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ORIGINAL PAPERS

Studies on the Morphine* Content of *Papaver somniferum L*

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Abstract

The present paper investigates the variation of the morphine content related to the vegetation stages on *Papaver somniferum L,* cultivated at Braşov. The study stresses the importance of creating specific poppy cultures for morphine cultures harvested in a stage of immature capsules when the content of morphine and the morphine yield per hectare increase three times. The study also indicates that research in this field led to the creation of a new poppy variety (Safir) with superior morphine content (0.63 g/100 g shells). This variety can be used in seed production for growing cultures used in the production of morphine.

Keywords: Papaver somniferum, morphine.

Introduction

The garden poppy, *Papaver somniferum L,* was cultivated since ancient times, both for the alimentary qualities of its seeds and for the medicinal virtues of its capsules.

In time, a distinction was made between the poppy cultivated for alimentary use and that for medicinal use, alongside with an increasing interest in researches

* Total alkaloids expressed in morphine.

on the amelioration and selection for creating varieties that are more productive and have an enriched active principles content.

The use of poppy as a source of opium goes back to the 15th century B.C. in Greece [1]. In 1930, in Hungary, Kabaz elaborated the technology for the extraction of morphine from dried capsules. From that moment on a new concept is used, that of yield with mixed use: seed and capsules. The issue of selection and amelioration of the garden poppy, presenting this double objective, became an interesting topic for many researchers.

Morphine is an alkaloid well known in therapeutics due to its analgesic, hypnotic and narcotic qualities that are directly linked to its structural conformation.

Although important researches were performed (in the USA, Great Britain) in order to replace morphine with the so-called enkephalins (endorphins) so that the therapeutics would benefit from strong analgesics without the pharmacoaddiction phenomena that occur to morphine and its derivatives, they very soon observed that these synthesis products generate, no less than morphine, the same kind of phenomena. It was back to morphine but effective antagonists were also created (s.a. nalorphine) chemical substances that prevent the severe respiratory depression occurring in acute intoxication with morphine [2].

Considering the increasing number of cancer cases and other diseases that require strong analgesic therapy in certain phases of their evolution, we stress the importance of the scientific research focused on obtaining poppy varieties with a high content of morphine and at the same time on improving crop growth processes in order to increase the production of morphine per hectare.

Materials and Methods

The research was conducted inside the Medicinal and Aromatic Plants Research Laboratory, Braşov on two different varieties: Extaz and Safir (the latter is certified and licensed as a variety of this species at the SCPMA Laboratory Fundulea from Braşov [3]).

A study of the dynamics of accumulation of morphine in poppy capsules at different stages of vegetation was carried out to determine the optimal timing for harvesting in relation with the maximum amount.

The vegetative phase was defined as the duration from sprouting to the maturity of the capsule. The collection of sample material and the analysis of the morphine content were conducted along 10 stages of vegetation corresponding to the important moments in the ontogenetic development of plants:

C_1 – beginning of flowering (15% of plants in bloom)
C_2 – complete flowering (50% of plants in bloom)
C_3 – end of flowering (80% of plants in bloom)
C_4 – beginning of milk maturity of the capsules (capsules begin to increase dimension and weight)
C_5 – milk maturity of the capsules
C_6 – beginning of seed setting (the browning of the seeds and immature capsules that completed the growing process)
C_7 – immature capsules with set seeds in the main capsule and white seed in the secondary capsules
C_8 – the beginning of capsule maturation (when capsules begin to lose weight)
C_9 – maturity of the capsules
C_{10} – full maturity (on harvesting the capsules)

To permit the comparison of the analytical results the authors determined the quantity of morphine in all the freshly collected samples (the humidity varying from 75–80% for stages C_1, C_2, C_3, C_4, C_5, C_6 to 40-45% for stages C_7 and C_8 and up to 13–15% for stages C_9 and C_{10}) and then in the samples dried at 13% humidity. The comparison revealed no significant differences in the quantity of morphine. Hence, in presenting the results, the authors took the medium values determined for a medium humidity of 13% for each sample.

The dosing of the total alkaloids expressed in morphine was carried out by the spectrophotometric method following the extraction by chemical methods [4]. Medium samples from capsules collected from an area of 0.25 m^2 were used. The values can indicate the real value of the content of morphine.

Considering the capsule yield per hectare, the medium production of morphine was determined (in kg/ha).

Results and Discussion

The experiment used in the determination of the maximum morphine content reported to the vegetation stages was obtained from three different sources. The sources differ in point of the nutrition space and of the seed norm per hectare. The variant that was finally selected (on the criteria of morphine content and production) had 25 cm seeding distance between rows and a seed norm of 1.5 kg/ha. The present study presents only the results obtained with this variant.

The graphs show the dynamics of the accumulation of alkaloids expressed in morphine from immature poppy capsules (g%) during the vegetation phase of the Extaz variety, then the medium capsule yield expressed in q/ha for each of the

stages of vegetation and finally the medium morphine yield per hectare determined for each of the vegetation stages.

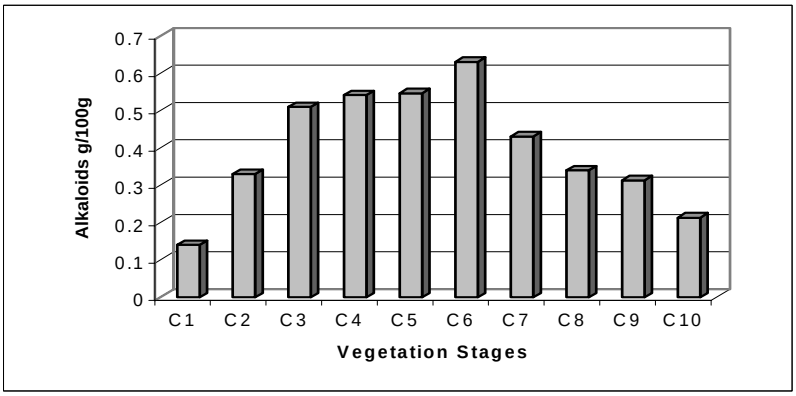

Figure 1 – The dynamics of the accumulation of alkaloids expressed in morphine from immature poppy capsules (g/100 g capsules).

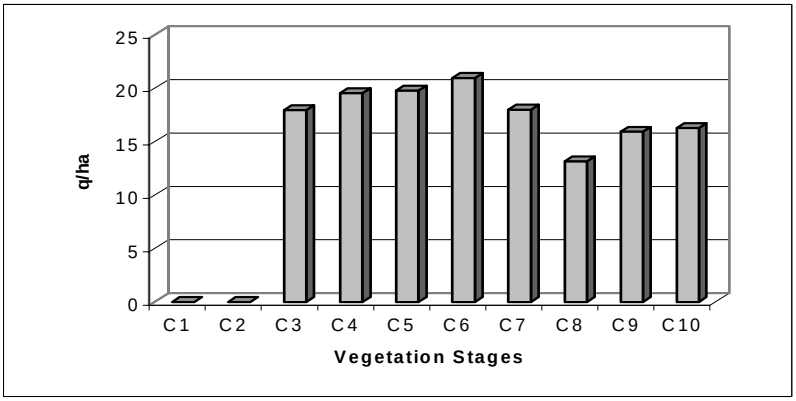

Figure 2 – The dynamics of the medium capsule yield (q/ha).

All measurements were performed with the full capsule, including the seeds.

As the graph shows, the vegetation stages that present the maximum quantity of morphine are C_5, C_6 and C_7 when the capsule is immature. In these stages the quantity of morphine in the capsules ranges from 0.546 g/100 g of capsules in C_5 to 0.63 in C_6 and to 0.43 in C_7. In these vegetation stages the medium morphine yield

reaches 13 kg/ha while at the harvesting time, when the capsules are maturated and the quantity of morphine is of 0.213 g/100 g of capsules, medium morphine yield reaches 3. 46 kg/ha.

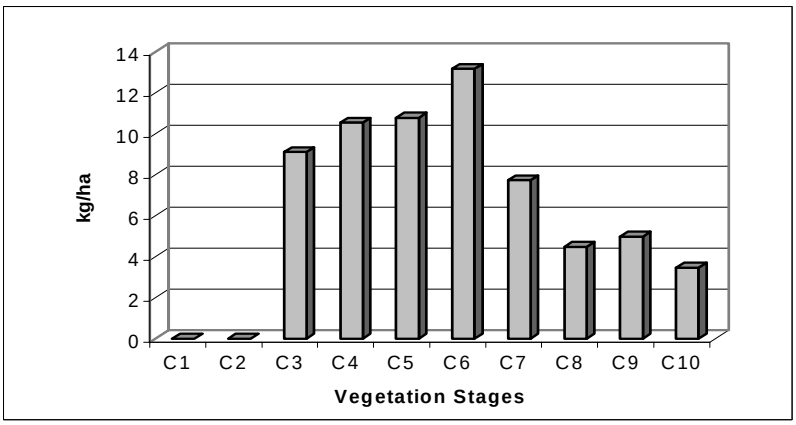

Figure 3 – The dynamics of the medium total alkaloids (expressed in morphine) yield on immature poppy capsules (kg/ha).

Considering these data, the harvesting of the capsules in an immature stage is recommended when the plants are cultivated for morphine. The content of alkaloids expressed in morphine is obviously superior to other stages and, at the same time, the capsule yield per hectare is superior to other stages of vegetation. This leads to a medium morphine yield of 13.1 kg/ha.

In case of a poppy culture grown for the production of shells for morphine and seeds for food industry the harvesting will be done in stage C_{10} when capsules are maturated and the seeds can be separated from the shells and processed independently.

A valuable poppy variety named "Safir" was created inside the Medicinal and Aromatic Plants Research Laboratory, Braşov, by a five generation individual selection combined with auto-pollination of valuable plants, using genitors selected from the genetic resource collection and after a three year morphological and chemical study of the genotypes created in comparative cultures. This variety morphine content is superior to that of the "Extaz" variety. This is due to the fact that, in creating this variety, the objective was obtaining of a high rate of capsules with a high content of morphine and attaining of an important morphine yield.

The morphine measurements for the Safir variety were carried out on dried shells in stage C_{10} and they revealed an important increase of the total content of alkaloids expressed in morphine in comparison with the Extaz reference variety.

The medium values determined in four experimental stations for the two *Papaver somniferum L* varieties, Safir and Extaz, firmly reveal that the newly created variety represents an important material for promoting valuable poppy cultures for both the production of morphine (a necessity for the pharmaceutical industry) and seeds (for food industry).

Table 1 shows an increase of 5% in shells yield and of 8% in seed yield for the Safir variety as compared with the Extaz variety as a reference. A medium increase of 27% in morphine content (g/100g of shells) and of 34% in morphine production per hectare (kg/ha).

Table 1 – The poppy and the morfine yieldfor Safir and Extaz variety

Variety	Safir	Extaz	Medium increase (%)
Seed yield q/ha	11.32	10.45	8
Capsule shells yield q/ha	6.94	6.76	5
The content of total alkaloids (expressed in morphine) g/100 g shells	0.680	0.535	27
Total alkaloids (expressed in morphine) yield kg/ha	4.69	3.48	34

According to the data presented in this study (for the Extaz variety), the production of alkaloids expressed in morphine per hectare is considerably decreasing when using shells from a maturated harvest (3.48 kg/ha) as compared with the use of immature capsules (13.1 kg/ha).

By means of well-conducted efficiency estimation, poppy cultures for exclusive production of morphine could be promoted using multiplication seed from the Safir variety, again superior to Extaz variety.

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