Volume 3, Issue 10, October - 2025
ISSN (E): 2938-3781

Web of Agriculture: Journal of Agriculture and Biological Sciences
webofjournals.com/index.php/8

INFLUENCE OF TERMS AND RATES OF BIOSTIMULANTS APPLICATION ON THE DYNAMICS OF LEAF DEVELOPMENT IN MUNG BEAN VARIETIES

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Abstract
This article studies the effect of the timing and rates of the use of biostimulants (Phytobiosol, Gumi-20, Avangard Start) on the development of leaves in mung bean varieties "Durdona" and "Marjon". Experimental work was carried out in 2022–2024 at two planting densities (200 and 300 thousand plants/ha). According to the results of the experiment, the largest number of leaves (16.5 pcs.) was recorded in the variety "Durdona" when treated with the biostimulant Avangard Start at a planting density of 200 thousand plants/ha the number of leaves. The positive effect of biostimulants activated the growth of leaves, which confirms their importance in the development of effective agricultural technology.

Keywords: Biostimulant, Phytophytobisol, Gumi-20, Avangard Start, mung bean, Durdona, Marjon, seedling density, number of leaves, development, term, norm, experiment, observation.

Introduction

Currently, agriculture in Uzbekistan is rapidly developing and is considered as one of the strategic sectors of the national economy. Systemic reforms are being carried out in the sector aimed at modernization, increasing yields and strengthening export potential. Agriculture plays an important role in ensuring food security, increasing employment and strengthening economic stability.

Within the framework of agrarian reforms, a number of important regulatory documents were adopted in the country, which created a solid legal basis for the development of the industry. In particular, such documents include: Decree of the President of the Republic of Uzbekistan dated January 28, 2022 No UP-60 "On the development strategy of New Uzbekistan for 2022-2026", resolution "On approval of the strategy for the development of agriculture of the Republic of Uzbekistan for 2020-2030", as well as resolution No PP-113 dated April 5, 2023 "On additional measures to expand production, processing and support of agricultural products in 2023".

At the heart of these reforms, the introduction of scientifically based, resource-saving agricultural technologies for the cultivation of leguminous crops, in particular, mung bean, is of particular importance. When growing mung beans, high results are achieved due to the selection of environmentally friendly, rich in proteins and vitamins, high-yielding varieties and their adaptation

Volume 3, Issue 10, October - 2025
ISSN (E): 2938-3781

to soil and climatic conditions.

Modern approaches provide for a clear definition of sowing dates and rates, effective use of biostimulants and mineral fertilizers, as well as the use of a crop rotation system, which allows to maintain and increase soil fertility. This, in turn, is of great scientific and practical importance in meeting the needs of the population in the production of leguminous crops and the formation of a high-quality fodder base for animal husbandry. aimed at improving agricultural technologies for the cultivation of high-yielding varieties of mung bean, remain relevant and serve as an important factor in ensuring the country's food security.

Literature Analysis and Methodology

In ensuring high yields of mung bean, agrotechnical measures, in particular, the sowing scheme and plant nutrition, are the most important factors.

In studies conducted by N. Ravshanova and N. Khalilov [4; pp. 15–17], as well as N. Ravshanova [5; pp. 12–25] in the conditions of the Samarkand region, the optimal sowing scheme for the Pobeda-104 mung bean variety was 45×12 cm (185.2 thousand plants per hectare), in which a yield of 9.1 c/ha was obtained. however, the number of beans, grains, leaves, and nodules on the roots decreases. This once again confirms the influence of the optimal sowing scheme and plant density on yield.

In recent years, the use of biostimulants to activate the growth and development of plants has become relevant. As noted by B. B. Mirzakhmetova [3; p. 5], humic acids are distinguished by their complex chemical structure, as well as the content of biologically active substances, such as ascorbic acid, boron, zinc, and carboxylic acids. Under the influence of these substances, physiological processes are activated, metabolism improves, the root system develops, photosynthesis is enhanced, which, in turn, contributes to the active growth of vegetative organs.

In this regard, a comprehensive study of the effect of the timing and rates of the use of biostimulants on the dynamics of leaf development in mung bean varieties makes it possible to determine the optimal agricultural practices and achieve a high and stable yield. Scientific research in this direction is especially important for the formation of environmentally sustainable agricultural systems.

Results and Discussion

The dynamics of leaf development in mung bean varieties has a direct impact on the photosynthetic activity of the plant and the overall rate of its vegetative growth. The number, area and formation of green mass of leaves are important factors that contribute to increasing the yield of grains. Varieties with abundant foliage and early leaf formation stand out, which actively assimilate nutrients and are highly adaptable to agroecological conditions. Therefore, when choosing varieties, it is necessary to take into account the rate of leaf development, as this plays an important role in increasing yields and introducing resource-saving technologies.

If biostimulants are applied at optimal times and doses, leaf development improves, photosynthetic activity is at the proper level, which ultimately contributes to an increase in yield. According to experimental observations, it has been established that the formation of leaves in mung bean varieties depends on the varietal characteristics, as well as on the doses and terms of application of the studied biostimulants.

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In the course of the experiment, the studied mung bean varieties showed the following indicators for this trait (see Table 1).

In the control variant of the Durdona **variety** , at the beginning of the panicling phase, the number of leaves was 3.5–3.2 pcs. In the flowering phase, the number of leaves was 9.3–8.7 pcs., and in the phase of bean formation — 12.4–11.7 pcs. At the same time, it was found that with an increase in sowing density, the number of leaves decreased by 0.6–0.7 pcs.

Influence of terms and rates of biostimulant application on the dynamics of leaf development in mung bean varieties, units/plant (Three-year averages – 2022–2024)

Table 1.

№	Mung bean varieties	Experience options	Theoretical sowing density, ths/ha	Phases of development		
				Whisking (pcs)	Flowering (pcs)	Bean Formation (Pieces)
1	Durdona	Control	200	3,5	9,3	12,4
2			300	3,2	8,7	11,7
3		Phytobiosol	200	4,4	11,1	15,3
4			300	4,1	10,6	14,5
5		Tires-20	200	4,2	10,2	13,7
6			300	3,8	9,4	12,7
7		Avangard Start	200	4,6	12,5	16,2
8			300	4,2	11,8	15,4
9	Marjon	Control	200	3,4	8,9	11,8
10			300	3,1	7,7	10,4
11		Phytobiosol	200	4,2	10,4	14,9
12			300	3,3	10,1	13,7
13		Tires-20	200	4,0	9,7	13,1
14			300	3,5	9,2	12,4
15		Avangard Start	200	4,3	12,1	15,7
16			300	4,0	11,3	14,3

In the variant of treatment with the biostimulant **Phytobiosol** (4 l/t, 4 l/ha), the number of leaves at the beginning of the panicle-forming phase was 4.4–4.1 pcs., in the flowering phase — 11.1–10.6 pcs., in the phase of bean formation — 15.3–14.5 pcs.

In the variant of treatment with the biostimulant **Gumi-20** (2.4 l/t, 1.8 l/ha), the number of leaves at the beginning of the panicle phase was 4.2–3.8 pcs., in the flowering phase — 10.2–9.4 pcs., in the phase of bean formation — 13.7–12.7 pcs.

In the variant of treatment with the biostimulant **Avangard Start** (1.5 l/t, 1.0 + 2.0 l/ha), the number of leaves at the beginning of the panicle-forming phase was 4.6–4.2 pcs., in the flowering phase — 12.5–11.8 pcs., in the phase of bean formation — 16.2–15.4 pcs.

In the control variant of the **Marjon variety** , the number of leaves at the beginning of the panicle phase was 3.4–3.1 pcs., in the flowering phase — 8.9–7.7 pcs., in the phase of bean formation — 11.8–10.4 pcs.

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In the variant of treatment with the biostimulant **Phytobiosol** (4 l/t, 4 l/ha), the number of leaves at the beginning of the panicle phase was 4.2–3.3 pcs., in the flowering phase — 10.4–10.1 pcs., in the phase of bean formation — 14.9–13.7 pcs.

In the variant of treatment with the biostimulant **Gumi-20** (2.4 l/t, 1.8 l/ha), the number of leaves at the beginning of the panicle phase was 4.0–3.5 pcs., in the flowering phase — 9.7–9.2 pcs., in the phase of bean formation — 13.1–12.4 pcs.

In the variant of treatment with the biostimulant **Avangard Start** (1.5 l/t, 1.0 + 2.0 l/ha), the number of leaves at the beginning of the panicle phase was 4.3–4.0 pcs., in the flowering phase — 12.1–11.3 pcs., in the phase of bean formation — 15.7–14.3 pcs. which we attribute to a lack of light and nutrients.

The highest rates were recorded in the **Durdona variety** (200 thousand / ha) in the version of treatment with the biostimulant **Avangard Start** (1.5 l/t, 1.0 + 2.0 l/ha).

Based on the results of three-year observations, it was established that the dynamics of leaf development in the Durdon and Marjon mung bean varieties is directly related to the timing and rates of biostimulant use. In the experimental versions, the number of leaves per plant (pieces) was compared by year, and the effectiveness of biostimulants was also studied (see Table 2).

Influence of terms and rates of biostimulant application on the development of mung bean leaves (pcs.) per plant.

Table 2

№	Mung bean varieties	Experience options	Theoretical sowing density, ths/ha	Years		
				2022	2023	2024
1	Durdona	Control	200	12,4	12,0	12,8
2			300	11,7	11,5	11,9
3		Phytobiosol	200	15,2	15,6	15.1
4			300	14,7	13,9	14,9
5		Tires-20	200	13,4	13,6	14,1
6			300	13,1	12,4	13,2
7		Avangard Start	200	16,3	15,8	16,5
8			300	15,3	15,2	15,7
9	Marjon	Control	200	11,7	11,6	12,3
10			300	10,3	10,1	10,8
11		Phytobiosol	200	14,9	14,6	15,2
12			300	13,5	13,2	14,4
13		Tires-20	200	13,1	12,8	13,4
14			300	12,4	12,1	12,7
15		Avangard Start	200	15,8	15,3	16,0
16			300	14,3	14,1	14,5

In the Durdona **variety**, especially in the variant of treatment with the biostimulant **Avangard Start** (200 thousand plants/ha), with the timely and optimal use of the biostimulant in the period 2022-2024, the number of leaves reached the maximum level - 16.3; 15.8; 16.5 pcs, respectively. In the variant of treatment with the biostimulant **Phytobiosol** (4 l/t, 4 l/ha) in the same variety also obtained good results - about 15.2-15.6 leaves, which indicates the average effectiveness of the norms for the use of this biostimulant.

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ISSN (E): 2938-3781

A similar trend is observed in the Marzhon **variety** : in the variant with the biostimulant **Avangard Start** (200 thousand plants/ha), an average of 15.8; 15.3; 16.0 leaves were formed per plant. In other variants, especially in the control one (without the use of biostimulants), the number of leaves was much lower — on average about 11.9 pcs.

In addition, with an increase in sowing density (300 thousand plants/ha), even with the use of biostimulants, the rate of leaf growth was relatively lower. This indicates that in dense planting conditions, competition between plants for light and nutrients has increased, as a result of which the effect of biostimulants is not fully manifested.

These results show that the timely and optimal use of biostimulants, especially at a sowing density of 200 thousand plants/ha, significantly activates the formation of leaves and vegetative development of mung bean varieties. This is an important factor for increasing yields and ensuring agrotechnological efficiency.

Based on the results of three-year field experiments, it was found that the development of mung bean leaves directly depends on the type, number and timing of the use of biostimulants. In the biostimulant variants, especially in the Durdona and Marjon varieties, the number of leaves at all phenological stages (digging, flowering, bean formation) was higher compared to the control variants.

The best results were observed in the Durdona variety with a sowing density of 200 thousand plants/ha and the use of **the Avngard Start** biostimulant (1.5 l/t, 1.0+2.0 l/ha), where 16.3–16.5 leaves per plant were formed in the bean formation phase. also had a positive effect, but the indicators were relatively lower: with the use of Phytobiosol, 13.7–15.6 leaves were noted, with Gumi-20 — 12.4–13.7 leaves.

In the control variants without the use of biostimulants, the lowest indicators were observed: in the Durdona variety — 11.7–12.4 leaves, in the Marjon variety — 10.4–11.8 leaves. In addition, an increase in sowing density to 300 thousand plants/ha in both varieties led to a decrease in the number of leaves, which indicates increased competition for light and nutrients during dense planting.

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