

## PRE-SOWING LASER BIOSTIMULATION OF SEEDS OF CULTIVATED PLANTS AND ITS RESULTS IN AGROTECHNICS

*R. Koper*

Department of Physics, University of Agriculture, Akademicka 13, 20-934 Lublin, Poland

**A b s t r a c t.** Pre-sowing laser biostimulation of seeds of cultivated plants to its results in crops of cultivated plants is arising great interest among practitioners. Results of many years' studies carried out in University of Agriculture confirm the effect of using the laser biostimulation reported both in Polish and foreign literature. Studies carried out in University of Agriculture in Lublin made it possible to elaborate our own technology of making laser biostimulation of seeds of selected cultivated plants. Within the framework of these studies a machine for laser biostimulation of seeds has been constructed. Pre-sowing laser biostimulation of seeds of some studied plants resulted in the following increase of crops: maize - from 10 to 20 %, spring wheat - from 20 to 30 %, spring barley - from 20 to 25 %, sugar beets - from 10 to 35 %. Better plant seedlings, higher resistance to cold and earlier plant maturation are the additional effects of using the pre-sowing laser biostimulation of plants. In the case of corn the vegetation period is shortened by about 10 days. The quality of plants grown from the seeds which underwent the laser biostimulation is also higher, for example in the case of laser spring wheat the protein content increased by about 2 %, in laser sugar beets the amount of sugar increased from 15 % to 17 %. Initial studies proved that it is possible to diminish nitrogen fertilization when applying laser biostimulation of seeds without essential decrease in crops.

**K e y w o r d s:** laser biostimulation of seeds, maize, spring wheat, spring barley, sugar beets

### INTRODUCTION

The influence of the pre-sowing laser biostimulation on a vegetation and crops of plants has been investigated since more than 20 years in all of the world. In our laboratory (University of Agriculture in Lublin) such studies, carried on for a few years, have proved the positive effects of the pre-sowing laser biostimulation using a He-Ne

laser [3,6]. The results of other authors [1,4,8] also showed that the positive effects as an increase of crops occur when natural non-divergent 20-25 mW light beam is applied. The parameters of the procedure as the irradiation time of laser biostimulation on seeds and the number of repetitions are different for different kinds and variety of plants.

The pre-sowing laser biostimulation of seeds changes also the spectrum of some micro-elements (selenium) absorbed by the plants grown from these seeds [2]. It may be important for new technologies of ecologically healthy food.

### METHOD

Our own and original method of the seed biostimulation has been prepared in Department of Physics of the University of Agriculture in Lublin [5]. In this method the laser biostimulation of seeds is performed by using the set-up described schematically in Fig. 1. Seeds are irradiated by a divergent beam using He-Ne laser with the power ranging from 40 to 50 mW. The biostimulation occurs when seeds freely fall down by the region irradiated by the divergent light with the power density from 2 to 5 mW/cm<sup>2</sup>. In order to obtain the best effects of the biostimulation the irradiation time and the number of repetition must be precisely determined. Laser biostimulation of seeds is applied 3 to 15 days before sowing.

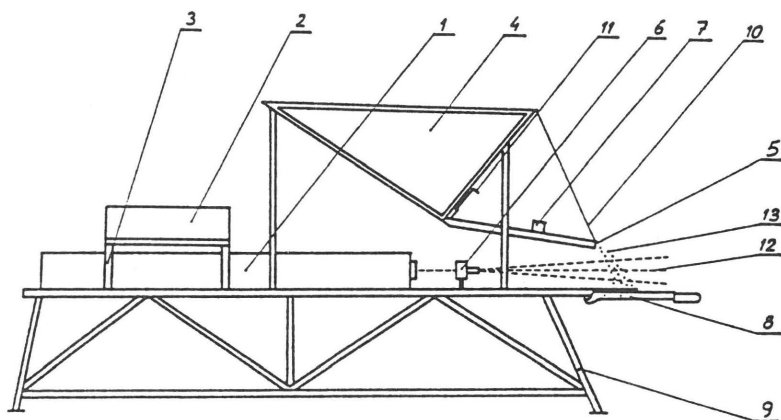


Fig. 1. Schematic drawing of a machine for pre-sowing laser biostimulation of seeds of cultivated plants: 1 - laser He-Ne, 2 - laser power supply, 3 - base of power supply, 4 - charging hopper, 5 - seed pan, 6 - microscope lens, 7 - pan vibrator engine, 8 - sack holder, 9 - frame of mechanism, 10 - strings holding the pan, 11 - damper for seeds, 12 - laser beam, 13 - seeds.

### RESULTS

The effects of using the machine for pre-sowing laser biostimulation of seeds according to the studies carried out by Dziamba, Koper and Wójcik from the University of Agriculture in Lublin show the increase in crops which for the examined plants are as follows:

Maize	from 10% to 20%
Spring wheat	from 20% to 30%
Spring barley	from 10% to 25%
Sugar beets	from 10% to 35%
Rape	from 5% to 15%
Greenhouse tomatoes	from 10% to 30%
Greenhouse cucumbers	from 5% to 60%
Field tomatoes	from 10% to 20%
Field cucumbers	from 10% to 25%

Better plant seedlings resistance to cold and earlier plant maturation are the additional effects of using the pre-sowing laser biostimulation of plants. In the case of maize the vegetation period is shortened by about 10 days. The quality of plants grown from the seeds which underwent the laser biostimulation is also higher, for example in the case of laser spring wheat the protein content increased by about 20%, in laser sugar beets the amount of sugar increased from 16% to 18%. Initial studies proved

that it is possible to diminish nitrogen fertilization when applying laser biostimulation of seeds without essential decrease in crops.

Results of 3-year investigations performed in private greenhouses in Lublin, Piotrków (n. Lublin) and Wysokie (n. Zamość) made it possible to elaborate the most favourable pre-sowing laser biostimulation technology for greenhouse tomatoes and cucumbers. This technology has provided an increase of crops and accelerated ripening of the plants.

The investigations on greenhouse tomatoes Proset performed in 1989 (Fig. 2a) showed that the total crop increased of about 25%, and the early crop (up to 1/3 of the cropping time) increased of about 60% as compared to a standard sample (non-biostimulated). Also, studies performed in 1990 (in the same greenhouse) on the tomatoes Precodor (Fig. 2b) showed clearly the increase in the total and early yield of about 11% and 27%, respectively.

The effects of the pre-sowing laser biostimulation applied for some greenhouse cucumber seeds were obtained in 1989 in greenhouses of PPS Leonów. For the cucumbers Atos the following crops were observed (Fig. 2c): the early crop for laser biostimulated seeds was equal to 3.65 kg/m<sup>2</sup>,

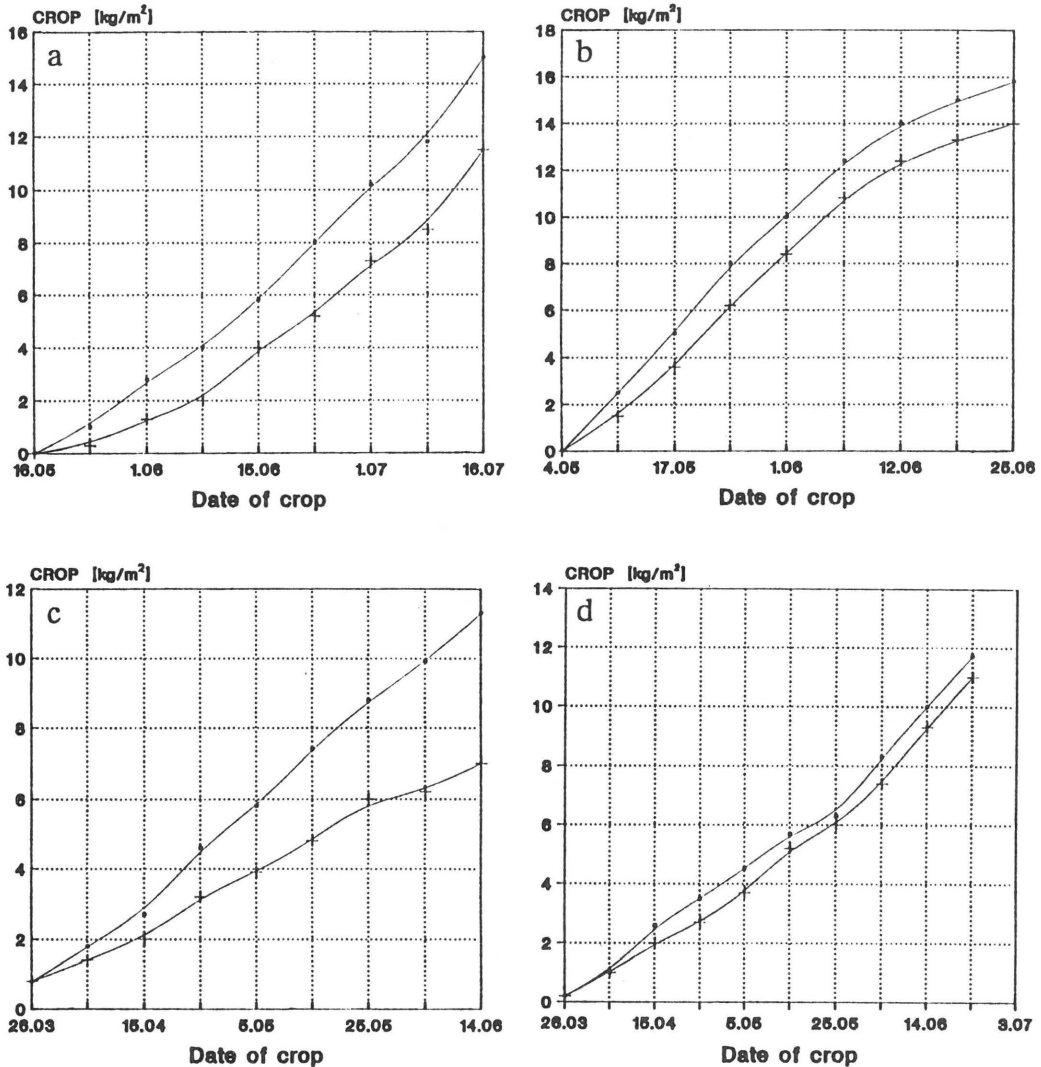


Fig. 2. Biostimulated (·) and non-biostimulated (+) tomato crops of: Proset (a), Precodor (b), Atos (c) and Corona (d).

whereas for non-biostimulated only 2.6 kg/m<sup>2</sup>, that means the increase of about 40%. The total crops for biostimulated and non-biostimulated seeds were equal to 13.1 kg/m<sup>2</sup> and 8.11 kg/m<sup>2</sup>, respectively, that indicates the increase up to 61%. For the cucumbers Corona the crops were as follows (Fig. 2d): the early crop for laser biostimulated seeds was equal to 4.1 kg/m<sup>2</sup>, whereas for non-biostimulated only 3.16 kg/m<sup>2</sup>, that means the increase of about 31%. The total crops for biostimulated and non-

biostimulated seeds were equal to 14.45 kg/m<sup>2</sup> and 13.61 kg/m<sup>2</sup>, respectively, i.e. the increase up to 6%.

The presented results are extreme: maximum for the tomatoes Proset, minimum for Precodor, and maximum for the cucumbers Atos, minimum for Corona. It means that the positive effects of the pre-sowing laser biostimulation obtained for other kind of seeds ranged from 10% to 27% and from 6% to 61% for greenhouse tomatoes and cucumbers, respectively.

## CONCLUSIONS

The positive effects of using the machines for pre-sowing laser biostimulation of seeds suggest that the technology will be widely applied in the plant production. Presently, at the Department of Physics of the University of Agricultural in Lublin an intensive research on a developing of new technologies for the pre-sowing laser biostimulation of seeds is being carried on. This development is based on the application of small power lasers [7]. An advantage of these technologies is a flexibility of controlling the energy radiation in these seeds by the helium-neon laser. By this way a process of the laser biostimulation of seeds will be more precise. At the same time, a prize of machines for this process will be significantly reduced.

## REFERENCES

1. Czarnomyrdina T.A., Kogut P.M.: Influence of pre-sowing laser biostimulation on some photosynthesis parameters of spring wheat (in Russian). In: Problems of Plant Photoenergetic and Crop Increasing. All-Union Conf. Lvov, 126-131, 1984.
2. Dobrowolski J.W., Borkowski J., Szymczyk S.: Laser stimulation of cumulation of selenium in tomato fruit. In: Photonemission from Biological System (Eds B. Jeżowska-Trzebiatowska et al.). World Sci., Hong-Kong, Singapore, 211-218, 1987.
3. Dziamba S., Koper R.: The influence of laser irradiation of seeds on the crop of spring wheat seeds. *Fragmenta Agronomica*, 1(33), 88-93, 1992.
4. Inyushin W.M., Iljasov G.U., Fedorova N.N.: *Laser Light and Crop*. Kainar Publ., Ałma-Ata, 1981.
5. Koper R., Dygdała Z.: Set-up for the pre-sowing laser bio-stimulation of seeds (in Polish). Patent nr P 283494 RP, 1990.
6. Koper R.: The effect of pre-sowing irradiation of seeds by laser light (in Polish). *Fruit, Vegetables, Flowers*, 23, 5, 1991.
7. Koper R.: Set-up for the pre-sowing biostimulation of seeds using natural laser beam (in Polish). *Bull. Patent RP Office*, 12, 2, 1993.
8. Tkaczuk W.N., Bokowej W.I.: Studying the influence of laser irradiation on sugar beet and mangel seeds and on their post-sowing properties and crops (in Russian). *Theory and Practice of Pre-Sowing Seeds Treatment*, Kiev, 97-101, 1984.