



International Journal of Research in Agronomy

E-ISSN: 2618-0618
P-ISSN: 2618-060X
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NAAS Rating (2026): 5.20
www.agronomyjournals.com
2026; 9(8): 547-550
Received: 24-06-2026
Accepted: 28-07-2026

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Effect of integrated nutrient management on growth parameters of grafted brinjal cv. VNR 212 Grafted onto (*Solanum torvum*)

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DOI: <https://www.doi.org/10.33545/2618060X.2026.v9.i8g.6288>

Abstract

A field experiment was conducted during the *Kharif* season 2025 at the Department of Horticulture, School of Agricultural Sciences, G.H. Rasoni University, Saikheda, Pandhurna, Madhya Pradesh, to evaluate the effect of integrated nutrient management on the growth, flowering and fruiting of grafted brinjal (*Solanum melongena* L.) hybrid VNR-212 grafted onto *Solanum torvum*. The experiment was laid out in a Randomized Block Design (RBD) with fourteen treatments and three replications comprising different combinations of inorganic fertilizers, vermicompost, neem cake, and poultry manure. The recommended fertilizer dose of 180:70:70 kg N:P₂O₅: K₂O ha⁻¹ served as the nutrient standard. Growth parameters, flowering behaviour, and fruiting attributes were recorded at different growth stages. The results revealed that integrated nutrient management significantly influenced all growth and flowering parameters. Treatment T₁₀ (75% RDN through inorganic fertilizer + 25% RDN through poultry manure) recorded the highest plant height (78.79 cm), maximum number of primary branches (4.33 plant⁻¹), highest number of leaves (72.47 plant⁻¹), earliest flower initiation (40.93 days), minimum days to 50% flowering (53.13 days), earliest fruit initiation (78.20 days), and the maximum number of fruits per plant (16.87). These improvements were attributed to balanced nutrient availability, enhanced nutrient-use efficiency, and the vigorous root system of *Solanum torvum*, which promoted better vegetative growth and reproductive development. The study concluded that the integrated application of 75% RDN through inorganic fertilizer and 25% RDN through poultry manure is an effective nutrient management strategy for improving the growth, flowering, and fruiting performance of grafted brinjal under the agro-climatic conditions of Madhya Pradesh.

Keywords: Grafted brinjal, vermicompost, neem cake and poultry manure

Introduction

Brinjal (*Solanum melongena* L.), popularly known as eggplant or aubergine, is an important vegetable crop belonging to the family *Solanaceae* with a chromosome number of 2n = 24. It is believed to have originated in the Indo-Burma region and has been cultivated in India since ancient times. Brinjal is widely grown in tropical and subtropical regions of the world and is valued for its nutritional importance as a rich source of vitamins, minerals, dietary fibre, and antioxidants. In India, brinjal is known by different regional names, including Baingan (Hindi), Vange (Marathi), Venkaya (Telugu), Kathiri (Tamil), Ringna (Gujarati), and Vazhuthana (Malayalam) (Patel and Sarnaik, 2003; Pramila *et al.*, 2015) [5, 7].

Brinjal can be grown in a range of soils; however, deep, fertile, and well-drained soils are preferred. Brinjal grows well in slightly acidic soils with pH levels ranging from 5.5 to 6.5, and even up to pH 7.5. Maharashtra, Gujarat, Uttar Pradesh, Karnataka, Tamil Nadu, Punjab, Bihar and Madhya Pradesh are the primary brinjal-growing states in India. Madhya Pradesh ranks 4th in India for brinjal production, cultivating an estimated 0.67 lakh hectares (67,000 hectares) of land to produce approximately 14.33 lakh tonnes (1.43 million metric tonnes) of brinjal annually, with an average crop productivity of 21.38 tonnes per hectare.

Agriculture is the economic backbone of Madhya Pradesh, which currently ranks fourth nationally in brinjal (*Solanum melongena* L.) production. According to recent horticultural data, the state dedicates approximately 67,000 hectares to this crop, generating an annual output of 14.33 lakh tonnes and contributing over 9% to India's total production. While the state's average productivity

(21.38 t ha⁻¹) slightly exceeds the national average (18–19 t ha⁻¹), it remains well below its true genetic potential. This yield gap is primarily driven by improper nutrient management, devastating soil-borne diseases like bacterial and *Fusarium* wilt, and escalating abiotic stresses. To enhance productivity on shrinking cultivable land, adopting modern advanced cultivation practices—specifically vegetable grafting combined with Integrated Nutrient Management (INM)—is essential.

Vegetable grafting has emerged as a highly effective approach to combat biotic and abiotic constraints (Lee and Oda, 2003) [4]. By uniting a high-yielding scion with a resilient rootstock, grafting enhances plant vigour, extends harvest duration, and provides resistance to soil-borne pathogens. In this study, VNR-212—a popular commercial F₁ hybrid known for early flowering, uniform fruits, and high yield potential—was selected as the scion. It is grafted onto *Solanum torvum* Swartz (Turkey berry), a highly vigorous, wild rootstock that exhibits strong resistance to bacterial wilt, nematodes, and moisture stress while enhancing nutrient uptake through its extensive root system.

However, maximizing the potential of this high-vigour, extended-fruiting grafted composite requires adequate nutrient supply. Based on previous studies, grafted VNR-212 performed better with a recommended fertilizer dose of 180:70:70 kg N:P₂O₅: K₂O ha⁻¹. (RDF) (Pradhan *et al.*, 2022) [6]. Relying solely on continuous, high-dose chemical fertilizers degrades soil structure and microbial life (Erisman *et al.*, 2008) [2], while relying entirely on organic manures fails to meet the immediate crop demand. Therefore, an INM framework that strategically combines mineral fertilizers with organic sources is necessary to synchronize nutrient release with crop uptake.

Organic amendments play a distinct, complementary role in this framework. Vermicompost delivers readily available macronutrients while improving soil aeration and water retention (Edwards and Burrows, 1988) [1]. Neem cake provides essential nutrients and serves as a natural nitrification inhibitor and nematode suppressant. Poultry manure, possessing a narrow C:N ratio, acts as a highly concentrated and rapidly available nutrient source.

While the individual benefits of grafting and fertilization are well-known, limited research exists on how the VNR-212 hybrid grafted on *Solanum torvum* responds to combined organic and inorganic matrices under the unique agro-climatic conditions of Madhya Pradesh. This investigation addresses this research gap to optimize yields, maintain soil health, and maximize net returns for farmers.

Materials and Methods

The experiment was carried out in the field of Department of Horticulture, School of Agricultural Sciences, G.H. Rasoni University, Saikheda, Pandhurna, Madhya Pradesh during *khari*f 2025. The experimental site at Saikheda is geographically situated between 21°57' to 22°57' N latitude and 78°35' to 78°58' E longitude, at an approximate elevation of 340 to 450 meters above the mean sea level (MSL). The region features a typical subtropical climate, characterized by hot, dry summers (April–June) and pleasant, relatively dry, cool winters (November–February). The area experiences a sub-humid to semi-arid climate transition with an average annual rainfall ranging between 1020 mm and 1130 mm, with more than 85% of the precipitation received exclusively through the South-West monsoon stretching from June to September. The soil profile characterizing the experimental site is predominantly classified as medium to deep black cotton soil (Vertisols) mixed with clayey or silty loam, which exhibits neutral to slightly alkaline reaction alongside high

water-holding capacities. The experiment was carried out in statistical Randomized Block Design (RBD) with 14 treatments and three replications. Variety used Hybrid VNR 212(scion) + *Solanum torvum* (rootstock) with a spacing of 90 cm X 60 cm and RDF followed 180:70:70 (kg ha⁻¹) of NPK.

Half dose of nitrogen and recommended dose of phosphorus and potassium was applied at the time of transplanting and half dose of nitrogen was applied at 30 days after transplanting and organic manures like Vermicompost, Neem cake, Poultry manure were applied. Observation on growth parameters like plant height (cm), no. of primary branches, no of leaves were recorded at 45 and 90 DAT interval. Yield attributes like number of fruits per plant, fruit yield per plant (kg/plant), fruit yield per plot (kg/plot) and fruit yield per hectare (t/ha) were recorded from five selected plants in the plot area at each picking time and average was workout. Fruits were harvested at fruit maturity and yield obtained after each harvesting.

Table 1: Description of various treatments used for the cultivation of grafted brinjal (*S. melongena*)

T ₁	Control
T ₂	25% RDN supplied through inorganic fertilizer + 75% RDN through vermicompost
T ₃	50% RDN supplied through inorganic fertilizer + 50% RDN through vermicompost
T ₄	75% RDN supplied through inorganic fertilizer + 25% RDN through vermicompost
T ₅	25% RDN supplied through inorganic fertilizer + 75% RDN through neem cake
T ₆	50% RDN supplied through inorganic fertilizer + 50% RDN through neem cake
T ₇	75% RDN supplied through inorganic fertilizer + 25% RDN through neem cake
T ₈	25% RDN supplied through inorganic fertilizer + 75% RDN through poultry manure
T ₉	50% RDN supplied through inorganic fertilizer + 50% RDN through poultry manure
T ₁₀	75% RDN supplied through inorganic fertilizer + 25% RDN through poultry manure
T ₁₁	50% RDN supplied through vermicompost + 50% RDN through neem cake
T ₁₂	50% RDN supplied through poultry manure + 50% RDN through vermicompost
T ₁₃	50% RDN supplied through neem cake + 50% RDN through poultry manure
T ₁₄	100% RDF (180:70:70) kg/ha

Results and Discussion

Plant Height (cm)

The Treatment T₁₀ (75% I.N. + 25% PM) consistently recorded the maximum plant height throughout the entire crop lifecycle, peaking at 78.79 cm at final maturity. This performance was statistically at par with treatments T₉ (50% I.N. + 50% PM) and T₄ (75% I.N. + 25% VC) during early and mid-growth intervals (30–60 DAT). By peak maturity (90 DAT), the strong nutrient absorption capacity of the mature *Solanum torvum* rootstock allowed the 100% chemical baseline (T₁₄, 75.79 cm) and the pure organic matrix (T₁₂, 73.43 cm) to catch up, remaining statistically equivalent to T₁₀. Conversely, the absolute control plots (T₁) lacking systemic nutrient inputs yielded the shortest plants (63.19 cm) at harvest. The late-season canopy stabilization of the mineral baseline T₁₄ and organic matrix T₁₂ highlights the extensive subsoil foraging capacity of a fully established *Solanum torvum* root system (King *et al.*, 2010) [3].

Number of Primary branches

Primary branches were entirely absent at 30 DAT across all treatments due to early scion establishment. At the peak vegetative and flowering transition phase (60 DAT), the maximum number of primary branches was recorded under treatment T₁₀ (3.27), which remained statistically at par with T₁₁ (3.07) and T₃ (2.93). Conversely, the minimum branch development at this mid-vegetative milestone was observed in treatment T₈ (2.27), closely followed by T₁ (2.40) and T₁₄ (2.47). At final crop maturity (90 DAT), treatment T₁₀ (75% RDN through inorganic fertilizer + 25% RDN through poultry manure) maintained its structural dominance, yielding the peak value of 4.33 primary branches per plant. Statistically, T₁₀ remained at par with T₄ (4.07) and T₉ (3.93). The absolute control plots (T₁) recorded the significantly lowest final branch count (3.13), remaining statistically at par with T₁₃ (3.47) and T₁₁ (3.53). Similar findings were reported by Subbiah *et al.*, (2019) ^[9], who observed improved vegetative growth under integrated nutrient management owing to balanced nutrient availability.

Number of Leaf per plant

At 30 DAT treatment T₁₀ (75% I.N. + 25% PM) recorded the highest initial leaf count of 12.40 per plant, which was statistically comparable with T₄ (11.73), T₉ (11.53), and T₁₂ (11.27), while the absolute control plots (T₁) recorded the lowest early leaf count of 9.33. This vegetative dominance was maintained through the peak flowering transition phase (60 DAT), where T₁₀ sustained its physiological leadership by producing a peak of 29.27 leaves per plant, tightly competing and remaining statistically at par with T₄

(28.84), whereas the lowest intermediate foliar development remained restricted in the control T₁ (19.27). At final crop maturity (90 DAT), T₁₀ achieved the ultimate maximum canopy structure, yielding 72.47 leaves per plant and standing statistically at par exclusively with the vermicompost blend T₄ (66.87). Conversely, plots under control T₁ generated the significantly lowest final photosynthetic canopy at harvest (34.80), remaining statistically at par with T₁₃ (45.67). Sustained superiority under treatment and its statistical parity T₁₄ with vermicompost fractions T₄ confirms that immediate mineral delivery backed by a slow-release organic stream optimizes leaf area indexing (Mohapatra *et al.*, 2025; Ramesh *et al.*, 2020) ^[1,8].

Days to flower initiation

Treatment T₁₀ (75% RDN through inorganic fertilizer + 25% RDN through poultry manure) achieved the fastest reproductive development across all three monitored phases, recording the minimum days to flower initiation (40.93 days), days to 50% flowering (53.13 days), and days to fruit initiation (78.20 days). Statistically, T₁₀ exhibited strong precocity and remained at par with T₄ (75% I.N. + 25% VC) and T₉ (50% I.N. + 50% PM) across these parameters, whereas the absolute control plots (T₁) significantly delayed reproductive milestones, requiring 54.73 days for flower initiation, 65.00 days for 50% flowering, and 96.80 days for fruit initiation. These findings closely corroborate the observations of Pradhan *et al.*, (2022) ^[6], who evaluated the identical scion-rootstock composite (VNR-212 grafted on *Solanum torvum*) and noted that optimized, high-tier nutrient delivery frameworks drastically trigger earliness parameters.

Table 2: Effect of integrated nutrient management on plant growth, flowering and fruiting parameters of brinjal

Treatments	Plant height (cm)			Number of primary branches			No of leaves			Days to flower initiation	Days to 50% flowering	Days to fruit initiation
	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT	30 DAT	60 DAT	90 DAT			
T ₁	11.65	29.12	63.19		2.40	3.13	9.33	19.27	34.80	54.73	65.00	96.80
T ₂	14.85	38.55	67.12		2.53	3.73	10.53	23.20	56.27	43.67	57.00	89.87
T ₃	15.36	40.52	69.82		2.93	3.87	11.13	23.67	61.20	43.00	56.15	84.53
T ₄	16.79	42.21	72.63		2.47	4.07	11.73	28.84	66.87	41.67	54.67	80.47
T ₅	13.77	35.23	69.82		2.67	3.80	9.67	22.73	55.20	46.20	58.53	94.53
T ₆	14.03	34.09	63.85		2.73	3.73	10.27	23.13	53.87	45.93	58.40	94.00
T ₇	14.23	36.35	70.45		2.53	3.67	10.73	23.87	54.27	45.47	57.87	93.07
T ₈	14.90	39.85	70.87		2.27	3.80	11.13	24.47	58.07	43.33	56.40	88.13
T ₉	15.93	43.23	71.42		2.87	3.93	11.53	24.80	62.87	42.47	55.33	83.07
T ₁₀	17.77	46.36	78.79		3.27	4.33	12.40	29.27	72.47	40.93	53.13	78.20
T ₁₁	12.35	34.52	67.91		3.07	3.53	9.73	21.40	46.40	47.60	60.80	95.53
T ₁₂	13.45	37.01	73.43		2.60	3.60	11.27	22.27	48.13	46.67	60.33	94.93
T ₁₃	11.87	32.90	71.04		2.80	3.47	10.00	22.20	45.67	49.20	61.87	96.33
T ₁₄	14.69	40.63	75.79		2.47	3.67	10.13	24.67	50.33	44.93	57.40	90.27
S. Em±	0.802	1.27	3.13		0.21	0.15	0.80	1.60	1.40	0.52	0.65	0.73
CD (5%)	2.331	3.70	9.11		0.61	0.45	2.33	4.65	4.10	1.51	1.90	2.11

Conclusion

The present investigation demonstrated that integrated nutrient management significantly influenced the growth, and flowering characteristics of grafted brinjal (*Solanum melongena* L.) hybrid VNR-212 grafted onto *Solanum torvum*. Among the different nutrient combinations, treatment T₁₀ (75% RDN through inorganic fertilizer + 25% RDN through poultry manure) consistently recorded superior performance with respect to plant height, number of primary branches, number of leaves, earlier flowering, earlier fruit initiation, and maximum number of fruits per plant. The improved performance under this treatment may be attributed to the balanced and continuous supply of nutrients, enhanced nutrient uptake through the vigorous root system of *Solanum torvum*, and the beneficial effects of poultry manure on

soil fertility and microbial activity. The findings indicate that partial substitution of inorganic fertilizers with poultry manure is an effective nutrient management strategy for improving the vegetative growth and reproductive performance of grafted brinjal. Therefore, the application of 75% RDN through inorganic fertilizer combined with 25% RDN through poultry manure can be recommended as a suitable integrated nutrient management practice for achieving better growth and fruiting in grafted brinjal under the agro-climatic conditions of Madhya Prade.

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