Assessment of Different Nutrient Combination on the Performance of Maize (*Zea mays* L) in North Indian Plains

Abstract

A field experiment entitled "Assessment of Different Nutrient Combination on the Performance of Maize (*Zea mays* L) in North India Plains" was conducted during the kharif season of 2023 at the Agriculture Research Farm, Graphic Era Hill University, Uttarakhand. Surface soil (0-15 cm) of the experiment field was sandy loam in texture, low organic carbon (0.39%), medium in available nitrogen (157 kg h^{-1}), medium in available phosphorus (15.5 kg ha^{-1}) and medium in available potassium (112.6 kg ha^{-1}) with neutral soil reaction (pH 7.4). The experiment consisted of eleven treatments *viz.*, 100% NPK (T_1), 100% N (T_2), 100% P (T_3), 100% K (T_4), 100% NP (T_5), 100% NK (T_6), 100% PK (T_7), 100% NPK + VC 5 t ha^{-1} (T_8), 100% + *Azotobactor* (T_9), 100% + VC 5 t ha^{-1} + *Azotobactor* (T_{10}), Control (T_{11}). Each treatment was replicated thrice and constituted total of 33 plots. The field experiment was laid out in a randomized block design (RBD). The variety used for the field experiment was K-55. The results of the field experiment reported that the effect of different treatments was significant on growth and productivity of maize. Significantly higher emergence count m^{-2} (9 m^{-2}) of maize was obtained with the application of 100% NPK + VC @ 5t ha^{-1} + *Azotobacter* (T_{10}).Maximum plant height (102.07 cm, 155.02 cm and 225.87 cm) was observed under treatment 100% NPK + VC @ 5t ha^{-1} + *Azotobacter* (T_{10}) at 30, 45 and 60 days of sowing, respectively. It also produced highest dry matter m^{-2} (556.56 g, 1023.20 g, and 2062.00 g, respectively at 30 DAS, 45 DAS and 60 DAS). Application of vermicompost along with *Azotobacter* and chemical fertilizer produced maximum number of leaves per plant (4.05, 8.87 and 14.20 at 30 DAS, 45 DAS and 60 DAS, respectively). Application of 100% NPK + VC @ 5t ha^{-1} + *Azotobacter* (T_{10}) resulted in significant improvement in yield attributes and yield of maize compared to other treatments. The maximum grain yield (59.93 q ha^{-1}) and straw yield (69.90q ha^{-1}) was produced under 100% NPK + VC @ 5t ha^{-1} + *Azotobacter* (T_{10}). Moreover, adoption of different nutrient combination resulted in improving the economic status of the farmer. Significantly higher B:C ratio of 1.90 was recorded for 100% NPK + VC @ 5t ha^{-1} + *Azotobacter* (T_{10}) and it were 14.45 % higher than that for 100

% NPK (T_1). Hence, it is concluded that application of 100% NPK + VC 5 t ha^{-1} + *Azotobactor* exhibited higher growth and yield along with B: C ratio.

Keyword- Maize, Nutrient, Vermicompost, *Azotobactor,* Optimizing, Combination

Introduction

Maize (*Zea mays* L.) is one of the most important cereal crops and also known as "**queen ofcereals**" due to its high productive potential compared to other cereal crop (**Borase *et al*., 2018;Nirere *et al*., 2019**) It is a C4 plant, due to its ability to utilize solar radiation more efficientlyeven at higher radiation intensity **(Borase *et al*., 2018).** Maize grain contains 70% carbohydrate,10% protein, 4% oil, 10.4% albumin, 2.3% crude fiber, 1.4% ash. Sugar-rich varieties calledsweet corn are usually grown for fresh consumption, while field-corn varieties are used foranimal feed and as chemical feedstocks. Moreover, maize is also a major source of oil, gluten,and starch, which can be hydrolyzed and enzymatically treated to produce syrups, particularlyhigh fructose corn syrup. The corn steep liquor, a plentiful watery byproduct of the maize wetmilling process, is widely used in the biochemical industry and research purposes as a culturemedium to grow many kinds of microorganisms. Its world average yield is 27.8 q ha^{-1} maize ranksfirstamongthecerealsfollowedbyrice,wheat,andmillets;withaveragegrainyieldof22.5, 6.6 q ha^{-1} (**Nasimet *et al*., 2020**). In area, Maize is the third most important staple foodrespectively crop in the world after wheat, and rice regarding to productivity.Worldwide maizeis cultivated on approximately 177 mha area with production of 967 mt and productivity of 5.46t ha^{-1}, Similarly in world, USA, China, Brazil, India and Argentina are leadingcountries in maize production. In India, maize is cultivated on 10.43 mha area, with productionand productivity of 32.35 mt and 2.12 t ha^{-1}, respectively (**Sinha, 2022**). Maize is grown mainly asa rainfed crop during rabi season with only 22.8% area under irrigated conditions. Karnataka,Maharashtra, Andhra Pradesh, and Madhya Pradesh and Uttar Pradesh are leading states in area,Andhra Pradesh, Karnataka, Maharashtra and Biharin production and Tamil Nadu, Punjab,Andhra PradeshandWestBengalhavehighercropproductivity.

Use of different source of nutrient is an integrated manner helps to produce sustainableyields with good quality crop. Organic matter induces life into this inter mixture and promotesbiological activity, vermicompost and farmyard manure are two examples of organic manuresthat are crucial parts of integrated nutrient management. Micronutrients are provided in traceamounts by organic manures, which are typically not provided by farmers as pure fertilizers.(**Ghosh *et al.* 2019**). Therefore, the only solution that should be supported in order to reduceinputcosts and enhance soil health is organicfarming. By enhancing the physico-chemicalcharacteristics of the soil, the use of organic manures like FYM and vermicompost not only helpsto sustain soil productivity but alsoincreases the effectiveness of chemical fertilizers that areusedbyloweringchemical toxicity tothebacteriaandsopromotingtheirproliferation,itmitigates the negative effects of chemical fertilizers applied to the soil. Additionally, organicmanure increases the soil's ability to store water and exchange cat ions which results in a moreefficient supply of nutrients to crop plants and, ultimately, more profitable harvests. (**Ariraman*et al*., 2020**). Organic fertilizer, a soil improvement material, itself contains a large amount oforganic matter, metabolites, and microorganisms, which could improve the recovery of soilnutrients and contribute to the dissolution and absorption of P by plants (**Luo *et al*., 2019**,**Mahmood *et al*.**, **2017**). Application of organic fertilizer alone insufficiently increases crop yieldbecause nutrient content of organic fertilizer is unbalanced and if it is applied in a large quantityto balance nutrient supply the loss will increase. Therefore integrated plant nutrient managementcanminimizetheproblem.Applicationofmineralfertilizerincombinationwithlocally available organic fertilizer to maintain oil fertility and to balance nutrient supply in order to increase cropyield.Itisoneofthebestpracticesofplantnutrientmanagementtotakeintoconsiderationmineral fertilizer integration with organic sources of the plant nutrients to optimize social, economic, andenvironmentalbenefitsofcropproduction.

The efforts are to be made to boost up to the yield per hectare of maize productionthrough different nutrient combination. Through the input management had been given due toimportance still there is a need to quality and optimizing the different nutrient source of cerealscrop.

2. MATERIAL AND METHOD

The present experiment is conducted at Agricultural Research Farm of Graphic Era Hill University;Dehradun Uttarakhand during karif season of 2023 “Assessment of Different Nutrient Combination on thePerformance of Maize (*Zea mays* L.) in North India Plains”The experimental siteliesin region offoothills of Shivalik range of Himalayas, Dehradun. Geographically, it is situated at

30.34^{0}Nlatitude,78.02^{0}Elongitudeand64^{0}mabovemeansealevel.Dehradun is characterized by humid sub-tropical climate with warm summer and severecoldwinter.Generally,south-westmonsoon setsin thesecond or thirdweek of Juneandcontinues up to the end of September. The highest temperature is found in the month of May-June and that of the lowest in December-January. The mean annual rainfall of this region is 2025mm, of which 70% is received during rainy season (July- September). Few showers may also bereceived during the winter months. Frost generally occurs towards the end of December and Maycontinue till the end of January. Winters are very cold and continue from November to March.The daily average minimum temperature in the coldest month during winter varies from 1.0-9.0^{0}Candduringsummer,themaximumtemperature variesfrom30-43^{0}C.

The experiment was laid out in Randomized Block Design (RBD) with three replications. Thetreatments were randomly allocated to different plots *viz,* 100% NPK (T_1), 100% N(T_2), 100% P(T_3), 100% K(T_4), 100% NP(T_5), 100% NK (T_6), 100% KP (T_7), 100% NPK + Vermicompost 5 t ha^{-1}(T_8), 100% NPK + Biofertilizer 20g kg^{-1} seed (T_9), 100% NPK + Vermicompost 5 t ha^{-1}+ Biofertilizer 20g kg^{-1} seed (T_{10}), Control (T_{11}) each replicated thrice. In each plot ten plant taken randomly from the produce harvest from net plot (2m x 2m) for recording yield attributes (cob length, number of cobs per plant, number of grains^{-1}and cob length), yield (grain, straw and biological yield) and economics (cost of cultivation, net return, gross return and benefit cost ratio). Benefit cost ratio was calculated using the following formula:

$$\textbf{B:C} = \frac{\textbf{Netreturn}}{\textbf{Coastofcultivation}}$$

The initial soil samples were collected from the experimental field at 0-15 cm depth. the experiment field was low organic carbon (0.39%), medium in available nitrogen(157 kg h^{-1}), medium in available of phosphorus (15.5 kg h^{-1}) and medium in available potassium (112.6 kg h^{-1}) of withnetural soil reactions was sandy loam in texture, low organic carbon medium availability of nitrogen with neutral soil reaction (pH 7.4).

3. REASULT AND DISCUSSION

i. Emergence count and plant height

The different nutrient combination treatment significantly affected the emergence count and plant height of maize. The result showed that maximum emergence count per m^{-2}(9.0) was obtained with the application of 100% NPK + Biofertilizer + VC @ 5t ha^{-1} (T_{10}). It was statistically at par with 100% NPK + Biofertilizer, 100% NPK +VC @ 5 t ha^{-1} (T_{10}) and significantly higher than rest of the treatments. The results showed that 100% NPK + Azotobacter + VC @ 5t ha^{-1} increased emergence count$m^{-2}$by 34% and 200% over 100% NPK (T_1) and control (T_{11}), respectively. The results are in conformity with **Kakarliya*et al*. (2017)** as they reported maximum emergence count (10) with combined application of 100% RDF + vermicompost + biofertilizer.

The plant height of maize increased progressively with advancement in crop growth up till harvest irrespective of the treatment. The data enumerated in Table 1. reveals that plant height of maize varied significantly under the influence of different treatments at all the crop growth stages. The result shows that maximum plant height (102.0 cm, 155.0 cm and 225.8, respectively at 30, 45 & 60DAS) was obtained with the application of 100% NPK +VC @ 5t ha^{-1} + Azotobacter (T_{10}). At 30 and 45 DAS, it was statistically at par with 100% NPK + *Azotobacter* (T_9), 100 % NPK + VC @ 5t ha^{-1} (T_8), 100% NPK (T_1), 100% NP (T_5) and 100% NK (T_6) and significantly higher than rest of the treatments. At 60 DAS, it was statistically at par with 100% NPK + *Azotobacter* (T_9) and 100 % NPK + VC @ 5t ha^{-1} (T_8) and significantly higher than rest of the treatments rest.Application of 100% NPK +VC @ 5t ha^{-1} + *Azotobacter* (T_{10}) increased plant height by 137% over control and 13.2% over 100% NPK (T_1). It might be possibly due to influence of vermicompost and biofertilizer in improving soil organic matter and microbial activity, leading to long-term soil fertility which improves the availability and essential micro-nutrient uptake, water retention, and water holding capacity which help to improved soil health increase plant height. Similar research finding in **G. Baradhan and S. M. Suresh Kumar (2017)** with application of 100% RDF + vermicompost @ 5 t ha^{-1} + soil application of azospirillum @ 2

Table 1. Effect of different nutrient combination emergence m^{-2} and plant height at different crop growth stages

Treatments	Emergence Count m^{-2}	Plant height (cm)		
		30 DAS	45 DAS	60 DAS
T_1	6.6	94.3	144.9	199.50
T_2	5.6	87.6	94.5	176.60
T_3	3.3	80.0	98.7	184.37
T_4	3.6	75.0	85.4	173.63
T_5	4.6	92.5	141.5	195.73
T_6	5.6	91.9	141.2	189.37
T_7	4.6	80.3	117.5	181.97
T_8	8.0	96.8	148.1	212.60
T_9	8.5	98.1	150.2	217.37
T_{10}	9.0	102.0	155.0	225.87
T_{11}	3.0	54.3	80.3	93.47
SEm±	0.4	3.4	3.6	7.8
CD (at 5 %)	1.1	10.1	10.7	23.1

i. Dry matter accumulation m^{-2} and Number of leaves per plant

The dry matter of maize increased progressively with advancement in crop growth up till harvest irrespective of the treatment. The data enumerated in Table 2. indicates that dry matter accumulation of maize varied significantly under the influence of different treatments at all the crop growth stages. The results shows that maximum dry matter accumulation per m^{-2} (556.56 gm, 1023.20 gm and 2062.00 gm, respectively at 30, 45 & 60 DAS) was obtained with the application of 100% NPK + Biofertilizer + VC @ 5t ha^{-1} (T_{10}). It is statistically at par with 100% NPK+ Biofertilizer (T_9), 100% NPK + VC @ 5 t ha^{-1} (T_8) and significantly higher than rest of the treatments. Minimum dry matter g per plant (235.6 g, 476.4 g, and 772.8 g at 30, 45 and 60

DAS, respectively) was recorded under control (T_{11}) at all crop growth stages.It might be due to Azotobacter being able to enhance the plant's ability to tolerate various abiotic stresses, such as drought and salinity. This resilience helps maintain growth and productivity under adverse conditions due to adverse effect on NPK, which provide an immediate supply of nutrient and increases the weight of plant.

The data with respect to number of leaves per plant clearly significant indicates influence of different treatments. The results shows that maximum number of leaves (4.0, 8.6, and 14.2 respectively at 30, 45 & 60 DAS) was obtained with the application of 100% NPK +VC @ 5t ha^{-1} + Azotobacter (T_{10}). At 30 and 45 DAS, it was statistically at par with 100% NPK + Biofertilizer (T_9), 100 % NPK + VC @ 5t ha^{-1} (T_8), 100% NPK (T_1), 100% NP (T_5) and 100% NK(T_6) and significantly higher than rest of the treatments. However, at 60 DAS, it was statistically at par with 100% NPK + Biofertilizer (T_9) and 100% NPK + VC @ 5t ha^{-1} (T_8) but significantly higher over rest of the treatments. Minimum number of leaves per plant (1.0, 5.8 and 8.5 at 30, 45 and 60 DAS, respectively) was recorded under control (T_{11}) at all crop growth stages.It may be attributed to the assured and continuous supply of all the essential nutrients in adequate amount through combined application of synthetic fertilizers, vermicompost and biofertilizers. Additionally, continuous supply of nitrogen affects photosynthetic rate which help to increases the number of leaves per plant vigorously.

Table 2. Effect of different nutrient combination on dry matter accumulation m^{-2} and number of leaves at different crop growth stages

Treatment	Dry matter accumulation m^{-2}			No. of leaves per plant		
	30 DAS	45 DAS	60 DAS	30 DAS	45 DAS	60 DAS
T_1	490.8	861.6	1379.6	3.7	7.6	13.0
T_2	425.2	817.6	1357.9	3.4	7.2	12.6
T_3	398.8	798.0	1239.3	2.0	6.6	11.2
T_4	410.8	777.60	1232.2	1.8	7.2	11.5
T_5	398.8	838.4	1422.2	3.5	7.4	12.9
T_6	438.8	826.8	1433.6	3.4	7.3	12.9

T_7	464.8	803.60	1736.8	2.0	6.7	12.5
T_8	486.8	960.40	1722.4	3.8	8.2	13.3
T_9	524.5	989.0	1979.6	3.9	8.6	13.9
T_{10}	556.5	1023.2	2062.0	4.0	8.8	14.2
T_{11}	235.6	476.4	772.8	1.0	5.8	8.5
SEm±	22.0	24.1	58.1	0.1	0.5	0.4
CD (at 5 %)	64.9	71.1	171.4	0.5	1.4	1.3

i. Cob length and Number of cob per plant yield attributes of maize

The result shows that maximum cob length (14.9 cm) was obtained with the application of 100% NPK + Biofertilizer + VC @ 5t ha^{-1} (T_{10}) but it was statistically at par with (100% NPK+ Biofertilizer T_9 and 100% NPK + VC @ 5 t ha^{-1} T_8) and significantly higher than rest of the treatments.The minimum cob length (5.8 cm) was recorded under control (T_{11}). Minimum cob lent found in this result was not conformity with**Jeevabharathi *et al*. (2020)** with application of 100% recommended dose of fertilizer + vermicompost @ 5t ha^{-1} + seed treatment (Azospirillum) @ 600 g ha-1 + soil application (Azospirillum) @ 2000 g ha^{-1} (26.0 cm).

Data pertaining to number of cobs/plant of maize as recorded under various treatments are presented in Table 3. The perusal of data reveals that maximum number of cob/plant (2.67) was obtained with the application of 100% NPK + Biofertilizer + VC @ 5t ha^{-1} (T_{10}) but it was statistically at par with 100% NPK+ Biofertilizer (T_9) and 100% NPK + VC @ 5 t ha^{-1} (T_8) and significantly higher than rest of the treatments. The minimum number of cob per plant (1.0) was recorded under control (T_{11}) treatment. It might be due to imbalances in the nutrients nitrogen (N), phosphorus (P), and potassium (K) can significantly affect the growth and health of corn and decrease the cob number in plant which is not benefit for better yield that’s why proper NPK balance ensures efficient photosynthesis, energy transfer, and overall plant health.

Treatments	Cob length(cm)	Cobs $plant^{-1}$
T_1	12.9	1.5
T_2	8.5	1.3
T_3	8.0	1.2
T_4	7.2	1.3
T_5	12.2	1.5

Table 3. Effect of different nutrient combination on cob length (cm) and number of cob per plants on yield attributes

T_6	11.8	1.7
T_7	10.7	1.5
T_8	13.9	2.5
T_9	14.2	2.6
T_{10}	14.9	2.6
T_{11}	5.8	1.0
SEm±	0.5	0.09
CD (at 5 %)	1.5	0.2

Biological yield, Grain yield, Stover yield and Harvest index of maize

The result reveals that biological yield of maize was influenced significantly due to different treatments. Maximum biological yield (129.8 q ha^{-1}) was obtained with the application of 100% NPK + Biofertilizer + VC @ 5t ha^{-1} (T_{10}). It was found statistically at par with 100% NPK+ Biofertilizer (T_9), 100% NPK + VC @ 5 t ha^{-1} (T_8) and significantly higher than rest of the treatments. Percent increase of 18.8% and 126% for biological yield was obtained with application of 100% NPK + Biofertilizer + VC @ 5t ha^{-1} (T_{10}) over100% NPK (T_1) and control (T_{11}), respectively. Minimum biological yield of 55.5q $ha^{-1}$was recorded control (T_{11}).It might be possible due to the application of recommended dose of NPK in addition to vermicompost and biofertilizer gave the best results with respect to growth and yield attribute of crops. The application of nitrogen from chemical fertilizers promoted the plant growth, whereas organic sources of nutrition improved the growth at later stages. Application of vermicompost exerted the positive influence on growth of plants owing to presence of readily available nutrients and growth enhancing substances, which resulted in better crop production and biofertilizers, not allow pathogens to flourish, they are also eco-friendly and cost-effective. Similar findings were observed by **Singh *et al*. (2017)** 75% RDF + Vermicompost (5t ha^{-1}) + FYM (5t ha^{-1}) + Azotobacter gave highest biological yield of 207.7 q ha^{-1}.

The result shows that maximum grain yield (59.9 q ha^{-1}) was observed with the application of 100% NPK +*Azotobacter* + VC @ 5t ha^{-1} (T_{10}). It was statistically at par with (100% NPK+ *Azotobacter* (T_9), 100% NPK + VC @ 5 t/ha (T_8) and significantly higher than rest of the treatments. Application of 100% NPK+ *Azotobacter* + VC @ 5t ha^{-1} increased grain yield by 14.87% and 135.66% over 100% NPK (T_1) and 100% NP (T_4), respectively. It may be due to the fact that organic manures and biofertilizers could have provided required amount of available nutrients along with chemical fertilizers and improved chemical and biological properties of soil which ultimately reflected in increasing the growth parameters as well as yield attributing characters and which leads to increase in yield. Azotobacter promote plant growth by several mechanisms including N-fixation, phytohormone production such as auxin, gibberellins, cytokines, nitric oxide as signals of plant growth promotion. Similarly findings was observed by **Singh *et al*. (2017)** 75% RDF + vermicompost (5t ha^{-1}) + FYM (5t ha^{-1}) + azotobacter with grain yield (63.7 q ha^{-1}). The minimum grain yield (11.6 q/ha) was recorded in control (T_{11})

The result shows that maximum stover yield (69.9 q ha^{-1}) was obtained with the application of 100% NPK + *Azotobacter* + VC @ 5t/ha (T_{10}). It was statistically at par with (100% NPK+ *Azotobacter* (T_9), 100% NPK + VC @ 5 t/ha (T_8) and significantly higher than rest of the treatments. Percent increased of 29.13% and 120.71% was observed that with application of 100% NPK + *Azotobacter* + VC @ 5t ha^{-1} compared to 100% NPK (T_1) and control (T_{11}), respectively. The minimum stover yield (31.6 q ha^{-1}) was recorded under control (T_{11}). Similar finding was observed by **Jeevabharathi *et al*. (2020)** application of 100% RDF + vermicompost @ 5t ha^{-1} + seed treatment (*Azospirillum*) @ 600 g/ha + soil application (*Azospirillum*) @ 2000 g/ha gave higher stover yield (94.3 q ha^{-1}).

Data related of harvest index as influenced by different treatments is presented in Table 4. The perusal of data shows that harvest index did not vary significantly under the influence of different treatments. However, maximum harvest index (52.1%) was obtained with the application of 100% NPK (T_1). Minimum harvest index (44.4%) was obtained with the application of control (T_{11}).

Table 4. Effect of different nutrient combination on biological yield, grain yield, stover yield and harvest index% of maize

Treatments	Biological yield (q ha^{-1})	Grain yield (q ha^{-1})	Stover yield (q ha^{-1})	Harvest index (%)
T_1	109.2	52.1	57.1	47.7
T_2	89.3	42.9	46.4	48.0

T_3	87.5	42.0	45.4	48.0
T_4	89.1	39.9	49.2	44.7
T_5	92.8	45.8	47.0	49.3
T_6	92.6	44.7	47.9	48.2
T_7	96.6	43.2	53.4	44.7
T_8	121.5	57.3	64.1	47.1
T_9	124.6	57.7	66.8	46.3
T_{10}	129.8	59.9	69.9	46.1
T_{11}	57.1	25.4	31.6	44.5
SEm±	2.97	0.9	3.0	2.0
CD (5 %)	8.7	2.9	9.09	N/S

i. Economics of maize

The maximum cost of cultivation (₹ 52178.0 ha^{-1}) was obtained with the 100% NPK + VC @ 5t ha^{-1} + Azotobacter (T_{10}). This is because of additional cost of synthetic fact, vermicompost and biofertilizer. The minimum cost of cultivation amounting to ₹ 24900.0ha^{-1} was calculated under control (T_{11}) because of no application fertilizer. Highest cost of cultivation was recorded in treatment (T_{10}) because it involves the use of 100% NPK along with vermicompost and biofertilizer and minimum cost of cultivation was recorded in (T_{11}) as this treatment included no application of fertilizers.

The perusal of data indicates Table 5. shows that gross return of maize cultivation varied significantly under the influence of different treatments. Application of 100% NPK + VC @ 5t ha^{-1} + *Azotobacter* (T_{10}) resulted in maximum gross return (₹ 125099.7).It was found to be significantly higher than control (T_1), 100% NPK (T_1), 100% NPK + VC @ 5t ha^{-1} (T_8), 100% NPK +Azotobacter (T_9) and statistically at par with rest of the treatments. Gross return increased by 10.72% with the application of 100% RDF + VC @ 5t ha^{-1} + Azotobacter (T_{10}) compared to 100% RDF (T_1).

The data enumerated in Table 5. reveals that maximum net return (₹ 101145.4 ha^{-1}) was obtained with the application of 100% NPK + *Azotobacter* (T_9). It was found to be significantly higher than control (T_1), 100% NPK (T_1), 100% NPK + VC @ 5t ha^{-1} (T_8) and 100% NPK + VC 5 t ha^{-1} + Azotobacter (T_{10}). Minimum net return (₹ 28287.5 ha^{-1}) was found in control (T_{11}). Higher net return under these treatments shows that these treatments accrued high gross return with a lower or similar cost of production.Higher net return under these treatments shows that these treatments accrued high gross return with a lower or similar cost of production. The results are in conformity with**Tomar *et al*. (2017)** as they recorded highest net return (₹ 36073.5 ha^{-1}) with application 100% NPK + 5 t FYM + *Azotobactor* + PSB.

Data presented in Table 5. shows that maximum B:C ratio (1.9) was obtained for 100% NPK + VC @ 5t ha^{-1} + Azotobacter (T_{10}). The result showed that Application of 100% NPK + VC @ 5t ha^{-1} + Azotobacter (T_{10}) was statically at par with application 100% NPK + *Azotobacter* (T_9). Percent increased by 43.9% and 14.4% with application of 100% NPK +VC 5 t ha^{-1} (T_8) and 100% NPK (T_1). Minimum benefit cost found in treatment 100% P (T_4) 1.2.This may be due to combination of treatment give better yield .The findings align with that of **Joshi *et al.* (2015)** registered maximum value of B: C ratio (1.9) with the application of 100% NPK + seed inoculation *Azotobacter*.

Table 5. Effect of different nutrient combinations on economics of maize

Treatments	**Cost of cultivation**	**Gross return**	**Net return**	**Benefit cost**
T_1	43086.0	112985.6	69899.6	1.6
T_2	34164.0	89365.7	55201.7	1.6
T_3	39581.0	87624.9	48043.9	1.2
T_4	33751.0	83486.4	49735.4	1.4
T_5	41664.0	95279.8	53615.8	1.2
T_6	36534.0	93160.6	56626.6	1.5
T_7	41251.0	90458.0	49207.0	1.1
T_8	51586.0	119537.7	67951.6	1.3
T_9	43678.0	101145.4	101145.4	1.7
T_{10}	52178.0	125099.7	72373.7	1.9

T_{11}	24900.0	53187.5	28287.5	1.1
SEm±	-	1964.9	1964.9	0.07
CD (at 5 %)	-	5796.5	5796.5	0.2

Conclusion

The results obtained from the current study led to the conclusion that the combined application of 100% NPK along with vermicompost @ 5t ha^{-1} and *Azotobacter* @ 20 g kg^{-1} seed resulted in enhanced plant growth and increased yield, accompanied by a higher benefit-cost ratio (B: C ratio). This outcome may be attributed to the improved nutrient provisioning achieved through integrating different nutrient sources which facilitated optimal growth and yielded the highest harvest. Different nutrient management presents a promising and sustainable approach to modern agriculture. By judiciously combining organic and inorganic nutrient sources, this practice ensures a healthy crop yield. As we face the challenges of feeding a growing global population while conserving our ecosystems, integrated nutrient management stands as a vital step towards achieving both agricultural productivity and ecological balance.

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