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Ricinus Communis: A Climate Resilient Commercial Crop for Sustainable Environment

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Preface

In the past few decades, there has been a noticeable increase in population, unplanned urbanization, and rampant industrialization along with unsustainable mining activities as a consequence of which the world is witnessing a new low in the environmental quality with each passing day. To feed such a large population, there is a need to produce unimaginably high number of edible crops, which has compelled the human kind to take resort to excess usage of pesticides and chemical fertilizers. Their deleterious effects on the components of ecosystem, i.e., air, water, and soil, are not hidden. Using these chemical compounds is synonymous with dumping heavy loads of metal and organic contaminants in soil. Sustainability has become central to any present-day solution to environmental problems, and it envisages minimization of impact on environment, operational efficiency along with socioeconomic concerns; all of these factors are intertwined. Use of plants for the purpose of eco-restoration of polluted soil and water is the most environment friendly and benign method for keeping deleterious environmental impacts at bay.

This book deals with a detailed role of *Ricinus communis* (Castor) in tackling such environmental problems. An attempt has been taken to project *R. communis* as the most suitable candidate for phytoremediation along with several other environmental benefits as discussed in the introductory chapter followed by establishing Castor as an industrially important plant. Easy availability and very low or virtually no maintenance cost is imperative for it to be used economically so a dedicated chapter in the book lets the reader know about the different geographical locations of this plant. The chapters also deal with its morphological variations, different techniques of cultivation, genotypic variations, conducive soil type, and also the yield.

R. communis is one of the best mitigators of several pollutants. There is a dedicated chapter that serves to discuss in detail the reclamation of mining spoiled site, saline soil, drought-affected soil, heavy metal contaminated soil, etc. *Ricinus* is also a biodiesel plant, being a monotypic species contains approximately 60% of unique oil. High molecular weight, highest and most stable viscosity, –12 to –18 °C (to be precise) of solidification point, and 5 °C melting point are some of the many characteristics which make this plant extremely useful for various industrial purposes. Also, the presence of 90% of ricinoleic acid in its oil makes it suitable

for production of good quality resins, lubricants, nylon, and soaps. A chapter in the book specially elaborates such aspects.

Although there are several plants which tend to serve as phytoremediators, the purpose of this book is to advocate *Ricinus communis* L. (Castor) which is a hardy angiosperm with perennial flowering. It is a multi-benefit plant, which serves the dual purpose of simultaneously being an excellent phytoremediator and bioenergy generator. Furthermore, Castor is also effective in treating several human diseases, especially relieving joint pains, skin ailments, and intestinal problems. Besides, anti-inflammatory activity, antioxidant activity, antidiabetic activity, hepatoprotective activity, antimicrobial activity, insecticidal activity, etc. have also been discussed separately. Owing to such diverse properties, this book truly establishes *R. communis* as a "Climate Resilient Value-Added Crop of Future." Also, the book will serve as guiding lamp for academicians, researchers, farmers, policymakers, and society at large.

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Medicinal Properties of *Ricinus communis* L. Oil and Their Applications: An Overview

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Abstract

Castor (*Ricinus communis* L.) is a significant medicinal plant which belongs to the family Euphorbiaceae, and it is a native to the Mediterranean, eastern Africa, and India. This plant attains the height around 200–400 cm and has large, lobed, toothed, and glossy leaves. The male and female flowers are borne on individual plants. The female flowers develop into spiny, green capsules which contains the seeds. The seeds contain a toxin, ricin, and are used to produce oil that is used in a variety of medicinal and industrial applications. The plant is also used as an ornamental and is being studied for its potential as a biofuel crop. Castor plant has many environmental benefits such as source of renewable energy, especially biodiesel which can be used as a cleaner alternative as compared with traditional fossil fuels. Castor oil is considered to be a biodegradable and non-toxic resource and also used in the production of various products, including soaps, lubricants,

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and polymers. Castor is a fast-growing crop that can be used as an organic fertilizer (green manure) and to amend soil health that help to reduce the need for chemical fertilizers. Additionally, it can be used to help prevent soil erosion, as it has deep and extensive root systems. Additionally, the plant is a great source of habitat for beneficial pollinators and other beneficial insects.

Keywords

Antimicrobial agent · Essential oil · *Ricinus communis* · Medicinal plants

1 Introduction

Ricinus communis L. is commonly known castor and yields castor oil (non-edible) obtained from its seeds. With an ideal temperature range of 20–25 °C, it thrives well in the wet tropics to the sub-tropical zone (Patel et al. 2016). India is the top most country for production and export of *R. communis* L. oil (Global AI 2018). Moreover, castor oil is the only profit oriented hydroxylated fatty acids; it is a crucial feedstock for the chemical industry that uses it primarily to produce biodiesel and for pharmaceutical applications (Severino et al. 2012). The RCA (*Ricinus communis* agglutinin) and other poisonous substances like ricin, ricinin, and ricin are also found in the castor plant (Chakrabarty et al. 2021). More than 30 countries produce castor on a commercial scale with a peak of 1.99 million ha in 2011. The global castor area climbed from 1.23 million ha in 1961 and 1.68 million ha in 2012 (Chakrabarty et al. 2021; FAOSTAT 2014; www.faostat.com). In 2012, India accounted for 66% of the global castor area, as compared with 39% in 1961. China is the next country (11%) and Brazil, which was close to India in the castor area until 1986 but now only accounts for 5% due to the switch from castor to soybean (*Glycine max* L.) production. Additionally, few regions of the word viz., Thailand, Kenya, South Africa, Vietnam, Madagascar, Ethiopia, Paraguay, Indonesia, Tanzania, etc. grow castor to a restricted area. The production of its seeds enhanced from 0.58 Mg in 1961 to 1959, a compound growth rate (www.faostat.com) (Table 1).

India produced 83.2% (1.63 million Mg) in 2012, up from 18.8% in 1961 (www.seaofindia.com). Gujarat yields 86% of India's production, which is then followed by Rajasthan and Andhra Pradesh. In context with countries, there are very few countries cultivating the castor in which the production of Brazil and China is about 5.56% and 12.5%, respectively. With a current castor production of 0.18 million metric tonnes, China, which grew castor production (from 0.035 million Mg in 1961 to 0.025 million Mg in 2004), switched from castor cultivation to soybean after 2004 (Fig. 1).

In India, there is a huge opportunity and area for its cultivation but yet following constraints as faces by the grower viz., (i) limited awareness about importance of this plant, (ii) there is a need to developed high-yielding cultivar along with improved