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Effect of integrated nutrient management on baby corn (*Zea mays* L.) in new alluvial zone of West Bengal, India in rabi season

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Abstract
A field experiment was conducted in the rabi season of 2021-2022 at the District Seed Farm (AB) of Bidhan Chandra Krishi Viswavidyalaya (B.C.K.V.), Kalyani, Nadia, West Bengal, India with the objectives of to study the effect of Integrated Nutrient Management (INM) on the growth, yield attributes, yield, and economics of baby corn, and to evaluate the nutrient uptake and residual soil fertility under different INM treatments.

The analysis was carried out by using a Randomized Block Design (RBD) with 3 replications and 7 treatments, namely, T_1 [Farmers' Fertilizer Practice (120:60:40 kg N:P_2O_5:K_2O ha^{-1})], T_2 [Recommended Dose of Fertilizer (RDF) (150:60:40 kg N:P_2O_5:K_2O ha^{-1})], T_3 [RDF + Green Manuring (Dhaincha)], T_4 (RDF + 5 t ha^{-1} FYM), T_5 (RDF + 10 t ha^{-1} FYM), T_6 (RDF + 15 t ha^{-1} FYM), and T_7 (RDF + 20 t ha^{-1} FYM). Other cultivation practices were kept according to standard recommendations.

Plant height (cm), leaf area index (LAI), dry matter accumulation, and crop growth rate (g.m^{-2}.day^{-1}) were all recorded under the T_7 treatment, which was statistically at par with T_6 at all stages of crop growth. The T_7 treatment had a 50.4% higher average cob yield without husk than the T_1 treatment (Farmers' Fertilizer Practice) as well as the highest gross return (Rs. 3,78,938.52 ha^{-1}) and net return (Rs. 2,77,588.52 ha^{-1}),but the T_6 treatment had the highest benefit-cost ratio (4.02).

As a result, from the findings it can be concluded that cultivating baby corn in the new alluvial zone of West Bengal with RDF + 15 t ha^{-1} FYM is a suitable option for increasing yield, income and nutrients absorption during the rabi season.

Keywords: Integrated nutrient management, soil health, plant height, leaf area index, dry matter accumulation, crop growth rate

Introduction
Maize, a term derived from the Haitian Arawak language and the Spanish word "mahiz" is widely recognized as a staple food crop, ranking third in global production behind rice and wheat. In India, maize holds extraordinary importance due to its diverse uses in food, feed, and industrial sectors. Baby corn cultivation has emerged as an effective method for increasing the value and diversity of maize production, especially in West Bengal.

Baby corn, harvested before fertilization, offers lucrative domestic and international market opportunities. Well-established in Chinese culinary practices, baby corn has gained prominence across various Asian regions, finding its way into diverse dishes. Nutritionally, it is comparable to other non-legume vegetables like cauliflower, tomato, cucumber, and cabbage. A 100-gram serving of baby corn typically contains 89.1% moisture, 0.2 grams of fat, 1.9 grams of protein, 8.2 grams of carbohydrates, 0.06 grams of ash, 28.0 milligrams of calcium, 86.0 milligrams of phosphorus, and 11.0 milligrams of ascorbic acid (Thavaprakash *et al.*, 2005; Das *et al.*, 2008) [16, 3]. The development of baby corn has been notably successful in countries like Thailand and Taiwan. In India, there is a growing interest in exploring its potential to boost farmers' economic returns and foreign exchange earnings. Its cultivation is increasingly popular in various regions, including Meghalaya, western Uttar Pradesh, Haryana, Maharashtra, Karnataka, and Andhra Pradesh (Ramachandrappa *et al.*, 2004) [13].

Baby corn has emerged as a lucrative crop providing opportunities for increased income, value accumulation, and production diversification (Pandey *et al.*, 2002) [12]. It has gained favor among producers in peri-urban areas due to its flexibility and promising returns. According to research (Barik *et al.*, 2016) [2], cultivating baby corn as a standalone crop, compared to other intercropping systems, significantly increases corn yield per hectare, baby corn production, gross returns, and return on investment.

The agronomic requirements for growing baby corn are very similar to those for growing grain maize, with a few exceptions, such as choosing the right varieties, adjusting the density of the plant population, applying more nitrogen, and most importantly, harvesting early. The application of fertilizer and other cultural management practices profoundly impacts baby corn yield and quality. Maize yield and quality are significantly influenced by the nutritional levels provided to the plants (Kunushi *et al.*, 1986) [9].

The goal of this study is to find out how Integrated Nutrient Management (INM) affects baby corn production in the new alluvial zone of West Bengal during the rabi season. The study specifically examines growth attributes, yield, economics, nutrient uptake, and soil fertility under various INM practices. The research addresses the critical need for sustainable nutrient management practices in maize cultivation, considering the challenges posed by reliance on inorganic fertilizers and the imperative to maintain soil health and productivity. This study aims to improve maize crop yield, economic viability, and soil sustainability through a balanced approach that incorporates both chemical and organic fertilizers.

2. Materials and Methods

The main goal of the study was to determine how integrated nutrient management affects baby corn (*Zea mays L.)* in the new alluvial zone of West Bengal, India, during the Rabi season. The trial was carried out at the District Seed Farm of Bidhan Chandra Krishi Viswavidyalaya during the rabi season of 2021–2022. The area had a subtropical climate characterized by hot summers, variable rainfall, and high humidity. The pH of the sandy loam soil was neutral, and it was medium-fertile.

7 treatments were replicated 3 times in the experiment, which used a Randomized Block Design with a total of 21 plots. Plot dimensions were 5 m x 5 m, bund width was 0.5 m, and irrigation channel width was 1.0 m. The seed rate was 25 kg/ha, and spacing was 50 cm x 20 cm. The hybrid baby corn variety G-5414 was utilized in the experiment. These crops typically ranged in height from 180 to 220 cm. Fertilizer application varied throughout the treatments, utilizing organic sources such as Farm Yard Manure (FYM) and Green Manuring (Dhaincha).

In the T_1 treatment [Farmers' Fertilizer Practice (120:60:40 kg $N:P_2O_5:K_2O$ ha^{-1})], 1/3 of the nitrogen was applied as the basal dosage, 1/3 as the first top dressing three weeks after sowing, and the remaining 1/3 as the second top dressing at 50 DAS. In T_2 [RDF (150:60:40 kg $N:P_2O_5:K_2O$ ha^{-1})] and T_3 [RDF + Green Manuring (Dhaincha)], the nutrient application was the same as T_1, and green manuring was carried out at least 15 days prior to sowing in T_3. In T_4 (RDF + 5 t ha^{-1} FYM), the nutrient application was the same as T_1, and FYM was applied 15 days before sowing. In T_5 (RDF + 10 t ha^{-1} FYM), T_6 (RDF + 15 t ha^{-1} FYM), and T_7 (RDF + 20 t ha^{-1} FYM), the nutrient and FYM application was the same as in T_4.

The nutritional contents of the organic sources employed in the experiment were as follows: Farm Yard Manure (FYM) contained 0.5% nitrogen (N), 0.2% phosphorus pentoxide (P_2O_5), and 0.5% potassium oxide (K_2O), whereas Green Manure (Dhaincha) had 3.50% N, 0.60% P_2O_5, and 1.20% K_2O.

Field activities were carefully planned, encompassing weeding, irrigation, fertilizing, seeding, harvesting, and land preparation. Several biometric observations, including plant height, leaf area index, and dry matter accumulation at distinct growth phases, were recorded. Yield components such as the number of cobs per plant, cob length, and cob girth were also recorded. To assess changes in soil fertility, nutrient uptake by baby corn and residual soil fertility analysis after harvest of baby corn were carried out.

Estimating the cost of cultivation, gross return, net return, and benefit-cost ratio were all part of the economic analysis. Analysis of Variance was used in the statistical analysis to determine the significance of differences among the treatments.

Overall, by combining agronomic, economic, and appropriate statistical procedures applied to the raw data, the study offered thorough insights into the impacts of Integrated Nutrient Management on the cultivation of baby corn (Gomez and Gomez, 1984) [5].

3. Results and Discussion

3.1 Growth attributes

Plant height was measured at 20, 40, and 60 days after sowing (DAS) and was highly impacted by integrated nutrient management. Short-stature plants (30.71 cm, 119.08 cm, and 209.53 cm at 20, 40, and 60 DAS, respectively) were produced in treatment T_1 (Farmers' Fertilizer Practice), where the plot received 120:60:40 kg $N:P_2O_5:K_2O$ ha^{-1}. Tall-stature plants (46.81 cm, 141.02 cm, and 231.11 cm at 20, 40, and 60 DAS, respectively) were produced from treatment T_7, which received RDF + 20 t ha-1 FYM, and this was statistically similar to treatment T_6, which received RDF + 15 t ha-1 FYM. Plant height increased significantly with an increase in FYM level up to 20 t ha-1 + RDF at all growth phases, according to the mean data. Higher FYM + RDF may have encouraged plant growth, which in turn increased the number and length of internodes due to more cell division and cell elongation, ultimately leading to higher plant height. This could explain the increase in plant height associated with higher FYM dosages + RDF (Mahapatra *et al.*, 2018; Hussain *et al.*, 2014; Singh *et al.*, 2016) [11, 7, 15].

Table 1: Effect of Integrated Nutrient Management on Plant height of Baby Corn

Treatments	Plant height (cm)		
	20 DAS	40 DAS	60 DAS
T_1-Farmers' Fertilizer practice (120:60:40 kg N: P_2O_5:K $_2$O ha^{-1})	30.71	119.08	209.53
T_2- RDF (150:60:40 kg N: P_2O_5:K_2O ha^{-1})	33.81	121.59	212.97
T_3- RDF + Green Manuring (Dhaincha)	36.90	123.84	213.72
T_4- RDF + 5 t ha^{-1} FYM	38.08	130.48	222.50
T_5- RDF + 10 t ha^{-1} FYM	42.32	134.13	225.50
T_6- RDF + 15 t ha^{-1} FYM	46.69	140.07	230.07
T_7- RDF + 20 t ha^{-1} FYM	46.81	141.02	231.11
SEm (±)	0.23	0.53	0.63
CD at 5%	0.72	1.65	1.97

The leaf area index (LAI) is a crucial growth parameter that directly impacts photosynthesis, crop yield, solar radiation absorption by the canopy, and more. The LAI of baby corn was measured at 20, 40, and 60 days after sowing (DAS), showing a rising trend from 20 DAS to 60 DAS. Statistical analysis of the recorded data revealed that integrated nutrient management significantly impacted the LAI. Treatment T_7, in which crops received RDF + 20 t ha-1 FYM, had the highest LAI (0.98, 2.41, and 4.85 at 20, 40, and 60 DAS, respectively), which was statistically comparable to treatment T_6, in which crops received RDF + 15 t ha-1 FYM. The lowest LAI (0.73, 2.16, and 3.89) was observed in treatment T_1 (Farmers' Fertilizer Practice).

At all growth stages, the mean data showed that the LAI increased significantly with FYM levels up to 20 t ha^{-1} + RDF. The increase in LAI may be due to the enhanced photosynthetic activity and the number of leaves per plant with higher FYM and RDF doses. Under integrated nutrient management, higher canopy development was facilitated by taller plants with an abundance of leaves, which may have enhanced photosynthesis by increasing light interception, absorption, and utilization of solar radiation (Mahapatra *et al*., 2018; Jinjala *et al*., 2016) [11, 8].

Table 2: Effect of Integrated Nutrient Management on LAI of Baby Corn

Treatments	Leaf Area Index (LAI)		
	20 DAS	**40 DAS**	**60 DAS**
T_1-Farmers' Fertilizer practice (120:60:40 kg N: P_2O_5:K_2O ha^{-1})	0.73	2.16	3.89
T_2- RDF (150:60:40 kg N: P_2O_5:K_2O ha^{-1})	0.82	2.18	4.26
T_3- RDF + Green Manuring (Dhaincha)	0.86	2.22	4.31
T_4- RDF + 5 t ha^{-1} FYM	0.93	2.27	4.71
T_5- RDF + 10 t ha^{-1} FYM	0.95	2.27	4.73
T_6- RDF + 15 t ha^{-1} FYM	0.97	2.40	4.83
T_7- RDF + 20 t ha^{-1} FYM	0.98	2.41	4.85
SEm (±)	0.008	0.031	0.02
CD at 5%	0.02	0.09	0.08

Dry matter accumulation (DMA) is one of the most important parameters impacting crop yield. When sufficient dry matter is accumulated and enough assimilates are distributed to the growing sink, crops can reach their full yield potential. In the study, it was observed that up to 60 DAS (days after sowing), DMA of baby corn increased in all the treatments. The T_7 treatment had the highest DMA rate (98.97, 565.59, and 901 g/m² at 20, 40, and 60 DAS respectively), which was statistically at par with the results of the T_6 treatment (68.13, 442.23, and 657.33 g m^{-2}).

According to statistical observations, RDF (recommended dose of fertilizers) and an increased dose of FYM (farmyard manure) up to 20 t/ha both played an important role in the DMA rate at all growth stages. Increased light interception, absorption, and utilization of solar radiation enhanced the photosynthetic activities of the crop, which was reflected in the production of dry matter. Additionally, the incorporation of organic manure and inorganic fertilizers increased the availability and absorption of nutrients, leading to maximum crop growth through the production of growth-promoting substances and the solubilization of nutrients (Thavaprakash and Velayudham, 2007; Dadarwal *et al*., 2009; Rasool *et al*., 2015) [17, 4, 14].

Table 3: Effect of Integrated Nutrient Management on Dry matter accumulation of Baby Corn

Treatments	Dry matter accumulation (g m-2)		
	20 DAS	**40 DAS**	**60 DAS**
T_1-Farmers' Fertilizer practice (120:60:40 kg N: P_2O_5:K_2O ha^{-1})	68.13	442.23	657.33
T_2- RDF (150:60:40 kg N: P_2O_5:K_2O ha^{-1})	70.46	448.27	689.43
T_3- RDF + Green Manuring (Dhaincha)	79.44	514.27	763
T_4- RDF + 5 t ha^{-1} FYM	84.36	520.81	791.33
T_5- RDF + 10 t ha^{-1} FYM	89.18	528.89	805.33
T_6- RDF + 15 t ha^{-1} FYM	97.58	563.53	883.41
T_7- RDF + 20 t ha^{-1} FYM	98.97	565.59	901
SEm (±)	0.607	2.30	16.13
CD at 5%	1.87	7.09	49.7

Regardless of the treatments, the crop growth rate (CGR) value increased rapidly between 20 and 40 days after sowing (DAS) and then decreased between 40 and 60 DAS due to leaf senescence. The maximum crop growth rate was observed in treatment T_7, with a CGR of 23.33 g m^{-2} day $^{-1}$ at 20-40 DAS and 16.77 g m^{-2} day $^{-1}$ at 40-60 DAS, when the crop received RDF + 20 t ha^{-1} FYM. This was statistically comparable to treatment T_6, where the CGR was 23.30 g m^{-2} day $^{-1}$ at 20-40 DAS and 15.99 g m^{-2} day $^{-1}$ at 40-60 DAS, when the crop received RDF + 15 t ha^{-1} FYM. The minimum CGR was observed in treatment T_1 (Farmers' Fertilizer Practice) with a CGR of 18.7 g m^{-2} day $^{-1}$ at 20-40 DAS and 10.76 g m^{-2} day $^{-1}$ at 40-60 DAS. There was no critical change in crop development rate by the harvest among treatments.

Table 4: Effect of Integrated Nutrient Management on Crop growth rate of Baby Corn

Treatments	CGR (g m^{-2} day^{-1})	
	20-40 DAS	40-60 DAS
T_1-Farmers' Fertilizer practice (120:60:40 kg N: P_2O_5:K_2O ha^{-1})	18.7	10.76
T_2- RDF (150:60:40 kg N: P_2O_5:K_2O ha^{-1})	18.89	12.06
T_3- RDF + Green Manuring (Dhaincha)	21.74	12.44
T_4- RDF + 5 t ha^{-1} FYM	21.82	13.53
T_5- RDF + 10 t ha^{-1} FYM	21.99	13.82
T_6- RDF + 15 t ha^{-1} FYM	23.30	15.99
T_7- RDF + 20 t ha^{-1} FYM	23.33	16.77
SEm (±)	0.11	0.81
CD at 5%	0.36	NS

3.2 Yield attributes
In the observation, it was found that the number of cobs per plant was statistically significant. Treatment T_1 showed the lowest number of cobs per plant (1.52), while treatment T_7 (2.06) showed the highest, and it was statistically on par with treatment T_6 (2.04).
Similarly, in terms of cob length and cob girth, treatment T_7 showed the highest results (cob length: 8.59 cm, cob girth: 1.45 cm), which were very close to the results observed in plants under treatment T_6 (cob length: 8.22 cm, cob girth: 1.35 cm). In contrast, plants under treatment T_1 had the lowest outcomes (cob length: 6.75 cm, cob girth: 1.2 cm).
This is because integrated nutrient management appears to have increased crop productivity, cob girth, cob length, and cob weight due to the greater availability of photosynthates, metabolites, and nutrients for the development of reproductive structures (Jinjala *et al*., 2016) [8].

Table 5: Effect of Integrated Nutrient Management on Yield attributes and associated parameters of Baby Corn

Treatments	No. of cobs/plant	Cob length (cm)	Cob girth (cm)
T_1-Farmers' Fertilizer practice (120:60:40 kg N: P_2O_5:K_2O ha^{-1})	1.52	6.75	1.2
T_2- RDF (150:60:40 kg N: P_2O_5:K_2O ha^{-1})	1.63	7.01	1.24
T_3- RDF + Green Manuring (Dhaincha)	1.67	7.34	1.24
T_4- RDF + 5 t ha^{-1}	1.71	7.42	1.28
T_5- RDF + 10 t ha^{-1} FYM	1.92	7.86	1.30
T_6- RDF + 15 t ha^{-1} FYM	2.04	8.22	1.35
T_7- RDF + 20 t ha^{-1} FYM	2.06	8.59	1.45
SEm (±)	0.04	0.15	0.02
CD at 5%	0.13	0.48	0.08

3.3 Yield
The experiment showed significant variation in cob yield with husk among the treatments. Treatment T_7 produced the highest yield with husk (6.01 t ha^{-1}), which was statistically similar to Treatment T_6 (5.85 t ha^{-1}). In contrast, Treatment T_1 resulted in the lowest yield with husk (4.31 t ha^{-1}). Incorporating organic and inorganic nutrient sources while maintaining a balanced C:N can enhance baby corn yield and related attributes (Lone *et al*., 2013; Gupta *et al*., 2014) [10, 6].
For cob yield without husk, Integrated Nutrient Management (INM) positively influenced all treatments compared to Treatment T_1 (100% Farmers' fertilizer practice), with Treatment T_7 showing the highest result (2.56 t ha^{-1}), statistically similar to Treatment T_6 (2.48 t ha^{-1}). The minimum yield was found in Treatment T_1 (1.29 t ha^{-1}). The significant increase in cob yield without husk under these treatments was due to improvements in yield components such as cob length, cob girth, and the number of cobs per plant. The enhancement of yield might be attributed to the effective utilization of applied nutrients, better assimilation of photosynthates, and their efficient translocation from source to sink, resulting in an overall yield improvement and a beneficial effect on soil properties (Lone *et al*., 2013) [10].
Fodder yield was also influenced by the INM approach. The maximum fodder yield was observed in Treatment T_7 (35.59 t ha), which was statistically similar to Treatment T_6 (34.76 t ha^{-1}), while Treatment T_1 showed the minimum fodder yield (24.50 t ha^{-1}). The integrated application of organic and inorganic nutrient sources may have increased the protoplasmic constituents and accelerated cell division and elongation processes, leading to increased growth attributes and fodder yields (Lone *et al*., 2013) [10].

Table 6: Effect of Integrated Nutrient Management on Yield of Baby Corn

Treatments	Baby corn yield with husk (t ha^{-1})	Baby corn yield without husk (t ha^{-1})	Fodder Yield (t ha^{-1})
T_1-Farmers' Fertilizer practice (120:60:40 kg N: P_2O_5:K_2O ha^{-1})	4.31	1.29	24.50
T_2- RDF (150:60:40 kg N: P_2O_5:K_2O ha^{-1})	4.40	1.36	25.56
T_3- RDF + Green Manuring (Dhaincha)	4.71	1.40	28.51
T_4- RDF + 5 t ha^{-1} FYM	5.09	1.52	31.46
T_5- RDF + 10 t ha^{-1} FYM	5.5	1.9	32.65
T_6- RDF + 15 t ha^{-1} FYM	5.85	2.48	34.76
T_7- RDF + 20 t ha^{-1} FYM	6.01	2.56	35.59
SEm (±)	0.056	0.028	0.65
CD at 5%	0.17	0.08	2.00

3.4 Nutrient uptake

In the experiment, it was found that Treatment T_7 recorded the maximum uptakes of N, P, and K (N-200.33 kg ha^{-1}, P-65.33 kg ha^{-1}, K-118.76 kg ha^{-1}), which was statistically similar to Treatment T_6 (N-199 kg ha^{-1}, P-65 kg ha^{-1}, K-118.46 kg ha^{-1}). The increase in nutrient availability led to higher nutrient uptake. The minimum uptake was registered by the plants under Treatment T_1 (N-135.33 kg ha^{-1}, P-46 kg ha^{-1}, K-85.46 kg ha^{-1}). Accelerated growth in terms of dry matter production (DMP) and N content augmented more N uptake in crops (Bharathi *et al.*, 2020) [1]. The higher uptake of N, P, and K with the combined application of organic and inorganic sources of nutrients, compared to inorganic sources alone, was attributed to proportionate increases in dry matter production and total biological yield, ultimately resulting in increased total nutrient uptake (Bharathi *et al.*, 2020) [1].

Table 7: Effect of Integrated Nutrient Management on Nutrient Uptake of Baby Corn

Treatments	N uptake (Kg ha^{-1})	P_2O_5 uptake (Kg ha^{-1})	K_2O uptake (Kg ha^{-1})
T_1-Farmers' Fertilizer practice (120:60:40 kg N: P_2O_5:K_2O ha^{-1})	135.33	46	85.64
T_2- RDF (150:60:40 kg N: P_2O_5:K_2O ha^{-1})	145.67	46.33	90.52
T_3- RDF + Green Manuring (Dhaincha)	153.67	48.67	96.47
T_4- RDF + 5 t ha^{-1} FYM	163.33	59.67	98.62
T_5- RDF + 10 t ha^{-1} FYM	178	62.33	99.58
T_6- RDF + 15 t ha^{-1} FYM	199	65	118.46
T_7- RDF + 20 t ha^{-1} FYM	200.33	65.33	118.76
SEm (±)	0.45	0.45	0.56
CD at 5%	1.38	1.40	1.72

3.5 Soil nutrient status after harvest

After the harvest of baby corn, the residual soil fertility was evaluated at a soil depth of 0-15 cm. In terms of soil organic carbon percentage, no significant difference was found among the treatments. Due to the addition of organic matters such as FYM and green manure, all the treatments showed an increase in organic carbon content, except for treatment T_1, which remained at the initial level (before sowing). However, after harvest, the maximum soil nitrogen was available in treatment T_1 (254.3 kg ha^{-1}), while the minimum was in treatment T_7 (140.2 kg ha^{-1}). In the plots that received organic manures, microbiological activities were high, resulting in increased plant nutrient availability. The lower level of soil available nitrogen after harvest in treatment T_7 was due to greater uptake of nitrogen by the crop.

No significant variation was found among the treatments with respect to residual phosphorus. However, an increasing trend was observed in all treatments compared to the initial soil phosphorus levels. During the decomposition of organic manures, various phenolic and aliphatic acids are produced. These acids help solubilize phosphatase and other phosphate-bearing minerals, reducing phosphate fixation and increasing its availability in the soil. After harvest, the highest available potassium was recorded in treatment T_1 (254.3 kg ha^{-1}), while the lowest was observed in treatment T_7 (140.2 kg ha^{-1}).

Table 8: Effect of Integrated Nutrient Management on Residual Soil Fertility after harvesting of Baby Corn

Treatments	Soil Organic carbon (%)	Soil available N (Kg ha^{-1})	Soil available P_2O_5 (Kg ha^{-1})	Soil available K_2O (Kg ha^{-1})
T_1-Farmers' Fertilizer practice (120:60:40 kg N: P_2O_5:K_2O ha^{-1})	0.59	185.73	45.52	254.3
T_2- RDF (150:60:40 kg N: P_2O_5:K_2O ha^{-1})	0.61	177.26	44.67	245.5
T_3- RDF + Green Manuring (Dhaincha)	0.62	175.42	44.13	238.3
T_4- RDF + 5 t ha^{-1} FYM	0.63	171.87	43.76	168.7
T_5- RDF + 10 t ha^{-1} FYM	0.64	159.72	43.42	157.6
T_6- RDF + 15 t ha^{-1} FYM	0.64	148.67	42.90	150.8
T_7- RDF + 20 t ha^{-1} FYM	0.65	134.26	42.61	140.2
SEm (±)	0.02	8.66	1.10	7.76
CD at 5%	NS	25.50	NS	20.56

3.6 Economic analysis of the experiment

The economic analysis of the treatments showed that the integrated application of nutrients increased the gross and net returns compared to chemical fertilizer treatments. The highest gross return (Rs. 3,78,938.52 ha^{-1}) and net return (Rs. 2,77,588.52 ha^{-1}) were recorded in T_7 treatment, where the crop received RDF + 20 t ha^{-1} FYM, due to the highest yield. The lowest gross return (Rs. 2,04,603.45 ha^{-1}) and net return (Rs. 1,43,642.25 ha^{-1}) were recorded for treatment T_1 (Farmers' Fertilizer Practice).

The maximum benefit-cost ratio was recorded in T_6 treatments (4.02), where the crop received RDF + 15 t ha^{-1} FYM, due to lower cost of cultivation than the T_7 treatment, and the minimum was obtained in T_1 (3.36) (Farmers' Fertilizer Practice) (Lone *et al.*, 2013) [10].

Table 9: Effect of Integrated Nutrient Management on Economics of baby corn

Treatments	Cost of cultivation (Rs. ha^{-1})	Gross return (Rs. ha^{-1})	Net return (Rs. ha^{-1})	B:C
T_1- Farmers' Fertilizer practice (120:60:40 kg $N:P_2O_5:K_2O$ ha^{-1})	60961	204603.45	143642.25	3.36
T_2- RDF (150:60:40 kg $N:P_2O_5:K_2O$ ha^{-1})	61350	214204.37	152854.37	3.49
T_3- RDF + Green Manuring (Dhaincha)	63350	225426.00	162076.00	3.56
T_4- RDF + 5 t ha^{-1} FYM	71350	246288.44	174938.44	3.45
T_5- RDF + 10 t ha^{-1} FYM	81350	292519.71	211169.71	3.60
T_6- RDF + 15 t ha^{-1} FYM	91350	367325.57	275975.57	4.02
T_7- RDF + 20 t ha^{-1} FYM	101350	378938.52	277588.52	3.74
SEm (±)	-	3095.24	3095.24	0.035
CD at 5%	-	9536.763	9536.76	0.11

4. Conclusion

Throughout the experiment, it was observed that the application of FYM at 20 t ha^{-1} along with RDF significantly enhanced the growth attributes, yield attributes, and associated parameters of baby corn compared to conventional practices. This treatment tremendously affected plant height, leaf area index, dry matter accumulation, crop growth rate, and significantly increased the number of cobs per plant, cob length, cob girth, cob yield, and nutrient uptake by the crops in a positive manner.

In soil fertility evaluation, an improvement in organic carbon content and nutrient availability was found, particularly in treatments incorporating organic sources of nutrients. Economic analysis demonstrated higher gross and net returns with Integrated Nutrient Management, with the highest returns recorded in the treatment combining RDF with 15 t ha^{-1} FYM. This study underscores the efficacy of Integrated Nutrient Management, specifically RDF combined with Farm Yard Manure, for achieving superior yields, economic benefits, and enhanced nutrient uptake of baby corn in the rabi season within the new alluvial zone of West Bengal. Adoption of such practices not only ensures higher productivity but also contributes to long-term soil health and sustainability.

5. Referrences

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