# POTENTIAL OF DYEING AND FIBER PLANTS IN APULIA REGION [1]

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**Abstract**

This The Apulia Region has large underutilized and, in some cases, abandoned areas. At the same time, soil and climatic conditions are suitable for the development of dyeing and fibre plants that could rise to the role of alternative crops in the context of local agriculture.

This work intends to be a contribution to the appreciation of the tradition of dyeing and fiber crops of our country such as *Reseda luteola L., Rubia tinctorum L. and Urtica dioica L.*

In particular for the latter crop, a cost-benefit analysis will be offered for disadvantaged areas of the Apulia Region. The development perspectives appear promising and worthy of testing on site.

**Riassunto**

La Regione Puglia dispone di ampie superfici sottoutilizzate ed, in alcuni casi, abbandonate. Al contempo esistono le condizioni edafiche e climatiche idonee allo sviluppo di piante officinali tintorie e da fibra che potrebbero assurgere al ruolo di colture alternative nel contesto dell'agricoltura locale.

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[(*)] This work is the result of the authors commitment, starting from the idea and ending in its accomplishment. Particularly "Introduction" and relative reference is ascribed to Giovanni Lagioia", the section 2, 3 5 with relative references are ascribed to Danilo Tavano, the section 4 and relative references are ascribed to Teodoro Gallucci, the "Final remarks" are ascribed to Danilo Tavano, Teodoro Gallucci, Giovanni Lagioia and Gigliola Camaggio.

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Il presente lavoro intende rappresentare un contributo alla rivalutazione di colture della tradizione tintoria e tessile del nostro Paese come la *Reseda luteola L., la Rubia tinctorum L. e l'Urtica dioica L*. In particolare per quest'ultima coltura verrà proposta un'analisi costi-benefici per aree svantaggiate della Regione Puglia. Le prospettive di sviluppo appaiono promettenti e meritevoli di sperimentazioni in loco.

**Keywords:** dyeing and fiber plants, natural dyes, fiber

## Introduction

The current Common Agricultural Policy (CAP) is oriented towards the promotion of a multifunctional agriculture not only aimed at the production of foodstuffs. Included in this context is the recovery and enhancement of plant species for medicinal use and dyeing of ancient tradition, the cultivation of which could allow, in certain distribution areas, the exploitation of marginal land or land otherwise unsuitable for traditional crops. In a historic moment like the present, characterized by high uncertainty in the financial markets and business in general, the ability to offer integration of farm income derived from the processing of these plants is an occasion worthy of study. Medicinal plants are species that are directly used in pharmacy, pharmaceutical industries, liquor and cosmetics, or as material for extraction of active ingredients for cosmetic and dyeing use (1).

According to data from the 2008 International Federation of Organic Agriculture Movements (IFOAM), the area under cultivation of medicinal plants in Europe is about 70,000 hectares and it is estimated that about 29,000 of these would be under organic farming.

With regard to Italy, some estimates say that 4,500 hectares are occupied by the cultivation of medicinal plants, and 2,238 hectares of such land is under organic farming (2).

The medicinal plant species cultivated in the world number, more or less, one hundred. These species differ in soil and climatic requirements, for the biological cycle and uses.

The number of plants collected in the wild state is significantly higher and it is estimated, in fact, at 100,000 crops. If we want to make a specific reference to dyeing plants, certain data is missing in the bibliography.

We only know that the cultivation of these species does not differ substantially from that of other plants; although, from the point of view of cultural practices, we must consider the difficulties associated with inadequate knowledge of the agronomic and production aspects of many species.

Particularly critical is the control of weeds, given the lack of registered herbicides and difficult mechanization of farming operations such as the collection and storage of material and the subsequent extraction of the pigments. Furthermore, it is important to consider that for many types of medicinal crops, plant material must be processed immediately after collection to prevent degradation of the constituents.

For our country, the field of dyeing plants, in particular, is absolutely marginal and this is also due to the lack of interest in the scientific community, which has not developed an applied research on the propagation material, intended as seed, as well as supplementary studies to their genetic improvement.

In Italy, registered pesticides, and even mechanical solutions for the collection, are not available for most fiber and dyeing plants. At the vivarium you cannot find material propagation; and people working in the field use imports or spontaneous plants of our area.

From these considerations, the importance of enhancing the fiber and dyeing plants, which represent a marginal sector today but with a high potential, is clear, as an alternative to the traditional ones in order to reproduce a production chain on a regional scale.

The present work aims to select the most promising fiber and dyeing plants which can be potentially grown in Apulia for the purposes of a trial field in the Apulia Region. The crops that have been identified are: *Reseda luteola L.* and *Rubia tinctorum L.* for dyeing species and l'*Urtica dioica L.* for fiber species.

## Methodology

The work was divided into two distinct phases characterized by a detailed literature search carried out on paper and digital resources.

The first phase was based on the study of plant species; making up a shortlist prepared following a previous paper to which reference is made (3). The plants considered most promising for the purpose of their exploitation in the Apulia Region, the aforementioned *Reseda luteola L., Rubia tinctorum L.* and *Urtica dioica L.*, have been selected on the basis of their documented hardiness, ubiquity, affordability and adaptability to the climatic and soil conditions of Apulia.

These plant species are already widespread in the spontaneous state, and they colonize marginal and often over-fertilized land which is difficult to use for other crops.

The second phase of the study was focused on the phytoclimatic areas which interest Apulia. Phytoclimatic area is defined as the geographical distribution of plant species for homogeneous climatic features. We referred to the Pavari Mayr model (1916), which identifies five areas in the national territory which take their name from the plant species that are more widespread. They are, from the warmest to the coolest ones: *Lauretum, Castanetum, Fagetum, Picetum and Alpinetum* (4).

Each phytoclimatic zone is further divided into types and subzones in consideration of temperature values and rainfall. Pavari climate classification allows not only to classify the different plant associations on the basis of rainfall and temperature values, but also to assume, as in our case study, whether or not a plant species can be successfully grown in a geographical area. On the basis of average annual temperatures, average temperatures of the coldest month, and average minimum temperatures, it can be said, with a sufficient approximation, that a phytocoenoses can develop.

## Characteristics of Reseda luteola L., Rubia tinctorum L. and Urtica dioica L. and their possible uses

From Reseda luteola L. and Rubia tinctorum L., natural high quality dyes extracts can be obtained that can be employed both in the cosmetic and pharmaceutical sectors. In Italy, where the plains are planted with the most common crops, it can be assumed that cultivation of fiber and dyeing plants is reserved to marginal lands. This would also allow recovery of these areas from a geological and environmental point of view. It will provide some brief information about the extraction process of pigment dyes with their main technical characteristics.

*Technical characteristics and related extraction process of Reseda luteola L. and Rubia tinctorum L.*

Reseda luteola L. belongs to the Resedaceae family, and is native to the Mediterranean basin where it is known with different vulgar names such as: *Reseda biondella, Amorino, Biondella*. It has a two-year cycle and it is spontaneous throughout the peninsula and the islands. The plant prefers calcareous soils and dry and sunny places; it grows in marginal lands, but also colonizes roadsides, and even cracks in the dry stone walls typical of the Apulian countryside.

This crop is very ancient if we think that the first evidence of its use has been found in the writings of Roman authors such as Pliny the Elder. The plant has been cultivated for centuries in order to extract the dye pigment called luteolin until it was replaced by synthetic dyes.

With regard to the organs of the plant used, the flower has remarkable colouring properties, but all the crop is used because roots, leaves, twigs and seeds also contain the yellow dye pigment. This molecule, called lutein, gives rise to a natural dye which is one of the most tenacious existing. Field trials set up in Tuscany suggest a simple or coupled row cultivation whose mutual distance is, more or less, 15-30 cm (5).

During the first year of vegetation, the crop produces a basal rosette, while in the second year it obtains flowers that are made of yellow fragrant spikes. Sowing can be done in autumn or spring, depending on the cultivation area.

The collection preferably takes place at the end of the two-year cycle of the plant and that is after the development of flowers. The yield of dried material of Reseda luteola L. has been assessed as approximately 1-3 t/ha, but in irrigated conditions, these values may grow up to 5 t/ha. Regarding the yield of luteolin, a value of 1-1.5 g/plant dry weight is considered. There aren't clear indications in the literature about the thermal and water requirements, which cause the variability of environmental conditions.

Rubia tinctorum L. belongs to the Rubiaceae family and is also known as its vulgar names robbia and garanza; it is endemic in the Mediterranean basin where it is found in wild state in coastal and foothill areas characterized by temperate climate conditions.

The crop is similar to Rubia peregrina L., which is another species widespread in the same range. It's a dyeing long tradition plant with the already mentioned Reseda luteola L. and Isatis tinctoria L. For centuries, in fact, roots and underground stems have been exploited for the extraction of the red pigment alizarin.

The colour obtained from this plant species is stable because it is firmly fixed to textile fibers, even after repeated washings. It is a herbaceous perennial plant whose height can reach one meter, and it produces rhizomes responsible for the production of red pigment from the third year after planting. Alizarin is a glucoside and accumulates over time in the roots, and is then collected, rinsed, dried and ground to obtain a red powder with which it is easy to colour natural fibers such as cotton and wool.

From tests conducted in the territory of the Tiber Valley in Tuscany, it is clear that the cultivation of Rubia tinctorum L. can favourably perform in rows with a distance of 20-30 cm; seeding can take place in spring, but there is the possibility of planting rooted cuttings in spring or autumn (6).

If transplantation is preferred, the collection may take place in the second year; while if seeding is chosen, it is expected in the third year of vegetation. The root yield values, still in Tuscany, are approximately equal to 3 t/ha of dried roots, while the free alizarin is 3.3 mg/g of dried root, alizarin bound is 3.4 mg/g and, therefore, the total content of alizarin is, more or less, 6.7 mg/g (7).

Roots actually contain also other compounds such as aglycone anthraquinones and glycosides. The dye pigments are contained in the plant as a percentage of 2.3 to 4.4%. Despite the lack of experimental data relating to the cultivation of madder in the Apulia Region, yield values not far from those obtained in Tuscany could be supposed on the basis of agro climatic conditions of Apulia, where, however, the plant is massively present in the wild state.

The difficulties of introducing such a plant species as a cultivated plant are related to the lack of botanical knowledge, the lack of appropriate mechanical equipment to the collection and, in general, the shortage of facilities for processing the collected material.

Whether for Reseda luteola L. or for Rubia tinctorum L., collection occurs after the extraction of pigments, which consists of the fulfilment of the colour bath from plant material that has been previously dried and shredded.

After that, maceration in water will occur, first at room temperature for about 12 hours and then at 90 ° C for one hour. The macerated powder, thus obtained, is filtered to prepare the colour bath. All the steps already described are highly changeable because of the initial quantity of plant material, the plant used, the working temperature and the extraction time.

Fresh or dried plant can be used, but in the first case, it would be suggested to double doses of the starting material. After the preparation of the colour bath, it goes to the washing of fibers to remove any impurities.

This phase is common to all textile fibers, but there are differences regarding the treatment modalities. Vegetable fibers are first immersed in hot water with soap for about an hour, then cooled down and rinsed with cold water. Animal fibers are treated with soapy water for half an hour at a temperature of 50°C, then rinsed, centrifuged and dried.

After the washing step, is the etching, which consists of treating the fibers with substances called mordants with the primary aim being to promote the establishment of colour but also to change it.

Technically, this step is accomplished by boiling the fibers in water in which mordants have been previously dissolved. The substances used could be synthetic or natural; the most common are tannins and potassium alum.

The last step in the processing of fibers is dye, which is accomplished by immersing the textile materials in the dye bath by adjusting parameters such as pH, time and temperature as a function of the treated fibers and the desired colour (8).

With regard to natural fibers, such as those arising from Urtica dioica L., interest has increased in recent years because of the possibility of overcoming the overproduction of agricultural commodities for food use.

*Specifications of Urtica dioica L. and its related extraction process*

Urtica dioica L is one of the most promising fiber plants that fits well with a view to multifunctional agriculture and rediscovery of ancient traditions.

Belonging to the family of Urticaceae, the crop colonizes the entire peninsula and it prefers a temperate climate but it is equally adaptable to many soil and climatic conditions. The plant is universally known as a weed because it is very common and does not fear competition with other crops as it can develop in different distribution areas.

*Urtica dioica L* is a dioecious plant, and so there are male and female individuals; the stem grows from a rhizome and it is covered with stinging hairs as well as leaves.

It's possible cultivation in the Apulia Region is supported by the following considerations: the crop does not need massive doses of fertilizers and water, shows a satisfactory tolerance to diseases and pests, allows the exploitation of so-called over-fertilized soils because it is a nitrophilous species, and it enables the recovery of marginal soils and a healthy complication of the agroecosystem with clear business benefits from environmental point of view.

Taking into account what it has been said, it appears that Urtica dioica L. could easily be cultivated under organic farming, even if the lack of sufficient experimental data doesn't allow us to know plant requirements regarding water intake and temperature values.

Unlike the dyeing plants described above, there is an agricultural technique for Urtica dioica L. cultivation which results in mechanization of operations.

The planting of the crop can be done by sowing or transplanting cuttings in spring; the latter case will ensure a more uniform flowering. With regard to the planting of the crop, a distance of about 50 cm between rows appears to be an optimal solution for intensive cultivation.

The collection may occur from the second year and for several years; although a specific harvesting technology hasn't been developed, it can be borrowed from the cultivation of hemp that has similar morphological characteristics to Urtica dioica L.. One harvesting a year can be done because fiber produced from the stalks, which push back in the same year, does not have high quality (9).

An Italian chain based on cultivation of Urtica dioica L. does not exist so it is difficult to provide information about the real feasibility of the crop. This chain, limited in size, is present in Germany and is wholly owned by a single industrial company whose name is Stoffkontor Kranz AG. This company produces fiber *Urtica dioica L* garments. They are marketed under the brand name World Urtica dioica L..

The feasibility of Urtica dioica L. growing in order to obtain the fiber, however, does not eliminate the difficulty of making a textile chain, especially in a time of severe economic crisis like the present. Regarding the methods of textile fiber extraction, they are borrowed from those of other crops such as flax and hemp.

One of the most widespread techniques is based on the use of steam and is called "steam explosion fiber".

This method consists of treating fibers after they have been peeled, washed and pre-treated with an impregnating solution, with saturated steam. Values of pressure, time and alkaline concentration vary depending on quality of fibers themselves. After the treatment phase, the next step is to proceed with boiling and acceleration of fibers, thus operating a refinery before sending the material to spinning. Another, much more promising method is done by maceration using pectinolytic enzymes.

The big advantage of this technique lies in the fact that process waste water is biodegradable, and therefore easy to dispose of. Enzymes are produced as a result of fermentation of microorganisms such as *Bacillus* and *Aspergillus niger*. The only industrial company in Europe operating the production of *Urtica dioica L* fiber uses a patented system.

The yield of fiber obtained in the changing conditions in which it operates is the subject of the study. Data obtained shows that fiber yield is greatly influenced by the clone used and climatic conditions, especially the scarcity of water and nutrients (10).

**Exploitation of Apulian marginal lands**

The first part of the research involved the selection of plant species that have been judged most promising, by a geo-climatic point of view, for a possible cultivation in Apulian marginal lands. The next phase planned the study of phytoclimatic areas with the aim of identifying crops that could have been suitable for growing in Apulian climatic conditions. The Apulia Region is part of the Lauretum zone that consists of three types and three sub-zones as shown in Table 1:

TABLE 1

**SUBDIVISION OF LAURETUM ZONE**

| **Type** | **Characteristic** |
|---|---|
| Type I | rainfall is evenly distributed throughout the year |
| Type II | significant summer drought |
| Type III | no summer drought |
| **Sub-zones** | **Characteristic** |
| Sub-zone I | warm sub-zone |
| Sub-zone II | middle sub-zone |
| Sub-zone III | cold sub-zone |

Source: (4)

Table 2 shows the main characteristics of the three sub-zones according to the parameters considered essential for the development of a phytocoenoses: average annual temperatures, average temperatures of the coldest month and average minimum temperatures.

TABLE 2

**LAURETUM SUB-ZONES CHARACTERISTICS**

| Sub-zone | Average annual temperature | Average temperature of the coldest month | Average minimum temperature |
|---|---|---|---|
| **Warm** | 15-23 °C | ›7 °C | ›-4 °C |
| **Middle** | 14-18 °C | ›5 °C | ›-7 °C |
| **Cold** | 12-17 °C | ›3 °C | ›-9 °C |

*Source: (4)*

From literature sources which have been consulted, it is shown that ontogenetic features of the three plant species that are subject of the present work are adequately satisfied by Lauretum climatic values (11).

However, if it is clear that climate influences phytocoenoses of a determined area, it is difficult to determine quantitative parameters of this relationship because they are closely dependent on the actual responses of plant species to their natural habitat. The present work is, therefore, a preliminary study about the feasibility of fiber and dyeing plant cultivation in Apulia, waiting for a field trial.

The methodological approach, that it has been followed, has contemplated the intimate belief in the scientific community that the winter temperatures, and in particular those of the coldest month, are the most representative to establish distribution of phytocoenoses.

The feasibility study must be followed by field tests supporting the hypothesized thesis.

*The potential of Apulian marginal areas*

The potential of the Apulian marginal areas is significant, and they could provide great opportunities for economic growth if they are properly exploited.

For this reason, the idea of replacing the traditional synthetic dyes with natural ones could steer the rural economy in a direction of renovation and growth in a sector particularly hit by the financial crisis which is still ongoing, as well as preserving the land from an environmental point of view.

According to the latest General Census of Agriculture in 2010 (12), it is shown that Apulia utilized agricultural area is equal to more than

1,200,000 hectares, while total agricultural area amounts to about 1,400,000 hectares.

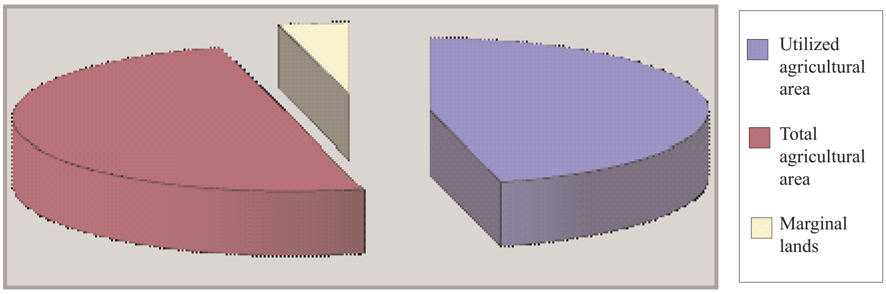
The distribution of utilized agricultural area is as follows: about 651,000 hectares are planted with sown crops, 521,000 hectares are covered by woody crops, 3,000 hectares are family gardens and, finally, about 105,000 hectares are meadows and pastures.

From the data listed above, it appears that there are unused lands in Apulia whose destination could be cultivation of dye and fiber crops; these areas are estimated to cover about 115,000 hectares. We must consider that there is, in the whole Italian territory and Apulia in particular, the tendency to cover the so-called marginal agricultural lands with solar panels.

From data processed by the manager for the electrical services, Apulia stands in first place in the special classification of the subdivision of land plants that have replaced agricultural fields, with about 1,500 hectares dedicated to solar energy.

This form of investment, however, is only one possibility and it must also take into account the reduction of incentives for the coming year. The objective of this study is not to prepare an economic evaluation of a photovoltaic system; however it should be noted that the reduction of incentives for 2011 stands at about 18% divided into quarters, and for 2012 and 2013 there will be a further reduction to each beginning of the year. For this reason, the research conducted in this paper could provide useful suggestions both for an agronomic and economic exploitation of marginal lands in Apulia.

The figure below shows the distribution of lands in the Apulia Region as it is clear from the data of the VI General Census of Agriculture.




*Source (12).*

*Fig. 1* - Distribution of Apulian agricultural lands.

It is worth remembering that about 70% of medicinal plants purchased in Italy come from Eastern Europe, and hence there are real opportunities for sector growing in Italian territory (13). Critical issues that have impeded the development of fiber and dyeing crop cultivation are briefly mentioned below:

- Competition of foreign low cost material
- Excessive fragmentation of farms
- Uniformity of the imported product
- Pulverization of processing facilities
- Effect of labour costs on production ones

From what has been said, it is clear that to limit production costs, low labour costs would be necessary; for instance, searching for cultivators within the same families or improving an adequate level of farming operations mechanization.

A technical solution adoptable would be to use the farm machines for the most common farming operations. Using organic production methods, where there is the technical ability and cultural background of the farmer, should also be suggested.

The market for medicinal plants, generally speaking, is regulated by strict standards of quality set by industry associations and widely shared by producers and consumers, but these requirements are not imposed by law.

Parameters are present in the Codex herbarum and concern heavy metals, pesticides, polycyclic aromatic hydrocarbons (PAHs), mycotoxins and the total bacterial load. Quality requirements demanded by the market can be met only with an adequate level of specialization and operators professionalism. As far as the purely economic aspect of the cultivation of medicinal plants is concerned, the prices applied by wholesalers are based on international prices and stood on average at € 1.50/kg of dry product.

To clarify what has been said above, we consider three plant species of interest for Puglia, Urtica dioica L. as a fiber plant, and Rubia tinctorum L. and Reseda luteola L. as dye plants.

## Technical economic analysis of Urtica dioica L.

The economic life of Urtica dioica L. varies from 4 to 10 years, depending on growing conditions, which can be more or less intensive.

Yield values have been estimated at about 3-5 t/ha of dry stalks, while the amount of fiber varies from 0.14 to 1.28 t/ha of dry weight.

The apical part of the plant is richer in fiber than the baseline and the content is highly variable depending on the clone used. The fiber yield has been estimated, following tests, at around 12-15% of dry matter.

Doing a brief calculation, if just 10% of Apulian marginal land (11,000 ha) is destined for cultivation of Urtica dioica L. and if an average yield of 4 t/ha of dry matter is assumed, it is possible to obtain about 44,000 t of Urtica dioica L. (11,000 ha × 4 t/ha).

A yield fiber of 12% makes it possible to produce about 5,280 tons of fiber which can be transformed into textile yarns. If we consider that the net income per hectare of Urtica dioica L. crop is € 39 (14), it would be possible to obtain, at full capacity, a profit of € 429,000.

The economic life of Urtica dioica L. cultivation is about 6 years, and productive years range from second to sixth, with a maximum at the third and fourth year. In the table below, Urtica dioica L. net income is compared with those for alternative crops:

TABLE 3

**COMPARISON BETWEEN NET INCOMES PER HECTARE OF SOME CROPS GROWN IN THE SOUTH ITALY**

| CROP | HARD WHEAT | BARLEY | HYBRID CORN | RAPE | BROAD BEAN | URTICA DIOICA |
|---|---|---|---|---|---|---|
| **NET INCOME €/ha** | 188 | 25 | 262 | 66 | 16 | 39 |

*Source: (14)*

Although there is a gap between Urtica dioica L. and traditional crops, an interesting comparison is between broad bean and Urtica dioica L. because they have the same place in crop rotation. Cultivation of Urtica dioica L. appears competitive with broad bean and certainly deserves further studies.

*Technical analysis of Rubia tinctorum L.*

Rubia tinctorum L. can provide a radical production of about 8 t/ha with an estimated content of 918 mg of alizarine per plant, considering 30 months harvesting; experimental data show that an average production of about 5 t/ha, at the end of third year vegetation, may be sufficient to stain 16.7 tons of yarn.

Considering the same area assumed for Urtica dioica L., it would be possible to achieve 55,000 tons of roots (11,000 ha * 5 t/ha). With regard to cultivation of Rubia tinctorum L., there is no data about net income per hectare. Precise cost and revenue analysis will be evaluated in the next paper.

*Technical analysis of Reseda luteola L.*

Another interesting crop is Reseda luteola L. with an average production of 1-3 t/ha of dried material and a luteolin content of about 1 g/plant of dry weight. Considering the Apulia available area, it is evident that exploitation of these zones would represent a development opportunity for the territory itself. In this case, assuming an average production of 2 t/ha, 22,000 t of dried roots (11,000 ha × 2 t/ha) would be obtained. In the case of Reseda luteola L., please refer to the next note for a proper analysis of costs and revenues.

**Final remarks**

In the Apulia Region there are mostly enterprises that deal with packaging of the finished products of clothing. However, beyond official statistics, there are many small businesses that are not counted and so it is extremely difficult to survey the actual textile companies operating in Apulia, also taking into account the severe economic crisis that has hit the sector in recent years and which swept away several factories.

According to Infocamere 2009 data, the number of active textile factories that are members of Commerce chambers is about 1,700 with a number of employees of about 7,000 units.

The sector in Apulia is suffering because of the mentioned global crisis that has resulted in specific industrial strategies as a strong outsourcing and, in some cases, the use of the mechanism of closing and subsequent reopening to obtain tax benefits.

The number of crises is significant if we think that in 2005 the textile industry relied on, more or less 6,000 companies with 28,000 employees (15).

The four districts of the textile industry are located in many geographic areas. It is clear that in an economic situation like the one described, offering an opening to textile product innovation and a rediscovery of natural dyes is risky but appropriate to revitalize the whole textile sector.

Dyeing plant extracts, specifically those of Rubia tinctorum L. and Reseda luteola L., could be attractive if we think that their price is about € 24/kg for both (16). If we consider that the amount of dye extracts is respectively equal to about 8% of Rubia tinctorum L. root production and 5% for Reseda luteola L., it is possible to obtain about 4,000 t of red pigments and 1,000 t of yellow ones.

Thus the potential economic return would be approximately 96 million € for Rubia tinctorum L extract and 24 million € for that of Reseda luteola L. The following table summarizes what has been said.

TABLE 4

**PRICES OF EXTRACTS OF RUBIA TINCTORUM L. AND RESEDA LUTEOLA L.**

| Crop | Price of extract (€/kg) | Quantity of dye extract (t) | Total price (million €) |
|---|---|---|---|
| Rubia tinctorum L. | 24 | 4,000 | **96** |
| Reseda luteola L. | 24 | 1,000 | **24** |

*Source: (16)*

In light of what it has been said, we can say that no-food crops can be a great opportunity for agriculture which look to the future with optimism, but especially with foresight. Apulia, thanks to its climate, is suitable for cultivation of fiber and dye plants, and is a candidate to be the scientific laboratory of an operation to re-launch an industry: the textile and dyeing one, which is suffering but capable of major changes.

However, the European Technology Platform (ETP) of the textile sector has also included implementation of ecological processes for the production of fibers and natural dyes in the program document "Vision for 2020". Moreover, Common Agricultural Policy, with the inclusion of "decoupling," which came into force in 2005, gives a premium to farmers regardless of the type of cultivation, and encourages, even if not directly, the development of new crops like those that have been spoken about.

In a difficult macroeconomic context, local companies can develop the exploitation of marginal lands as we have tried to suggest in this note. Research of potential market opportunities could be, without doubt, the subject of further studies.

It will open new perspectives for producers and, at the same time, it will provide healthier and more environmental friendly products to consumers. It isn't a coincidence that Purchase Solidarity Groups, formed by sensitive people to environmental issues and potential buyers of natural products, are already a reality.

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