as possible and at the same time plant health is essential for the food security. Plant relationships should therefore be taken into account for the set up, to make best use of possible synergies and to avoid losses. Plant influence can be spatial, between neighbouring plants or over time, over the seasons.

Rotation

Plant companionship over time is often referred to as rotation. Different plants have different needs and use the soil they grow in different ways. Some improve soil fertility while other crops are very demanding.

On the farm the following rotation scheme is in place:

Rotation at Ekhaga Forsokgard	
Year 1	Oats with under sown ley
Year 2	Ley 1
Year 3	Ley 2

Year 4	Winter wheat
Year 5	Peas
Year 6	Potatoes

In a small scale intensive system with a lot of different crops a flexible rotation is needed. Following the ideas of bio dynamic farming, the rotation for such vegetable plots can be easily guided by the organ of the vegetable that is consumed. Vegetables can be grouped into those grown for their leaves, their roots, their fruit and their flowers. Very little of our vegetables are grown for their flower, but ornamental flowers or potatoes can take their place in the rotation or even strawberries. But strawberries can better be grown on the same bed for up to four years, when they should be moved. Their space can then be used to start a new rotation with leafy vegetables, especially all *brassica*, since they do best on a plot where they have not grown before for some time.

Late and early crops who can be seen as neutral for the rotation include Spinach, lettuce, chicory and endive. The crops can be used to fill gaps as soon as the main crops are harvested. Spinach makes for good green manure then.

Other aspects of importance in the rotation scheme are the following:

- Sunflowers might inhibit plant growth of sensitive plants even in the following year(true?)

Plant guilds

Spatial plant companionship can be used to support and protect crops and to make best use of space. There are different aspects when looking at the relationships between neighbouring crops.

1. The most simply and easily to observe aspects are speed of growth and space requirements of the plant. Fast growing plants can use the space in the beginning of the season and after their harvest the slower growing varieties will take over. Plants with round and long roots can be planted closer together as well as broadleaved and narrow-leaved plants. It is then also important to check which part of the plant will be used for consumption later.

2. Secondly there are more sophisticated interactions between plants and other organisms in the soils. Plants with a strong smell and etheric oils can deter pests. Onions are one such example. When planted alongside sweet roots they will deter rodents effectively. Marigolds help keep nematodes out of the potato plot.

3. There are also allelopathic effects between plants. Plants exudates can strengthen or inhibit the development of neighbouring crops.

Another aspect of planning plant guilds is the gathering. Culinary associates, i.e. plants that are used together in cooking or processing can be planted close to each other to save time and work when gathering fresh vegetables. Dill and cucumber or tomatoes and basil are examples.

Plant guilds in permaculture make use of the whole range of effects. (picture apple guild)

Manure

The system works without any animal products and all manure is green manure grown on the plot itself. It is therefore important to plan the space well and to include sufficient green manure every season.

Half of the keyhole-beds have been dug and the soil mixed with composted green manure to create a more favourable condition for the demanding crops.

Mulching

The importance of mulching became very obvious wherever it was not done: after seeding the ground was left uncovered for a long time. The result was a very dry surface and a late seeding of the newly sown plants. The second big problem was the bird damage in the field. When the heavily damaged crops were re-sown, the plant beds were covered with grass clippings which turned out to be an effective protection for the small seedlings. When weeding the all plant material was left on the plot between the crop- rows. This mulch then helped suppress weeds for a while, and helped maintain soil moisture.

All pathways need to be well mulched to protect the soil here and make work without damage to the soil possible in all weather. Unmulched paths otherwise turn into mudslides in rainy weather and when the mud dries up the soil surface becomes crusted and caked.

Sheltering

To create a shelter hedge for protection against the winds from the south-west, I have planted willow, hawthorn and some wild plums, and have seeded borage for a faster growing, temporary windbreak for this season. One seedbed is set up in the form of key-hole beds⁴. I have planted sun root (*helianthus tuberosus*) around the edge for extra wind shelter and protection in the next season and am planning to plant perennial herbs there as well. The beds can be accessed from one side only and will be sheltered from all other sides. I have seeded borage around the edges here too, again to provide shelter for this season.

weeds

We should not confuse order and tidiness.

Tidiness separates species and creates work (and may also invite pests),

Whereas order integrates, reducing work and discouraging insect attack.

Bill Mollison

A lot of plants that are considered weeds have both positive and negative effects on the system, depending on where exactly they grow, when and how big they are. In early spring edible weeds such as dandelion and fat-hen (*Chenopodium album*) can provide the first spring greens for the diet and help bridge the period of scarcity after the winter. Early in the season and late in the year weeds can provide a protective ground cover within a small scale

system, that is easily surveyed. This spring the weeds were the first plants to be out of the ground and they provided some protection for been seedlings that were otherwise heavily attacked by birds. Later in the season flowering weeds alongside the seedbeds, or on the paths attract wild pollinators and other insects to the plot. Other plants which are commonly perceived as weeds can make strong companions for other cultivars, such as dead nettles (*Lamium amplexicaule*) on the borders of vegetable beds and as bordering plants for potatoes. In traditional farmer's gardens in Germany plants like Good-King-Henry (*chenopodium bonus*) were planted as emergency food, since they produced even under unfavourable conditions, when the cultivated crops failed. It is most important to know ones plot or garden and be conscious about the role of weeds.

Weed regulation:

To suppress weeds, I have spread old newspaper which was steeped in water on some of the beds and covered them with green manure. This technique has worked very well and has saved a lot of work in this part of the plot. I have used newspaper now, although it is off course an outside input. But today a lot of people have subscribed to a newspaper and this might be a good use for it. In Brazil broad leaves are used to fulfil the same purpose and there are some alternative fast and early growing plants in Sweden, which could replace the newspaper. There are a number of weeds, which could serve that purpose, for example Colt's foot (*Tussilago forfora*),

⁴ see B. Mollisons 'Permaculture' for a more detailed description of key-hole beds

Butterbun (*Petasites hybridus*), or oak leaves may be used, since they decompose slowly.

The crops⁵

The choice of crops for an intensive subsistence system, has to be based on different criteria. These relate to harvest security, nutrition, storage qualities and space or labour effectiveness. The use of locally adapted crops and a great variety in the system make it easier to meet the requirements.

1. Plants with food products from roots, tubers or shoots

allium spp., Onion

All onion varieties can be used for plant protection, since they repel rodents when planted next to crops with sweet roots such as parsley root, parsnips etc.

allium ampeloprasum, Leek

seed directly as soon as possible (or pre-grow in February to March and plant out in May or the beginning of June)

leek is frost hardy and can stay late in the field.

space requirements: 10-20 cm between plants and 60cm between rows

Leek has a slow development and can therefore be planted together with early harvested crops e.g. lettuce. It can stay late in the field since it is frost resistant. Plant in about 10 deep ridges and cover

⁵ See also project report from 2000 for a complete list and description of crops grown in the first years.

with little soil. When the plant has come up, cover with more soil about two times in the season, to keep stalks white. The young leek plants need watering in dry weather.

Allium cepa, Onion

Plant as soon as possible but the latest by May 1st

Harvest when 20 % of the leaves (lagt sig) and dry out on the field for some time

Space requirements: 4-7 cm between plants and 50cm between rows

The birds liked to play with the onions and took them out of the soil. We pre-grew some onions, but that didn't really solve the problem and the onion didn't grow better either. The best way to keep out the birds turned out to be covering the freshly planted onions with grass clippings. If the birds are very persistent it is also possible to fix thorny branches between little sticks across the onion seed bed. We planted red and yellow onions.

Allium untans, Perennial Onion⁶

This perennial onion is rich in vitamins and minerals, and can serve as a vegetable for the early spring

beta vulgaris, beetroot, (pronto, forano, libero, action f1)

seed early varieties when the soil reaches a temperature of 8-10% and winter varieties towards the end of May until the end of June

⁶ Species in small print were not grown in 2001

space requirements: 40-50 cm
between rows

staple food, doesn't need irrigation,
leaves are also edible
grow together with root persilja

All varieties gave good harvest,
and there were very little to no
pests. Beets grown under fiberduk
came up faster, but there was no
significant difference in yield in the
end.

The varieties we used were
Some give long beets, while others
produce compact round beets.
Both are tasty, the long ones might
be a little softer, but they might also
be more frost prone since the beet
sticks out of the ground more.

Beta vulgaris semisaccarifera,
Sugarbeet

easy to harvest and store, roots
and leaves are edible, high yields

Beta vulgaris crassa, Fodderbeet

fodder beet as energy reserve, in
case the other staple crops do not
produce enough

Beta vulgaris sicla, Mangold,
(bright yellow, silver)

Seed from the beginning of April
Space requirements: 10-15 cm
between plants, 40-50 cm between
rows

Mangold leaves are rich in sodium,
but contain less nitrates than
spinach and are therefore better for
small children.

When seeded early the risk for
(stocklöppning) is not as high. The
mangold started producing a lot,
when the spinach had already gone

into flower, and gave harvest into
late November after the first frosts.
Single leaves can be harvested at
a time and the plant will keep
producing. Mangold can also be
grown with elastic bands around
the outer leaves, to grow stronger
white stalks and less green leaves.
Mangold is (zweijaehrigen) and can
give a very early harvest in the
following spring (it is unlikely that it
will stand the cold in Uppsala
though)

I grew two varieties, one with white
stalks(silver) and one with yellow
stalks(bright yellow). 'Silver', the
white mangold was more frost
hardy and yielded well until
November.

Brassica rapa, Turnip

Daucus carota, Carrot, (kampe,
parmex, lobbericher)

Seed in April and until the end of
June

Space requirements: 45-55 cm
between rows

Carrots are rich in vitamin A, they
are space effective and can be kept
in the soil until the following year.

There is a huge number of
different varieties. I seeded round
and long carrots and an old yellow
variety, which is now considered a
fodder carrot. The old variety
yielded best and gave healthy large
roots, while carrots on another plot
were heavily attacked by.....

Plant carrots with sage.

Helianthus tuberosus, sun root or
Jerusalem artichoke

Sun roots are perennial, roots can
be harvested in late autumn and

small tubers which stay in the soil will grow new plants the following year. Sun roots make good windbreaks. Nutrients?

pastinaca sativa, parsnip,
(halblange weisse)

seed as soon as possible
space requirements: 8-12 cm
between plants, 50 cm between
rows

needs to be planted together with
onion for protection against
rodents.

Petroselinum hortense tuberosum,
Root parsley, (bero)

Slow growing sweet root, therefore
seed early in spring or late in
autumn and plant with e.g. early
beetroots to best use space.

Raphanus sativus, Radish,

Prone to jordloppa, but with
because of its deep roots, it can be
used as green manure, since it is
good for the soil structure, even of
the harvest is not too good.

Scorzonera hispanica, black root,
(maxima)

Seed as soon as possible
Space requirements: 10 cm
between plants and 40-50 cm
between rows

Black roots grow best in light, deep,
loose soil. They grow till late in
autumn and can stay late in the
field. Black roots can even be
harvested early the following year.
They are best stored in humid
sand.

Sonalum tuberosum, Potatoe,
(Asterix, Ditte, Sabina)

Potatoes are often attacked by
nematodes. Marigold can be
planted in the potato plot, to deter
those. In any case should potatoes
not be planted on the same plot
more then once every seven years.
The potatoes yielded well this year,
but they got infected with potato
blight, and have therefore not done
very well in storage.

2. grains and cereals

The cereals have been planted in
wider rows which are bordered with
rows of their companion plants,
Lucerne for wheat and peas for the
oats.

Avena sativa, Oats

Oats are rich in calcium and very
nutritious,

Avena sativa nudical, Naked oats

This oat variety does not need to
be shelled for consumption. It is
more perceptible to disease
though. But is could well be
included in next years plot, since it
reduces the amount of energy
needed for the food processing and
is therefore a good crop for
subsistence agriculture. It is also
an old variety which is worth
preserving and using.

Fagopyrum esculentum,
Buckwheat

Hordeum, Naked barley
Old cereal variety, no shelling
needed, but 'naked' grains are
more susceptible to fungi

Secale cereale, Rye

Triticum aestivum, Wheat

Long growing period, for the next season winter weed has been seeded to ensure a better harvest next year

Zea mays, Corn

Seed from the middle of May onwards, but not too late, otherwise cobs won't fully develop
Space requirements: 25 cm between plants and 70-100 cm between rows, 3-5 cm deep

Corn can be used as natural trellis for beans, low growing plants such as cucumber grow well in the slightly shaded spaces between the rows, so does the slow growing New Zealand spinach.

3. Brassica

Brassica juncea, Japanese cabbage

Seed early in the year or late in August, because the plant will go to flower in midsummer.
Space requirements: 30 cm between plants-or plant in continuous rows, 50 cm between rows

Japanese cabbage has green leaves with a strong mustardy taste, which can be eaten in stir fries or in salads. They are fast growing and easy to grow, if there is enough water for the seeds to sprout. The plants are shade tolerant and can be used to fill gaps.

Brassica napus, Kalrot, (ostgota II)

Seed from May until midsummer.

Space requirements: 15 cm between plants and 50 cm between rows

High yielding root, which is not attacked by rodents. Frost resistant. Plant together with carrots(30cm) and spinach(40cm).

Brassica oleracea, Cabbage, white and red

Pregrow in March or seed in March- middle of April.
Space requirements: 50 cm between plants and 60-70 cm between rows
There are winter and summer varieties.

Cabbages take up quite a lot of space and need a lot of nutrients. They did well in mulched keyhole beds. Can be attacked quite heavily by caterpillars. Can be pre-grown in the greenhouse and transplanted later.

Brassica oleracea botrytis, Cauliflower and Broccoli, (fastman)

Pregrow starting from February onwards.
Space requirements: 30-55 cm between plants, 60 cm between rows

More secure harvest when precultivated, but can be seeded directly also. Broccoli is more resistant to pest than cauliflower.

Brassica oleracea gemmifera, Brussel sprouts, (roodnerf)

Pregrow 15th March to 15th of May, or seed directly between April and May

Space requirements: 40-55 cm between plants, 65 cm between rows

High protein content, the plant can stay on the field and can be harvested bit by bit. This year only very few plants came up, and were too late to yield. It looks like it is better to pre-cultivate it.

Brassica oleracea gongylodes, Kohlrabi?

Long-lived, high protein, can be eaten raw or cooked. Kohlrabi should be seeded together with leafy greens such as rucola, spinach lettuce and fennel to make best use of space.

Brassica oleracea var. Sabellica, Kale, (Westland autumn)

Seed in April until the end of June, when the soil has warmed up well
Space requirements: 45-60 cm between plants, 65 cm between rows

Frost tolerant crop. Can stay out in the field until the winter. The leaves are harvested from the bottom up.

4. Leafy vegetables

Apium graveolens, Celery

Lactuca sativa, Lettuce

There are a lot of different lettuce varieties. Lettuce can be used to fill gaps since it is a fast growing vegetable. It is not very rich in nutrients, but it contains folic acid, which is important in the diet. Winter lettuce is frost hardy and thus provides fresh greens until late in the year.

Portulaca oleracea sativa, Portlak?

Slow growing, but high yielding and anspruchslos?

Spinacia oleracea, Spinach

Spinach gave the first green vegetables this season. It then went into flower quite early.

Tetragonia expansa, New Zealand Spinach

New Zealand Spinach is similar to portlak? With very low yields and a long growing period. It doesn't really seem to be worth growing, unless there are seeds left over. In that case it is perfect for filling small gaps or spaces between rows of larger crops such as sunflower corn etc.

5. Fruit vegetables

Cucumis sativus, Cucumber

Seed towards the middle of May
Space requirements: 15-20 cm between plants, 150 cm between rows

Cucumbers can be planted in between rows of corn to efficiently use space and because the cucumbers can use the light shade of the corn plants.

Curcubita Pepo, Pumpkin and Zucchini

The flowers are edible. Zucchini give a higher and more secure harvest than cucumber, but they take up a lot of space. Pumpkin can self seed if the whole fruit is left in the field under mulch.

3. fruit

Lycopersicum esculentum,
Tomatoe

Tomatoes must be protected against the wind and should be transplanted very late for them to survive. A low bushy variety did well this year in a protected keyhole bed with borage or basilicum as companions. They encourage growth and make tomatoes more tasty.

2. oil plants

Brassica napus, nigra, hirta

oilradish...

Corylus avellana L., Hazelnut

Helianthus annuus, Sunflower

Sunflowers can be used for direct consumption and to make oil. Sunflowers have deep roots and can therefore retrieve nutrients and minerals. They can also heal compressed soils. Sunflowers can in some cases serve as natural trellis for beans or peas, but I found it a little hard to time the seeding well, so that the pea doesn't grow before the sunflower.

Sunflowers release strong root exudates, which inhibit growth of other plants. Plant therefore at least 30 cm away from potatoes.

Linus usitatissimum, Linseed

Papaver somniferum, Poppy

Tasty seeds, which are rich in oil and starch

Crataegus, Hawthorn

Hardy fruit bush which produces fruit very high in vitamin C.

Malus pumila, Apple

Apple trees are best planted with a number of companions to use the space under the canopy and to keep out grass.

Rosa rugosa, Rose hips

Rose hips are very high in vitamin C and have been traditionally used in Sweden. The flowers are also edible. There are a number of local varieties which could be established on the plot within the shelter hedge.

Rubus spp., Raspberry

Other cultivars include boysenberry, loganberry. Raspberries grow on trellis. There are a number of local varieties in the Uppsala area, which grow wildly in the forest and on road edges. It could be interesting to take some cuttings for the next year. These varieties are not highly productive, but very well adapted to the area. They could be part of the shelter hedge.

Sambucus nigra, Elder

A locally well adapted plant which produces rich flowers and fruit that can be preserved for the winter.

Vaccinium oxycoccus/marocarpon,
Cranberry

Cranberries need a lot of moisture and normally grow in the forest. It could be worth a try to establish some plants around the edge of the plot under the larger trees.

Vaccinium spp., Blueberry

plants with high vitamin C content

4. herbs and other companion plants

Anethum Graveolens, Dill

Dill is fast growing and its flowers make good bee and wasp fodder. Allow some to flower and self seed.

Borago officinalis, Borage

Young leaves and flowers can be eaten in salads. It has anti-inflammatory qualities. Borage is excellent bee forage and can function as a temporary windbreak. The plant tolerates poor soils but needs regular water. It makes good manure since it breaks down quickly and contains potash.

Carum carve, Caraway

Chamaemelum nobile, Chamomile

Corinadrum sativum, Cilantro

Fast growing herb to fill gaps, flowers easily and produces seeds. Cilantro has a very strong taste and can be used for cooking.

Foeniculum vulgare, Fennel

Seed directly in May or pre-grow in March-April, about 5-6 weeks before transplanting

Space requirements: 20 between plants and 40-50 cm between rows

Fennel can be planted with broadleaved vegetables such as beets and cabbage to make best use of space.

Lepidium sativum, Cress

Leaves and seed (for the winter!) are edible. Use to fill gaps.

Marygolds

Petrosilium hortense, Parsley

Slow growing, therefore plant with faster growing crops such as lettuce and mangold. Parsley leaves are rich in iron. Parsley did very well on the plot and since it is quite hardy it gives green leaves until late into the autumn, after the first frosts. It can be frozen, dried or preserved in oil and salt for the winter.

Pimpinella anisum, Anis

Salvia spp., Sage

Sage is a good companion to carrots.

Utrica dioica, Nettle

5. legumes and other nitrogen fixers

Caragana, Siberian pea shrub

Windbreak and hedge shrub, is cold and wind hardy. But the Siberian pea shrub is not native to Sweden.

Medicago sativa, Lucerne

Lucernes deep roots open up the soil, the seeds can be sprouted in winter and eaten.

Phaseolus vulgaris, Common bean

Seed as soon as possible
Space requirements: 10-15 cm
between plants and 50-70 cm
between rows

Bushy varieties have a shorter growth period and are more frost resistant, but trellis save space. Beans can be grown on sunflowers.

Pisum sativum, Peas

The peas were heavily attacked by the birds. It was therefore essential to cover freshly seed beds with grass clipping.

Trifolium, Clover

Vicia Fava, Fava beans

The young leaves and pods and the beans are edible. Careful! Some people are highly allergic against fava beans!

Vicia sativa, Common vetch

For manure, cut before flowering, so that the nitrogen stays in the soil.

Workload

When working in a subsistence garden there are different periods over the year which require different kinds of inputs. The planning stage is very important for a successful growing year and it should start in early winter when the memories of the past growing season are still fresh. A good plan makes the work in the spring much easier.

I have worked approx. 300 hours between April until the 20th of August 2001 and then for a week in October to finish the harvest. The most time consuming activities in the field were the set up of the plot, the seeding, and the harvest. The set up will require significantly less time next season and eventually no time at all once the system is set up. Weeding time was along side crop protection and thinning another larger factor. This could be considerably lowered by more mulching and newspaper-mulching. Much time was invested in documenting and searching for additional information. When seen over the entire season workload was of course highest in the beginning and end of the season and after short vacations.

Exchange of experiences and consultation with others are essential parts of the work. Some time every day should be spent to observe the plot, the development of the crops, the weather etc. It can be very helpful to keep a garden diary. Some time needs to be spent thinking, looking and elaborating on new ideas, so that the process is a dynamic one and that it doesn't end up being pure drudgery.

Harvest

The following calculations of the harvested nutrients⁷ are preliminary, since not all crops could be harvested and since I have not yet been able to find the nutritional analysis of all species that were grown. All calculations about the dietary requirements have been based on the United States Recommended Dietary Allowance (RDA). These calculations are based on the needs of a person on a high protein diet and therefore not a hundred percent adequate for a vegan. They can give some first insight though and in the next season it is hoped to involve a nutritionist to investigate and clarify.

Up to know the yearly caloric requirements of one person have not been met. Oil crops have not been harvested, because I was absent during their ripening. This is the main reason for the lack of calories and fat in the overall results. No cereals were harvested either this year. The wheat was dug under to make space for the winter wheat, which was sown to ensure a better harvest next year. The oats were also too late to be harvested due to the major bird damage early in the year. Not all beans have been harvested, because I was not in Sweden in the months of September when most crops ripened and when I got back the first frosts had already destroyed beans.

All these factors account for another large part of the lack in proteins and calories. Vitamin C

⁷ The nutrient values of the crops have been taken from the USDA Nutrient data base and from a nutrient analysis by Platt(1983).

was one more difficult factor. Here the future contribution of fruit trees and bushes will realize the requirements.

Iron and Vitamin A requirements were almost met entirely.

Plan for 2002 and long term

The most important initial steps for the set up of a stable food system will be completed by the end of the next season and continuation of the project would then be a combination of the maintenance of the established frame and additions and changes according to new or different experiences.

One important aspect of permaculture thinking is the idea of embeddedness of the agricultural system within the whole and the need for overall sustainability and the recreation of links and bridges between the productive sector and the consumers. There is no permaculture garden close to Uppsala, where some of the aspects, which I tried to include in my system such as the use of perennial plants, the set up of a interconnected system etc. could be seen in practice. I therefore find it important to keep up this project on a longer term basis. Students should be enabled to work in the garden like we have done in the past years, through a regular scholarship by the Ekhaga foundation. The set up of a self sufficient food plot is a permanent, long term process and the organisational and financial frame needs to be adapted to this.

In the next season it would be interesting to strengthen this link between the project on the farm and consumer in the city. This can

be done in a number of ways. Field visits will be organized on a regular basis. A monthly leaflet about seasonal vegetables and new from the farm could be produced and if resources and time permit a more direct collaboration with a school or a consumer group in the form of study visits and study groups could be initiated.

Such activities can open a little window to a different way of producing food.

On the more practical side there are a number of things which will be changes for the next season:

- A naked oat variety will be grown to gain a little more experience on such old variety.
- Over the winter I will search for more perennial plants as well, which could be suited to the area. And cuttings of local fruit bushes can be taken to keep building up the shelter hedge. The plan is to introduce more herbs this coming season as well.
- Mushrooms could be grown (on straw) in addition to give some B12 and extra protein and because it is a relatively secure source of food which can be grown in disadvantages places like in the own basement.

Concluding remarks

The harvest so far does not meet the nutritional requirements of one person. This results from a number of different reasons: oil crops and beans could not be harvested, and were therefore not yet included in the overall calculations making for a lack of fat in the diet. No cereals were harvested either due the damage of the crop earlier in the year.

It also has to be taken into consideration that the planning period before the beginning of the project was too short and that seeding was rushed because it was already late into the season. I was also not an experienced gardener to start with and had to learn a lot from scratch or transfer theoretical knowledge into practice.

The results show clearly that a lot depends on the set up and the maturity of the system. Vitamin C and also fat needs can be more easily and securely be met when fruit and nut trees are part of the system. With experience on the site and once the system matures it should be possible to produce sufficient food with high security on the plot.

The question whether to plant cereals or root crops as the main staple crop remains. Cereals are easy to store and they are also a very traditional part of the Swedish diet. It would therefore be interesting to keep looking for better ways of growing them in a small system while ensuring a secure harvest. Root crops have again proven to be more space efficient in this system and they form the basis of the diet.

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[Simply Vegan: Quick Vegetarian Meals](#), by Debra Wasserman and Nutrition Section by Reed Mangels, Ph.D., R.D. Published (1990/1991) by the [Vegetarian Resource Group](#), P.O. Box 1463, Baltimore, MD 21203, (410) 366-VEGE. ISBN 0-931411-05-X

Internet guides to vegan nutrition:

The Vegan Society: <http://www.vegansociety.com/html/info/infohome.html>

The vegan society has a number of information sheets posted on the net, which provide information on the most important nutrition and other aspects of a vegan diet.

The Vegan Village: <http://www.veganvillage.co.uk/web.htm>

The vegan village website includes a number of links to other sites with information on nutrition, health and campaigns as well as own recipes and links to other vegan cookbooks on the net.

Other useful net sites (from December 2001):

Den virtuella floran: <http://linnaeus.nrm.se/flora/welcome.html>

Database about Nordic flora with plant descriptions and pictures, information on the natural habitat of the plants and their use, as well as the common plant names in five northern European languages.

Nutrient Data Laboratory: www.nal.usda.gov/fnic/foodcomp/

Database for nutrient analysis of all main food crops

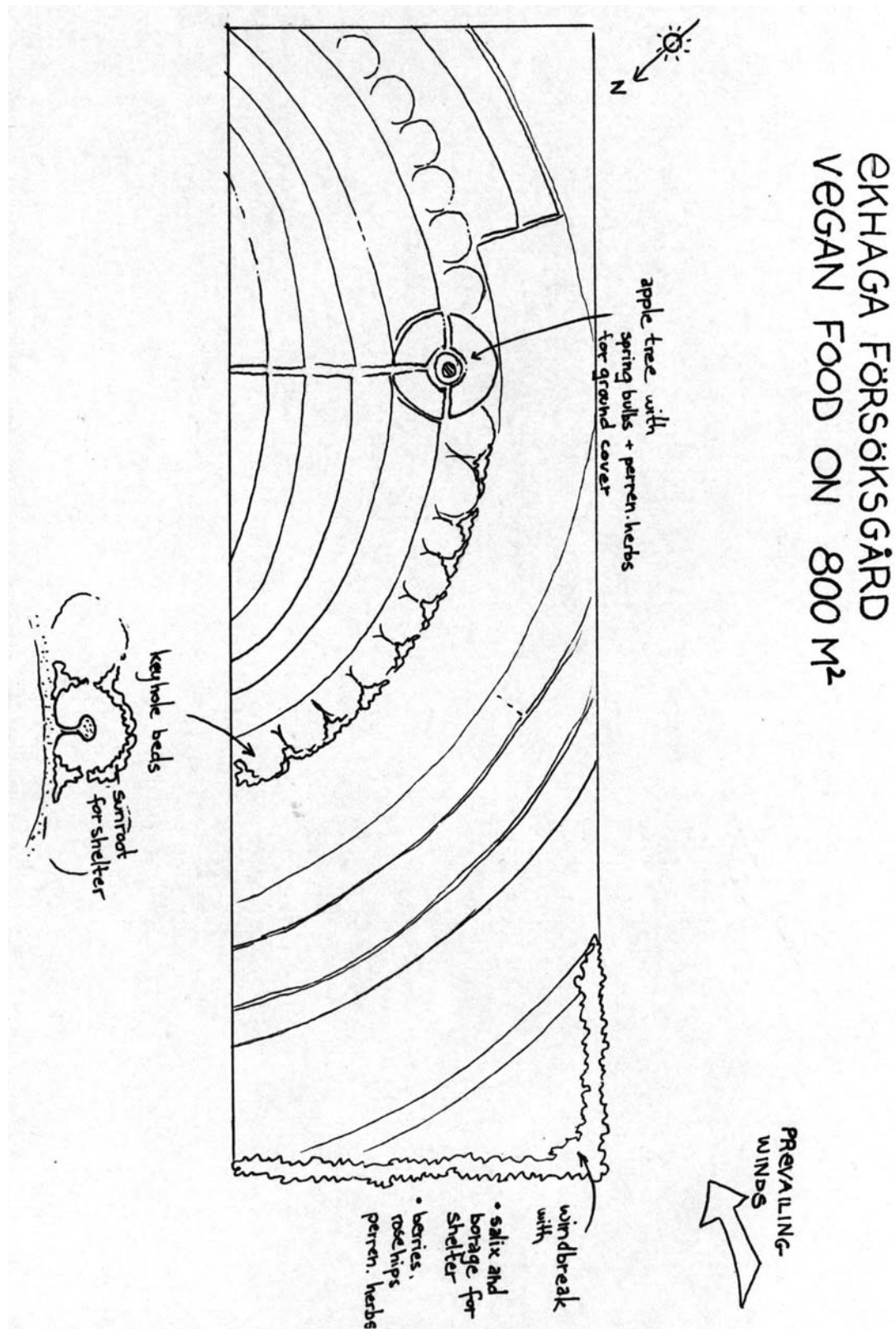
Kalf-Hansens Matateljé AB: www.kalf-hansen.com

This is the website of Kalf Hansen, a chef who works with seasonal cooking and offers cooking courses too. Their seasonal menu provides good ideas for the own cooking.

Contacts in Sweden

Appendix 1.

In the centre of the plot there is an apple tree and two berry bushes, accompanied by some grass competitors, herbs and spring bulbs to provide ground cover from early in the year until the start of the winter.



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