# CULTIVATION AND USE OF *ISATIS TINCTORIA* L. (BRASSICACEAE) IN SOUTHERN ITALY[1]

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**Guarino, Carmine** *(Università degli Studi del Sannio-Facoltà di Scienze MFN, Via Port'Arsa 11, I-82100 Benevento, Italy),* **Paolo Casoria and Bruno Menale** *(Università degli Studi di Napoli "Federico II"-Orto Botanico della Facoltà di Scienze MFN, Via Foria 223, I-80139 Napoli, Italy).* CULTIVATION AND USE OF *ISATIS TINCTORIA* L. (BRASSICACEAE) IN SOUTHERN ITALY. *Economic Botany 54(3):395–400, 2000.* Isatis tinctoria *L. (Brassicaceae), commonly known as woad, is a biennial species with erect stem, hastate leaves, and yellow flowers clustered in racemes. Fruits are pendulous siliques. This species, probably indigenous of southeastern Asia, was used for the extraction of a dyeing agent called "indigo." Woad was introduced in ancient times in Italy and the first records of its cultivation date back to the Roman period. For many centuries, woad cultivation remained stable, but grew dramatically in the eighteenth century. In that century, the Società Economiche established by Bourbons encouraged the cultivation of it in Southern Italy. Near Caserta, in Campania region (Italy), a factory for the extraction of dyeing agents was established and the dye was used in textile production in San Leucio (Caserta). The cultivation of* I. tinctoria *is abandoned today, although this species grows spontaneously as a weed in Italy. The authors discuss the history of woad and some ancient extractive and dyeing methods.*

COLTIVAZIONE ED USO DI ISATIS TINCTORIA L. (BRASSICACEAE) NELL'ITALIA MERIDIONALE. Isatis tinctoria *L. (Brassicaceae), il guado, è una specie biennale con foglie astate e fiori gialli riuniti in racemi. I frutti sono silique pendule. Questa specie, probabilmente originaria dell'Asia sud orientale, era usata per l'estrazione di un principio colorante, l'indaco. Il guado fu introdotto in Italia in tempi antichi e le prime informazioni relative alla sua coltivazione risalgono agli antichi Romani. Per molti secoli la coltivazione del guado rimase stabile, ma nel diciottesimo secolo subì un notevole incremento, poiché le "Società Economiche" volute dai Borboni incoraggiarono la coltivazione di* I. tinctoria *nell'Italia meridionale. Vicino Caserta (Campania, Italia) fu impiantata una fabbrica per l'estrazione del principio colorante che era utilizzato nella manifattura tessile di San Leucio (Caserta). Verso la metà del diciannovesimo secolo, la coltivazione del guado fu abbandonata; attualmente tale specie si ritrova allo stato selvatico. In questo contributo gli autori riportano la storia della coltivazione del guado ed alcuni antichi metodi di estrazione del principio attivo e di colorazione.*

**Key Words:** *Isatis tinctoria*; woad; cultivation; dyeing method; extraction method.

In Southern Italy, the use of dyes obtained from species growing wild goes back to remote times; the first evidence of this art comes from ancient Roman times. The tradition of dyeing cloth with wild species reached a peak during the Bourbon period before disappearing with the advent of synthetic dyes.

The plants used for dyeing in Southern Italy in the past are currently being studied by Neapolitan botanists. The results of these studies will be used to establish an exhibition area where various species of dye plants will be cultivated at the Naples Botanical Gardens. This area will be linked to museum exhibition of materials used in the processes relating to the art of cloth dyeing. As part of the project, the following contribution on *Isatis tinctoria* L. (Brassicaceae), woad, has been prepared.

## THE PLANT

*Isatis tinctoria* is an upright herbaceous biennial species up to 120 cm in height. The leaves, with a waxy and slightly hairy surface, are hastate with minute auricles. The flowers, gathered in a racemose inflorescence are small

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**Fig. 1.** *Isatis tinctoria* L. (Pignatti, 1982).

**Fig. 2.** Distribution in Italy of *I. tinctoria* L.

and yellow in color (Ball 1964; Pignatti 1982) (Fig. 1).

In Italy, this species is found in the southern and northcentral areas of the peninsula and along the western side of the northern border, as well as on the major islands (Fig. 2). Because of the variability of the species, especially the size of the fruit, various infraspecific variants have been identified, among which are, in ascending order according to the width of the siliqua: *I. tinctoria* f. *oxycarpa* (Jordan) Thell. and *I. tinctoria* subsp. *tinctoria*. *I. praecox* Kit. has been placed in synonymy with this species (Pignatti 1982). These taxa have little systematic importance, as the limits between them are not precisely defined.

According to Pignatti (1982), the most important form from the taxonomic point of view could be *I. canescens* DC. This entity has also been recognized by other authors (Fiori 1923–29; Ball 1964). It is widespread in Southern Italy and is characterized by densely tomentose siliqua.

The origin of *I. tinctoria* remains open to question. Some authors maintain that the species is native to southeastern Europe, whereas others believe that it is an Asian plant and was introduced into Europe in remote times (Pignatti 1982).

## Historical Background

The properties of *I. tinctoria* were known in the earliest historical periods, as shown by references in ancient texts and several historical findings. Recently, an important finding has been made in Latium: a tomb dating back to the Iron Age containing the remains of a woman wearing a blue dress. Because at that time indigo (*Indigofera tinctoria* L.) had not yet been introduced from the East, the coloring of the garment was probably due to the use of woad.

In works from subsequent historical periods, many writers mention woad for its dyeing qualities. Pliny the Elder makes frequent mention of the plant and the use made of it by female Britons, who colored their entire bodies blue for religious ceremonies (Plinio 1985).

Caesar, too, refers to the properties of woad in *De Bello Gallico* (Cesare 1989). When, as head of the Roman army, he crossed the English Channel and invaded the British Isles, he found a native population who, by means of stone instruments, would cut the skin, rub woad on, and as the juice penetrated the wounds, formed a blue tattoo. The Romans called these people *Picti*, meaning "painted people." This term is the

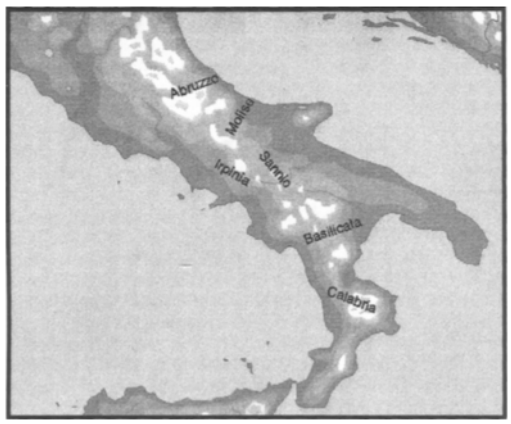


**Fig. 3.** Cultivation areas of *I. tinctoria* in Italy.

translation of the Celtic "Brythen" (Brunello 1961).

Woad was named *vitrum* or *glastum* (Cesare 1989; Plinio 1985; Pomponius Mela 1984), the former term is a Latin translation of the Celtic word *glas,* meaning both "glass" and "blue," whereas the second is a Latinization of the Celtic word itself (Brunello 1968).

In short time the Romans learned the art of using the colorant properties of woad and perfected the method of extracting the color from the plant. Important evidence comes from Pompeii, a town in Campania that saw important economic changes with the advent of the Roman Empire, reaching its peak in the period immediately prior to the catastrophic eruption of Vesuvius in A.D. 79. (Corti 1957; Della Corte 1912). What many consider to be the largest dye works of the Empire, with nine furnaces, nine cauldrons, lead pipes, and various terracotta amphorae, has been unearthed at Pompeii. The fresco at the entrance showed a man holding a pole with blue cloth hanging off it (Maiuri 1951). Many Pompeian dye works specialized in woad, using matter from the *I. tinctoria* crops cultivated widely in Southern and Central Italy. The plants used in these dye works were mainly from the areas now known as Sannio, Irpinia, Abruzzo, Molise, Basilicata, and Calabria (Fig. 3).

With the fall of the Roman Empire, many activities came to a complete stop, including those connected to the dyer's craft. As a consequence, the cultivation of woad was abandoned but the cultural heritage of dyeing was not completely lost and was handed down almost intact to the beginning of the Middle Ages, at which time the industry reawakened in Southern Italy. An important factor that contributed to the craft's new life was the introduction by the Arabs of new techniques and dyes hitherto unknown in the West (Borlandi 1949:297–324). Also in Southern Italy, an increase in the activity of the silk industry gave another boost to the dyeing industry. As a result, there was a remarkable increase in the cultivation of dyeing plants, especially woad, which in some regions became the most cultivated plant, sometimes giving a high-quality product such as, the dye deriving from the Sannio crops.

The increased production of *Indigofera tinctoria* L, one of the species from which it is possible to obtain the dye coloring called "indigo," caused a gradual reduction in the use of woad. From *In. tinctoria,* indigo can be obtained by steeping the leaves in water and adjusting the pH during this process (Perkin and Everest 1918). A similar method was used in Shanghai during the nineteenth century to extract indigo from *I. indigotica* (Fortune 1846).

In Southern Italy, the reduction in demand for products deriving from *I. tinctoria* caused violent protest from growers, whose earnings took a sharp drop. In many regions, to solve this situation, special regulations and statutes were set up to protect the cultivation of woad (Melis 1962), and the use of indigo obtained from *In. tinctoria* was forbidden (Borlandi 1949:297–324). However, during the following centuries, this prohibition did not prevent a noticeable reduction in the use of woad. The consequence was that the cultivation of woad was abandoned.

The abandonment of woad cultivation did not extend to Southern Italy. Initially the cultivation of woad underwent a slight drop and then beginning in the eighteenth century saw a slow but sure revival thanks to the Bourbons (Gasparrini 1845). Around 1750, a huge factory for extracting indigo from woad was set up at Caserta, and to make it operational, one of the past masters of the craft, Giuseppe Madera was sent for from Turin. The rationale for such a factory near Caserta was its proximity to San Leucio, famous for its silk, and the presence of terrain suitable for the cultivation of woad (A.S.C. 1750).

During the decade of French domination (1806–1815), at which time real agricultural planning structures were instituted in the Kingdom, the so-called economic societies provided the suggestions of experts on cultivation meth-

ods relating to woad and how to extract the color (Granata 1830).

The cultivation of *I. tinctoria* in Southern Italy continued until c. 1830 when it began a constant decline leading to its final abandonment (Gasparrini 1845). The Caserta works were subsequently closed down (A.S.C. 1836).

## The Cultivation of Woad

In Central and Southern Italy, the cultivation of *I. tinctoria* was widespread over several zones, especially in the Outer Principality (now Abruzzo), Sannio, and Irpinia (Briganti 1842; Gasparrini 1845; Gussone 1826; Gussone 1854; Pasquale 1876; Tenore 1811; Terracciano 1891; Trotter 1905). *I. tinctoria* grows wild on arid and rocky soils and also on humid soils. When cultivated, however, the nature of the soil proved to be crucial for the quality and quantity of the product (Bruni 1858; De Lastreyrie 1811). Sparse crops with little colorant in the leaves grew on arid soil, whereas on damp clayey terrain rich in organic substances, the yield was extremely high, but the colorant was present in negligible quantities. In addition, the cultivation of *I. tinctoria* on the same soil for several successive years caused serious impoverishment of the soil. In this case, the soil was enriched by manuring (De Lastreyrie 1811).

To sow woad, the ground was leveled, a few furrows were traced and the seeds were buried in them. The sowing period varied depending on the climate of the various districts: in mountainous areas, it was carried out in February; in Sicily some preferred to sow woad in October. One reason why sowing was brought forward was that it was necessary to pick the leaves before dipteris parasites got to them. Further operations necessary for a good harvest consisted of two or three hoeings, the elimination of weeds and, the thinning out of the young plants if they were too close together.

The leaves were gathered when they began to yellow around the edges. In Southern Italy, this gathering usually took place in the first week of June and might be repeated again up to six times over a period of 15–20 days, generally with a gradual reduction of the quality of the material gathered. The gathering was usually on dry windy days, never in the early morning when the leaves were dew-laden (De Lastreyrie 1811; Gasparrini 1845).

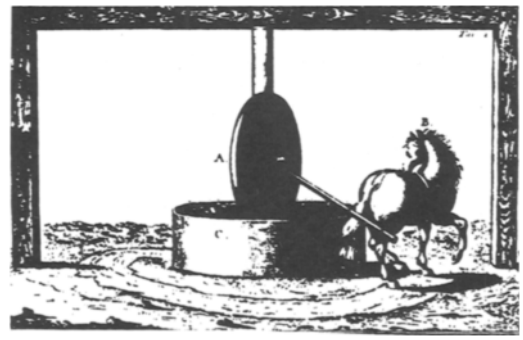

**Fig. 4.** The mill used for the preparation of woad.

## Techniques for Preparing the Pastel

Once gathered, the woad leaves were ground in mills until a dense paste was produced (Fig. 4). This was laid out in heaps in a covered place, closed on three sides and was trodden underfoot. Then, to make the paste uniform, and to eliminate residual liquid, the heap was beaten with a shovel along the back wall of the enclosure, where the floor level was higher.

The heaps were then left to ferment for varying periods depending on the temperature of the place. Next, they were turned and left to ferment for another 10–15 days. After fermentation, the heaps were broken up to eliminate the crust that formed on the surface and creating a mulch. Next, the mulch was formed into small "loaves" approximately 30 g each. Three specialist workers were required for this, two of whom squeezed the mulch hard while the other gave it its shape. The resulting loaves were left to dry on mats, usually in an airy and shady place, although some claimed to obtain better results drying in the sun.

In some regions, for example, Calabria, the heaps were left to ferment in the sun for 24 hours, were kneaded again and, after a month, subjected to a grinder. This did not, however, produce a good result, as the heaps were not left to ferment enough (De Lastreyrie 1811).

Once the loaves were dry they were delivered to the merchant, who stored them in large and airy warehouses. The quality of the pastel was linked to the amount of material left to ferment. It was not possible to work successfully if there were not enough for at least 50 000 loaves.

To ready the loaves for use, they were squashed with a mallet and divided into two or

three portions, then placed on the ground and dampened usually only with water, although some recommended a mix of water and urine, lime, or wine. The layer was raised at one end, thus forming a second layer, which, once it too had been watered, was superimposed on the first one. This operation was carried on until a pile around 80 cm was built. Next, after a period of three days, the piles were removed and dampened again in the ratio 2.4 kg of water to every 1000 loaves (Ghiara 1976). Finally, they were left to lie for a period of time to allow the elimination of excess water. The product obtained after all this was called "powdered pastel" and was ready for use.

The most delicate part of the whole process was the preparation of the vats where the chemical reduction of the indigo, the main colorant present in the leaves of *I. tinctoria,* took place. Indigo is insoluble, but because of the action of the enzymes deriving from the fermentation process, it breaks down into glycoside and indossile. The latter is soluble, can penetrate into textile fibers and when oxidized in the atmosphere becomes insoluble (Pellizza 1905). The greater part of this delicate and complex operation was controlled by the dyers in a completely empirical way, which became the "secrets" of each master: the color, odor, and even taste of the bath liquid were, for a long time, the only elements the dyer could use to check the fermentation and solution processes.

Originally, the vats were copper and placed directly over the flame. Indeed the maintenance of a constant temperature of between 45°–60°C was a crucial element in preventing the slow down or stopping of the reduction of the indigo (Pellizza 1905). During the sixteenth century, both in Southern Italy and Genoa, the whole process, controlled by the *magistri goaldorum* was carried out in wooden vats, following a process established probably two hundred years before. To keep the heat, the vats were buried and sealed into the floor of the dye works.

The bath vat was prepared by mixing warm water and alkaline agents, the most common of which was wood ash. As an alternative, urine could be used, despite its low alkaline level, or slaked lime, or potash. In Naples, from the fifteenth to seventeenth centuries, dyers used local ash, produced in furnaces annexed to the dye works. Only in the eighteenth century did mineral potash begin to be used the first time, imported from various countries, especially France. Bran and hay as well as the pastel supplied the acids that allowed the formation of enzymes able to free the hydrogen to reduce the indigo. The alkalinity from the ashes regulated the fermentation, saturating the acids present and liberating the bases, which maintained the solubility of the compost (Panizzon 1918, 1927).

Once the vat was ready, it was necessary to wait for an interval of 24–30 hours for the fermentation and solubility of the mixture to reach the optimum level. During this period the risk of compromising the whole process was extremely high, as any imperfection in the vat, or excess fermentation could cause a ruinous deceleration of the process, or an error in adding material could ruin the bath completely (Rebora 1970).

With the frequent addition of ash, to a proportion of about a quarter of the pastel, as well as hay and bran, the vat period could last three to four days. During this period it was possible to obtain different tones of color. From an intense dark blue, which was obtained the first day it was possible to go to a royal blue, a turquoise, and even paler shades such as sky blue as the fermentation process slowed down (Hellot 1750).

A significant economic problem was the need to cover the costs of the various procedures by producing an adequate amount of color during fermentation. To obtain a greater quantity of the product, an attempt was made to prolong the individual processes going on in each vat.

A habit that spread rapidly in the major European centers and made it possible to prolong the time scale, and thus produce greater quantities, was to heat the vat without eliminating each soaking cycle as had been the case previously. In Southern Italy, this process was introduced in the eighteenth century, to coincide with the construction of the Bourbon factory at Caserta (A.S.C. 1750).

Using this repeated heating method, all the pastel used and rendered insoluble after fermentation was reduced and oxidized again. The workers added, at each heating, small doses of pastel, in relation to the quantity of material to be dyed and the shade desired. This process allowed a reduction to the absolute minimum of ingredients consumed, carrying out in the meantime another seven to nine reheats, for a total of

40 days, before filling the vat again (Hellot 1750).

Another important factor was represented by the capacity of the vats. They had to be voluminous, because in this way the water could remain hot for a longer period of time. Furthermore, the dosage of the ingredients was easier to handle and the water became less cloudy because the notable deposits of insoluble matter had less effect on the water.

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