

International Journal of Advanced Biochemistry Research



ISSN Print: 2617-4693
 ISSN Online: 2617-4707
 IJABR 2024; 8(8): 321-326
www.biochemjournal.com
 Received: 02-05-2024
 Accepted: 06-06-2024

Geeta Patel
 Research Scholar, Department
 of Farm Machinery and Power
 Engineering, IGKV, Raipur,
 Chhattisgarh, India

Dr. RK Naik
 Professor, Farm Machinery
 and Power Engineering,
 IGKV, Raipur, Chhattisgarh,
 India

Sourabh Kumar Dewangan
 Research Scholar, Department
 of Farm Machinery and Power
 Engineering, IGKV, Raipur,
 Chhattisgarh, India

Corresponding Author:
Geeta Patel
 Research Scholar, Department
 of Farm Machinery and Power
 Engineering, IGKV, Raipur,
 Chhattisgarh, India

Study on different threshing technology and factor influencing threshing of linseed for the development of linseed thresher: A review

Geeta Patel, Dr. RK Naik and Sourabh Kumar Dewangan

DOI: <https://doi.org/10.33545/26174693.2024.v8.i8e.1749>

Abstract

Linseed is a *Rabi* crop, cultivated for both seed and fibre purposes. It provides vital vitamins, minerals, and proteins, catering to vegetarian and vegan needs. Its stem is also used for fiber extraction so the every part of the linseed plant is valuable. The review of previous research works related to mechanism of threshing employed for various crops, influence of crop, machine and operational parameters on the design of threshers are studied. The findings concluded that physical and engineering properties of the linseed seed and agronomical parameters of linseed crop are important for designing different components of the threshing machine such as the hopper, threshing drum, selection of beaters, concave opening size, cleaning unit design, aspirator, conveying unit etc. It was also observed that impact and rubbing force is required for the threshing of linseed crop and wire loop type threshing mechanism is required for stripping linseed capsule. Peg with canvas strip type threshing cylinder provides the impact and friction force to the crop simultaneously a wire loop for stripping. Also the thresher performance is influenced by feed rate, moisture content, peripheral speed of threshing cylinder and concave clearance. The performance parameters of thresher to be studied are threshing efficiency, cleaning efficiency, threshing capacity broken grain and loss percentage. A head feed type thresher is required for threshing linseed and saving the stem for by product utilization as fiber.

Keywords: Linseed thresher, peg and canvas, threshing efficiency, physical property, moisture content

1. Introduction

Linseed (*Linum usitatissimum* L.) is a valuable oilseed crop used for both industrial and feed applications. The cultivation of linseed is a crucial aspect of the agricultural industry due to its various applications in food, textile and industrial sectors. Linseed holds substantial economic importance due to its versatile applications. Historically, flax was cultivated primarily for its fibers, used in the production of linen. Linseed's emergence as a functional food is attributed to its rich nutritional content, including omega-3 fatty acids and lignans, which have been linked to various health benefits (Kajla *et al.* 2015) [2].

The demand for linseed and its by-products has been progressively increasing due to its various applications in different industries. This has created new market opportunities and increased the value of agricultural residues. The survey data can help uncover research gaps and design new linseed threshers. Additionally, it enhances mechanization in linseed processing.

1.1 Historical prospect of linseed and its production

Linseed, has been utilized for over 8,000 years for its diverse applications in food, feed, fiber, and medicine (Zuk *et al.* 2015) [20]. India is one of the world's major producers of linseed. Linseed is cultivated in about 1.97 lakh hectares with contribution of 1.26 lakh tones to the annual production of the India. The average productivity of linseed is 642kg/ha (Indiastat, 2021-22) [1]. Major linseed growing states in India are Madhya Pradesh, Uttar Pradesh, Chhattisgarh, Bihar, Rajasthan, Orissa and Karnataka. In Chhattisgarh it occupies 34 per cent share in total oilseeds production in the state and 17 per cent in India.

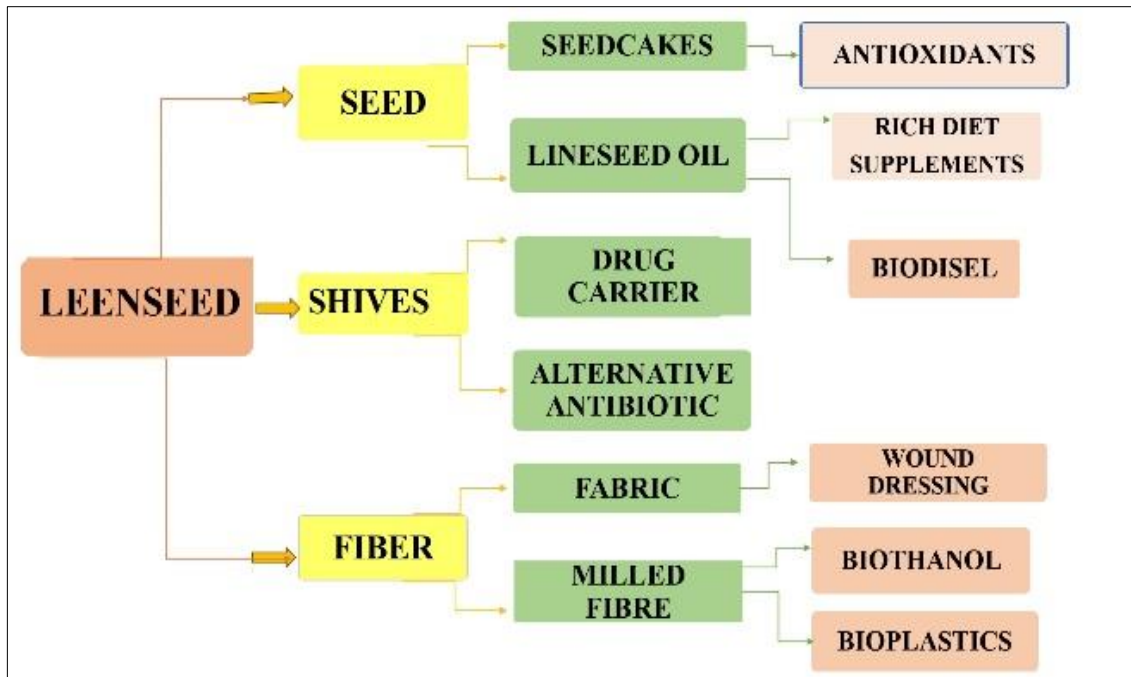


Fig 1: Flow chart for various application of linseed

2. Physical and Engineering Properties of Linseed Crops

Physical characteristics of this seed and comparison with other seeds are considered to be essential for the appropriate design of machinery for handling, conveying, separating, dehulling, drying, mechanically expressing oil, storing, and other operations Kachru *et al.* (1994) [5].

Selvi *et al.* (2006) [7] conducted a study on various physical properties of linseed, examining the effects of changing moisture content. As the moisture content increased from 8.25% to 22.25% (dry basis), several characteristics of the linseed exhibited noticeable changes. The average length, width, thickness, and the geometric mean diameter of the seeds increased from 4.57 to 4.86 mm, 2.40 to 2.59 mm, 1.03 to 1.13 mm, and 2.24 to 2.43 mm, respectively. In a similar study within the same moisture range but focusing on rewetted linseed, the sphericity, surface area, seed mass of one thousand seeds, and true density increased from 49.09% to 49.94%, 15.83 mm² to 18.56 mm², 6 g to 6.7 g, and 1010.1 kg/m³ to 1020.4 kg/m³, respectively. However, as the moisture content increased from 8.25% to 22.25% (dry basis), certain other changes were observed. Bulk density decreased from 690.5 kg/m³ to 545 kg/m³, while the angle of repose, terminal velocity, and porosity increased from 21.59° to 26.85°, 2.46 m/s to 3.82 m/s, and 31.64% to 46.59%, respectively.

Patel *et al.* (2021) [23] explored the physical and engineering characteristics of three different linseed varieties, namely Neelam, Shekhar, and Sheela, across a moisture content range spanning from 8% to 14% (dry basis). Their investigation revealed an interesting trend: as moisture content increased, the linear dimensions of these linseed varieties demonstrated a consistent increase. Notably, the Neelam variety appeared outstanding physical attributes, boasting the highest surface area, volume, and 1000 grain weight, with measurements reaching 21.51 mm², 8.86 mm, and 310.59 g, respectively, particularly at a moisture content of 14%. Moreover, at this 14% moisture content, the Neelam variety showcased individual engineering properties, including the highest true density at 1128.56 kg/m³, a porosity of 41.16%, and the lowest bulk density at

664.03 kg/m³. It also exhibited an angle of repose at 23.19° and various coefficients of friction on surfaces such as GI sheet, MS sheet, and plywood, measuring 0.41, 0.47, and 0.53, respectively. The terminal velocity for the Neelam variety at 14% moisture content was 3.14 m/s. The study further reported mean values for rupture force, with linseed seeds registering 46.25 N, linseed capsules at 5.99 N, and linseed stalk tips at 8.08 N.

Wang *et al.* (2007) [31], Bhise *et al.* (2013) [32], Coskuner and Karababa (2007) [6] Conducted the study on physical and engineering properties of linseed for different variety and moisture content; and found that the properties was varied from variety to variety and also at different moisture content and concluded that the determination of physical properties was important for designing agricultural equipments.

Kashyap *et al.* (2020) [34], conducted an experiment on yield and yield attributes of linseed and measured the plant height, number of capsule per plant, technical height, number of seed per capsule, number of branches, seed yield and stover yield of linseed.

3. Traditional methods of linseed threshing

The crop takes approximately 130 to 150 days to mature. During maturity, the leaves dry off, the capsule turns brown, and the seed becomes glossy. After harvesting, bundle the plants and put them on the threshing floor for 4-5 days to dry. Threshing involves hitting the plant with sticks or trampling with bullocks (Singh *et al.* 2018) [9, 10]. To optimize fibre length, mature plants are lifted up with their roots, rather than being clipped. After drying, the flax seeds are extracted and retted. The length of time the flax remains on the ground for retting varies based on meteorological conditions, flax kind, and field features. Farmers turn over straw during retting to ensure uniform retting of stalks. After retting and drying, the straw is coiled up. Farmers will store it before extracting fibers. Flax produced for seed is harvested when the capsules turn yellow and begin to split, then dried to extract the seed (Dhirhi *et al.*, 2015) [11]. Make small bundles of the harvested crop, thresh out the seed by beating against hard surface or with mallet (Mungari) and

subsequently plant stalks are cut into technical height (height from ground level to first fruiting branch) (Singh and Chopra, 2018) [10].

Threshing is a crucial step in the processing of linseed, which involves separating the seeds from the capsules. The traditional method of threshing linseed has been practiced for centuries, and it is still used in some parts of the country. Hand beating is another traditional method of threshing linseed. This method involves manually beating the plants capsules to separate the seeds from the capsules. This method is often used in small-scale linseed production or in areas where mechanical threshing is not feasible. The performance of the traditional method of threshing linseed is evaluated based on several factors, including threshing efficiency, un-threshed capsules, seed damage, seed losses, seed cleanliness, and seed germination ratio. The performance of the prototype machine has been tested and evaluated based on these factors.

4. Hand operated thresher

Patel *et al.* 2020 [14] developed the linseed thresher by using locally available materials for deseeding linseed crops. The two rollers were used for deseeding the linseed that drive through the handle. Fabrication of a manually operated linseed thresher is given full dimensions. The frame's dimensions (L×W×H) are 50×30×100 cm, with a roller diameter of 13 cm and length of 30 cm. The physical properties of the linseed crop were determined as follows: average length of linseed capsule 79.4 mm, average width of linseed capsule 70.8 mm, average length of linseed 4.54 mm, and average width of linseed 2.27 mm. The results demonstrate the machine capacity, threshing efficiency, and grain damage of this thresher (Patel *et al.* 2020) [14].

5. Development and Performance Evaluation of Different threshers

Chandranthappa *et al.* (2001) [24] studied the multi-crop rasp-bar type thresher to thresh finger millet. The best results for mechanical damage 2.95 percent and threshing efficiency 79.51% were obtained at drum speeds of 1000 rpm (1200 m/min), 4 mm concave clearance, and 10% grain moisture (wb). The performance was evaluated in terms of output capacity, threshing efficiency, grain damage, grain losses, grain and material other than grain (MOG) separation, power requirement and specific energy consumption against different drum types, drum speeds and feed rates. The sunflower threshing capacity of a rasp bar drum was higher than peg tooth type, both with open and closed threshing drums. The threshing efficiency was more than 99 per cent. Visible grain damage increased with an increase in threshing drum speed and feed rate for each threshing drum. The minimum specific energy consumption could be achieved with the rasp bar drum at all speeds and feed rates (Sudajan *et al.* 2002) [25]. Gbabo *et al.* (2013) [27] developed pearl millet thresher. The optimum operating parameters of the thresher were found to be 13 per cent (wb) moisture content and drum speed 800 rpm yielded the maximum threshing and cleaning efficiencies viz. 63.2 and 62.7 percent, respectively. The developed machine's performance was evaluated. According to the findings, the machine's capacity was 32 kg/h, damaged grains at all outlets was 0.58 percent, blown grain was 0.83 percent, threshing efficiency, 94.3 percent, cleaning efficiency was

92.47 percent, and dehussing efficiency was 94.91 percent, respectively (Dassanayake *et al.* 2010) [28].

6. Effect of moisture content of crop on performance of thresher

The moisture content of the grain plays a crucial role in determining machine efficiency. When the moisture content of the crop is high, it leads to poor separation of grains from the crop and consequently reduces efficiency. Conversely, if the moisture content is too low, it increases the risk of mechanical damage. Therefore, selecting the optimal moisture content for the crop is crucial to achieve the best results

Singh *et al.* (2015) [21] identified optimal conditions for millet threshing, revealing peak threshing efficiency (99.5%) and cleaning efficiency (88.5%) at 7.79% moisture content. Their findings indicated a decrease in threshing efficiency with an increase in moisture content.

Kamble *et al.* (2003) [19] evaluated a pearl millet thresher and reported that threshing efficiency was reduced with increase of moisture content because high moisture content increased the plasticity of grain.

Patel and Naik (2022) [35] studied the performance parameters of a finger millet thresher, focusing on various components such as the threshing drum, concave unit, and reciprocating sieve unit. The study included different feed rates, threshing cylinders, and concave types to identify the optimized threshing parameters. The investigation revealed that seed moisture content significantly impacts thresher performance. Specifically, a moisture content of 12.0-13.5 per cent was found to be optimal for achieving high threshing efficiency and minimal seed breakage. The study's findings demonstrated that moisture content affects the threshing process by influencing the friction and impact forces during operation. Higher moisture content can lead to increased seed breakage, while lower moisture content can result in incomplete threshing.

Prasanna and Naveen (2015) [36] tested the ragi MR1 and HR911 varieties. At 9.8 per cent grain moisture content, the cultivar MR1 had the maximum threshing efficiency of 79.6 per cent. The best threshing efficiency of 79.0 per cent was attained for variety HR911 at a grain moisture level of 10.1 per cent. It was discovered that threshing of ragi crop is more efficient at 10% to 13% grain moisture level. Despite the fact that mechanical damage to grain was significant and seed germination was reduced when threshed at a lower (10%) grain moisture level.

7. Effect of concave clearance on performance of thresher

Sharma and Devnani (1980) [16] stated that threshing efficiency decreased as feed rate and concave clearance increased. Furthermore, for a given concave clearance, energy consumption was constant and closely correlated with feed rate. A study by Ramteke and Sirohi (2003) [7] determined that the optimal concave clearance for threshing linseed was 5-7.5 mm, which would maximise efficiency while minimising grain damage and energy consumption while according to Fakrany *et al.* (2013) [37], 15 mm was the appropriate concave clearance for threshing flaxseed.

El-Fawal *et al.* (2012) [15] evaluated a modified flax threshing machine at four different concave clearances: 2, 4, 6, and 8 mm. The results showed that a 2 mm concave clearance was appropriate to achieve the best threshing

efficiency of 98.45%, cleaning efficiency of 92.3%, and germination ratio of 91%.

Zaky (2006) ^[18] suggested that a concave clearance of 2.5-3 mm is ideal for minimising black seed damage and losses while maintaining a satisfactory level of cleaning efficiency. Threshing efficiency decreased as feed rate and concave clearance increased. Furthermore, for a given concave clearance, energy consumption was constant and closely correlated with feed rate (Sharma and Devnani, 1980) ^[16].

Salari *et al.* (2014) ^[38] investigated the effect of concave clearance of a laboratory peg-tooth thresher on threshing efficiency and grain damage in chickpea. They found that varying the concave clearance between 12, 14, and 16 mm had an impact on both threshing efficiency and grain damage. As the concave clearance increased, the threshing efficiency decreased and grain damage increased. The optimum point was obtained at a cylinder speed of 10.63 m/s, a concave clearance of 13.74 mm, a feed rate of 240 kg/h, and a moisture content of 12% (w.b). The optimal values for grain damage, threshing efficiency, and seed germination in this setting were 3, 98.3, and 84.29 per cent, respectively.

8. Energy and cost

Energy requirements for threshing one tone of pearl millet in kWh for manual beating, bullock tramping and power thresher were 10.65, 13.70 and 7.90, respectively (Varshney *et al.* 2004) ^[26]. Stated that threshing process that requires four day using local practice may be accomplished in less than two hour using mechanically operated stationary thresher (Ghaly 1985) ^[30]. Behera *et al.* (1990) ^[29] estimated net unit threshing cost of wheat using the developed thresher was Rs. 13.63 / quintal, where as it was Rs. 14.94 /quintal when threshed by conventional methods.

9. Effect of cylinder speed on performance of thresher

Alizadeh and Khodabakhshpour (2010) ^[33] investigated the influence of axial-flow threshing drum speed on grain quality, focusing on levels of 450, 550, 650, 750, and 850 rpm, along with paddy moisture content at 17.0, 20.0, and 23.0 per cent (w.b.). Findings indicated maximum grain breakage (0.677) at 850 rpm and 17% moisture.

Kumar *et al.* (2016) ^[39] evaluated the performance of modified thresher at three different levels each of cylinder concave clearance (10, 20, 30 mm), seed moisture content (12.5, 14.0, 17.0%), two levels of cylinder speed (580,600 rpm peripheral speed 4.2m/s and 4.4m/s), and feed rate 10kg/hr of dried wheat. The test results indicated the threshing efficiency increases by increasing speed and seed damage also increases.

Ukatu (2006) ^[40] studied a modified a soybean threshing unit, demonstrating the importance of rotor speed in the threshing operation. The study concluded that increased rotor speeds improved threshing efficiency and output capacity. However, this gain was accompanied by a trade-off: increased rotor speed was associated with more seed damage. The findings highlight the need of balancing rotor speed considerations in soybean threshing processes to improve both efficiency and seed preservation.

Ardeh *et al.* (2009) ^[41] assess the threshing unit in a single plant thresher. observations revealed that increasing drum speed across all varieties led to a reduction in threshing loss. However, this increase in drum speed was associated with a higher percentage of damaged grains across all speed levels

10. Result and discussion

The engineering properties of grains and crops play a vital role in shaping the design and advancement of agricultural machinery used for processing farm products. Factors like seed size and shape are central when determining the right sieve dimensions and equipment for handling materials. Bulk density and porosity are key determinants affecting structural loads and are pivotal in establishing the specifications for hoppers and machine capacity. The angle of repose is a significant metric when it comes to designing hoppers, storage arrangements, and transportation systems. Furthermore, grain terminal velocity, bulk density, and characteristics of stalks and husks are crucial considerations in the development of pneumatic conveyors and grain cleaning systems. The coefficient of friction between grains and various surfaces is also a critical factor when designing conveyors, transportation setups, and storage facilities. Moreover, understanding crop physiology is essential for assessing fiber characteristics and determining the optimal feeding length for the feeding system to achieve the highest flax quality. This section provides a review of the physical properties of linseed seeds and crops.

The impact of various factors related to crops, such as moisture content, crop variety, and feed rate, as well as machine-related parameters like peripheral speed, concave clearance, sieve size, cleaning unit, and threshing drum optimization etc., has been thoroughly reviewed. The moisture content of the grain plays a pivotal role in determining machine efficiency. When the moisture content of the crop is high, it leads to poor separation of grains from the crop and consequently reduces efficiency. Conversely, if the moisture content is too low, it increases the risk of mechanical damage. Therefore, selecting the optimal moisture content for the crop is crucial to achieve the best results.

Cylinder speed was playing crucial role for good threshing because threshing was done by impact force acting on the crop or grain. a low cylinder speed may lead to more un-threshed grains, and the choice of speed is crucial in balancing grain retention and threshing efficiency. Maintaining the right threshing drum speed is crucial for achieving optimal efficiency in crop threshing machinery. If the speed is too high, it can lead to grain breakage, an undesirable outcome. Conversely, if the speed is too slow, it may impede the proper threshing of the crop. Therefore, selecting the optimum threshing drum speed is essential to strike a balance, ensuring efficient threshing without compromising grain quality. Studies indicate that the choice of drum speed significantly influences threshing efficiency, cleaning efficiency, seed loss, and overall performance of threshers.

It was also observed that impact and rubbing force is required for the threshing of linseed crop and wire loop type threshing mechanism is required for stripping linseed capsule just like paddy. Many researchers reported that peg with canvas strip type threshing cylinder provides the impact and friction force to the crop simultaneously a wire loop for stripping.

11. Conclusion

The optimized values of design parameters for the linseed thresher for the threshing and stripping operation were reported to be varied between 15-22 m/s speed of operation of the threshing cylinder, concave clearance should be 10

mm at moisture content of 8-14 per cent. The crop parameters which affect the performance were observed as feed rate, moisture content of grains, varieties etc. The machine parameters such as the peripheral speed of the threshing cylinder, reciprocating sieve speed, concave clearance etc. were the parameters that affect the performance of the thresher.

12. Reference

1. Indiastat. Agricultural Statistics at a Glance; c2021-22. Available from: <http://www.indiastat.com>
2. Kajla P, Sharma A, Sood DR. Flaxseed - a potential functional food source. *J Food Sci Technol.* 2015;52(4):1857-1871.
3. Beejmohun V, Fliniaux O, Grand É, Lamblin F, Bensaddek L, Christen P, *et al.* Microwave-assisted extraction of the main phenolic compounds in flaxseed. *Phytochem Anal.* 2007;18(4):275-282.
4. Mazza G. Production, processing and uses of Canadian flax. In: Proceedings of the First CGNA International Workshop; Aug; Temuco, Chile; c2008. p. 3-6.
5. Kachru RP, Gupta RK, Alam A. Physico-chemical constituents and engineering properties of food crops. 1st ed. Jodhpur: Scientific Publishers; c1994.
6. Coskuner Y, Karababa E. Some physical properties of flaxseed (*Linum usitatissimum* L.). *J Food Eng.* 2007;78(3):1067-1073.
7. Selvi KC, Pinar Y, Yesiloglu E. Some physical properties of linseed. *Biosyst Eng.* 2006;95(4):607-612.
8. Pradhan RC, Meda V, Rout PK, Naik S, Dalai AK. Supercritical CO₂ extraction of fatty oil from flaxseed and comparison with screw press expression and solvent extraction processes. *J Food Eng.* 2010;98(4):393-397.
9. Singh SK, Manibhushan M, Kumar A. Organic linseed (Tisi) farming: a step towards doubling farmers income. *Indian Farming.* 2018;68(1):55-58.
10. Singh PK, Chopra P. Double purpose linseed: a viable option for doubling farmers' income in the north-western Himalayan region. *Indian Farming.* 2018;68(1):1-4.
11. Dhirhi N, Shukla R, Patel NB, Sahu H, Mehta N. Extraction method of flax fibre and its uses. *Plant Arch.* 2015;15(2):711-716.
12. Addo A, Bart-Plange A, Asuboah RA, Dzisi K. Effect of different threshing cylinders on soybean quality. *J Sci Technol.* 2004;24(2):121-126.
13. Rice Machinery. Textbook of Japan International Cooperation Agency (JICA), Kyoto University, Japan.
14. Patel NK, Chandra S, Kumar V. Performance evaluation of hand operated linseed thresher. *J Pharmacogn Phytochem.* 2020;9(4S):91-93.
15. El-Fawal NK, Attar MA. Modification of a small machine for flax threshing and cleaning seeds. *J Soil Sci Agric Eng.* 2012;3(1):125-135.
16. Sharma KD, Devnani RS. Threshing studies on soybean and cowpea. *Agric Mech Asia Afr Latin Am.* 1980;11(4):65-68.
17. Ramteke AS, Sirohi NPS. Studies on design parameters for linseed crop thresher. *J Agric Eng.* 2003;40(2):39-45.
18. Zaky WM. Engineering studies on threshing of black seed (*Nigella sativa*). MSc Thesis. Agricultural Engineering Department, Faculty of Agriculture, Mansoura University; c2006.
19. Kamble HG, Srivastava AP, Panwar JS. Development and evaluation of a pearl-millet thresher. *J Agric Eng.* 2003;40(1):18-25.
20. Zuk M, Richter D, Matuła J, Szopa J. Linseed, the multipurpose plant. *Ind Crops Prod.* 2015;75:165-177.
21. Singh KP, Poddar RR, Agrawal KN, Hota S, Singh MK. Development and evaluation of multi-millet thresher. *J Appl Nat Sci.* 2015;7(2):939-948.
22. Oomah BD. Flaxseed as a functional food source. *J Sci Food Agric.* 2001;81(8):889-894.
23. Patel G, Naik RK, Patel KK. Studies on some physical and engineering properties of linseed. *Biol Forum Int J.* 2021;13(3):303-308.
24. Chandrakanthappa K, Batagurki SB, Kumar C. Evaluation of different threshing methods for primary processing of finger millet. *Mysore J Agric Sci.* 2001;35(2):128-132.
25. Sudajan S, Salokhe VM, Triratamasirichai K. Effect of type of drum, drum speed, and feed rate on sunflower threshing. *Biosyst Eng.* 2002;83(4):413-421.
26. Varshney AC, Tiwari PS, Narang S, Mehta CR. Data book for agricultural machinery design. Bhopal: CIAE; c2004. p. 392-404.
27. Gbabo A, Gana IM, Amoto MS. Design, fabrication and testing of a millet thresher. *Net J Agric Sci.* 2013;1(4):100-106.
28. Dassanayake ADSL, Bandara MHM, Weerasooriya GVTV. Design and development of a finger millet threshing, dehulling, and cleaning machine. Farm Mechanization Research Centre, Mahailuppallama, Anuradhapura, Sri Lanka; c2010.
29. Behera BK, Dash SK, Das DK. Development and testing of a power-operated wheat thresher. *Agric Mech Asia Afr Latin Am.* 1990;21(4):15-21.
30. Ghaly AE. A stationary threshing machine: design, construction, and performance evaluation. *Agric Mech Asia Afr Latin Am.* 1985;16(3):19-30.
31. Wang B, Li D, Wang L, Huang Z, Zhang L, Chen XD, Mao Z. Effect of moisture content on the physical properties of fibered flaxseed. *Int J Food Eng.* 2007;3(5):1-8.
32. Bhise S, Kour A, Manikantan AR. Engineering properties of flaxseed (LC 2063) at different moisture levels. *J Postharvest Technol.* 2013;01(01):52-59.
33. Alizadeh MR, Khodabakhshipour M. Effect of threshing drum speed and crop moisture content on the paddy grain damage in axial-flow thresher. *Cercetări Agronomice în Moldova.* 2010;4(144):5-11.
34. Kashyap R, Kuttippurath J, Patel VK. Improved air quality leads to enhanced vegetation growth during the COVID-19 lockdown in India. *Applied Geography.* 2023 Feb 1;151:102869.
35. Naik O, Patel N, Baba SA, Dalvi H. Decentralized Ride Hailing System using Blockchain and IPFS. In 2022 IEEE Bombay Section Signature Conference (IBSSC) IEEE; c2022. p. 1-5.
36. Naveen AL, Rajeeva MP, Prasanna GD. Microwave Dielectric and Magnetic Properties of Co-Zn Ferrites. 2015;73:01-04.
37. Alqhtani E, Samsudin Z, Fakrany H. The Transformation of Saudi Arabia Through Tablet-Based

- Technology. *International Journal of Scientific & Engineering Research*. 2013;4(5):149-151.
38. Babri S, Doosti MH, Salari AA. Strain-dependent effects of prenatal maternal immune activation on anxiety-and depression-like behaviors in offspring. *Brain, behavior, and immunity*. 2014 Mar 1;37:164-176.
 39. Kumar V, Reinartz W. Creating enduring customer value. *Journal of marketing*. 2016 Nov;80(6):36-68.
 40. Ukatu AC. A modified threshing unit for soya beans. *Biosystems engineering*. 2006 Nov 1;95(3):371-377.
 41. Asli-Ardeh EA, Gilandeh YA, Abbasi S. Study of performance parameters of threshing unit in a single plant thresher. *Amer. J Agric. Biol. Sci*. 2009 Feb 1;4(2):92-96.