© 2026 Arabian International Conference on Science,Technology and Innovation. All rights reserved.

UDC: 631.53.027:633.51

DRYING METHODS FOR COATED FUZZY COTTONSEED

Po‘latov Bekzodbek Maxammadjon o‘g‘li
Namangan State Technical University
Lecturer, Department of Electrical Engineering
12 Islom Karimov Street, Namangan 160103, Uzbekistan
Tel.: (+99894) 155-77-21
Email: bekzodbekpolatov26@gmail.com
ORCID: https://orcid.org/0009-0001-4604-6720

Abstract. This paper examines the principal methods of drying fuzzy cottonseed coated with protective and nutrient-containing formulations: ambient-air drying, forced-air drying, low-temperature convective drying, belt drying, rotary-drum drying, and fluidized-bed drying. The methods are compared in terms of moisture-removal characteristics, coating integrity, seed sensitivity to thermal and mechanical stresses, and equipment complexity. A review of the literature suggests that gentle convective drying with controlled airflow and seed-temperature monitoring warrants further investigation. However, the suitability and optimal operating parameters of any particular drying regime must be established experimentally.

Keywords: coated fuzzy cottonseed, drying methods, moisture content, convective drying, airflow, coating integrity, seed germination, energy consumption.

Introduction. In cotton production, seed germination capacity, freedom from mechanical damage, and uniform delivery by sowing equipment are essential attributes of planting seed. Coating fuzzy cottonseed with protective and nutrient-containing formulations can bind the residual short fibres, produce a functional surface layer, and improve seed flowability during sowing [1, 2]. However, the use of aqueous binders or suspensions leaves residual moisture in the newly formed coating. If this moisture is not adequately removed, seeds may agglomerate, the coating may detach, and storage stability may deteriorate [3, 4].

Drying involves more than the evaporation of water: the coating must set while changes in seed temperature are controlled and the physiological properties of the seed are preserved. Surface irregularities caused by residual fibres, together with variations in coating thickness, complicate heat and mass transfer. Therefore, selecting a drying method for coated fuzzy cottonseed requires consideration of air temperature, humidity and velocity, seed-bed thickness, and residence time in the dryer [3, 5].

Research objective: to classify the drying methods applicable to coated fuzzy cottonseed, compare their technological advantages and limitations, and identify the principal control parameters for subsequent experimental investigations.

Literature review. In the fuzzy-cottonseed coating process described by G. L. Duke, moistened seeds treated with powder are dried on a perforated conveyor by a stream of heated air. Although the patent refers to an air temperature of approximately 60 °C, it also indicates that the internal seed temperature should not exceed approximately 49 °C [2]. This distinction highlights the importance of monitoring drying-air temperature and actual seed temperature separately.

Another patent concerning coated cottonseed identifies airflow and the conditions under which air passes through the seed bed as factors governing drying rate and coating condition [6]. The temperature and time values reported in such technical solutions are specific to the equipment and coating formulations concerned; they should not be regarded as universal operating standards for all fuzzy cottonseed intended for planting. General seed-processing literature likewise cautions that

© 2026 Arabian International Conference on Science,Technology and Innovation. All rights reserved.

excessive heating may impair germination and recommends gentler drying conditions when seed moisture content is high [5].

Langlet and co-authors reported that incomplete drying of polymeric coatings may adversely affect coating adhesion and abrasion resistance, potentially leading to dust formation and seed agglomeration [4]. Guidance published by Cornell University also recommends reducing the moisture content of coated seeds to a level suitable for safe storage, applying gentle drying under controlled airflow where practicable, and assessing germination after treatment [1].

Research on seed treatment in fluidized beds has shown that bed temperature, air humidity, and liquid feed rate are closely associated with coating formation [7]. Studies by Jittanit and co-authors involving wheat and rice seeds indicate that such systems can be compared with respect to drying performance and energy consumption. Nevertheless, findings obtained for these crops cannot be directly extrapolated to fuzzy cottonseed [8].

Materials and methods. This study was based on a comparative analysis of scientific articles, technical patents, and publicly available resources on seed processing. Drying methods were evaluated using the following criteria: moisture-removal conditions; controllability of temperature and airflow; the likelihood of seed agglomeration; mechanical integrity of the coating; preservation of germination capacity; energy consumption; and equipment design. As no drying experiments were conducted within this study, the assessments are qualitative and technological in nature; no claims of quantitative superiority are made.

Description of drying methods. In ambient-air drying, seeds are spread in a thin layer and exchange moisture with the surrounding air. The equipment is simple, but the process depends strongly on weather conditions, relative humidity, and seed-bed thickness. Uneven distribution of fuzzy cottonseed and the tackiness of freshly applied coatings may increase the risk of seed agglomeration.

In forced-air drying, a fan drives filtered ambient air through a perforated support or a bed of seeds. Moisture can be removed without a substantial increase in air temperature; however, high relative humidity reduces the drying rate. Dehumidified air may be employed when necessary

Low-temperature convective drying uses a flow of moderately heated air to evaporate moisture from the seed surface. The process can be controlled by adjusting air temperature, air velocity, drying time, and seed-bed thickness. For planting seed, the principal requirements are to prevent excessive heating of the seed itself and to minimize cracking or detachment of the coating. The drying regime should be selected according to the coating formulation and initial moisture content [2, 5].

In a belt-conveyor dryer, seeds are transported in a layer of specified thickness on an air-permeable belt through one or more ventilation zones. This arrangement is suitable for continuous processing; however, uneven distribution of the seed layer may leave some seeds insufficiently dried. A rotary-drum dryer mixes the material by rotation. Because friction may damage coatings that are still moist, drum speed and filling level must be selected with care [2, 6].

In a fluidized-bed dryer, upward-flowing air mobilizes the seed bed, increasing contact between the gas and the particles. The principal advantage is intensive heat and mass transfer. Potential limitations include coating abrasion at elevated air velocities, entrainment of fine particles, and seed agglomeration. Because of the irregular shape and fibrous surface of fuzzy cottonseed, this method requires dedicated experimental evaluation before practical application [7, 8].

Comparative analysis. Table 1 summarizes the relative characteristics of the drying methods. Descriptors such as “high” and “moderate” represent preliminary qualitative assessments based on equipment design and the underlying physical principles; they are not results of experiments conducted in this study.

© 2026 Arabian International Conference on Science,Technology and Innovation. All rights reserved.

Table 1
Comparative characteristics of drying methods for coated fuzzy cottonseed

Criterion	Ambient air	Forced air	Convective belt	Rotary drum	Fluidized bed
Airflow control	Very limited	Available	Precisely controllable	Controllable	Precisely controllable
Drying rate	Condition-dependent	Condition-dependent	Controllable	Controllable	Potentially intensive
Mechanical stress	Very low	Low	Low	Present due to rotation	Particle collisions occur
Risk of agglomeration	Present while coating is wet	Depends on bed conditions	Depends on bed conditions	Depends on operating regime	Depends on airflow
Equipment complexity	Low	Low–moderate	Moderate–high	Moderate	High
Suitable application	Small batches	Small to medium batches	Continuous processing	Requires specific testing	Requires testing and optimization

Quantitative assessment of the drying process. Calculating the mass of water evaporated and the energy consumed during drying enables objective comparison of different dryer configurations. When moisture content is expressed on a wet basis, it is calculated as $W = (m - m_s)/m \times 100\%$, where m is the current mass of the product and m_s is its dry-solids mass. Assuming that the dry-solids mass remains constant, the mass of water removed is determined as follows:

$m_v = m_0 \times (W_0 - W_1) / (100 - W_1)$.

Here, m_0 is the initial product mass (kg); W_0 and W_1 are the initial and final moisture contents on a wet basis (%), respectively; and m_v is the mass of evaporated water (kg). For illustration only, if the moisture content of 100 kg of material decreases from 16% to 10%, the amount of water removed is $100 \times (16 - 10)/(100 - 10) = 6.67$ kg. This is a calculation example, not an experimental result or a recommended target moisture content for coated cottonseed. The specific energy consumption is calculated as $q = E/m_v$ (kWh/kg of water evaporated), where E is the energy consumed during drying.

For coated seeds, the moisture content of the combined product may differ from that of the seed itself because binders and fillers in the coating retain water to differing degrees. Accordingly, seed moisture content, coating condition, and, where relevant, water activity should be evaluated separately [1]. Experimental measurements should include inlet and outlet air temperatures and relative humidity, seed temperature, airflow rate, drying time, electricity consumption, the degree of post-drying agglomeration, coating dust generation, and laboratory germination.

Conclusions

The review of scientific and technical sources indicates that the selection of a drying method for coated fuzzy cottonseed must satisfy two requirements simultaneously: removing excess moisture from the coating and preserving the physiological quality of the planting seed. Ambient-air drying is simple but highly dependent on external conditions. Forced-air ventilation and controlled low-temperature convective drying offer opportunities for investigation because they facilitate monitoring

© 2026 Arabian International Conference on Science,Technology and Innovation. All rights reserved.

of seed heating and coating condition. Belt dryers provide a feasible configuration for continuous processing, whereas rotary-drum and fluidized-bed systems require additional assessment of mechanical stresses and coating integrity.

Future research should compare drying regimes experimentally in terms of seed temperature, airflow velocity, seed-bed thickness, drying time, and energy consumption, while also assessing germination and coating durability. Only such experimental evidence can provide a scientific basis for identifying the most suitable dryer design or operating regime.

References

1. Bugingo C., Taylor A. G. Seed Coating Technologies: Practical Guidance for Growers and Seed Professionals. Cornell University, 2025 (updated in 2026). Available at: https://blogs.cornell.edu/seedbiology/resources/seed-coating-technologies-practical-guidance-for-growers-and-seed-professionals/
2. Duke G. L. Coating fuzzy cottonseed. US Patent 5787640A, 1998. Available at: https://patents.google.com/patent/US5787640A/en
3. US20050246953A1. Coated planting cotton seed and a process for its manufacture. 2005. Available at: https://patents.google.com/patent/US20050246953A1/en
4. Langlet R., Valentin R., Morard M., Delgado Raynaud C. Transitioning to Microplastic-Free Seed Coatings: Challenges and Solutions. Polymers. 2024;16(14):1969. doi:10.3390/polym16141969.
5. Sinha J. P., Kumar A., Weissmann E. Seed Processing for Quality Upgradation. In: Seed Science and Technology. Springer; 2023. pp. 213–237. doi:10.1007/978-981-19-5888-5_10.
6. US5750466A. Coated cottonseed and a process for its manufacture. 1998. Available at: https://patents.google.com/patent/US5750466A/en
7. Kage H., Takahashi T., Yoshida T., Ogura H., Matsuno Y. Coating efficiency of seed particles in a fluidized bed by atomization of a powder suspension. Powder Technology. 1996;86(3):243–250. doi:10.1016/0032-5910(95)03066-2.
8. Jittanit W., Srzednicki G., Driscoll R. H. Comparison Between Fluidized Bed and Spouted Bed Drying for Seeds. Drying Technology. 2013;31(1):52–56. doi:10.1080/07373937.2012.714827.