# EFFECT OF BACTERIAL STRAINS ON THE YIELD OF INDIGOFERA TINCTORIA AND CROTALARIA JUNCEA PLANTS

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***Abstract.*** *In this article, it is stated that the number and weight of pods per plant, the weight of 1000 grains, and the grain yield are higher when the seeds of non-traditional crops are treated with rhizosphere bacterial strains. The number of pods in one crotalaria plant is 58.0-75.0; the average number of seeds in one pod is 5; seed weight in one pod is 0.187-0.189 g; The weight of 1000 seeds is 37.5-37.8 g, when the bacterial strain Rizo No. 15 is applied, high results were observed, compared to the control group. Compared to the control group, seed weight in pods was higher by 0.02 g; The weight of 1000 seeds was higher by 0.3 g; when Rizo No. 15 bacterial strain was applied to Indigofera, 414.0 pods were produced in one plant, which were 64 pods more than the control group; The seed yield of crotalaria variant 4 treated with Rezo No. 15 bacterial strain was 22.5 centner per ha, which is 5.8 centner per ha higher than the control variant; 2.8-3.2 centner per ha compared to variants treated with other strains; the 8th variant of indigofera seed treated with bacterial strain, 11.7 t/ha yield was obtained and 2.4 t/ha additional yield was obtained and all the results above were scientifically explained.*

***Keywords:*** *indigofera tinctoria, crotalaria juncea, rhizosphere bacterial strain, legume, 1000 seed weight, seed yield.*

**Introduction.** In the world agriculture, in recent years, practices of taking into account the biological characteristics of crops, choosing the type of crops suitable for soil and climate conditions, crop rotation systems are being implemented, and in this, soil fertility is being improved by updating the structure of crops and developing agrotechnologies. So, and as a result of the effective use of modern technologies, the cost of production in cotton cultivation is reduced due to the preservation and improvement of the fertility characteristics of the land, the saving of mineral fertilizers in the production of abundant and high-quality crops.

Due to the soil and climate conditions, Uzbekistan is a favorable region for the cultivation of plants that provide food and raw materials. The main currency income coming to the republic from abroad is directly dependent on agriculture, which provides employment and income for the majority of the population.

Today, the issue of food supply has become one of the priority tasks in all countries of the world. At the same time, one of the main problems is the question of protein, that is, meeting the demand for protein of mankind. Leguminous crops are of great importance in solving this problem.

In our country, it is necessary to expand the food base, to use the tools that protect the soil and increase its productivity as much as possible in a timely manner. For this, it is necessary to

pay great attention to the correct selection and placement of crop types in agriculture. Leguminous crops are one of such types of crops.

Nowadays, the area of degraded soils is increasing from year to year, which causes not only a decrease in soil fertility, but also a decrease in the yield of agricultural crops. In order to prevent these negative situations, the introduction of new leguminous plants, introduction of new types of non-traditional leguminous crops into crop rotation systems, and the development of agrotechnologies of cultivation are one of the most important issues.

Literature review. Legumes are not only grain, but also a source of high-quality fodder for livestock. Because the hay of these crops is also rich in protein, which fundamentally improves the quality of fodder. Also, leguminous grain crops are considered good predecessor crops, they increase soil fertility with the help of root and tuber residues, nodule bacteria, and have a positive effect on the yield and quality indicators of the next year's crops. Crotalaria and indigofera can be included among such crops.

Crotalaria is a plant belonging to the Fabaceae family, Papilionoideae subfamily, Crotalariae category, Calycinae division [3]. According to the information in the encyclopedia published in Moscow in 1981, it was reported that there are more than 500 species of the genus Crotalaria in the world. They are mainly shrubs, semi-shrubs, annual herbs. The USDA collection contains 242 specimens of only 30 of the 600 species of Crotalaria plants.

Indigofera (Leguminosae) belongs to the third largest legume family, the genus Indigofera, and consists of almost 800 species of plants. Plants belonging to the genus Indigofera can grow up to 1,630 meters above sea level, with more than 600 species distributed in Africa [9], nearly 200 species in Asia, about 80 species in the Americas, and 60 species in Australia [11].

Crotalaria juncea plant is adapted to different soil and climate conditions by its biological properties. The seed can be used as a food product; the hay can be used as a high-calorie fodder in animal husbandry; in agriculture in increasing soil fertility and improving land reclamation; in the treatment of various diseases in medicine; source of nectar in beekeeping; source of fiber for light industry [3, 12].

*Crotalaria is considered a wide-ranging crop and is mainly used as a fiber in other countries. Several foreign scientists [10] have conducted research on its use as a natural fiber and green manure. To obtain fiber from Crotalaria, the crop is harvested at full bloom 75-80 days after planting. Fiber yield - 4-6 tons of dry stems per hectare are obtained from 2 harvests, and 3-6 t/ha of fiber is obtained from it.*

*Crotalaria is also used as a nitrogen-fixing green manure to improve soil quality, reduce soil erosion, conserve soil moisture, control weeds [8], suppress nematodes, and recycle plant nutrients.*

Crotalaria is also important in crop rotation systems due to its nematode removal, short-term nitrogen fixation and biomass accumulation [7]. When it is planted after cereal crops, it covers the soil surface, reduces moisture loss, and accumulates a large amount of nitrogen and biomass [6].

Since Indigofera is a leguminous plant, it enriches the soil with nitrogen and is a convenient predecessor crop in crop rotation. After the dye is extracted, the stems and leaves are composted and incorporated into the soil before plowing. Indigo has also been used as a fuel for boiler tanks and cisterns in factories in India.

S. Negmatova and others [4.] In order to obtain dyes from seeds and biomass of the Indigofera plant, it is advisable to plant it as a main crop (at the end of April and the first decade of May when the soil temperature exceeds 18-20 0C); it was noted that the Indigofera plant can be grown as a repeat crop after winter wheat for the purpose of obtaining indigo dye.

Ali Esmail Al-Snafi [5] Crotalaria has also been studied as a medicinal plant due to its safe and effective pharmacological properties

Also, experiments have shown that drugs made from extracts of crotalaria seeds are effective in the development of the fetus, in increasing the follicles in the ovary, and against liver damage.

In the traditional medicine, indigofera also has healing properties, it is used for constipation, liver diseases, gout, and heart diseases. The Vietnamese use it to treat various skin diseases, while in India it is used to treat kidney diseases [2]. It is also a valuable antibacterial and antifungal agent in the folk medicine of Tibet, India and China, as well as in the pharmaceutical industry, and this medicinal herb is a type of plant that is widely used as a medicine for epilepsy, skin ulcer, liver toxicosis, as an antidepressant and even as a raw material for the production of drugs against some types of cancer [1].

Considering the fact that crotalaria and indigofera meet the needs of our people in all aspects and are not fully studied from the scientific point of view, it is urgent to develop and improve agrotechnologies of its cultivation and to introduce the results into production.

Research methodology. The research was conducted in field and laboratory conditions, using methodological manuals such as " Methodology of the State Variety Testing of Agricultural Crops" (1964), " Methods of conducting field experiments" (2007), " and data mathematical statistical analysis of data was performed according to B. A. Dospekhov (1985). In the experiment, Indigofera and Crotalaria seeds were inoculated with 3 different rhizosphere bacteria - Rezo No. 03; Reza No. 76; Rezo No. 15 strains, and their effect on plant growth, development and productivity was studied.

Research results. It is known that the scale of plant crop is determined by the quantity and quality of the elements collected in the crop. In crotalaria and indigofera, the yield of seed depends on the elements of the crop formed in the plant, that is, the number of pods and the weight and quality of the seed in it. The formation of pods, the number and weight of pods, the number of seeds in pods and the weight of 1000 seeds were studied when different rhizosphere strains were applied to non-traditional legumes.

The effect of bacterial strains on the formation of pods was also observed. When crotalaria was planted with 10 kg of seeds per hectare in the third ten days of April, the number of pods formed on October 1 was 58-75, and a high result was observed in the 4th variant, where the Rizo No. 15 bacterial strain was used. The number of pods formed in this variant was 58, which was 17 pods more than the control variant without bacterial strain and 8-10 pods more than variants 2 and 3, where other types of bacterial strains were used. The yield of legumes is also related to the number of seeds and the weight of the seed. However, the abundance of seed is not always the basis for growing a high yield. Because, only if the number of grains and their weight are at the level of requirements, the grown crop will be abundant and of high quality. Ripe grain can be estimated by the weight of 1000 grains. For this reason, the study of the degree of dependence of the number of seeds and seed weight in crotalaria pods on seed inoculation is of great scientific and practical importance.

At the end of October, 80-90% of crotalaria seeds ripen. In Crotalaria, during the entire period of operation, the appearance of buds, flowers, and pods was observed in one plant. Pods are light brown when ripe, 3-4 (6) cm long. It was found that there are seeds with a diameter of 4-6 mm, up to 2-8 (in some cases 10-12) seeds of gray-olive, dark gray, dark brown and black color.

In the conducted scientific research experiment, together with the number of pods, the number and weight of seeds in pods, as well as the weight of 1000 seeds were determined. According to the observed phenological data, the number of pods is 58-75; the average number of seeds in one pod is 5; seed weight in one pod is 0.187-0.189 g; The weight of 1000 seeds is 37.5-37.8 g, and high results are observed in the 4th variant, where the bacterial strain Rizo No. 15 was applied. It was found that, compared to the control variant, the weight of the seed in pods is higher by 0.02 g; the weight of 1000 seeds were higher by 0.3 g.

In the Indigofera plant, in early July, the height of the main stem was 75-100 cm according to the variants, and 150-200 pods began to form on each of these plants. During the period of operation, 350.0-450.0, some up to 500 pods are formed in one bush of indigofera.

There was an effect of bacterial strains on the formation of pods. The number of formed pods was 350.0-414.0 in the case of October 1, and a high result was observed in the 8th variant. The number of pods formed in this variant was 414.0, which was 64 more pods than the control variant.

When determining the number of seeds in one pod and its weight together with the number of pods, the number of seeds in one pod is 2; seed weight in one pod is 0.018 g; The weight of 1,000 seeds was 9.0-9.3 g, and the best results were observed in the variant in which Rizo No. 15 bacterial strain was applied along with indigofera sowing (Table 1).

***Table 1***

***The formation of pods on a plant***

| Variants | The number of pods | | | | The number of seeds in a pod | The weight of a seed in a pod, g | The weight of 1000 seeds, g |
|---|---|---|---|---|---|---|---|
| | 01.07 | 01.08 | 01.09 | 01.10 | | | |
| Crotalaria | | | | | | | |
| 1-variant | 8.0 | 18.4 | 44.4 | 58.0 | 5 | 0.187 | 37.5 |
| 2- variant | 10.2 | 22.0 | 61.0 | 65.0 | 5 | 0.188 | 37.6 |
| 3- variant | 10.0 | 22.7 | 62.7 | 67.0 | 5 | 0.189 | 37.8 |
| 4- variant | 12.5 | 28.0 | 71.0 | 75.0 | 5 | 0.189 | 37.8 |
| Indigofera | | | | | | | |
| 5- variant | 7.7 | 160.7 | 280.0 | 350.0 | 2 | 0.018 | 9.0 |
| 6- variant | 10.2 | 180.2 | 304.0 | 376.0 | 2 | 0.018 | 9.2 |
| 7- variant | 12.0 | 189.0 | 307.0 | 380.0 | 2 | 0.018 | 9.3 |
| 8- variant | 14.0 | 214.0 | 324.0 | 414.0 | 2 | 0.018 | 9.3 |

Therefore, in order to obtain high-quality seed yield from Crotalaria and Indigofera, treatment with bacterial strain Rizo #15 at the time of sowing is a guarantee of high yield.

The main task of agricultural research is scientific justification of the effect of the target agrotechnical measures and external influencing factors on plant productivity.

It should be noted that, as mentioned above, the different levels of effects of bacterial strains on plant growth, development, harvest and biometric indicators were finally reflected in the seed yield of crotalaria.

*Crotalaria juncea seeds ripen in about 6-6.5 months after sowing. We can know that the seeds are ready when the pods crackle, the stems dry up and some of the leaves fall off. The harvest is collected in a combine harvester or by hand. Depending on the agrotechnical measures and maintenance, 15-25 centner per ha seed yield can be obtained.*

To get a higher seed yield from Indigofera in the conditions of typical gray soils of the Tashkent region, Geohumat stimulator was applied at the rate of 1.0 l/ha along with planting and 1.6 l/ha during the growing season and budding period. As a result, a higher seed yield of 18.3 t/ha was obtained, and an additional yield of 6.8 t/ha was obtained compared to the control variant without stimulants [13].

Also, in order to obtain a quality seed crop from crotalaria in the conditions of alluvial soils of the degraded meadow of Khorezm region, it is recommended to sow 10 kg per hectare on April 20-25; 14 kg/ha of germinating seed for high grain yield [12].

Under the conditions of typical gray soils of Tashkent region, crotalaria seed yield was harvested in late October and early November. In the soil-climate conditions of Tashkent region, 75-80% of crotalaria pods are fully ripened and 20.0-25.0% of the seeds were not fully ripe.

According to the obtained data, the seed yield was 16.7-22.5 t/ha, and the highest result, 22.5.0 centner per ha was observed in variant 4, where the seeds were treated with Rizo No. 15 bacterial strain using 10 kg of seeds per hectare in the third ten days of April. Yield obtained from this variant was higher by 5.8 centner per ha, compared to the control variant, and higher by 2.8-3.2 centner per ha than the variants treated with other strains were obtained (diagram 1).

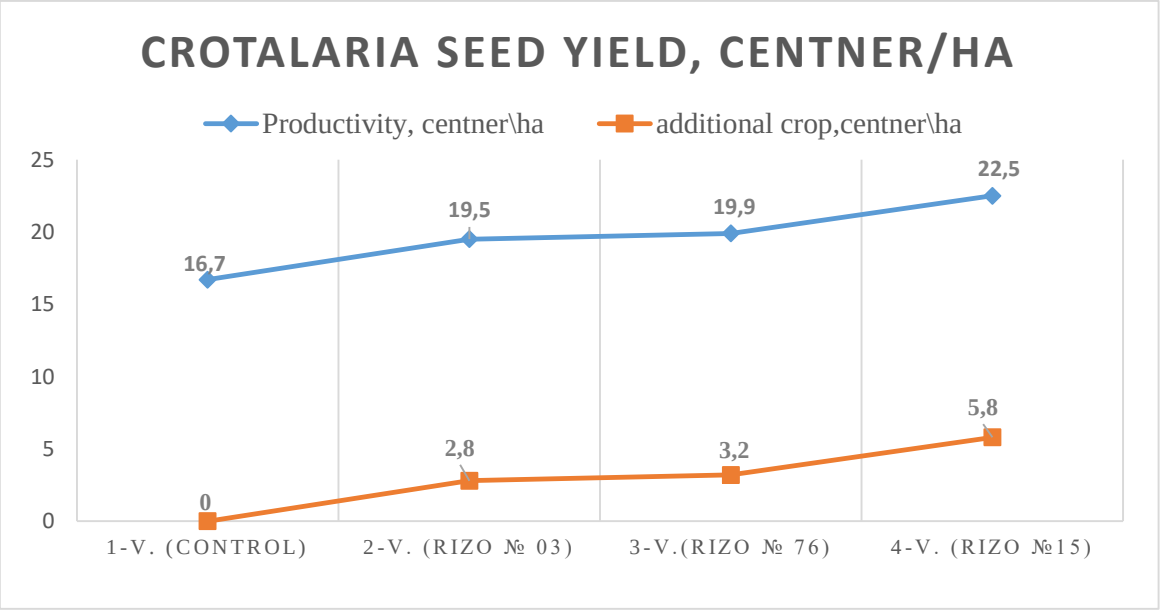


***Diagram 1. Effect of bacterial strains on Crotalaria seed yield, centner/ha***

It is necessary to determine the period of harvesting of the Indigofera plant when the seed pods begin to ripen from the bottom of the bush. In this case, the formation process of the leaf mass has almost come to an end and it stands on the leaf shoot without falling out. During this period, the mass of stems and leaves of plants is complete.

In our experiments, it was planned to harvest seeds from indigofera in order to save seeds. If indigofera is grown for seeds, it is necessary to delay its harvesting day by 15-20 days. In this

period, the bulk of the seed pods ripen and the color of the seed pods turns dark brown. It is advisable to harvest the pods when they are on average 75-85% dark brown in order to obtain plant seeds. In doing this, the plant stalks are washed and dried and the defoliated and seed pods left on the stem are crushed, separated and cleaned and stored dry in permeable containers.

According to the data obtained on the seed yield of indigofera in the conditions of typical gray soils of the Tashkent region in 2023, the yield was found to be 9.3-11.7 centner per ha when different strains were applied (diagram 2).

The highest result was observed in variant 8, where indigofera seeds were treated with bacterial strain, and was 11.7 centner per ha. The yield obtained from this variant was higher by 2.4 centner per ha compared to variant 5, where the bacterial strain was not applied; additional yield by 1.0-1.1 centner per ha was obtained compared to variants treated with other strains.

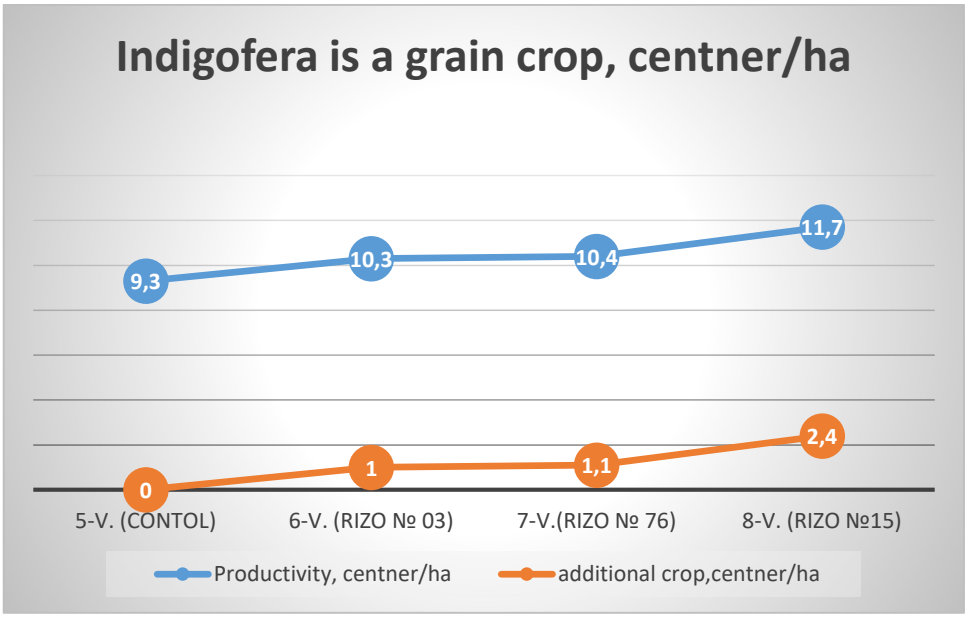


***Diagram 3.4.5.2. Effect of bacterial strains on Indigofera seed yield, centner per ha***

Therefore, during the planting of crotalaria and indigofera plants, when treated with bacterial strains, the growth and development of the plant was accelerated, and a high yield was obtained as a result of more crop elements.

Summary. Taking into account that the climate of Tashkent region, the typical gray soil conditions are very favorable for the cultivation of abundant and high-quality crops from crotalaria and indigofera as the main crops, and the fact that soil fertility is decreasing in our republic in recent years, It is desirable to introduce non-traditional crops belonging to this legume family as the main and repeated crops in short-rotation cropping systems.

In the conditions of typical gray soils of Tashkent region, the number and weight of pods per plant, the weight of 1000 seeds and the seed yield, when the seeds of leguminous crops are treated with Rizo No. 15 rhizosphere bacterial strain, are higher than the variant without bacterial strain. It is recommended to sow the seeds in the last ten days of April at the rate of 10 kg/ha of crotalaria and 3 kg/ha of indigofera and inoculate with Rizo No. 15 rhizosphere bacteria strain.

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