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Yield and energy efficiency of phytoenergy crops under biopreparation treatments in the conditions of the Southern Steppe of Ukraine

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Abstract

In the current context of energy–resource shortages and increasing environmental pressures, the cultivation of phytoenergy crops is becoming particularly relevant, especially in regions with limited moisture, such as the Southern Steppe of Ukraine. The aim of the study was to determine the optimal species and varieties of energy crops, assess the effectiveness of biopreparations for increasing yield, and analyse the energy output of raw materials depending on cultivation technology. The methodology was based on field experiments using different crop species (*Sorghum*, Jerusalem artichoke, and cup plant), as well as biopreparations based on *Bacillus megaterium*, *Trichoderma* spp. and *Azotobacter chroococcum*. The results obtained showed that the highest yields were recorded in sorghum: Sudan grass (48.6 ± 1.2 t/ha) and sweet sorghum (46.8 ± 1.4 t/ha), whereas Jerusalem artichoke (38.4 ± 0.9 t/ha) and cup plant (32.6 ± 0.8 t/ha) lagged behind due to slower development in the first years. Combined treatment with biopreparations (Groundfix + Ekostern *Trichoderma*) provided a yield increase of up to 25.18% compared with the control, and sweet sorghum hybrid Verblud achieved the maximum output of standard fuel equivalent (13.2 ± 0.4 t/ha) due to a high calorific value (4,120 kcal/kg). At the same time, raw-material moisture proved to be a key factor affecting energy efficiency. The conclusions confirm that the choice of crop, variety and biopreparation treatment is decisive for maximising energy output. The study's practical value is found in its recommendations for farmers on how to best cultivate phytoenergy crops in arid environments, which will advance bioenergy production and lessen the anthropogenic burden on agroecosystems.

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Data availability

No datasets were generated or analysed during the current study.

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Contributions

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Ethics declarations

Competing interest

The authors declare no competing interest.

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