Role of Potash and other organicis vital nutrient for qualitative and Quantitative Yield of Banana (*Musa pardisicsica* L.) in Bihar

Abstract

One of the most significant fruit crops is the banana (Musa paradiscica L.). In the Bihar district of Bhagalpur, it comes in second place behind mangos as a major fruit crop. It may be grown in a variety of climates across the world, including temperate, tropical, and subtropical areas. Because bananas are highly nutritious and have therapeutic qualities, they are produced primarily for their commercial worth. Because of their superior qualities and abundant nutritional content, bananas hold a prominent position in society. Given its significant commercial value and vast cultivated area, an on-farm experiment was developed to determine the contribution of various nutrient fertilisers to the quality and yield of bananas. This experiment was carried out in the banana growing seasons of 2014–15, 2015–16, and 2016–17. Treatment T1 had given the best result with 1234.5 quintal per hectare with 3.30 BC ratio

Comment [SN1]: Italic the scientific name

Comment [SN2]: Add this in introduction and here add experimental material, experimental design and other description related to result

Introduction

The botanical name for banana, Musa paradiscica, is an essential part of the Musacae family. Other banana species include Musa acuminita, Musa balbisiana, and hybrids of the two species that have distinct genetic compositions. The herbaceous banana plant can grow up to fifteen feet in height. It is a monocotyledonous plant with rapid growth. Regarding plant height, fruit size, morphology, fruit quality, and resistance to disease and insects, banana plants exhibit significant variability within their species. Except for plantains, which are used as food, most banana plants have a sweet flavour when they are fully ripe. There are many different varieties of bananas. It enjoys India's varied environment.

Comment [SN3]: Italic the scientific name

Comment [SN4]: Also italic these names

Popular cultivars grown include Robusta, Red Banana, Poovan, Nendran, Grand Naine, Rasthali, Chiniya, and Alpan. In Bhagalpur district, bananas are the second most important fruit crop in India, only surpassed by mangos in terms of area. Due to its year-round availability, diverse range of varieties, flavour, nutritional value, and medicinal qualities, it is a favourite fruit of all social classes, especially the impoverished. Following rice, maize, and wheat, it is ranked as the fourth staple food (Falcomer et al., 2019). A banana's inexpensive cost and great nutritional value make them immensely popular. Either raw or cooked forms are consumed. A banana is an excellent source of vitamins, minerals, and carbohydrates, especially vitamin B.Significant amounts of potassium, phosphorus, calcium, and magnesium are also present. The fruits are readily digested and low in fat and cholesterol. They are abundant energy sources. Powdered bananas are regarded as the original baby food. It is recommended that patients with high blood pressure, arthritis, ulcers, gastroenteritis, and kidney diseases eat bananas. Bananas are used to make a wide range of processed goods, including chips, pureed bananas, jam, jelly, juice, wine, and confections. Vegetables with banana blooms are lovely and well-liked. Ropes, wall hangings, purses, pots, and high-quality papers are all made from banana fibres. Eating plates that are hygienic and nutritious can be made from banana leaves. It has a respectable export potential as well. By using a scientific

method, crop cultivation can be made economically feasible and result in higher-quality output, productivity, and early crop maturity, which can fetch higher prices on the market. From a nutritional perspective, bananas are similar to potatoes in that they digest more readily and have a calorific content of 116 calories per 100 g (Gopalan et al. 2004). Bananas have been significant since prehistoric times. The Sanskrit term for it is Kadliphalam. It is well-known in Hinduism that Lord Vishnu resides in bananas. India was one of the sites of origin for the banana, which evolved in the damp tropical regions of South-East Asia.Africa and Egypt were affected by it in the seventeenth century AD. Bananas are currently grown anywhere in the world's warm tropical regions between 30 degrees north and 30 degrees south of the equator.

Roughly 120 countries cultivate bananas. In a total area of 858 thousand hectares, the expected yearly production of fruits is 29163 thousand metric tonnes (horticulture Statistics at a Glance 2017, published by Government of India, Ministry of Agriculture & Farmers Welfare). With an estimated yearly production of 14.2 million tonnes, India is the world leader in the production of bananas. The other main producing nations are Brazil, Ecuador, China, Costa Rica, Mexico, Thailand, Columbia, Indonesia, and the Philippines. Of all the fruit crops grown in India, bananas are the most produced and occupy the third most area. It makes up 33% of the overall fruit production and 13% of the entire area.Maharashtra (3924.1 thousand tonnes) and Tamil Nadu (3533.8 thousand tonnes) have the largest production, respectively. Compared to the national average of 30.5 tonnes per hectare, Maharashtra has the highest production at 65.70 metric tonnes per hectare (NHB, 2017). The states that are expanding the fastest include Gujarat, Andhra Pradesh, Assam, Karnataka, and Bihar. In Bihar, 544,910 metric tonnes of bananas are produced on 27.2 thousand hectares of land (NHB, 2001 & 2002). Hajipur, Vaishali, and Bhagalpur are the three main growing districts. The four main growing blocks of Bhagalpur district are Gopalpur, Bihpur, Kharik, and Naugachhia. The crop's growth graph in the Rangra and Pirpainti blocks has recently increased. The district is now dealing with a number of issues that are affecting the quality of banana output, such as floods, disease and pest infestations, and incorrect fertiliser use. Even while banana crops meet strict export requirements, these problems keep them from realising their full potential.

Comment [SN5]: Follow the same style of citation

Comment [SN6]: Rephrase this paragraph

Increased banana yield can be achieved by high-yielding varieties, sustainable production and protection techniques, soil fertility, and fertiliser management. In terms of yield, bananas are very responsive to main critical nutrient elements such as potassium, phosphorus, and nitrogen. Compared to practically all other crops, bananas absorb more nutrients per unit area (Chandrakumar et al., 2011). Poor growth and a decrease in yield are caused by deficiencies and imbalances in these nutrients (Chattopadhyay et al., 2018). According to Hossain and Haque (2013), increasing the amount of N in combination with uniform doses of P_2O_5 and K_2O per plant led to greater yield (Jagirdar and Ansari, 2016) as well as enhanced vegetative development, highest plant height, and pseudo-stem girth. When compared to applying simply nitrogen fertiliser, the use of other fertilisers, particularly potassium and nitrogen, produced better outcomes (Jambulingum et al., 2011). The plant's growth parameter was enhanced by the increased N and K fertilisation levels, and it responded favourably to increased K application following flowering (Chandrakumar et al., 2011). Thus, an On Farm Trial (OFT) was carried out by KrishiVigyaan Kendra, Sabour, Bhagalpur, taking into consideration all of these facts. The trials focus on standardising fertilisers for high-quality banana cultivation with a maximum B:C ratio. The OFT took place in the years 2014–15 and 2015–16.

Materials and Methods

Located in Sabour, Bhagalpur, on the banks of the sacred Ganga river, lies Krishi Vigyan Kendra. This area offers a wide variety of terrain to work on. The purpose of this OFT was to optimise and

standardise the banana fertiliser dosage. District Bhagalpur comprises sixteen blocks. Five of these blocks are primarily grown bananas. These blocks, which have an average area under banana cultivation of 12,000 hectares, are Kharik, Bihpur, Naugachhia, Gopalpur, and Narayanpur. The Ganga divides the district of Bhagalpur, and from July to August, bananas suffer from flooding. In certain places, the earth has a distinct composition. Bananas and litchi are these regions' two principal crops. Bananas thrive in neutral soil, but litchi grows best in acidic soil. On the other hand, bananas grow best in neutral soil. There was pre- and post-soil testing. The soil status is indicated in Table 1 as follows. Based on their qualifications, passion for and aptitude in the agricultural industry, as well as their primary interests, farmers were chosen at random. They came from Gopalpur, TelghiKharik, Kairiyan, Khalgaon, Dharhara, and MahadatpurNaugachhia. A randomised block design was used to create the trial. Every developmental stage was closely observed during the trial. Plant height (cm), stem girth (cm), bunch weight (kg), hand weight (kg), yield (t/ha), and B:C ratio were measured and recorded. Every piece of data that was gathered was statistically analysed.

Comment [SN7]: Kindly add material and method not introduction of experimental site

Table 1. Treatments which were used during the experiments given below:

S.No.	Treatments	Technology option	Treatments
1.	T_0	Farmer'spractice	500g urea+400gDAP+150gMOPperpseudostemrandomapplication no any composting
2.	T_1	Technologyoption-1	Urea400g+DAP 150g+700gMOP+2.5 kg vermicompost +20 g PSB per pseudostem at 30DAT,75DAT, 135DAT,170DAT, 225DAT&270DAT
3.	T_2	Technologyoption- 2	Urea400g+DAP100g+300gMOP+ 2.5kg vermicompost + 25g PSBfollowed sameDAT
4.	T_3	Technologyoption-3	Urea300g+200gDAP+150gMOP+500g vermicompost 30 g PSB per peudostemapplied at0DAT,45 DAT, 90 DAT, 150 DAT, 200 DAT & at thetimeofflowering
5.	T4	Technology option -4	350 g urea +250g DAP + 250 g MOP + 2.5 kg vermicompost + 40 g PSB

Table 2. Soil chemical characteristics at the experiments site in Bhagalpur, Bihar.

Soiltest	pH	EC	OC	P_2O_5	K_2O
Pre-Planting	7.38	0.45	0.51	40.3	155
Post -planting	7.20	0.43	0.50	41.2	142

Comment [SN8]: Mention the unit of each parameters

Results and Discussions

~~The banana is the most profitable and widely grown fruit crop globally. The most crucial thing is to strive towards improving the yield and quality of bananas. The banana crop is a major feeder. Throughout the year, the application of certain products and fertiliser should be timed to coincide with the plant cycle. It should obviously be used during the fast growth stage.~~ The greatest potassium uptake occurred during the first half of the limited potassium supply (Vorm and Diest 1982), which allowed for further dry matter buildup. According to certain reports (Mr. Guy Selo, 1918; Willemse et al., 2008), an average banana eliminates 8 kg of nitrogen, 1.5 kg of phosphorus, and 25 kg of potassium per tonne of production. Additionally, post-analysis soil study shows that potash removal was greater than that of the other elements.The ~~2013~~ Banana Cultivation Guide 2013 recommended using fertilizs~~er in the 3:1:6 ratio of~~ nitrogen, phosphorous~~ate~~, and potassium with the ratio of 3:1:6and emphasised the value of potash. Additionally, it is evident from several treatments that the technology option 1 (urea 400g+DAP 100g +700g MOP + vemicompost) has a larger potash dose.

Table 3.Performanceof Technologywithperformanceindicators

Technology option	Plantheight(cm)	Stem girth(cm)	Weight ofhand(kg)	Weight ofbunch(kg)	Yield(quintal /ha)	B:Cratio
T_0 (Farmer Practices)	173.00	42.75	1.40	15.40	457.5quintal /ha	2.50
T_1	190.80	46.10	2.00	22.00	1234.5 quintal	3.30
T_2	188.80	45.10	1.86	20.46	954.5	2.90
T_3	174.00	43.10	1.76	19.36	934.2	2.80
T4	177.5	42.5	1.78	20.25	901.3	2.34
CD	14.59	3.75	0.30	4.15	867.5	0.52
SEm	4.22	1.08	0.09	1.20	856.4	0.15

In terms of plant height (cm), stem girth (cm), hand weight (kg), bunch weight (kg), yield (t/ha), and B:C ratio, the effects of different levels of nitrogen, phosphorus, and potassium on vegetative growth and yield were noted. Plants that grew consistently and vigorously were chosen, and observations were made. ~~Here, the findings are addressed and presented.~~ Examining the plant height (cm) data in Table 3 showed that there were notable variations for this characteristic. T_1 had the highest plant height (190.80 cm), which was significantly higher than T_2~~'s~~ (188.80 cm), T_3~~'s~~ (174.00 cm), and T_0~~'s~~ (173.00 cm). Regarding stem girth, the relevant data showed that T_1 had the largest recorded stem girth (46.10 cm), followed by T_2 (45.10), T_3 (43.10), and T_0 (42.75 cm). Variations in NPK levels and the availability of the right nutrients may be the cause of variations in stem girth and height among the treatments. On the other hand, plant development characteristics were enhanced by N and K fertilisation levels (Chandrakumar et al., 2011). In Nendran, Suresh et al. (2008) reported findings similar to this observation, and Rahate et al. (2020) reported similar findings in Red Banana.

There are notable variations in this feature with regard to hand weight (kg) (Table 3). T_1 (2.00) had the significantly highest hand weight (kg), followed by T_2 (1.86 kg), T_3 (1.76 kg), and T_0 (1.40 kg). Similar results were observed for this characteristic in terms of bunch weight (kg), with T1 having the highest bunch weight ~~(kg) at~~of 22.00 kg, followed by T_2, T_3 and T_0 having bunch weight ~~at~~ 20.46 kg, 19.36 kg and 15.40 kg, respectively.~~, T_2 at 19.36 kg, and T_0 at 15.40 kg.~~

Comment [SN9]: Remove introduction from results and discussion

Comment [SN10]: Remove unit from values

Comment [SN11]: Kindly correct the font size of the table

Formatted: Subscript

Formatted: Subscript

Formatted: Subscript

Formatted: Subscript

Formatted: Subscript

Formatted: Subscript

Formatted: Subscript

Formatted: Subscript

Comment [SN12]: Kindly rewrite this sentence in an other way

Formatted: Subscript

Formatted: Subscript

Formatted: Subscript

Formatted: Subscript

Formatted: Subscript

Formatted: Subscript

Formatted: Subscript

Formatted: Subscript

Formatted: Subscript

Formatted: Normal, Left, Right: 0"

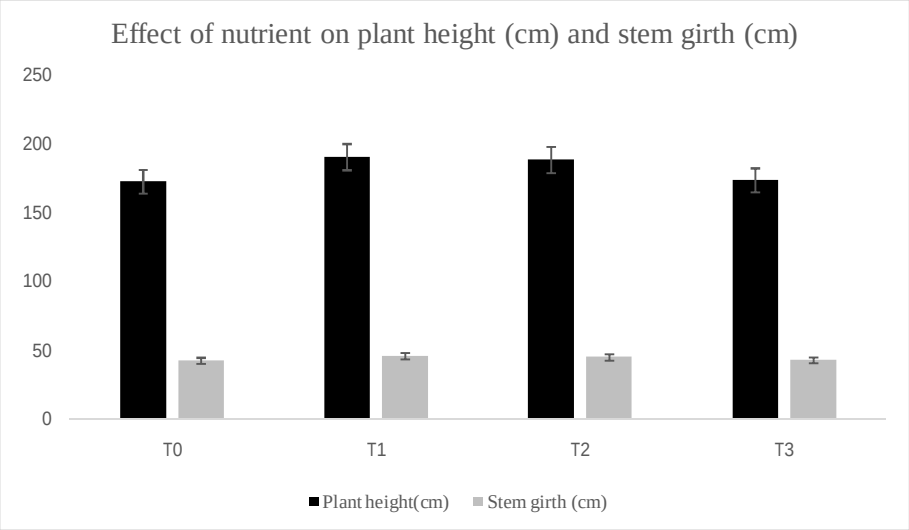

Figure 1: Effect of different level of NPK on plant height (cm) and stem girth (cm)

The maximum yield of 67.89 tonnes per acre was achieved with this treatment. This is because potassium is essential for the production of proteins and carbohydrates. Make it a crucial component of its cultivation, then. Potash also gives bananas disease resistance and aids in managing the cold. (TNAU's Banana Expert System). Improved photosynthetic rate is also aided by higher nitrogen dosages. The work of IPNI (china.ipni.net) also supports higher potassium consumption by bananas. T2 produced the second-highest yield, 63.14 tonnes per hectare (urea 400g + DAP 100g + 300g MOP + vermicompost).This demonstrates that during times of rapid development, a larger dose of fertiliser is needed. A good amount of nitrogen applied at the right time contributes significantly to increased yield. The main factor promoting growth is nitrogen. Strong green structure is created by inducing vegetative development, which is necessary for increased yield (www.ikisan.com). As far as we are aware, the DAP dosage for each therapy is nearly the same. Therefore, using a greater dose of DAP by farmers instead of potash is a waste of money that raises the cost of cultivation. Farmers' high cultivation costs are a result of the government-fixed high DAP rate.

Comment [SN13]: Unit of every parameters should be same in table and discussion
Here unit of yield t A^{-1} but in table qualtal ha^{-1}

The effects of higher doses of nitrogen and potash are also displayed in the table. The banana plant has its own support system to give phosphorus when needed, therefore a higher dose of the mineral is not needed. High phosphorus is used in the very early stages of growth, which aids in the development of a robust root system. The strong root system aids with the other nutrients' absorption.For growers, bananas are an impotent crop. Its upgrading is required nationwide. Appropriate disease and fertiliser control can help achieve this. For bananas with a high BC ratio to yield well, both factors are essential.

This is what contemporary agriculture demands. The greatest result, 67.89 tonnes with a ratio of 3.3, was obtained with technology option 1, which is urea 400g + 100g DAP+700g MOP per pseudostem per year at five split doses at 30 DAT, 75 DAT, 135 DAT, 225 DAT, and 270 DAT. This suggests that a higher potash dose is a fundamental need for a higher-quality banana production. Another worker defended this outcome.

Comment [SN14]: Add conclusion with brief result of best performing treatment

References

Chattopadhyay, P.K., Halder, C., Halder, S. C., Maiti, S. C. and Bose, T. K. (2018). Effect of nitrogen on growth, yield and quality of banana. Indian Journal of Agriculture, 2(3), 109-112.

Chandrakumar, S. S., Thimmegowda, S., Srinivas, K. and Reddy, B. M. C. (2011). Performance of Robusta banana under nitrogen and potassium fertilization. South Indian Horticulture, 49 (1), 92-94.

Hossain, M.I. and Haque, M. A. (2013). Effect of nitrogen on the growth, yield and quality of banana cv. Amritasagar. Bangladesh Journal of Agriculture, 13(4), 247-253.

Jagirdar, S. A. P. and Ansari, A. R. (2016). Effect of nitrogen, phosphorus and potassium on the growth production and production of Cavendish banana. International Journal of Agricultural Science, 3(1), 71-78.

Jambulingum, A. R., Ramaswamy, N. and Muthukrishnan, C. R. (2011). Studies on the effect of potassium on Robusta banana. International Journal of Applied Agricultural Science, 5(1), 50- 62.

Falcomer AL, Riquette RFR, De Lima BR, Ginani VC, Zandonadi RP. Health benefits of green banana Consumption: A Systematic Review. Nutrients 2019;11:1222.

Gopalan C, Sastri BVR, Balasubramanian SC. Nutritive value of Indian foods. National Institute of Nutrition, Indian Council of Medical Research, Hyderabad 500007, India 2004, 2-58.

Suresh CP, Mahato SK, Gurung S, Chhteri B. Effect of N and K on growth morphology of plantain Cv. Nendran under Terai region of West Bengal. International Journal of Agriculture Sciences 2008;7:707-713, 0975-3710.

Rahate SC, Shinde VV, Ghavale SL, Salvi BR, Dhopavkar RV. Effect of nutrient management on growth and yield performance of banana (Musa spp.) varieties under coastal ecosystem of Maharashtra. Journal of Pharmacognosy and Phytochemistry 2020;9(5):317-326.

Devaux .B 1989 Role of constituents volcanic soils and their charges propertiesin the functioning of the banana agrosystem in camroon . Fruits 44(6):309-319

HorticultureStatisticsatagalance2017publishedbyGovernmentofIndia,Ministryof Agriculture.
http://www.bananaplanters.com/BananacultivationGuide
(2013)ssMrGuySelo(1918)BananaFertilizerManagement, CEO of Smart FertilizerManagementSoftware
AndInternationalexpertinPlantNutritionandirrigation.nhb.gov.in/reportfiles/banana/banana.htm(2017)Willemse,W.&KwaZuluNatal(2008)
BananaProductioncompiledbyDirectrote of Agriculture. Text revisedbyInstituteofTropicalandSub-Tropicalcrops South Africa.WWW.agritech.Tnau.ac.in
www.ikisaan.comBananaNutrientManagement.
Vorm ,P.D.J Van der andDiest A. Van 1982 Redistribution of Nutritiveelements in a gross Michalbanana plants .NetherlandsJournalofagricultural Science30:286-296s

Comment [SN15]: Follow the same reference style according to journal format