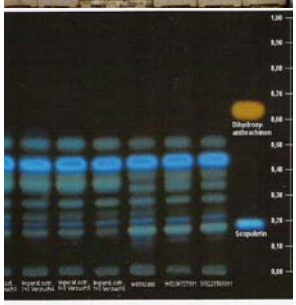

Research on medicinal plant cropping by WELEDA

English summary of the "collection book of research projects" about medicinal plant cultivation and wild collection of WELEDA AG/ WELEDA NATURALS GMBH and cooperating partners

WELEDA
Im Einklang mit Mensch und Natur

WELEDA NATURALS

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Content

Preface

It is nothing new. For as long as we can recall, people have used the healing power of plants. But our world is constantly changing. As a result, the conditions under which medicinal plants must grow and thrive to yield healing power and potency are also in flux. In order to be prepared for such changes of all the elements of earth and to protect our environment over the long- term, people must be actively involved in research.
This results in three major research fields in medicinal plant cultivation:

- Quality stabilization of plants within a selected type of cultivation
- Cultivation of threatened, wild plants
- Sustainable collection of wild plants

Each of these areas are at the heart of Weleda, in order to bring the indigenous, vital quality of the plant to live and to protect nature.
Bas Schneiders, Managing director

Introduction

WELEDA is the worlds leading producer of holistic body care products and anthroposophic medicines. Over 90 products for body care, including natural cosmetics, 3500 proprietary medicines, 100 products for self-medication are produced.
For WELEDA are fresh plants, drugs and extracts of plants important starting-materials for the production. Raw materials are carefully sourced, ensuring fair margins for all parties involved. A guiding principle is to strive for transparency in all communications.
To make the best qualities available WELEDA is going mainly four different ways:

- Cultivation in the biodynamic gardens belonging to the company
- Inculturing of plant species
- Sustainable wild collection of medicinal and aromatic plants in combination with habitat management and/or eco-certification.
- Worldwide Projects as well as close collaboration with small- scaled farms, cooperatives and collectors. Long term contracts with farms, training sessions and financial support underline this engagement.

Since the foundation of the company the biodynamic cultivation of medicinal plants in the company-owned gardens is serving fresh plants and is a source of several drugs. The gardens are eco and DEMETER certified. Biodynamic agriculture is based on the understanding that soil, plants, animals and humans work together in one agricultural whole by using cosmical forces. The biodynamic agriculture is creating intact ecosystems with a very high biological diversity and therefore contributing and supporting the worldwide ecosystem like island of biodiversity.
Annually, there is at least one new wild species taken into cultivation in WELEDAs garden. For most of the wild species cultivation experience does not exist so that a systematic approach is necessary. To gain this, additionally, WELEDA-Naturals, maintains a vivid co-operation with universities, governmental and private research institutions.
In this collection book, you will find a compact shelving of the most important sourcing projects of the past 10 years.
Michael Straub, Head of Department ‘research and cropping of medicinal plants’ WELEDA-Naturals

Sustainable wild collection: *Lobaria pulmonaria*

The primary focus of this research project is the sustainable wild collection and in situ propagation of the protected lichens specie *Lobaria pulmonaria.*
The lichen specie, *Lobaria pulmonaria,* is protected in central Europe as it is threatened due to air pollution and forest cultivation. This specie is important to Weleda for its use in an approved cough-medicine.
The goal of the project was to establish an instruction guide for the non destructive collection of *L. pulmonaria*, while also finding a method for in situ cultivation of this species as a test for environmental protection and species management. Weleda, therefore, developed a unique approach, combining classical population protection techniques with the sustainable use of the *L. pulmonaria*.
Beginning with a short description of the morphology, development– and reproductive biology of L. Pulmonaria, a practical and manageable guide was developed for the specie's sustainable collection.
The guide defines:

- In which population the collection can be made
- Which and how many Thalli can be collected
- Which part of the Thallus can be collected

In conjunction with this specific approach to collection, a simple method for the transplantation of Thallusfragments was suggested. In doing so, the loss of Thalli can be compensated in the intermediate term. Due to a selective choice of different genotypes, the spread- and propagation potential of *L. pulmonaria*- Population can be simultaneously supported.

Christoph Scheidegger Eidg. Forschungsanstalt für Wald, Schnee und Landschaft WSL/Zürich
Andreas Ellenberger Weleda AG, Schweiz

Sustainable wild collection: *Arnica montana*

In 2004 WWF- UK initiated a project to develop a model for the sustainable production and trade of *Arnica montana* in Garda (Apuseni, Romania) commune to benefit both biodiversity and the livelihood of the local people. Arnica flower heads are a by-product of subsistence based grassland management. The wild- growing Arnica sites are threatened by intensification, abandonment due to out-migration, and/or reforestation. Baseline studies in resource assessment and habitat management were performed. Sustainable was than linked to annual resource and habitat monitoring and compared to the baseline studies. Resource monitoring of the resource provides basic information on the density of Arnica flower heads and the plant's population size. Habitat monitoring is a tool to determine the conservation value of the native growing sites and to monitor meadow management activities. Transparent monitoring methods were developed and documented.
Two sets of sites are monitored every year. From conservation and resource point of view, the large sites are of special interest for monitoring. From an overall, landscape perspective, the random monitoring of a set of sites represents the development of the Arnica population, the resource of flower heads and the habitat. While the sites of the large set remain the same from year-to-year and should be monitored annually, the sites of the random set are newly selected every year. Resource assessment is based on a landscape approach. The Arnica sites are numerous (597 sites) and of various size and spread over 80 km² throughout the Apuseni mountainous region.

Dr. Barbara Michler, Dr. Hagen S. Fischer, Dr. Florian Pacurar

Rhatany is well established in Peru for use in both folk medicine and as a dye plant due to its high tannin content. The roots are traditionally used to treat inflammation and minor injuries and it is used in dental care. Commercial sourcing of this plant primarily takes place in Peru and all Rhatany is collected from natural populations.
Research on the ecology, parasitism, feasibility for cultivation and the sustainable collection of *Rhatany* was conducted from 2003 to 2007.
The primary goal of this project was to develop a harvest protocol consisting of the best collection practices and the definition of sustainable levels of extraction for a designated collection area. This research was initiated and financed by a private-public-partnership between Weleda AG and the German Gesellschaft für Technische Zusammenarbeit (GTZ).
Field research, experimental cultivation and anatomical studies revealed that *K. lappacea* is a semi-parasitic shrub like most of its congeners. It therefore parasitizes a wide range of host plants.
Commercial cultivation of *Rhatany* is not economically viable due to the plant's extremely slow growth and yields and the necessary additional cultivation of host plants. A protected area, comprised of 2000 ha in Arequipa was established in conjunction with the INRENA (Peru's National Institute for Natural Resources). The overall abundance, age structure and regeneration rate of *Rhatany* populations in the protected zone was monitored and analyzed. In order to precisely determine the plant's sustainable yield a tremendous amount of data was collected in a variety of ways, including a long-term survey of population size and dynamics. As a result of this research and statistical sampling we propose a survey (in plots) and the documentation of adult plants in each prospective collection area. This approach requires considerably less effort and spending. This data can than be used to calculate the average density of individual plants and the width of the 95% confidence interval. The confidence interval is an interval estimate of a population parameter. When applied here, it shows the size of the *Rhatany* population with 95% probability for accuracy. Following the precautionary approach we suggest setting the maximum acceptable yield to 5% of the lower limit within the 95% confidence interval. On this basis, the data yielded from our data designated collection area allows for a maximum harvest of 2t/a/2000 ha, representing twice the amount of the current annual harvest in the area. Additionally, the existing data suggests that enrichment planting supports the annual recruitment. We therefore recommend the sowing of Rhatany seeds during the harvest process, while, for instance, refilling the excavation holes.
The final part of the project (to be conducted in 2008) includes the publication by the INRENA of the methods for resource assessment, training of stakeholders and the implementation of the management plan as a national strategy for the sustainable wild harvest of endangered *K. lappacea*.

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Incultivation *Euphrasia*

The eyebright herb of (Herba Euphrasiae) often used for pharmaceutical and cosmetic products is currently and exclusively collected from agrestal habitats. The anthroposophical pharmaceutical industry is, however, interested in cultivating eyebright. In addition to preserving the species and conserving landscapes, cultivation will reduce costs and improve the quality of the raw herbal material. Pharmacists often carry medicines with *E. officinalis*

noted as the plant of origin. This name is used to describe different Euphrasia species such as *E. rostkoviana,* Hayne. All species of the genus Euphrasia are semi-parasites.
Throughout several experiments seeds of wild accessions of *E. rostkoviana,* were used and tested for viability and germination. The growth of *E. rostkoviana,* in conjunction with different host plants was then documented in greenhouse and outdoor trials. The primary objective was to establish *E. rostkoviana,* on a meadow in the area of Weleda AG /Schwäbisch Gmünd in order to obtain concrete knowledge about its cultivation. After a cold stratification period of three weeks a suitable germination of *E. rostkoviana* was cultivated in Petri dishes as well as in greenhouse and outdoor trials. *E. rostkoviana* was established on the tested host plants: *Agrostis capillaries, Dactylis glomerata and Festuca rubra rubra,* but while growing there were no significant difference. The plants in the outdoor trials were more vigorous which could be explained by the extra nourishment from older host plants. The total amount of the *E. rostkoviana* fresh matter, when harvested, was 241, 6 g/m². In order to garner 100 kg fresh *E. rostkoviana,* 200 g seeds must be sown on an area of 415 m².

B. Waßmann, W. Claupein; Universität Hohenheim, M. Straub Weleda Gärten

Incultivation *Imperatoria*

Through our research on *Imperatoria*, we have proven that it is feasible to successfully incultivate this plant. Propagation can primarily be achieved through generative and vegetative methods. The vegetative method of propagation is, however, of greatest use, as it is more secure and yields more efficient growth. In order to achieve successful generative propagation, the seeds should be stratificated for four weeks in a temperature of 2 °C or the plant should be seeded directly after ripening. Imperatoria can tolerate many varieties of soil, what was tested in modified soils in the Weleda garden. However lime, in particular, has a very positive influence on the plant's growth. After using a wide range of different testing methods, we can conclude that tinctures from cropped plants have the same potency as tinctures from wild collected plants.

E.M. Walle, W. Claupein; Universität Hohenheim, M. Straub Weleda Gärten

Incultivation *Lamium album*

The main goal of the work was to research into soil for the incultivation of *Lamium album*.
Prior to our research, the white deadnettle *L. album* had not been cultivated within standardised gardening agricultural practices. The flowers for medicinal plant production were only taken from wild collection or small-scaled gardening.
In the trial the influence of the soil on yield parameters such as shoot numbers, growth height, number of pseudoquirlen and flower- horizon- length of *L. album* was tested. To do so, five different soils were tested in outdoor pot- trials. *L. album* significantly reacted in specific soil compositions within the defined yield parameters.
Nutrients such as nitrogen and potassium along with organic matter had a major influence on growth. The soil with the highest N-contents yielded the best shoot numbers and plant growth height and higher flower yields.

The soil with the highest content of potassium also had the highest yields in the beginning of the trial period.
The study results also showed that organic matter in the soil allowed the longest growth within the season. Overall, the soil containing high quantities of N, K and organic matter yielded the best growth of *L. album*.
Indra Baumgart, Universität Bonn

Incultivation: *Oxalis acetosella*

In the cultivation of *Oxalis acetosella* L., the pH value of the research field as a growth limiting factor has an indirect effect. For the plant's incultivation it has a secondary meaning.
Oxalis acetosella L. shows significant, positive results with the addition of nitrogen fertilization. Prior to conducting research, our hypotheses was: The increasing yields of growing variables within the nitrogen-fertilizing trial is linked to the higher nitrate content in the soil, which also results in a better Ca nutrition.
Through our research it appeared that the plant has a significant incompatibility for hot-dry climate conditions and an illumination above 1000 lx. An illumination above 15000 lx may lead to chlorophyll losses around the leave's nerves due to photo oxidation. Moreover, factors like temperature and humidity have a regulating effect.
A relation between the content of oxalic acid and the nitrogen nutrition on *Oxalis acetosella* L. could not be found. The following hypothesis was made in conjunction with oxalic acid: The dissolvable oxalic acid in the aerial plant part of *Oxalis acetosella* L. decreases after flowering. A shaded tunnel is also a necessary light condition for the cultivation of *Oxalis acetosella* L..
Through this research, direct seeding cannot be recommended, as there is little knowledge about the plants germination. At present, the only alternative is to replant plants from wild habitats.
Mario Schubart, Hochschule für Technik und Wirtschaft Dresden

Incultivation of selected medical plants

From 1999 to 2002 WELEDA AG in cooperation with the Institut für Pflanzenbau, University of Bonn carried out pot and field trials for the domestication of selected medicinal plants. The aim of the project was to grow meadow saffron (*Colchicum autumnale*), white deadnettle (*Lamium album*), bearberry (*Arctostaphylos uva ursi*), lily of the valley (*Convallaria majalis*) and dog's mercury (*Mercurialis perennis*) under field conditions according to the guidelines of organic farming. The primary goal was to establish, fertilize and harvest the medicinal plants. To achieve this objective the effects of the soil type, plant material, planting date, fertilization, cultivation system and harvest time on growth and yield structure was investigated. In order to describe and compare the growth of the plants with other scientific results, a scale for the different growth stages was developed for each species. The growth of the medicinal plants was regularly assessed with this scale, and specific yield parameters were measured. The experimental results were used to provide recommendations for the cultivation of each plant.

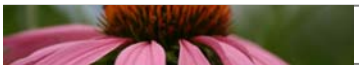
In the trial the establishment of meadow saffron, bearberry and dog's mercury in the trial was successful, leading to stable yields. However, the cultivation of the lily of the valley in the field was not satisfying. The white dead nettle was only tested in pot trials, so no field results are available. The removal of nutrients by the medicinal plants occurred at very low level with the exception of the white dead nettle. Interestingly, only the meadow saffron responded to fertilization with an increase in yield. Compared to the other medicinal plants, the white dead nettle was the most susceptible to disease and parasites. Small changes to the cultivation system, such as the shading of the dog's mercury, resulted in substantially better plant growth. It was also discovered through a mechanisation experiment that the meadow saffron could be grown using the machinery for normal vegetable cultivation, which led to a reduction of manual labour. The yields of the medicinal plants gained under experimental conditions provide only a guideline as to what can be expected in practice.
Stefan Zimmer Universität Bonn

Substratum tests: *Hypericum perforatum*

The substratum trials were designed to explain the relations between the young plant losses of *Hypericum perforatum* and the nutrient content in the companies own substratum. To answer this question, several substratum from other producers were compared.

A) 40 % mainly compost from animal manure, 60 % peat, fertilized with horn-flower
B) 20 % green manure, 80 % peat, fertilized with horn flower
C) 30 % green manure, 70 % peat, fertilized with maltaflor
D) 100 % compost, fertilized with thomasphosphate
D1) Additional with nettle liquid manure and treatments with algae
E) TKS1: 100 % peat, fertilized with minerals

The plants were rated based upon their plant height, leaf colour, necroses and red- colour on their lower leaves. Additionally, substratum- and plant- analyses were made. After three months the plants in substratum (A) showed the strongest growth. Even the necroses on the older leaves in substrate A, as a result of the high salt content (2, 4 g/l), experienced only small growth reductions in an early stage (seven weeks after seeding) At the end of the trials the plants in substrate (C), (D1) and (E) developed red-coloured basal leaves and top-leaf necroses, due to nitrogen and phosphor deficiency. The P- and N- content were 20-30% above those of the companies own substratum. This sample characteristic could not be observed, however, in the variant (D2) with additional nettle green manure and algae preparates. Du to the nitrogen release rate and the nutritional pool, especially the high salt- and potassium content, the companies own substratum can be used for the young plant cultivation of *Hypericum*.
D. Kolb, Universität Hohenheim



Microbiological claim causes on *Echinacea angustifolia*

The goal of this thesis was to identify the causes of those problems associated with the cultivation of *Echinacea* plants. Therefore, facile fumigated plant material and seeds were used to find putative pathogenic micro-organisms. In total, 11 bacteria and 17 fungi strains

had been successfully isolated and cultivated. Afterwards, they were physiologically and morphologically characterized. An analysis of selected DNA sequences was only incorporated into the research. This lead to the identification of 5 bacterial and all fungal strains. Inoculation experiments, on the other hand, did not reveal which organisms are responsible for the observed plant disease symptoms.
Additionally, the effect of plant strengtheners and seed treatments on plant yields of *Echinacea angustifolia* biomass was investigated. The application of the plant strengthener PRORADIX®-DS and a seed treatment with Arena C® (served as positive control) in the main experiment were able to significantly increase dry yield compared to untreated control plants.
It could be concluded that:

- Commercial products were not able to induce resistance of *E. angustifolia* against pathogens, whereas warm water treatment of seeds lead to satisfying results regarding plant health, plant growth and dry weight, respectively.
- An adequate amount of viable and healthy seeds of *Echinacea angustifolia* is a prerequisite for growing healthy seedlings at Weleda Inc.
- In order to achieve optimal growth conditions due to the salt sensivity of Echinacea plants a composition of prick-out substrates must be adapted.

Anke Serr, A. Kortekamp, H. Buchenauer, Universität Hohenheim

Powdery mildew on *Calendula officinalis*

In organic agriculture yield and quality of *Calendula officinalis* is strongly reduced due to powdery mildew (*Podosphaera xanthii*) infestation. Therefore the development cycle of the fungus was documented microscopically and protective- effective plant strengtheners as well as conventional fungicides were tested in glasshouse- and field trials.
With the use of Azoxystrobin (Fungisan® only in the glasshouse) and netsulfur the infestation of Podophaera xanthii and its diffusion was successfully suppressed. In the application of plant strengtheners only one extract from Reynoutria sachalinensis (Milsana®) had an acceptable regulation potential on a low infestation pressure whereas praparates on the base of lecithin (bioBlatt, mildew product), silicate (waterglass, horn pebble), sodiumhydrogencarbonate ("Steinhauer's Mehltauschreck") as well as certain plant oils (TRF-FU-08®) were nearly ineffective with the given concentrations. Temperatures above 15°C and a relative air humidity above 80°C seem to be necessary to establish of P. xanthii in the field.
D. Heibertshausen, A. Kortekamp, H. Buchenauer, Universität Hohenheim