



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
© Agronomy
NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(2): 46-48
Received: 05-11-2025
Accepted: 13-01-2026

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The impact of organic manures on the growth and yield of toria (*Brassica campestris* L.)

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DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i2a.4830>

Abstract

The declining soil fertility and diminished productivity associated with intensive agricultural practices underscore the necessity of sustainable nutrient management strategies. Organic manure is integral to enhancing soil health, nutrient availability, and crop productivity. This study was conducted during the Rabi season of 2023–24 at the Om Sterling Global University Farm, Hisar, Haryana, India, to assess the impact of various organic manures on the growth, yield, oil content, and economic aspects of toria (*Brassica campestris* L.). The experiment employed a Randomized Block Design with 12 treatment combinations, including two varieties (T₉ and Uttara) and three organic nutrient sources: Vermicompost (2 and 4 t ha⁻¹), poultry manure (2 and 4 t ha⁻¹), and farmyard manure (10 and 15 t ha⁻¹), each replicated thrice. The findings revealed that the application of Vermicompost at 4 t ha⁻¹ to variety T₉ significantly improved growth parameters, such as plant height, number of branches, dry matter accumulation, and crop growth rate. Yield attributes, including the number of siliquae per plant and seed yield, were optimized under this treatment. The highest seed yield, oil content, net returns, and benefit–cost ratio were observed with T₉ + Vermicompost at 4 t ha⁻¹. This superior performance can be attributed to enhanced nutrient availability, improved soil structures, and increased microbial activity. The study concludes that Vermicompost at 4 t ha⁻¹ is an effective and sustainable nutrient management strategy for toria cultivation. A sustainable nutrient source for improving productivity and profitability of toria under semi-arid conditions.

Keywords: Toria, organic manures, vermicompost, poultry manure, FYM, growth, yield, sustainability

1. Introduction

Oilseeds are integral to the Indian agricultural economy and significantly contribute to the production of edible oils. Despite India's status as a leading oilseed producer, the productivity of crops such as toria remains suboptimal, primarily because of poor soil fertility, imbalanced nutrient application, and limited use of organic inputs (Babu *et al.*, 2023) ^[2]. Toria (*Brassica campestris* L.) is a short-duration oilseed crop extensively cultivated during the rabi season and is valued for its oil, fodder, and industrial applications. Continuous reliance on chemical fertilizers has led to the degradation of the physical, chemical, and biological properties of soil, resulting in a decline in factor productivity (Dhaliwal *et al.*, 2021) ^[4]. Conversely, organic manures, including Vermicompost, poultry manure, and farmyard manure (FYM), enhance soil organic carbon, nutrient availability, water-holding capacity, and microbial activity (Omokaro *et al.*, 2024) ^[11]. Vermicompost, in particular, provides nutrients in readily available forms and improves nutrient uptake efficiency (Ghosh *et al.*, 2020) ^[6]. With growing concerns regarding environmental sustainability and soil health, organic nutrient management has become increasingly important in oilseed-based cropping systems such as soybean. Consequently, the present study was conducted to examine the effects of various organic manures on the growth, yield, quality, and economics of toria under semi-arid conditions.

2. Materials and Methods

2.1. Experimental Site

The field experiment was conducted during the Rabi season of 2023–24 at the Om Sterling Global University Farm in Hisar, Haryana. This region is classified as a semi-arid agro-climatic zone, characterized by hot summers and cool winters. The soil of the experimental field was

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sandy loam in texture, nearly neutral in reaction (pH 7.6), and exhibited low organic carbon content.

2.2. Experimental Design and Treatments

The experiment was conducted using a Randomized Block Design (RBD) comprising 12 treatments with three replicates. The treatments involved two toria varieties, T₉ and Uttara, and three types of organic manure applied at varying levels: Vermicompost at 2 and 4 t ha⁻¹, poultry manure at 2 and 4 t ha⁻¹, and farmyard manure (FYM) at 10 and 15 t ha⁻¹.

2.3. Crop Management Practices

Toria was sown at a seed rate of 4 kg ha⁻¹ with a spacing of 30 × 10 cm. Organic manure was applied as a basal dose according to the treatment schedule. Standard agronomic practices, including thinning, weeding, irrigation, and plant protection measures (such as neem oil and cow urine spray), were uniformly implemented across all the treatments.

2.4. Statistical Analysis

The collected data on growth, yield, quality, and economic parameters were analysed using analysis of variance (ANOVA) within a randomized block design (RBD). The treatment means were compared at a significance level of 5%.

3. Results and Discussion

3.1. Growth Parameters

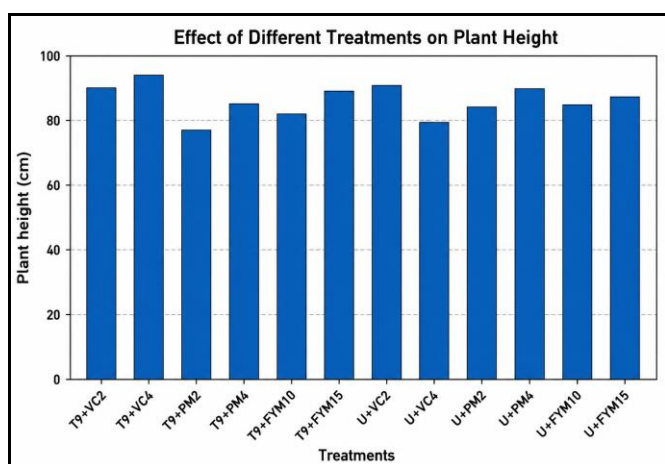


Fig 1: Effect of organic manures on plant height of toria

(Figure 1. illustrates the variation in plant height as influenced by different organic manure treatments.)

The growth performance of toria was markedly affected by the application of different organic manures. Among all treatments, the application of Vermicompost at 4 t ha⁻¹ to variety T₉ (T₉ + VC @ 4 t ha⁻¹) consistently exhibited superior growth attributes throughout the crop growth period. At harvest, the maximum plant height (92.36 cm) was recorded under T₉ + VC @ 4 t ha⁻¹, which was significantly greater than most other treatments and statistically comparable to that of Uttara + poultry manure @ 4 t ha⁻¹ and T₉ + FYM @ 15 t ha⁻¹ (Joshi *et al.*, 2014) [8]. The increased plant height under Vermicompost application may be attributed to the continuous and balanced supply of macro- and micronutrients, improved soil aeration, and enhanced microbial activity, which collectively promote cell division and elongation (Nieto-Cantero *et al.*, 2025) [10]. Similarly, the highest number of branches per plant (7.71) was observed with T₉ + VC at 4 t ha⁻¹. Adequate nitrogen availability and improved root growth under Vermicompost application might have facilitated better

vegetative growth and branching in the present study (Ali *et al.*, 2020) [1]. The results clearly indicate that Vermicompost was more effective than poultry manure and FYM in enhancing the vegetative growth of toria.

3.2. Crop Growth Rate (CGR) and Relative Growth Rate (RGR)

The crop growth rate (CGR) and relative growth rate (RGR) showed significant variation across the different treatments. Notably, the treatment T₉ + VC @ 4 t ha⁻¹ exhibited the highest CGR during the active growth phase (45–60 DAS), suggesting rapid biomass accumulation (Das *et al.*, 2021) [3]. This phenomenon may be attributed to the sustained nutrient release from Vermicompost, which facilitates continuous photosynthetic activity and efficient dry matter production. Previous studies have reported higher CGR under Vermicompost application, often linked to enhanced nutrient uptake efficiency and improved plant physiological performance.

3.3. Yield Attributes

Yield attributes, including the number of siliques per plant, seeds per silique, and test weight, were significantly influenced by the organic manure treatments. The highest number of siliques per plant (102.34) was observed under the treatment T₉ + VC @ 4 t ha⁻¹, which was statistically superior to most other treatments and comparable to Uttara + poultry manure @ 4 t ha⁻¹ (Mandal & Sinha, 2004) [9]. The improved yield attributes associated with Vermicompost application can be attributed to an enhanced source-sink relationship, more efficient translocation of photosynthates from vegetative parts to reproductive organs, and increased nutrient availability during the critical stages of crop growth. Vermicompost enhances enzymatic activity and hormonal balance in plants, ultimately leading to improved flowering, pod formation, and seed development.

3.4. Seed Yield and Biological Yield

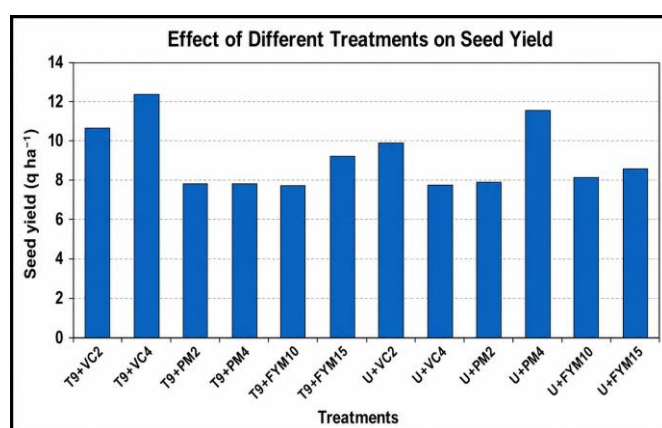


Fig 2: Effect of organic manures on seed yield of toria

(Figure 2 depicts the response of seed yield of toria to different organic manure treatments.)

Seed yield exhibited significant variation across the treatments, indicating the impact of organic nutrient sources on productivity. The highest seed yield (12.30 q ha⁻¹) was observed under the T₉ + VC @ 4 t ha⁻¹ treatment, which was significantly superior to all other treatments, followed by the Uttara + poultry manure @ 4 t ha⁻¹ (Urmi *et al.*, 2022) [12]. The increased seed yield associated with Vermicompost application can be attributed to the synergistic effects of enhanced growth and superior yield

attributes. Vermicompost improves soil physical properties, augments nutrient availability, and stimulates microbial activity, all of which contribute to improved crop establishment and yield (Durak *et al.*, 2017) ^[5]. The higher biological yield observed under this treatment further corroborates the enhanced biomass production achieved through organic-nutrient management.

3.5. Oil Content

The oil content of toria seeds was positively affected by the application of organic manure. Among the treatments, T₉ + VC @ 4 t ha⁻¹ exhibited the highest oil content, suggesting enhanced metabolic efficiency and effective nutrient utilization (Urmi *et al.*, 2022) ^[12]. The sufficient availability of nutrients, particularly nitrogen and sulphur, under Vermicompost application may have been instrumental in augmenting the oil synthesis in toria seeds.

3.6. Economics

Economic analysis identified significant differences among the treatments in terms of gross returns, net returns, and benefit–cost (B: C) ratio. The treatment T₉ + VC @ 4 t ha⁻¹ achieved the highest gross and net returns, as well as the maximum B: C ratio, which was attributed to its higher seed yield and relatively lower cultivation costs compared to other organic manure treatments (Jjagwe *et al.*, 2020) ^[7]. Based on the overall performance in terms of growth, yield attributes, seed yield, oil content, and economic returns, the application of Vermicompost at 4 t ha⁻¹ to variety T₉ was determined to be the most effective and economically viable treatment for toria cultivation under semi-arid conditions (Joshi *et al.*, 2014) ^[8].

4. Conclusion

The study clearly demonstrated that organic manure management significantly influenced the growth, yield attributes, and productivity of toria. Among the treatments evaluated, application of Vermicompost at 4 t ha⁻¹ to variety T₉ proved superior, recording the highest seed yield (12.30 q ha⁻¹) along with improved siliquae number, oil content, and economic returns. This yield advantage was attributed to enhanced nutrient availability, better soil physical condition, and increased microbial activity under Vermicompost application. Poultry manure at 4 t ha⁻¹ ranked next in performance, while FYM showed comparatively lower yield response. Overall, T₉ + Vermicompost @ 4 t ha⁻¹ emerged as the most effective and sustainable organic nutrient management practice for maximizing toria yield and profitability under semi-arid conditions, while also supporting long-term soil health.

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