



EFFECT OF SOWING RATES AND BIOPREPARATIONS ON THE FORMATION OF NODULE BACTERIA IN THE ROOTS OF CROTALARIA

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Abstract: This article presents the effect of sowing rates and biopreparations on the number of nodule bacteria formed in the roots of the non-traditional legume crop *Crotalaria juncea* L., cultivated as a secondary crop under the conditions of meadow-alluvial soils in the Khorezm region. It has been scientifically substantiated that when *Crotalaria* is sown at different seeding rates with the application of biopreparations, the number of nodule bacteria per plant ranges from 8 to 62. However, as the seeding rate increases from 16 kg/ha to 24 kg/ha, the number of nodules decreases from 14 to 25. Furthermore, when seeds are treated with various biopreparations, the number of nodules increases by 18–47 compared to the untreated control variant.

Keywords: Meadow-alluvial soils, *Crotalaria juncea*, nodule bacteria, “BIST”, “AZOS-UZ” biopreparations.

Taking into account the possibility of obtaining 2–3 harvests per year from the irrigated lands of our republic, the correct selection and cultivation of legume crop species and varieties that contain high-quality protein and can positively address the existing problem of protein deficiency as a secondary crop is extremely important for improving soil fertility.

As a result of the activity of nodule bacteria living in the roots of legumes, atmospheric nitrogen is assimilated, leading to the accumulation of biological nitrogen in the soil, an increase in the amount of organic matter, improvement of the soil's water-physical properties, enhancement of fertility, prevention of secondary salinization, and a 20–30% increase in the yield of crops planted after legumes, as recorded in scientific sources.

According to D.W. Reeves et al. [5], since *Crotalaria* species belong to legumes, they accumulate nodule bacteria in their roots, thereby improving soil fertility. Moreover, *Crotalaria* can also be used as mulch. The advantage of using legumes as organic mulch rather than as green manure lies in the fact that when the plant is left as mulch, 30.4–32.2 kg of nitrogen per 0.4 ha is formed in the soil during the winter season.



R.A. Garcia et al. [3, 6] recommended sowing *Crotalaria* immediately after harvesting maize and soybean crops. In this way, the land remains fallow for a shorter period, and the soil does not undergo degradation. It was recorded that in fields where *Crotalaria* was sown, the amount of nitrogen in the 0–5 cm soil layer increased. Furthermore, in crop rotation systems, when maize was planted after *Crotalaria*, both the grain and green mass yields as well as the quality of maize improved [2].

S. Negmatova and Z. Babaeva [1] recommended treating *Crotalaria* seeds with bacterial strains before sowing in order to accelerate plant growth and development and to stimulate the formation of a large number of root nodules. In addition, according to M. Nurullaeva [4], under the conditions of Khorezm region, when the number of root nodules on *Crotalaria* roots was studied, the highest accumulation of nodules was observed during the podding–ripening stage. When 18 kg/ha of seeds were sown during the period of April 20–25, *Crotalaria* produced 36 nodules per plant, with the average weight of nodules per plant amounting to 0.684 g.

In the conducted scientific experiments, the number and weight of root nodules on *Crotalaria* roots, cultivated as a secondary crop, were studied during the flowering stage before each harvest. The experimental field was rotated annually under a crop rotation system, with trials carried out on different plots each year. In the experiment, *Crotalaria* seeds were sown with the application of biopreparations according to the experimental design.

According to the data obtained in 2024, during the flowering stage before the first harvest, the number of root nodules ranged from 5 to 39, with the control variant (without biopreparations) showing very few nodules. Before the second harvest, the number of nodules increased further, ranging from 8 to 62.



Appearance of nodule bacteria formed on the roots of Crotalaria

When observing the effect of sowing rates on the number of nodules on Crotalaria roots, it was found that as plant density increased, the number of nodules per plant decreased. For example, in variants where 400,000 seeds per hectare were sown, the number of nodules per plant ranged from 15 to 62; when 500,000 seeds per hectare were sown, the range was 13 to 58; and when 600,000 seeds per hectare were sown, the number decreased further to 8 to 37, i.e., by 7–25 nodules. The highest number of nodules per plant was observed in the variants with 400,000 seeds per hectare. Along with sowing rates, the effect of biopreparations on the number of nodule bacteria was also studied.

Table 1.

The number of nodule bacteria formed on the root of a single Crotalaria plant, pcs. (2022–2024)

№	Plant density, plants/ha	Bacterial strains	Before the 1st harvest	Before the 2nd harvest	Difference, %	
					Compared to the control	Compared to the seeding rate
2022 year						
1	400 000	-	5	11	-	-
2		«AZOS-UZ»	35	52	+41	-
3		«BIST»	14	25	+14	-
4	500 000	-	5	10	-	-1
5		«AZOS-UZ»	32	48	+38	-4
6		«BIST»	12	23	+13	-2
7	600 000	-	2	6	-	-5/-4
8		«AZOS-UZ»	18	31	+25	-21/-17
9		«BIST»	8	17	+11	-8/-6
2023 year						
1	400 000	-	7	16	-	-
2		«AZOS-UZ»	41	68	+52	-
3		«BIST»	18	38	+22	-
4	500 000	-	6	14	-	-2
5		«AZOS-UZ»	37	65	+51	-3
6		«BIST»	17	34	+20	-4
7	600 000	-	4	9	-	-7/-5
8		«AZOS-UZ»	23	40	+31	-28/-25
9		«BIST»	10	21	+12	-17/-13
2024 year						
1		-	8	15	-	-



2	400 000	«AZOS-UZ»	39	62	+47	-
3		«BIST»	19	33	+18	-
4	500 000	-	8	13	-	-2
5		«AZOS-UZ»	36	58	+45	-4
6		«BIST»	16	30	+17	-1
7	600 000	-	5	8	-	-7/-5
8		«AZOS-UZ»	21	37	+29	-25/-21
9		«BIST»	9	19	+11	-14/-11

It became clear from the experiment that the crotalaria plant is not selective regarding bacteria, since even though this new crop had never been cultivated in the experimental field before, nodular bacteria were observed on the roots of plants in all variants from the very first year. The highest results across all seeding rates were obtained in variants where crotalaria seeds were treated with the "AZOS-UZ" bio-preparation at sowing.

When 400,000 crotalaria seeds per hectare were sown and treated with "AZOS-UZ" and "BIST" bio-preparations, the number of nodules ranged from 33 to 62, which was 18–47 more than in the control variant. Furthermore, when the "AZOS-UZ" bio-preparation was applied, 62 nodules were formed, which was 47 more than in the control variant and 29 more than in the variant treated with "BIST."

The increase in the number of nodules when "AZOS-UZ" was applied is due to the presence of active bacteria in its composition that assimilate molecular nitrogen.

In the years 2022 and 2023, the number of nodular bacteria on crotalaria roots was also determined, and it was observed that nodules were relatively more numerous in 2023. The obtained results are presented in the table.

Conclusion. Under the conditions of meadow-alluvial soils in Khorezm region, when crotalaria is cultivated as a secondary crop after winter wheat stubble, the optimal measure for increasing the number of root nodules per plant is to treat the seeds with the bio-preparation “AZOS-UZ” and sow 400,000 seeds per hectare.

Meanwhile, in order to preserve and improve soil fertility across one hectare of land by ensuring greater formation of root nodules, the optimal measure is to treat the seeds with “AZOS-UZ” and sow 500,000 seeds per hectare.





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