THE EFFECT OF MINERAL FERTILIZATION ON THE PIGMENT CONTENT IN MARIGOLD (*CALLENDULA OFFICINALIS* L.)

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Pot marigold (Calendula officinalis) is a valuable species of medicinal plants, having many uses in plant therapy and cosmetics. The carotenoid pigments from pot marigold' inflorescence represent a fundamental component of medicines. This paper examines the dynamics of the pigment content from pot marigold leaves and inflorescences.

***Key words**: marigold, medicinal plants, pigments.*

The experimentally field took place in the Didactical field of Plant Physiology Discipline of the Uneversity of Agricultural Sciences and Veterinary Medicine “Ion Ionescu de la Brad”, Iaşi.

We have determined the most adequate treatments with biofertilizers and mineral fertilizers for obtaining high quality productions, under the soil and climatic conditions of the region of Iasi. We have also determined the action of different treatments on the content of chlorophyllian and carotenoid pigments from studied plants, under conditions of the studied growing area, knowing that carotenoid pigments are a component part of the active substance in marigold.

In 2007, at the stage of stem formation, we have applied treatments with complex fertilizers (ammonium nitrate, solid and liquid complex fertilizers).

Under the weather conditions of the year 2007, with very high temperatures and lack of rainfall, supplemented by repeated watering, the highest yield was found at the NPK + Foliar 1 fertilized variant followed by NPK fertilized variant and NH_4NO_3 fertilized variant, the yield differences being not so high.

MATERIALS AND METHODS

The plants were harvested in sunny days, after 10 a clock in the morning, after the morning dew vanished and flowers unfolded. We took leaves and flower samples, for the study of assimilating pigments. For each sample, we weighed 0.5 g of fresh vegetal material, which was turned into powder in mortar by means of pounded glass, gradually adding acetone, a solvent for assimilating pigments.

The material turned into powder in mortar is then filtered until the vegetal residues remain white. The filtered material is put in a 50 ml flask and acetone is added until the mark.

We took samples from the pigment acetonic extract and introduced them in 10 or 5 mm thick tanks.

The pigment content from leaves, buds and inflorescences was assessed by the spectrophotometrical method with computer presentation, by determining the light absorption capacity by the acetonic extract in the blue and red zones of the visible spectrum, which characterises maximum absorption wave lengths for chlorophyll (431-432, 453-454 and 662-663 nm) and carotenoid pigments (425-427 and 447-448 nm**).**

The results are shown in absorbance units.

RESULTS AND DISCUSSION

In 2007, we have investigated the eco-physiological reaction of pot marigold plants by determining the content of chlorophyll and carotenoid pigments from plant aerial organs. At the same time, we noticed that the summer of 2007 was characterized by special climatic conditions, represented by excessive drought, with temperatures of 38-40^{o}C during July-August, on the background of rainfall deficit of -63.4 mm in June and -44.2 mm in July.

Under these conditions, our goal was to analyse a group of pigments, with role in increasing plant resistance under stress conditions, which are the flavonoid pigments, with maximum absorption in the near ultraviolet, in 320-322 nm.

For correcting the eco-physiological reaction of pot marigold plants, under the ecological conditions of year 2007, we proposed the application of treatments with solid complex fertilizers for soil and leaf fertilizers (ammonium nitrate, Foliar -1 treatment, Foliar -2 treatments, a solid complex fertilizer and a mixture between solid complex fertilizer and Foliar -1 treatment).

The analysis of the pigment content at the phenological phase of vegetative growth shows that in leaves, the content of *a* 663 nm chlorophyll is increased by all the applied treatments, the maximum value being found at treatments with ammonium nitrate and Complex + Foliar -1 treatment, respectively. The pigment content from the absorption centre (*a* 431-432 nm chlorophyll and *b* 453-454 nm chlorophyll) has been also stimulated by all the applied treatments, the same maximum values being maintained at treatments with ammonium nitrate and Complex + Foliar -1.

The content of flavonoid pigments (320-322 nm) diminished in leaves at all the applied treatments, excepting the Foliar -1 treatment variant.

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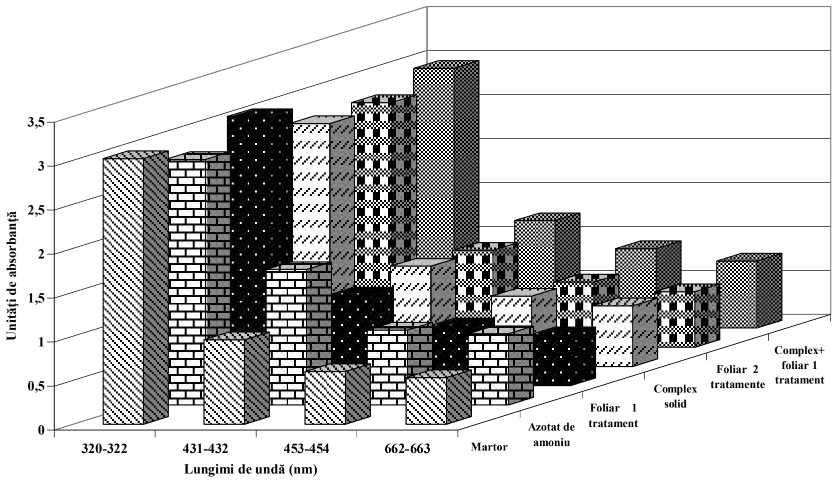

Figure 1 **The Pigment content at the growth phase in leaves**

At the flowering phenological phase, we found that in leaves, all the applied treatments determined a deep intensification of the biosynthesis in photosynthetic pigment content, shown both at the light absorption zone and at the reaction zone of the photosynthetic systems.

The same stimulating effect was also shown in the biosynthesis of flavonoid pigments, with one exception, at the treatment with Complex solid fertilizer.

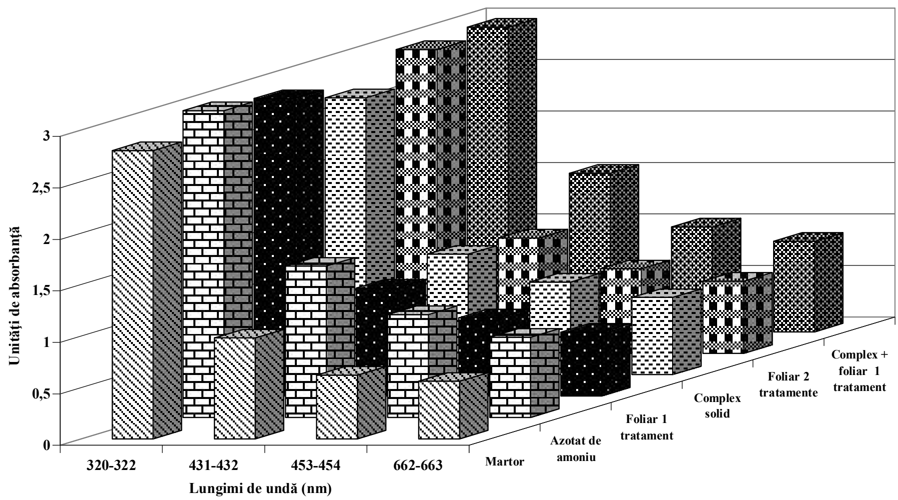

Figure 2 **The Pigment content at the flowering phase in leaves**

At the flowering phenological phase in inflorescences, we found out the almost total disappearance of photosynthetic pigments, *a* 663 nm chlorophyll, under conditions of maintaining at high values *a* 431-432 nm chlorophyll, with role in light absorbance. Maximum values are found in case of treatments with Complex solid fertilizer and ammonium nitrate. The accumulation of 425-426 nm carotenoid pigments is stimulated by all the treatments, except the Foliar 1 treatment, and of 447-448 nm pigments is stimulated by all the treatments, except the Complex + Foliar 1 fertilizer.

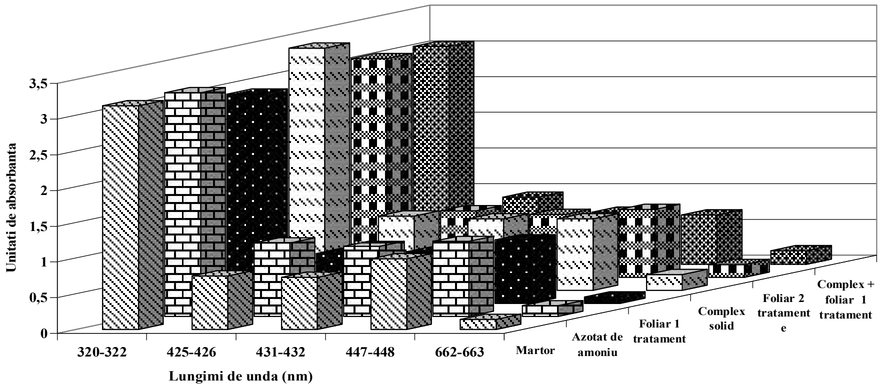

Figure 3 **The Pigment content at the flowering phase in inflorescences**

The stimulating effects of treatments on the pigment content (chlorophyll and carotenoid) in inflorescences are present under conditions of maintaining a high flavonoid content with protection role.

We conclude that the treatments applied in pot marigold plants have stimulated both the photosynthesis and the accumulation of carotenoid pigments in inflorescences, under conditions of maintaining a high capacity of plant resistance at climatic stress, caused by drought.

At the end of the flowering phenological phase, we found that in leaves the stimulation activity of different treatments was present both on photosynthetic and on flavonoid pigments.

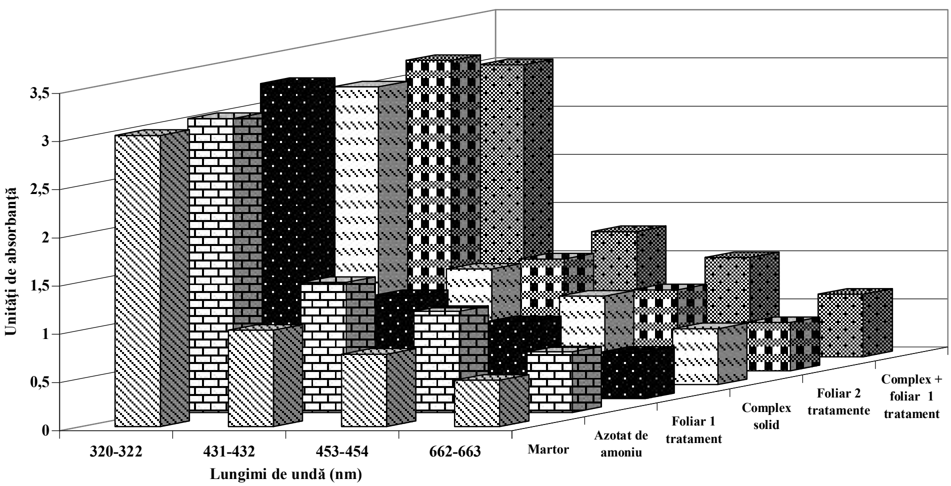

Figure 4 **The Pigment content after flowering in leaves**

In inflorescences, there is a high intensification of the carotenoid pigment accumulation (425-425 nm, 447-448 nm), shown at all the treatments, except Foliar 2 at 447-448 nm. This stimulating effect takes place under conditions of a relatively high diminution in the content of flavonoid pigments, at all the treatment variants, compared to the control.

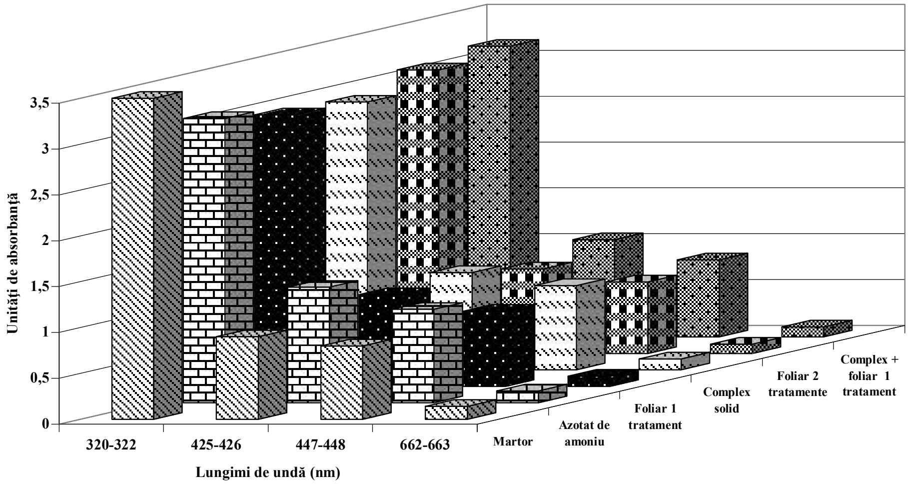

Figure 5 The **Pigment content after flowering in inflorescences**

CONCLUSIONS

The mineral fertilizer treatments applied in pot marigold plants have stimulated both the photosynthesis and the accumulation of carotenoid pigments in inflorescences, in case of maintaining a high capacity of plant resistance to the climatic stress , caused by drought.

At the flowering phenological phase, in inflorescences, the maximum values are found at treatments with Complex solid fertilizer and ammonium nitrate.

The investigations have shown that after flowering, the treatments stimulate the accumulation of carotenoid pigments, based on the partial directing of the metabolic effort to this process, resulting in the increase in the quality of inflorescence production, by intensifying the biosynthesis of one of the main components of the active substance.

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