

The Effect Of Mineral Fertilizers Applied To Cotton Following Repeated Cropping On Soil Mineral Nitrogen Content And Cotton Yield

Azimova Madinabonu Gulamjanovna

+998 90 983 05 98

Senior Researcher, Laboratory of Agronomic Practices for Foreign and Local Cotton Varieties, Cotton Breeding, Seed Production and Agrotechnology Research Institute

ABSTRACT

This study examines the effect of mineral fertilizers applied to cotton following repeated cropping on soil mineral nitrogen content and cotton yield. Mineral fertilizers play an important role in maintaining soil fertility, improving nutrient availability, and supporting cotton growth and development. The cultivation of cotton after repeated cropping may influence the balance of mineral nitrogen in the soil due to changes in nutrient uptake, residue decomposition, and soil nutrient dynamics. Appropriate fertilizer management is therefore essential for maintaining soil productivity and achieving stable cotton yields.

Keywords: *cotton, repeated cropping, mineral fertilizers, soil mineral nitrogen, nitrogen availability, soil fertility, cotton yield, fertilizer application, nutrient management, sustainable agriculture.*

INTRODUCTION

Cotton is one of the most important industrial crops worldwide and plays a significant role in the textile industry, agricultural employment, and the economies of cotton-producing countries. Its productivity depends on several interacting factors, including soil fertility, irrigation management, climatic conditions, crop rotation, the availability of essential nutrients, and the selection of appropriate mineral fertilizer application rates.

Nitrogen is a particularly important nutrient for cotton because it contributes to chlorophyll formation, protein synthesis, vegetative growth, leaf development, and the formation of reproductive structures. However, the effect of nitrogen fertilization depends on the amount applied, the timing of application, the initial nutrient status of the soil, and the ability of the crop to absorb available nitrogen.

The term repeated cropping in this research title requires a precise agronomic definition. It may refer to growing cotton repeatedly on the same land, cultivating cotton after another crop, or growing cotton after a preceding crop within a rotation system. These practices may influence soil mineral nitrogen differently. Continuous cotton cultivation can alter nutrient removal and soil organic matter dynamics, while a preceding legume crop may contribute biologically fixed nitrogen to the system. Therefore, the preceding crop and the history of the experimental field should be clearly identified when interpreting the effects of mineral fertilizers.

MAIN PART

Soil mineral nitrogen generally refers to nitrogen present in mineral forms, principally nitrate nitrogen (NO_3^- -N) and ammonium nitrogen (NH_4^+ -N). These forms are important for plant nutrition, although their concentrations change over time through fertilizer application, mineralization, plant uptake, microbial immobilization, leaching, and other soil processes.

The scientific importance of this topic lies in determining how mineral fertilizer application affects both the amount of mineral nitrogen remaining in the soil and the final cotton yield. An appropriate fertilization strategy should provide sufficient nitrogen for crop development while limiting unnecessary fertilizer expenditure and potential nitrogen losses to the environment.

One of the most directly relevant publications identified for this topic is the article by L. A. Mirzaev, N. M. Ibragimov, N. N. Dmitriev, A. M. Zaitsev, O. L. Orifjonov, and Sh. O. Oribjonov, entitled Effects of Fertilizers Applied to Cotton on Soil Mineral Nitrogen after Repeated Cropping. It was published in the World Journal of Agriculture and Urbanization, Volume 3, Issue 1, in January 2024. The field experiments were conducted in the Republic of Karakalpakstan during 2014-2017. The article is particularly relevant because it examines mineral nitrogen under cotton following preceding crops, including sunflower and bean crops.

The experimental field had irrigated meadow-alluvial soil. The researchers reported that the 0-30 cm soil layer contained 0.517% humus and that the initial mobile nutrient levels indicated relatively low fertility. The experiment used three replications, and the researchers compared different mineral fertilizer rates applied to cotton and its preceding crops. Fertilizers included ammonium nitrate, superphosphate-based fertilizer, and potassium chloride.

The study reported several findings relevant to the proposed research:

Ammonium nitrogen was generally more abundant than nitrate nitrogen in the sampled soil layers during the observed cotton growth stages.

Mineral nitrogen concentrations varied according to the preceding crop and the fertilizer regime used for that crop and for cotton.

The researchers observed higher mineral nitrogen accumulation during cotton flowering and fruiting periods, which they associated with fertilizer applications during the growing season.

The results indicated that the preceding crop and its fertilization history influenced the amount of mineral nitrogen present in the soil under the subsequent cotton crop.

Mineral fertilizers supply essential nutrients required for cotton development. Nitrogen supports vegetative growth and contributes to the development of reproductive structures, while phosphorus and potassium support root development, energy transfer, water regulation, and other physiological processes.

Nevertheless, the relationship between fertilizer application rate and cotton yield is not always linear. Increasing the fertilizer rate can raise the amount of mineral nitrogen in the soil, but the additional nitrogen may not result in a proportional increase in yield. The outcome depends on the initial soil fertility, irrigation regime, preceding crop, fertilizer timing, variety, and other limiting factors.

In the Karakalpakstan study published in January 2024, the researchers compared cotton fertilizer regimes that included N160P100K75 and N200P140K100 kg/ha, alongside additional treatments and different fertilizer rates applied to preceding crops. The study documented differences in soil mineral nitrogen concentrations across these treatments and growth stages. These rates are experimental treatments reported in the article; they should not be interpreted as universal recommendations for cotton cultivation.

A further relevant source is Texas A&M AgriLife Extension Service's publication Managing Nitrogen Fertilizer in Cotton, dated 7 December 2021. The publication reports findings from a five-year study and highlights over-fertilization with nitrogen as a common problem. It recommends efficient fertilizer management supported by soil testing and appropriate application practices.

The preceding crop is an important factor when evaluating fertilizer requirements and the mineral nitrogen status of soil under cotton. Different crops absorb nutrients at different rates, return different amounts of plant residues to the soil, and affect soil moisture and biological activity in different ways.

Leguminous crops, including beans and alfalfa, may contribute nitrogen through biological nitrogen fixation. The amount that becomes available to a subsequent cotton crop depends on the quantity of nitrogen fixed, the amount removed in harvested material, the roots and residues left in the field, and the rate at which these materials decompose. In contrast, crops such as sunflower may remove substantial quantities of nutrients, depending on biomass production and yield.

The 2024 Karakalpakstan study specifically compared cotton following different preceding crops and found differences in mineral nitrogen concentrations associated with those cropping and fertilization histories. It also recommended short-rotation cropping as a means of maintaining soil fertility, with beans included after winter wheat in the proposed sequence. These observations are relevant to the design of experiments examining cotton following repeated crops.

A separate study by Botir Khaitov and Kholik Allanov, entitled Crop Rotation with No-Till Methods in Cotton Production of Uzbekistan, was published in the Eurasian Journal of Soil Science, Volume 3, Issue 1, in 2014. The journal records the article's online publication date as 21 March 2014, with the issue listed as November 2014. The study investigated cotton-based crop rotations in the Tashkent region, including systems involving wheat, maize, sorghum, and soybean. The authors discussed the relationship between crop rotation, soil organic matter, nitrogen retention, and crop productivity.

Research conducted in the Khorezm region provides additional evidence on nitrogen management under the irrigated soil conditions characteristic of western Uzbekistan.

The article Tillage and Nitrogen Fertilization Effects on Yield and Nitrogen Use Efficiency of Irrigated Cotton investigated cotton production in Khorezm during 2008 and 2009. The experimental field had been under cotton monoculture for more than 20 years, and the study evaluated the effects of tillage and nitrogen fertilization on cotton yield and nitrogen-use efficiency. The article also examined nitrate concentrations in groundwater and their relationship with irrigation and fertilizer application.

CONCLUSION

The literature indicates that mineral fertilizer application, preceding crops, and soil conditions interact in determining the availability of mineral nitrogen and the productivity of cotton. The most directly relevant evidence comes from the 2014-2017 field research in Karakalpakstan published in January 2024, which examined mineral nitrogen under cotton following different preceding crops. Additional studies in Khorezm demonstrate the importance of nitrogen management, irrigation, crop rotation, and integrated nutrient management.

An important distinction is that soil mineral nitrogen represents the nitrogen present in measurable mineral forms at the time of sampling. It is not equivalent to total soil nitrogen, cumulative fertilizer input, or the quantity of nitrogen absorbed by the cotton crop. Its concentration can increase after fertilization and decrease through plant uptake, microbial immobilization, leaching, and other processes.

Similarly, the highest fertilizer rate does not necessarily produce the highest yield. The evidence from the 2026 Khorezm study indicates that a balanced combination of mineral fertilizer and manure was more effective under its experimental conditions than simply increasing mineral fertilizer input. The 2021 Texas A&M AgriLife Extension publication also emphasizes that excessive nitrogen fertilization can be a problem in cotton production.

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