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Effect of organic manures and inorganic fertilizers on vegetative growth of Banana (*Musa spp*) cv. Poovan (AAB Group)

Abhimanyu Kumar Tomar, VM Prasad, Vijay Bahadur and Samir E Topno

Abstract
India tops the rank in Banana production. Banana cv. Poovan is the popular variety of Tamil Nadu & Kerala. This cultivar is not grown in Prayagraj agroclimatic condition. To study the Effect of organic manures and inorganic fertilizers on vegetative growth of Banana (*Musa spp*) cv. Poovan (AAB Group) in Prayagraj Agro-Climatic Conditions; a field experiment was conducted on the Horticulture research farm of the Department of Horticulture, SHUATS, Prayagraj during year 2020-21. The experiment was comprised of 13 treatments of different combinations of inorganic fertilizers and organic manures replicated thrice in a Randomized Block Design. The main objective of the experiment was to evaluate the vegetative growth, survival percentage and mortality rate of Banana cv. Poovan in the prayagraj agroclimatic zone. The levels of N:P:K include 80:30:250 i.e.180g Urea+170g SSP+400g MOP, 60:20:170 i.e. 120g Urea+110g SSP+280g MOP, 30:10:80 i.e. 60g Urea+50g SSP+140g MOP respectively followed by Farmyard manure (5.5, 11, 16.5) kg, Vermicompost (2, 3.5, 5) kg, Goat manure (1, 2, 3) kg, Sheep manure (4, 8, 12) kg respectively. From the present investigation it may be concluded that T3 (180g Urea +170g SSP+400g MOP+1 kg goat manure) resulted in highest vegetative parameters *viz*., plant height (88.71 cm), Number of leaves per plant (20.03), plant girth (9.79 cm), plant spread (E-W and N-S) (99.47 cm), number of suckers per plant (6.33), chlorophyll (91.97 SPAD). It is also concluded that T3 (180g Urea +170g SSP+400g MOP+1 kg goat manure) resulted in highest survival percentage (100%) and mortality percent (0.00%). This may be due to perfect combination of organic and inorganic fertilizer which supplied plant with RDN for its rapid growth which may not have been fulfilled solely by soil or organic manures. Since this is based on one season trail therefore, further evaluation trails are needed to substantiate the findings.

Keywords: Banana, nitrogen, phosphorus, potassium, farmyard manure, goat manure, vermicompost, sheep manure, RDN

Introduction
Banana (*Musa spp*.) is considered as the symbol of ‘prosperity and fertility’ owing to its greater socio-economic significance and multifaceted uses, banana is referred as ‘Kalpatharu’ (plant of virtues) and Kalpavriksh. Banana feeds heavily on soil. To sustain high production with quality banana, it is of paramount importance to ensure proper nutrition of the crop. The adverse environment and soil effects of modern agriculture characterized by intensive use of fertilizers, pesticides and other off-farm inputs have been documented worldwide Singh *et al*., (2018) [11].

'Mysore', also known as 'Fillbasket' and 'Poovan', is the most important banana type of India, constituting 70% of the total crop. Other common names: ‘Liganimarama’ (Fiji); ‘Misiluki' Mysore', also known as 'Pisang Keling', 'Thousand Grain', 'Fillbasket'. It is sparingly grown in Malaya, Thailand, Ceylon and Burma. It is thought to have been introduced into Dominica in 1900 but the only place where it is of any importance in the New World is Trinidad where it is cultivated as shade for cacao. In India, banana is cultivated in an area of 0.83 million ha with a production of 30 million tonnes (Anon., 2011) [2]. The major banana growing areas are in Tamil Nadu, Maharashtra, Andhra Pradesh, Gujarat, Kerala, Karnataka, West Bengal and Orissa. It is being grown in an area of 1.12 lakh ha with a production of 2.28 lakh tonnes in Karnataka state. Banana is known to consume more nutrients for its growth, yield and biomass production (Hazarika *et al*., 2015) [4].

It has a chromosome no of 2n=22, 33, 44 with origin of Indo-Malayan region i.e South East Asia. The plant is large and vigorous, immune to Panama disease and nearly so to Sigatoka;

very hardy and drought tolerant. It bears large, compact bunches of medium sized, plump, thin skinned, attractive, bright yellow fruits of subacid flavor Ploetz *et al*., (2007). Poovan is a very hardy cultivar with excellent ratooning ability and good keeping quality. Poovan is a highly popular cultivar, best ratooner, leading variety of north and south eastern states, bears heavy bunches of more than 25 kg, bunch is closely packed with short and stout fruits, fruits with conspicuous beak, bunch maybe with 150-300 fruits and 10-14 hands. Plants 3-5 m high, crop duration 16-17 months, plants hardy, fruits with good keeping quality, ripe fruits yellow, pulpy and slightly acidic.

The nutrient requirement of banana is very high which is mainly exploited from a very limited soil depth due to shallow root system of the crop. There is good response from a plant which is given with combined form of nutrients than separately. Increase or decrease of one nutrients element may substantially increase or decrease the uptake of the other nutrients. Banana has a high demand for nitrogen and specifically potassium. Hence, better vegetative growth ensures better bunch development. Banana takes up more nutrients per unit area than any other crop Pattar *et al*., (2018) [8].

In traditionally banana plants are propagated vegetatively by suckers which grow from lateral buds originating from corms, and suckers are separated for production of individual plants. In some instances, complete or spitted corms with one or several buds are used. Conventional vegetative multiplication of banana has been found to express several negative impacts including, low production, transmission of diseases and poor preservation of original plant genetic material (Ngomuo *et al*., 2014) [6]. There-fore the application of various biotechnological approaches has become an integral part of the banana industry now days. Hence, *in vitro* culture technology is proved as best alternative for the production of large numbers of planting material of banana in shorter time, lesser space, disease-free plants and adequate germplasm preservation.

Fertilizer application is one of the best means of increasing yield per unit area. Banana has a fast growth and is highly influenced by environmental conditions, such as light, salinity, water quality, temperature and nutrients (Li *et al*. 2010) [5]. Due to its development speed, the crop needs sufficient absorption of macro nutrients in order to meet the photosynthetic demand and adequate fruit growth (Li *et al*. 2010) [5]. Among the macro nutrients (Nitrogen, Phosphorus and Potassium) are very important. It is believed that NPK fertilizers improve both yield and quality.

Nitrogen is an essential component in the synthesis of amino acids and proteins in the plant. As a fertilizer, it stimulates vegetative growth, such as leaves, petioles and shoots. It was also found that when there is N surplus, the exaggerated growth is evident with excess of leaves, increase in the susceptibility to pathogens and a poor overall performance of the plant. Thus, nitrogen is referred to as the "balance wheel" of nutrition as excess or deficiency is bad for the plant.

Phosphorus being a constituent of various nucleoproteins, enzymes and lipids, plays a vital role in the formation of new cells and promotion of root growth. With respect to phosphorus (P), which is an essential and important nutrient for crop propagation, health and vigour (Li *et al*. 2010) [5], Banana plants show intensification in the tonality of the leaves to a dark green under deficiency. This occurs due to the reduction in the leaf blade area and consequently, higher concentration of chlorophyll per unit of area. (Choi *et al*. 2013) [3] indicated that a deficient P nutrition causes retardation in the development of branches, reduction in stem elongation and a decrease in the capacity to withstand the weather, such as low or high temperatures, and the stress caused by pathogens.

Potassium increases the photosynthetic rates of crop leaves, CO2 assimilation rate and facilitates carbon movement (Sangakkara *et al*. 2000) [10]. The high concentration of K+ is thought to be essential for normal protein synthesis. Potassium is the mineral nutrient required in the largest amount by plants. It is an important component of banana fruit and helps the plants regulate water movement and enzymatic reactions. Also, potassium is required for protein synthesis, affects photosynthesis at various levels, stimulated a large number of enzymes and has important functions in phloem transport (Marschner, 1995; Alderfasi and Alghamdi, 2010) [7, 1]. Potassium (K) is also highly demanded by the crop for directly favouring fruit quality and increasing the contents of total soluble solids and ascorbic acid, besides improving aroma, taste, color and firmness of fruits.

Organic matter serves as a reservoir for plant nutrients and prevents depletion of nutrients essential to plant growth. Organic manure also produces an ecosystem that promotes beneficial soil species, i.e. earthworms. Organic matter undergoes mineralization with the release of large quantities of nitrogen, phosphorus, sulphur and minimal amounts of micronutrients.

Farmyard manure is rich in nutrients and increases soil fertility. It refers to the decomposed mixture of dung and urine and farm animals along with litter and left-over material from roughages or fodder fed to the cattle. Well decomposed farmyard manure includes 0.5 percent N, 0.2 percent P2O5 and 0.5 percent K2O. Recommended dose of Farmyard manure for planting of banana is 16 tonnes per acre.

Goat manure is an outstanding soil conditioner. It improves the soil structure so that it uses water more efficiently and allows more oxygen to enter the roots of the plant. Goat manure, like all manures, provides a low-cost, renewable source of nitrogen and other nutrients. Goat manure is comparatively high in organic matter, N and P compared with K, Ca and Mg and has a higher nitrogen content compared to other manures and cow dung.

The application of vermicompost in crop production is an important feature of organic farming. Vermicompost can be used as important manure in the cultivation of crops and as biofertilizer in preservation of soil health. Vermicompost is a rich organic nutritious fertilizer that is rich in humus, micronutrients, and beneficial soil microbes- nitrogen fixing and phosphorus solubilizing bacteria and actinomycetes and growth hormones "auxins", "gibberlins" and "cytokinins". Vermicompost contains several nutrient elements such as N- 1.9 percent, C:N- 13.6 percent, P- 2 percent, K- 0.8 percent, Zn- 100ppm and Mn- 500ppm.

Nutrient-rich sheep manure is a natural slow-release fertilizer, high in both phosphorus and potassium, essential elements for optimal plant growth. These nutrients help plants to establish strong roots, defend against pests and grow into vibrant and productive.

Material and Methods

The current research was conducted at the Research Farm Department of Horticulture, Sam Higginbottom University of Agriculture, Technology and Science (SHUATS) Allahabad,

during the rabi season of 2020-2021. The experimental field lies about 8 kilometres from Allahabad city, on the left side of the Allahabad-Rewa Road, near the Yamuna River.

Prayagraj lies in Uttar Pradesh's subtropical zone, which enjoys scorching summers and mild winters. The peak temperature in the area is between 46°C to 48°C, with temperatures rarely falling below 4°C or 5°C. The relative humidity varies between 20% to 94%. The average annual rainfall in this area is 1013.4 mm.

The soil chemical analysis found that the texture was sandy loam, the reaction was acidic (pH 6.20), there was a medium amount of organic carbon (0.70 percent) and potassium (112.50 kg/ha), and there was a low amount of accessible phosphorus (18.0 kg/ha). The soil had a conductivity of 0.15 dS/m and was electrically conductive.

Three replications were used for each of the 13 treatment combinations. Table 1 and Table 2 exhibit the treatment details and treatment combinations, respectively. On the 21st of October, 2020, banana c.v. Poovan was physically transplanted. Crop spacing was kept constant at 2.1 × 2.1 m. At 60, 120, and 180 (DAT) days after planting, the combinations of the aforementioned treatments were applied. The measurements of survival and mortality percentages, as well as growth metrics such as plant height, girth, number of leaves per plant, number of suckers per plant, plant spread (E-W & N-S), and chlorophyll content, were successfully taken.

Table 1: Treatment Details

Treatments	N:P_2O_5:K_2O (g/plant/year)	Dosage of Urea, SSP & MOP (g/plant/year)
Inorganic Fertilizers	75% RDF 80:30:250	180g Urea+170g SSP+400g MOP
	50% RDF 60:20:170	120g Urea+110g SSP+280g MOP
	25% RDF 30:10:80	60g Urea+50g SSP+140g MOP
	N:P_2O_5:K_2O	Dosage (kg/plant/year)
Organic manures	Farmyard manure (0.5:0.2:0.5)	(5.5, 11, 16.5)
	Vermicompost (1.6:0.7:0.8)	(2, 3.5, 5)
	Goat manure (3:1:2)	(1, 2, 3)
	Sheep manure (0.7:0.3:0.9)	(4, 8, 12)

Table 2: Details of the treatment combinations

S. No.	Treatment symbols	Treatment combinations (Kg/ha)
1	T_0	Control
2	T_1	180g Urea+170g SSP+400g MOP+5.5 kg FYM
3	T_2	180g Urea+170g SSP+400g MOP+2 kg vermicompost
4	T_3	180g Urea+170g SSP+400g MOP+1 kg goat manure
5	T_4	180g Urea+170g SSP+400g MOP+4kg sheep manure
6	T_5	120g Urea+110g SSP+280g MOP+11 kg FYM
7	T_6	120g Urea+110g SSP+280g MOP+3.5kg vermicompost
8	T_7	120g Urea+110g SSP+280g MOP+2kg goat manure
9	T_8	120g Urea+110g SSP+280g MOP+8kg sheep manure
10	T_9	60g Urea+50g SSP+140g MOP+16.5 kg FYM
11	T_{10}	60g Urea+50g SSP+140g MOP+5kg vermicompost
12	T_{11}	60g Urea+50g SSP+140g MOP+3kg goat manure
13	T_{12}	60g Urea+50g SSP+140g MOP+12 kg sheep manure

Results and Discussion

Survival %

The survival % was calculated in each of the treatments chosen in each plant, and the results were subjected to statistical analysis using ANOVA. Table 3 and Fig 1 show that varying levels of organic manures and inorganic fertilizers applied to the soil had a significant effect on survival percentages when compared to control. T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_9 and T_{11} had the highest survival percentage (100%) and were considerably superior to T_8, T_{10}, T_{12} and control.

Increased survival rates in treatments T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_9 and T_{11} could be attributed to improved soil structure, root biomass, and metabolic activities driven by the availability of food for bacteria in organic content rich soil. The findings in bananas are consistent with those of Marak *et al*. (2017).

Mortality %

The mortality % was calculated in each of the treatments chosen in each plant, and the results were subjected to statistical analysis using ANOVA. Table 3 and Fig 1 show that varying levels of organic manures and inorganic fertilizers applied to the soil had a significant effect on mortality percentages. T_1, T_2, T_3, T_4, T_5, T_6, T_7, T_9 and T_{11} had the lowest mortality percentage (0%). The maximum mortality % (33.33%) was recorded under treatment T_0 followed by T_8, T_{10} and T_{12}.

The highest mortality rate under Treatment T_0 could be attributed to water logging and nutritional deficiency, which resulted in root rotting, stunted development, and eventual death. The findings in bananas are consistent with Marak *et al*. (2017).

Table 3: Effect of organic manures and inorganic fertilizers on Survival (%) and Mortality (%) of Banana (*Musa spp*) c.v. Poovan (AAB Group)

Treatment Notations	Treatment Combinations	Survival Percentage (%)	Mortality Percentage (%)
T0	Control	66.67	33.33
T1	180g Urea+170g SSP+400g MOP+5.5 kg FYM	100	0
T2	180g Urea+170g SSP+400g MOP+2 kg vermicompost	100	0
T3	180g Urea+170g SSP+400g MOP+1 kg goat manure	100	0
T4	180g Urea+170g SSP+400g MOP+4kg sheep manure	100	0

T5	120g Urea+110g SSP+280g MOP+11 kg FYM	100	0
T6	120g Urea+110g SSP+280g MOP+3.5kg vermicompost	100	0
T7	120g Urea+110g SSP+280g MOP+2kg goat manure	100	0
T8	120g Urea+110g SSP+280g MOP+8kg sheep manure	77.78	22.22
T9	60g Urea+50g SSP+140g MOP+16.5 kg FYM	100	0
T10	60g Urea+50g SSP+140g MOP+5kg vermicompost	88.89	11.11
T11	60g Urea+50g SSP+140g MOP+3kg goat manure	100	0
T12	60g Urea+50g SSP+140g MOP+12 kg sheep manure	77.78	22.22
	F-test	S	S
	SE.d (±)	1.933	0.531
	CD (5%)	3.99	1.096

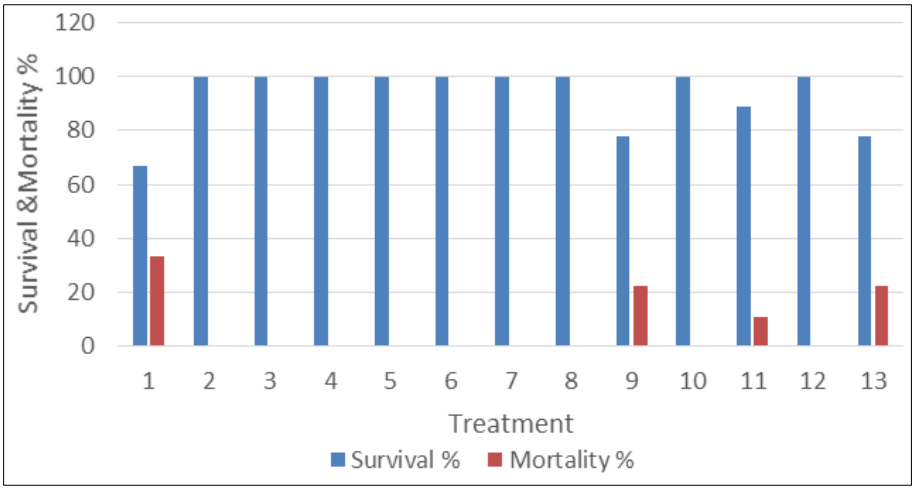

Fig 1: Effect of organic manures and inorganic fertilizers on Survival (%) and Mortality (%) of Banana (*Musa spp*) c.v. Poovan (AAB Group)

Plant Height

The plant height (cm) of Banana (*Musa spp*) cv. Poovan (AAB Group) at 30, 60, 90, 120, 150, and 180 DAT was statistically evaluated and shown in table 4 and graphically depicted in fig. 2. The treatment of different levels of organic manures and inorganic fertilizers had a significantly favourable influence on plant height (cm) at 30, 60, 90, 120, 150, and 180 DAT. Treatment T_3 was determined to be the best, with the highest plant height (14.84, 29.49, 36.09, 50.75, 63.35, 75.42, and 88.71), followed by T_7 and T_{11}, and treatment T_0 Control with the lowest plant height (cm) (8.56, 19.57, 28.60, 37.16, 48.90, 54.74 and 78.60). Treatment T_3 has the highest maximum value due to existing agro-climatic circumstances as well as their sensitivity to changing environmental conditions. The findings are consistent with those of Badgujar *et al*. (2010) in Banana.

Number of Leaves per plant

The number of leaves per plant of Banana (*Musa spp*) cv. Poovan (AAB Group) at 30, 60, 90, 120, 150, and 180 DAT was statistically evaluated and given in table 5 and graphically displayed in fig. 3. The application of organic manures and inorganic fertilizers had a significantly favourable influence on the number of leaves per plant, as shown in the table. Treatment T_3 was found to be the best and had the maximum number of leaves per plant (4.86, 6.81, 8.71, 10.86, 13.80, 16.83, 20.03), followed by T_7 and T_{11}. Treatment T_0 Control having the lowest number of leaves per plant (1.13, 3.17, 6.09, 8.44, 10.22, 12.86 and 15.66). Treatment T3 has the highest value due to the rapid breakdown of available nutrients in organic and inorganic sources, as well as easy uptake by the roots. The findings are consistent with those of Marak *et al*. (2017) in Banana.

Plant Girth

The plant girth (cm) of Banana (*Musa spp*) cv. Poovan (AAB Group) at 30, 60, 90, 120, 150, and 180 DAT was statistically examined and is provided in table 6 and graphically depicted in fig 4. The application of organic manures and inorganic fertilizers had a significantly favourable influence on plant girth. Treatment T_3 was found to be the best, with the highest plant girth (cm) (3.35, 4.60, 5.27, 6.80, 7.64, 8.67, and 9.79) followed by T_7 and T_{11}, while treatment T_0 Control had the lowest plant girth (cm) (1.20, 1.64, 2.25, 3.41, 4.38, 5.66, 6.53). The highest value associated with Treatment T_3 can be attributed due to the use of a combination of recommended fertilizer doses and organic manures, which increased the activity of beneficial microbes in the soil, resulting in improved soil health and increased plant girth. The findings are consistent with Ganapathi and Dharmatti's (2018) findings in Banana.

Plant Spread (E-W & N-S)

The plant spread (E-W and N-S) of Banana (*Musa spp*) cv. Poovan (AAB Group) at 30, 60, 90, 120, 150, and 180 DAT was statistically evaluated and shown in table 6 and graphically depicted in fig 7. The application of various quantities of organic manures and inorganic fertilizers had a significantly favourable influence on plant spread. As per the table T3 was found to be the most effective, with the maximum plant spread (cm) (E-W and N-S) (57.17, 65.63, 74.09, 82.55, 91.01, 99.47), followed by T7 and T11. The T0 Control treatment had the minimum plant spread (cm) (E-W and N-S) (37.36, 42.82, 48.28, 53.74, 59.20 and 64.66). The maximum value associated with Treatment T3 may be attributed to the availability of nitrogen, which is clearly evident in treatment T3, indicating that the availability of

nitrogen from various sources may have increased leaf area with higher synthesis of assimilates, which is due to an increased rate of photosynthesis and thus increased the Leaf Area and thus the plant spread. The findings are consistent with those of Geetha and Nair (2000) in Banana.

Number of sucker per plant

The number of sucker per plant of Banana (*Musa ssp*) cv. Poovan (AAB Group) at 150 and 180 DAT was statistically investigated and is provided in table 8 and visually depicted in fig 5. The administration of different levels of organic manures and inorganic fertilizers had a significantly positive influence on the number of sucker per plant at 150 and 180 DAT, as shown in the table. T_3 was found to be the most effective, with the maximum number of sucker per plant (4.69 and 5.88), followed by T_7 and T_{11}. T_0 Control had the lowest number of sucker per plant by a substantial margin (1.52 and 2.37). The maximum value associated with Treatment T_3 could be attributed to the availability of nitrogen, which is clearly evident in treatment T_3, indicating that the availability of nitrogen from various sources may have increased the plant's vegetative growth and thus increased the number of suckers per plant. The findings are consistent with Geetha and Nair's (2000) findings in Banana.

Chlorophyll content

The chlorophyll content was measured in each treatment which were selected in each plant and the data so obtained were subjected in statistical computation as shown in ANOVA. Data presented in Table 9 and depicted Fig 6 reveal that soil application of different levels of organic manures and inorganic fertilizers significantly effect Chlorophyll (SPAD meter). The maximum Chlorophyll (SPAD metre) (91.97) was obtained under T_3 followed by T_7 and T_{11}, while the minimum Chlorophyll (SPAD metre) (44.70) was obtained under control.

The greatest value associated with Treatment T_3 could be attributed to a plentiful supply of phosphorus in easily accessible form. Phosphorus, which is found in a variety of nucleoproteins, enzymes, lipids, and chlorophyll, is essential for cell development. The findings are consistent with Li *et al.* (2010) [5].'s findings in Banana.

Table 4: Effect of organic manures and inorganic fertilizers on plant height (cm) of Banana (*Musa spp*) cv. Poovan (AAB Group)

S. No.	Treatment symbols	Treatment combinations (Kg/ha)	Plant height (cm)					
			30 DAT	60 DAT	90 DAT	120 DAT	150 DAT	180 DAT
1	T_0	Control	19.57	28.60	37.16	48.90	54.74	78.60
2	T_1	180g Urea+170g SSP+400g MOP+5.5 kg FYM	22.58	30.33	45.53	55.83	58.53	83.47
3	T_2	180g Urea+170g SSP+400g MOP+ 2 kg vermicompost	27.21	34.75	48.80	59.43	71.56	85.14
4	T_3	180g Urea+170g SSP+400g MOP+1 kg goat manure	29.49	36.09	50.75	63.35	75.42	88.71
5	T_4	180g Urea+170g SSP+400g MOP+4kg sheep manure	25.66	33.56	47.67	57.03	69.62	83.41
6	T_5	120g Urea+110g SSP+280g MOP+11 kg FYM	22.22	30.05	44.78	54.55	58.26	82.61
7	T_6	120g Urea+110g SSP+280g MOP+3.5kg vermicompost	26.82	34.21	48.66	59.09	70.45	84.24
8	T_7	120g Urea+110g SSP+280g MOP+2kg goat manure	28.11	35.27	49.73	62.50	73.81	87.57
9	T_8	120g Urea+110g SSP+280g MOP+8kg sheep manure	24.50	33.39	47.43	56.58	69.40	83.22
10	T_9	60g Urea+50g SSP+140g MOP+16.5 kg FYM	22.08	29.79	47.34	52.98	57.39	80.80
11	T_{10}	60g Urea+50g SSP+140g MOP+5kg vermicompost	25.94	35.47	48.38	57.49	70.25	84.12
12	T_{11}	60g Urea+50g SSP+140g MOP+3kg goat manure	27.75	35.08	49.67	61.32	73.23	86.44
13	T_{12}	60g Urea+50g SSP+140g MOP+12 kg sheep manure	24.25	33.10	47.19	56.10	69.18	81.69
		F-Test	S	S	S	S	S	S
		C.D.at 0.5%	0.991	1.384	0.770	0.874	1.231	0.810
		SE.d(+)	0.480	0.670	0.373	0.424	0.597	0.393

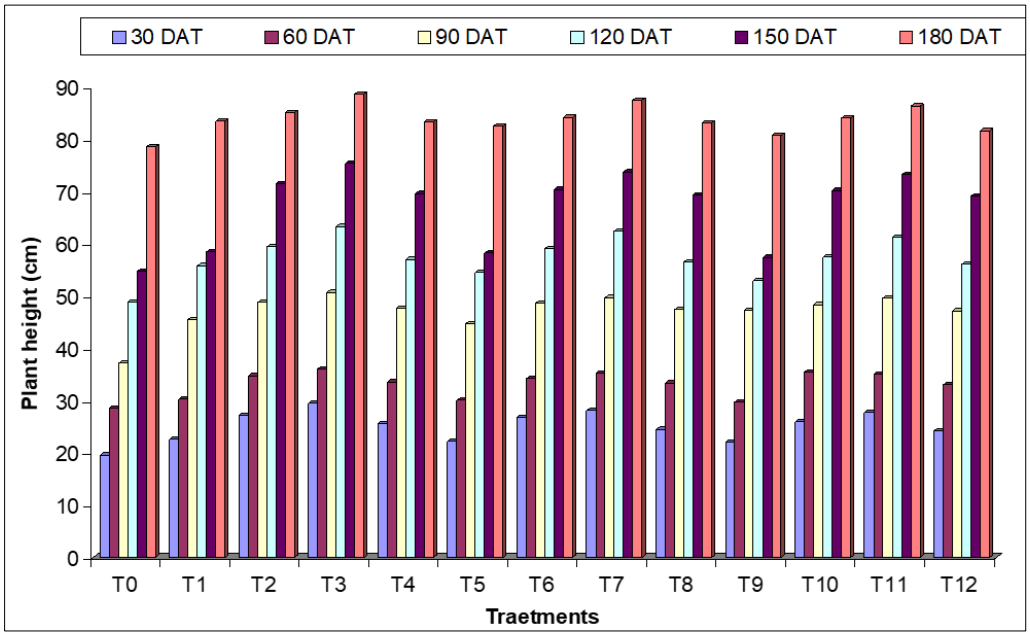

Fig 2: Effect of organic manures and inorganic fertilizers on plant height (cm) of Banana (*Musa spp*) cv. Poovan (AAB Group)

Table 5: Effect of organic manures and inorganic fertilizers on Number of leaves per plant of Banana (*Musa spp*) cv. Poovan (AAB Group)

S. No	Treatment symbols	Treatment combinations (Kg/ha)	Number of leaves per plant					
			30 DAT	60 DAT	90 DAT	120 DAT	150 DAT	180 DAT
1	T_0	Control	3.17	6.09	8.44	10.22	12.86	15.66
2	T_1	180g Urea+170g SSP+400g MOP+5.5 kg FYM	5.15	7.23	9.49	11.99	14.69	18.22
3	T_2	180g Urea+170g SSP+400g MOP+2 kg vermicompost	6.32	8.15	10.54	13.27	16.19	19.33
4	T_3	180g Urea+170g SSP+400g MOP+1 kg goat manure	6.81	8.71	10.86	13.80	16.83	20.03
5	T_4	180g Urea+170g SSP+400g MOP+4kg sheep manure	5.89	7.74	9.75	12.74	14.64	18.75
6	T_5	120g Urea+110g SSP+280g MOP+11 kg FYM	5.05	7.10	9.19	11.63	14.43	17.50
7	T_6	120g Urea+110g SSP+280g MOP+3.5kg vermicompost	6.19	8.09	10.38	16.51	15.66	19.27
8	T_7	120g Urea+110g SSP+280g MOP+2kg goat manure	6.65	8.66	10.67	13.63	16.68	19.71
9	T_8	120g Urea+110g SSP+280g MOP+8kg sheep manure	5.72	7.62	9.72	12.73	15.56	18.67
10	T_9	60g Urea+50g SSP+140g MOP+16.5 kg FYM	4.83	7.08	9.05	12.00	14.20	17.09
11	T_{10}	60g Urea+50g SSP+140g MOP+5kg vermicompost	6.08	7.99	10.24	13.05	15.51	19.16
12	T_{11}	60g Urea+50g SSP+140g MOP+3kg goat manure	6.49	7.49	10.64	13.46	16.46	19.42
13	T_{12}	60g Urea+50g SSP+140g MOP+12 kg sheep manure	5.56	7.38	9.57	12.33	15.20	18.41
		F-Test	S	S	S	S	S	S
		C.D.at 0.5%	0.093	0.883	0.201	1.450	0.698	0.314
		SE.d(+)	0.045	0.428	0.097	0.702	0.338	0.152

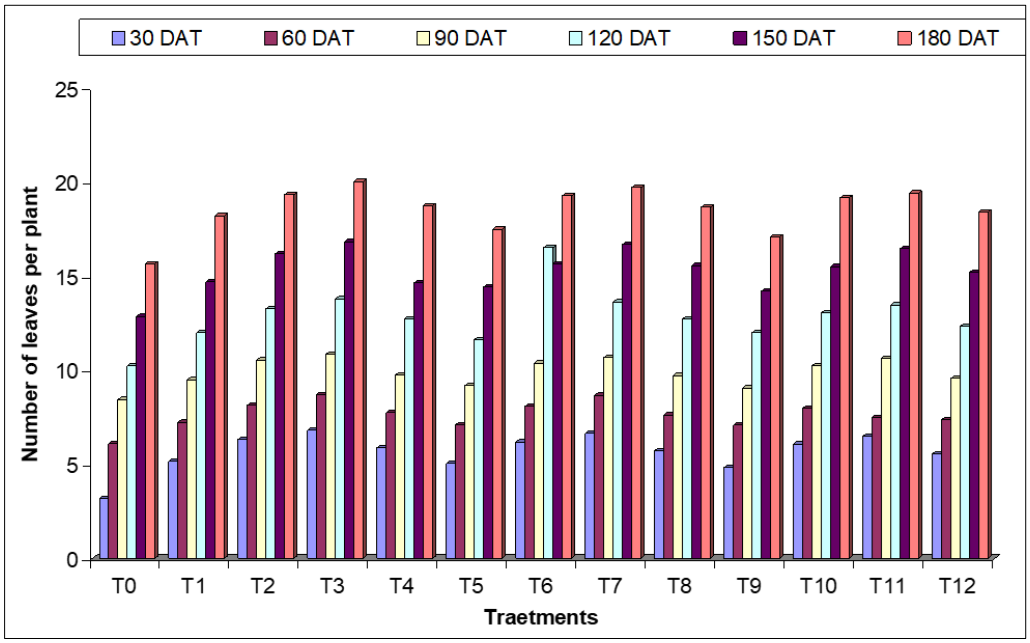

Fig 3: Effect of organic manures and inorganic fertilizers on Number of leaves per plant of Banana (*Musa spp*) cv. Poovan (AAB Group)

Table 6: Effect of organic manures and inorganic fertilizers on plant girth (cm) of Banana (*Musa spp*) cv. Poovan (AAB Group)

S. No.	Treatment symbols	Treatment combinations (Kg/ha)	Plant girth (cm)					
			30 DAT	60 DAT	90 DAT	120 DAT	150 DAT	180 DAT
1	T_0	Control	1.64	2.25	3.41	4.38	5.66	6.53
2	T_1	180g Urea+170g SSP+400g MOP+5.5 kg FYM	2.78	3.48	4.48	5.37	6.33	7.66
3	T_2	180g Urea+170g SSP+400g MOP+2 kg vermicompost	3.06	3.83	4.51	5.77	6.44	7.80
4	T_3	180g Urea+170g SSP+400g MOP+1 kg goat manure	4.60	5.27	6.80	7.64	8.67	9.79
5	T_4	180g Urea+170g SSP+400g MOP+4kg sheep manure	2.89	3.41	4.33	5.24	6.61	7.51
6	T_5	120g Urea+110g SSP+280g MOP+11 kg FYM	3.19	3.63	4.27	5.30	6.34	7.27
7	T_6	120g Urea+110g SSP+280g MOP+3.5kg vermicompost	3.19	3.36	4.55	5.09	6.44	7.48
8	T_7	120g Urea+110g SSP+280g MOP+2kg goat manure	4.24	5.18	6.49	7.44	8.42	9.50
9	T_8	120g Urea+110g SSP+280g MOP+8kg sheep manure	2.65	3.24	4.16	5.16	6.41	8.12
10	T_9	60g Urea+50g SSP+140g MOP+16.5 kg FYM	2.53	3.55	4.29	4.65	5.72	7.80
11	T_{10}	60g Urea+50g SSP+140g MOP+5kg vermicompost	2.89	3.42	4.49	4.72	5.59	7.71
12	T_{11}	60g Urea+50g SSP+140g MOP+3kg goat manure	4.13	4.78	6.30	7.21	8.25	9.23
13	T_{12}	60g Urea+50g SSP+140g MOP+12 kg sheep manure	3.10	3.66	4.33	5.40	6.35	8.04
		F-Test	S	S	S	S	S	S
		C.D.at 0.5%	0.316	0.232	0.342	0.420	0.347	0.836
		SE.d(+)	0.153	0.112	0.166	0.204	0.168	0.405

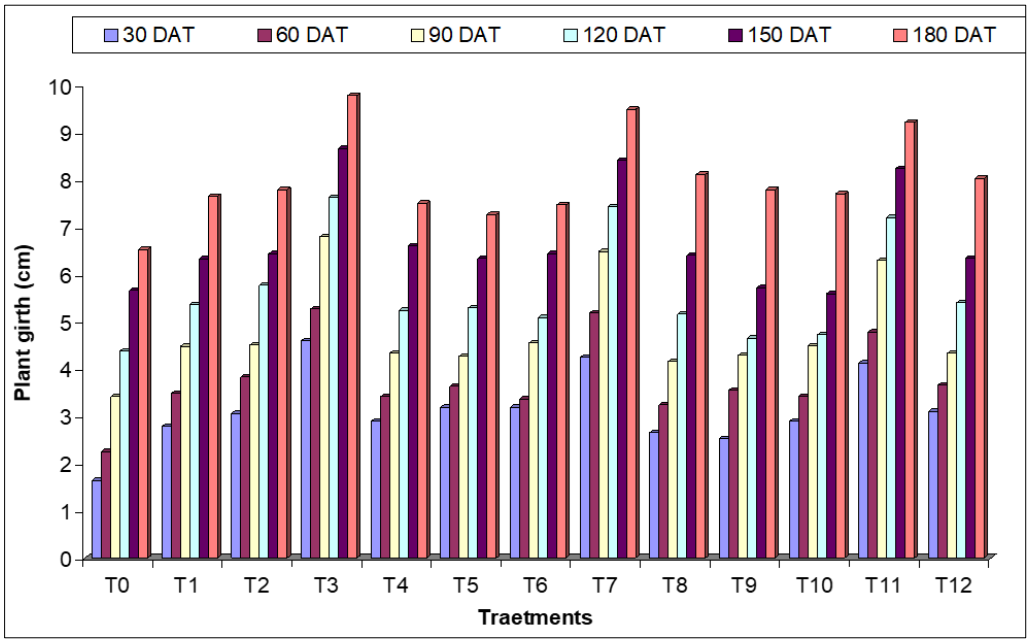

Fig 4: Effect of organic manures and inorganic fertilizers on plant girth (cm) of Banana (*Musa spp*) cv. Poovan (AAB Group)

Table 7: Effect of organic manures and inorganic fertilizers on plant spread (cm) (E-W and N-S) of Banana (*Musa spp*) cv. Poovan (AAB Group)

S. No.	Treatment symbols	Treatment combinations (Kg/ha)	Plant spread (cm) (E-W and N-S)					
			30 DAT	60 DAT	90 DAT	120 DAT	150 DAT	180 DAT
1	T_0	Control	37.36	42.82	48.28	53.74	59.20	64.66
2	T_1	180g Urea+170g SSP+400g MOP+5.5 kg FYM	47.87	56.37	64.87	73.37	81.87	90.37
3	T_2	180g Urea+170g SSP+400g MOP+2 kg vermicompost	48.88	57.28	65.68	74.08	82.48	90.88
4	T_3	180g Urea+170g SSP+400g MOP+1 kg goat manure	57.17	65.63	74.09	82.55	91.01	99.47
5	T_4	180g Urea+170g SSP+400g MOP+4kg sheep manure	51.04	59.48	67.92	76.36	84.80	93.24
6	T_5	120g Urea+110g SSP+280g MOP+11 kg FYM	46.48	54.84	63.20	71.56	79.92	88.28
7	T_6	120g Urea+110g SSP+280g MOP+3.5kg vermicompost	43.11	51.52	59.93	68.34	76.75	85.16
8	T_7	120g Urea+110g SSP+280g MOP+2kg goat manure	54.31	62.75	71.19	79.63	88.07	96.51
9	T_8	120g Urea+110g SSP+280g MOP+8kg sheep manure	47.98	56.39	64.80	73.21	81.62	90.03
10	T_9	60g Urea+50g SSP+140g MOP+16.5 kg FYM	48.43	56.79	65.15	73.51	81.87	90.23
11	T_{10}	60g Urea+50g SSP+140g MOP+5kg vermicompost	50.55	58.71	66.86	75.02	83.17	91.32
12	T_{11}	60g Urea+50g SSP+140g MOP+3kg goat manure	54.48	62.92	71.36	79.80	88.24	96.68
13	T_{12}	60g Urea+50g SSP+140g MOP+12 kg sheep manure	47.99	56.10	64.21	72.32	80.43	88.54
		F-Test	S	S	S	S	S	S
		C.D.at 0.5%	3.710	3.651	4.270	5.244	3.71	4.047
		SE.d(+)	1.798	1.769	2.069	2.541	1.798	1.961

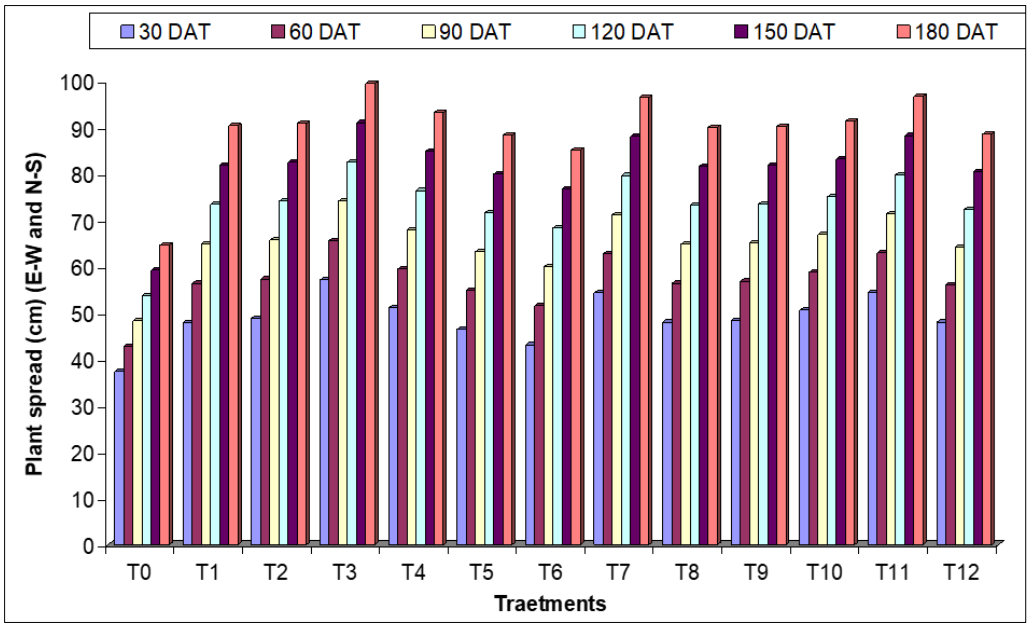

Fig 5: Effect of organic manures and inorganic fertilizers on plant spread (cm) (E-W and N-S) of Banana (*Musa spp*) cv. Poovan (AAB Group)

Table 8: Effect of organic manures and inorganic fertilizers on number of sucker per plant of Banana (*Musa spp*) cv. Poovan (AAB Group)

S. No.	Treatment symbols	Treatment combinations (Kg/ha)	Number of sucker per plant	
			150 DAT	180 DAT
1	T_0	Control	1.52	2.34
2	T_1	180g Urea+170g SSP+400g MOP+5.5 kg FYM	4.23	5.59
3	T_2	180g Urea+170g SSP+400g MOP+2 kg vermicompost	3.52	4.56
4	T_3	180g Urea+170g SSP+400g MOP+1 kg goat manure	4.38	6.33
5	T_4	180g Urea+170g SSP+400g MOP+4kg sheep manure	2.87	4.73
6	T_5	120g Urea+110g SSP+280g MOP+11 kg FYM	2.67	3.26
7	T_6	120g Urea+110g SSP+280g MOP+3.5kg vermicompost	3.25	4.23
8	T_7	120g Urea+110g SSP+280g MOP+2kg goat manure	4.69	5.88
9	T_8	120g Urea+110g SSP+280g MOP+8kg sheep manure	3.29	5.24
10	T_9	60g Urea+50g SSP+140g MOP+16.5 kg FYM	3.07	5.22
11	T_{10}	60g Urea+50g SSP+140g MOP+5kg vermicompost	3.32	4.36
12	T_{11}	60g Urea+50g SSP+140g MOP+3kg goat manure	4.18	5.76
13	T_{12}	60g Urea+50g SSP+140g MOP+12 kg sheep manure	2.82	3.58
		F-Test	S	S
		C.D.at 0.5%	0.567	0.596
		SE.d(+)	0.275	0.289

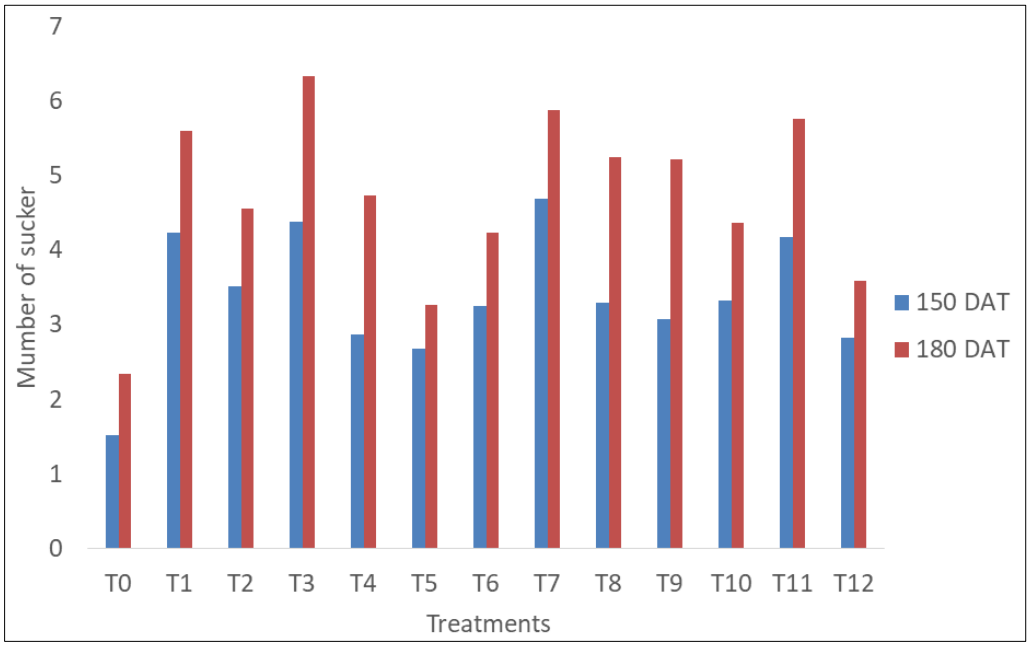

Fig 6: Effect of organic manures and inorganic fertilizers on number of sucker per plant of Banana (*Musa spp*) cv. Poovan (AAB Group)

Table 9: Effect of organic manures and inorganic fertilizers on Chlorophyll (SPAD meter) of Banana (*Musa spp*) cv. Poovan (AAB Group)

S. No.	Treatment symbols	Treatment combinations (Kg/ha)	Chlorophyll (SPAD meter)
1	T_0	Control	44.70
2	T_1	180g Urea+170g SSP+400g MOP+5.5 kg FYM	75.09
3	T_2	180g Urea+170g SSP+400g MOP+2 kg vermicompost	52.49
4	T_3	180g Urea+170g SSP+400g MOP+1 kg goat manure	91.97
5	T_4	180g Urea+170g SSP+400g MOP+4kg sheep manure	63.33
6	T_5	120g Urea+110g SSP+280g MOP+11 kg FYM	59.82
7	T_6	120g Urea+110g SSP+280g MOP+3.5kg vermicompost	65.53
8	T_7	120g Urea+110g SSP+280g MOP+2kg goat manure	88.75
9	T_8	120g Urea+110g SSP+280g MOP+8kg sheep manure	76.99
10	T_9	60g Urea+50g SSP+140g MOP+16.5 kg FYM	67.52
11	T_{10}	60g Urea+50g SSP+140g MOP+5kg vermicompost	71.64
12	T_{11}	60g Urea+50g SSP+140g MOP+3kg goat manure	85.38
13	T_{12}	60g Urea+50g SSP+140g MOP+12 kg sheep manure	65.42
		F-Test	S
		C.D.at 0.5%	5.98
		SE.d(+)	2.900

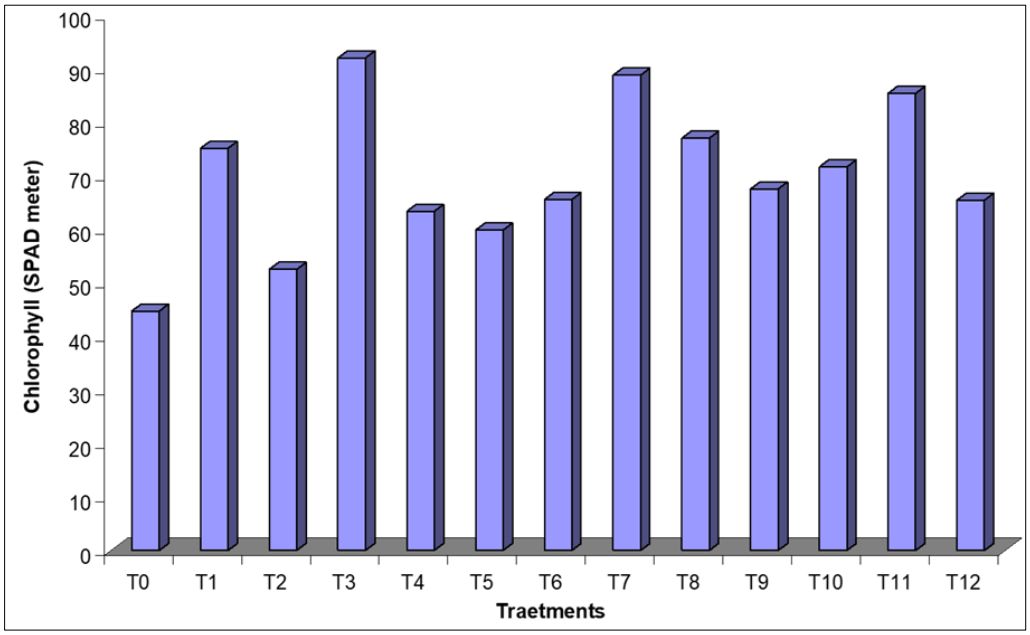

Fig 7: Effect of organic manures and inorganic fertilizers on Chlorophyll (SPAD meter) of Banana (*Musa spp*) cv. Poovan (AAB Group)

Conclusion

From the present investigation it may be concluded that T3 (180g Urea +170g SSP+400g MOP+1 kg goat manure) i.e. 75% RDN (80:30:250) NPK through inorganic fertilizers and 25% RDN through Goat manure resulted in highest vegetative parameters *viz*., plant height (88.71 cm), Number of leaves per plant (20.03), plant girth (9.79 cm), plant spread (E-W and N-S) (99.47 cm), number of suckers per plant (6.33), chlorophyll (91.97 SPAD)

It is also concluded that T3 (180g Urea +170g SSP+400g MOP+1 kg goat manure) resulted in highest survival percentage (100%) and mortality percent (0.00%). Since this is based on one season trail therefore, further evaluation trails are needed to substantiate the findings.

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