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The effect of agronomic practices on cotton yield of cotton varieties on irrigation-eroded lands

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Abstract

The paper presents data on the effects of plant population density and fertilizer application rates on the growth, development, and seed cotton yield of the cotton varieties Andijan-35 and Sulton grown on the washed and depositional sections of irrigation-eroded sloping lands.

Keywords

irrigation erosion, washed and depositional sections of sloping lands, mineral fertilizer rates, Andijan-35 and Sulton cotton varieties, seedling emergence, plant population density, growth and development, seed cotton yield.

Introduction

In many countries around the world, the factors causing soil erosion have been identified, classification systems based on the degree of erosion have been developed and mapped, and effective methods and techniques for the efficient use of irrigation water on erosion-prone lands have been introduced. In addition, agrotechnologies aimed at reducing soil particle loss, preserving and improving soil fertility, and producing high and high-quality yields of agricultural crops have been developed and implemented. Nevertheless, the efficient use of land, water, fertilizers, and other resources, the development of resource-saving agrotechnologies, and ensuring food security, supplying raw materials for industry, and providing nutritious feed for livestock remain among the most pressing challenges.

In the Republic of Uzbekistan, approximately 722 thousand hectares of land are affected by irrigation erosion, 1,812 thousand hectares of cultivated land are affected by wind erosion, and a total of 1,929 thousand hectares are subject to combined water and

wind erosion. Therefore, preventing erosion processes, maintaining and improving soil fertility, and obtaining high and high-quality crop yields remain among the most important priorities of modern agriculture.

Scientific research was conducted to investigate the effects of different plant population densities and fertilizer application rates on the growth, development, and productivity of the cotton varieties Andijan-37 and Sulton grown on the washed and depositional sections of irrigation-eroded light sieroz soils in Andijan Region (Table 1). The field experiments were carried out in accordance with the methodological guidelines Methods for Conducting Field Experiments (Tashkent, 2007).

In the experiment evaluating the optimum plant population density of cotton varieties according to the slope conditions of irrigation-eroded lands and different fertilizer application rates, the soil bulk density was determined before sowing. In the washed section of the slope, the bulk density was 1.28 g/cm³ in the 0–30 cm soil layer and 1.33 g/cm³ in the 30–50 cm layer. In the depositional section, the corresponding values ranged from 1.26 to 1.31 g/cm³. By the end of the growing season, the soil bulk density in the washed section increased by 0.05–0.10 g/cm³ in the 0–30 cm layer and by 0.04–0.06 g/cm³ in the 30–50 cm layer, whereas in the depositional section the increase amounted to 0.03–0.07 g/cm³ and 0.02–0.06 g/cm³ respectively.

Analysis of the soil humus content showed that, in the eroded section of the slope, the humus content before the experiment was 1.17% in the 0–30 cm soil layer and 0.87% in the 30–50 cm layer. By the end of the growing season, due to nutrient uptake by plants and the loss of humus associated with irrigation-induced soil erosion, the humus content decreased. In the plots planted with the Andijan-37 cotton variety and fertilized at a rate of $N_{180}P_{110}K_{80}$ kg/ha, maintaining a plant population of 80–90 thousand plants/ha resulted in humus contents of 0.89% and 0.65% in the respective soil layers. When the plant population was increased to 120–130 thousand plants/ha, the humus content declined to 0.75% and 0.63%, respectively. Under the higher fertilizer rate of $N_{200}P_{140}K_{100}$ kg/ha, the corresponding values were 0.89% and 0.69%, and 0.85% and 0.65%, respectively. In the corresponding treatments planted with the Sulton variety, the

humus contents were 0.89%, 0.80%, 0.85%, 0.71%, 0.86%, 0.81%, 0.84%, and 0.63%, respectively.

Table 1

Experimental Layout

<table>
<tr><th>№</th><th colspan="2">Slope section</th><th colspan="2">Cotton varieties</th><th>Mineral fertilizer rate, kg ha</th><th>Plant density, thousand plants/ha</th></tr>
<tr><td>1</td><td rowspan="9">Washed section of the soil on sloping land</td><td rowspan="9">Depositional section of the slope</td><td rowspan="9">Andijan-37</td><td rowspan="9">Sulton</td><td rowspan="3">N_{160} P_{110} K_{80}</td><td>80-90</td></tr>
<tr><td>2</td><td>100-110</td></tr>
<tr><td>3</td><td>120-130</td></tr>
<tr><td>4</td><td rowspan="3">N_{200} P_{140} K_{100}</td><td>80-90</td></tr>
<tr><td>5</td><td>100-110</td></tr>
<tr><td>6</td><td>120-130</td></tr>
<tr><td>7</td><td rowspan="3">N_{240} P_{170} K_{120}</td><td>80-90</td></tr>
<tr><td>8</td><td>100-110</td></tr>
<tr><td>9</td><td>120-130</td></tr>
</table>

In the depositional section of the slope, where soil particles transported by irrigation erosion accumulated, the humus content increased by 0.08–0.25% across the experimental treatments owing to the deposition of eroded soil materials in the lower part of the field. Nevertheless, by the end of the growing season, the humus content decreased in all treatments as a result of plant nutrient uptake and the effects of irrigation erosion. The total nitrogen content was considerably lower in the eroded soils, amounting to 0.086% and 0.073%, respectively. By the end of the growing season, it had decreased by 0.012–0.020 percentage points. Irrigation-eroded soils were also characterized by the accumulation of carbonates. Part of the phosphorus applied as fertilizer underwent retrogradation (phosphorus fixation), and consequently, by the third year of the study, a slight increase in the soil phosphorus content was observed.

It is well known that each cotton variety requires specific agronomic practices depending on the prevailing soil and climatic conditions.

Achieving an early, abundant, and high-quality cotton yield on irrigation-eroded lands remains one of the key challenges of modern cotton production. Therefore, the

development and implementation of variety-specific agrotechnologies tailored to the biological characteristics of each cotton variety and the conditions of irrigation-eroded soils are of great importance for sustainable and efficient cotton cultivation.

On 1 June, plants of the Sulton cotton variety grown in the lower depositional section of the slope, where eroded soil particles had accumulated, reached a height of 21.8–23.0 cm, exceeding the height of the Andijan-37 variety by 3.0–3.5 cm. Accordingly, the number of true leaves also increased (Treatments 28–36). In the eroded upper section of the slope, plant height was 2–3 cm lower than that observed in the depositional section, although the varietal differences remained consistent.

It should be noted that, for both cotton varieties and under both slope conditions, increasing plant population density in combination with the respective mineral fertilizer rates (Treatments 4–8, 13–18, 22–27, and 31–36) promoted more vigorous plant growth. In these treatments, plant height exceeded that of the other treatments by 5–6 cm, while maintaining the varietal characteristics. A corresponding increase in the number of fruiting branches and fruiting structures was also observed. Similar trends were recorded during the August observations. During this period, both cotton varieties exhibited accelerated vegetative growth, each expressing its characteristic growth pattern. Furthermore, plant population density and fertilizer application rates created favorable conditions for the formation of reproductive organs and boll development. For example, under fertilizer rates of $N_{200}P_{140}K_{100}$ kg/ha and $N_{240}P_{170}K_{120}$ kg/ha, applied in the above-mentioned treatments at both slope positions, vegetative growth was somewhat reduced compared with the other treatments; however, the number of fruiting branches and fruiting structures increased. Regarding boll formation, the greatest number of bolls was recorded in Treatments 1–3, 10–12, 19–21, and 28–30, where plant population was maintained at 80–85 thousand plants/ha. In these treatments, the average number of bolls per plant exceeded that of the other treatments by 1.5–2.0 bolls. In the remaining treatments, boll formation decreased as plant population density increased.

In both cotton varieties, under both slope conditions, plant growth was influenced by mineral fertilizer rates. When the plant population was maintained at 110 thousand plants/ha, vigorous vegetative growth was observed under all fertilizer application rates

(Treatments 4–8, 13–18, 22–27, and 31–36). In these treatments, plants were on average 5–10 cm taller than those in the remaining treatments, while the characteristic differences between the varieties were maintained. Correspondingly, the number of fruiting branches and reproductive structures also increased. Similar trends were observed in the development of yield components. During August, the growth of both cotton varieties became even more vigorous, with each variety exhibiting its characteristic pattern of development. It was evident that the combination of plant population density and fertilizer application rates created favorable conditions for the formation of reproductive organs and boll development. For example, at both slope positions, the application of fertilizers at rates of $N_{200}P_{140}K_{100}$ kg/ha and $N_{240}P_{170}K_{120}$ kg/ha resulted in slightly reduced vegetative growth compared with the other treatments; however, an increase in the number of fruiting branches and reproductive structures was observed. In particular, the greatest boll formation occurred in Treatments 1–3, 10–12, 19–21, and 28–30, where the plant population was maintained at 80–85 thousand plants/ha. Under these conditions, the average number of bolls per plant increased by 1.5–1.9 bolls compared with the other treatments. In the remaining treatments, boll formation decreased as plant population density increased.

Observations conducted on 1 September showed that, under both slope conditions, the greatest number of bolls was recorded in Treatments 1–3, 10–12, 19–21, and 28–30, where the cotton varieties received fertilizer at rates of $N_{200}P_{140}K_{100}$ kg/ha and $N_{240}P_{170}K_{120}$ kg/ha, and the plant population was maintained at 80–85 thousand plants/ha. In these treatments, the number of bolls increased by an average of 1.5–2.0 bolls per plant compared with the other treatments. The corresponding numbers of bolls per plant were 7.7–9.0, 8.1–8.4, 8.3–9.1, and 7.7–8.3, respectively (Treatments 1–3, 10–12, 19–21, and 28–30). No significant differences were observed between the Andijan-37 and Sulton cotton varieties. The results indicate that both the Andijan-37 and Sulton cotton varieties can produce high and good-quality seed cotton yields under different slope conditions when cultivated with mineral fertilizer application rates of $N_{200}P_{140}K_{100}$ kg/ha and $N_{240}P_{170}K_{120}$ kg/ha.

It should be noted that, under both slope conditions, the number of bolls formed on the cotton plants increased in all treatments in relation to plant population density. For example, in all treatments where the plant population was maintained at 80–85 thousand plants/ha, the average number of bolls per plant was 1.5–2.0 higher than in the other treatments. In treatments with higher plant populations, the total number of bolls per unit area increased primarily due to the greater number of plants.

This can be explained by the fact that, in both cotton varieties, increased plant density within the rows resulted in reduced plant height. Under these conditions, the proportion of weak plants increased, and consequently, the number of bolls formed per individual plant decreased. However, this did not have a significant negative effect on seed cotton yield. On the contrary, under both slope conditions, yield increased across all treatments of both cotton varieties as plant population increased, reflecting the varietal characteristics and the greater number of plants per unit area.

The pattern observed in the formation of yield components in the experimental treatments was also reflected in the maturation of seed cotton. Under both slope conditions, the ripening period varied depending on plant population density. In addition, the seed cotton yield differed among the cotton varieties grown under these conditions. In the eroded section of the slope, the Andijan-37 cotton variety, grown at plant populations of 82.3–84.7 thousand plants/ha and 101.8–103.5 thousand plants/ha, produced seed cotton yields of 31.4–31.3 s/ha and 32.6–32.4 c/ha, respectively, when fertilized at rates of $N_{200}P_{140}K_{100}$ kg/ha and $N_{240}P_{170}K_{120}$ kg/ha. Compared with the fertilizer rate of $N_{160}P_{110}K_{80}$ kg/ha, these treatments produced an additional 1.7–1.6 s/ha and 1.4–1.2 s/ha of seed cotton, respectively (Treatments 2–3 and 5–6). Similarly, the Sulton cotton variety, grown at plant populations of 84.0–84.7 thousand plants/ha and 102.6–105.6 thousand plants/ha, produced seed cotton yields of 33.2–33.2 s/ha and 32.4–33.3 c/ha, respectively, under the same fertilizer application rates. Compared with the application of $N_{160}P_{110}K_{80}$ kg/ha, these treatments provided an additional 2.0–2.3 s/ha and 1.1 s/ha of seed cotton yield.

Thus, in the eroded section of the slope, the Andijan-37 cotton variety produced a seed cotton yield that was 1.5 s/ha higher than that of the Sulton variety. A similar trend

was observed in the lower depositional section of the slope, where eroded soil particles had accumulated, and both cotton varieties produced nearly identical seed cotton yields. It should be noted that although some year-to-year variation in seed cotton yield was observed during the experimental period, the overall relationships between fertilizer application rates, plant population density, and yield remained consistent. For example, the Sulton cotton variety, grown at average plant populations of 86.9–87.4 thousand plants/ha and 103.2–105.0 thousand plants/ha, produced seed cotton yields of 32.2–32.6 s/ha and 33.4–33.8 c/ha, respectively, under the above-mentioned fertilizer regimes. Compared with the application of $N_{160}P_{110}K_{80}$ kg/ha, these treatments produced an additional 2.2–2.6 s/ha and 2.8–3.2 s/ha of seed cotton, respectively (Figure 1).

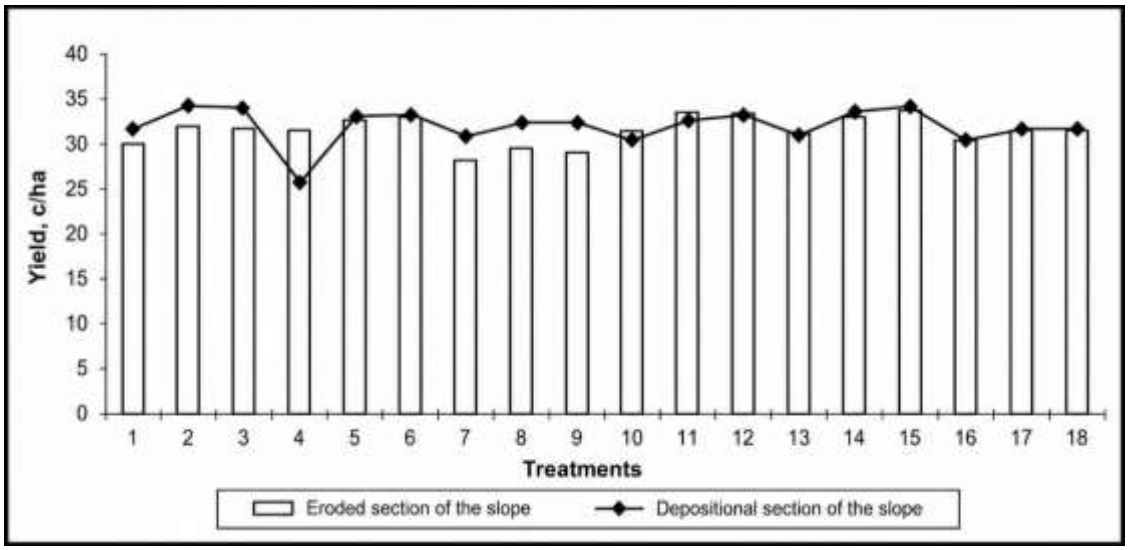

Figure 1. Effect of plant population density and mineral fertilizer rates on seed cotton yield under different slope conditions, c/ha.

Conclusion

Based on the results of the present study, the following recommendations can be made. To achieve high seed cotton yields of the Andijan-37 and Sulton cotton varieties on irrigation-eroded lands, it is recommended to maintain a plant population of 120–130 thousand plants/ha in the eroded section of the slopeand 80–90 thousand plants/ha in the depositional section, where eroded soil particles accumulate. For the eroded section of the slope, the recommended fertilizer application rate is 200 kg/ha nitrogen, 140 kg/ha phosphorus, and 100 kg/ha potassium, whereas for the lower depositional section the

recommended rates are 160 kg/ha nitrogen, 112 kg/ha phosphorus, and 80 kg/ha potassium.

References:

1. Abdurakhmonov, I., & Haydarov, A. (2013). **Water-physical properties of irrigation-eroded soils.** In *Improvement of Agrotechnologies for Cotton and Cotton-Based Cropping Systems: Proceedings of the Republican Scientific and Practical Conference* (December 4–5, 2013) (pp. 300–303). Tashkent.

2. **Methods for Conducting Field Experiments.** (2007). Tashkent, pp. 33–61.

3. Mirzajonov, Q.M., & Rakhmonov, R.U. (2016). **Differentiated rates of nitrogen and phosphorus fertilizers for cotton.** *Agrarnaya Nauka (Agrarian Science)*, International Scientific-Theoretical and Production Journal of the Interstate Council for Agrarian Science and Information of the CIS Countries, **1**(16), 12–13.

4. Ismailov, J., & Tillabekov, B. (2015). **Effect of local potassium fertilizer on the growth, development, and yield of cotton.** *Agroilm, Scientific Supplement to O‘zbekiston Qishloq Xo‘jaligi*, **4**(36), 13–15.

5. Xaydarov, A., & Yusupov, S. (2006). **Agrotechnology of the Andijan-36 and Andijan-37 cotton varieties.** In *Scientific Foundations for the Development of Cotton and Wheat Production in Farmer Enterprises* (pp. 205–208). Tashkent.

6. Omonova, A., & Raxmonova, G. (2025). **Effect of mineral (NPK) fertilizer rates on the growth, development, and yield of a medium-fiber cotton variety.** *Agro Ilm, **2**(109), 16–18.*