GROWTH AND YIELD OF MAIZE VARIETIES AS INFLUENCED BY INTEGRATED NUTRIENT MANAGEMENT

ASMAUL HUSNA

DEPARTMENT OF AGRONOMY

SHER-E-BANGLA AGRICULTURAL UNIVERSITY

DHAKA-1207

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BY

ASMAUL HUSNA

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Approved by:

Prof. Dr. Md. Abdullahil Baque	**Prof. Dr. Parimal Kanti Biswas**
Supervisor	**Co-Supervisor**

Prof. Dr. Md. Abdullahil Baque
Chairman
Examination Committee

DEPARTMENT OF AGRONOMY

Sher-e-Bangla Agricultural University

Sher-e-Bangla Nagar, Dhaka-1207

CERTIFICATE

*This is to certify that the thesis entitled, "**GROWTH AND YIELD OF MAIZE VARIETIES AS INFLUENCED BY INTEGRATED NUTRIENT MANAGEMENT**" submitted to the Faculty of Agriculture, Sher-e-Bangla Agricultural University, Dhaka, in partial fulfilment of the requirements for the degree of **MASTER OF SCIENCE (MS) in AGRONOMY**, embodies the result of a piece of bona-fide research work carried out by **ASMAUL HUSNA**, Registration no.**15-06432** under my supervision and guidance. No part of the thesis has been submitted for any other degree or diploma.*

I further certify that such help or source of information, as has been availed of during the course of this investigation has duly been acknowledged.

Date:

Place: Dhaka, Bangladesh

Prof. Dr. Md. Abdullahil Baque

Department of Agronomy

Sher-e-Bangla Agricultural University,

Dhaka-1207

Dedicated to

My

Beloved Parents

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GROWTH AND YIELD OF MAIZE VARIETIES AS INFLUENCED BY INTEGRATED NUTRIENT MANAGEMENT

ABSTRACT

A field experiment was conducted at Sher-e-Bangla Agricultural University, Dhaka during the period from October-2021 to February-2022 in Rabi season, to study the growth and yield of maize varieties as influenced by integrated nutrient management. The experiment consisted of two factors, and followed split plot design with three replications. Factor A. Varieties (2) *viz:* V_1: WIN-142 maize genotype V_2: Pioneer 3355 maize genotype and Factor B. Different integrated nutrient management (6) *viz:* T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1} + MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50 % Trichocompost + 50 % RDF and T_6 = 100% Trichocompost + RDF. For the purpose of evaluating the experimental outcomes, data on various parameters were evaluated. The analysis of various parameter data revealed significant differences in maize growth and yield, as a result of variety and different integrated nutrient management and their combination treatment. In case of different maize varieties the lowest grain yield (8.72 t ha^{-1}) was observed in V_1 (WIN-142 maize genotype) treatment. Whereas cultivating Pioneer 3355 maize genotype (V_2) gave the highest cob length (20.86 cm), cob breadth (17.11 cm), number of rows cob^{-1} (16.72), number of grains cob^{-1} (579.31), 1000-grain weight of maize (234.65 g) and grain yield (9.89 t ha^{-1}). Among different doses of bio-fertilizers rated nutrient management strategies the highest cob length (22.58 cm), cob breadth (17.56 cm), number of rows cob^{-1} (18.17), number of grains cob^{-1} (616.48), 1000-grain weight (234.65 g) and grain yield (12.08 t ha^{-1}) were observed in T_6 treatment. In case of combination, V_2T_6 combination treatment gave the highest grain yield (13.08 t ha^{-1}) in maize comparable to other treatment combination. Therefore, it would be suggested that cultivation of Pioneer 3355 maize genotype along with application of 100% Trichocompost + RDF (V_2T_6) combination treatment would help to influence plant growth and increase its ability to enhance better yield production of maize.

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ABBREVIATIONS

Full word	Abbreviations
Agriculture	Agr.
Agro-Ecological Zone	AEZ
Bangladesh Bureau of Statistics	BBS
Biology	Biol.
Biotechnology	Biotechnol.
Botany	Bot.
Cultivar	Cv.
Dry weight	DW
Editors	Eds.
Emulsifiable concentrate	EC
Entomology	Entomol.
Environments	Environ.
Food and Agriculture Organization	FAO
Fresh weight	FW
International	Intl.
Journal	J.
Least Significant Difference	LSD
Liter	L
Science	Sci.
Serial	Sl.
Soil Resource Development Institute	SRDI
Technology	Technol.
Triple super phosphate	TSP

CHAPTER I

INTRODUCTION

Maize is the most important cereal crop in Bangladesh after rice and wheat. It has potential nutritional values i.e., 100 grams of mature maize seeds contain 9.42 g of protein, 74.26 g carbohydrates, 0.64 g sugar, 7.3 g dietary fiber, 365 kcal energy (Islam and Hoshain, 2022). At present, the annual demand for maize in Bangladesh is around two million tons, but production is 4,700 thousand tonnes (BBS, 2021) which is a big gap between demand and production. To fulfil the demand, huge amount of money drains to import maize seeds and products. The consumption of maize in Bangladesh both as human food, livestock and poultry feed overall in all the segments will be increased in the future. In addition, Maize has a potential prospect in Bangladesh and annual average weather had a positive effect on maize production in Bangladesh.

Maize has a wide genetic variability and able to grow successfully in any environment in Bangladesh. It generally grows both in winter and summer time in Bangladesh and shows potential yield. Recently, the yield of maize has experienced explosive growth in Bangladesh. Maize has now positioned itself as the first among the cereals in terms of yield (6.15 t/ha) as compared to boro rice (3.90 t ha^{-1}) and wheat (2.60 t ha^{-1}) (BBS, 2020).

There are two kinds of maize in respect of grain colour; yellow and white. Worldwide, the yellow maize is mainly used as fodder while the white ones are consumed as human food (Revilla *et al*., 2022). The currently grown maize in this country is yellow type, which is mainly adapted importing genetic materials from CIMMYT. Again, although there are some indigenous local maize in the south east hills those have also not improved for having higher yields (Ullah *et al.*, 2016). Maize currently grown in Bangladesh is of yellow type and is used in the feed industry. Hybrid maize cultivation area has increased at the rate of about 20-25% per year since nineties as the yield potential of hybrid maize is greater than those of local races (Shompa *et al*., 2020). Now-a-days, there are many government and non government organizations are working for increasing maize production in Bangladesh.

Bangladesh Agricultural Research Institute (BARI) has developed seven open pollinated and 11 hybrid varieties whose yield potentials are 5.50–7.00 t ha^{-1} and 7.40–12.00 t ha^{-1}, respectively, which are well above the world average of 3.19 t ha^{-1} (Nasim *et al*., 2012). Different varieties respond differently to input supply, cultivation practices and prevailing environment etc during the growing season (Bithy and Ahamed, 2018). The low productivity of maize is attributed to many factors like decline of soil fertility, poor agronomic practices (such as proper management of planting configuration, irrigation interval, fertilizer managements, weeding, thinning, earthing up etc), and limited use of input, insufficient technology generation, poor seed quality, disease, insect, pest and weeds (Ullah *et al.*, 2017).

Inadequate and imbalanced use of major nutrients is one of the major bottlenecks in low productivity of maize. It is well known that maize is a heavy feeder for both nutrients and soil moisture due to its high productivity. Most of the farmers in Bangladesh are not aware of the use of balanced fertilizers and they grow different crops without maintaining proper doses of fertilizers to test the soil. Generally, to get higher yields, the farmers indiscriminately use chemical fertilizers without addition of sufficient quantities of organic manures. The irresponsible use of fertilizers can lead to the deterioration of soil health and, at the same time, reduce the quality and shelf life of the products (Krasilnikov *et al*., 2022). Only chemical fertilizers may accelerate the crops yield initially, but they eventually have adverse effects (Gupta *et al*., 2019). However the cost of inorganic fertilizers is very high but the organic manure is easily available and low cost. The use of readily available organic sources of nutrients should be used to maximize the economic return. Organic manures, Vermicompost, Tricho-compost, and Farm Yard Manure (FYM) are able to maximize the crop’s yield and protect from devastating pests and environmental pollution (Tarafder *et al*., 2023).

Application of bio-fertilizer encouraged plant growth and productivity of many crops (Ramasamy *et al.*, 2020). Bio-fertilizer have the potential to provide biological control of disease and pathogens, through its microbial actions (Sharma *et al*., 2022). Tricho-compost is a Bio-fertilizer that is prepared by using *Trichoderma sp*. fungi in the composting process which has an antifungal agent and nutritive value compounds that stimulate growth and plant defense mechanism (Rahman and Birkey, 2015) . It's also a good source of macro and micronutrients which can solve the lack of organic matter (Rahman *et al*., 2010). Use of *Tricho*-compost for crop production in large scale can solve the problem for disposal of wastes and also solve the lack of organic matter. On the other hand, a judicious combination of organic and inorganic sources of nutrients might be helpful to obtain a good economic return with good soil health for the subsequent crops. Kumar and Sharma (2004) reported that the use of organic fertilizer sources with mineral nitrogen, phosphorus and potassium fertilizers were found more beneficial in terms of maximum yield and in providing macronutrients in tomato. Single source of nutrients such as mineral fertilizers, compost, animal manures and bio-fertilizers cannot meet the nutrient requirements of the crops for sustainable production; therefore, a suitable ratio of organic and inorganic fertilizers is necessary for higher crop yield (Khan *et al*., 2017).

Therefore by considering the above facts, the present study entitled, "Growth and yield of maize varieties as influenced by integrated nutrient management" was undertaken with the following objectives :

i. To observe the varietal performance of two maize varieties
ii. to evaluate the effect of Tricho-compost and inorganic fertilizer on growth and yield of maize, and
iii. to investigate the combined effects of maize varieties and integrated nutrient management on growth, yield and yield contributing characteristics of maize.

CHAPTER II

REVIEW OF LITERATURE

The literature relevant to the present investigation regarding "Growth and yield of maize varieties as influenced by integrated nutrient management" has been reviewed in this chapter under the appropriate headings, which will provide an overview of the current status of the research work on these aspects.

2.1 Effect of variety

Adhikari *et al*. (2021) conducted a study to determine the effects of different rates of nitrogen and varieties on growth and yield of hybrid maize in Lamahi Municipality, Dang, Nepal from June to October, 2019. Three levels of hybrid maize varieties (10V10, Rajkumar F_1 and NMH-731) and four levels of nitrogen (160, 180, 200 and 220 kg N ha^{-1}) were evaluated using two factorial randomized complete block design with three replications. The results showed that the hybrid maize variety 10V10 produced the highest grain yield (9.35 t ha^{-1}), net returns (NRs. 91740.66 ha^{-1}) and B:C ratio (1.91) accompanied by the highest cob length (16.25 cm), and as number of grains per row (32.35) as compared to other varieties.

Subaedah *et al.* (2021) conducted a research in South Sulawesi, Indonesia, from April to August 2018. The research was designed under a split-plot design. The main plot consisted of planting systems (single row and twin-row), whereas subplots consisted of three varieties (Bonanza, Talenta, and Master Sweet) and three harvest times (65, 70, and 75 days after planting). Variables measured consisted of plant height, cob length, cob weight, estimation of cob weight per hectare, and sugar content. Significant varietal differences were observed in plant height, cob length, cob weight, and sugar content. Master Sweet variety had the greatest plant height and cob length, whereas Bonanza variety produced the greatest cob weight, cob weight per hectare, and sugar content.

Acharya *et al.* (2020) carried out an experiment to study the effect of plant population on performance of maize hybrids under different sowing dates in western terai of nepal and showed that among four hybrids (Rampur hybrid 2, Rampur hybrid 4, Rajkumar and

Nutan (KH 101) Rampur hybrid 2 produced 20% higher average grain yield (7.2 Mt ha^{-1}) than Nutan (KH 101) variety (6 Mt ha^{-1}).

Ihwan *et al.* (2019) carried out a study aimed to study performance of four maize hybrid varieties grown in two planting patterns under rainfed conditions. The four varieties tested were BISI18 (PT. BISI International), NK212 (PT. Syngenta Indonesia), P21 (PT. Du Pont Indonesia) and DK 771 (Monsanto Indonesia). The results showed that no interaction between planting pattern and variety. No effect of planting pattern on plant height and leaf area at tasseling but the leaf area index (LAI) and light interception were higher in a double row pattern. The tallest crop with the highest leaf area and LAI was performed by DK771 but there was no different recorded in light interception by the crops canopy at tasseling. DK771 produced the longest ear but in term of number of kernels row per ear, BISI18 was the highest. No difference was found in yield of the four varieties and the double row planting pattern produced only 8% higher yield than the single row. All the four tested maize varieties performed well under rainfed conditions.

Akil *et al.* (2018) revealed the highest mean of the weight 1000 grains of maize was found in Bima-4 (351.1 g followed by Nasa-29 (347.5g) and Bima-20 323.3g) variety.

Hasan *et al.* (2018) reported that the highest plant height, highest number of leaves $plant^{-1}$, longest cob, maximum diameter of cob, highest number of kernel cob^{-1}, the highest 1000-grain weight, maximum grain yield and stover yield were observed in BARI hybrid maize 7. On the other hand, the shortest plant, lowest number of cob, diameter of cob, lowest number of grains cob^{-1}, 1000-grain weight, grain yield and stover yield were observed in Khoi bhutta.

Khan *et al.* (2017) conducted a field experiment during kharif 2016 at Crop Research Farm, Department of Agronomy, SHUATS, Allahabad, (U.P.) The experiment was laid out in Randomized Block Design. The result showed that growth yield attributes viz., cob weight with husk (325.27 g), cob weight without husk (250.30 g) were recorded maximum in ‘sweety’ as compared to ‘Sweet glory’ variety.

Meena *et al.* (2017) at Udaipur (Raj), reported that grain, stover and biological yield of "V L Amber pop corn" was significantly higher over "Bajaura Pop corn" and "Amber Pop corn"during two successive years.

Ghimire *et al.* (2016) reported that the maximum grain yield ranging from (3.17 to 7.25 t/ha) and (1.60 to 6.32 t/ha) was produced by Rajkumar in improved practice and farmers practice of cultivation respectively while minimum grain yield was found in Arun2 ranging from (0.95 to 4.43 t/ha) and (0.81 to 4.09 t/ha) in improved practice and farmers practice of cultivation respectively.

Snehlata *et al*. (2016) conducted an experiment with four quality protein maize varieties *viz.*, HQPM 1, HQPM 5, Pratap QPM hybrid 1 and Vivek QPM 9. Highest values of yield attributing parameters, grain (4.26 t ha^{-1}), stover yield (6.33 t ha^{-1}), net return ` 45176 ha^{-1} and B C ratio 2.42 were obtained with HQPM 1.

An experiment was carried out by Asaduzzaman *et al*. (2014) to find out the suitable variety and N fertilizer rate for baby corn production at the Regional Station under Bangladesh Agricultural Research Institute at Jamalpur, Bangladesh during rabi season of 2008-09 and found that, variety Shuvra produced the tallest plant (179.1 cm) and BARI sweet $corn^{-1}$ produced the shortest plant (149.3 cm). They also founded that, Hybrid baby corn-271 produced the highest (160.50 g) dry matter $plant^{-1}$. On the other hand Khoibhutta had the lowest dry matter plant-^{1}(122.13 g) accumulation.

An experiment was carried out by Enujeke (2013) in Teaching and Research Farm of Delta State University, Asaba Campus from March, 2008 to June, 2010 to evaluate the effects of variety and spacing on growth characters of hybrid maize. The results obtained during the 8th week after sowing revealed that hybrid variety 9022-13 which gave highest number of leaves of 13.2 and the lowest number of leaves 12.2 was recorded from Oba Super 2.

Shafi *et al* (2012) conducted field experiment at Peshawar, (Pakistan). The experiment consist of four maize varieties viz., Azam, Pahari, Jalal-2003 and Sarhad white. Analysis of the data indicated that Maize varieties significantly ($p<0.05$) affected leaf area index, plant height, ear length, was maximum in Sarhad white variety.

Sobhana *et al.* (2012) conducted field experiment at, New Delhi showed that 'HM 4' was a better baby corn hybrid (*Zea mays* L.) than 'PEHM 2' as it had early cob initiation, produced more and heavier cobs and recorded higher cob yield.

Tahir *et al* (2008) conducted field experiment at Faisalabad (Pakistan) and investigated the comparative yield performance of different Maize hybrids under local conditions of Faisalabad was investigated. Plant population, plant height ultimately maximum plant height was obtained in maize hybrid HG- 3740.

Agele (2006) conducted field experiment at Nigeria and reported that, late maturing varieties of maize produced higher seed yield than the early maturing varieties, and when both were sown in the rainy season, they produced larger seed yield than the late season crop in the maize cultivars Varieties (Golden and Sultan) seem to have similar production potential under uniform and similar growing condition.

Almeida *et al*. (2005) conducted an experiment using ten baby corn cultivars *viz.*, AG 405, AG 1051, AG 2060, AG 6690, AG 7575, AG 8080, DKB 333, DKB 435, DKB 350 and DKB 747 and reported that the cultivar DKB 350 had the highest green cob yield of 6100 kg/ha and baby corn yield of 877 kg/ha. The cultivar DKB 350 also recorded the highest number of cobs (1, 72, 393 cobs/ha) whereas the variety AG 405 recorded the lowest number of cobs (80,695 cobs/ha).

Alise *et al*. (2003) conducted field experiment at Faisalabad, (Pakistan) found that 1000-grains weight was significantly increased by increasing levels of P. Maximum grain yield, number of grains cob^{-1} and 1000 grain weight was observed at 125 kg P2O5 ha^{-1}. On overall basis cv. "Composite -17" performed better than cv. "Golden".

Verma and Sarma (2001) studied the phenotypic stability of five maize genotypes used as baby corn over three environments for yield and yield attributing characters and concluded that genotypes 'RCM 1-1', 'MLY' and 'RCM 1-3' were found to be most suitable for baby corn yield for their average performance and responsiveness along with stability for mid hills of Meghalaya.

2.2 Effect of different nutrient management

Sarwar *et al.* (2023) designed a field study to see the impact of INM on a maize–wheat cropping system during winter (wheat) and summer (maize) season at Agronomic Research Farm, Bahauddin Zakariya University Multan, Pakistan. Both wheat and maize crops were grown consecutively along with full inorganic fertilizer (NPK) as well as with partial dose of fertilizer (25%, 50%, 75% NPK) supplemented with or without the addition of biochar (5 ton/ha). Data were collected regarding crop growth, yield and quality and further analyzed using MSTAT-C statistics software. Results revealed that the INM approach (75% of NPK + Biochar) enabled crops to improve dry matter production and its translocation towards sink which in turn boosted the crop productivity. This treatment improved dry matter (19%, 57%), grain weight (44%, 54%), grain yield (60%, 63%) and harvest index (30%, 29%) over the control in maize and wheat crops. It also improved the nutrient uptake in the plants which in turn improved the nutrient contents in the grains.

Kumar *et al.* (2022) reported that integrated plant nutrient supply system could aid in achieving balanced fertilization goals, which would improve the soil's physicochemical qualities on a long-term basis. The treatment T_2 (100 percent N_2 through Urea + Boron @ 3 kg. ha^{-1}) has emerged superior over other treatments and shows better growth, yield, followed by T_{14} (50 percent N_2 through Urea + 25 percent N_2 through FYM + 25 percent N_2 through Azotobactor @ 3 kg. ha^{-1}), while the treatment T_4 (50 percent N_2 through Urea + 25 percent N_2 through FYM + 25 percent N_2 through Azotobactor @ 3 kg. ha^{-1}).

Barde *et al.* (2021) carried out an experiment during 2019 Kharif seasons to investigate the effect of integrated nutrient management on growth, yield attributes, yield and economics of sweet corn under northern tract condition of Madhya Pradesh. Methods: The experiment was laid out in randomized block design with three replicates. Observations were recorded on growth parameters (plant height, dry matter accumulation), yield attributes (number of cobs per plant, number of rows per cob, number of grains per cob, cob length, grain weight per cob) and green cob yield and stover yield of sweet corn. Results: Revealed that combination of 75% RDF + BF + 25 % VC recorded higher mean growth parameters were plant height (196.4 cm), dry matter

(193.45 g plant^{-1}) and yield attributes were number of cobs per plant (1.60), length of cob (20.2 cm), number of rows per cob (16.5), number of grains per cob (612), grain weight per cob (126 g) and green cob yield & stover yield (18603 & 9770 kg ha^{-1} , respectively) as compared to rest of treatments, whereas above parameters lowest under absolute control. The practice of integration of 75% RDF + BF + 25 % VC gave maximum net returns of Rs.306657 ha^{-1} compared to other treatments.

Arthy *et al.* (2020) conducted a field experiment to study the effect of nutrient management practices on growth and yield enhancement in maize to various nutrient management practices. The combination of organic manures (vermicompost and poultry manure) along with various fertilizer levels of NPK and biofertilizer significantly influenced the plant growth, yield components and yield of maize. Among the integrated nutrient management combinations, 125% RDF + vermicompost 2 t ha^{-1} + azophos 10 kg ha^{-1} resulted in the increased values of green cob yield (9468 kg ha-1), stover yield (9876 kg ha^{-1}) and harvest index.

Audu (2020) observed that the effect of nitrogen fertilizer on the yield and yield parameters, increased significantly with the use of 120 kg N ha^{-1} with highest cob length (17.68 cm), seed index (32.89 g) and grain yield (5658.3 kg ha^{-1}). The control plot produced the least. Application of 2 ton ha^{-1} cowdung exhibited the highest yield. Application of 120 kg N ha^{-1} with 2 t ha^{-1} cowdung significantly increased the yield of QPM.

Gao *et al.* (2020) showed that combined application of the biofertilizer mixture (*Azotobactor chrocoocum*, AMF, and *Bacillus circulans*) with organic fertilizers increased maize growth, yield and nutrient uptake. The bio-organic fertilization has improved the soluble sugars, starch, carbohydrates, protein, and amino acid contents in maize seeds. Moreover, the bio-organic fertilization increase the microbial activity by enhancing acid phosphatase and dehydrogenase enzymes activity, bacterial count and mycorrhizal colonies in maize rhizosphere as compared with only chemical fertilization. The integrated use of fertilizers and manures with biofertilizers has improved alpha-amylase and gibberellins activities and their transcript levels and decrease the abscisic acid level in the seeds as compared to the purely chemical fertilizers. They recommend use of bio-organic as an alternative tool to reduce chemical fertilizers.

Hou *et al.* (2020) carried out an experiment to see the effects of various fertilization regimes with climate variability on yield stability for sweet corn production in southern Taiwan. Three combinations of treatment composed of only chemical fertilizer (CF), integrated fertilizer (IF) and organic fertilizer only (OF) were implemented. They found that different fertilization changed the marketable yields of fresh fruit (ear), which slightly increased for OF, but substantially decreased for chemical and integrated fertilizer both. In this study, they showed that chemical fertilizer had the lowest yield as compared to organic and integrated fertilizers. Their results also stipulate that specific soil microbes have the potential to help sweet corn in facing environmental vulnerability.

Hussain *et al.* (2020) observed that the (Bio-activated organic fertilizers) BOZ4 performed outstandingly by manifesting the maximum plant growth, yield, physiology, Zn content and quality. BOZ4 increased the dry shoot-biomass by 46% than control. The photosynthetic rate, transpiration rate, stomatal conductance, chlorophyll contents, carotenoids, and carbonic anhydrase activity were increased by 47%, 42%, 45%, 57%, 17%, and 44%, respectively, under BOZ4 over control in both cropping seasons. BOZ4 increased the Zn content of grain and shoot by 46% and 52% and reduced the phytate content by 73% as compared with control. Application of BOZ4 showed highest average fat (4.79%), crude protein (12.86%), dry matter (92.03%), fiber (2.87%), gluten (11.925%) and mineral (1.53%) contents as compared by control. They concluded that bio-activation of ZnO with zinc solubilizing bacteria (ZSB) helps in enhancing the growth, yield, physiological and quality parameters of maize under field conditions.

Kumar *et al.* (2020) conducted an experiment to know the effect of nutrient integration on the yield attributes and yield of the cultivar PBW-550. The study revealed that maximum increase in yield attributes were recorded with 100% RDF + 25% N through vermicompost + S + Zn + bio-fertilizers (*Azotobacter* + PSB) followed by 100% RDF + 25% N through FYM + S + Zn + bio-fertilizers (*Azotobacter* + PSB). Integration of vermicompost results in highest yield attributes in comparison to FYM. Highest grain and straw yield were recorded with 100% RDF + 25% N through vermicompost + S + Zn +

bio-fertilizer (*Azotobacter* + PSB) which was 104% and 108% higher in grain and 96.5% and 98.3% in straw as compared to control.

Kumar *et al.* (2020) noticed that growth and yield of maize were significantly improved by combined application of fertilizers with organic manures. The maximum plant height was obtained under the application of 100% RDF at growth stage while at harvesting time maximum plant height was registered under 50% RDF with lime application. Maximum yield was found under 100% RDF which was followed by 50% RDF with lime application. They concluded that combined application of inorganic fertilizers along with organic manures can be used in place of only chemical fertilizers to increase the crop productivity on sustainable basis.

Mahato *et al.* (2020) carried out a field experiment at Instructional Farm, Jaguli, BCKV, West Bengal to see the effect of integrated nutrient management on growth, yield and economics of hybrid maize. The result of the experiment revealed that application of vermicompost @ 2 t ha^{-1} with 75% RDF and 0.5% foliar application of ZnSO4 shows maximum plant height (250.97 cm), LAI (4.58), dry matter accumulation (1680.38 g m-2), number of grains cob^{-1} (402.64), cob length (22.34 cm), grain yield (9.04 t ha^{-1}), stover yield (13.50 t ha^{-1}), net return (Rs.77112 ha^{-1}), BCR (2.33) which was significantly higher than 100% RDF.

Miner *et al.* (2020) revealed that crop yield was found maximum with the combined application of inorganic fertilizers and organic manures, which shows the positive linkage between soil health and the crop productivity. Their results indicated that the practices which improves the soil health, also helps in improving crop productivity and nutritional supply by maize which sustains better human as well as animal life.

Naveen *et al.* (2020) found enriched compost @ 2.5 t ha^{-1} has shown the significantly better results in terms of yield attributing characters and cob yield followed by application of FYM @ 2.5 t ha^{-1} + lime + ash (1000:10:1). Treatments with straw mulch @ 2 t ha^{-1} recorded better results with respect to different yield attributing characters, cob yield, green fodder yield and high monetary return with B:C ratio.

Pal *et al.* (2020) noticed that surface irrigation with 75% RDN + 25% RDN as vermicompost was found best in terms of yield and economic realization which being competitive with drip irrigation at 1.0 ETc with 75% RDN + 25% RDN as vermicompost.

Pradhan *et al.* (2020) found the highest values of growth parameters of rice like plant height and dry matter accumulation under the treatment 75% N through fertilizer + 25% N through vermicompost with full dose of P and K. Higher tiller m^{-2}, grain $panicle^{-1}$ and panicle length were recorded under 75% N through fertilizer + 25% N through vermicompost with full dose of P and K. Maximum grain yield (4.93 t ha^{-1}) and straw yield (6.01 t ha^{-1}) were observed under 75% N through fertilizer + 25% N through vermicompost with full dose of P and K. They concluded that substituting a part of nitrogen fertilizer with organic manure improves soil quality and increases crop productivity.

Tamele *et al.* (2020) conducted an experiment to evaluate the effect of organic amendments (OAs) with different C/N ratios on nitrogen use efficiency (NUE) and recovery rate on the growth and yield of maize and soil properties. They found that the plant height of the treatment groups decreased in the following order: inorganic fertilizer (IF) = rapeseed waste (RW) > chicken manure (CnM) > bamboo tealeaf (BTL) > cow manure (CwM) > bamboo compost (BC). The maize fertilized with rapeseed waste only took up half of the nitrogen in inorganic fertilizer, which indicates that the physiological nitrogen efficiency (PUE) of rapeseed waste was twice as high as that of inorganic fertilizer. Rapeseed waste and chicken manure were regarded as valuable fertilizers that could be used to replace inorganic fertilizers.

Rao *et al.* (2020) observed that the crop growth parameters like plant height, number of leaves $plant^{-1}$ and leaf area index and yield attributes such as number of cobs $plant^{-1}$, cob length, cob girth and cob weight and green cob and forage yield were markedly influenced by integrated nutrient management treatments. Application of 75% RDF + 25% RDN (vermicompost) + BFC @15 kg ha^{-1} recorded the highest crop growth, yield attributes and green cob (12.01 t ha^{-1}) and green fodder (16.52 t ha^{-1}) yield. The combined application of 100% RDF (120-60-60 kg N, P_2O_5 and K_2O ha^{-1}) and biofertilizers

(*Azotobacter* + *Azosporillum* + phosphobacter) @15 kgha^{-1} registered the highest net returns (Rs.164206 ha^{-1}) and benefit cost ratio (1.92).

Geng *et al.* (2019) found that the chemical fertilizer with the equal amounts of substitutions with cow manure or chicken manure increased production and 25% nutrient substitution resulted in the best yield. They suggested that an appropriate proportion of organic substitution not only provides enough nutrients but also improves the soil environment and leads to increased yields.

Kamlakannan *et al.* (2019) conducted a field experiment to evaluate the effect of recommended dose of fertilizer with zinc sulphate fertilization on yield of maize. The results of the study indicated that the application of 150% recommended dose of fertilizer, zinc sulphate @ 25 kg ha^{-1} and neem cake @ 200 kg ha^{-1} along with *Azotobactor* @ 2 kg ha^{-1} was significantly superior in increasing the grain yield (7620.48 kg ha^{-1}) of maize and available nutrient status in soil and application of 50% recommended dose fertilizer registered lowest growth and yield of maize.

Naher and Rapar (2019) carried out a study to determine the efficacy of Tricompost as biofertilizer as maintenance for the chilli plant growth and productivity in the net house at Agropark, UMK jeli campus. The treatments were: T_1 = 100 g Tricompost, T_2 = 10 g chemical, T_3 = control, T_4 = 50 g Tricompost + 5 g chemical, T_5 =15 g chemical and T_6 = 150 g Tricompost. A total of 53 chilli seedlings were planted in polybags contained soils. Plant growth was determined based on plant length, diameter of stem and number of leaves. The result showed that T_6 (150 g Trichocompost +15 g NPK) was effective for the highest growth of chili plant and increased the number of leaves while T_5 (15 g NPK) result was highest in length of chili plant growth among the rest other treatments. To vast using chemical fertilizer can increase the yield; nevertheless, chemical residues caused environment pollution. The result of this study indicate that Trichocompost had the efficacy to growth chilli plant as like chemical fertilizer; thus it might be inform that combination of Trichocompost and chemical fertilizer can play role to reduce the unparalleled using of chemical fertilizer.

Singh *et al.* (2019) obtained highest grain yield, biological yield and harvest index in the treatmentN100 -P60+ *Azotobacter* + PSB as compared to N100 - P75 + *Azotobacter* and N120-P75-K50 (RDF) as well as control. The maximum net return and B:C ratio was found in N100 -P60 along with *Azotobacter* + PSB over N100-P75 + *Azotobacter* and RDF. The application of *Azotobacter* and PSB with N100-P60 registered net positive balance status of the available nitrogen and phosphorus. They concluded that application of biofertilizers improves the fertility status of the soil in sustainable manner.

Snehaa *et al.* (2019) observed that among the different treatments, RDF (150:60:40 kg NPK ha^{-1}) gave the best result in terms of growth, yield attributes, cob and green fodder yield in baby corn for I and II crops which was at par with the application of vermicompost @ 5 t ha^{-1}. The lowest values of growth, yield attributes and yield were recorded by farm compost @ 5 t ha-1. They concluded that application of fertilizer may be good in the short term for getting maximum yield and net income to the farmers but, in the long run, to increase the corn quality and sustain the soil fertility, vermicompost @ 5 t ha^{-1} treatment is the best and thus this practice can be recommended to the maize growing farmers.

Baradhan and Kumar (2018) found that integrated nutrient management practice (100 per cent RDF + vermicompost @ 5 tonnes ha^{-1} + soil application of *Azospirillum* @ 2 kg ha^{-1}) resulted in the increased values of various growth and yield attributes *viz.*, plant height, leaf area index, dry matter production, cob length, cob diameter, number of grains cob^{-1} and yield of maize. Application of 75 per cent RDF alone resulted in the lowest values of the growth and yield components of maize. They inferred that application of vermicompost @ 5 tonnes ha^{-1} + soil application of *Azospirillum* @ 2 kg ha^{-1} along with 100 percent recommended N, P and K was ecofriendly and economically viable integrated nutrient management practice for increasing the yield of maize.

Bekele *et al.* (2018) noticed that tasseling days (102), silking days (109), highest leaf area index (5.91), plant height (3.48 m), cob length (47.83 cm), number of grain per cob (644)and above ground dry biomass yield (22 t ha^{-1}) were registered by 5 t ha^{-1} vermicompost and 40 kg ha^{-1} chemical P fertilizer with lime of 0 and 4 t ha^{-1}. The highest test weight (508 g), grain yield (4.87 t ha^{-1}) and harvest index (24%) were obtained at 2.5

t ha^{-1} vermicompost and 40 kg P ha^{-1} with lime. They concluded that combined use of VC at 2.5 t ha^{-1} and chemical P fertilizer at 20 kg ha^{-1} with lime at 4 t ha^{-1} is economically optimum and could be recommended for reclaiming soil acidity and improve nutrients for maize as it enhanced grain yield and yield components of maize plant in strongly acidic soils for the two consecutive years pooled together.

Gill *et al.* (2018) carried out a field to study the response of maize to integrated use of organic, inorganic and biofertilisers. They found that the combination of *Azotobacter* + vermicompost + 60 kg ha^{-1} N by urea gave the significant results in growth, yield attributes and seed yield (53.56 q ha^{-1}) than other treatment combinations.

Gupta *et al.* (2018) conducted an experiment to study the effect of different levels of phosphorus and zinc on the physico-chemical properties of soil, growth and yield of maize. They found that the treatment 100% phosphorus ha^{-1} + 100% Zinc ha^{-1} significantly increased the number of grain per cob, cob length, grain yield and straw yield as compared to control.

Jadav *et al.* (2018) conducted an experiment at SDAU, Gujarat. The results revealed that combined application of 100% RDF + *Azotobacter* + PSB gave higher green forage (557 q ha^{-1}) and dry fodder (116 q ha^{-1}) yield of *Rabi* forage maize over other treatments. The Combined application of 100% RDF + *Azotobacter* + PSB recorded highest plant height (175.8 cm), number of leaves per plant (13.5), stem girth of 3rd internode (9.28 cm), leaf area per plant (4000 cm^2), leaf: stem ratio (0.37) and length of internodes (12.7 cm) over other treatments.

Kumar *et al.* (2018) carried out an experiment during *kharif* 2016 at C.S.A.U of Agriculture and Technology, Kanpur. The results showed that application of 100% RDF + 25 t FYM ha^{-1} significantly enhanced growth and yield parameters of maize as compared to control.

Prajapati *et al.* (2018) recorded the highest plant height 158.22 cm, number of leaves per plant 11.00, cob length 17.50 cm leaf length per plant 48.50 cm, and dry weight 163.46 g, yield, 42.77 q ha^{-1}, test weight 209.03 g of maize with NPK 100% + vermicompost

100%. They also revealed that the application of NPK with vermicompost were excellent source for fertilization than sole application of fertilizers.

Raman and Suganya (2018) conducted a field experiment to study the effect of integrated nutrient management on the growth and yield of hybrid maize. They found that growth and yield components of hybrid maize *viz*., plant height, leaf area index, dry matter production, cob length, cob diameter and number of grains cob^{-1}, test weight, grain yield, stover yield and harvest index were favorably influenced with 100% RDF + pressmud compost @ 5 t ha^{-1}. It was followed with 100% RDF + enriched farmyard manure @ 750 kg ha^{-1}. Their results evidently proved that 100% RDF + press mud compost @ 5 t ha^{-1} in hybrid maize is an effective integrated nutrient management practice for better maize yield and productivity and soil health.

Singh *et al.* (2018) observed that the combined application of 100% RDF + PSB produced significantly more cob and green fodder yields of corn than other treatments. Maximum plant growth (plant height and stem girth) and green fodder yield was recorded with the application of 150% RDF + PSB. Yield attributes and green cob yield was maximum with the application of 100% RDF + PSB. 100% RDF + PSB recorded highest net returns (Rs. 97466.66 ha^{-1}) and B: C ratio (2.77).

Verma *et al.* (2018) found that integrated organic and inorganic application to maize significantly improved the growth, yield attributes, grain and stover yield of maize. Treatments receiving organics for substituting 25% N either through fortified vermicompost or vermicompost gave the best results among the organic and inorganic combinations.

Tiwari *et al.* (2017) conducted a field experiment at Kanpur to evaluate the effect of inorganic, organic and integrated use of nutrients in terms of yield and soil health of maize-potato-onion cropping system. They observed the maximum productivity of maize cob, potato tuber and onion bulb with the application of 100% inorganic fertilizer followed by integrated organic and organic + bio-fertilizer treatments.

Shah and Wani (2017) observed that application of 100% RDF (NPK) + vermicompost @ 3 tonnes per hectare recorded maximum grains per cob, number of cobs per meter square, test weight, cob length and grain yield (3.26 q ha^{-1}) of maize.

Singh *et al.* (2017) observed that the application of 75% RDF + vermicompost (5 t/ha) + FYM (5 t/ha) + *Azotobactor* gave highest growth character and yield which was significantly at par with application of 100% RDF and 75% RDF + vermicompost (5 t/ha). Application of 75% RDF + vermicompost (5 t/ha) + FYM (5 t/ha) + *Azotobactor* gave the maximum net returns of Rs. 84272 ha^{-1} and maximum benefit cost ratio.

Wailare and Kesarwani (2017) conducted a field experiment to study the effect of integrated nutrient management on growth and yield parameters of maize and soil physico-chemical properties. They observed that the yield parameters (number of grains per cob, cobs weight per plant, test weight and stover yield) were significantly higher under integrated nutrient management system compared to 100% chemical fertilizer. They concluded that the integrated combination of 50% RDF with either FYM or poultry manure or both at 5 t ha^{-1} resulted in maximum maize productivity as compared with sole use of 100% RDF.

Khursheed *et al.* (2013) discern that application of poultry manure and vermicompost along with chemical fertilizers to supply nitrogen, phosphorus and potassium resulted in highest grain yield of rice. Their study shows that for better soil management, crop yield and environmental security, organic manures needs to be added along with chemical fertilizers.

Mahesh *et al.* (2010) conducted an experiment to study the effect of integrated nutrient management on growth & yield of maize. They noticed that the combined application of recommended dose of NPK + FYM 10 t ha^{-1} recorded higher number of grains cob^{-1} (458.5), grain weight cob^{-1} (166.9 g), test weight (38.9 g) and grain yield (65.9 q ha^{-1}) respectively.

Rahman *et al.* (2010) carried out a study to investigate the effect of Tricho-compost, compost and NPK on growth, yield and yield components of chili the experiment was conducted with randomized design at Botanical garden, Rajshahi University, Rajshahi, Bangladesh during August 2006 to February 2007. Experimental result showed that tricho-compost, compost and NPK significantly (P=0.05) influenced the growth and yield of chili. The treatment Tricho-compost (3 kg/pot) + NPK (T_1) produced the highest germination (%), vigour index, growth and yield of chili and the lowest yield and yield contributing parameters were recorded in control (T_{15}). The results suggest that inorganic fertilizers (NPK) with Tricho-compost (3 kg/pot) is suitable for better production of chili that may increase soil fertility and this integrated approach could be contributed to improve crop production.

CHAPTER III

MATERIALS AND METHODS

This part presents a concise depiction about the duration of the experimental period, site description, climatic state of the area, harvest or planting materials that are being utilized in the test, treatments, design, crop growing procedure, intercultural activities, data collection and statistical analyses.

3.1 Experimental period

The experiment was conducted during the period from October- 2021 to February-2022 in Rabi season.

3.2 Site description

3.2.1 Geographical location

The experiment was directed at the Agronomy field of Sher-e-Bangla Agricultural University (SAU), Sher-e-Bangla Nagar Agargong Dhaka, Bangladesh. The experimental site is geographically situated at 23°77′ N scope and 90°33′ E longitude at an elevation of 8.6 meter above ocean level.

3.2.2 Agro-Ecological Zone

The experimental field belongs to the Agro-ecological zone (AEZ) of "The Modhupur Tract", AEZ-28. This was a region of complex relief and soils developed over the Modhupur clay, where floodplain sediments buried the dissected edges of the Modhupur Tract leaving small hillocks of red soils as 'islands' surrounded by floodplain. For better understanding about the experimental site has been shown in the Map of AEZ of Bangladesh in Appendix-I. (Banglapedia, 2014)

3.3 Climate and weather

The climate of the experimental site was subtropical, characterized by the winter season from November to February and the pre-monsoon period or hot season from March to April and the monsoon period from May to October (Edris *et al.,* 1979). Meteorological data related to the temperature, relative humidity and rainfall during the experiment period of was collected from Bangladesh Meteorological Department (Climate division), Sher-e-Bangla Nagar, Dhaka and has been presented in Appendix- III.

3.4 Soil

The soil of the experimental pots belongs to the General soil type, Shallow Red Brown Terrace Soils under Tejgaon soil series. Soil pH ranges from 5.4–5.6 (Anon., 1989). The land was above flood level and sufficient sunshine was available during the experimental period. The morphological, physical and chemical characteristics of the experimental soil have been presented in Appendix-II (Biswas *et al*., 2019).

3.5 Planting materials

In this research work, " seeds of WIN-142 and Pioneer 3355 of maize genotypes were used as planting material which was collected from Department of Agronomy, Sher-e-Bangla Agricultural University, Dhaka-1207, Bangladesh.

3.6 Treatment of the experiment

The experiment consists of two factors which are given below:

Factor A: Varieties (2 types)

V_1= WIN-142 maize genotype

V_2= Pioneer 3355 maize genotype

Factor B: Integrated nutrient management (6 types)

T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + ZnS: 10 kg ha^{-1} +Boric acid: 10 kg ha^{-1})

T_2= 100% Trichocompost

T_3 = 100% Trichocompost + 50% RDF

T_4 = 100% Trichocompost + 75% RDF

T_5 = 50 % Trichocompost + 50% RDF

T_6 = 100% Trichocompost + RDF

3.7 Experimental design

The experiment was laid out in the Split plot design with three replications. Varieties factors were given in main plot whereas integrated nutrient management were given in sub plot. The field was divided into 3 blocks to represent 3 replications. Total 36 unit plots were made for the experiment with 12 treatments. The size of each unit plot was 3.89 m^2 (3.17 m × 1.23 m). Distance maintained between replication and plots were 1.0 m and 0.50 m, respectively.

3.8 Detail of experimental preparation

3.8.1 Preparation of experimental land

The land was opened with the help of a tractor drawn disc harrow on (19 October 2021) and then ploughed with rotary plough twice followed by laddering to achieve a medium tilth required for the crop under consideration. All weeds and other plant residues of previous crop were removed from the field. Immediately after final land preparation, the field layout was made on (19 October 2021) according to experimental specification. Individual plots were cleaned and finally the plot were prepared.

3.8.2 Fertilizer application

Manures and fertilizers were used according with par treatments requirements. The recommended dose of maize fertilizer by BARI Krishi Projukti Hatboi is as follows:

Fertilizers	Dose ha^{-1}
Trichocompost	5 t ha^{-1}
Cowdung	10 ton
Urea	400 kg
Triple super phosphate	200 kg
Gypsum	190 kg
Muriate of potash	200 kg
Zinc sulphate	10 kg
Boric acid	10 kg

(BARI, 2019)

The whole amounts of fertilizers were applied as basal doses except Urea. Only one third Urea was applied as basal doses and the rest amount was applied at 15 DAS interval for three installments. Fertilizer were applied according with par treatment requirement.

3.8.3 Seed sowing and maintaining spacing

The maize seeds were sown in lines maintaining 60 cm × 20 cm row to row and plant to plant spacing, having 2 seeds hole^{-1} under direct sowing in the well prepared plot on 20 October 2021.

3.9 Intercultural operations

After raising seedlings, various intercultural operations such as irrigation, weeding, gap filling and thinning, drainage, pest and disease control etc. were accomplished for better growth and development of the maize seedlings.

3.9.1 Gap filling and thinning

Gap filling was done at seventh day after sowing to maintain uniform plant population. Thinning was done two weeks after the sowing in order to maintain required plant density in each plot. By pulling out the excess seedlings in each spot, one seedling retained at each spot to maintain optimum plant population per plot.

3.9.2 Weed management

To check the weed growth, two inter cultivations were done during fourth and sixth week after sowing with the help of blade hoe and two hand weeding were carried out at 25 and 45 days after sowing.

3.9.3 Water management

Protective irrigation was provided to the crop depending upon the soil moisture content and prevailing weather conditions during the period of experiment. Five irrigations were given at 15, 30, 45, 60 and 90 DAS to avoid moisture stress.

3.9.4 Earthing up

Earthing up was done at 45 DAS along with second hand weeding and top dressed with urea fertilizer. It helped to give the better anchorage and favorable environment for root growth and development. It also helped to loosen the soil, to reduce the bulk density and to increase the water holding capacity of the soil**.**

3.9.5 Plant protection measure

Plant protection measures was adopted where ever they found necessary during the crop growth period. at 50 DAS Chloropyriphos spray @ 2.5ml lt^{-1} was sprayed against the control of stem borer.

3.9.6 Harvesting

The crop was harvested after attaining the physiological maturity at 110 DAS when cobs were dried and the entire plants turn yellow. The border rows from each plot were harvested first, leaving the net plot area. Later, net plot area was harvested after separating the plants designated for recording biometric observations. The cobs harvested from net plot area were dried thoroughly under the sun. The stover was dried under the sun separately for recording the weight and expressed in kg ha^{-1}. Shelling of cobs was done with a power operated maize sheller. Harvesting was done on 20 February 2022.

3.10 Data collection

Data on various parameters were collected from the sample plants. To avoid the border effect and achieve the highest level of accuracy, five plants were chosen at random from each plot to collect data. For this, the outside rows and the outer plants in the middle rows were avoided.

3.11 Collection of different data

Data were collected on the following parameters:

i. Plant height
ii. Number of leaves $plant^{-1}$
iii. Total dry matter $plant^{-1}$ at harvest
iv. Cob height from ground base
v. Cob length
vi. Cob breadth
vii. Cob unfilled area
viii. Number of rows cob^{-1}
ix. Number of grains cob^{-1}

x. 1000 grain weight
xi. Grain yield
xii. Stover yield
xiii. Biological
xiv. Harvest index

3.12 Procedure of recording data

A brief outline on data recording procedure followed during the study was given below

i. Plant height

At different stages of crop growth (30, 60, 90 DAS and at harvest), the height of five randomly selected plants per plot from the inner rows was measured from ground level to the tip of the plant portion and the mean value of plant height was recorded in cm.

ii. Number of leaves plant^{-1}

At different stages of crop growth (30, 60, 90 DAS and at harvest), the number of leaves of five randomly selected plants from the inner rows per plot was measured by counting the number of leaves of the plant and the mean value of the number of leaves was recorded.

iii. Dry matter weight plant^{-1}

At harvest 5 plants from each plot were uprooted randomly. Then the plant was cut into pieces. Then the various parts of the plant were put into a paper packet, and placed in oven maintaining 70^0 C for 72 hours. Then the sample was transferred into desiccators and allowed to cool down at room temperature. Then the sample weight was taken and then calculate the total dry matter of a plant for each plot. It was performed at harvest.

iv. Cob height from ground base

Cob height was measured in centimeter. The cobs' height was measured from the ground to the point where they were attached to the plant. Five plants were chosen in each plot using a centimeter scale, and average data were recorded.

v. Cob length

Cob length was measured in centimeter. Cob length was measured from the base to the tip of the cob of the five selected plants in each plot with the help of a centimeter scale then average data were recorded.

vi. Cob breadth

Cob breadth measured in centimeter from the base, middle and top portion of the ear and averaged.

vii. Unfilled area cob^{-1} (%)

Five cobs were randomly selected from each plot and unfilled area % cob^{-1} was calculated by using the following formula–

$$\text{Unfilled area cob}^{-1}\ \% = \frac{\text{Unfilled grain length from tip}}{\text{Total length of the cob}} \times 100$$

viii. Number of grain rows cob^{-1}

Five cobs from each plot were selected randomly and the number of grain rows per cob was counted. Then the average result was recorded.

ix. Number of grains cob^{-1}

The numbers of grains per cob was measured from the base to tip of the ear collected from five randomly selected cobs of each plot and finally average result was recorded.

x. 1000-grain weight

After removing the grain from each cob from each plot grains are stored in a specific grain stock or pot. From the seed stock of each plot 1000 seeds were calculated and the weight was measured by an electrical balance. It was recorded in gram.

xi Grain yield

After removing the grain from the cob, grain yield was calculated. Grain yield was calculated from cleaned and well dried grains collected from 1m^2 area of each plot and expressed as t ha^{-1}.

xii Stover yield

After separation of grains from shell, all the parts excepts grains from harvested area was sun dried and the weight was recorded and then converted into t ha^{-1}.

xiii Biological yield

Seed yield and Stover yield together were regarded as biological yield. The biological yield was calculated with the following formula:

Biological yield = Seed yield + Stover yield.

xiv Harvest Index

Harvest Index indicate the ratio of economic yield (grain yield) to biological yield and was calculated with the following formula:

$$\text{Harvest index (\%)} = \frac{\text{Grain weight}}{\text{Biological weight}} \times 100$$

3.13 Statistical data analysis

The collected data were compiled and analyzed statistically using the analysis of variance (ANOVA) technique with the help of a computer package program Statistix 10 software .The significant differences among the treatment means were compared by Least Significant Difference (LSD) at 5% levels of probability (Gomez and Gomez, 1984).

CHAPTER IV

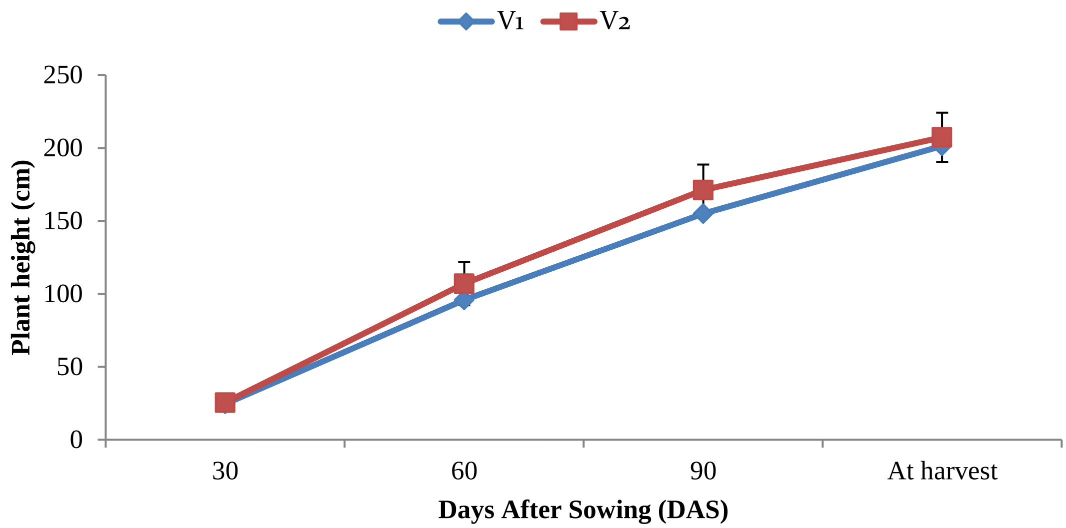
RESULTS AND DISCUSSION

This section contains a presentation and discussion of the study's findings on growth and yield of maize varieties as influenced by integrated nutrient management. The information was presented in various tables and figures. The findings had been discussed, and possible interpretations were provided under the headings listed below.

4.1 Plant height

Effect of variety

Plant height is an essential character of the vegetative stage of the crop plant and indirectly impacts on yield of crop plants. Different variety significantly influenced on plant height of maize at different days after sowing (DAS). It was seen that height increased gradually with the age of the crop (Figure 1). Experimental result revealed that the highest plant height (25.49, 107.03, 171.22 and 207.28 cm at 30, 60, 90 DAS and at harvest, respectively) was observed in V_2 (Pioneer 3355) treatment. Whereas, the lowest plant height (24.51, 95.87, 155.05 and 201.35 cm at 30, 60, 90 DAS and at harvest, respectively) was observed in V_1 (WIN-142 maize genotype) treatment. The variation of plant height is probably due to the genetic make-up of the varieties. Adhikari *et al*. (2021) reported that in maize varieties height of a plant is determined by genetical character and under a given set of environment different varieties will acquire their height according to their genetical makeup.

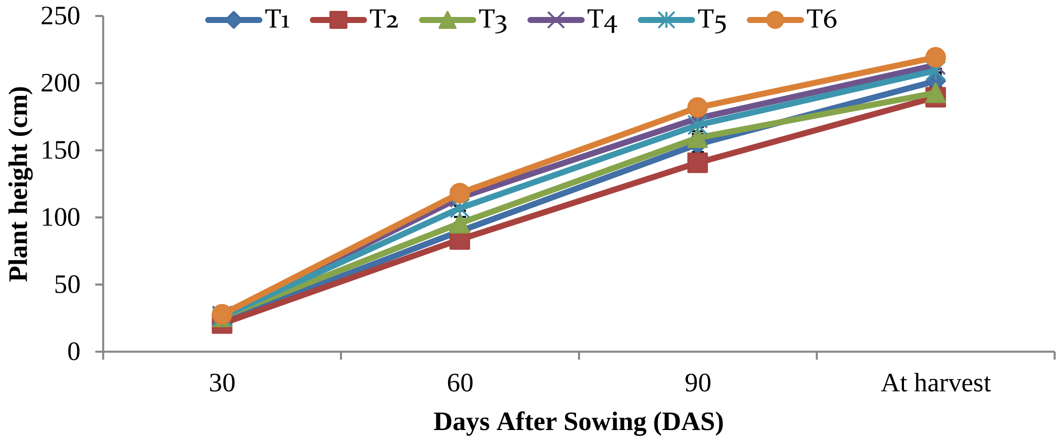


Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype.

Figure 1. Effect of variety on plant height at different days after sowing of maize (LSD$_{(0.05)}$: 1.36, 5.08, 7.17 and 6.65 at 30, 60, 90 DAS and at harvest, respectively).

Effect of integrated nutrient management

Plant height of maize was influenced significantly under different nutrient management practices at different days after sowing (DAS). According to the experimental findings the T_2 treatment had the lowest plant height (20.92, 83.60, 140.75 and 189.60 cm) at 30, 60, 90 DAS and at harvest, respectively which was statistically similar with T_1 (89.77 cm) treatment at 45 DAS (Figure 2). While Trichocompost along with recommended dose of fertilizer application increased uptake of nutrients in the plants leading to enhanced chlorophyll content and carbohydrate synthesis that led to the increase cell division and enlargement of the cell size which helped in increased plant height comparable to only Trichocompost application treatment. As a result the highest plant height (27.78, 118.14, 181.95 and 219.18 cm) at 30, 60, 90 DAS and at harvest, respectively was observed in T_6 treatment which was statistically similar with T_4 (26.85, 114.80 and 213.45 cm) treatment at 30, 45 and at harvest, respectively. Similar results were discovered by Arthy *et al.* (2020) supporting the current finding, and reported that the combination of organic manures along with various fertilizer levels of NPK and biofertilizer significantly influenced the plant growth, yield components and yield of maize.



Here, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50 % Trichocompost + 50 % RDF and T_6 = 100% Trichocompost + RDF.

Figure 2. Effect of integrated nutrient management on plant height at different days after sowing of maize (LSD$_{(0.05)}$: 1.24, 6.43, 7.77 and 6.20 at 30, 60, 90 DAS and at harvest, respectively).

Combined effect of variety and integrated nutrient management

Variety along with integrated nutrient management had shown significant effect on maize plant height at different days after sowing (Table 1). The results of the experiment showed that the V_2T_6 combination treatment gave the highest plant height (28.76, 124.37, 189.00 and 224.97 cm at 30, 60, 90 DAS and at harvest, respectively) which was statistically similar with V_2T_4 (27.30 cm) and V_1T_6 (26.80 cm) combination treatment at 30 DAS and with V_2T_4 (117.70, 182.70 and 217.80 cm) at 60, 90 DAS and at harvest, respectively. While V_1T_2 combination treatment showed the lowest plant height (20.57, 77.47, 132.90 and 184.10 cm at 30, 60, 90 DAS and at harvest, respectively) which was statistically similar with V_1T_1 combination treatment (21.27 and 80.93 cm) at 30, 60 DAS respectively.

Table 1. Combined effect of variety and integrated nutrient management on plant height at different days after sowing of maize

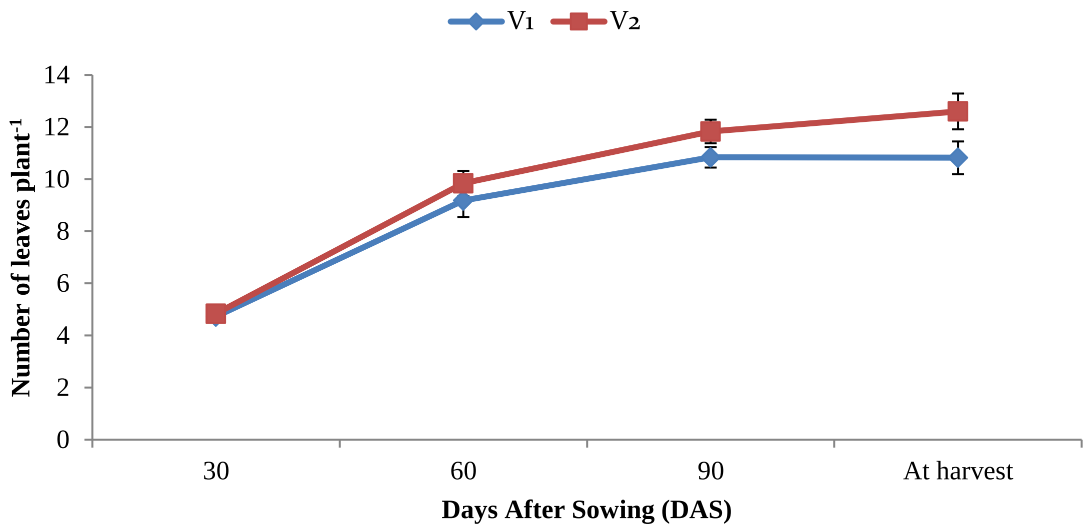
Treatment combinations	Plant height (cm) at different days after sowing			
	30	45	60	At harvest
V_1T_1	21.27 d	80.93 gh	146.30 g	194.50 ef
V_1T_2	20.57 d	77.47 h	132.90 h	184.10 g
V_1T_3	25.97 b	88.93 g	152.20 e-g	199.50 de
V_1T_4	26.40 b	111.90 bc	164.70 cd	209.10 bc
V_1T_5	26.03 b	104.10 c-e	159.30 d-f	207.50 cd
V_1T_6	26.80 ab	111.90 bc	174.90 bc	213.40 bc
V_2T_1	23.30 c	98.60 ef	162.60 de	208.60 cd
V_2T_2	21.27 d	89.73 fg	148.60 fg	195.10 e
V_2T_3	25.87 b	102.30 de	166.20 cd	186.00 fg
V_2T_4	27.30 ab	117.70 ab	182.70 ab	217.80 ab
V_2T_5	26.47 b	109.50 b-d	178.20 ab	211.20 bc
V_2T_6	28.76 a	124.37 a	189.00 a	224.97 a
$LSD_{(0.05)}$	2.01	9.41	11.83	9.91
CV(%)	4.15	5.27	4.96	4.52

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability. Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50 % RDF and T_6 = 100% Trichocompost + RDF.

4.2 Number of leaves plant^{-1}

Effect of variety

Depending on the variety, maximum number of leaves plant^{-1} of maize varied significantly at different days after sowing (DAS). According to the experimental results, the V_2 treatment had the higher number of leaves 4.84, 9.84, 11.83 and 12.60 at 30, 60, 90 DAS and at harvest, respectively. While the V_1 treatment, had the lower number of leaves plant^{-1} 4.73, 9.18, 10.84 and 10.82 at 30, 60, 90 DAS and at harvest, respectively (Figure 3). The reason of difference in number of leaves among varieties are the genetic makeup of the varieties, which is primarily influenced by heredity. Subaedah *et al.* (2021) found a significant difference in the number of leaves per plant among maize varieties.

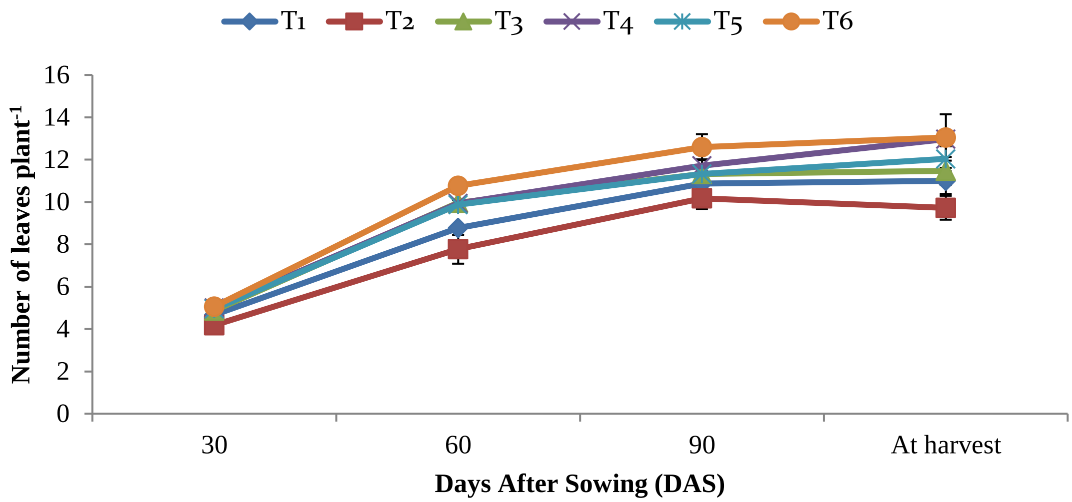


Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype.

Figure 3. Effect of variety on number of leaves plant^{-1} at different days after sowing of maize (LSD$_{(0.05)}$: NS, 0.62, 0.77, 0.63 and at 30, 60, 90 DAS and at harvest, respectively).

Effect of integrated nutrient management

The number of leaves plant^{-1} of the maize at different DAS responded significantly to various nutrient management (Figure 4). According to the experimental findings the T_2 treatment had the lowest number of leaves on plant^{-1} (4.18, 7.77, 10.17 and 9.73) at 30, 60, 90 DAS and at harvest, respectively. While application of trichocompost along with recommended dose of fertilizer increased nutrient uptake in the plants, this resulted in increased chlorophyll content and carbohydrate synthesis, which resulted in increased cell division and enlargement of cell size, resulting in increased number of leaves on plant^{-1}. As a result the highest number of leaves plant^{-1} (5.06, 10.77, 12.59 and 13.05) at 30, 60, 90 DAS and at harvest, respectively was observed in T_6 (Trichocompost + RDF) treatment which was statistically similar with T_4 (12.97) treatment at harvest respectively. The result was similar with the findings of Naher and Rapar (2019) who reported that application of 150 g Trichocompost +15 g NPK (T_6) was effective for the highest growth of chili plant and increased the number of leaves among the rest other treatments.



Here, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

Figure 4. Effect of integrated nutrient management on number of leaves plant^{-1} at different days after sowing of maize ($LSD_{(0.05)}$: NS, 0.53, 0.69, 0.72 and at 30, 60, 90 DAS and at harvest, respectively).

Combined effect of variety and integrated nutrient management

The results of the combined effect of variety and integrated nutrient management, statistically significant variation in respect of number of leaves plant^{-1} of maize was observed at 60, 90 DAS and at harvest, respectively, whereas non-significant variation was observed at 30 DAS (Table 2). It was revealed that the highest number of leaves plant^{-1} of maize (5.13, 11.14, 13.47 and 14.60) at 30, 60, 90 DAS and at harvest, respectively was observed in V_2T_6 combination treatment which was statistically similar with V_1T_6 (10.40) combination treatment at 60 DAS. While the lowest number of leaves plant^{-1} of maize (4.13, 6.80, 9.47 and 8.93) was observed in V_1T_2 combination treatment.

Table 2. Combined effect of variety and integrated nutrient management on number of leaves plant^{-1} at different days after sowing of maize

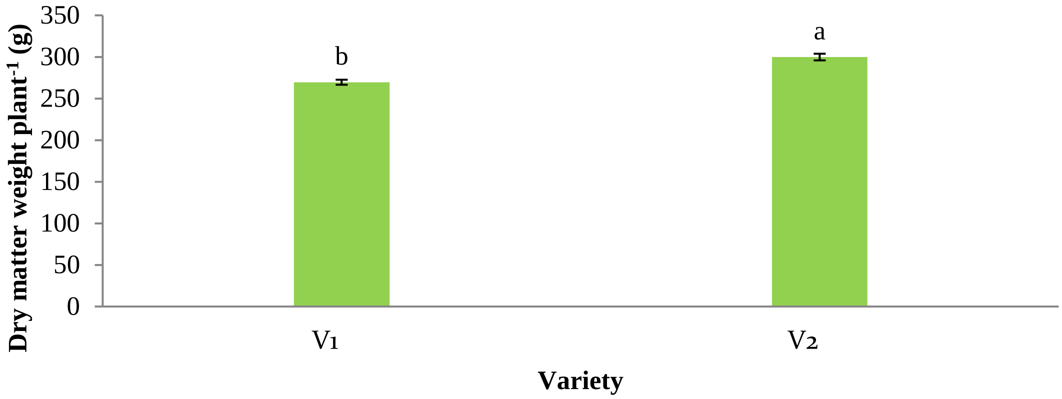
Treatment combinations	Number of leaves plant^{-1} at different days after sowing			
	30	60	90	At harvest
V_1T_1	4.60	8.87 d	10.47 d	10.13 g
V_1T_2	4.13	6.80 e	9.47 e	8.93 h
V_1T_3	4.87	9.80 bc	11.13 b-d	10.53 fg
V_1T_4	4.93	9.67 bc	11.30 b-d	12.60 bc
V_1T_5	4.87	9.53 cd	10.93 cd	11.20 ef
V_1T_6	5.00	10.40 ab	11.73 bc	11.50 d-f
V_2T_1	4.73	8.67 d	11.27 b-d	11.87 c-e
V_2T_2	4.23	8.73 d	10.87 cd	10.53 fg
V_2T_3	4.87	10.13 bc	11.53 b-d	12.40 b-d
V_2T_4	5.07	10.20 bc	12.13 b	13.33 b
V_2T_5	5.03	10.20 bc	11.73 bc	12.87 bc
V_2T_6	5.13	11.14 a	13.47 a	14.60 a
$LSD_{(0.05)}$	NS	0.88	1.12	1.08
CV(%)	6.38	4.65	5.07	5.13

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability. Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

4.3 Dry matter weight plant^{-1}

Effect of variety

The result of the experiment shown that different varieties had shown significant effect on the dry matter weight plant^{-1} of maize at harvest respectively (Figure 5). According to the experimental result, the highest dry matter weight plant^{-1} (299.85 g) was observed in V_2 treatment while the lowest dry matter weight plant^{-1} (269.58 g) was observed in V_1 treatment. The reason of varying dry matter weight plant^{-1} of maize among different varieties is because each variety has a unique growth stage and makes use of resources from its environment differently. Asaduzzaman *et al.* (2014) reported that dry matter weight plant^{-1} of maize varied among different maize varieties and the highest (160.50 g) dry matter plant^{-1} was produced by Hybrid baby corn-271 variety.

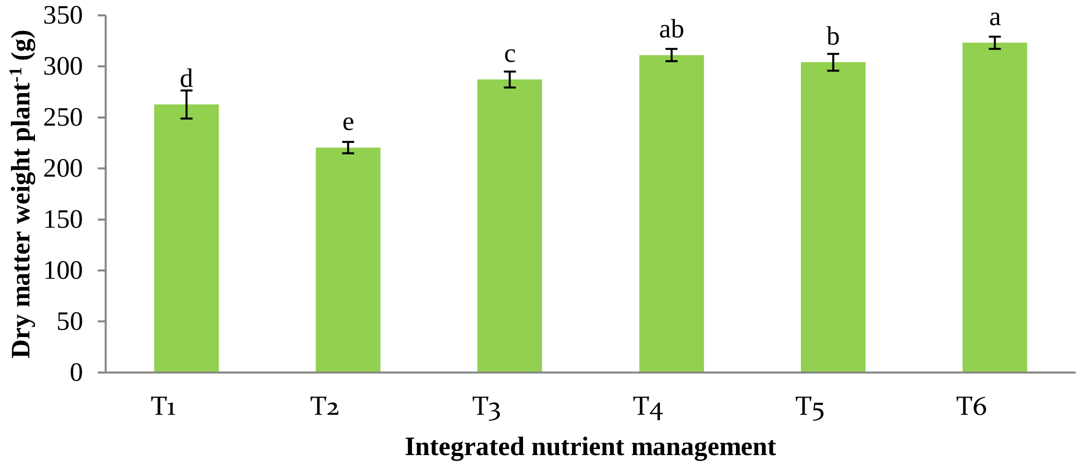


Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype.

Figure 5. Effect of variety on number of leaves on dry matter weight plant^{-1} at harvest of maize (LSD$_{(0.05)}$: 10.94).

Effect of integrated nutrient management

Different integrated nutrient management had shown significant effect on the dry matter weight plant^{-1} of maize at harvest (Figure 6). The highest dry matter weight plant^{-1} (323.11 g) was observed in the T_6 treatment, which was statistically similar with T_4 (311.10 g) treatment, while the lowest dry matter weight plant^{-1} (262.61 g) was observed in the T_2 treatment. Increased maize dry matter weight plant^{-1} may be due to the positive effects of integrated nutrient management, which may have induced proper nutrient supply around the root zone of the plant, resulting in increased nutrient uptake in the plants, which eventually helped in the synthesis of a greater amount of food material, which was later translocated into the various parts of the plant, resulting in an increase in dry matter weight plant^{-1}. Similar result also observed by Baradhan and Kumar (2018) reported that organic along with inorganic fertilizer application significantly influenced growth and yield of maize.



Here, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

Figure 6. Effect of integrated nutrient management on number of leaves on dry matter weight plant^{-1} at harvest of maize (LSD$_{(0.05)}$: 16.08).

Combined effect of variety and integrated nutrient management

The dry matter weight plant^{-1} of maize at harvest significantly varied as a result of the combined effect of variety and integrated nutrient management (Table 3). Experimental result revealed that the highest dry matter weight plant^{-1} (331.89 g) was observed in the V_2T_6 combination treatment, which was statistically similar with V_2T_5 (322.40 g), V_2T_4 (324.53 g) and V_1T_6 (314.33 g) combination treatment. While the lowest dry matter weight plant^{-1} (207.93 g) was observed in the V_1T_2 combination treatment.

Table 3. Combined effect of variety and integrated nutrient management on dry matter weight plant^{-1} at harvest of maize.

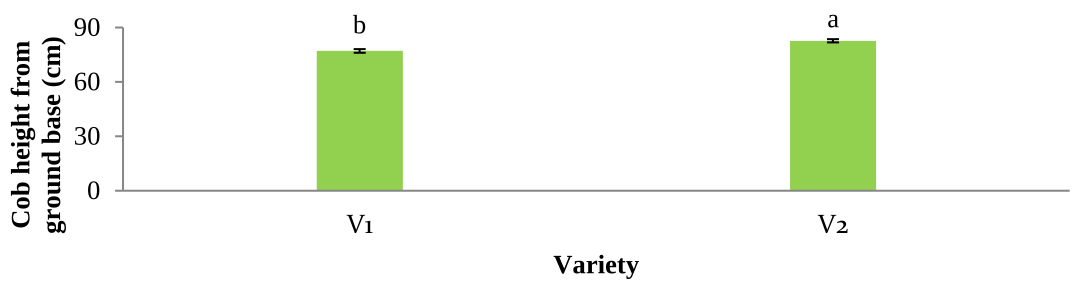
Treatment combinations	Dry matter weight plant^{-1} at harvest
V_1T_1	242.33 f
V_1T_2	207.93 g
V_1T_3	269.67 e
V_1T_4	297.67 cd
V_1T_5	285.55 de
V_1T_6	314.33 a-c
V_2T_1	282.89 de
V_2T_2	232.88 f
V_2T_3	304.53 b-d
V_2T_4	324.53 ab
V_2T_5	322.40 ab
V_2T_6	331.89 a
$LSD_{(0.05)}$	22.83
CV(%)	4.69

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability. Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

4.4 Cob height from ground base

Effect of variety

Cob height from ground base of maize varied significantly among different varieties. Experimental result showed that the highest cob height from ground base of maize (82.69 cm) was observed in V_2 treatment while the lowest cob height from ground base of maize (77.09 cm) was observed in V_1 treatment (Figure 7). Different maize varieties had different cob height from ground base was due to the genetic makeup of the variety.

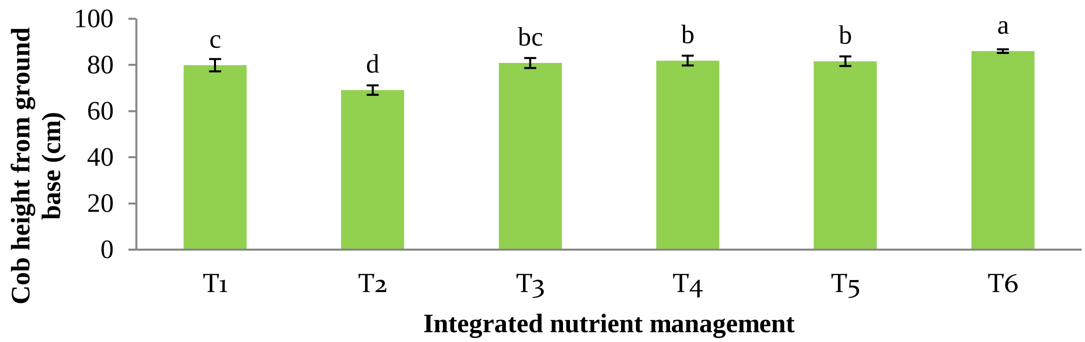


Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype.

Figure 7. Effect of variety on cob height from ground base of maize ($LSD_{0.05}$: 1.26).

Effect of integrated nutrient management

The cob height from the ground base of maize had significantly varied as a result of various integrated nutrient management strategies. (Figure 8). According to the experimental findings the highest cob height from ground base of maize (85.99 cm) was observed in T_6 treatment while the lowest cob height from ground base of maize (69.11 cm) was observed in T_2 treatment. This might be due to the improvement in soil physico-chemical properties (viz. pH, Bulk density and infiltration rate) and optimum availability of major nutrients and organic carbon which acted as the growth and yield enhancing factors for maize crop result in variation of cob height from the ground base.



Here, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

Figure 8. Effect of integrated nutrient management on cob height from ground base of maize ($LSD_{0.05}$: 1.30).

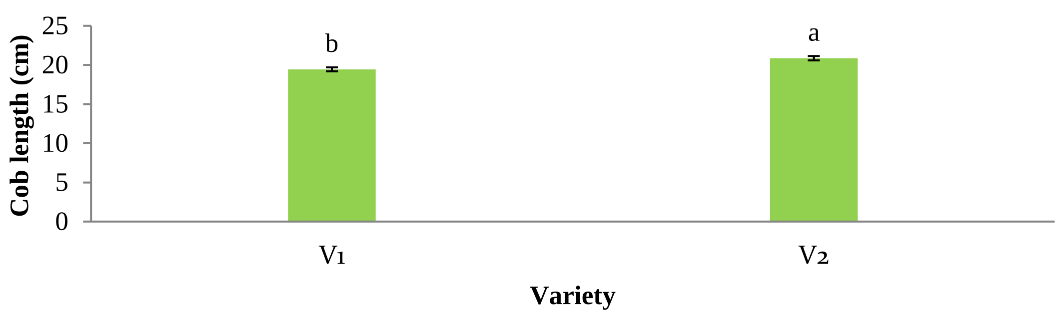
Combined effect of variety and integrated nutrient management

The cob height from the ground base of maize was significantly varied as a result of the combined effect of variety and integrated nutrient management (Table 4). Experimental result revealed that the highest cob height from the ground base of maize (87.12 cm) was observed in the V_2T_6 combination treatment. While the lowest cob height from the ground base of maize (66.22 cm) was observed in the V_1T_2 combination treatment.

4.5 Cob length

Effect of variety

The cob length of maize was significantly influenced by different varieties (Figure 9). Experimental result revealed that the highest cob length of maize (20.86 cm) was found in V_2 treatment. Whereas the lowest cob length of maize (19.44 cm) was found in V_1 treatment. Different maize varieties had different cob length was due to the genetic makeup of the variety however physiological variations in maize varieties at different growth stages can exhibit variations in physiological traits to growing conditions, resulting in influenced cob length and quality, which may then result in variations in maize yield. The result obtained from the present study was similar with the findings of Ihwan *et al.* (2019).

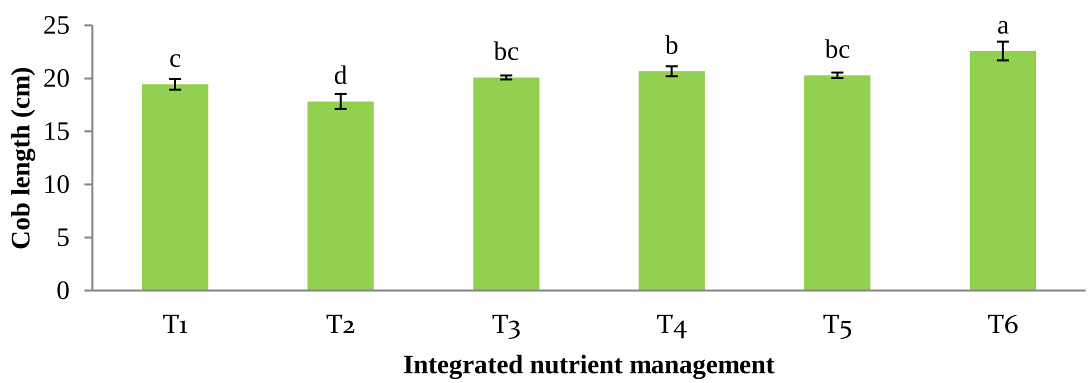


Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype.

Figure 9. Effect of variety on cob length of maize ($LSD_{0.05}$: 0.41).

Effect of integrated nutrient management

Different integrated nutrient management had shown significant effect on cob length of maize at harvest. Experimental result showed that the highest cob length of maize (22.58 cm) was found in T_6 treatment. Whereas the lowest cob length of maize (17.83 cm) was found in T_2 treatment (Figure 10). The results showed that maximum cob length was found in treatment which involves integrated application of organic and inorganic fertilizers to maize as compared to sole application of organic fertilizer. This might be due to adequate and balanced supply of nutrient from integrated nutrient management and plant received large amount of nutrient throughout their growth period and nourished properly which enhanced yield attributing characters. The result was similar with the findings of Shah and Wani (2017) who observed that application of 100% RDF (NPK) + vermicompost @ 3 tonnes per hectare recorded maximum cob length of maize.



Here, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

Figure 10. Effect of integrated nutrient management on cob length of maize ($LSD_{0.05}$: 0.91).

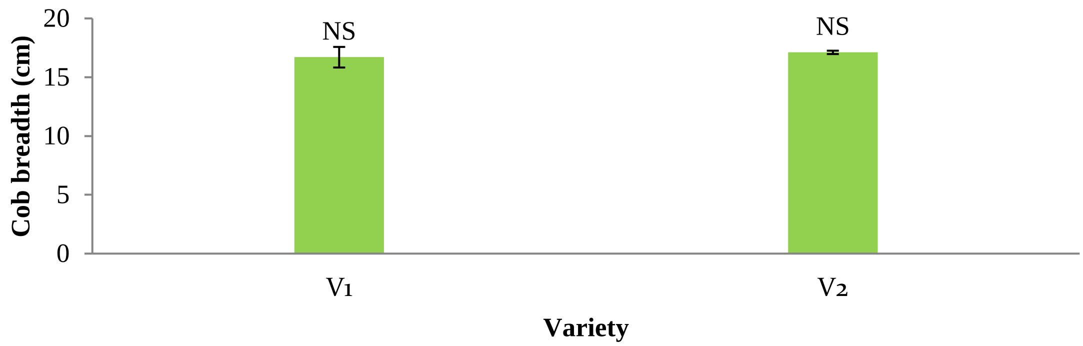
Combined effect of variety and integrated nutrient management

The cob length of maize was significantly varied as a result of the combined effect of variety and integrated nutrient management (Table 4). Experimental result revealed that the highest cob length of maize (23.83 cm) was observed in the V_2T_6 combination treatment. While the lowest cob length of maize (16.83 cm) was observed in the V_1T_2 combination treatment.

4.6 Cob breadth

Effect of variety

Different varieties of maize had shown non significant impact on cob breadth (Figure 11). The results of the experiment showed that the V_2 treatment had the highest cob breadth of maize (17.11 cm). However, the V_1 treatment had the lowest cob breadth of maize (16.70 cm).

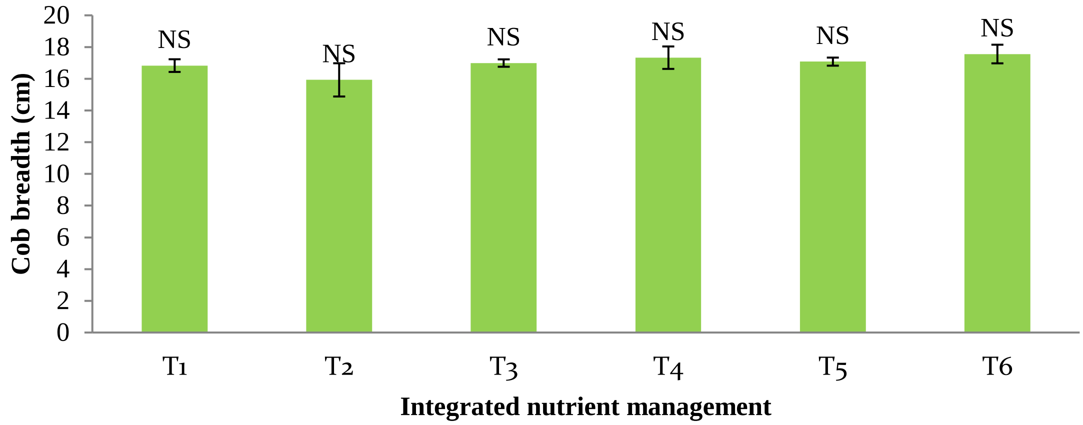


Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype.

Figure 11. Effect of variety on cob breadth of maize ($LSD_{0.05}$: NS).

Integrated nutrient management

Different integrated nutrient management strategies had no significant effect on maize cob breadth at harvest (Figure 12). According to the experimental findings, the highest cob breadth of maize (17.56 cm) was observed in T_6 treatment. However, the T_2 treatment had the lowest cob breadth of maize (15.63 cm).



Here, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

Figure 12. Effect of integrated nutrient management on cob breadth of maize ($LSD_{0.05}$: NS).

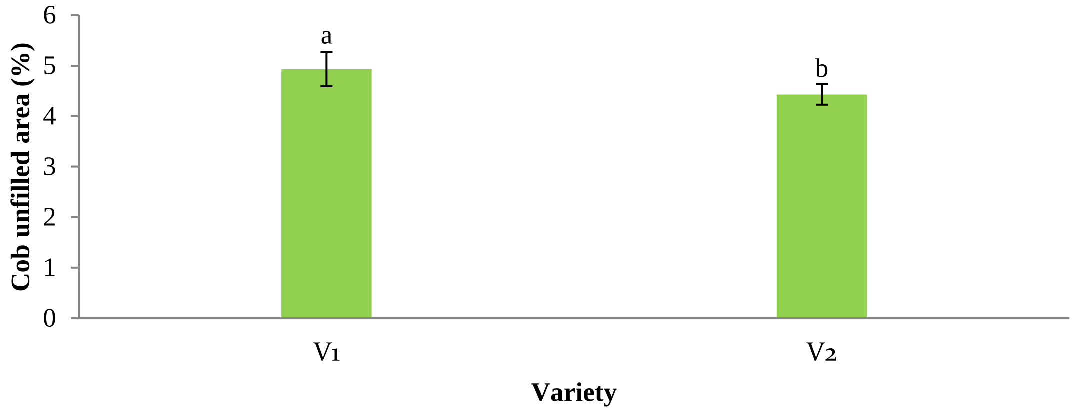
Combined effect of variety and integrated nutrient management

The combined effect of variety and integrated nutrient management had no significant effect on maize cob breadth (Table 4). According to the experimental results the highest cob breadth of maize (17.99 cm) was observed in the V_2T_6 combination treatment. While the V_1T_2 combination treatment had the lowest cob breadth (16.83 cm) of maize.

4.7 Cob unfilled area

Effect of variety

Cob unfilled area varied significantly among different varieties of maize. Experimental result showed that the highest cob unfilled area of maize (4.93 %) was observed in V_1 treatment while the lowest cob unfilled area of maize (4.43 %) was observed in V_2 treatment (Figure 13). The genetic makeup of the varieties might be the possible reasons for these variations.

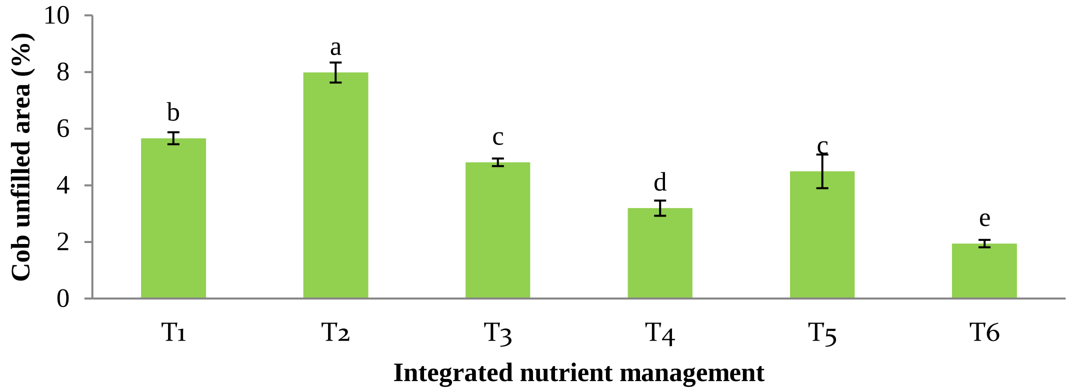


Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype.

Figure 13. Effect of variety on cob unfilled area percentage of maize ($LSD_{0.05}$: 0.28).

Effect of integrated nutrient management

The cob unfilled area of maize, in fields treated with various integrated nutrient management techniques varied significantly (Figure 14). According to the experimental findings the highest cob unfilled area of maize (7.98 %) was observed in T_2 treatment while the lowest cob unfilled area of maize (1.94 %) was observed in T_6 treatment. The improvement in soil nutrition and the creation of an ideal environment for better root growth through the secretion of growth-promoting substances (gibberellins, cytokinin, and auxin), as well as the availability of nitrogen fixed by microorganisms, may be the reasons for the decrease in the cob unfilled area of maize in organic and inorganic fertilizer treated plots.



Here, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

Figure 14. Effect of integrated nutrient management on cob unfilled area percentage of maize ($LSD_{0.05}$: 0.38).

Combined effect of variety and integrated nutrient management

The combined effect of variety and integrated nutrient management had shown significant effect on maize cob unfilled area. (Table 4). According to the experimental results the highest cob unfilled area of maize (8.03 %) was observed in the V_1T_2 combination treatment which was statistically similar with V_2T_2 (7.93 %) combination treatment. While the V_2T_6 combination treatment had the lowest cob unfilled area of (1.87 %) of maize which was statistically similar with V_1T_6 (2.02 %) combination treatment.

Table 4. Combined effect of variety and integrated nutrient management on cob height from ground base, cob length, cob breadth and cob unfilled area of maize

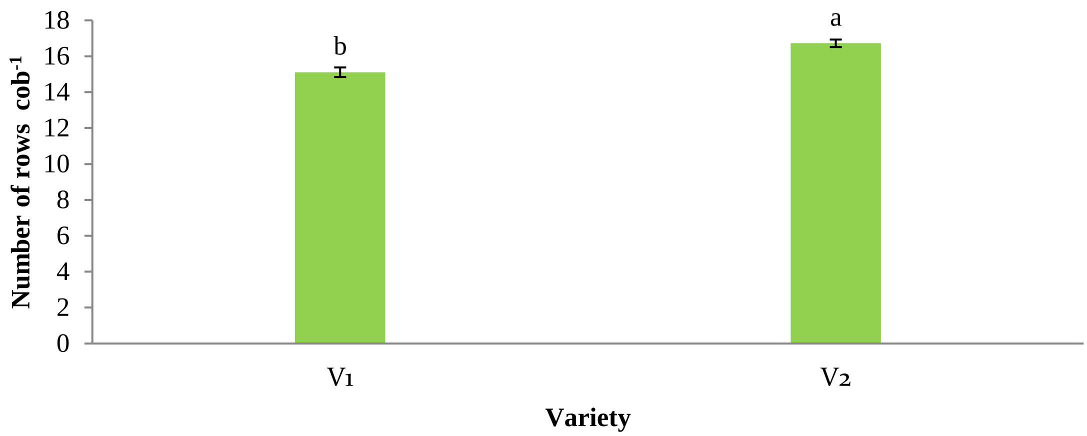
Treatment combinations	Cob height from ground base (cm)	Cob length (cm)	Cob breadth (cm)	Cob unfilled area (%)
V_1T_1	76.11 d	18.73 d	16.83	5.63 b
V_1T_2	66.22 f	16.83 e	15.66	8.03 a
V_1T_3	77.77 cd	19.83 cd	16.83	5.00 cd
V_1T_4	78.89 c	20.00 cd	16.83	3.57 e
V_1T_5	78.68 c	19.93 cd	16.90	5.33 bc
V_1T_6	84.88 b	21.33 b	17.16	2.02 g
V_2T_1	83.67 b	20.16 bc	16.83	5.69 b
V_2T_2	72.00 e	18.83 d	15.60	7.93 a
V_2T_3	83.89 b	20.36 bc	17.16	4.62 d
V_2T_4	84.89 b	21.33 b	17.83	2.81 f
V_2T_5	84.56 b	20.66 bc	17.26	3.65 e
V_2T_6	87.12 a	23.83 a	17.99	1.87 g
$LSD_{(0.05)}$	2.01	1.23	ns	0.55
CV(%)	4.36	5.69	6.19	6.79

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability. Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

4.8 Number of rows cob^{-1}

Effect of variety

The number of rows cob^{-1} was significantly influenced by various maize varieties (Figure 15). According to the experimental findings, the V_2 treatment of maize had the highest number of rows cob^{-1} (16.72). While the lowest number of rows cob^{-1} (15.11) was found in the V_1 treatment. The genetic makeup of the varieties might be the possible reasons for these variations. Adhikari *et al*. (2021) reported that number of rows cob^{-1} were differed significantly by the maize varieties.

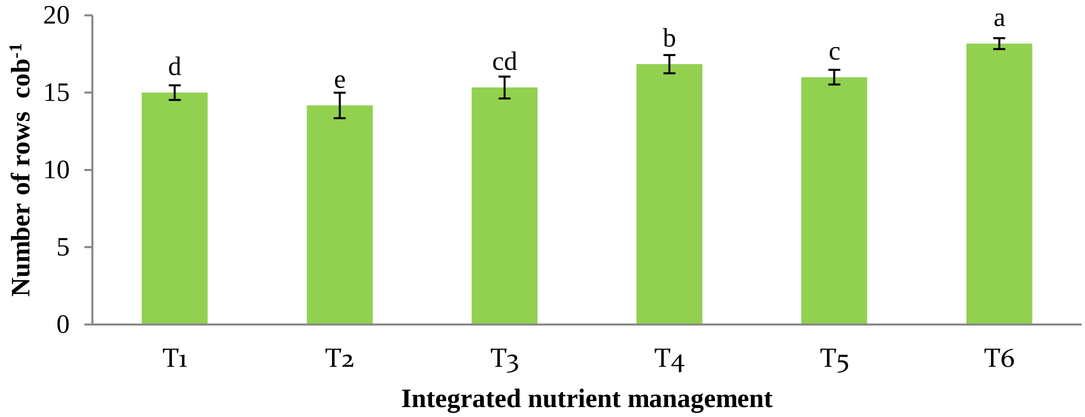


Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype.

Figure 15. Effect of variety on number of rows cob^{-1} of maize ($LSD_{0.05}$: 0.41).

Effect of integrated nutrient management

Different integrated nutrient management strategies had a significant effect on the number of rows cob^{-1}. According to the experimental findings the highest number of rows cob^{-1} (18.17) was observed in T_6 treatment while the lowest number of rows cob^{-1} of maize (14.17) was observed in T_2 treatment (Figure 16). The balanced nutrient supply as per crop demand through Trichocompost + RDF, yielded better crop growth which enabled the crop to have more accumulation of assimilates in source and thereby translocation of photosynthesis to sink leading to increased number of rows cob^{-1}. The result was similar with the findings of Kumar *et al.* (2018) who showed that application of 100% RDF + 25 t FYM ha^{-1} significantly enhanced growth and yield parameters of maize as compared to control.



Here, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

Figure 16. Effect of integrated nutrient management on number of rows cob^{-1} of maize ($LSD_{0.05}$: 0.74).

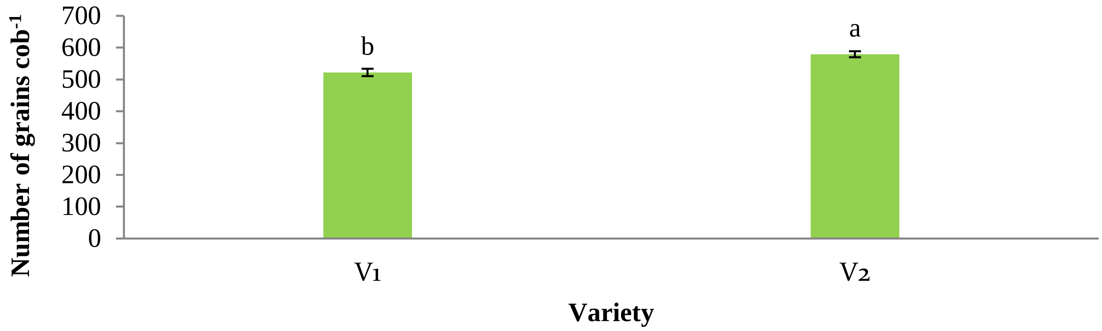
Combined effect of variety and integrated nutrient management

The combined effect of variety and integrated nutrient management had shown significant effect on number of rows cob^{-1} of maize. (Table 5). According to the experimental results, the highest number of rows cob^{-1} of maize (18.67) was observed in the V_2T_6 combination treatment which was statistically similar with V_2T_4 (17.67) and V_1T_6 (17.67) combination treatment. While the V_1T_2 combination treatment had the lowest number of rows cob^{-1} of maize (13.00) of maize.

4.9 Number of grains cob^{-1}

Effect of variety

The number of grains cob^{-1} was significantly influenced by maize varieties (Figure 17). According to the experimental result the V_2 treatment had the number of grains cob^{-1} (579.31). While the V_1 treatment had the lowest number of grains cob^{-1} (522.02). These variations could be caused by the genetic makeup of the varieties.

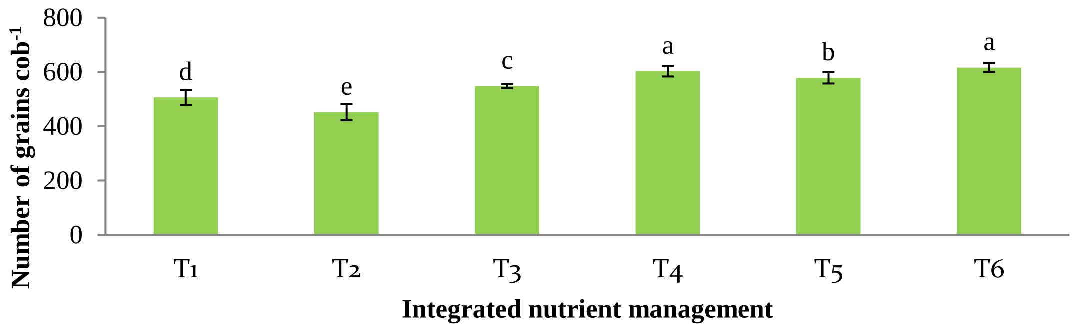


Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype.

Figure 17. Effect of variety on number of grains cob^{-1} of maize ($LSD_{0.05}$: 4.14).

Effect of integrated nutrient management

The number of grains cob^{-1} was significantly affected by integrated nutrient management strategies. The highest number of grains cob^{-1} (616.48) was observed in the T_6 treatment, while the lowest number of grains cob^{-1} (451.94) was observed in the T_2 treatment (Figure 18). Application of inorganic fertilizer with Trichocompost might have supplied continuous and adequate amount of nutrients at different stages due to release of sufficient amount of nutrients by mineralization at a constant level that resulted in higher number of grains cob^{-1} compared to sole application of Trichocompost.



Here, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

Figure 18. Effect of integrated nutrient management on number of grains cob^{-1} of maize ($LSD_{0.05}$: 18.97).

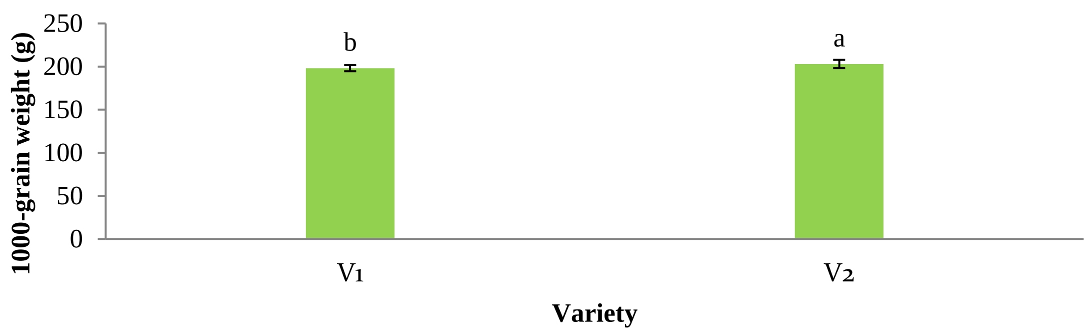
Combined effect of variety and integrated nutrient management

The number of grains cob^{-1} of maize had been significantly impacted by the combined effects of variety and integrated nutrient management. (Table 5). According to the experimental results, the highest number of grains cob^{-1} of maize (640.00) was observed in the V_2T_6 combination treatment which was statistically similar with V_2T_4 (630.29). While the V_1T_2 combination treatment had the lowest number of grains cob^{-1} of maize (409.87) of maize.

4.10 1000-grains weight

Effect of variety

The effect of varietal difference on 1000-grain weight of maize was found to be significant (Table 4). The result of the experiment revealed that the highest 1000-grain weight of maize (234.65 g) was observed in V_2 treatment. While the lowest 1000-grain weight of maize (198.07 g) was observed in V_1 treatment. The difference in 1000-grain weight between varieties is due to the fact that each variety has a unique growth stage and use resources from its environment differently. The result obtained from the present study was similar with the findings of Hasan *et al.* (2018) reported that 1000-grain weight of maize varied among different varieties of maize and the highest 1000-grain weight was observed in BARI hybrid maize 7 on the other hand, the lowest 1000-grain weight was observed in Khoi bhutta.

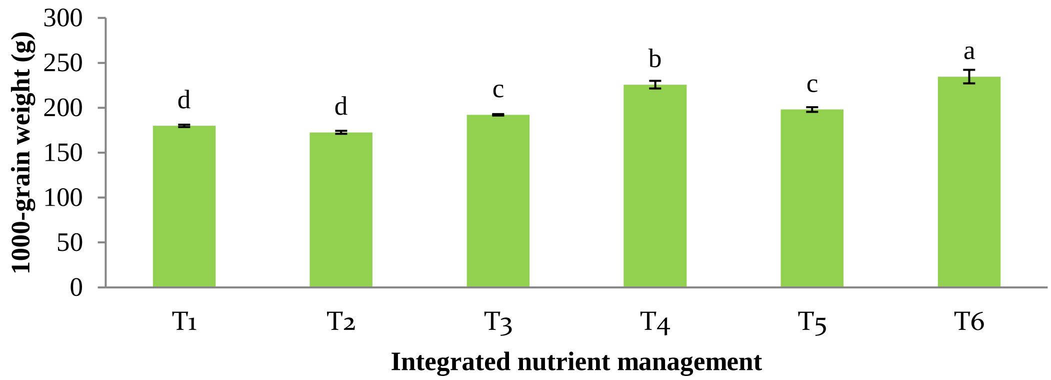


Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype.

Figure 19. Effect of variety on 1000-grain weight of maize ($LSD_{0.05}$: 4.14).

Effect of integrated nutrient management

The effect of various integrated nutrient management strategies on maize's 1000-grain weight was significant (Figure 20). In the T_6 treatment, the 1000-grain weight of maize was found to be the highest (234.65 g), whereas in the T_2 treatment, it was found to be the lowest (172.65 g). These findings are in agreement with the results of Shah and Wani (2017) who observed that application of 100% RDF (NPK) + vermicompost @ 3 tonnes per hectare recorded maximum 1000-grain weight of maize.



Here, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

Figure 20. Effect of integrated nutrient management on 1000-grain weight of maize ($LSD_{0.05}$: 8.37).

Combined effect of variety and integrated nutrient management

The 1000-grain weight of maize had been significantly impacted by the combined effects of variety and integrated nutrient management. (Table 4). According to the experimental results, the highest 1000-grain weight of maize (245.30 g) was observed in the V_2T_6 combination treatment while the V_1T_2 combination treatment had the lowest 1000-grain weight of maize (170.30 g) of maize which was statistically similar with V_2T_1 (178.00 g), V_2T_2 (175.00 g) and V_2T_1 (181.70 g) combination treatment.

Table 5. Combined effect of variety and integrated nutrient management on number of rows cob^{-1}, number of grains cob^{-1} and 1000-grain weight of maize

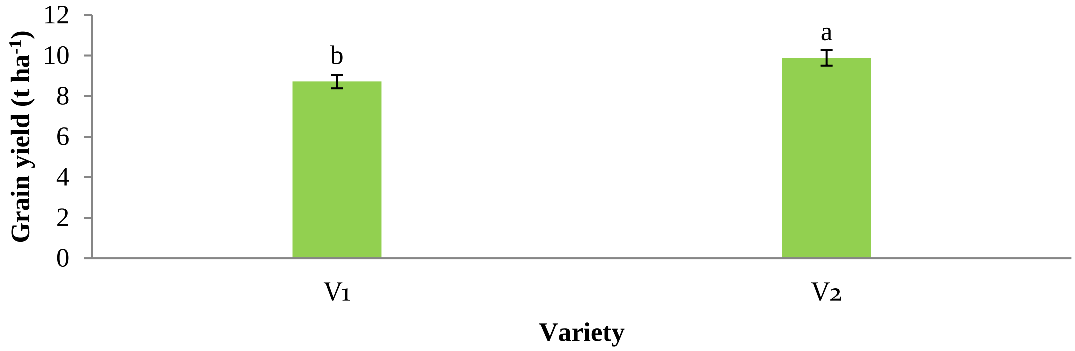
Treatment combinations	Number of rows cob^{-1}	Number of grains cob^{-1}	1000-grain weight (g)
V_1T_1	14.33 e	467.61 h	181.70 ef
V_1T_2	13.00 f	409.87 i	170.30 f
V_1T_3	14.33 e	537.29 f	191.00 de
V_1T_4	16.00 cd	575.46 de	219.70 c
V_1T_5	15.33 de	548.94 ef	201.70 d
V_1T_6	17.67 ab	592.95 cd	224.00 bc
V_2T_1	15.67 cd	544.54 f	178.00 f
V_2T_2	15.33 de	494.00 g	175.00 f
V_2T_3	16.33 cd	558.87 ef	193.30 d
V_2T_4	17.67 ab	630.29 ab	231.70 b
V_2T_5	16.67 bc	608.14 bc	194.30 d
V_2T_6	18.67 a	640.00 a	245.30 a
$LSD_{(0.05)}$	1.02	24.75	11.38
CV(%)	5.89	5.86	5.47

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability. Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

4.11 Grain yield

Effect of variety

Maize grain yield per hectare was significantly influenced by different varieties (Figure 21). In this experiment result revealed that the V_2 treatment recorded the highest grain yield of maize (9.89 t ha^{-1}). While V_1 treatment had the lowest grain yield of maize (8.72 t ha^{-1}). Different maize varieties had different genetic makeup which affects the growth and yield among varieties. The result obtained from the present study was similar with the findings of Snehlata *et al*. (2016) who reported that the varieties showed wide differences in their agronomic characteristics and grain yield, depending on their genotypes and environmental conditions.

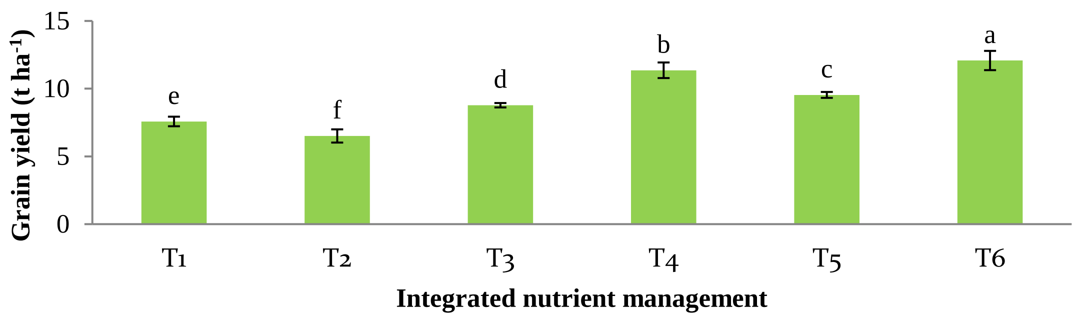


Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype.

Figure 21. Effect of variety on grain yield of maize ($LSD_{0.05}$: 0.82).

Effect of integrated nutrient management

The effect of various integrated nutrient management strategies on maize grain yield was significant (Figure 22). According to the experimental findings the T_6 treatment produced the highest grain yield of maize (12.08 t ha^{-1}). While the T_2 treatment had the lowest grain yield (6.51 t ha^{-1}) of maize. This might be due to adequate supply of essential elements which facilitated better growth and development of maize and which ultimately increased the yield components and yield. Mahesh *et al.* (2010) reported that the combined application of recommended dose of NPK + FYM 10 t ha^{-1} recorded highest grain yield (65.9 q ha^{-1}) respectively.



Here, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

Figure 21. Effect of integrated nutrient management on grain yield of maize ($LSD_{0.05}$: 0.43).

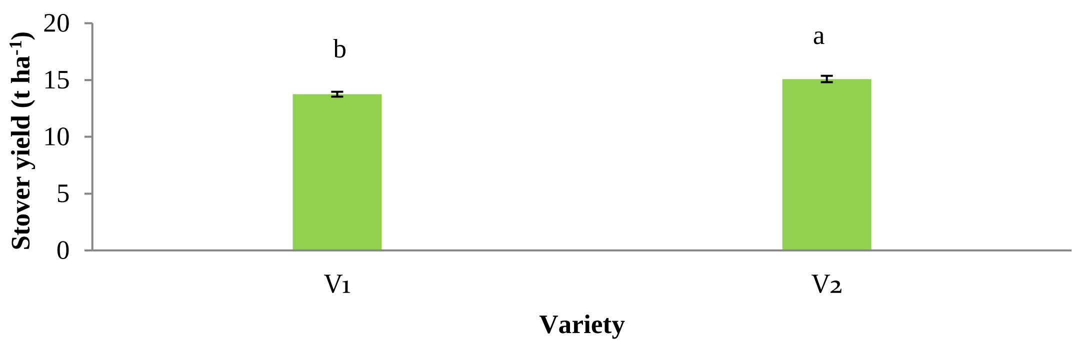
Combined effect of variety and integrated nutrient management

The combined effects of variety and integrated nutrient management had a significant impact on maize grain yield (Table 6). According to the experimental results, the highest grain yield of maize (13.08 t ha^{-1}) was observed in the V_2T_6 combination treatment while the V_1T_2 combination treatment had the lowest grain yield of maize (5.82 t ha^{-1}) of maize.

4.12 Stover yield

Effect of variety

Different varieties had shown significant effect on maize grain yield per hectare (Figure 23). According to the experimental findings the V_2 treatment produced the highest stover yield of maize (15.09 t ha^{-1}) in this experiment. On the other hand the V_1 treatment had the lowest maize stover yield (13.75 t ha^{-1}). Different maize varieties have different genetic makeup, which affects growth and yield. Meena *et al.* (2017) reported similar results as varieties differed significantly in stover yield of maize.

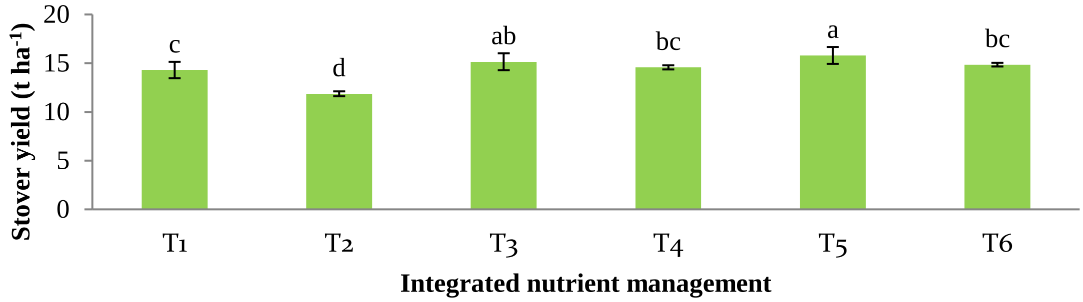


Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype.

Figure 23. Effect of variety on stover yield of maize ($LSD_{0.05}$: 0.41).

Effect of integrated nutrient management

Various integrated nutrient management strategies had a significant impact on maize stover yield (Figure 24). According to the experimental results, the T_5 treatment produced the highest maize stover yield (15.80 t ha^{-1}) which was statistically similar with T_3 (15.15 t ha^{-1}). While the T_2 treatment had the lowest maize stover yield (11.86 t ha^{-1}). This may be due to increased nutrient availability with application of organic fertilizer in combination with chemical fertilizer, which might have been utilized by crop leading to higher values of growth and yield components, which ultimately increased the grain yield of maize. Raman and Suganya (2018) reported that 100% RDF + press mud compost @ 5 t ha^{-1} in hybrid maize is an effective integrated nutrient management practice for better maize yield and productivity and soil health.



Here, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

Figure 24. Effect of integrated nutrient management on stover yield of maize ($LSD_{0.05}$: 0.83).

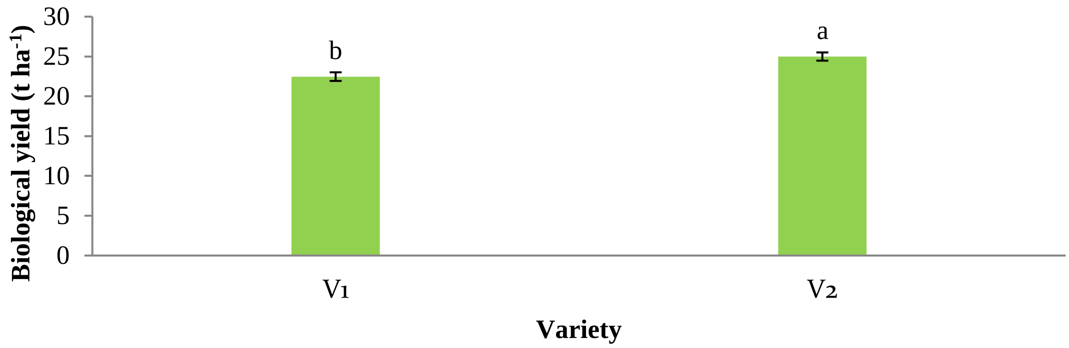
Combined effect of variety and integrated nutrient management

The combined effects of variety and integrated nutrient management on maize stover yield were significant (Table 6). According to the experimental results, the V_2T_5 combination treatment had the highest stover yield of maize (17.02 t ha^{-1}) which was statistically similar with V_2T_3 (16.37 t ha^{-1}) combination treatment while the V_1T_2 combination treatment had the lowest stover yield of maize (11.51 t ha^{-1}).

4.13 Biological yield

Effect of variety

The effect of different varieties on maize biological yield per hectare was significant (Figure 11). According to the experimental results the V_2 treatment produced the highest biological yield of maize (24.99 t ha^{-1}) in this experiment. The V_1 treatment, on the other hand, had the lowest maize biological yield (22.47 t ha^{-1}) of maize (Figure 25). The reason of difference in biological yield among varieties are the genetic makeup of the varieties, which is primarily influenced by heredity. Meena *et al.* (2017) at Udaipur (Raj), reported that grain, stover and biological yield of "V L Amber pop corn" was significantly higher over "Bajaura Pop corn" and "Amber Pop corn"during two successive years.

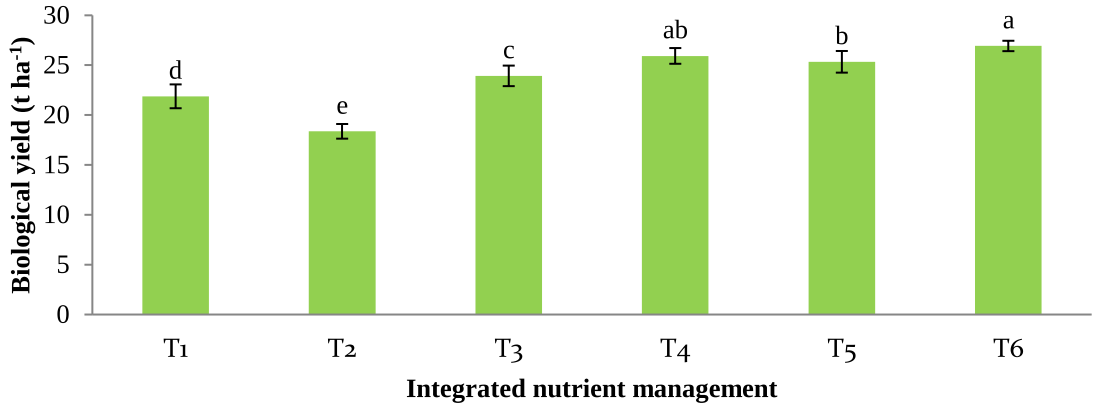


Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype.

Figure 25. Effect of variety on biological yield of maize ($LSD_{0.05}$: 1.65).

Effect of integrated nutrient management

The effect of various integrated nutrient management on maize biological yield was found to be significant (Figure 26). The result of the experiment showed that the T_6 treatment recorded the highest maize biological yield (26.93 t ha^{-1}), which was statistically similar to T_4 (25.93 t ha^{-1}). While on the other hand the T_2 treatment produced the lowest biological yield of maize (18.37 t ha^{-1}). Enhanced stover yield is the outcome of the positive and synergistic interaction between the nutrient supply and growth stature of maize as reflected in enhanced growth parameters with the supply of higher dose of Trichocompost and use of recommended dose of fertilizer application. The result was quite similar with the findings of Singh *et al.* (2019) who obtained highest grain yield, biological yield and harvest index in the treatment N100-P60+ *Azotobacter* + PSB as compared to N100-P75 + *Azotobacter* and N120-P75-K50 (RDF) as well as control.



Here, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

Figure 26. Effect of integrated nutrient management on biological yield of maize ($LSD_{0.05}$: 1.03).

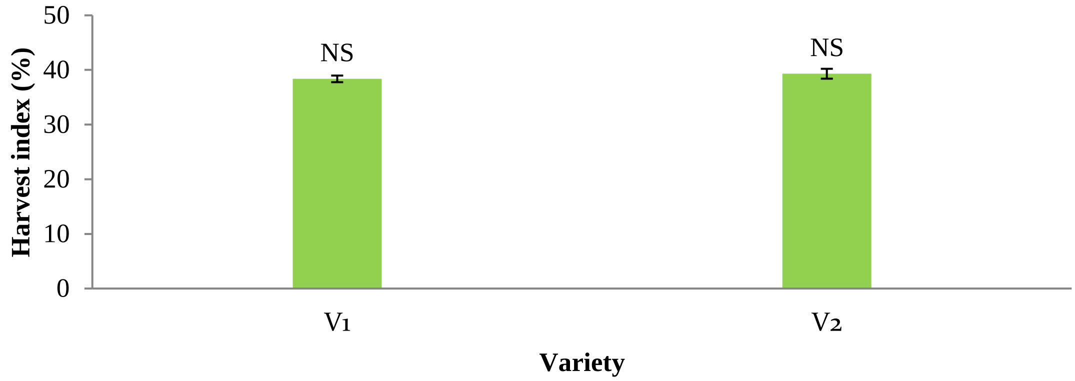
Combined effect of variety and integrated nutrient management

Variety along with integrated nutrient management had a significant impact on maize biological yield (Table 6). According to the experimental results, the V_2T_6 combination treatment had the highest maize biological yield (27.66 t ha^{-1}) which was statistically similar to the V_2T_5 (26.87 t ha^{-1}), V_2T_4 (27.04 t ha^{-1}) and V_1T_6 (26.19 t ha^{-1}) combination treatment while the V_1T_2 combination treatment had the lowest maize biological yield (17.33 t ha^{-1}).

4.14 Harvest index

Effect of variety

Different varieties of maize had shown non significant effect on harvest index (Figure 27). The result of the experimental data revealed that, the highest harvest index (39.31 %) was observed in V_2 treatment while the lowest harvest index (39.31 %) was observed in V_1 treatment.

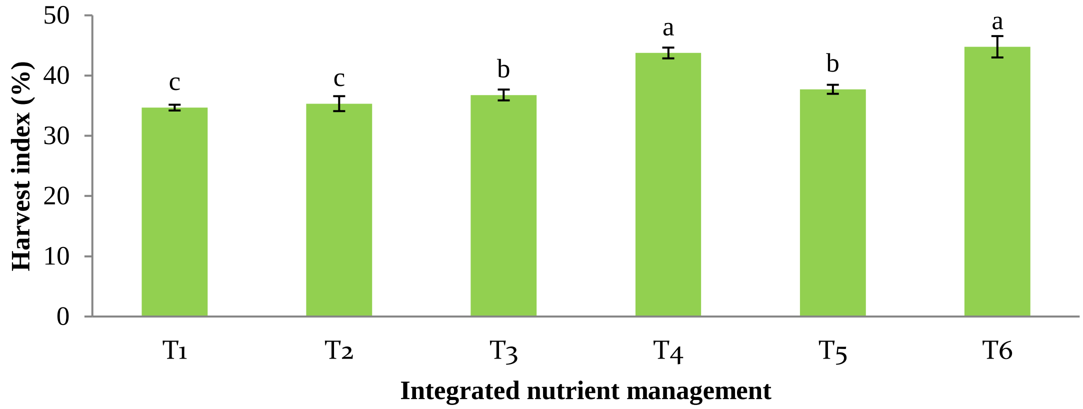


Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype.

Figure 27. Effect of variety on harvest index of maize ($LSD_{0.05}$: NS).

Effect of integrated nutrient management

Different integrated nutrient management had shown significant effect on harvest index of maize (Figure 28). According to the experimental findings, the highest harvest index (44.78 %) was observed in T_6 treatment which was statistically similar to T_4 (43.75 %) treatment. While the lowest harvest index (34.68 %) was observed in T_1 treatment which was statistically similar to T_2 (35.34 %) treatment. Bekele *et al.* (2018) noticed that harvest index of maize varied among different integrated nutrient management strategies and the highest harvest index (24%) were obtained at 2.5 t ha^{-1} vermicompost and 40 kg P ha^{-1} with lime. They concluded that combined use of VC at 2.5 t ha^{-1} and chemical P fertilizer at 20 kg ha^{-1} with lime at 4 t ha^{-1} is economically optimum and could be recommended for reclaiming soil acidity and improve nutrients for maize as it enhanced grain yield and yield components of maize plant in strongly acidic soils for the two consecutive years pooled together.



Here, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

Figure 28. Effect of integrated nutrient management on harvest index of maize ($LSD_{0.05}$: 1.13).

Combined effect of variety and integrated nutrient management

The maize harvest index was significantly affected by variety and integrated nutrient management (Table 6). According to the experimental results, the V_2T_6 combination treatment had the highest harvest index of maize (47.29 %) while the V_1T_2 combination treatment had the lowest harvest index (33.58 %) which was statistically similar to the V_2T_1 (34.28 %) and V_2T_3 (35.50%) combination treatment.

Table 6. Combined effect of variety and integrated nutrient management on grain yield, stover, biological yield and harvest index of maize

Treatment combinations	Grain yield (t ha^{-1})	Stover yield (t ha^{-1})	Biological yield (t ha^{-1})	Harvest index (%)
V_1T_1	7.08 i	13.11 fg	20.19 f	35.07 ef
V_1T_2	5.82 j	11.51 h	17.33 g	33.58 f
V_1T_3	8.55 gh	13.92 ef	22.47 e	38.05 d
V_1T_4	10.54 cd	14.27 d-f	24.81 b-d	42.48 c
V_1T_5	9.23 ef	14.57 c-e	23.80 c-e	38.78 d
V_1T_6	11.07 c	15.12 cd	26.19 ab	42.27 c
V_2T_1	8.08 h	15.49 bc	23.57 de	34.28 f
V_2T_2	7.20 i	12.21 gh	19.41 f	37.09 de
V_2T_3	9.01 fg	16.37 ab	25.38 bc	35.50 ef
V_2T_4	12.17 b	14.87 c-e	27.04 a	45.010 b
V_2T_5	9.85 de	17.02 a	26.87 a	36.66 de
V_2T_6	13.08 a	14.58 c-e	27.66 a	47.29 a
$LSD_{(0.05)}$	0.94	1.13	1.99	2.37
CV(%)	6.20	4.82	4.87	5.72

In a column means having similar letter(s) are statistically similar and those having dissimilar letter(s) differ significantly at 0.05 level of probability. Here, V_1= WIN-142 maize genotype, V_2= Pioneer 3355 maize genotype, T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1}+ MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF.

CHAPTER V

SUMMARY AND CONCLUSION

A field experiment was conducted at Sher-e-Bangla Agricultural University, Dhaka during the period from October-2021 to February-2022 in Rabi season, to study the growth and yield of maize varieties as influenced by integrated nutrient management. The experiment consisted of two factors, and followed split plot design with three replications. Factor A. Varieties (2) *viz:* V_1: WIN-142 maize genotype V_2: Pioneer 3355 maize genotype and Factor B. Different integrated nutrient management (6) *viz:* T_1= Recommended dose of fertilizer application (RDF: Urea: 400 kg ha^{-1} + TSP: 200 kg ha^{-1} + MoP: 200 kg ha^{-1} + Gypsum: 190 kg ha^{-1} + $ZnSO_4$: 10 kg ha^{-1} + Boric acid: 10 kg ha^{-1}), T_2= 100% Trichocompost, T_3 = 100% Trichocompost + 50% RDF, T_4 = 100% Trichocompost + 75% RDF, T_5 = 50% Trichocompost + 50% RDF and T_6 = 100% Trichocompost + RDF. For the purpose of evaluating the experimental outcomes, data on various parameters were evaluated. The analysis of various parameter data revealed significant differences in maize growth and yield, as a result of variety and different integrated nutrient management and their combination treatment.

In case of different varieties of maize the highest plant height (25.49, 107.03, 171.22 and 207.28 cm at 30, 60, 90 DAS and at harvest, respectively), number of leaves $plant^{-1}$ (4.84, 9.84, 11.83 and 12.60 at 30, 60, 90 DAS and at harvest, respectively), dry matter weight $plant^{-1}$ (299.85 g), cob height from ground base (82.69 cm), cob length (20.86 cm), cob breadth (17.11 cm), number of rows cob^{-1} (16.72), number of grains cob^{-1} (579.31), 1000-grain weight of maize (234.65 g), grain yield (9.89 t ha^{-1}), stover yield (15.09 t ha^{-1}), biological yield (24.99 t ha^{-1}) and harvest index (39.31 %) were observed in V_2 treatment. However the lowest the lowest plant height (24.51, 95.87, 155.05 and 201.35 cm at 30, 60, 90 DAS and at harvest, respectively), number of leaves $plant^{-1}$ (4.73, 9.18, 10.84 and 10.82 at 30, 60, 90 DAS and at harvest, respectively), dry matter weight $plant^{-1}$ (269.58g), cob height from ground base (77.09 cm), cob length (19.44 cm), cob breadth (16.70 cm), number of rows cob^{-1} (15.11), number of grains cob^{-1} (522.02), 1000-grain weight of maize (198.07 g), grain yield (8.72 t ha^{-1}), stover yield (13.75 t ha^{-1}), biological yield (22.47 t ha^{-1}) and harvest index (39.31 %) were observed in V_1 treatment.

Growth and yield of maize significantly influenced due to application of different integrated nutrient management. Experimental result revealed that the highest plant height (27.78, 118.14, 181.95 and 219.18 cm) at 30, 60, 90 DAS and at harvest, respectively, number of leaves on $plant^{-1}$ (5.06, 10.77, 12.59 and 13.05) at 30, 60, 90 DAS and at harvest, respectively, dry matter weight $plant^{-1}$ (323.11 g), cob height from ground base (85.99 cm), cob length (22.58 cm), cob breadth (17.56 cm), number of rows cob^{-1} (18.17), number of grains cob^{-1} (616.48), 1000-grain weight (234.65 g), grain yield (12.08 t ha^{-1}), biological yield (26.93 t ha^{-1}) and harvest index (44.78 %) were observed in T_6 treatment. However the T_2 treatment recorded the lowest plant height (20.92, 83.60, 140.75 and 189.60 cm) at 30, 60, 90 DAS and at harvest, respectively, number of leaves on $plant^{-1}$ (4.18, 7.77, 10.17 and 9.73) at 30, 60, 90 DAS and at harvest, respectively, dry matter weight $plant^{-1}$ (262.61 g), was cob height from ground base (69.11 cm), cob length (17.83 cm), cob breadth (15.63 cm), number of rows cob^{-1} (14.17), number of grains cob^{-1} (451.94), 1000-grain weight (172.65 g), grain yield (6.51 t ha^{-1}) and biological yield of maize (18.37 t ha^{-1}).

In case of combination, V_2T_6 combination treatment gave the highest plant height (28.76, 124.37, 189.00 and 224.97 cm at 30, 60, 90 DAS and at harvest, respectively), number of leaves on $plant^{-1}$ of maize (5.13, 11.14, 13.47 and 14.60) at 30, 60, 90 DAS and at harvest, respectively, dry matter weight $plant^{-1}$ (331.89 g), cob height from the ground base (87.12 cm), cob length of maize (23.83 cm), cob breadth of maize (17.99 cm), number of rows cob^{-1} of maize (18.67), number of grains cob^{-1} of maize (640.00), 1000-grain weight of maize (245.30 g), grain yield (13.08 t ha^{-1}), biological yield (27.66 t ha^{-1}) and harvest index of maize (47.29 %). While corresponding lowest value were found in V_1T_2 combination treatment.

Conclusion

Based on the above, it could be revealed that different varieties and application of different integrated nutrient management significantly influenced the growth and yield of maize. However, considering above all facts, it may be concluded that Pioneer 3355 maize genotype (V_2), application of 100% Trichocompost + RDF (T_6), and their combination (V_2T_6) seems promising for increasing growth and yield of maize than compared to other combination treatment. Therefore, it was suggested that cultivation of Pioneer 3355 maize genotype along with application of 100% Trichocompost + RDF (V_2T_6) combination treatment would help to influenced plant growth and increase its ability to enhanced better yield production of maize.

Recommendations

Considering the results of the experiment, further studies in the following areas are suggested:

- ✓ More varieties and different doses of Trichocompost + RDF may be taken for further experiments to get more accurate result.
- ✓ Studies of similar nature could be carried out in different agro-ecological zones (AEZ) in different seasons of Bangladesh for the evaluation of zonal adaptability.

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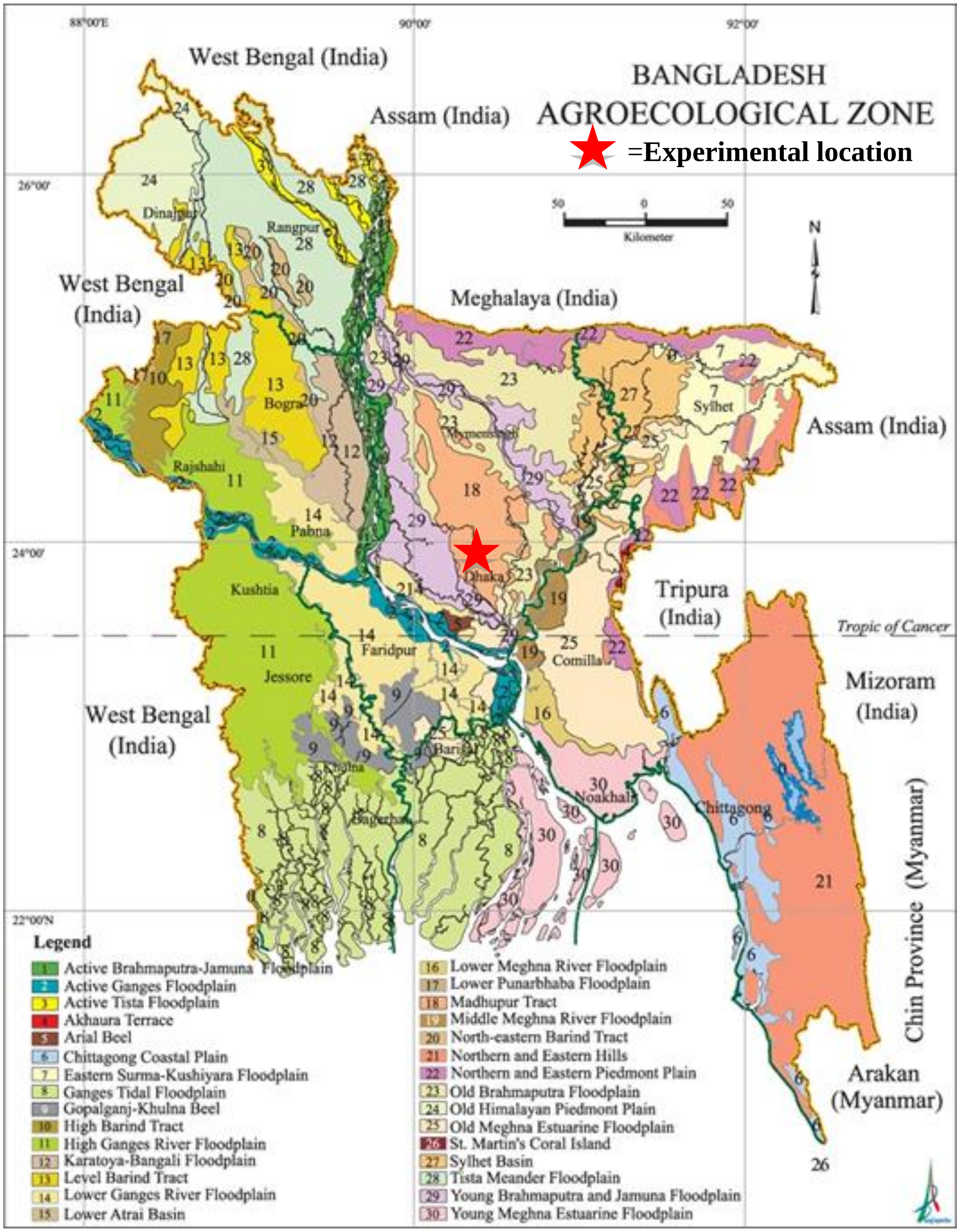
APPENDICES

Appendix I. Map showing the experimental location under study



Appendix II. Soil characteristics of the experimental field

A. Morphological features of the experimental field

Morphological features	**Characteristics**
AEZ	AEZ-28, Modhupur Tract
General Soil Type	Shallow Red Brown Terrace Soil
Land type	High land
Location	Sher-e-Bangla Agricultural University Agronomy research field, Dhaka
Soil series	Tejgaon
Topography	Fairly leveled

B. The initial physical and chemical characteristics of soil of the experimental site (0- 15 cm depth)

Physical characteristics	
Constituents	**Percent**
Clay	29 %
Sand	26 %
Silt	45 %
Textural class	Silty clay
Chemical characteristics	
Soil characteristics	**Value**
Available P (ppm)	20.54
Exchangeable K (mg/100 g soil)	0.10
Organic carbon (%)	0.45
Organic matter (%)	0.78
pH	5.6
Total nitrogen (%)	0.03

Sourse: Soil Resources Development Institute (SRDI), Khamarbari, Farmgate, Dhaka.

Appendix III. Monthly meteorological information during the period from October 2021 to February, 2022.

Year	Month	Air temperature (^0C)		Relative humidity (%)	Average rainfall (mm)
		Maximum	Minimum		
2021	October	31.2	23.9	76	52 mm
	November	29.6	19.8	53	00 mm
	December	28.8	19.1	47	00 mm
2022	January	25.5	13.1	41	00 mm
	February	25.9	14	34	7.7 m

Source: Metrological Centre, Agargaon, Dhaka (Climate Division)

Appendix IV. Analysis of variance of the data of on plant height at different days after sowing of maize

Source	DF	Mean square of plant height at			
		30	45	60	At harvest
Replication (R)	2	0.8411	12.58	58.33	21.528
Variety (V)	1	8.8011^{Ns}	1121.25*	2352.25*	316.247*
Error	2	0.9078	12.58	25.00	21.528
Nutrient (N)	5	45.1040*	1169.33*	1306.98*	825.351*
V×N	5	1.0835*	33.63*	6.01*	154.319*
Error	20	1.0744	28.58	41.67	26.528

*: Significant at 0.05 level of probability
^{Ns}: Non-significant

Appendix V. Analysis of variance of the data of on number of leaves plnat^{-1} at different days after sowing of maize

Source	DF	Mean square of number of leaves plnat^{-1} at			
		30	45	60	At harvest
Replication (R)	2	0.09333	0.18952	0.42861	0.5278
Variety (V)	1	0.10890 ^{Ns}	3.99334*	8.90028*	28.6582*
Error	2	0.09333	0.18952	0.29528	0.1944
Nutrient (N)	5	0.64732 ^{Ns}	6.82763*	3.97669*	9.5450*
V×N	5	0.00492 ^{Ns}	0.74522*	0.35142*	0.8701*
Error	20	0.09333	0.19552	0.32994	0.3611

*: Significant at 0.05 level of probability

Appendix VI. Analysis of variance of the data of on dry matter weight plant^{-1}, cob height from ground base, cob length, cob breadth and cob unfilled area of maize

on **Source**	**DF**	Dry matter weight plant^{-1}	Cob height from ground base	Cob length	Cob breadth	Cob unfilled area
Replication (R)	2	58.33	0.778	1.0833	0.69444	0.0408
Variety (V)	1	8248.27*	281.848*	18.1476*	1.50880 ^{Ns}	2.2650*
Error	2	58.33	0.778	0.0833	0.69444	0.0408
Nutrient (N)	5	8605.66*	193.676*	14.4883*	2.75428 ^{Ns}	25.9245*
V×N	5	111.52	4.708*	0.8338*	0.27766 ^{Ns}	0.6211*
Error	20	178.33	1.178	0.5833	1.09444	0.1008

*: Significant at 0.05 level of probability
^{Ns}: Non-significant

Appendix VII. Analysis of variance of the data of on number of rows cob^{-1}, number of grains cob^{-1} and 1000-grain weight of maize

on **Source**	**DF**	Number of rows cob^{-1}	Number of grains cob^{-1}	1000-grain weight
Replication (R)	2	0.0833	8.3	8.33
Variety (V)	1	23.4256*	29535.9*	213.16*
Error	2	0.0833*	8.3*	8.33*
Nutrient (N)	5	12.2167	23491.7	3695.14
V×N	5	0.3576*	748.8*	165.42*
Error	20	0.3833	248.3	48.33

*: Significant at 0.05 level of probability

Appendix VIII. Analysis of variance of the data of on grain yield, stover, biological yield and harvest index of maize

on **Source**	**DF**	Grain yield	Stover yield	Biological yield	Harvest index
Replication (R)	2	0.3333	0.0833	1.3333	2.083
Variety (V)	1	12.6025*	16.1604*	57.3049*	7.840 ^{Ns}
Error	2	0.3333	0.0833	1.3333	2.083
Nutrient (N)	5	27.5927*	11.0300*	59.7506*	113.392*
V×N	5	0.5387*	2.4112*	0.7723*	15.095*
Error	20	0.1333	0.4833	0.7333	0.883

*: Significant at 0.05 level of probability

^{Ns}: Non-significant

Plate 1. Layout of the experimental field

Plate 2. Vegetative stage of maize

Plate 3. Tassel initiation of maize

Plate 4. Data recording

Plate 5. Picture with experimental signboard