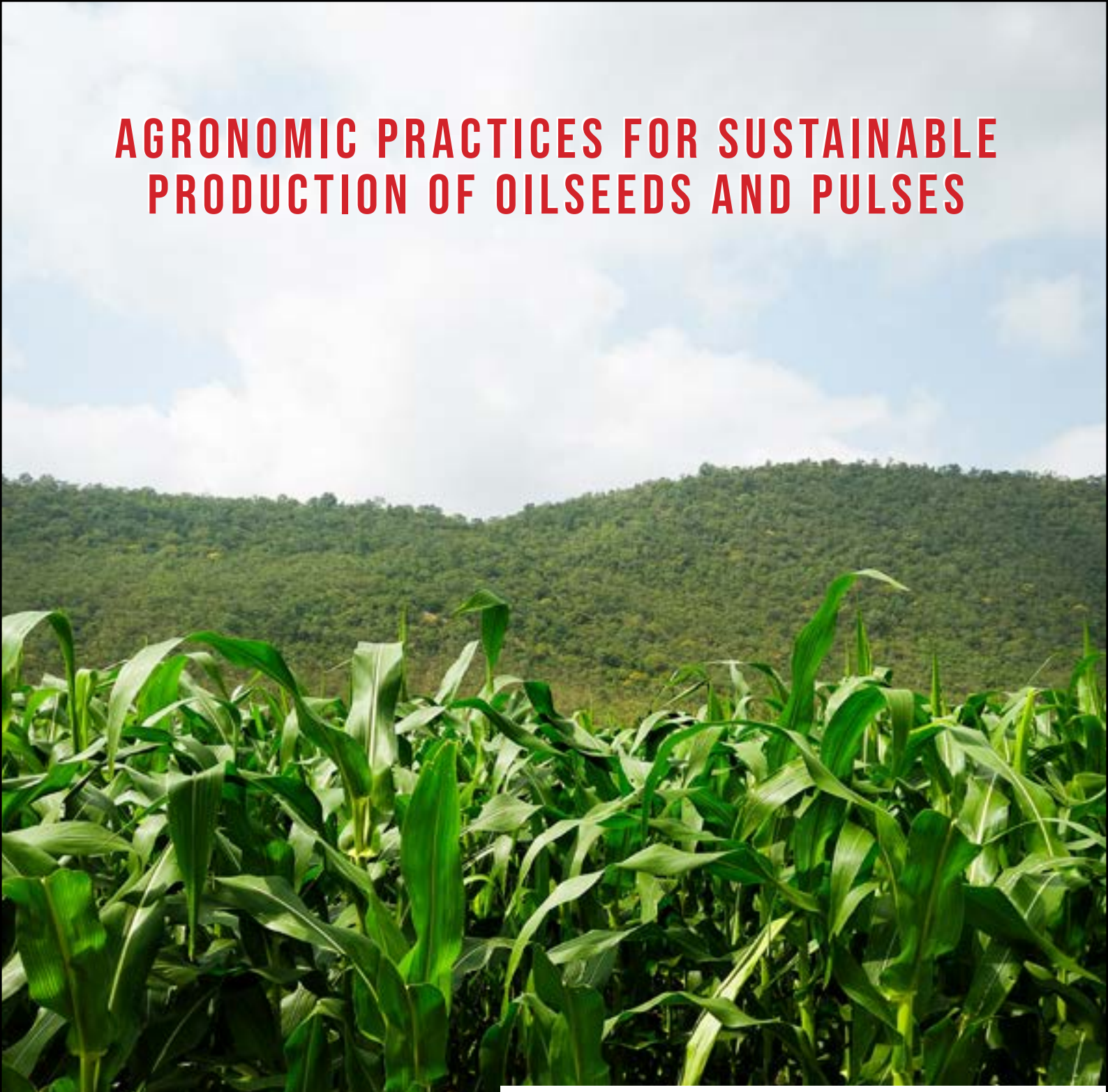
AGRONOMIC PRACTICES FOR SUSTAINABLE PRODUCTION OF OILSEEDS AND PULSES



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ISSN : 3107 - 9903

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EDITION: VOLUME 02, ISSUE 04 , - APR 2026

Agronomic Practices for Sustainable Production of Oilseeds and Pulses

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ISSN No.: 3107-9903
Frequency: Monthly
Month: April
Volume- 2, Issue- 4

Abstract

In addition to providing essential oils, proteins, and nutrients, oilseeds and pulses are crucial crops in global agriculture that promote sustainable farming practices and food security. With an emphasis on sustainable intensification, this article examines important agronomic techniques for oilseeds (such as soybean, canola, and sunflower) and pulses (such as chickpeas, lentils, and peas). Soil management, seed selection, planting methods, fertilizer, irrigation, insect control, and harvesting are examples of practices. To emphasize effective practices that improve yield, quality, and environmental resilience, the review summarizes recent studies. Issues like soil deterioration, insect pressures, and the effects of climate change are discussed, along with suggestions for integrated solutions. Results show that using organic and precision farming techniques can increase output by 20–30% while reducing the use of inputs. In order to support sustainable production in a variety of agro-ecosystems, this synthesis emphasizes the necessity of region-specific adaptations.

Keywords: Oilseeds, pulses, agronomic practices, sustainable agriculture and crop management.

Introduction

Pulses and oilseeds are staple crops in agricultural systems across the world, making substantial contributions to industrial uses, animal feed, and human nourishment. Oilseeds, such as sunflower (Helianthus annuus), canola (Brassica napus), and soybean (Glycine max), are valued for their oil content, which varies from 20 to 50% depending on the species and is utilized in biofuels, medicines, and culinary oils. Pulses, such as lentils (Lens culinaris), peas (Pisum sativum), and chickpeas (Cicer arietinum), are high in protein (15–25%) and work as nitrogen-fixing legumes that enhance soil fertility by forming symbiotic interactions with rhizobia bacteria.

According to the Food and Agriculture Organization (FAO, 2023), the world produced about 600 million tons of oilseeds and 100 million tons of pulses in 2022. From tropical places in Asia and Africa to temperate regions in North America and Europe, these crops are grown in a variety of temperatures. However, issues like soil erosion, climatic unpredictability, and the growing need for sustainable practices call for the use of optimal agronomic techniques.

With a focus on sustainability, this article attempts to offer a thorough analysis of agronomic techniques for oilseeds and pulses. Preparing the soil, choosing seeds, planting, fertilizing, irrigating, controlling weeds and pests, and harvesting are all covered. The review emphasizes evidence-based methods that increase productivity while reducing environmental effects by using scientific research. It is a useful tool for farmers, academics, and politicians since it incorporates case studies and future directions.

Importance of Oilseeds and Pulses in Agriculture

In cropping systems, oilseeds and pulses serve as both primary food sources and rotation crops that enhance soil health. For instance, pulses fix atmospheric nitrogen, which lessens the demand for artificial fertilizers and lowers greenhouse gas emissions. For example, research by Jensen et al. (2012) showed that adding pulses to rotations boosted nitrogen availability, which raised future wheat yields by 10–15%. On the other hand, oilseeds are essential to the manufacturing of biofuels and offer high-energy feedstocks; canola oil is a crucial part of biodiesel (Smith & Johnson, 2018).

Since pulses are inexpensive sources of protein, these crops help

combat hunger in underdeveloped nations. Economically, oilseed exports from nations like Canada and Argentina add billions to international trade. However, biotic elements like pests and abiotic pressures like drought pose a danger to production, highlighting the necessity of sound agronomic techniques.

Key Challenges

Challenges are made worse by climate change, since rising temperatures impact pulse blooming and pod development (Chakraborty & Newton, 2011). While insect outbreaks, such as aphids in canola, need integrated pest management (IPM), soil deterioration from intensive cultivation lowers yields. Furthermore, crops that rely on irrigation are limited by water shortages in dry areas. In order to achieve objectives like the Sustainable Development Goals (SDGs) of the United Nations for climate action and zero hunger, sustainable practices must strike a balance between production and ecological stewardship.

Preparation and management of soil

For oilseeds and pulses, good soil management is essential. Conservation tillage minimizes soil disturbance, protects organic matter, and lessens erosion. No-till soybean systems raised soil carbon by 15% over five years, according to research conducted in the Midwest of the United States (Lal, 2015). Deep ploughing improves root penetration in compacted soils for pulses.

[Table 1: Recommended Soil pH and Nutrient Levels for Oilseeds and Pulses]

Crop	Optimal pH	Nitrogen	Phosphorus	Potassium
Soyabean	6-7	20-40	30-50	40-60
Canola	5.5-7	100-150	20-40	50-70
Chickpeas	6.5-8	10-20	20-30	30-50
Lentils	6-7.5	15-25	25-35	35-55

Source: Adapted from FAO (2021).

Compost and other organic amendments increase microbial activity, which is advantageous for nitrogen-fixing pulses. Applying vermicompost to chickpeas increased yields by 18% in India (Singh & Singh, 2019).

Planting Methods and Seed Selection

It is essential to have high-quality seeds with genetic characteristics for disease resistance. Drought-tolerant oilseed cultivars, such as drought-resistant canola hybrids, improve adaptation (Basu et al., 2016). Planting density has an impact on production; for soybeans, rows should be spaced 30 to 45 cm apart to allow light penetration and minimize lodging.

Uniform emergence is ensured by precision planting using GPS-guided equipment. Ethiopia's practice of intercropping pulses with grains lowers weeds and diversifies revenue (Alemayehu et al., 2022).

Methods of Fertilization

Nutrient utilization efficiency is maximized by balanced fertilization. Although biological nitrogen fixation (BNF) is necessary for pulses, root nodulation requires additional phosphorus. Higher nitrogen is needed for oilseeds; divided treatments (e.g., 50% at planting, 50% at blooming) stop leaching.

Manure and other organic fertilizers support sustainability. According to Brazilian research, using biofertilizers instead of synthetics increased soybean yields by 22% (Costa et al., 2021). Deficiencies are avoided with micronutrients like boron for canola.

Water Management and Irrigation

In places with limited water resources, drip irrigation saves water. Deficit irrigation during crucial periods (such as pod filling) for pulses in semi-arid areas preserves yields while conserving 30% of water (Kirda et al., 2004). Furrow irrigation helps oilseeds, such as sunflowers, prevent waterlogging.

Rainwater collecting and other climate-smart initiatives are essential. For chickpeas, mulching with leftovers decreased evaporation by 25% in Australia (Turner, 2017).

Disease, Weed, and Pest Control

Biological controls are used with a few chemicals in integrated pest management (IPM). Releasing ladybugs decreased the usage of pesticides for canola aphids by 40% (Hokkanen et al., 2015). In pulses, weeds compete for nutrients and are suppressed by mechanical weeding or

cover crops like clover.

Crop rotation and resistant types are used to control diseases like Fusarium in lentils. To prevent resistance, fungicides are used sparingly.

Harvesting and Post-Harvest Procedures

Yield losses are avoided by timely harvesting. While pulses need to be gently threshed to prevent seed damage, oilseeds are combine-harvested at 8–10% moisture. Hermetic bags lower aflatoxin in peanuts, whereas cold, dry storage preserves quality (Hell et al., 2000).

Profitability is increased by value addition, such as oil extraction for oilseeds. Pulse processing cooperatives raised farmer earnings by 15% in Ethiopia (Tadesse et al., 2020).

Regional Adaptations and Case Studies

Precision farming is used in Canada to produce canola, which utilizes fewer inputs and yields 3–4 tons/ha (Canola Council, 2022). In rainfed settings, chickpea production in India incorporates organic methods, reaching 1.5 tons/ha (Kumar et al., 2018 and Ramirez et al., 2020). These illustrations show flexibility.

Conclusion

Oilseed and pulse agronomic techniques are essential to sustainable agriculture because they provide avenues for increased yields and environmental advantages. Adopting conservation tillage, precision fertilizing, and IPM are important suggestions for addressing issues like soil degradation and climate change. Future studies should concentrate on genetic enhancements for resilience and technologies like AI-driven crop monitoring.

Farmers may increase production by 20–30% while encouraging biodiversity and lowering carbon footprints by putting these strategies into practice. Sustainable practices should be encouraged by policymakers through training and subsidies. In the end, integrated agronomic approaches will guarantee both ecological balance and food security in a changing world.

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