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EFFECT OF INTEGRATED NUTRIENT MANAGEMENT ON GROWTH, YIELD AND QUALITY OF POTATO (*SOLANUM TUBEROSUM* L.) IN SOUTHERN ODISHA

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ABSTRACT: Objective of this study was to investigate the effect of the integrated nutrient management on growth, yield and quality of Potato (*Solanum tuberosum* L.). Continuous application of chemical fertilizers causes nutritional imbalance and adverse effects on the physico-chemical and biological characters of soil. Thus, an integrated nutrient supply by chemical fertilizer along with organic manures is given importance, especially in heavy feeder crops like potato. The experiment was conducted at PG Research Farm of M.S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Paralakhemundi, Odisha during *rabi* season of 2023-24 under the sandy clay loam soil with an altitude of 90 m above the mean sea level. The experiment was laid out in randomized complete block design (RCBD) with three replications and eight treatments: 100% recommended dose of nitrogen (RDN) (T_1), 90% RDN + 10% N through farm yard manure (FYM) (T_2), 90% RDN + 10% N through vermicompost (T_3), 80% RDN + 20% N through FYM (T_4), 80% RDN + 20% through vermicompost (T_5), 70% RDN + 30% through FYM (T_6), 70% RDN + 30% through vermicompost (T_7) and control (without any chemical fertilizer or organics) (T_8). The application of 100% RDN resulted in a significant increment till harvest in terms of growth parameters over the control. A significant increase in total tuber yield (239.1%), starch content (8.7%), carbohydrate content (15.8%), net return (17.26 times) was also observed under 100% RDN when compared to no chemical or organics application. Treatments integrating 90% RDN with organic amendments such as farm yard manure (FYM) and vermicompost closely matched the performance of 100% RDN. The study advocates for a balanced use of chemical and organic fertilizers, emphasizing the importance of optimizing nutrient management to achieve sustainable agricultural practices that ensure high productivity, quality and economic profitability.

KEYWORDS: Farmyard manure, nitrogen, tuber, vermicompost

INTRODUCTION

The potato (*Solanum tuberosum* L.) has a rich history, originating in the Peru-Bolivian region of the Andes in South America, and was introduced to India from Europe by the Portuguese during the seventeenth century. This crop has become integral to Indian agriculture, particularly in regions where cool season temperatures remain below 18°C, allowing it to flourish in various latitudes and altitudes within India's tropics and subtropics. Globally, the potato ranks fourth among food crops, following rice, wheat, and maize. Between 1991 and 2007, potato production increased by 21%, underscoring its rising importance as a staple food (Jimwan *et al*. 2022). Currently, about 19 million hectares are dedicated to potato cultivation worldwide, with an average yield of around 17 tonnes per hectare (FAO, 2012).

Potatoes are nutritionally significant, consisting of approximately 80% water and 20% dry matter. Their carbohydrate content, mainly in the form of starch and sugar, constitutes about 16% of their fresh weight. They also contain about 2% crude protein and

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minimal fat at 0.1%. Additionally, potatoes are rich in fiber, vitamins, and glycoalkaloids. When boiled, they provide an estimated 69 Kcal per 100 grams, offering high-quality protein with a well-balanced amino acid profile. Potatoes are known for their efficiency in yielding the highest consumable product per unit area in the shortest time, supplying 2.5 times more calories than wheat and rice (Singh *et al*. 2022).

India is the second-largest potato producer globally after China, with the crop occupying approximately 2.22 million hectares and yielding 53.6 million metric tonnes (MT) in 2020-21 (NHB Database, 2021). In Odisha, potatoes are becoming a major crop, especially during the dry season, with cultivation spanning about 15,000 hectares and yielding approximately 2.5 lakh MTs annually. However, potato productivity in Odisha is 16.48 MT/ha, below the national average of 22.76 MT/ha (GoO, 2019). Farmers in Odisha primarily grow potatoes during the *rabi* season and as a monsoon crop during kharif, particularly in the hilly regions of Koraput and Kandhamal. The main potato-growing districts in Odisha include Puri, Cuttack, Kandhamal, Mayurbhanj, Balasore, Sambalpur, and Koraput, with planting seasons extending from July to November and November to March (GoO, 2019).

Potatoes are one of the most efficient food crops, yielding significant dry matter and serving as a rich source of vitamins, minerals, dietary fiber, and quality proteins, thus constituting a substantial energy source (Zaheer and Akhtar, 2016). However, intensive potato cultivation can deplete soil nutrients, making it necessary to add organic matter to restore soil health. Integrated Nutrient Management (INM) presents a viable approach to sustainably maintain soil quality while enhancing potato productivity (Shubha *et al*. 2018). Recent studies have underscored the importance of nutrient management in optimizing potato growth. Yadav *et al*. (2017) conducted a field experiment at the ICAR- Central Research Station, Shillong, Meghalaya, and noticed that the highest tuber yield (18.8 t ha^{-1}) was recorded with the application of 75% RDN + 25% FYM when compared to the 100% RDN application (17.1 t ha^{-1}).

Given the importance of maintaining soil health and enhancing crop productivity, this study aims to investigate the effectiveness of integrated nutrient management strategies in improving potato productivity and soil health in Odisha, with a focus on optimizing fertilizer application to achieve higher yields while ensuring sustainable agricultural practices. Specifically, the objectives of this study are to study the effect of integrated nutrient management on the growth and yield of potatoes and to find out the effect of integrated nutrient management on the economics of potato cultivation. By examining these aspects, the study seeks to provide valuable insights for farmers and policymakers to improve potato cultivation in Odisha.

MATERIALS AND METHODS

The field experiment was carried out at the post Graduate research farm (23˚39' N latitude, 87˚42' E longitude) of M.S. Swaminathan School of Agriculture, Centurion University of Technology and Management, Paralakhemundi, Gajapati district, Odisha under the sandy clay loam soil with an altitude of 90 m above the mean sea level during the *rabi* season of 2023. During the crop growing season, which lasted from 4th November, 2023 to 4th February, 2024. The crop received a total rainfall of 35.35 mm. The experiment was laid out in a randomized complete block design (RCBD) with eight treatments. The treatment details are T_1:

100% recommended dose of nitrogen (RDN), T_2: 90% RDN + 10% N through FYM (*i.e.*, 2.4 t ha^{-1}), T_3: 90% RDN + 10% N through vermicompost (*i.e.*, 1.0 t ha^{-1}), T_4: 80% RDN + 20% N through FYM (*i.e.*, 4.8 t ha^{-1}), T_5: 80% RDN + 20% through vermicompost (*i.e.*, 2.0 t ha^{-1}), T_6: 70% RDN + 30% through FYM (*i.e.*, 7.2 t ha^{-1}), T_7: 70% RDN + 30% through vermicompost (*i.e.*, 3.0 t ha^{-1}) and T_8: Control (Without any chemical fertilizer or organics). The variety, Kurfi Jyoti was sown with a spacing of 50 cm x 20 cm, and all the required agronomic practices were followed to raise the crops successfully. For treatments involving the 100% recommended dose of fertilizer, the following amounts were used: 120 kg ha^{-1} of N, 60 kg ha^{-1} of P_2O_5 and 120 kg ha^{-1} of K_2O. Inorganic fertiliser sources included urea, single super phosphate (SSP), muriate of potash (MOP) and organic fertilisers like farm yard manure and vermicompost. The farm yard manure and vermicompost were applied to the soil before ten days of sowing, mixing it with soil properly. Half nitrogen and a full dose of phosphate and potash were incorporated into the soil before planting. The other half dose of nitrogen was side dressed in two equal splits at 30 and 45 DAP during earthing up. For nitrogen estimation, potassium permanganate method out lined by Subbaiah and Asija (1965) was followed. The methodology for analyzing starch involved treating the sample with 80% alcohol to remove sugars, followed by starch extraction using perchloric acid. In a hot, acidic medium, starch undergoes hydrolysis to glucose and subsequent dehydration to hydroxymethyl furfural. This compound forms a green-colored product with anthrone, as described by Hodge and Hofreiter (1962). The glucose content of the sample was determined using a standard graph, and the value was multiplied by a factor of 0.9 to obtain the starch content. For carbohydrate analysis, concentrated sulfuric acid was used to convert the carbohydrate into furfural or its derivatives, which then reacted with β-naphthol to produce a purple-colored product, also described by Hodge and Hofreiter (1962). The data were analyzed statistically by following the standard ANOVA technique, and the difference between the treatment means was tested for their statistical significance with appropriate critical difference (CD) values at a 5% level of significance (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Influence of integrated nutrient management on plant height of potato

The findings revealed that the treatments significantly impacted potato growth parameters (Table 1). In the context of the influence of integrated nutrient management on the growth and productivity of potato, the plant height served as a valuable parameter to assess the response of the crop to various nutrient management practices. The maximum plant height (64.7 cm) at harvest was recorded with the application of 100% recommended dose of nitrogen (RDN), which remained statistically at par with the application of 90% RDN + 10% N through vermicompost and 90% RDN + 10% N through farm yard manure (FYM). The lowest plant height (50.5) was noted with the control treatment, where no chemical fertilisers and organics were applied. Applying 100% RDN likely provided the plants with optimal nitrogen levels for growth, leading to the maximum plant height observed. The similar performance of the 90% RDN combined with organic sources suggests that these treatments could supply the necessary nitrogen effectively as well (Koch *et al*. 2020). Earlier, Choudhary *et al*. (2022) and Tirkey *et al*. (2023) reported similar results.

Influence of integrated nutrient management on dry matter accumulation of potato

The data on dry matter accumulation of haulm at harvest was statistically analyzed and presented in Table 1. Integrated nutrient management practices significantly influenced the accumulation of dry matter in haulm. The highest dry matter accumulation of haulm occurred where 100% RDN was applied followed by 90% RDN + 10% N through Vermicompost which was also on par with the highest recorded treatment. As anticipated, the control treatment resulted in the lowest dry matter accumulation in haulm. The data on dry matter accumulation in the tuber exhibited similar results to those of the haulm. The highest results were achieved with application of 100% RDN as nitrogen is a critical component of chlorophyll, amino acids and protein and its adequate supply influenced the vegetative growth and haulm dry matter accumulation (Congera *et al*. 2013). The close performance of 90% RDN + 10% N through vermicompost indicates that organic amendments can effectively complement chemical fertiliser to provide a balanced nutrient supply and enhance soil organic matter and structure (Sahoo *et al*. 2021). The results are in conformity with the findings of Kumar *et al*. (2020) and Narayan *et al*. (2013).

Influence of integrated nutrient management on leaf area index of potato

Observation on leaf area index recorded at 30 DAP, 60 DAP and harvest have been statistically analysed and presented in Table 2. The leaf area index of potato increased steadily up to 60 DAP and then decreased due to the rapid senescence of the older leaves as the crop progressed towards maturity. Applying 100% RDN through chemical fertiliser resulted in the maximum leaf area index in all three stages of plant growth. Among all the crop growth stages, the highest leaf area index was observed at 60 DAP. The leaf area index of potato obtained the maximum value with the application of 100% RDN at all three stages of plant growth, and it was statistically at par with the application of 90% RDN + 10% N through Vermicompost during 30 DAP and at harvest. However, during 60 DAP and at harvest, the treatment which received 90% RDN + 10% N through Vermicompost and 90% RDN + 10% N through FYM were also statistically

Table 1. Influence of integrated nutrient management on plant height, dry matter accumulation of haulm and dry matter accumulation of tuber of potato.

Treatments	Plant height (cm) at harvest	Dry matter accumulation (g m^{-2}) of haulm	Dry matter accumulation (g m^{-2}) of tuber
T_1 : 100% Recommended Dose of Nitrogen (RDN)	64.7	441.0	542.6
T_2 : 90% RDN + 10% N through Farm Yard Manure (FYM)	62.3	401.7	446.4
T_3 : 90% RDN + 10% N through Vermicompost	62.8	429.0	525.9
T_4 : 80% RDN + 20% N through FYM	61.7	344.0	436.4
T_5 : 80% RDN + 20% N through Vermicompost	61.9	361.0	444.6
T_6 : 70% RDN + 30% N through FYM	61.1	280.7	390.6
T_7 : 70% RDN + 30% N through Vermicompost	61.7	299.0	415.2
T_8 : Control (Without any chemical fertilisers or organics)	50.5	259.7	341.6
S. Em. ±	0.8	9.3	15.5
C.D. (0.05)	2.4	27.8	46.0

Table 2. Influence of integrated nutrient management on Leaf Area Index (LAI) of potato at different growth stages.

Treatments	Leaf Area Index (LAI)		
	30 DAP	60 DAP	HARVEST
T_1 : 100% Recommended Dose of Nitrogen (RDN)	0.98	3.74	2.68
T_2 : 90% RDN + 10% N through Farm Yard Manure (FYM)	0.85	3.41	2.55
T_3 : 90% RDN + 10% N through Vermicompost	0.90	3.44	2.66
T_4 : 80% RDN + 20% N through FYM	0.72	3.31	2.44
T_5 : 80% RDN + 20% N through Vermicompost	0.84	3.34	2.46
T_6 : 70% RDN + 30% N through FYM	0.60	3.19	2.26
T_7 : 70% RDN + 30% N through Vermicompost	0.74	3.21	2.32
T_8 : Control (Without any chemical fertilisers or organics)	0.26	1.54	0.89
S. Em. ±	0.03	0.13	0.89
C.D. (0.05)	0.09	0.38	0.06

at par with the highest recorded treatment. This indicates that adequate nitrogen is critical for maximising leaf expansion and canopy development. It also indicates that organic amendments can be nearly as effective as chemical fertilisers in supporting leaf growth, especially during the mid to late stages of the crop cycle (Sudhakar *et al*. 2018; Diacono and Montemurro, 2011). The results confirm the findings of Kazamba *et al.* (2019) and Mohammed *et al.* (2018).

Influence of integrated nutrient management on SPAD meter reading of potato

The data pertaining to SPAD meter reading as influenced by integrated nutrient management indicated non-significant results during 30 DAP. At 60 DAP, the 100% RDN application resulted in a significantly higher SPAD value (1.68), which was superior to all other treatments. The treatment which received 90% RDN + 10% N through vermicompost and 90% RDN + 10% N through FYM were statistically at par with the highest recorded treatment. The significant increase in SPAD value at 60 DAP with 100% RDN application suggests that nitrogen availability is closely linked to chlorophyll synthesis and leaf accumulation, which is crucial for photosynthesis and plant growth (Ghosh *et al*. 2020). It also shows that a reduced amount of chemical fertiliser, when supplemented with organic sources like FYM and vermicompost, can still support optimal chlorophyll content and plant health (Xiong *et al*. 2015). The results corroborate the findings of Kafle *et al*. (2019) (Table 3).

Influence of integrated nutrient management on growth rate (g m^{-2} day^{-1}) of potato

Crop Growth Rate (CGR) of Potato as estimated during 30-60 DAP have been presented in Table 4. It was observed that in all the stages of nutrient management the CGR significantly increased with the application of 100% RDN, followed by the treatment which received 90% RDN + 10% N through vermicompost. The lowest value was obtained with the control treatment. The higher CGR with 100% RDN suggest that the plants had an optimal nitrogen supply for vigorous growth during the critical growth period (Aytenew and Bore, 2020). Additionally, it indicates that applying organic amendments such as FYM and vermicompost with reduced doses of

Table 3. Influence of integrated nutrient management on SPAD reading of potato at different growth stages.

Treatments	SPAD reading	
	30 DAP	60 DAP
T_1 : 100% Recommended Dose of Nitrogen (RDN)	45.2	41.5
T_2 : 90% RDN + 10% N through Farm Yard Manure (FYM)	41.9	38.7
T_3 : 90% RDN + 10% N through Vermicompost	42.3	40.8
T_4 : 80% RDN + 20% N through FYM	41.1	35.3
T_5 : 80% RDN + 20% N through Vermicompost	41.2	36.3
T_6 : 70% RDN + 30% N through FYM	40.7	34.1
T_7 : 70% RDN + 30% N through Vermicompost	40.8	37.0
T_8 : Control (Without any chemical fertilisers or organics)	30.5	27.9
S. Em. ±	1.5	1.2
C.D. (0.05)	4.5	3.5

Table 4. Influence of integrated nutrient management on growth rate (g m^{-2} day^{-1}) of potato at different growth stages.

Treatments	Crop Growth Rate (g m^{-2} day^{-1}) (30 – 60 DAP)	Tuber growth Rate (g m^{-2} day^{-1}) (60 – 90 DAP)	Tuber Bulking Rate (g m^{-2} day^{-1}) (30 – 60 DAP)
T_1 : 100% Recommended Dose of Nitrogen (RDN)	9.1	15.7	0.49
T_2 : 90% RDN + 10% N through Farm Yard Manure (FYM)	8.0	11.7	0.47
T_3 : 90% RDN + 10% N through Vermicompost	8.8	15.0	0.48
T_4 : 80% RDN + 20% N through FYM	7.1	12.6	0.46
T_5 : 80% RDN + 20% N through Vermicompost	7.3	12.7	0.47
T_6 : 70% RDN + 30% N through FYM	6.0	10.0	0.44
T_7 : 70% RDN + 30% N through Vermicompost	6.1	11.3	0.44
T_8 : Control (Without any chemical fertilisers or organics)	5.6	9.3	0.28

synthetic fertiliser can be nearly as effective as sole synthetic fertiliser application (Ranjan *et al*., 2023). Similar results were reported by Hensh *et al*. (2020) and Koireng *et al*. (2018).

The tuber growth rate (TGR) estimated from tuber dry weight during 60-90 DAP has been presented in Table 4. The data on the TGR showed similar results among all the treatments except the control treatment, which obtained the lowest value (13.6 g m^{-2} day^{-1}) where no nutrient was applied. This suggests that nitrogen is a vital component for plant growth, and its adequate supply during the tuber bulking stage is crucial for optimal tuber development and the markedly lower TGR in the control treatment, where no nutrients were applied, underscores the importance of nutrient management in potato cultivation (Akkamis and Caliskan, 2023). The results are in agreement with the previous findings of Rahman *et al*. (2020) and Mondal *et al*. (2016).

The tuber bulking rate (TBR) estimated from fresh tuber weight during 30-60 DAP is presented in Table 4. The maximum TBR was obtained with the treatment that received 100% RDN (15.7 g m^{-2} day^{-1}) followed by the treatment that received 90% RDN + 10% N through Vermicompost The lowest value was obtained with the control treatment regarding TBR where no nutrients were applied. The above result signifies the importance of

nitrogen for maximising the tuber bulking process and also indicates that organic amendments can play a significant role in providing nitrogen and other nutrients, thereby supporting robust tuber growth (Akkamis and Caliskan, 2023; Meena *et al*. 2016). Earlier, Koireng *et al*. (2018) reported similar results in their study.

Influence of integrated nutrient management on Grade tuber yield, marketable yield and non-marketable yield of potato

The data on the tuber yield of potato comprising all graded at maturity has been statistically analysed and presented in Table 5. The result showed that the highest total tuber yield (23.37 t ha^{-1}) was obtained from the treatment receiving 100% RDN. Thereafter there was a decrease in the yield by 7.7%, 12.41%, 49.71%, 56.74%, 50.80%, 108.29% and 240.67% with the application of 90% RDN + 10% N through FYM, 90% RDN + 10% N through vermicompost, 80% RDN + 20% N through FYM, 80% RDN + 20% N through vermicompost, 70% RDN + 30% N through FYM, 70% RDN + 30% N through vermicompost and control treatment, respectively. The total tuber yield and the non-marketable yield showed a similar trend. The highest yield obtained with 100% RDN suggests that this nitrogen application level may be optimal for maximising potato tuber yield under the conditions tested. Nitrogen is a critical nutrient for plant growth, particularly for tuber formation and development (Rittl *et al*. 2023). The decrease in yield with reduced RDN levels and increased organic amendments indicates that while organic amendments can provide essential nutrients, they may not be as immediately available or as efficiently utilised by the plants as synthetic fertilisers (Lynch *et al*. 2008). Similar findings were reported by Chaurasiya *et al.* (2020), Kumar *et al*. (2023) and Tiwari *et al*. (2022).

Influence of integrated nutrient management on starch and carbohydrate content (%) of potato

The data on the starch and carbohydrate content was statistically analysed and presented in Table 6. The administration of 100% RDN produced the maximum starch content, and this result was statistically

Table 5. Influence of integrated nutrient management on Grade wise tuber yield, marketable yield and non-marketable yield of potato (t ha^{-1}).

Treatments	Grade wise tuber yield of potato (t ha^{-1})					Total tuber yield (t ha^{-1})
	A >75g	B >50g – 75g	C >25g – 50g	Marketable yield (t ha^{-1})	Non-Marketable yield ≤ 25g	
T_1 : 100% Recommended Dose of Nitrogen (RDN)	7.6	7.2	6.9	21.7	1.7	23.4
T_2 : 90% RDN + 10% N through Farm Yard Manure (FYM)	6.6	6.4	6.3	19.3	1.5	21.8
T_3 : 90% RDN + 10% N through Vermicompost	6.9	6.4	6.6	20.1	1.6	22.7
T_4 : 80% RDN + 20% N through FYM	4.8	5.1	3.8	13.6	1.3	14.9
T_5 : 80% RDN + 20% N through Vermicompost	5.0	5.3	3.9	14.2	1.4	15.6
T_6 : 70% RDN + 30% N through FYM	3.4	3.6	3.1	10.1	1.1	11.2
T_7 : 70% RDN + 30% N through Vermicompost	4.6	5.0	3.6	13.3	1.1	14.4
T_8 : Control (Without any chemical fertilisers or organics)	2.2	1.8	1.7	5.8	1.1	6.9
S. Em. ±	0.8	0.6	0.4	1.4	0.1	1.4
C.D. (0.05)	2.4	1.9	1.2	4.2	0.3	4.2

Table 6. Influence of integrated nutrient management on Starch and carbohydrate content (%) of potato.

Treatments	Quality parameter	
	Starch Content (%)	Carbohydrate content (%)
T_1 : 100% Recommended Dose of Nitrogen (RDN)	18.6	60.6
T_2 : 90% RDN + 10% N through Farm Yard Manure (FYM)	17.1	57.6
T_3 : 90% RDN + 10% N through Vermicompost	18.1	59.5
T_4 : 80% RDN + 20% N through FYM	15.9	57.4
T_5 : 80% RDN + 20% N through Vermicompost	17.9	57.6
T_6 : 70% RDN + 30% N through FYM	16.5	57.2
T_7 : 70% RDN + 30% N through Vermicompost	17.6	57.3
T_8 : Control (Without any chemical fertilisers or organics)	14.1	52.3
S. Em. ±	0.7	0.8
C.D. (0.05)	2.2	2.3

comparable to treatments that received 90% RDN + 10% N through vermicompost and 90% RDN + 10% N through FYM. The treatment with the lowest starch level was the control treatment, which did not receive any organic or chemical fertiliser. Similar trends were seen in the data on the amount of carbohydrates, except the treatment that received 90% RDN + 10% N through vermicompost, which stayed on par with the 100% RDN application. This can be attributed to nitrogen, which plays a crucial role in the synthesis of starch, a primary storage carbohydrate in potato. The high starch content with 100% RDN suggests the plants had an optimal nitrogen supply for starch synthesis during the tuber development stage (Goss *et al*. 2013). The comparable starch content in treatments with 90% RDN + 10% N through FYM and vermicompost indicates that organic amendments can effectively supplement chemical fertilisers to provide the necessary nitrogen for starch production (Iqbal *et al*. 2022). Similar results were observed by Walia *et al.* (2023), Srija *et al*. (2022), Biswas and Dutta (2020) and Mohamed *et al*. (2016).

Influence of integrated nutrient management on the economics of potato

The data presented in Table 7 demonstrates the economics of potato cultivation as

Table 7. Influence of integrated nutrient management on the economics of Potato.

Treatments	Economics			
	Cost of cultivation (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B:C
T_1 : 100% Recommended Dose of Nitrogen (RDN)	90236	350600	260364	2.89
T_2 : 90% RDN + 10% N through Farm Yard Manure (FYM)	111938	311900	199962	1.79
T_3 : 90% RDN + 10% N through Vermicompost	111538	325550	214012	1.92
T_4 : 80% RDN + 20% N through FYM	132872	223675	90003	0.67
T_5 : 80% RDN + 20% N through Vermicompost	133672	234200	101328	0.76
T_6 : 70% RDN + 30% N through FYM	155437	168275	12838	0.08
T_7 : 70% RDN + 30% N through Vermicompost	154237	215850	61613	0.40
T_8 : Control (Without any chemical fertilisers or organics)	88671	102925	14255	0.16

affected by integrated nutrient management practices. Applying 100% RDN resulted in the highest gross return (350600 Rs. /ha) and net return (260364 Rs. /ha) followed by the treatment that received 90% RDN + 10% N through vermicompost. The highest benefit cost ratio was obtained with 100% RDN application which is likely due to lower cost of cultivation and it was followed by the treatment which received 90% RDN + 10% N through vermicompost. This indicates that the investment in nitrogen fertilization paid off significantly, resulting in increased yield and profitability. Interestingly, the treatment that received 90% RDN + 10% N through vermicompost closely followed the returns of the 100% RDN treatment. This suggest that integrating organic amendments like vermicompost can be a effective strategy compared to FYM. The results are in conformity with the findings of Chaudhary *et al*. (2022), Pandit *et al*. (2021) and Patel *et al*. (2022).

CONCLUSION

This study has demonstrated the significant impact of integrated nutrient management (INM) practices on the growth, yield, and quality of potato. The application of a 100% recommended dose of nitrogen (RDN) resulted in the highest growth, yield and quality performance, underscoring the critical role of nitrogen in potato cultivation. Notably, treatments integrating 90% RDN with organic amendments such as vermicompost closely matched the performance of 100% RDN in several parameters, highlighting the effectiveness of INM practices.

The findings emphasize the potential of INM to optimize crop productivity while enhancing soil health and sustainability. The economic analysis revealed that the highest gross and net returns were achieved with 100% RDN, with the benefit-cost ratio affirming its financial viability. However, the near-equivalent performance of specific treatments with organic amendments suggests that by fine-tuning nutrient levels and integrating organic sources, potato growers can achieve a balance between yield optimization and long-term profitability.

In response to the scientific hypotheses and objectives raised, the study confirms that INM can significantly enhance potato growth and yield, as well as improve the economics of potato cultivation. Future research should focus on refining nutrient management strategies and exploring additional organic amendments to further enhance sustainable potato production.

CONFLICT OF INTEREST

The authors declare that they have no conflict of interest

ETHICAL STATEMENT

This article does not contain any studies with human participants or animals performed by any of the authors

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