

System of mustard intensification

Paving the way for India's self-reliance in oilseed production

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The global vegetable oils sector, playing a crucial role in nutrition, energy, and economic stability, has witnessed a robust growth rate of 4.1% per annum over the last three decades. However, India faces a deficit of 14.1 million tonnes in edible oil, leading to increased import expenditures, reaching ₹150,800 crore in 2021–22. Escalating demand, driven by rising per capita income and consumption, necessitates innovative solutions to enhance productivity. System of Mustard Intensification (SMI) has recently caught attention of the cultivators in some not so traditional mustard growing areas of the country. Drawing inspiration from successful practices like the System of Rice Intensification, SMI optimizes mustard cultivation, emphasizing resource efficiency and minimal environmental impact. This technology has already been tested and performed well in the field experiments at the Indian Agricultural Research Institute, New Delhi, and in farmers' fields in Umariya, Madhya Pradesh. The system of mustard intensification stands as a promising agricultural innovation with the potential to address challenges in mustard cultivation, contribute to oilseeds production, and reduce import burdens. The positive outcomes observed in diverse regions underscore the importance of promoting and adopting SMI for sustainable and efficient mustard cultivation.

Keywords: Intensification, Mustard, Oilseeds, Self-reliance, Transplanting

THE global vegetable oils sector plays a pivotal role in nutrition, energy, and economic stability. Globally, despite a robust growth rate of 4.1% per annum over the last three decade and between 2015-2016 and 2020-2021, the compound annual growth rate of oilseed production of India was 7.7%, the demand for vegetable oils is outpacing supply due to cultivation challenges and uncertain profitability. The area, production, and yield of oilseeds crops in India are 25.65 million hectares (mha), 40 million tonnes (MT), and 1.5 tonnes per hectare (t/ha), respectively. Specifically, for rapeseed and mustard, the corresponding data are 9.2 mha, 11.4 MT, and 1.26 t/ha. The annual edible oil production (11.5 MT) and consumption (25.6 MT) in India, indicates a deficit of 14.1 MT edible oil per annum. To fulfil this deficit, India's import expenditure on

edible oils has increased to ₹150,800 crore in 2021–22 from ₹90,636 crore in 2020–21. The escalating demand, driven by rising per capita income and improved living standards, is expected to widen the demand-supply gap. As the current per capita consumption of ~18 kg per annum is projected to increase by 60% in developing countries, particularly in South Asia, the role of technologies/ agricultural practices in sustaining vegetable oils production to meet the demand of the world's growing population becomes important. The System of Mustard Intensification (SMI) is an agricultural innovation aimed at optimizing mustard cultivation. It draws inspiration from successful practices like the System of Rice Intensification (SRI). SMI emphasizes the judicious use of resources, incorporating scientific methods to maximize yield while minimizing environmental impact.

To highlight the significance of the system of mustard intensification, we have compiled valuable information intended for dissemination among farmers and the scientific community. This compilation aims to raise awareness about the benefits of SMI, fostering a better understanding of its potential impact.

System of mustard intensification

The system of mustard intensification is a set of agricultural practices that aims to increase mustard yields. The SMI involves:

- Using lower seed rate, seed treatments and seed priming for healthy and quick growth of seedlings
- Raising seedling in nursery and then transplanting in the main field
- Square transplanting and low plant density to minimize inter plant competition.

- Mechanical weeding, shallow irrigation at minimal interval and integrated nutrient management to minimize agro-chemical loads in soil and make farming environment friendly, improved input use efficiency or climate resilient.

Seed priming, treatment and nursery preparation

Unlike traditional methods, SMI recommends wider spacing between mustard plants. This allows each plant to receive adequate sunlight,

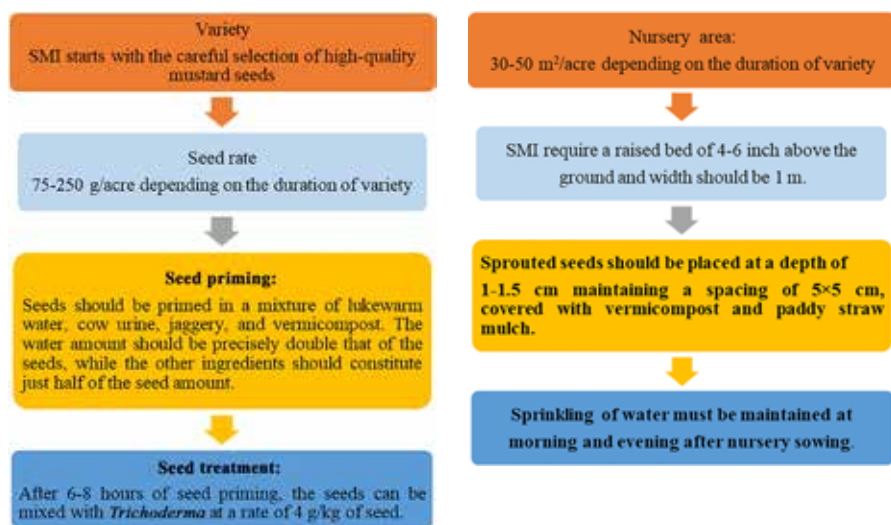


System of mustard intensification

Table 1. Contrasting features of SMI *vis-a-vis* conventional mustard cultivation

Feature	System of mustard intensification	Conventional mustard cultivation
Seed treatment (ST)	ST is very much essential in SMI with the use of <i>Trichoderma</i> , dung, urine, and compost	Yes, but only with <i>Trichoderma</i> or other fungicide
Seed rate	Low (75-250 g/acre)	High (1.5 – 2.5 kg/acre)
Spacing	Square crop geometry (30 cm x 30 cm, 45 cm x 45 cm)	Rectangular crop geometry (45 cm x 15 cm)
Methods of sowing	Transplanting	Broadcasting or Seed-drill sowing
Irrigation	Shallow irrigation at 15, 30, 45, 60, 80 and 100 DAT	Deep irrigation is essential at the branching, flowering, silique formation, and seed development stages
Weed management	Mechanical weeding	Herbicide approach
Nutrient management	The recommended approach involves the split application of fertilizer doses, combining both organic and inorganic sources	Primarily fertilizer-based, all fertilizers are applied at the time of sowing, except for nitrogen
Pest management	IPM approach	Chemical approach
Yield	25-35 quintal/ha	15-25 quintal/ha

Seed and Sowing



Seed priming, treatment and nursery preparation

Varieties: Pusa Mustard 28 (NPJ-124), Pusa Vijay (NPJ 93), CS52, RP-09, Sitara Sringer.

nutrients, and water, promoting healthier growth. Transplanting is done with precision, ensuring that each seedling is placed in the soil at the right depth. The nursery should be well-irrigated to facilitate the easy uprooting of seedlings. Transplantation is recommended at 8-12 days after sowing (DAS) or at the 3-4 leaf stage. Square planting patterns should be adhered to, with dimensions of 30 cm × 30 cm for crops below 100 days, 45 cm × 45 cm for 100-120 days, 60 cm × 60 cm for 120-130 days, and 75 cm × 75 cm for 130-150 days. Seedlings are to be transplanted at a shallow depth in each mark made during final land preparation.

Water management

SMI places a strong emphasis on efficient water management. Sprinkling of water must be maintained at morning and evening after nursery sowing. During the uprooting of the nursery for transplanting, optimal water is required to ensure the careful uprooting of seedlings without damage. One pre-sowing irrigation can be given if needed for field preparation before proper transplantation. The first irrigation is recommended at 14 days after transplanting (DAT). A second irrigation can be applied at 30 DAT, followed by weeding. The possibility of a third irrigation at 45 DAT depends on weather conditions. Ensuring healthy growth and development requires crucial irrigation at 60 DAT, 80 DAT, 100 DAT, and 120 DAT.



Nursery and transplanting

Nutrient management

During field preparation, the application of fertilizer is crucial, incorporating compost @ 8 t/acre, *Trichoderma* @ 1.5 kg/acre, DAP @27 kg/acre, and MOP @ 13.5 kg/acre. Subsequently, @ 15 DAT, plants should receive 27 kg of urea/acre. Depending on weather conditions, at 35 DAT, urea should be applied at the root zone @13.5 kg per acre. At 40 DAT, plants can be provided with

SUCCESS STORY

The field experiment conducted at the research farm of the Indian Agricultural Research Institute, New Delhi, demonstrated a positive response to the system of mustard intensification compared to traditional methods of mustard farming. The system of mustard intensification has demonstrated its excellence in numerous states. In the Umariya district of Madhya Pradesh, SMI has yielded between 4 to 5.7 tonnes per hectare of mustard, prompting nearly 10,000 farmers to adopt this innovative cultivation method. The success of SMI is not confined to Madhya Pradesh, as farmers in Bihar, Odisha, and West Bengal have also embraced the technology, reporting increased yields. Data compiled by the non-profit Preservation and Proliferation of Rural Resources and Nature (PRAN) in Gaya district, Bihar, revealed that fields using the RP-09 seed variety achieved mustard yields surpassing 4 tonnes per hectare, a fact validated by the government's Agricultural Technology Management Agency (ATMA). In addition to farmers utilizing SMI, a Rajasthan farmer and breeder have introduced a variety known as, yielding between 3-3.5 tonnes per hectare with an impressive 42% oil content.



Field visit by Dr S S Rathore (Head, Division of Agronomy), Dr T K Das (Professor, Division of Agronomy) and P R Sahu (Research Scholar), ICAR-IARI, New Delhi

Brassica carinata (PC-6)

Brassica napus (GSC 7)

Brassica juncea (Pusa Vijay)



60 cm x 60 cm transplanting



60 cm x 60 cm transplanting



60 cm x 60 cm transplanting



Direct sowing



Direct sowing



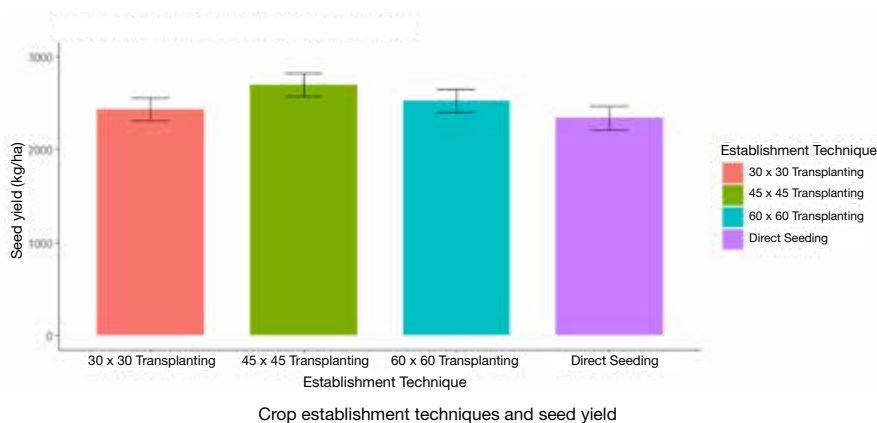
Direct sowing

Effect of system of mustard intensification on mustard plant

SUMMARY

The global vegetable oils sector has grown at 4.1% per year, but challenges in oilseed cultivation contribute to a significant edible oil deficit in India, prompting high import expenditures of ₹150,800 crore in 2021–22. The system of mustard intensification involves seed priming with dung, urine, and jaggery, followed by seed treatment with *Trichoderma*. Transplanting seedlings grown in a nursery for 10–12 days, along with optimizing soil conditions, selecting high-yield varieties, precise irrigation, timely fertilization, and effective pest control are integral components. Implementing these practices enhances mustard crop productivity and quality. The system of mustard intensification has proven successful in enhancing mustard yields, as demonstrated in various states like Madhya Pradesh, Bihar, Odisha, and West Bengal, attracting widespread adoption and contributing to agricultural advancements. It represents a significant step towards achieving self-reliance in oilseed production for India. By optimizing cultivation practices, enhancing resource efficiency, and promoting sustainability, SMI offers a holistic approach to mustard farming. As more farmers embrace this innovative system, India inches closer to reducing its dependence on edible oil imports, ensuring food security, and fostering economic prosperity for its agricultural community.

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13.5 kg of MOP per acre (equivalent to 8.1 kg of potassium per acre). The judicious use of fertilizers is a cornerstone of SMI. Soil testing is recommended to determine the specific nutrient requirements of the mustard crop. This personalized approach to nutrient management ensures that the plants receive the right balance of essential elements for robust growth.

Weed management

SMI advocates for non-chemical weed control methods. Mechanical methods such as inter-cultivation and hand weeding are preferred to minimize the environmental impact of herbicides. This approach not only reduces input costs for farmers but also aligns with sustainable farming practices. Weeding should be carried out within the first 20 days after transplanting and then again at 35 DAT to minimize competition between the crop and weeds. This can be achieved through either hand weeding or mechanical weeding.

Pest and disease management

White rust (*Albugo candida* or *A. cruciferarum*), downy mildew

(*Peronospora parasitica*), and powdery mildew (*Erysiphe cruciferarum*) stand out as the major diseases affecting mustard. These can be effectively controlled through seed treatment with *Trichoderma* at a rate of 4g/kg of seeds, followed by a single spray of Metalaxyl (Ridomil MZ) at 0.2%. Mustard aphid and painted bug are the major insects of mustard can be controlled through imidacloprid (17.8 SL) @ 0.2 g/litre.

Challenges

The system of mustard intensification prescribes specific recommendations for water, nutrients, and spacing. Some farmers may encounter challenges in implementing these agronomic principles due to resource constraints, particularly regarding nursery preparation, seed treatment, water availability and the affordability of inputs. The effectiveness of SMI may vary across regions and climates, requiring tailored approaches to suit diverse agro-ecological conditions. Addressing this challenge mandates strategic outreach and education efforts for successful adoption.

Water

- Even though households are relatively low consumers of water, population growth and expanded water use have outweighed the effect of water saving technology and behavior.
- Less than 3% of the world's water is fresh (drinkable), of which 2.5% is frozen in the Antarctica, Arctic and glaciers. Humanity must therefore rely on 0.5% for all of man's ecosystem's and fresh water needs.
- Man is polluting water faster than nature can recycle and purify water in rivers and lakes. More than one billion people still do not have access to fresh water.
- Excessive use of water contributes to the global water stress. Water is free from nature but the infrastructure needed to deliver it is expensive.

- See more at: <http://www.unep.org/wed/theme/water.asp#sthash.ki5vg3IB.dpuf>
 Courtesy: United Nations Environment Programme website - <http://www.unep.org/wed>