FIBER CROPS: PROSPECTS FOR CULTIVATION IN THE SOUTHERN STEPPE ZONE OF UKRAINE

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ABSTRACT

The article analyzes the prospects for cultivating industrial hemp and cotton as alternatives to sunflower in the Southern Steppe of Ukraine, where agricultural production is constrained by water scarcity, irregular precipitation patterns, rising temperatures, and increasing drought risks. It is demonstrated that over recent decades, the hemp sector in Ukraine has undergone a substantial decline: cultivated areas have decreased severalfold, and processing infrastructure has been nearly completely dismantled, necessitating renewed investment in technical equipment and processing capacity.

At the same time, recent government measures to deregulate industrial hemp cultivation, together with the introduction of the "e-Hemp" system, are highlighted as potential drivers for expanding sown areas and enhancing export capacity, particularly to the EU market under zero import duties. The environmental requirements of the crops are compared. Cotton is more heat- and water-demanding, and its economic viability in the region largely depends on the availability of irrigation, adapted cultivars, and adequate technological support. Hemp, by contrast, is generally better adapted to the available thermal resources and periodic moisture deficits, offers broader biomass utilization potential (fiber, seed, and bioenergy residues), and presents more favorable conditions for stable productivity.

Special attention is given to phytosanitary risks associated with cotton, a relatively new crop in the region, as well as to the need to develop effective crop protection systems for both crops.

The directions for further research are substantiated, including cultivar testing for drought tolerance and earliness, optimization of plant nutrition with consideration of micronutrients, economic modeling, and life-cycle assessment (LCA) to evaluate energy efficiency and carbon footprint.

Keywords: Southern Steppe of Ukraine; industrial hemp; cotton; drought tolerance; bioenergy potential.

INTRODUCTION

The Southern Steppe zone of Ukraine is characterized by an arid continental climate, insufficient precipitation, high temperatures, and their fluctuations, which limit the agroclimatic potential for cultivating agricultural crops (Gamayunova et al., 2025). The region's soils–southern chernozems and dark chestnut soils–contain sufficient reserves of macronutrients (N, P, K), but are often deficient in boron, zinc, and copper. For the sustainable development of agriculture, it is important to introduce crops that provide not only an economic effect but also improve phytosanitary conditions and biodiversity. In recent years, due to the need to ensure energy independence and changes in legislation regarding industrial crops, interest has been growing in finding alternatives to sunflower (Stepanenko, 2025). Such alternatives include industrial hemp and cotton, which is especially important in connection with military actions and the need for domestic raw materials for gunpowder production (Polishchuk, 2025).

Until now, cotton has been purchased for the manufacture of a solid explosive mixture composed of various components. Now, imported raw materials can be replaced with industrial hemp varieties bred by Ukrainian plant breeders. In terms of cellulose content required for gunpowder production, they are not only not inferior to cotton but, in some characteristics, even surpass it (Isaev, 2017).

Hemp is more tolerant of moisture conditions; therefore, cartridges containing such gunpowder can be stored longer and show minimal changes in moisture content, which is very important under combat conditions. According to studies conducted in other countries, hemp-based gunpowder has the best ballistic characteristics. If the velocity of a conventional bullet is 615 m/s, that of a bullet produced with hemp-derived ingredients increases to 800 m/s [5].

METHODOLOGY

In this study, secondary data on industrial hemp and cotton were collected and synthesized to assess their suitability for the Southern Steppe of Ukraine. Peer-reviewed publications were reviewed to summarize agroclimatic limitations, soil–nutrient (including micronutrient) constraints, and the biomass/energy potential of the crops (Hamayunova et al., 2025; Ratushnyak et al., 2024). Official and sectoral materials, along with reputable media sources, were used to track hemp acreage dynamics, processing capacity, and recent regulatory changes and state support measures (AgroWeek, n.d.; Landlord, 2025; Ukrinform, 2025). A comparative analytical framework was applied across key criteria–photoperiod and temperature requirements, moisture demand, phytosanitary risks, infrastructure constraints, and economic/energy potential–allowing a qualitative evaluation of each crop under rainfed and irrigated production scenarios.

FINDINGS

Under the current conditions of the Southern Steppe–where precipitation is insufficient and irregular, soils have undergone degradation, temperatures have increased, and drought risks have intensified–hemp appears to be a more promising crop than cotton. By introducing hemp varieties adapted to regional conditions and stress-tolerant, providing proper fertilization (including micronutrients), and maintaining phytosanitary measures, it is possible to obtain stable yields with high energy and economic potential. Today, for expanding the sown area under this crop, a less urgent need is the development of agrotechnological measures and the provision of seed material. A much bigger problem is the shortage of machinery for cultivating and harvesting both hemp and cotton, as well as processing equipment, which is lacking even in European countries.

It should be noted that cotton (*Gossypium* spp.) is a more heat-loving crop compared to hemp and is not widespread in temperate latitudes due to its long growing season, increased requirements for temperature regimes, and adequate moisture supply. Cultivating cotton in the Southern Steppe zone of Ukraine can be economically viable only with irrigation, selection of appropriate varieties, and well-developed technology elements, including plant protection and fertilization systems. Experimental studies in Odesa region (Stepanenko, 2025) have shown that cotton cultivation there is possible, but large-scale production requires significant investment, technological and state support. In particular, in

2025 the Ukrainian government decided to pay farmers in Odesa, Mykolaiv, and Kherson regions 10,000 hryvnias for each hectare of cotton crops (Stepanenko, 2025).

Hemp has been cultivated in temperate latitudes for millennia. Just a few decades ago, industrial hemp was an important part of Ukraine's agricultural sector. The country operated 35 processing plants, and this crop was grown on about 120 thousand hectares (Fig. 1).

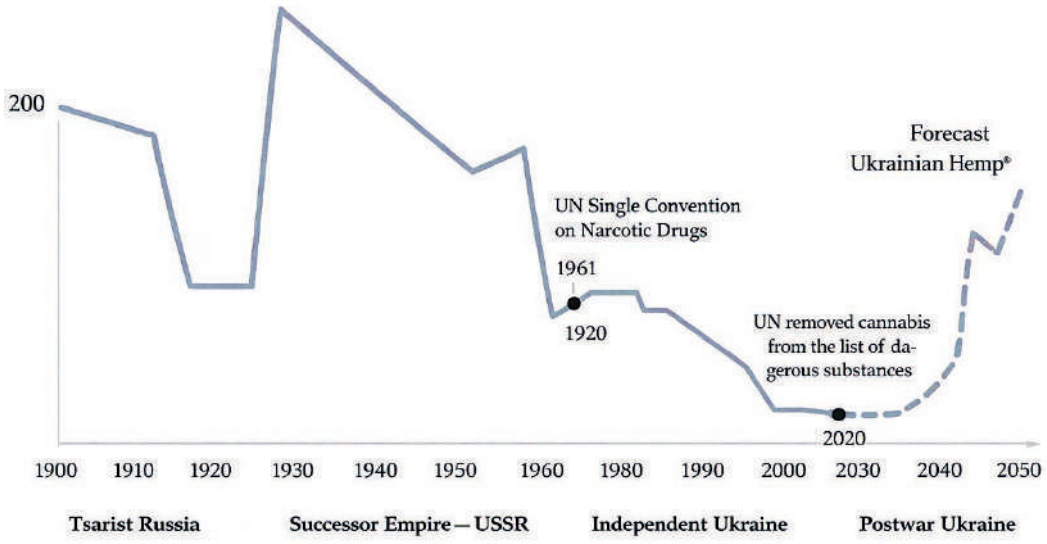

Fig. 1. Dynamics of hemp sown areas in Ukraine, thousand ha (Ukrainian Hemp)

In recent years, the scale of production has decreased by a factor of 30: only 2–4 thousand hectares are sown annually, and of all processing plants only three remain, indicating an urgent need to revive the sector and invest in infrastructure development. At the state level, a number of regulatory and legislative measures have been adopted, and from 2025 Ukrainian farmers will be able to cultivate industrial hemp freely without obtaining a permit–registration in a special register will be sufficient. The launch of the "eHemp" ("ieKonopli") system before the start of hemp sowing, along with government approval of the necessary by-laws, will contribute to expanding the area under this crop and will stimulate sectoral development (Landlord, 2025).

At the same time, the cultivation of industrial hemp is currently expanding abroad. In particular, according to the Association for the Development of Flax and Hemp Production, industrial hemp is grown in more than thirty countries worldwide. The largest volumes of raw materials and products are produced in Asia, which accounts for about 75% of global production. China is the world leader in industrial hemp cultivation. The country runs a state program to increase hemp acreage at the expense of cotton, which is traditionally grown worldwide. Hemp areas are also increasing in EU countries–over the past decade they have expanded from 10 thousand ha to more than 40 thousand ha (Ukrinform, 2025). Europe accounts for only 15% of this share; however, it plays an important role in the market due to the high added value of processed products. For Ukraine, exporting hemp to the EU would be advantageous because the import duty on this crop is zero.

Regarding photoperiod, temperature, and water requirements, both crops are predominantly short-day plants. For cotton, it is important that day length becomes shorter after flowering; in this respect, hemp is generally less strictly photoperiod-dependent, depending on the cultivar. In addition, cotton requires higher temperatures, especially during flowering and fiber formation, which in the Southern Steppe creates risks if heat is insufficient in autumn. Hemp plants are less sensitive to declining temperatures; however, cold spring frosts may slow the initial growth processes.

A key requirement for both crops is an adequate water supply during the growing season. Cotton grows best in regions receiving 600 to 2000 mm of moisture or where irrigation is available. Under current conditions in the Southern Steppe of Ukraine, average annual precipitation is generally 350–450 mm, most of which falls in spring or early summer. Spring and summer droughts are also a significant problem. It should also be considered that cotton requires sufficient irrigation, especially during

flowering and fiber growth. Hemp is more tolerant of periodic moisture deficits, but it also requires water for optimal growth and development.

In terms of phytosanitary status, cotton, as an exotic crop, may be more susceptible to new pathogens in the region (fungi, viruses, insects), especially in the absence of adapted varieties. Hemp, having a history of cultivation in Ukraine, is better adapted to local pests and diseases, although crop protection technology remains important.

According to research data, the energy potential and economic efficiency of hemp cultivation are considerable, as it is a significant source of biomass–both fiber and seed–which can serve as raw material for industrial products, while residues may be used for energy purposes (Ratushniak et al., 2024). Cotton is a fiber crop; part of its biomass (stems, leaves) can potentially be used as residues, but the main value is the fiber, which may reduce energy efficiency due to a larger share of investment required for fiber harvesting and processing. Hemp profitability: according to available data, cultivation on 100 ha can generate more than 12 million UAH in revenue, depending on cultivar, market, and growing conditions (Kurkul, 2024).

CONCLUSION

In the Southern Steppe of Ukraine, industrial hemp offers certain advantages: it is better adapted to the region's thermal conditions and irregular moisture availability, is less demanding in terms of photoperiod, and has substantial potential for biomass production. Cotton is a promising crop, but only if suitable varieties, technology elements, and support (state, financial, and technological) are in place. To realize the yield potential of both crops, research is needed to develop varieties adapted to specific conditions (soil, moisture, photoperiod), along with the development of processing infrastructure and government support. From an energy perspective, raw materials and residues from cultivating both crops can contribute to bioenergy potential, helping reduce Ukraine's dependence on imported energy sources and fossil fuels.

PROSPECTS FOR FURTHER RESEARCH:

- Testing local hemp and cotton varieties with a focus on drought tolerance and a short growing season.
- Detailed studies of nutrient management, especially micronutrient supply, for both crops across different soil types in the Southern Steppe.
- Economic models that account for irrigation, agrochemicals, harvesting and processing costs, subsidies, and environmental costs (erosion, soil degradation).
- Life-cycle assessment (LCA) for both crops: energy per unit of product, carbon footprint, and environmental interactions.

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