

Effect of New Biostimulants And Insecticides on Cotton Leaf Area Formation

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Abstract

This study evaluates the effects of new biostimulants and insecticides, applied individually and in combinations, on the formation and maintenance of cotton leaf area based on field data obtained in 2025. Leaf area was assessed at three principal phenological stages: budding, flowering–boll formation, and ripening, both per plant and per hectare. At the budding stage, the control produced 9,272 m² ha⁻¹ of leaf area, whereas Gulliver and Avangard Start produced 12,669 and 12,600 m² ha⁻¹, respectively. During flowering–boll formation, the highest leaf area was recorded with Gulliver at 26,880 m² ha⁻¹. At ripening, Avangard Start maintained the greatest leaf area, reaching 21,036 m² ha⁻¹. The findings indicate that the tested biostimulants promoted earlier development of the photosynthetic apparatus and supported its functional preservation during the later stages of crop development.

Keywords: Cotton, biostimulant, insecticide, leaf area, photosynthesis, Gulliver, Avangard Start, Antikolorad, crop productivity.

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1. Introduction

Leaf area and leaf number are among the major physiological traits determining the photosynthetic potential of cotton. Optimal development of the leaf apparatus expands the assimilative surface, enhances dry-matter accumulation, and improves the supply of assimilates to reproductive organs. Therefore, evaluating the physiological effectiveness of biostimulants and plant-protection products that regulate crop growth and development is an important component of modern cotton production technology.

Previous studies have reported positive effects of biostimulants and foliar nutrition on crop growth and yield formation. Sh. Karimov and Sh. Abdualimov demonstrated that the application of Albit under saline soil conditions in Jizzakh Region increased seed-cotton yield by 2.0–3.6 centners ha⁻¹ compared with the control. The best result, 36.7 centners ha⁻¹, was obtained when seed was treated at 75 ml t⁻¹ and the crop was additionally sprayed at the budding stage at 40 ml ha⁻¹. They also reported slight increases in 1,000-seed weight and lint percentage.

Q. Davronov and N. Teshaboyev showed that increasing mineral fertilizer rates does not necessarily accelerate flowering; rather, the balance among nutrients is more important. In their experiments, N230P160K115 did not significantly hasten flowering, whereas N180P125K90 proved more favorable. On this nutrient background, foliar application of liquid NPK and micronutrients accelerated flowering and promoted more stable boll formation.

According to Sh. Abdualimov, biostimulants are important tools for regulating cotton growth and development. When Entojean was applied during budding, flowering, and fruit formation, excessive vegetative growth was reduced and the shedding of fruiting organs was limited. High effectiveness was achieved either with three applications at 15+45+90 g ha⁻¹ or with a single 105 g ha⁻¹ treatment when 13–14 fruiting branches had developed, while also reducing resource and labor inputs.

W. Chen et al. found that drought suppressed cotton growth and limited the development and feeding of *Aphis gossypii*, resulting in a lower aphid population. This suggests that deterioration of plant physiological status under water deficit may restrict pest development. Kovács, Dezső, Horotán, Katalin, Orlóci, László, Makádi, Marianna and Mosonyi, István reported that biostimulant products containing macro- and micronutrients and extracts of *Ecklonia maxima* can increase soil humus content, improve root development, and increase yield and green biomass. A. Blinnik, V.

Naumkin, L. Naumkina, O. Artemova and A. Kryukov showed that foliar fertilization increased white lupin yield, with combined macro- and micronutrient treatments producing increases of up to 17%.

The objective of this study was to determine the effects of new biostimulants and insecticides, applied separately and in combined treatment schemes, on the dynamics of cotton leaf area during the main phenological stages.

2. Methods

The field experiment was conducted in 2025. Nine treatments were evaluated: an untreated control; the standard treatment (Universal); Antikolorad; Avangard Start; Gulliver; and several combinations of these products. Cotton leaf area was measured at the budding, flowering–boll formation, and ripening stages. The results were expressed as cm² per plant and m² ha⁻¹. Treatment effects were evaluated by comparing absolute values and percentage differences relative to the control.

3. Results

At the budding stage, leaf area in the control was 918 cm² per plant and 9,272 m² ha⁻¹. Across the treated variants, leaf area ranged from 1,050 to 1,230 cm² per plant. Gulliver produced the highest value, 1,230 cm² per plant, which was 34.0% above the control. Avangard Start reached 1,200 cm² (+30.7%), while Avangard Start + Gulliver reached 1,210 cm² (+31.8%). On a hectare basis, Gulliver and Avangard Start produced 12,669 and 12,600 m² ha⁻¹, respectively.

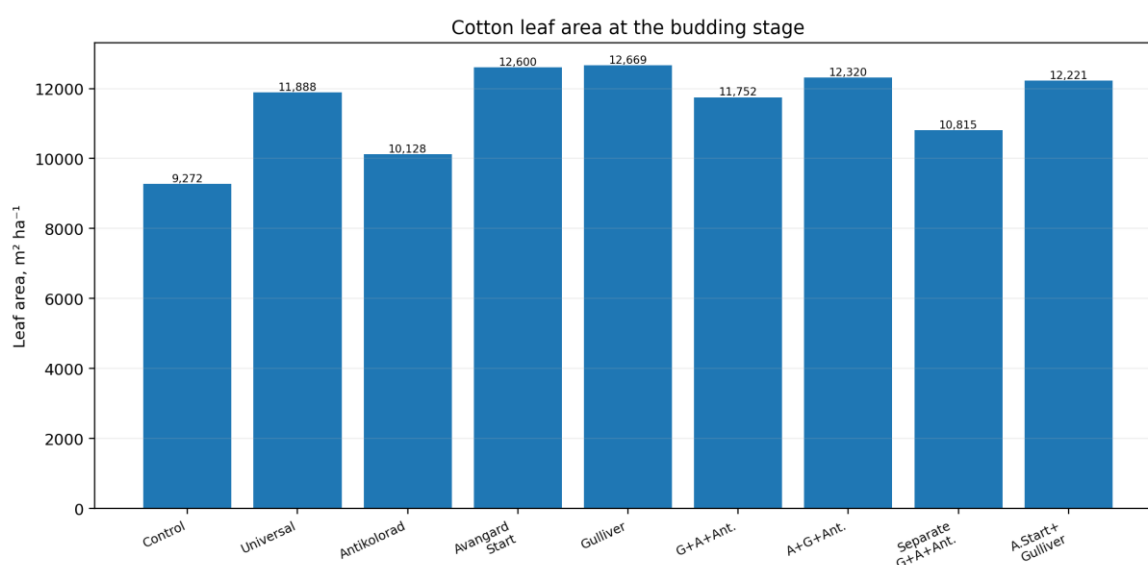


Figure 1. Cotton leaf area at the budding stage, m² ha⁻¹

During flowering–boll formation, the leaf apparatus reached its maximum development in all treatments. The control recorded 2,130 cm² per plant and 21,726 m² ha⁻¹. On a per-plant basis, Antikolorad produced the highest value at 2,600 cm², or 22.1% above the control, while Gulliver reached 2,560 cm² (+20.2%). On a hectare basis,

Gulliver produced the maximum leaf area of 26,880 m² ha⁻¹, representing an increase of 23.7% over the control. Avangard Start reached 26,322 m² ha⁻¹ (+21.2%), while the separately applied Gulliver + Avangard + Antikolorad combination reached 26,244 m² ha⁻¹ (+20.8%).

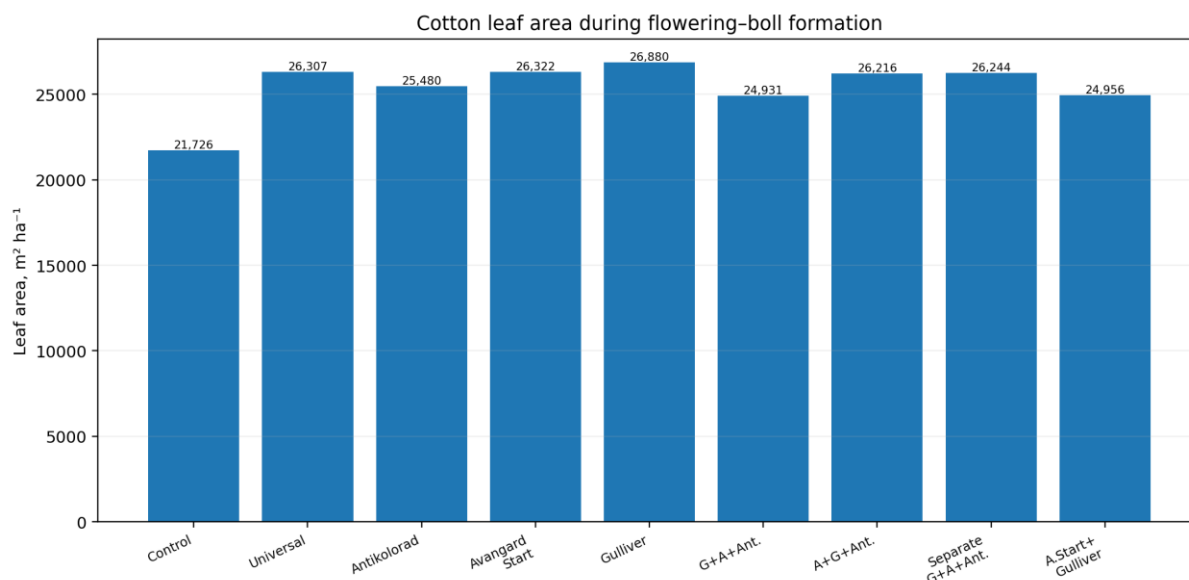


Figure 2. Cotton leaf area during flowering–boll formation, m² ha⁻¹

At the ripening stage, leaf area naturally declined. The control maintained 1,541 cm² per plant and 15,718 m² ha⁻¹. Avangard Start maintained 1,966 cm² per plant (+27.6%) and 21,036 m² ha⁻¹ (+33.8%). Gulliver

maintained 1,897 cm² per plant (+23.1%) and 19,918 m² ha⁻¹ (+26.7%). These results indicate that these treatments helped preserve a functional photosynthetic surface later into the growing season.

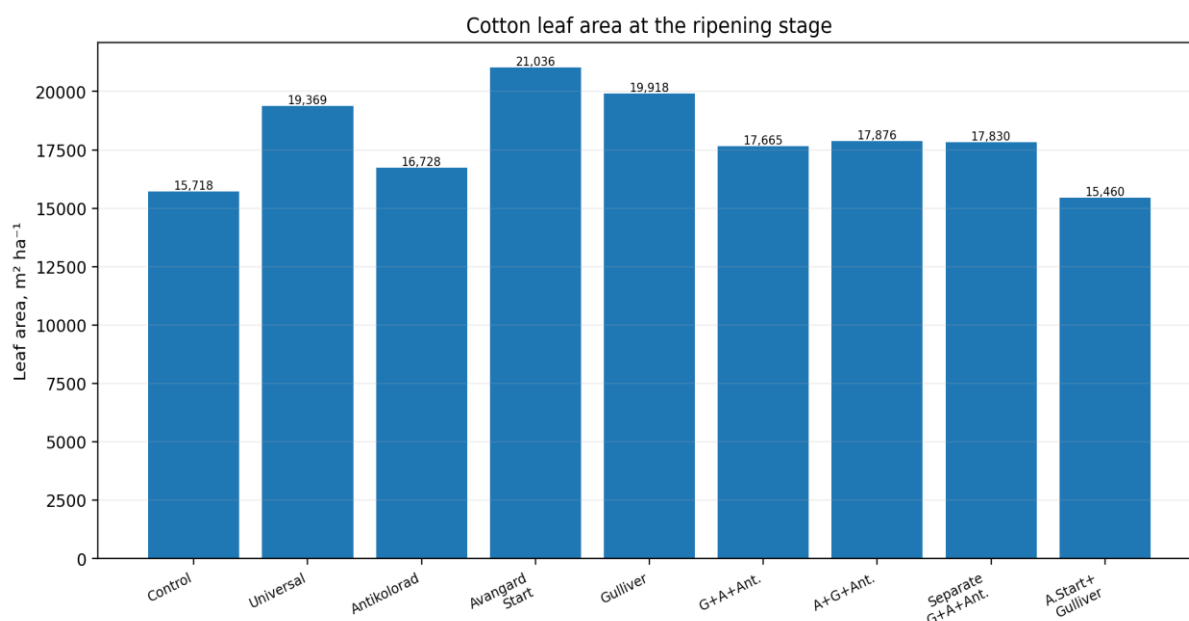


Figure 3. Cotton leaf area at the ripening stage, m² ha⁻¹

Table 1. Effect of new biostimulants and insecticides on cotton leaf area (2025)

No.	Experimental treatment	Budding 1 plant, cm ²	Budding 1 ha, m ²	Flowering– boll formation 1 plant, cm ²	Flowering– boll formation 1 ha, m ²	Ripening 1 plant, cm ²	Ripening 1 ha, m ²
1	Control	918	9272	2130	21726	1541	15718
2	Standard (Universal)	1100	11888	2370	26307	1745	19369
3	Antikolorad	1055	10128	2600	25480	1707	16728
4	Avangard Start	1200	12600	2460	26322	1966	21036
5	Gulliver	1230	12669	2560	26880	1897	19918
6	Gulliver + Avangard + Antikolorad	1130	11752	2330	24931	1651	17665
7	Avangard + Gulliver + Antikolorad	1120	12320	2320	26216	1582	17876
8	(Separate treatment) Gulliver + Avangard + Antikolorad	1050	10815	2430	26244	1651	17830
9	Avangard Start + Gulliver	1210	12221	2423	24956	1501	15460

4. Discussion

The results demonstrate that leaf-area development depended on both the product and treatment scheme. Gulliver promoted a larger leaf surface during the early and peak photosynthetic stages, whereas Avangard Start showed the strongest capacity to maintain leaf area during ripening. These differences may be associated with specific effects of the products on plant metabolism, nutrient uptake, and the functional longevity of leaves. Although combined treatments did not always exceed the maximum values observed with Gulliver or Avangard Start alone, several combinations maintained relatively stable leaf-area values throughout the growing season.

The findings are generally consistent with earlier reports showing positive effects of biostimulants and foliar nutrition on plant growth, green biomass accumulation, and reproductive development. Nevertheless, a larger leaf area alone does not fully determine final yield. Leaf-area data should therefore be interpreted together with net photosynthetic productivity, dry-matter partitioning, water status, fruit retention, and final yield. The results of W. Chen et al. further emphasize the importance of considering environmental conditions, particularly water

availability, when interpreting physiological responses.

5. Conclusion

The 2025 experiment showed that the application of new biostimulants and insecticides had a pronounced effect on cotton leaf-area formation and maintenance. At budding, Gulliver and Avangard Start produced 12,669 and 12,600 m² ha⁻¹, respectively. During flowering–boll formation, Gulliver gave the highest leaf area at 26,880 m² ha⁻¹. At ripening, Avangard Start maintained the largest leaf area at 21,036 m² ha⁻¹, which was 33.8% greater than the control. Thus, Gulliver can be considered promising for stimulating early and intensive leaf-apparatus development, whereas Avangard Start appears particularly effective in preserving leaf area during the later stages of crop development.

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