SOJA (*Glycine max*)

Soy is a hardy plant from the family *Fabaceae;* it most likely originates from Eastern Asia (Central China). In that area the growing of the plant began some 5.000 years ago, specificly for the edible seeds. Today, soybeans are grown in many countries and have a remarkable economic importance because the plant provides significant amounts of easily digestible vegetable protein diet food for people, while it is also used as a raw material for cca, one hundred major industrial products and derivatives. It should also be stated that soy is a very important component of animal food concentrates, which are abundantly used in livestock nutrition. In China, soy has long been used for human consumption and production of various medicinal preparations, and because of this it is assumed that soy is originated from China. Strains from China were gradually transmitted to other areas of the world. In 1810, soya has been transferred to the United States, where it's production rapidly expanded, so that the strain now occupies a large area of the country, especially in the warmer climate in the south of the United States.

Glycine max

The economic importance of soybean

The importance of soy in human nutrition and animal food today is unavoidable, and therefore the production of soybean spread quickly and now occupies large areas in many countries. Soy is very popular in the world market thanks to the oil content in soybean seeds and the high percentage of easily digestible protein. Soybean seeds contain 17 percent oil and 63 percent nutrients of which 50 percent goes to protein. An Additional positive quality of soybean is the fact that it does not contain significant amounts of starch, which makes it an excellent source of protein for diabetics. Soy is prepared in various ways in the cuisine of many nations. In Central Asia, soy is used for preparing soy milk and cheese; it also often replaces meat dishes.

Characteristics of soybean breeding and its cultivation

Soy is a herbaceous plant whose height depends on varieties and cultivation conditions. It can reach up to 2 meters in height, but usually it is a plant whose growth does not exceed a height of one meter. Soybean is a self-fertile plant whose flowers can be white, purple or reddish. Soybean grain may vary in color, usually it is yellow, but it can be brown, green or black. Some varieties give multicolor grain. There are usually 1 to 4 grains in a single soybean pod. Soy can thrive on different types of soils, but it grows best in warm, fertile and well drained soils. Sandy loam suits it best. Soybeans are to be sown in the spring when all dangers of coldness and frost are gone. It matures in September and October. Harvesting is done by combine harvesters when the plant looses all leaves and the grain moisture falls to 13 percent moisture. The biggest producers of soybeans are the United States, Brazil and China.

On the upper photo, we can see the area of soybean sown on 30 hectares, the farm belonging to Zvonko Bašljan. The surface is treated four times with a solution of Zeogrow and no fertilization was applied in the sense of dressing. On that picture you can notice the proper development of soybean, stronger and upright stems with a rich leaf mass with numerous, well-shaped string beans. On the surface we have found no traces of weeds.

In the picture below, we can see the culture of soybean, which was sown on 30 hectares, immediately next to the area that was treated. Although this area was not treated with Zeogrow, the total surface was treated with 300 kg per hectare with the fertilizer KAN. We noticed the development of weeds throughout the entire surface of untreated soybeans. The development of the plant stems and leafy parts were noticeably weaker. It can also be seen that the plants developed less pods. (Picture was taken on the farm Zvonko Bašljana 28th August 2009. Photo D. Dumančić.)

Modern Agricultural Science and selective research have enabled the creation of numerous, highly productive varieties, ecotypes and cultivars that are easily adapted to the environmental conditions of certain areas of the world. Also, the modern worldwide industry has created a number of industry products from soybean seeds. In the food refining industry, soy is used for the production of many very tasty food products, which successfully substitute the food of animal origin. Margarine products of good quality and many other nutrients and vegetarian dishes are being produced of soy oil. Soya oil is also used in addition to many industrial products ranging from paints, varnishes and adhesives all the way to fertilizers, sprays against insects, fire-extinguishing mixtures, etc.

Soybean breeding experiments with regular treatment with Zeogrow

Soy is a plant that gave excellent results in all experiments with Zeogrow which were set and achieved on private estates of farmers who buy Zeogrow and use it regularly for several years as a substitute for mineral and chemical fertilizers and also as a partial substitute for chemical pesticides. Multiple treatment of soybeans with Zeogrow produced impressive results everywhere. Particularly good quality and high yield was achieved in the areas of soy products that were treated more than three times. Five to six treatments give the best grain yield and richer oil and protein content, while they also markedly restore the quality and taste of food products obtained from soybean through various aspects of the manufacturing industry. So far the experiments with Zeogrow treatments were conducted in several countries, mostly in France, Serbia, Turkey, Russia, Bulgaria and Croatia.

Here we shall settle for the most important results achieved in our demonstration experiments and practical areas of application and production of individual private producers in northern Croatia.

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Zvonko Bašljana farm, village Kajgana, 43280 Garešnica. The property of this owner stretches in one piece across an area of 300 ha, of which 60 ha is designated for cultivation of soy. The Soil is acidic (Ph around 5). Soil preparation consisted of fall plowing and spring harrowing. The entire area designated for the planting of soybeans (60 ha) was fertilized before plowing with 300 kg / ha NPK - 7:20:30 and 200 kg of urea fertilizer.

On the upper photo we can recognize the production of treated soja bean which was more important in the number of the pods; the pods were bigger and uniformed and approximately of the same size, while on the untreated soja (on the photo below) the number of pods was much les and the formed and the size were unequal.

In the picture below we can see pods picked on ten stems of soybean, which was not treated with Zeogrow. As we can see the differences are pronounced. Untreated strains of soya plant gave significantly lower number of pods and grains, and the weight was much lower. (Picture was taken on the farm Zvonko Bašljana 29th September 2009. Photo D. Dumančić.)

The owner has self-initiatively decided to make additional fertilization of the soybean field which was scheduled for treatment with Zeogrow. He applied 300kg of KAN on 30 hectares of surface with untreated soybean. His desire was to see whether Zeogrow can really substitute the fertilization with chemical fertilizers.

Sowing of soybean throughout the area of 60 ha was carried out on 25th April of 2009. At the rate of 150 kg/ha. Sown was a variety called *Proteinka* acquired from the company *Biba* located in Suho Polje.

The upper image shows the soya beans pods picked on 10 untreated (pictured, left) and 10 treated (pictured, right) stalks or soybean plants. In the picture you can see a pronounced difference in the number of pods and their size and shape. Whentreated plants - beans are not only numerous but also nice and evenly shaped, And contain more soybeans grains in the pods, as opposed to untreated soybean. (Picture was taken on the farm Zvonko Bašljana 29th September 2009. Photo D. Dumančić.)

Treatment with Zeogrow was carried out on four occasions:

1. - Treatment in phenophase of the young plants with 4 to 5 ballots - 2 kg/ha of Zeogrow;
2. - Treatment was done 3 weeks after the first treatment - 2 kg/ha of Zeogrow;
3. - Treatment was done 3 weeks after the second treatment - 2 kg/ha of Zeogrow;
4. - Treatment was done 3 weeks after the third treatment - 4 kg/ha.

All treatment was made in the morning or evening, before sunrays or sunset. Spraying was carried out with a tractor spray atomizer. Thus was achieved an optimal dispersion of small droplets on the surface of the whole soybean plants.

Preliminary results of experiments treating soybean with Zeogrow

During the vegetation period we monitored the growth and development of soybean plants treated and untreated surface. In the period of the ripening soybean phenophases, on the 28 august 2009, we did harvest (by pulling out) of 10 plants in the treated and untreated soybean area.

From the harvested plants, we removed the green beans counting them by each plant, weighning then, after that we count string beans in individual plants, and made the total weight of grain treated and untreated beans. The table below shows the results obtained:

Table 1 - Results of experiments on the treated area of soybeans, the number and weight of pods and grains per plant and the total sum of ten plants

Soja bean treated 4 x (at the field of Z. Bašljan**)**						
Number plants	Number of grains in the pod beans				Total No pods	Total No grain
	1	**2**	**3**	**4**		
1	17	20	20	-	60	123
2	6	27	13	-	46	99
3	-	8	20	-	28	56
4	16	23	11	-	50	95
5	13	18	28	-	51	133
6	7	25	15	-	47	102
7	18	25	16	1	60	109
8	9	22	17	-	48	104
9	8	17	10	-	35	72
10	7	15	11	-	33	70
	101	**200**	**161**	**1**	**458**	**963**
Total					**260 gr.**	**468 gr.**

Table 2 - Results of experiments on the untreated surface of the soybean, the number and weight of pods and grains per plant and the total sum of ten plants

Soja bean untreated (at the field of Z. Bašljan**)**						
Number plants	**Number of grains in the pod beans**				**Total No pods**	**Total No grain**
	1	**2**	**3**	**4**		
1	5	8	12	-	19	45
2	3	8	13	-	24	48
3	-	1	12	-	13	38
4	8	9	16	-	33	48
5	8	8	10	-	26	54
6	17	7	4	-	28	43
7	6	17	8		31	66
8	1	7	13	-	21	51
9	-	6	16	-	22	48
10	2	7	14	-	23	60
Total	**50**	**78**	**118**		**240**	**501**
Total weight					**140 gr.**	**240 gr.**

Table 3 - **Results of experiments of soybean untreated surface -comparison of the number and weight of beans and soybeans in the treated and untreated fields.**

Comparison of treated and untreated plants						
Number plants	Number of grains in the pod beans				Total No pods	Total No grain
	1	2	3	4		
treated	101	200	161	1	458	963
untreated	50	78	118		240	501
total weight treated four times with Zeogrow					260 gr.	468 gr.
total weight untreated with Zeogrow					140 gr.	240 gr.

Fig. 1 - **Comparison of the number grains in the beans.**

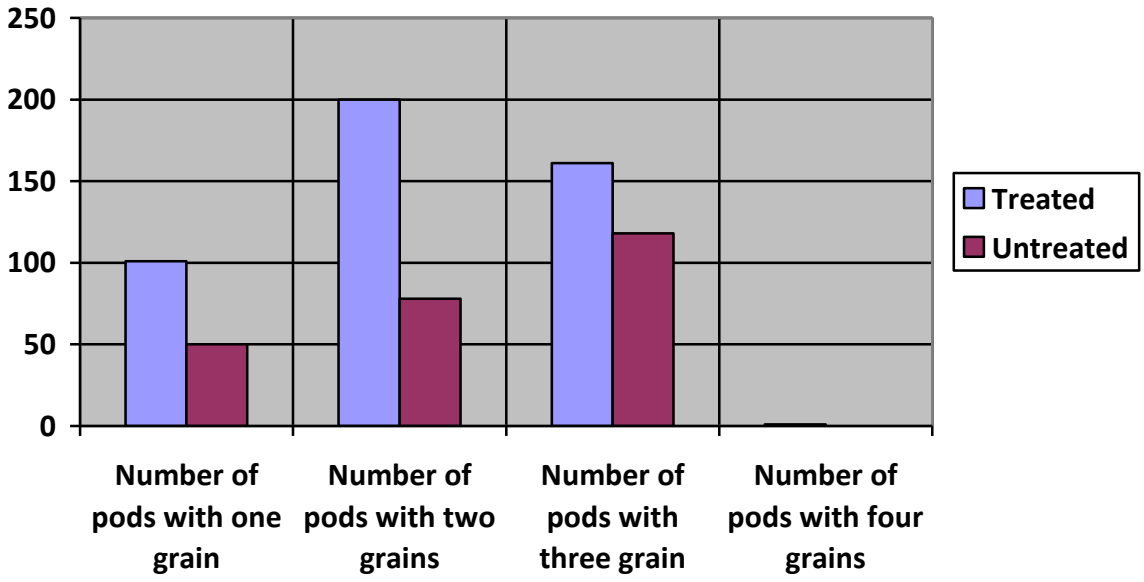


Fig. 2 - Comparison of the total number and weight of pods and grain.

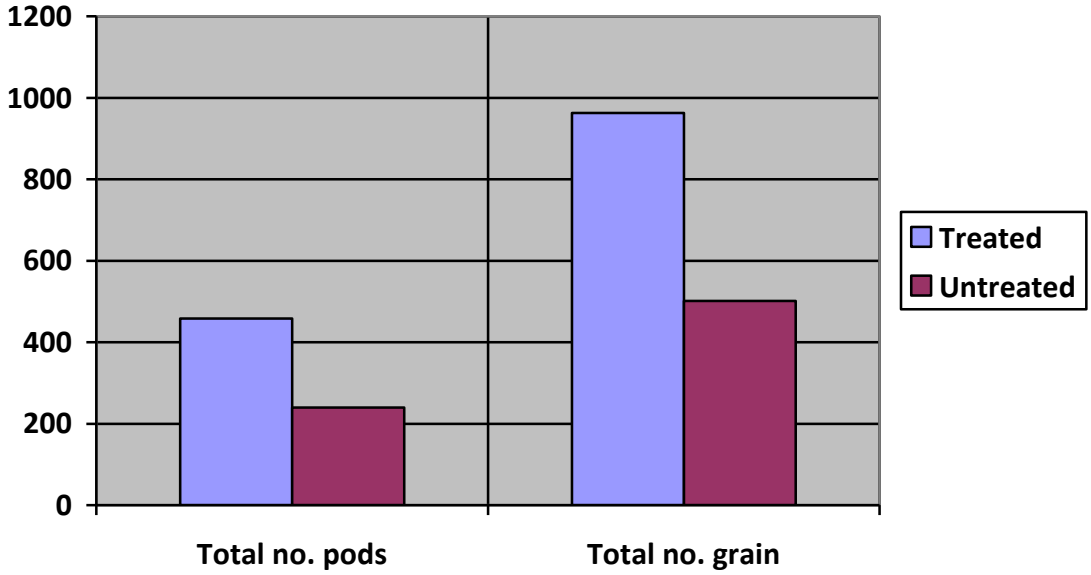
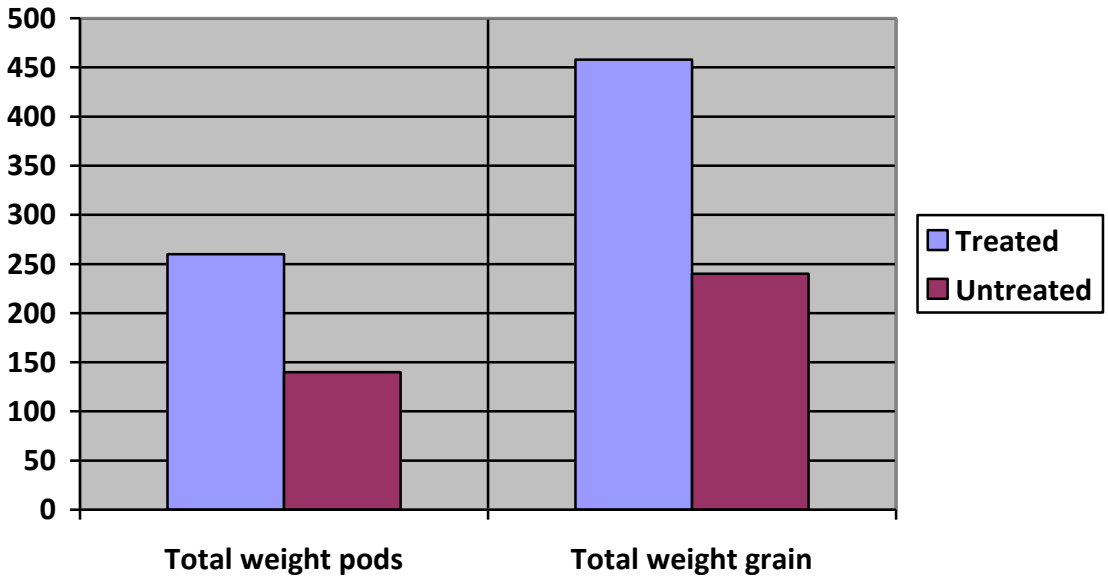


Fig. 3 - Comparison of weight of pods and grain in treated and untreated soya beans.



Results of chemical analysis.

Soybean samples from untreated and treated surfaces are submitted to chemical analysis laboratory in the Faculty of Technology of Zagreb University. Results of the analysis are presented in Table 4:

Table 4 - Results of chemical analysis of soybeans produced on the farm of Zvonimir Bašljan.

Mark Sample	Description	Dry sample matter, %	Oil, %	oil on dry matter, %
1	untreated	90.98	21.35	23.47
2	treated	90.49	20.61	22.77

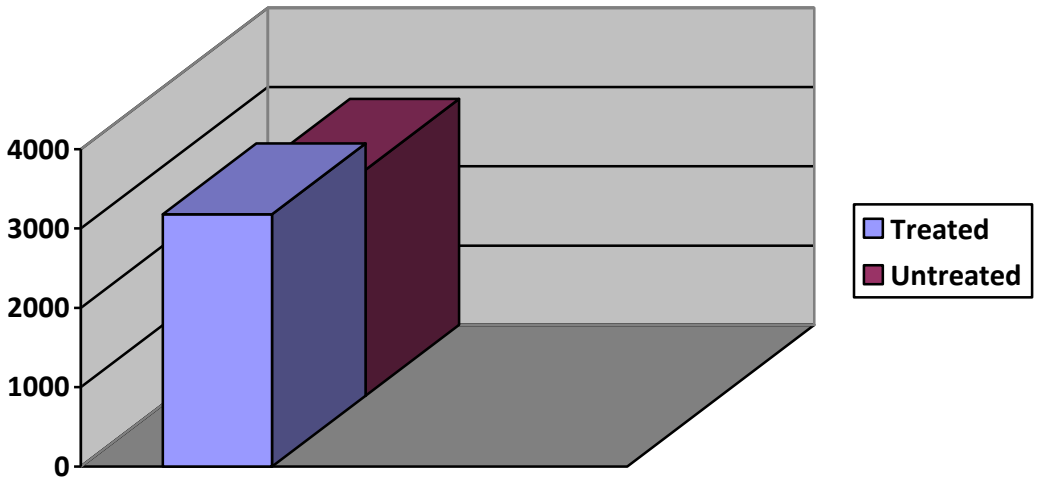
Harvested soybean yields

Soybean harvest was carried out in early October, the entire surface area of 60 ha, with the separate weights of yield of soybeans treated and untreated surfaces.

The actual yields were as follows:

- Treated soybean: 3,180 kg/ha;
- Untreated strain: 2,850 kg/ha.

Fig. 4 - Comparison of yield in treated and untreated soybean field.



Differences in yields of treated and untreated soybean are not as big (close to 9 percent) as they usually are. This can be partially explained by the fact that the untreated soybean received additional fertilization with 300 kg/ha of KAN, which influenced the increase in yield of the untreated soybeans; however, the soybean yields on the treated surface was higher regardless of the fact that it did not receive fertilization treatment with KAN.

On the upper image we see two plants (very left) picked on the surface of soybean, which was treated four times with saline Zeogrow. On the right side of the picture are two plants picked at the surface which was treated with Zeogrow. Differences in the appearance of the plants were fully visible. Treated plants have a rich leaf biomass, more pods and highly developed system korjenov, while untreated plants have fewer leaves that are pale green, a small number of pods and very poorly developed korjenov system. (Picture was taken on the farm Zvonko Bašljana 29th September 2009. Photo D. Dumančić.)

On the upper image we see a handful of ten soybean plants that were only 1 x treated with Zeogrow (pictured left to see plants with rich leaves biomass and a very developed root system) and a handful of ten soybean plants (pictured right plants are shorter with less leaves is smaller and less developed root system) that were not treated with Zeogrow. (Picture was taken on August 25, 2009th on the farm Zeljko Libera from Okešinca. Photo D. Dumančić.)

Conclusion

Throughout the vegetation period the plants were observed. Treated soybean was highly developed, having stronger and longer stems, richer leaf biomass and large number of well-developed pods. Therefore it was expected that the yields of soybeans treated by Zeogrow will probably have a very large oil and protein content in grain. However, results in grain yield of soybean were only 9 percent higher than the untreated soybeans; oil content was even lower in treated soybean. This can only be explained by the unequal fertilization application of top dressing fertilizer in treated soybean fields, because soybean

treated surfaces are given no aditional fertilization during the whole vegetation period, while the area of soybeans that were not treated with Zeogrow the fertilization was given: 300 kg/ha of KAN in phenophases of early flowering of soybean.

Thus result with Zeogrow is higher on one side and has saved the costs of synthetic fertilizer (300 kg/ha) additionally.

Prof Dumancic Soyabean .

Conclusion

The trial was disturbed by the unplanned extra fertilization of 300 kg/ha of KAN fertilizer in the untreated area., according to owners demande some how as the ballance to Zeogrow application

	
Harvest grain= 2,850 kg/ha	Harvest grain= 3,180 kg/ha
No pods/plant = 240	No pods/plant = 458
No grains/plant = 501	No grains/plant = 963
Dry matter sample 90,98%	Dry matter sample 90,49%
Oil = 21,35%	Oil = 20,61%
Harvest oil=608.5 kg/ha	Harvest oil=655.4 kg/ha
Oil in DM= 23,47%	Oil in DM= 22,77%
200 kg/ha Urea fertilizer	
300 kg/ha NPK – 7:20:30	
300 kg/ha - KAN fertilaizer	Zeogrow total 10 kg/ha divided in 4 treatments
30 ha ⟷	30 ha ⟷
60 ha Soya field in Kajgana, Croatia, owner Zvonko Bašljan. ⟷	