Exploring Castor Hybrid (YRCH 1) as an Alternate Crop in Mettur-Noyyal sub basin of Tamil Nadu

Original Research Article

PREVIEW

ABSTRACT:

Aims: The aim of this study is to introduce castor hybrid as an alternative crop in gap areas to promote agricultural diversification and enhance productivity.

Place and Duration of Study: Mettur-Noyyal confluence sub basin areas of Tamil Nadu by the Tapioca and Castor research Research station, Yethapur for the past five years (2019-2024).

Methodology: The on farm demonstrations was carried out at Salem, Namakkal and Dharmapuri district of Tamil Nadu including thirteen villages with 302 farmers holdings covering the areas of 260 ha. Looming water crisis, paucity of agricultural labourers, higher cost of cultivation owing to escalating labour costs, fluctuating in market price of the produce, the search for remunerative alternative crop to enhance the profitability without deteriorating soil productivity.

Results: The castor hybrid cultivation is gaining momentum in non-traditional area of Tamil Nadu. The advantages of castor over conventional crop are less demanding in terms of land, labour and water requirement, water deficit areas and problem soils, cost of cultivation is less with high profit, suitable for small and marginal farmers besides improving the soil health through addition of leaf litter and biological ploughing. By adopting castor hybrid as an alternative crop resulted in the highest yield of 1964 kg ha^{-1}, compared to the conventional method, which yielded 1376 kg ha^{-1}.The highest gross returns (Rs. 116287 ha^{-1}), net return (Rs. 91827 ha^{-1}) and BCR (3.68) were recorded in adoption of hybrid castor as alternate crop.

Conclusion: Castor is highly remunerative crop during *Kharif* season as compared to traditional crops because of its steady marketing price throughout the year unlike other crops. This technology increase yield up to 31.5 per cent when compared to farmer practice

Keywords: Castor hybrid, Alternate Crop, Soil health, Yield increase, Traditional method.

1. INTRODUCTION

Castor (*Ricinus communis L.*) is an ancient and valuable non-edible oilseed, widely recognized for its industrial and medicinal significance. With an oil content of 48-56 per cent, castor is an excellent candidate for producing high-value industrial oils and feedstocks. This crop is drought-tolerant and thrives in warm, dry climates with rainfall between 500-750 mm annually (Naidu *et al*., 2015). Castor oil represents 0.15 per cent of global vegetable oil production (Patel *et al*., 2016; Keera *et al*., 2018; Scholz and Silva, 2008). Castor beans are a promising biofuel crop, with a growth cycle of 140 to 180 days in temperate climates. It requires minimal water, grows vigorously, produces a significant oil output, tolerates drought, and can be grown on degraded or marginal lands (Kapazoglou *et al*., 2013). The high ricinoleic acid concentration in castor oil facilitates the production of high-purity derivatives (Nitbani *et al*., 2022; Singh *et al*., 2023; Bafor *et al*., 1991; Alvarez *et al*., 2022; Nisbett *et al*., 2024). The majority of global castor seed production (96 per cent as of 2009) comes from small farmers in four countries: India, China, Brazil, and Mozambique (Severino and Auld, 2013). In India, during the 2022-23 period, castor was grown on 1.007 million hectares, yielding 1.973 million tonnes (Nivetha *et al*., 2024). Tamil Nadu is a key castor-producing state, cultivating it on 5,132 hectares, with a total production of 1,695 tonnes and a productivity rate of 312 kilograms per hectare. Within Tamil Nadu, Namakkal is the largest producer, with 1,479 hectares under cultivation, followed by Salem with 1,001 hectares and Krishnagiri with 627 hectares, while other districts cover a combined 2,025 hectares (Hema and Keerthana, 2020). Introducing Castor as an alternate crop helps diversify cropping patterns, reducing the dependency on traditional crops and mitigating risks associated with climate change, pests, and diseases in the gap areas (Rathore *et al*., 2022). Castor, being a hardy crop, can thrive in less fertile soils and semi-arid conditions, making it suitable for underutilized or marginal lands in newer areas, thereby enhancing agricultural productivity (Chakrabarty *et al*., 2022). Cultivating Castor provides farmers with an additional source of income due to its high market demand for industrial applications like lubricants, cosmetics, and pharmaceuticals, while promoting sustainable agriculture practices (Kaur and Baskar, 2020). And also the highest crop equivalent yield (CEY) of 4220 kg ha^{-1}, net returns of Rs.157,453 ha^{-1}, and a benefit-cost ratio (B:C) of 3.78 were achieved with the Castor + mung bean (1:4) intercropping system (Gangadhar *et al*., 2023). By improving the population of castor beans requires new approaches and techniques to enhance the efficiency of obtaining lines and hybrids, while also reducing development time (Toppa *et al*., 2018).

In recent years, there has been growing interest in castor cultivation due to its potential to meet the increasing demand for castor oil. This has made castor farming a strategic choice for many countries (Anjani *et al*., 2014). Castor hybrid cultivation has gained significant attention, especially among rainfed farmers and those with limited irrigation resources. Castor hybrid offers higher productivity with lower labor, water and cost requirements compared to conventional crops like Bt cotton and hybrid maize. It is especially lucrative in the North Western Zone of Tamil Nadu, where castor hybrid is seen as a viable option under changing climatic conditions (Kathirvelan *et al*., 2021). Furthermore, hybrid castor farming on marginal lands helps address issues related to the competition between food and non-edible crops (Landoni *et al*., 2023). Hence, this study was conducted to present castor hybrid as a potential alternative crop for gap areas and to evaluate its impact.

2. MATERIAL AND METHODS

This demonstration was carried out in rainfed condition using the Introduction of Castor hybrid (YRCH 1) in newer area as alternate crop in gap area for 5 consecutive years during the period of 2019-2020 to 2023-2024 under Tamil Nadu Irrigated Agriculture Modernization Project (TNIAMP) Phase-II, Mettur-Noyyal sub basin (Fig. 1) by Tapioca and Castor

Research Station, Yethapur. The on farm demonstrations was carried out Salem and Namakkal district including six blocks with 302 farmers holdings covering the areas of 260 ha. These demonstrations took place at the fields of farmers in the village of K.N.Puthur, Alamarathupatti, Lakkampatti, Neethipuram, Perumbalai, Iruppali, Adaiyur, Pakkanadu, Chettimangurichi, Avadathur, Nangavalli, Thumbipadi, Thinnapatti, Kadaympatti south, Panikanur, Tharamangalam, Kurukapatti, Jalagandapuram, Mecheri, Veerakal in the Salem, Namakkal and Dharmapuri district of Tamil Nadu, India. In these demonstrations there were two treatments: T_1-Conventional method like farmer practice (their regular crops), T_2-Introduction of castor hybrid as an alternate crop. Castor hybrid gives a compelling opportunity for farmers seeking a resilient and efficient crop. Its drought tolerance, pest and disease resistance, and excessive yield capacity make it a precious addition to diverse agricultural systems (Rice, Maize, Groundnut etc..). At the same time as cultivation calls for cautious making of plans and control, the benefits, which include marketplace demand for castor oil, make it worth attention. With the aid of know-how the important thing factors concerned, farmers can correctly incorporate castor hybrid into their agricultural practices and acquire the rewards of this flexible crop.

Introduction of Hybrid Castor as an Alternate Crop

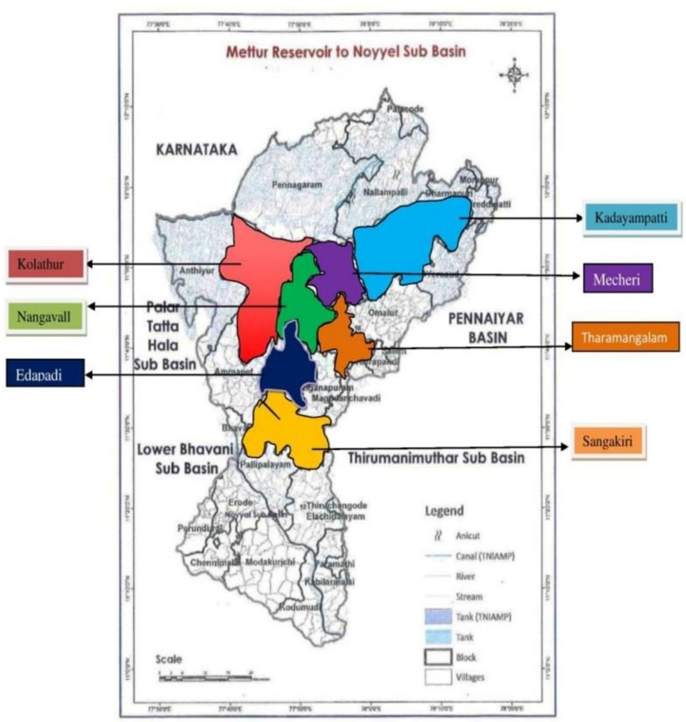

Figure 1: Map of Mettur-Noyyal sub basin

Why Farmers Are Hesitant to Try Castor Hybrid?

Farmers' reluctance to adopt castor hybrid as an alternative crop stems from several elements. Unfamiliarity with the crop, worries about marketplace fluctuations and potential risks, constrained getting admission to assets, and cultural resistance to exchange can hinder adoption. To triumph over these challenges, it's essential to offer farmers good enough education, technical help, marketplace get admission to, and infrastructure development. By way of addressing these worries, castor hybrid can be promoted as a viable and sustainable alternative crop choice (Yin *et al*., 2019).

Castor Hybrid: A Sole Crop Option

Castor hybrid offers many benefits for both farmers and the economic marketplace. Its excessive yield capacity, drought tolerance, and pest resistance make it a perfect crop for cultivation. Moreover, the robust call for castor oil and other by products ensures a stable market. Through adopting castor hybrid, farmers can beautify their profitability, reduce their environmental impact, and make a contribution to a greater sustainable agricultural system.

Data Analysis

The yield data was obtained from both the demonstration and conventional (farmer practice) method using the random crop cutting method. Qualitative data was converted to quantitative form and expressed as percentage increase in yield. The data was further analysed by using statistical tools.

Technology gap = Potential yield-Demonstrated yield

Extension gap = Demonstrated yield- Yield under existing practice

$$\text{Technology index} = \frac{\text{Potential yield- Demonstrated yield}}{\text{Potential yield}} \times 100$$

3. RESULTS AND DISCUSSION

The supervision of the Tapioca and Castor Research Station, Yethapur, TNIAMP Phase II Mettur-Noyyal sub basin scientist crop yield was harvested accordingly. Castor hybrid has emerged as a promising agricultural crop due to its resilience, excessive yield potential and diverse business packages. By way of examining the results and discussing the consequences, we intend to offer precious insights to farmers and researchers interested in this progressive crop.

Technology and extension gap analysis

From 2019 to 2024, the Technology Index has shown a consistent upward trend, rising from 9.9 per cent in 2019-2020 to 29.0 per cent in 2023-2024. This indicates that there has been a progressive improvement in the adoption of new technologies over the years. The Technology Gap has been increasing each year, growing from 248 in 2019-2020 to 725 in 2023-2024. This suggests that although technology adoption has improved, there is still a substantial gap in the implementation or utilization of the available technology, potentially

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highlighting the need for further technological advancements or better dissemination of technology to farmers. The Extension Gap has remained high, fluctuating between 441 and 733 from 2019-2024. While it slightly decreased in 2023-2024, it still remains significant. This indicates that there is a considerable gap in terms of reaching out to farmers with information, guidance, and support on the new technologies and practices. The extension services seem to be falling short in meeting the demand for technological knowledge. In the initial years (2019-2021), the technology index increased at a slower pace, but from 2022-2024, there was a marked rise in the technology index, which shows a more aggressive adoption of technology. Despite the rise in the technology index, the technology and extension gaps continue to widen, which could suggest that the implementation of new technology is not keeping pace with the need for education and support services for farmers (Tab. 1).

Table 1. Analysis of technology and extension gap

S. No	Year	Area (ha)	Technology index (per cent)	Technology gap	Extension gap
1	2019-2020	25	9.9	248	441
2	2020-2021	75	16.9	422	718
3	2021-2022	60	18.6	465	731
4	2022-2023	50	20.7	518	733
5	2023-2024	50	29.0	725	519

Rates of Adoption

Because of its multiple benefits, castor hybrid is becoming increasingly popular. The growing popularity among farmers can be attributed to a number of factors, including resilience, awareness efforts, and successful case studies, in addition to economic rewards. Even while problems like few resources and volatile markets still exist; resolving these problems is crucial to advancing the use of castor hybrid and achieving its maximum potential.

Farmers Perspectives

Farmers who have embraced castor hybrid have consistently expressed positive feelings regarding its production. They usually emphasize how resilient the crop is to bad weather, how well it grows in marginal areas, and how it can provide higher yields than traditional plants. Farmers also value the financial benefits of castor hybrid, including faster revenue from the sale of castor oil and other byproducts (Pari *et al*., 2020). While there may be initial difficulties, such as learning new growing techniques or navigating fluctuations in markets, many farmers discover that the long-term advantages exceed the disadvantages. Early adopters' success stories can encourage others to consider castor hybrid as a potential opportunity crop.

Yield Analysis

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The average yield under demonstrated plots was 2252,2078,2035,1982 and 1775 kg ha^{-1} with an average of 2024 kg ha^{-1} from the years 2019-2020 to 2023-2024 respectively when compared with farmers practices of 1811,1360,1304,1249 and 1256 kg ha^{-1} with an average of 1396 kg ha^{-1} (Tab. 2). The yield increase percentage was found to be 19.5 per cent, 34.5 per cent, 35.0 per cent, 37.0 per cent, 31.0 per cent for the years 2019, 2020, 2021, 2022, 2023 respectively. There was a steady improvement in yield increase over the years, starting at 19.5 per cent in 2019 and peaking at 37.0 per cent in 2022. The biggest jump came between 2019 and 2020, where yield increased from 19.5 per cent to 34.5 per cent, suggesting that changes or new practices in that period had a positive impact. While the trend remained strong through 2022, there was a slight dip in 2023, with the yield dropping to 31.0 per cent. This decrease could be due to factors like weather conditions or other challenges that affected crop production. Overall, though, the results are promising, showing that improvements are being made, and with some adjustments, even better yields can be achieved in the future (Fig. 2). Furthermore, castor hybrid's tolerance to pests, diseases, and harsh weather conditions might assist lower crop risk. Farmers that incorporate castor hybrid into their crop rotation can diversify their income streams while mitigating the risks associated with shifting market prices. Furthermore, government incentives in some locations may make castor hybrid even more appealing. Overall, the combination of higher yields, lower risk, market demand, diversification benefits, and support from government makes hybrid castor a viable option for many farmers. That makes castor hybrid a perfect alternate crop for farmers.

Table 2. Influence of Yield (Kg/ha) on Introduction of Castor hybrid as an alternate crop

Year	**Area (ha)**	**Yield (kg ha^{-1})**	
		Demo	**Conv.**
2019	25	2252	1811
2020	75	2078	1360
2022	60	2035	1304
2022	50	1982	1249
2023	50	1775	1256
Average		**2024**	**1396**

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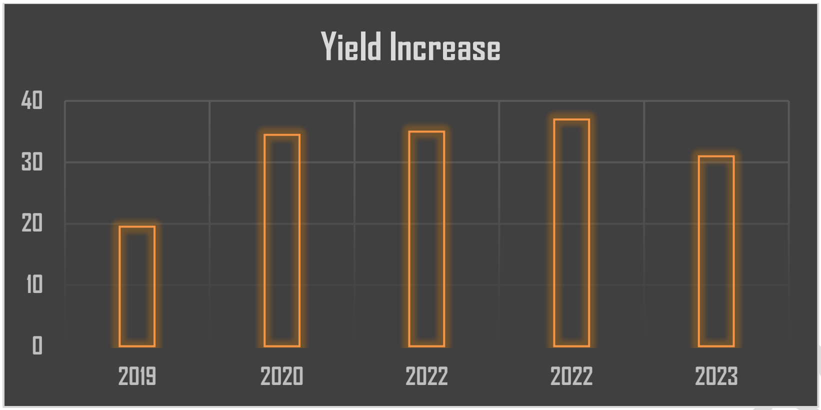

Figure 2. Impact of Introduction of Castor hybrid as an alternate crop on Yield increase (per cent)

Economic analysis

The demonstration plot was Introduction of castor hybrid as an alternate crop has demonstrated a higher economic return compared to traditional methods. This is primarily due to the increased less labour cost, stable market prize, drought tolerance, pest and disease resistance, and excessive yield capacity. The average net return over the past five years for the demonstration plots was Rs.91, 719 ha^{-1} and the farmer practice revealed that the average net return over the past five years was Rs.58, 945 ha^{-1}. The BCR (benefit-cost ratio) of the Introduction of castor hybrid as an alternate crop was found to be 3.6, 3.2, 4.9, 3.5, 3.21 for the years 2019, 2020, 2021, 2022, 2023 respectively compared with the conventional method (2.6, 1.9, 3.3, 2.0, 2.73). The average of the Introduction of castor hybrid as an alternate crop (3.6) was greater than that of the conventional method (2.5) (Tab. 3)

Table 3. Effect of Introduction of Castor hybrid as an alternate crop on Economics

Year	Area (ha)	Cost of cultivation (Rs ha^{-1})		Gross Return (Rs ha^{-1})		Net Return (Rs ha^{-1})		BCR	
		Demo	Conv.	Demo	Conv.	Demo	Conv.	Demo	Conv.
2019	25	21768	22138	101323	81508	79555	59370	3.6	2.6
2020	75	25628	24330	108040	70720	82412	46390	3.2	1.9
2021	60	25622	23874	151801	104775	126179	80901	4.9	3.3

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2022	50	26868	25124	122907	76425	96039	52301	3.5	2.0
2023	50	22958	20507	97367	76268	74409	55761	3.21	2.73
Average		24569	23195	116288	81939	91719	58945	3.6	2.5

Farmers feedback

Farmers have reported significant benefits from adopting hybrid corn as an alternate crop. They have observed reduced water consumption, improved soil health, pest and disease attack reduction, enhanced soil quality, increased yields, and overall economic and environmental advantages. Despite initial hesitation, many farmers have found castor hybrid to be a valuable and effective technique that has positively impacted their agricultural practices compared to their previous crops. So, if you're searching for a crop that produces well while being easy to handle, castor hybrid is an excellent choice. You might be amazed at how effective it is for you!"

4. CONCLUSION

The introduction of castor hybrid as an alternative crop in the Mettur-Noyyal confluence sub-basin of Tamil Nadu has shown significant potential for improving agricultural sustainability and profitability. The crop's ability to yield up to 31.5 per cent more than traditional farming methods, along with higher gross and net returns and a favourable benefit-cost ratio, highlights its economic viability. Additionally, castor hybrid contributes to improved soil health through the addition of leaf litter and biological ploughing, making it a valuable option for small and marginal farmers. With its steady market price throughout the year, castor hybrid is emerging as a highly profitable and sustainable alternative crop, addressing both economic challenges and environmental concerns.

Disclaimer (Artificial intelligence)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

REFERENCES

1. Bafor, M., Smith, M. A., Jonsson, L., Stobart, K., & Stymne, S. (1991). Ricinoleic acid biosynthesis and triacylglycerol assembly in microsomal preparations from developing castor-bean (Ricinus communis) endosperm. *Biochemical Journal*, **280(2)**, 507-514. 10.1042/bj2800507
2. Chakrabarty, S., Islam, A. K. M. A., Yaakob, Z., & Islam, A. K. M. M. (2021). Castor (Ricinus communis): An underutilized oil crop in the South East

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Asia. *Agroecosystems—Very Complex Environmental Systems; IntechOpen: London, UK*, **61**. 10.5772/intechopen. 92746 10.5772/intechopen.92746

3. Gangadhar, K., Hemavathi, K., & Veena, C. V. (2023) Evaluating the production potential and economic feasibility of castor (Ricinus communis L.) intercropping systems. *International Journal of Research in Agronomy*; **7(4):** 486-490. 10.33545/2618060X.2024.v7.i4g.594
4. Hema, P. & Keerthana, V. (2020). Constraints in Growing Hybrid Castor in North Western Zone of Tamil Nadu. In Krishnakumare. B & Niranjan. S, *Recent Researches in Social Science* (pp. 110-112). Phoenix Coaching Centre .
5. Kammili Anjani, K. A. (2014). A re-evaluation of castor (Ricinus communis L.) as a crop plant. *CABI Reviews*, 1-21 https://doi.org/10.1079/PAVSNNR20149038
6. Kapazoglou, A., Drosou, V., Nitsos, C. K., Bossis, I., Tsaftaris, A., Triantafyllidis, K., & Hilioti, Z. (2013). Biofuels get in the fast lane: developments in plant feedstock production and processing. *Advanced Crop Science Technology*, **1(4)**, 117-132. `https://doi.org/10.1016/j.biombioe.2007.08.004
7. Kathirvelan, P., Ramasamy, V. S., Arutchenthil, P., & Deivamani, M. (2021). Hybrid Castor: A Novel Crop and Money Spinner for Rainfed Farmers of Perambalur District. *AgroScience Today*, **(6)**, 0176-0180.
8. Kaur, R., & Bhaskar, T. (2020). Potential of castor plant (Ricinus communis) for production of biofuels, chemicals, and value-added products. *In Waste biorefinery* (pp. 269-310). Elsevier. 10.1016/B978-0-12-818228-4.00011-3
9. Keera, S. T., El Sabagh, S. M., & Taman, A. R. (2018). Castor oil biodiesel production and optimization. *Egyptian journal of petroleum*, **27(4)**, 979-984. https://doi.org/10.1016/j.ejpe.2018.02.007.
10. Landoni, M., Bertagnon, G., Ghidoli, M., Cassani, E., Adani, F., & Pilu, R. (2023). Opportunities and challenges of castor bean (Ricinus communis L.) genetic improvement. *Agronomy*, **13(8)**, 2076. https://doi.org/10.3390/agronomy13082076
11. Naidu, L. G. K., Dharumarajan, S., Lalitha, M., Vasundhara, R., Ramamurthy, V., Reddy, G., ... & Varaprasad, K. S. (2015). Identification and delineation of potential castor growing areas in different Agro-eco sub regions of India. *The Indian Society of Oilseeds Research*, **39**. 10.56739/jor.v32i2.141964
12. Nisbett, K. E., Vendruscolo, L. F., & Koob, G. F. (2024). Indulging Curiosity: Preliminary Evidence of an Anxiolytic-like Effect of Castor Oil and Ricinoleic Acid. *Nutrients*, **16(10)**, 1527. 10.3390/nu16101527
13. Nitbani, F. O., Tjitda, P. J. P., Wogo, H. E., & Detha, A. I. R. (2022). Preparation of ricinoleic acid from castor oil: A review. *Journal of oleo science*, **71(6),** 781-793 10.5650/jos.ess21226
14. Nivetha, S., Devi, S., Lavanya, T., & Aruna, K. (2024). Trends in Area, Production and Productivity of Castor in Telangana. *Archives of Current Research International*, **24(6)**, 278-285. 10.9734/acri/2024/v24i6785
15. Pari, L., Suardi, A., Stefanoni, W., Latterini, F., & Palmieri, N. (2020). Environmental and economic assessment of castor oil supply chain: a case study. *Sustainability*, **12(16)**, 6339. https://doi.org/10.3390/su12166339
16. Patel, V. R., Dumancas, G. G., Viswanath, L. C. K., Maples, R., & Subong, B. J. J. (2016). Castor oil: properties, uses, and optimization of processing parameters in commercial production. *Lipid insights*, **9, LPI-S40233**. 10.4137/LPI.S40233\

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17. Rathore, S. S., Shekhawat, K., Singh, R. K., Babu, S., & Singh, V. K. (2022). Diversification for Restoration of Ecosystems and Sustainable Livelihood. *Sustainable Agriculture Systems and Technologies*, 21-36. 10.1002/9781119808565.ch2
18. Sánchez-Álvarez, A., Ruíz-López, N., Moreno-Pérez, A. J., Venegas-Calerón, M., Martínez-Force, E., Garcés, R., & Salas, J. J. (2022). Metabolism and accumulation of hydroxylated fatty acids by castor (Ricinus comunis) seed microsomes. *Plant Physiology and Biochemistry*, **170**, 266-274. https://doi.org/10.1016/j.plaphy.2021.12.010
19. Scholz, V., & Da Silva, J. N. (2008). Prospects and risks of the use of castor oil as a fuel. *Biomass and bioenergy*, 32(2), 95-100.
20. Severino, L. S., & Auld, D. L. (2013). A framework for the study of the growth and development of castor plant. *Industrial Crops and Products*, 46, 25-38. https://doi.org/10.1016/j.indcrop.2013.01.006
21. Singh, S., Sharma, S., Sarma, S. J., & Brar, S. K. (2023). Roles of Process Parameters on the Ricinoleic Acid Production from Castor Oil by Aspergillus flavus BU22S. *Fermentation*, **9(4)**, 318. https://doi.org/10.3390/fermentation9040318
22. Toppa, E., Silva, J., Sartori, M., & Zanotto, M. (2018). Comparison of castor beans hybrids produced by the conventional method and by the cryptic hybrid method. *Journal of Experimental Agriculture International*, ***20*****(2),** 1-12.
23. Yin, X., Lu, J., Agyenim-Boateng, K. G., & Liu, S. (2019). Breeding for climate resilience in castor: Current status, challenges, and opportunities. *Genomic Designing of Climate-Smart Oilseed Crops*, 441-498. 10.1007/978-3-319-93536-2_8

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