International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2021; 9(1): 1476-1479

Received: 18-11-2020
Accepted: 27-12-2020

Satybhan Singh
School of Agricultural Sciences & Engineering, IFTM University, Moradabad, Uttar Pradesh, India

Himanshu Singh
School of Agricultural Sciences & Engineering, IFTM University, Moradabad, Uttar Pradesh, India

Pradeep Kumar
School of Agricultural Sciences & Engineering, IFTM University, Moradabad, Uttar Pradesh, India

Virendra Singh
School of Agricultural Sciences & Engineering, IFTM University, Moradabad, Uttar Pradesh, India

Sandeep Kumar
School of Agricultural Sciences & Engineering, IFTM University, Moradabad, Uttar Pradesh, India

Rajat Singh
School of Agricultural Sciences & Engineering, IFTM University, Moradabad, Uttar Pradesh, India

Corresponding Author:
Himanshu Singh
School of Agricultural Sciences & Engineering, IFTM University, Moradabad, Uttar Pradesh, India

Effect of NPK levels with bio-fertilizers on productivity of maize (*Zea mays* L.)

Satybhan Singh, Himanshu Singh, Pradeep Kumar, Virendra Singh, Sandeep Kumar and Rajat Singh

DOI: https://doi.org/10.22271/chemi.2021.v9.i1u.11431

Abstract
Maize is an important cereal crop which is utilized as a human food as well as raw material for processing industries. However, yield losses are prominent due to the improper nutrient management practices. Hence the study was carried out on "Effect of NPK Levels with Bio-Fertilizers on Productivity of Maize (*Zea mays* L.)" during summer season of 2019 at the Agricultural research farm of IFTM University, Lodhipur Rajput, Moradabad (U.P.). There are Nine treatment combinations were comprised in randomized block design with three replications. The treatment combinations are T_1-50% RDF Control, T_2-50% RDF+VAM, T_3-50% RDF+VAM +Vermicompost, T_4-100% RDF, T_5-100% RDF+VAM, T_6-100% RDF+VAM+Vermicompost, T_7-150% RDF, T_8-150% RDF+VAM and T_9-150% RDF+VAM+Vermicompost. Maize variety Pioneer *P-3377* was sown 50 × 20 cm spacing in sandy loam soil with 120: 60: 40 kg ha^{-1} RDF. Treatment T_9-150% RDF+VAM+Vermicompost was observed significant increase in all growth attributes *viz*., plant height (219.00 cm), number of leaves (15.75 plant^{-1}), fresh weight (840.10 g plant^{-1}), dry weight (141.00 g plant^{-1}) at harvesting stage as well as on yield attributes such as number of cobs (2.10 plant^{-1}) length of cobs (23.30 cm), number of grains (260.00 cob^{-1}), seed index (28.45 g), grain yield (43.63 q ha^{-1}), stover yield (74.77 q ha^{-1}), biological yield (118.40 ha^{-1}), harvest index (36.90%).

Keywords: Maize, NPK levels, VAM, vermicompost

Introduction
Maize (*Zea mays* L.) is one of the major cereal crops and is a very versatile grain that benefits mankind in many ways. It is a versatile crop and ranks third following wheat and rice in world production as reported by food and agriculture organization [1]. Maize is a staple human food, a feed for livestock and raw material for many industrial products. It is an important food crop grown commercially in large scale and subsistence level by many resource poor farmers. In advanced countries, it is an important source of many industrial products such as corn sugar, corn oil, corn flour, starch, syrup, brewer's grit and alcohol [2].

Nutrient management is an important factor for achieving the potential yield in maize production systems because mineral nutrients are the major contributors to increasing crop production [3]. Finding the best approaches to achieve efficient nutrient management systems is very essential both for economic and environmental reasons. Nitrogen, either in organic or inorganic forms is universally accepted as a key component to high yield in maize production [4]. Nitrogen is a component of a number of compounds, e.g. proteins, nucleic acids and chlorophyll; and plays important role in many plant physiological processes. In particular, it is important in the efficient capture and use of solar radiation [5]. It mediates the utilization of potassium, phosphorus and other elements in the plant. The optimum amount of these elements in the soil cannot be utilized efficiently if N is deficient in plants. Therefore, N deficiency can reduce maize yield substantially [6].

Phosphorus is essential in the plants for photosynthesis, respiration and energy transfer. Phosphorus use efficiency in maize fields is critically important, since this nutrient constitutes one of the most limiting factors to production [7]. Indian soils are characterized by high variation of climate conditions and low levels of available phosphorus. In this case, the lack of phosphorus is due to strong interaction of this nutrient with soil colloids, which causes high setting and low availability [8, 9]. The high adsorption power of these soils requires a

greater amount of nutrient to be applied per unit of dry matter produced, causing the soil to establish strong competition with the plant for the phosphorus available in solution [7].
Potassium has greater ability to produce tolerance in plant body. Hence, potassium can improve production and quality to fulfill the current food requirements under ever reducing irrigation water scenario [10].
The application of synthetic fertilizers on maize and other crops have certain adverse effects on the human health and wellbeing. Biofertilizers are the natural living microorganisms which are established either symbiotic relationship with the plant or are found at the rhizospheric soils of the plant and also increases the supply of nutrients to the plants. Vermicompost is the use of variety of worms called worm castings, worm humus that has high saturated nutrients than do organic materials have. It has huge water-soluble nutrients for which these vermicompots are popular organic fertilizers. In this paper which is also a review paper will describe the findings of experimental data on the effect of biofertilizers and vermicompost on the maize fields in India and other countries outside India with comparison to the synthetic fertilizers [11].

Materials and Methods

A field experiment on the "Effect of NPK Levels with Bio-Fertilizers on Productivity of Maize (*Zea mays* L.)" was conducted during summer season of 2019, at the research farm of IFTM University, Moradabad (U.P.). The experimental site lies between 28° 49′ North latitude and 78° 38′ East longitudes above mean sea level of 193.23 meters. There are nine treatment combinations were comprised in randomized block design with three replications. The treatment combinations are T_1 – 50% RDF Control, T_2 – 50% RDF + VAM, T_3 – 50% RDF + VAM + Vermicompost, T_4 – 100% RDF, T_5 – 100% RDF + VAM, T_6 – 100% RDF + VAM + Vermicompost, T_7 – 150% RDF, T_8 – 150% RDF + VAM and T_9 – 150% RDF + VAM + Vermicompost. Healthy seeds of maize variety Pioneer *P-3377* was sown at 50 × 20 cm spacing in sandy loam soil. The recommended doses of NPK were applied @ 120: 60: 40 kg ha^{-1}. The graded levels of NPK were applied through Urea, Diammonium phosphate and Murate of potash. Half dose of nitrogen and full doses of phosphorus and potassium were applied basally at the time of sowing. Observations on growth and yield attributes were recorded from five tagged plants randomly from the net plots, while the grain and straw yield was recorded from each net plot in kg and converted into q ha^{-1} by multiplying the conversion factor.

Result and Discussion

Growth Parameters

The plant height was recorded significantly maximum (219.00 cm) respectively, from treatment T_9 – 150% RDF + VAM + Vermicompost (Table-1). It is attributed due to the sufficient availability of plant nutrients to maize plant up to the maturity. Because of bio-fertilizers might enhance the plant height and productivity by synthesizing phyto-hormones, increasing in local availability of nutrients, facilitating the uptake of nutrients by the plants and decreasing the heavy metal toxicity in the plant antagonizing plant pathogens. Same finding also reported by [13].
Number of leaves plant^{-1} was recorded significantly maximum (15.76) respectively, from treatment T_9 – 150% RDF + VAM + Vermicompost (Table-1). It is attributed due to the more plant height was found under this treatment ultimately number of leaves was increased because of sufficient availability of plant nutrients to maize plant. It might be attributed due to the bio-fertilizers enhance the plant height by synthesizing phyto-hormones, increasing in local availability of nutrients, facilitating the uptake of nutrients by the plants and decreasing the heavy metal toxicity in the plants antagonizing plant pathogens. Same findings also reported by [11].
The fresh and dry weight (g plant^{-1}) of maize was recorded significantly highest at harvesting [(840.10 g) and (141.00 g plant^{-1})] respectively, from treatment T_9 – 150% RDF + VAM + Vermicompost (Table-1). It is attributed due to the maximum plant height and a greater number of leaves was found in this treatment because of photosynthesis enhanced in the presence of VAM and vermicompost as one of the studied bio-fertilizers, stimulated shoot and root dry weight Same findings also reported by [13, 14, 15].

Table 1: Growth parameters of maize as influenced by different levels of NPK and bio-fertilizers

Treatments	Plant height (cm)	No. of leaves plant^{-1}	Fresh weight (g plant^{-1})	Dry weight (g plant^{-1})
T_1 – 50% RDF (Control)	196.60	12.03	473.66	73.16
T_2 – 50% RDF + VAM	201.16	13.30	529.76	90.83
T_3 – 50% RDF + VAM + Vermicompost	204.00	13.30	598.93	94.66
T_4 – 100% RDF	208.33	13.96	618.16	104.83
T_5 – 100% RDF + VAM	209.23	14.40	647.20	107.99
T_6 – 100% RDF + VAM + Vermicompost	211.31	14.66	680.00	111.00
T_7 – 150% RDF	215.06	14.94	768.53	118.83
T_8 – 150% RDF + VAM	216.33	15.61	8.7.86	130.00
T_9 – 150% RDF + VAM + Vermicompost	219.00	15.75	840.10	141.00
SE(m)±	0.564	0.235	0.727	0.564
C.D. at 5%	1.707	0.709	2.199	1.705

Yield attributes

Number of cobs plant^{-1} was failed to touch the level of significance from various treatments (Table-2). It is attributed due to this character is genetically governed. The results are in conformity with those already reported by [16].
Cob length recorded significantly maximum (23.30 cm), with the application of treatment T_9 – 150% RDF + VAM + Vermicompost (Table-2). It is attributed due to the more availability of nutrients. The application of VAM fungi along with vermicompost can able to form a network in plant roots for enhancement of nutrients movement and enable plants more tolerance to environmental stresses ultimately cob length was increased. Same finding also reported by [13, 15, 17].
Number of grain cob^{-1} was recorded significantly maximum (260.00), from treatment T_9 – 150% RDF + VAM + Vermicompost (Table-2). It is attributed due to the VAM along with vermicompost activates several plant enzymes that are involved in carbohydrate metabolism, protein synthesis

and pollen formation ultimately increase in number of grains cob^{-1} and increased cob length has positively influenced the number of grains cob^{-1}. Same findings also reported by [13, 16]. Significantly maximum 100 seed weight (28.45 g) respectively, was recorded with the application of treatment T_9 – 150% RDF + VAM + Vermicompost (Table-2). The improvement in 100 seed weight is mainly attributed to complementary role of VAM and vermicompost in the whole life cycle of crop plants. Same findings also reported by [13, 15].

Table 2: Yield attributes of maize as influenced by different levels of NPK and bio-fertilizers

Treatments	No. of cobs plant^{-1}	Cob length (cm)	No. of grains cob^{-1}	100 seed weight (g)
T_1 – 50% RDF (Control)	1.00	9.16	140.00	19.33
T_2 – 50% RDF + VAM	1.10	11.83	147.66	21.43
T_3 – 50% RDF + VAM + Vermicompost	1.30	12.33	158.00	22.33
T_4 – 100% RDF	1.20	15.03	168.33	23.00
T_5 – 100% RDF + VAM	1.25	16.98	174.00	23.52
T_6 – 100% RDF + VAM + Vermicompost	1.50	18.35	183.66	24.30
T_7 – 150% RDF	1.30	21.85	202.33	25.24
T_8 – 150% RDF + VAM	1.50	22.05	226.00	26.19
T_9 – 150% RDF + VAM + Vermicompost	2.10	23.30	260.00	28.45
SE(m)±	0.133	0.397	0.862	0.423
C.D. at 5%	N/S	1.200	2.608	1.278

Yields

Grain yield (43.63 q ha^{-1}), stover yield (74.77 q ha^{-1}) and biological yield (118.4 q ha^{-1}) of maize were registered significantly maximum from treatment T_9 – 150% RDF + VAM + Vermicompost (Table-3). It is attributed due to the inoculation of VAM along with vermicompost were significantly increased plant height, number of leaves, fresh and dry weight, increased number of grains cob^{-1}, 100 seed weight over the rest treatments ultimately grain yield, stover yield and biological yields were increased. This increase in growth, yield attributes and yield might be due to the combined action of VAM and vermicompost. Vermicompost is a rich source of different essential nutrients which improve overall soil condition and promote growth and yield of plant. Same findings also reported by [13, 15, 17, 18, 19].

Harvesting index shows the physiological efficiency of plants to convert the fraction of photo-assimilation to grain yield. Obviously higher the harvest index is, greater will be the grain yield of crops. Significantly maximum harvest index (36.9%) was recorded with the application of treatment T_9 – 150% RDF + VAM + Vermicompost (Table-3). The increased harvest index might be due to efficient portioning of assimilates towards the economic portion. Integrated use of VAM and vermicompost with increasing levels of RDF, increase the physiological efficiency of maize to convert assimilates to grain yield that is the reason of highest harvest index. The results are in conformity with those already reported by [19, 20].

Table 3: Yield of maize as influenced by different levels of NPK and bio-fertilizers

Treatments	Grain yield (q ha^{-1}) of maize	Stover yield (q ha^{-1}) of maize	Biological yield (q ha^{-1}) of maize	Harvest index (%) of maize
T_1 – 50% RDF (Control)	15.10	37.33	52.43	28.8
T_2 – 50% RDF + VAM	17.00	38.33	55.33	30.7
T_3 – 50% RDF + VAM + Vermicompost	20.07	42.60	62.67	32.0
T_4 – 100% RDF	20.57	41.50	62.07	32.2
T_5 – 100% RDF + VAM	23.03	43.17	66.23	34.9
T_6 – 100% RDF + VAM + Vermicompost	28.03	49.90	77.93	36.0
T_7 – 150% RDF	30.10	52.00	82.10	36.7
T_8 – 150% RDF + VAM	33.23	57.00	90.23	36.8
T_9 – 150% RDF + VAM + Vermicompost	43.63	74.77	118.40	36.9
SE(m)±	1.05	1.66	1.43	1.55
C.D. at 5%	3.16	4.96	4.27	4.66

Conclusion

On the basis of above findings, it may be concluded that the T_9 - (150% RDF + VAM + Vermicompost) was found most appropriate nutrient combination for the maize crop, this treatment gives more yield. It is suggested to maize growers of the region that the use of higher level of RDF along with VAM and vermicompost should be considered as the nutrition of maize for obtaining maximum yield.

References

1. FAO. Fertilizer and the future. IFA/FAO Agriculture Conference on Global Food Security and the Role of Sustainability Fertilization. Rome, Italy. 16th-20th March 2003, 1-2.
2. Dutt S. A Handbook of Agriculture. ABD Publishers, India 2005, 116-118.
3. Khoshgoftarmanesh AH, Eshghizadeh HR. Yield Response of Corn to Single and Combined Application of Cattle Manure and Urea. Communications in Soil Science and Plant Analysis 2011;42:1200-1208.
4. Amanullah. Partitioning of dry matter and grain yield potential in maize (*Zea mays* L.) as influenced by plant density, rate and timing of nitrogen application. International Journal of Sustainable Crop Production 2007;2(5):1-7.
5. Amanullah, Marwat KB, Shah P, Maula N, Arifullah S. Nitrogen levels and its time of application influence leaf area, height and biomass of maize planted at low and

high density. Pakistan Journal of Botany 2009;41(2):761-768.
6. Nemati AR, Sharifi RS. Effect of rates and nitrogen application timing on yield agronomic charactersties and nitrogen use efficiency in corn. J Agri. Crop Sci 2012;4(9):534-539.
7. Coelho AM, França GE, Pitta GVE, Alves VMC, Hernani LC. Fertilidade de solos: nutricao e adubacao do milho. In: Cruz, JC (Ed.). Cultivo do milho. 5. ed. Sete Lagoas: Embrapa Milho e Sorgo 2009.
8. Correa RM, Nascimento CWA, Freire FJ, Souza SKS, Silva GB. Disponibilidade e níveis críticos de fósforo em milho e solos fertilizados com fontes fosfatadas. Rev Bras Ciênc Agrár 2008;3(3):218-224.
9. Costa JPV, Bastos AL, Reis LS, Martins GO, Santos AF. Difusão de fósforo em solos de Alagoas influenciada por fontes do elemento e pela umidade. Rev Caatinga 2009;22(3):229-235.
10. Cakmak I. Potassium for better crop production and quality. Plant Soil 2010;335:1-2.
11. Amitava Rakshit, Pratapbhanu S, Bhadoria. Role of VAM on growth and phosphorus nutrition of maize with low soluble phosphate fertilization. Acta Agronomica 2010;59(1):119-123.
12. Debo Jyoti Roy Chowdhury, Sandhimita Mondal, Sudip Kumar Banerjee. The Effect of Biofertilizers and the Effect of Vermicompost on the Cultivation and Productivity of Maize - A Review. Advances in Crop Science and Technology 2017;5(1):261.
13. Rachana, Vikram, Singh, Prasad, Mithare. Effect of different levels of phosphorus and bio-fertilizers (PSB and VAM) on growth and yield of hybrid maize (*Zea maize* L.). Journal of Pharmacognosy and Phytochemistry 2018;7(4):1076-1080.
14. Davoud Akhzari, Behnaz Attaeian, Abdolhossein Arami, Farnaz Mahmoodi, Fariba Aslani. Effects of Vermicompost and Arbuscular Mycorrizal Fungi on Soil Properties and growth of *Medicago Polymorpha* L. Compost Science ET Utilization 2015;23(3):142-153.
15. John. Combined effect of Vermicompost and VAM on the growth and yield of maize. International Journal of Current Sciences 2017;7(12):264-265.
16. Tahir, Asif Tanveer, Tajamal Hussain Shah, Naeem Fiaz, Allah Wasaya. Yield response of wheat (*Triticum astivum* L.) to boron application at different growth stage, Pak. J Life Soc. Sci 2009;7(1):39-42.
17. Minaxi JS, Chandra S, Nain L. Synergistic effect of phosphate solubilizing rhizobacteria and arbuscular mycorrhiza on growth and yield of wheat plants. J Soil Sci. Plant Nutr 2013;13:2. http//dx.doi.org/10.4067/s0718-95162013005000040 7(12): pp.265-264, December, 2017.
18. Pezeshkpour P, Ardakani MR, Paknejad F, Vazan S. Effects of Vermicompost, mycorrhizal symbiosis and bio phosphate solubilizing bacteria on seed yield and quality of chickpea as autumn plantation in rainfed conditions. Bull. Environ. Pharmacol. Life Sci 2014;3(2):53-58.
19. Mohadeseh, Veisi Nasab, Hamid, Reza Mobasser, Hamid, Reza Ganjali. Effect of Different Levels of Vermicompost on Yield and Quality of Maize Varieties. Biological Forum- An International Journal 2015;7(1):856-860.
20. Hokmalipour S, Darbandi MH. Investigation of nitrogen fertilizer levels on dry matter remobilization of some varieties of corn (*Zea mays* L.). World Appl. Sci. J 2011;12:862-870.