RESEARCH ARTICLE

EFFECT OF VARIOUS ORGANIC NITROGEN FERTILIZATION ON GROWTH, YIELD AND QUALITY OF *KHARIF* MAIZE (*ZEA MAYS* L.)

Abhishek Shori[1], R.N. Meena[2]*, Tej Ram Banjara[1], R. Meena[3], and M. Bhoi[4]

[1,2,4]Department of Agronomy, Institute of Agriculture Science, Banaras Hindu University, Varanasi 221005 UP, INDIA
[3]Department of Soil Science & Agricultural Chemistry, Institute of Agricultural, Sciences, Banaras Hindu University, Varanasi -221005 (U.P.), INDIA
Email: ramnarayanbhu@gmail.com

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Abstract: A field experiment was conducted to evaluate effect of various organic nitrogen fertilization on growth, yield and quality of *kharif* grain maize (*Zea mays* L.) at agricultural research farm of Banaras Hindu University during *kharif* season of 2015. At the experimentation site soil analysis was done before the sowing of the crop and after the harvesting of the crop. The net plot size was 3.0 m x 2.1 m for row to row and plant to plant spacing was 60 cm and 20 cm, respectively. The experiment was comprised of four organic source methods *viz.* B_1- 100% of RDN as GM, B_2 - 100% of RDN as VC, B_3 - 50% of RDN as GM +F50% VC, B_4- 100% of RDN Through inorganic sources and biofertilizer T_{1-} Control , T_{2-} *Azotobacter* , T_3 - *PSB*, T_4 -*PSB* + *Azotobacter*, Maize hybrid TRIPURESHWARI- 4477 was used as an experimental material. The experiment was laid out in split plot design and replicated thrice. Standard procedures were adopted for recording growth, yield and quality parameters. Organic materials (100 % RDN as GM, 100% RDN as vermicompost, 50 % RDN as GM + 50 % vermicompost and 100 % RDN through inorganic source was applied in the field. The significance of the treatment effect was judged with the help of 'F' test (Variance ratio). The difference of the treatments mean was tested using critical difference (C. D.) at 5% level of probability (Gomez and Gomez, 1984). Standard procedures were adopted for recording the data of agronomic and yield related parameters.

Keywords: Organic nitrogen, Biofertilizer, Green manure, Vermicompost, Tripureswari 4411, *Pseudomonas*, *Azotobacter*

INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereal crop grown all over the world. It is grown in various agroclimatic conditions, ranging from temperate to tropical regions from sea level to an altitude of 2500 metres throughout the world. In India, the present area under maize cultivation is about 9.43 million hectares with the annual production of 24.35 mt. The average productivity of crop is 2.58 tonnes ha^{-1} in the country (Anonymous, 2015). The integrated use of organic and inorganic fertilizers increase mutual efficiency but also help in the substitution of costly chemical fertilizers (Hussain and Ahmed, 2000; Ghosh and Sharma, 1999). Integrated nutrient management (INM) is a minimize the use of chemical sources of nutrients along with maximization of their efficiency and farmer's profit. Integrated use of organic and inorganic fertilizers not only recorded significantly greater root-shoot dry matter but also accelerated their growth compared to inorganic fertilizer application (Gour *et al*. 1992).

MATERIALS AND METHOD

This experiment was conducted during the *kharif* season of 2015-2016 at the Agriculture Research Farm, Department of Agronomy, Institute of Agriculture Science, BHU, situated at about 10 km. away from Varanasi station in south east direction of BHU campus. The geographical location of the research farm lies at 25°18' E longitude, 83°30' longitude and at altitude of 128.93 m above the mean sea level. Varanasi is situated the north-east plain zone in the eastern part of Uttar Pradesh, Varanasi (India) at 25°18' N latitude, 83°30' longitude and at altitude of 128.93m above the mean sea level. It has a subtropical climate with extreme of hot in summer and cold in winter. May and June are the hottest months with mean temperature ranging from 39° C to 43°C. The coldest month is January with mean minimum temperature varying between 9° C to 10°C. The average annual rainfall of the region is 1100 mm and average annual evapotranspiration is 1500 mm with annual moisture deficit is about 400 mm and moisture deficit index of 20 to 40 percent. To evaluate the initial fertility status of the field, soil sample were drawn before the start of experiment and after the harvesting of the experiment crop. This was done by drawing random sample up to a depth of 15 cm from each replication. These samples were composited and brought to laboratory, air dried and crushed to pass in a 2 mm sieve. Further, the samples were analyzed for physical and chemical properties. Experiment was laid out in split plot design having three replication. Soil analysis was done before the sowing of the crop and after the harvesting of the crop. The net plot size were 3.0 m x 2.1 m for 60 cm row spacing, plant to plant 20 cm, respectively. The experiment was comprised of four organic source methods *viz.* B_1- 100% of RDN as GM, B_2 - 100% of

*Corresponding Author

RDN as VC, B_3 - 50% of RDN as GM +50% VC, B_4- 100% of RDN through inorganic sources and biofertilizer. T_1- Control , T_2- *Azotobacter* , T_3 - *PSB*, T_4 -*PSB* + *Azotobacter*, Maize hybrid TRIPURESHWARI- 4477 was used as an experimental material. Standard procedures were adopted for recording growth, yield and quality parameters. Organic materials (100 % RDN as GM,100% RDN as vermicompost,50 % RDN as GM + 50 % vermicompost and 100 % RDN through inorganic source was applied in the field after the sowing of the maize. The significance of the treatment effect was judged with the help of 'F' test (Variance ratio). The difference of the treatments mean was tested using critical difference (C. D.) at 5% level of probability (Gomez and Gomez, 1984). Standard procedures were adopted for recording the data of agronomic and yield related parameters.

RESULTS AND DISCUSSION

Plant height: The plant height was influenced by organic treatments, B_3 - 50% of RDN as GM +50% VC was recorded highest plant height which was significantly different rest of the all treatments, and followed by B1 - 100% of RDN as GM and B2 - 100% of RDN as VC. However, minimum plant height was recorded under B_4 - 100% of RDN and Through inorganic source also Bio fertilizer Maximum plant height was recorded under T_4 - *Azotobacter* + *Psuedomonas* which were significantly higher over all the treatments, and followed by T_3 - *Psuedomonas* and T_2 - *Azotobacter* . However, minimum plant height was recorded under T_1 - Control**.** The similar result is also reported by Beigzade, *et al*. (2013).

Number of green leaves plant^{-1} : Organic sources brought significant differences in number of green leaves plant^{-1} at 30, 60, 90, and 120 DAS. The significantly highest number of leaves was recorded (11.84) under B_3- 50% RDN as GM + 50% as VC over rest of the organic sources and followed by B_1- 100% RDN as GM (11.67), B_2- 100% RDN as VC (11.50) at all growth stages of observation. However, minimum number of leaves was recorded (11.31) under B_4- 100% RDN as inorganic source. Haque *et al* march (2012**)** and Wagh (2002) also recorded that effect of different organic manure increased leaf number and LAI.

Various biofertilizer influenced the number of leaves significantly at all the stages of crop growth. Maximum number of leaves at harvesting was observed with T_4- *Azotobacter* + *Pseudomonas* (12.93), which proved significantly superior over T_3- *Pseudomonas* (12.10), T_2- *Azotobacter* (10.97) and T_1- Control (10.33), respectively at all growth stages of observation. The results are in close conformity with those of Wagh (2002).

Dry matter production

The data on dry matter accumulation pattern per plant as influenced by various organic sources and biofertilizer application at different stages of the crop have been presented in Table 1. The dry matter accumulation gradually increased up to harvest stage. Highest dry matter accumulation plant^{-1} was observed the application of different organic sources the significantly highest dry matter accumulation (g plant^{-1}) was recorded (152.63) under B_3- 50% RDN as GM + 50% as VC over rest of the organic sources followed by B_1- 100% RDN as GM (150.35) and B_2- 100% RDN as VC (148.18) at all growth stages of observation. However, minimum dry matter accumulation was recorded (145.79) under B_4- 100% RDN as inorganic source. This similar result was reported that the Pinjari (2007).

The bio fertilizers influenced the dry matter accumulation significantly at all the stages of crop growth. Maximum dry matter accumulation at harvesting was observed with T_4- *Azotobacter* + *Pseudomonas* (166.58), which proved significantly superior over T_3- *Pseudomonas* (155.94), T_2- *Azotobacter* (141.35) and T_1- Control (133.08), respectively at all growth stages of observation. While the minimum chlorophyll content and dry matter accumulation recorded also that Rasool *et al* (2015).

Chlorophyll content

Organic sources brought significantly difference on chlorophyll content of maize leaves were recorded at various growth stages and have been presented in Table-.2. The measurement of chlorophyll content of maize leaves in terms of SPAD values differed significantly due to various organic sources and biofertilizer application at various crop growth stages.

The maximum chlorophyll content were recorded with the application of different organic sources The significantly highest chlorophyll content was recorded (49.28) under B_3- 50% RDN as GM + 50% as VC over rest of the organic sources and followed by B_1- 100% RDN as GM (48.54) and B_2- 100% RDN as VC (47.84) at all growth stages of observation. However, minimum chlorophyll content was recorded (47.07) under B_4- 100% RDN as inorganic source. Combination of different organic manure have been reported to increase the chlorophyll content in maize (kmetova and kovacik 2014)

Various biofertilizers influenced the chlorophyll content significantly at all the stages of crop growth. Maximum chlorophyll content at harvesting was observed with T_4- *Azotobacter* + *Pseudomonas* (53.78), which proved significantly superior over T_3- *Pseudomonas* (50.35), T_2- *Azotobacter* (45.64) and T_1- Control (42.97), respectively at all growth stages of observation. While the minimum chlorophyll content and dry matter accumulation recorded also that. Rasool *et al* (2015).

Leaf area index

Organic sources brought significantly difference on Leaf area index of maize were recorded at various growth stages and have been presented in Table No. 2. The measurement of leaf area index of maize leaves values differed significantly due to various organic sources and biofertilizer application at various crop growth stages.

The maximum LAI were recorded with the application of different organic manure. The significantly highest LAI was recorded (2.23) under B_3- 50% RDN as GM + 50% as VC over rest of the organic sources and followed by B_1- 100% RDN as GM (2.20) and B_2- 100% RDN as VC (2.17). However, minimum LAI was recorded (2.13) under B_4- 100% RDN as inorganic source. Haque *et al* march (2012**)** and Wagh (2002) also recorded that effect of different organic manure increased leaf number and LAI. The same result also found of A.H. kalhapure *et al* (2015).

Various biofertilizers influenced the LAI significantly at all the stages of crop growth. The maximum LAI was observed with T_4- *Azotobacter* + *Pseudomonas* (2.44), which proved significantly superior over T_3- *Pseudomonas* (2.28), T_2- *Azotobacter* (2.07) and T_1- Control (1.95), respectively. The same result also found of A.H. kalhapure *et al* (2015).

Days to 50% tasseling

The data presented in Table no. 2 .revealed the effect various organic sources and bio fertilizer application on days to 50 % tasseling. Among the organic source for 50% tasseling significantly higher (73.47 days) was observed under B_3- 50% RDN as GM + 50% as VC over rest of the treatment followed by B_1- 100% RDN as GM (72.79 days) and B_2- 100% RDN as VC (71.80 days). However, minimum (70.99 days) were recorded under B_4- 100% RDN as inorganic source. Among the different biofertilizers was brought singnificantly effect on 50 % tasseling of maize. However, Maximum days was observed under T_4- *Azotobacter* + *Pseudomonas* (81.11 days) followed by T_3- *Pseudomonas* (75.32 days), T_2- *Azotobacter* (69.32 days) and T_1- Control (63.29 days).

Days to 50% silking

The effect various organic sources and biofertilizer application on days to 50 % silking. Among the organic source for 50% silking significantly higher (79.36 days) was observed under B_3- 50% RDN as GM + 50% as VC over rest of the treatment followed by B_1- 100% RDN as GM (78.18 days) and B_2- 100% RDN as VC (77.05 days). However, minimum (75.81 days) were recorded under B_4- 100% RDN as inorganic source. And the different biofertilizers was brought significantly effect on 50 % silking of maize. However, Maximum days was observed under T_4- *Azotobacter* + *Pseudomonas* (86.62 days) followed by T_3- *Pseudomonas* (73.50 days), T_2- *Azotobacter* (73.5 days) and T_1- Control (69.20 days).

Average cob length (cm)

The cob length increased with the different application of organic manure the significantly longest cob (15.03) was recorded under B_3- 50% RDN as GM + 50% as VC over rest of the organic sources of manure followed by B_1- 100% RDN as GM (14.81), B_2- 100% RDN as VC (14.60). However, minimum shortest cob (14.36) recorded under B_4- 100% RDN as inorganic source.

The cob length was not affected by different biofertilizer were longest cob was observed in T_4- *Azotobacter* + *Pseudomonas* (16.41) followed by T_3- *Pseudomonas* (15.36), T_2- *Azotobacter* (13.92) and T_1- Control (13.11). Similar positive effect of organic sources on maize was reported in by ashok kumar and shiva dhar (2010).

Girth of cob (cm)

Significantly highest girth of cob was recorded (10.87 cm) under B_3- 50% RDN as GM + 50% as VC over rest of the treatment followed by B_1- 100% RDN as GM (10.71 cm), B_2- 100% RDN as VC (10.56 cm). However, lowest cob recorded (10.39 cm) under B_4- 100% RDN as inorganic source.

Different biofertilizer did not affect on cob girth. However, maximum girth of cob was observed with T_4- *Azotobacter* + *Pseudomonas* (11.87) followed by T_3- *Pseudomonas* (11.11), T_2- *Azotobacter* (10.07) and T_1- Control (9.48),same result found ashok kumar and shiva dhar (2010).

Number of grains cob^{-1}

The significantly highest number grain cob^{-1} (372.84) was recorded under B_3- 50% RDN as GM + 50% as VC over rest of the organic sources followed by B_1- 100% RDN as GM (367.26), B_2- 100% RDN as VC (361.96). However, minimum number of grains cob^{-1} was recorded (356.14) under B_4- 100% RDN as inorganic source.

Appraisal of the data reveals that average number of grains cob^{-1} was found maximum with T_4- *Azotobacter* + *Pseudomonas* (406.90), which proved significantly superior over T_3- *Pseudomonas* (380.93), T_2- *Azotobacter* (345.28) and T_1- Control (325.08). Similar positive effect of organic sources on maize was reported in by ashok kumar and shiva dhar (2010).

Test weight (g)

The data pertaining to 1000 seed weight have been furnished in Table 4.8 which indicated increase in test weight occurred due to effect of different organic sources of manure. The significantly highest test weight (221.46 g) was recorded under B3- 50% RDN as GM + 50% as VC followed by B1- 100% RDN as GM (218.15g), B2- 100% RDN as VC(215.00). However, lowest test weight (211.54gm) was observed under B4- 100% RDN as inorganic source.

Regarding the influence of various effect of biofertilizer on test weight in maize showed highest values with T_4- *Azotobacter* + *Pseudomonas* (241.69), which proved significantly superior over T_3- *Pseudomonas* (226.27), T_2- *Azotobacter* (205.09) and T_1- Control (193.09). Similar positive effect was reported in by ashok kumar and shiva dhar (2010).

Shelling percentage

The shelling percentage maize was significantly affected by the effect of organic manure. The significantly highest shelling percentage (67.85) was recorded under B_3- 50% RDN as GM + 50% as VC over rest of the organic sources followed by B_1- 100% RDN as GM (66.84), B_2- 100% RDN as VC (65.87). However, minimum shelling percentage (64.81) was recorded under B_4- 100% RDN as inorganic source.

Among the biofertilizer, shelling per cent was found maximum with T_4- *Azotobacter* + *Pseudomonas* (74.05), which proved significantly superior over T_3- *Pseudomonas* (69.32), T_2- *Azotobacter* (62.84) and T_1- Control (59.16). Similar results were also reported by lakhwinder singh *et al* (2017).

Number of grains cob^{-1}

The average number of grains per cob. It is clear from the data the significantly highest number grain cob^{-1} (372.84) was recorded under B_3- 50% RDN as GM + 50% as VC over rest of the organic sources followed by B_1- 100% RDN as GM (367.26), B_2- 100% RDN as VC (361.96). However, minimum number of grains cob^{-1} was recorded (356.14) under B_4- 100% RDN as inorganic source.

Appraisal of the data reveals that average number of grains cob^{-1} was found maximum with T_4- *Azotobacter* + *Pseudomonas* (406.90), which proved significantly superior over T_3- *Pseudomonas* (380.93), T_2- *Azotobacter* (345.28) and T_1- Control (325.08). Similar results were also reported by lakhwinder singh *et al* (2017).

Grain weight cob^{-1}

The average grains weight per cob. It is clear from the data the significantly highest grain weight cob^{-1} (82.85) was recorded under B_3- 50% RDN as GM + 50% as VC over rest of the organic sources followed by B_1- 100% RDN as GM (81.61), B_2- 100% RDN as VC (80.43). However, minimum grains weight cob^{-1} was recorded (79.14) under B_4- 100% RDN as inorganic source.

And different organic source average grains weight cob^{-1} was found maximum with T_4- *Azotobacter* + *Pseudomonas* (90.42), which proved significantly superior over T_3- *Pseudomonas* (84.65), T_2- *Azotobacter* (76.72) and T_1- Control (72.23). Similar positive effect was reported in by ashok kumar and shiva dhar (2010).

Grain yield (q ha^{-1})

The data on grain yield of maize as influenced by organic sources of nitrogen management have been presented in Table 4.9. The significantly highest grain yield (42.92) was recorded under B_3- 50% RDN as GM + 50% as VC over rest of the followed by the B_1- 100% RDN as GM (35.81) and B_2-100% RDN as VC(35.32).However, minimum grain yield (28.91) recorded under B_4- 100% RDN as inorganic source.

It is clear from the data that grain yield of all the effect of various biofertilizer varied significantly from each other. Significantly maximum grain yield (36.83) was recorded under T_4- *Azotobacter* + *Pseudomonas* which was found superior over T_3- *Pseudomonas* (35.72), T_2- *Azotobacter* (35.59) and T_1- Control (34.83). Similar positive effect was reported in by ashok kumar and shiva dhar (2010).

Stover yield (q ha^{-1})

The stover production of crop varied with effect of integrated nutrient management. Application of B_3- 50% RDN as GM + 50% as VC produced significantly maximum (45.12) over rest of the organic sources and followed by B_1- 100% RDN as GM (41.36), B_2- 100% RDN as VC (41.23). However, minimum stover yield (29.74) recorded under B_4- 100% RDN as inorganic sources.

Different biofertilizer influenced production of stover yield. The maximum value was recorded in treatment T_4- *Azotobacter* + *Pseudomonas* (40.23), which proved significantly superior over T_3- *Pseudomonas* (39.36), T_2- *Azotobacter* (39.24), and T_1- Control (38.63). Similar results were also reported by lakhwinder singh *et al* (2017).

Harvest index (%)

The harvest index was not significantly influenced however, highest harvest index (49.28) found under treatment B4- 100% RDN as inorganic source followed by (48.76) under B_3- 50% RDN as GM+ 50% as VC of the organic sources, B_1- 100% RDN as GM (46.35) and B_2- 100% RDN as VC (46.06). Different biofertilizer also not influenced the harvest index but value was maximum under T_4- *Azotobacter* + *Pseudomonas* (47.87), followed by T_3- *Pseudomonas* (47.60), T_2- *Azotobacter* (47.60) and T_1- Control (47.37). Similar results were also reported by lakhwinder singh *et al* (2017).

Available protein content in grain (%)

The data presented in Table 4.15 clearly indicates that the content of protein in grain significantly affected by various organic source of nitrogen of nutrient management on growth, yield and quality of maize.

The data pertaining to the effect of various organic sources content of protein in grain . maximum with (9.52%) under B_3- 50% RDN as GM + 50% as VC over rest of the organic sources and followed by B_1- 100% RDN as GM (9.38%), B_2- 100% RDN as recorded (9.25%) under VC at all the different treatment of organic sources. However minimum protein in grain B_4- 100% RDN as urea (9.10%).

Screening of the data reveals that the content of protein in grain significantly influenced due to effect of different biofertilizer maximum recorded that the T_4- *Azotobacter* + *Psuedomonas* (10.40%), which proved significantly superior over T_3- *Psuedomonas* (9.73%), T_2- *Azotobacter* (8.82%), and T_1- Control (8.30%), respectively all the treatments. The similar result showed by A.V. Nagavani and P. Subbian (2014).

Protein yield (kg ha^{-1})

The data related to protein yield (kg ha^{-1}) are presented in Table 4.15. The protein yield was significantly influenced due to different source of organic nitrogen nutrient management on growth, yield and quality of maize production.

Perusal of the data indicated that the protein yield maximum with (307.34) under B_3- 50% RDN as GM + 50% as VC over rest of the organic sources and followed by B_1- 100% RDN as GM (298.15), B_2- 100% RDN as VC recorded (289.55) under VC. at all the different treatment of organic sources. However minimum protein yield recorded that B_4- 100% RDN as urea (280.45).

And effect of various biofertilizer resulted in a significant increase in protein yield during the year of investigation. The maximum protein yield recorded that the T_4- *Azotobacter* + *Psuedomonas* (363.23), which proved significantly superior over T_3- *Psuedomonas* (318.49), T_2- *Azotobacter* (261.69), and T_1- Control (232.08), respectively all the treatments. The similar result found by A.V. Nagavani and P. Subbian (2014).

Oil content in grain (%)

The data presented in Table 4 clearly indicates that the oil content in grain significantly affected by various organic source of nitrogen. Nutrient management on growth, yield and quality of maize.

The data pertaining to the oil content in grain effect of various organic sources . maximum with (5.42) under B_3- 50% RDN as GM + 50% as VC over rest of the organic sources and followed by B_1- 100% RDN as GM (5.34), B_2- 100% RDN as recorded (5.27) under at all the different treatment of organic sources. However minimum oil content recorded at B_4- 100% RDN through urea (5.18) as inorganic source.

Screening of the data reveals that the oil content in grain significantly influenced due to effect of different biofertilizer maximum recorded that the T_4- *Azotobacter* + *Psuedomonas* (5.92), which proved significantly superior over T_3- *Psuedomonas* (5.54), T_2- *Azotobacter* (5.02), and T_1- Control (4.73), respectively all the treatments. Also reported that Balai *et al* (2011).

Economics

The effect of organic nitrogen fertilization on growth, yield and quality of *kharif* maize treatments combination of cost of cultivation, gross return, net return and B: C ratio is presented in table 4.16. These attributes significantly affected by different treatments combination.

Cost of cultivation (₹ ha-^{1})

The data on economics of different treatments was calculated taking different The data pertaining to the effect of various organic sources on cost of cultivation showed that maximum with under B_2- 100% RDN as VC (42526.05), recorder under over rest of the organic sources and followed by B_3- 50% RDN as GM + 50% as VC (31505.13). B_4- 100% RDN as urea (₹24522.6) at all the different treatment of organic sources. However minimum cost of cultivation recorded that B_1- 100% RDN as GM (₹ 22059)

Each successive effect of various biofertilizer resulted in highest cost of cultivation recorded that the T_3- *Psuedomonas* (30364.44) followed by T_4- *Azotobacter* + *Psuedomonas* (30127.68). Than the T_1- Control (30086.94). And last one is T_2- *Azotobacter* (30033.63), respectively all the treatments. Also result found that A.H. kalhapure(2013).

Gross return (₹ ha^{-1})

The data in respect to gross return in (₹ ha^{-1}) under different organic mannure and different biofertilizer have been presented in Table 4.16. Gross return increased with increasing grain and stover yield of winter maize obtained under different treatments. It is evident from the finding that B_3- 50% RDN as GM + 50% as VC (₹ 86295) recorded highest gross return which was significantly superior over all the treatment and second is B_1- 100% RDN as GM (₹ 72747) than B_2- 100% RDN under the VC (₹ 71829). The minimum gross return recorded that B_4- 100% RDN through urea (57995).

And also the under of biofertilizer maximum gross return was recorded that the T_4- *Azotobacter* + *Psuedomonas* (₹ 74352) which proved significantly superior over T_3- *Psuedomonas* (₹ 72168.83), T_2- *Azotobacter* (₹ 71921) , and the minimum gross return recorded that T_1- Control (₹ 70425), respectively all the treatments. Also result found that A.H. kalhapure(2013).

Net returns (₹ ha-^{1})

The data pertaining to net return (₹ ha^{-1}) under different organic manure and different biofertilizer have been presented in Table 4. The net return markedly influenced due to different cost incurred and yield obtained under various treatments. Highest net return was recorded with B_3- 50% RDN as GM + 50% as VC (₹ 60289.83), followed by B_1- 100% RDN as GM (50688). Than the B_4- 100% RDN as urea (33472.83). and minimum net return recorded B_2- 100% RDN through VC(29303.78)

The effect of various biofertilizer indicated that highest net return (₹ ha^{-1}) was obtained from T_4- *Azotobacter* + *Pseudomonas* (44224.49) which was higher over the net return followed by T_2- *Azotobacter*(41887.88).than the T_3- *Pseudomonas* (41804.4). Than after While T_1- Control (40338.06), was recorded lowest net return over other treatments. Also result found that A.H. kalhapure(2013).

Benefit: cost ratio

Data related on benefit cost ratio of *kharif* maize influenced by different treatments are summarised in Table 4 Among the different organic sources, the significant highest benefit: cost (B: C) ratio was recorded under the B_1- 100% RDN as GM (2.29) which was superior over all the treatment followed by B_3- 50% RDN as GM + 50% RDN as vc (1.73) and B_4- 100% RDN as urea(1.36) Minimum benefit: cost ratio was recorded under treatment B_2- 100% RDN as VC(0.68). The different biofertilizer also proved variation in respect of B: C ratio the maximum benefit : cost ratio was recorded under T_4- *Azotobacter* + *Psuedomonas* (1.59)which proved significantly superior over rest of the treatments T_3- *Psuedomonas* (1.52),T_2- *Azotobacter* (1.51) and T_1- Control (1.47), respectively all the treatments highest B: C ratio. Also result found that A.H. kalhapure(2013).

Table 1. Effect of various organic nitrogen fertilisation on growth attribute of *kharif* grain maize

Treatments	**Plant height (cm)**				**Number of leaves plant^{-1}**				**Dry matter production (g plant^{-1})**			
	30 DAS	**60 DAS**	**90 DAS**	**120 DAS**	**30 DAS**	**60 DAS**	**90 DAS**	**120 DAS**	**30 DAS**	**60 DAS**	**90 DAS**	**120 DAS**
Organic source												
B_1 - 100% RDN as GM	70.04	122.55	141.48	149.74	6.97	9.46	11.36	11.67	22.38	79.11	141.92	150.35
B_2 - 100% RDN as VC	69.02	120.78	139.44	147.58	6.87	9.33	11.19	11.50	22.06	77.97	139.87	148.18
B_3 - 50% RDN as GM+ 50% as VC	71.09	124.41	143.63	152.02	7.07	9.61	11.53	11.84	22.72	80.32	144.07	152.63
B_4 - 100% RDN as inorganic source	67.91	118.84	137.20	145.21	6.76	9.18	11.01	11.31	21.71	76.72	137.62	145.79
SEm±	0.44	0.78	0.90	0.93	0.04	0.06	0.07	0.07	0.14	0.50	0.90	0.96
CD (*P*=0.05)	1.55	2.32	3.14	3.32	0.15	0.20	0.25	0.25	0.49	1.75	3.14	3.33
Biofertilizer												
T_1- Control	61.10	108.47	125.23	132.54	6.17	8.38	10.05	10.33	19.81	70.03	125.63	133.08
T_2- *Azotobacter*	65.84	115.22	133.01	140.78	6.55	8.90	10.68	10.97	21.04	74.38	133.43	141.35
T_3- *Pseudomonas*	72.64	127.12	146.75	155.32	7.22	9.81	11.78	12.10	23.22	82.06	147.20	155.94
T_4- *Azotobacter + Pseudomonas*	77.59	135.79	156.76	165.90	7.71	10.48	12.58	12.93	24.80	87.65	157.23	166.58
SEm±	0.64	1.11	1.28	1.36	0.06	0.08	0.10	0.10	0.20	0.72	1.29	1.37
CD(*P*=0.05)	1.86	3.18	3.76	3.98	0.18	0.25	0.30	0.31	0.59	2.10	3.77	3.99

Table 2. Effect of various organic nitrogen fertilisation on growth attribute of *kharif* grain maize

Treatments	Chlorophyll content				Leaf area index				Days to 50% tasseling	Days to 50% silking
	30 DAS	60 DAS	90 DAS	120 DAS	30 DAS	60 DAS	90 DAS	120 DAS		
Organic source										
B_1 - 100% RDN as GM	29.63	36.25	40.03	48.54	1.25	2.20	2.52	2.20	72.79	78.18
B_2 - 100% RDN as VC	29.20	35.75	39.45	47.84	1.24	2.17	2.48	2.17	71.80	77.05
B_3 - 50% RDN as GM+ 50% as VC	30.08	36.80	40.64	49.28	1.27	2.23	2.55	2.23	73.47	79.36
B_4 - 100% RDN as	28.73	35.15	38.82	47.07	1.22	2.13	2.44	2.13	70.99	75.81
SEm±	0.19	0.23	0.25	0.31	0.08	0.01	0.01	001	0.48	0.50
CD (*P*=0.05)	0.65	0.80	0.88	1.07	0.02	0.04	0.05	0.04	1.67	1.73
Biofertilizer										
T_1- Control	26.22	32.08	35.43	42.97	1.11	1.95	2.23	1.95	63.29	69.20
T_2- *Azotobacter*	27.85	34.08	37.64	45.64	1.18	2.07	2.36	2.07	69.32	73.50
T_3- *Pseudomonas*	30.73	37.59	41.52	50.35	1.30	2.28	2.61	2.28	75.32	81.09
T_4- *Azotobacter + Pseudomonas*	32.83	40.16	44.35	53.78	1.39	2.44	2.79	2.44	81.11	86.62
SEm±	0.26	0.33	0.36	0.44	0.01	0.02	0.02	0.02	0.50	0.71
CD(*P*=0.05)	0.78	0.96	1.06	1.29	0.03	0.05	0.06	0.05	1.48	2.07

Table 3. Effect of various organic nitrogen fertilisation on yield atrributes of *kharif* grain maize.

Treatments	**Av. length of cob (cm)**	**Av. girth of cob (cm)**	**No. of cobs plot^{-1}**	**Test weight**	**Shelling %**	**Av. No. of grain cob^{-1}**	**Grain weight cob^{-1}**
Organic source							
B_1 - 100% RDN as GM	14.81	10.71	70.29	218.15	66.84	367.26	81.61
B_2 - 100% RDN as VC	14.60	10.56	69.28	215.00	65.87	361.96	80.43
B_3 - 50% RDN as GM+ 50% as VC	15.03	10.87	71.36	221.46	67.85	372.84	82.85
B_4 - 100% RDN as	14.36	10.39	68.16	211.54	64.81	356.14	79.14
SEm±	0.09	0.06	0.45	1.39	0.42	2.35	0.52
CD (*P*=0.05)	0.32	0.23	1.56	4.84	1.48	8.15	1.81
Biofertilizer							

T_1- Control	13.11	9.48	62.22	193.09	59.16	325.08	72.23
T_2- *Azotobacter*	13.92	10.07	66.08	205.09	62.84	345.28	76.72
T_3- *Pseudomonas*	15.36	11.11	72.91	226.27	69.32	380.93	84.65
T_4- *Azotobacter* + *Pseudomonas*	16.41	11.87	77.88	241.69	74.05	406.90	90.42
SEm±	0.13	0.09	0.64	1.98	0.60	3.34	0.74
CD(*P*=0.05)	0.39	0.28	1.86	5.80	1.77	9.76	2.17

Table 4. Effect of various organic nitrogen fertilisation on yield attributes, Cost of cultivation and economics of *kharif* grain maize.

Treatments	Grain yield (q ha^{-1})	Protein content (%)	Protein yield (kg ha^{-1})	Stover yield (q ha^{-1})	Oil content (%)	Harvest index	Cost of cultivation (₹ ha^{-1})	Gross return (₹ ha^{-1})	Net return (₹ ha^{-1})	B:C ratio
Organic source										
B_1 - 100% RDN as GM	35.81	9.38	298.15	41.36	5.34	46.35	22059	72747	50688	2.29
B_2 - 100% RDN as VC	35.32	9.25	289.55	41.23	5.27	46.06	42526.05	71829.83	29303.78	0.68
B_3 - 50% RDN as GM+ 50% as VC	42.92	9.52	307.34	45.12	5..42	48.76	31505.13	86295.33	54790.21	1.73
B_4 - 100% RDN as	28.91	9.10	280.45	29.74	5.18	49.28	24522.5	57995.33	33472.83	1.36
SEm±	0.98	0.06	3.55	0.10	0.03	0.76		1757.719	1757.719	0.06
CD (*P*=0.05)	3.41	0.21	12.29	0.35	0.12	2.63		6082.729	6082.729	0.21
Biofertilizer										
T_1- Control	34.83	8.30	232.08	38.63	4.73	47.37	30086.94	70425	40338.06	1.47
T_2- *Azotobacter*	35.59	8.82	261.69	39.24	5.02	47.60	30033.63	71921.5	41887.88	1.51
T_3- *Pseudomonas*	35.72	9.73	318.49	39.36	5.54	47.60	30364.44	72168.83	41804.40	1.52
T_4- *Azotobacter* + *Pseudomonas*	36.83	10.40	363.23	40.23	5.92	47.87	30127.68	74352.17	44224.49	1.59
SEm±	0.45	0.09	5.16	0.26	0.05	0.40		790.9217	790.9217	0.029
CD(*P*=0.05)	1.31	0.25	15.07	0.77	0.14	1.18		2308.651	2308.651	0.08

CONCLUSION

Application of different organic source of nitrogen fertilization and effect of green manure, vermicompost, and also application of urea and also application of bio fertilizer *Pseudomonas* and *Azotobacter* in maize plot was found suitable to realize the high growth and high yield. The combination of 50 % RDN as GM and 50% RDN as VC and also the combination of bio fertilizer apllied *Psuedomonas* + *Azotobacter* maize was found highest plant growth and highest yield as compared to other treatment and also we are suggested farmer to adopt the following combination. After considering the overall economics, it could be concluded that the treatment combination B_3T_4 along with the application of **(**50% of RDN as GM + 50% as VC and *Azotobacter* + *Psuedomonas* was found to be the most economical combination among all the treatments under study

The different biofertilizer showed some variation in cost of cultivation, however highest net return and benefit cost ratio were observed. The maximum cost of cultivation with the treatment B2 -100 % RDN through VC (Table 4) and the minimum cost of cultivation recorded that B_1 100 % as GM and minimum net return an B:C ratio also found .

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