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Effect of Integrated Nutrient Management on Growth and Yield Parameters of Maize (*Zea mays* L.)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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Original Research Article

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ABSTRACT

Aim: To study effect of integrated nutrient management on growth and yield of maize (*Zea mays* L.).
Study Design: A field experiment was conducted at the Crop Research Farm, Department of Agronomy, AKS, University, Satna during Rabi season 2023 on Maize crop.
Methodology: The experiment trail was laid out in randomized block design. It consisted of three replications with ten treatment combinations i.e. T_1 - Control,, T_2 - 100% RDN by FYM (24 t/ha),, T_3 - 75% RDN by FYM+25% RDN by VC,, T_4 - 75%RDN by FYM+25% RDN by VC + Azotobacter and PSB @ 10 ml/kg seed,, T_5 - 100% RDN by VC (8 t/ha),, T_6 - 75% RDN by VC+25% RDN by FYM,, T_7 -75%RDN by VC+25% RDN by FYM+ Azotobacter and PSB @ 10 ml/kg seed,, T_8 - 50% RDN by VC + 50 % RDN by PM (3.8 t/ha),, T_9 - 50% RDN by VC+50% RDN by PM + Azotobacter and PSB @ 10 ml/kg seed,, T_{10} - 50%RDN by EC (6 t/ha) + Beejamrut + Jeevamrut spray 500 l/ha (twice).

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Results: The results showed that application of T_9 50% RDN by VC + 50% RDN by poultry manure + *Azotobacter* + PSB had significant effect on growth and yield of maize. The plant height, number of leaves per plant and dry matter accumulation were also significantly higher in T9 followed by T8 50% RDN by VC + 50 % RDN by PM (3.8 t/ha). The highest grain yield (39.40 q ha-1) was obtained in T9 followed by T8 (38.15 q ha-1), T7 (37.62 q ha-1) andT5(36.73 q ha-1).

Keywords: Biofertilizer; farmyard manure; Beejamrut + Jeevamrut; vermicompost.

1. INTRODUCTION

Maize (*Zea mays* L.) is one of the most significant cereal crops and plays a significant nutrition role in the world for human being and animals. In India, it comes in third place behind rice and wheat. The nutritional breakdown of maize (per 100 g) is as follows: 4 g protein, 30 g of carbohydrates, 3.5 g of dietary fiber, 1.5 g of fat, 3.6 g of sugar, 4 mg of calcium, 0.72 mg of zinc, and other nutrients. In India, maize is emerging as the third most important cereal crop after rice and wheat which occupies an area of 9.86 M/ha with a production of 31.51 MT, having average productivity of about 3.19 t/ha. About 28% of produced maize is used as food, 11% for livestock feed, 48% as poultry feed, 12% in wet milling industry and 1% as seed.

The soil health is maintained by the use of organics by improving the soil organic matter, physio- chemical properties and beneficial microbes. The role of organic manure is to sustain the soil fertility and crop productivity which mainly includes, vermicompost, farmyard manure, cow urine etc. These fermented liquid organics contain nutrients, growth promoting substances and beneficial microbes which helps in improving the metabolic activity, plant growth, development and resistance to diseases and pests.

Knowledge about improved food safety, problems of health hazards and environmental concerns are increasing at an alarming rate both at national and global level in recent years. Hence, there is a great demand on the international market for high quality products and organically grown foods that can capitalize on its potential for large scale organic farming. As consumer demand for good monetary returns, high quality, safe, nutritious and ethical organic foods increases, organic farming is preferred nowadays. In view of high economic returns from maize, the production potential of maize and its potential to generate employment opportunities, there is a need to develop the organic production technology for maize production in the state.

2. MATERIALS AND METHODS

The field experiment was conducted in Research Farm, Department of Agronomy, AKS, University, Satna Madhya Pradesh during the Rabi season of 2023-2024 to study effect of integrated nutrient management (INM) on growth and yield of rabi maize. The experiment was conducted in randomized block design with ten treatment and 3 replications the treatments were as follows. The experimental area was 450 square meters with 30 plots (5m*3m) 15m^2 and 'JM 218' Maize variety as sown in the field with spacing 60 cm (row to row) *20 cm (plant to plant) spacing. Throughout the experiment different growth and yield parameters were recorded.

3. RESULTS AND DISCUSSION

3.1 Growth Parameter

3.1.1 Plant Height

Plant height is the important growth parameter in maize which relates with crop growth and knows time to maturity and related with maize life span. In Fig. & Table 1 data reveals that significantly highest height at harvest (182.15 cm) was recorded in T9 50% RDN by VC+50% RDN by PM + Azotobacter and PSB @ 10 ml/kg seed followed by T8 50% RDN by VC + 50 % RDN by PM (3.8 t/ha) (180.34 cm) and lowest plant highest (158.18 cm) was recorded in T1 control.

3.1.2 Stem growth

Stem growth is an important parameter to evaluate the growth and development of maize crop. Results (Fig. 2) & Table 2 showed that significantly highest stem girth was observed in T9 (13.70 cm) followed by T8 basal dose T8 50% RDN by VC + 50 % RDN by PM (3.8 t/ha) (12.65 cm). The lowest stem girth was observed in T_1 control (8.45 cm).

Table 1. Treatment details

S.no	Treatments
T_1	Control
T_2	100% RDN by FYM (24 t/ha)
T_3	75% RDN by FYM+25% RDN by VC
T_4	75%RDN by FYM+25% RDN by VC + Azotobacter and PSB @ 10 ml/kg seed
T_5	100% RDN by VC (8 t/ha)
T_6	75% RDN by VC+25% RDN by FYM
T_7	75%RDN by VC+25% RDN by FYM+ Azotobacter and PSB @ 10 ml/kg seed
T_8	50% RDN by VC + 50 % RDN by PM (3.8 t/ha)
T_9	50% RDN by VC+50% RDN by PM + Azotobacter and PSB @ 10 ml/kg seed
T_{10}	50%RDN by EC (6 t/ha) + Beejamrut + Jeevamrut spray 500 l/ha (twice)

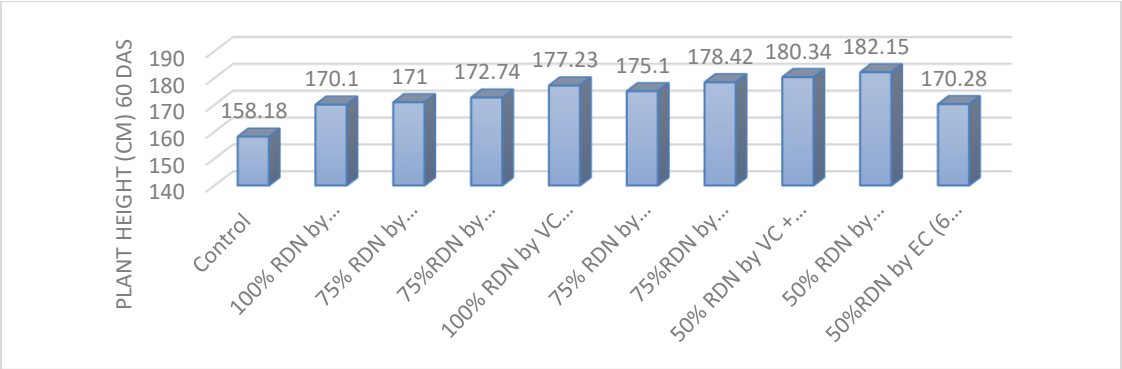

Fig. 1. Plant height (cm) of maize at 90 DAS as influenced by INM through organic sources

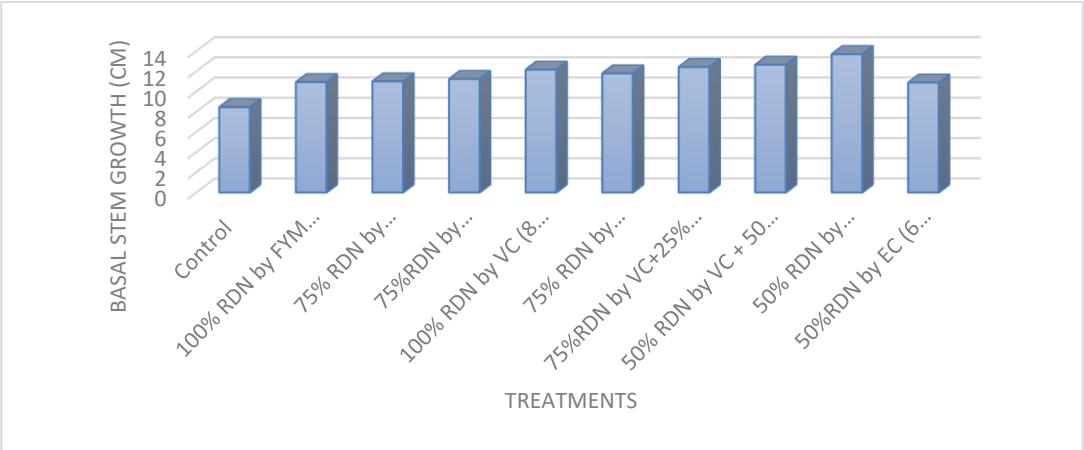

Fig. 2. Basal stem growth (cm) of maize as influenced by INM through organic sources

3.1.3 Cobb girth

Stem growth is an important parameter to evaluate the growth and development of maize crop. Results (Fig. 3) & Table 2 showed that significantly highest stem girth was observed in T9 (16.86 cm) followed by T8 basal dose T8 50% RDN by VC + 50 % RDN by PM (3.8 t/ha) (16.80 cm). The lowest stem girth was observed in T_1 control (13.82 cm). The data pertaining to growth attributes presented in Table 1, Out of the different INM through organic sources, multi-nutrients and as well as similar observance [1,2,3,4].

3.2 Yield Attributes

Yield attributes are yield characters which directly influence the maize crop yield. Yield attributes like cob length (cm), cob girth (cm),

number of grains per row, test weight (g), stover yield and biological yield. In Figs. 4 & 5 data revealed that maximum cob length (18.06 cm) and cob girth (16.86 cm), was recorded in T9 with application 50% RDN by VC+50% RDN by PM + Azotobacter and PSB @ 10 ml/kg seed followed by T8 (100% RDF + FYM @ 15 t ha-1) (cob length of 17.84 cm) and (cob girth of 16.80 cm), The lowest cob length (13.63 cm) and cob girth (13.82 cm) and harvest index 27.38% recorded in control.

3.2.1 Grain yield

In Fig. 4 the data showed the effect of integrated nutrient management of different treatments on maize grain yield. Maximum grain yield (39.40 q ha-1) was resulted in T_9 with application of 50% RDN by VC+50% RDN by PM + Azotobacter and PSB @ 10 ml/kg seed followed by T_8 (38.15 q ha-1) with application of 50% RDN by VC + 50 % RDN by PM (3.8 t/ha). The lowest grain yield was recorded in control (15.90 q ha-1).

The data of yield attributes and yield (Table 2), had shown significantly and maximum number of number of cobs/plants, cob length, grains/cob, 1000 - grain weight and cob girth weigh/plant) were enhanced significantly due to INM by organic sources treatments. These in turn, increased the higher yield-attributing parameters. These results are in close agreement with those of numerous workers [5,6,7,8].

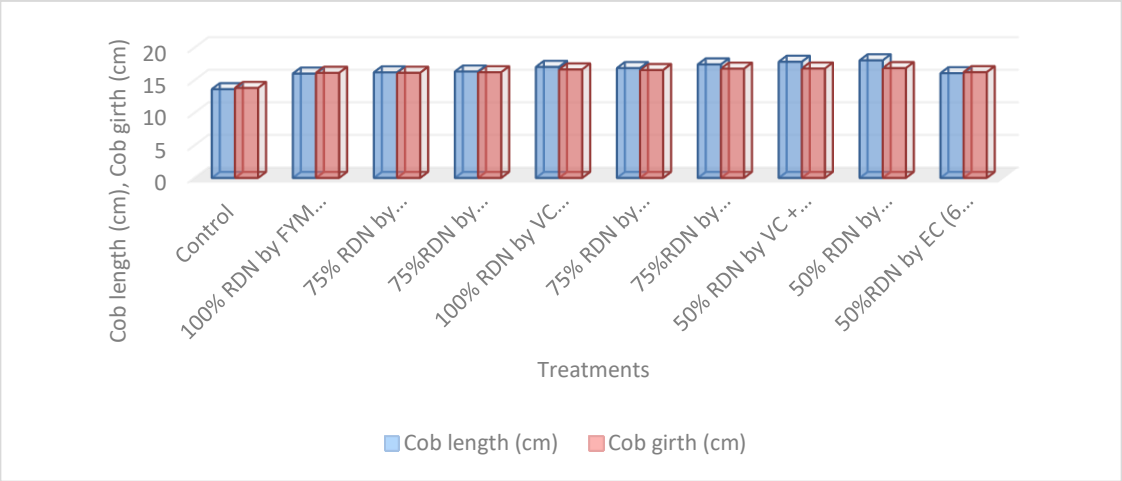

Fig. 3. Cob length and Cob girth (cm) of maize as influenced by INM through organic source

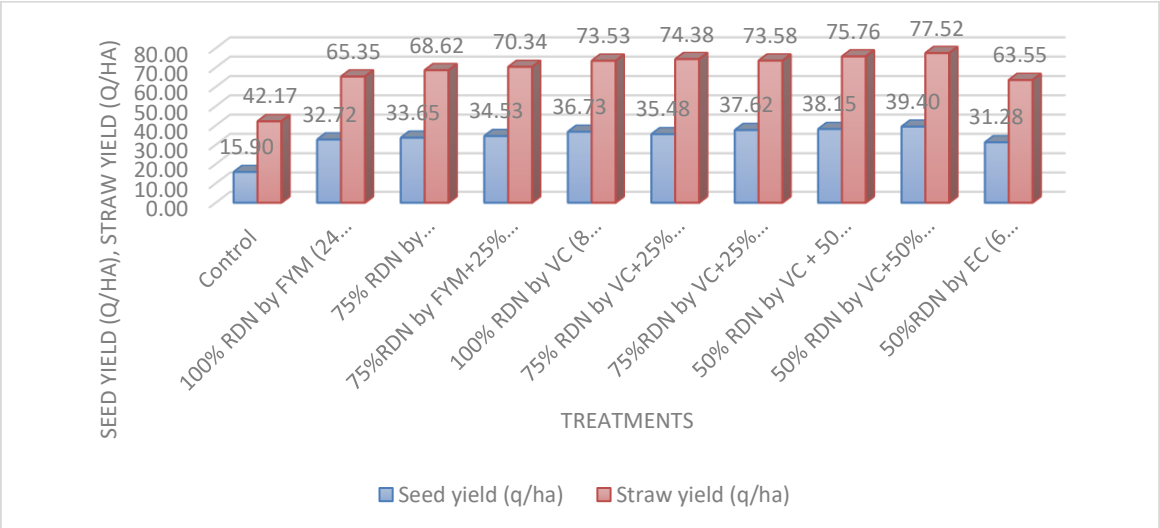

Fig. 4. Seed yield and Straw yield (q/ha) of maize as influenced by INM through organic sources

Table 1. Growth parameters of maize as influenced by INM through organic sources

Tr. No.	Treatments	Plant height (cm)			Leaves /plant			Basal stem growth (cm)
		30 DAS	60 DAS	90 DAS	30 DAS	60 DAS	90 DAS	
T_1	Control	68.86	155.40	158.18	8.28	10.65	7.35	8.45
T_2	100% RDN by FYM (24 t/ha)	75.10	167.82	170.10	9.87	12.37	9.10	10.93
T_3	75% RDN by FYM+25% RDN by VC	76.43	169.15	171.00	10.00	12.94	9.89	11.00
T_4	75%RDN by FYM+25% RDN by VC+Azotobacter and PSB @ 10 ml/kg seed	78.20	170.85	172.74	10.14	13.10	10.14	11.24
T_5	100% RDN by VC (8 t/ha)	82.50	175.22	177.23	11.48	13.46	10.38	12.16
T_6	75% RDN by VC+25% RDN by FYM	80.78	173.24	175.10	11.35	13.15	10.26	11.79
T_7	75%RDN by VC+25% RDN by FYM+Azotobacter and PSB @ 10 ml/kg seed	83.21	176.15	178.42	11.63	13.50	10.44	12.43
T_8	50% RDN by VC + 50 % RDN by PM (3.8 t/ha)	84.00	178.27	180.34	11.85	13.78	10.72	12.65
T_9	50% RDN by VC+50% RDN by PM + Azotobacter and PSB @ 10 ml/kg seed	85.87	18.30	182.15	12.10	14.74	11.56	13.70
T_{10}	50%RDN by EC (6 t/ha) + Beejamrut + Jeevamrut spray 500 l/ha (twice)	76.16	168.17	170.28	9.88	12.48	9.12	10.88
	S.Em ±	0.46	0.82	1.10	0.27	0.37	0.20	0.27
	C.D. (P=0.05)	1.32	2.38	3.17	0.79	1.06	0.58	0.77

E.C. = Enriched Compost, 100 % RDN = 120 kg N/ha

Table 2. Yield attributes of maize as influenced by INM through organic sources

Tr. No.	Treatments	No. of cobs/plant	Kernels per cob	Cob length (cm)	Cob girth (cm)	Seed index (g)	Seed yield (q/ha)	Straw yield (q/ha)	Harvest index (%)	Net income (Rs./ha)	B.C. Ratio
T_1	Control	1.05	288.6	13.63	13.82	22.30	15.90	42.17	27.38	63134	2.93
T_2	100% RDN by FYM (24 t/ha)	1.30	314.2	16.02	16.14	24.12	32.72	65.35	33.36	136280	3.40
T_3	75% RDN by FYM+25% RDN by VC	1.32	315.6	16.21	16.15	24.83	33.65	68.62	32.90	142049	3.50
T_4	75%RDN by FYM+25% RDN by VC+Azotobacter and PSB @ 10 ml/kg seed	1.36	321.0	16.34	16.23	25.14	34.53	70.34	32.93	145733	3.50
T_5	100% RDN by VC (8 t/ha)	1.42	328.5	17.05	16.66	27.93	36.73	73.53	33.31	159971	3.82
T_6	75% RDN by VC+25% RDN by FYM	1.39	320.4	16.87	16.57	26.56	35.48	74.38	32.30	153266	3.70
T_7	75%RDN by VC+25% RDN by FYM+Azotobacter and PSB @ 10 ml/kg seed	1.46	330.7	17.43	16.78	28.27	37.62	73.58	33.83	163376	3.80
T_8	50% RDN by VC + 50 % RDN by PM (3.8 t/ha)	1.48	335.6	17.84	16.80	29.05	38.15	75.76	33.49	173227	4.35
T_9	50% RDN by VC+50% RDN by PM + Azotobacter and PSB @ 10 ml/kg seed	1.52	341.3	18.06	16.86	29.42	39.40	77.52	33.70	178954	4.36
T_{10}	50%RDN by EC (6 t/ha) + Beejamrut + Jeevamrut spray 500 l/ha (twice)	1.25	315.8	16.08	16.24	24.54	31.28	63.55	33.00	141500	4.27
	S.Em ±	0.03	1.28	0.24	0.32	0.31	0.51	0.76	0.15	-	-
	C.D. (P=0.05)	0.08	3.70	0.69	0.92	0.89	1.47	2.20	0.44	-	-

E.C. = Enriched Compost, 100 % RDN = 120 kg N/ha

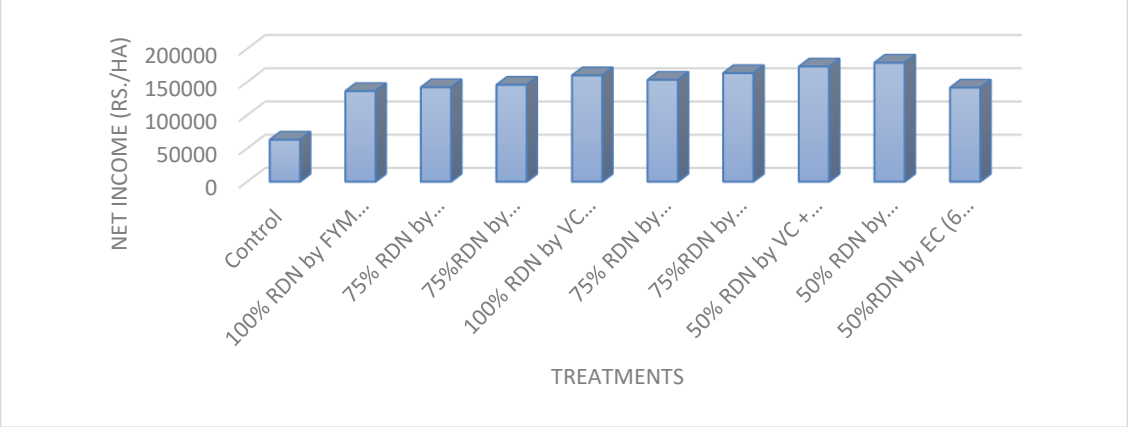

Fig. 5. Net income (Rs./ha) from maize as influenced by INM through organic sources

3.2.2 Stover yield

Stover yield is related with maize stalks and stem total dry matter which usually used as animal fodder after grain has been harvested. In Fig. 5 results showed that maximum stover yield (77.52q ha-1) was recorded T9 with application of 50% RDN by VC+50% RDN by PM + Azotobacter and PSB @ 10 ml/kg seed followed by (75.86 q ha-1) by applying 50% RDN by VC + 50 % RDN by PM (3.8 t/ha). The lowest stover yield (42.17 q ha-1) in control (T_1) [9,10].

3.3 Economics

The data pertaining to the economics of different treatments presented in Table 2 showed that the maximum net return (₹ 178954/ha), and benefit-cost ratio (4.36) was obtained in the treatment of 50% RDN by VC + 50% RDN by PM + Azotobacter and PSB @ 10 ml/kg seed, and the minimum net return (₹ 63134/ha), and lowest benefit-cost ratio (2.93) were recorded in treatment 1 (control) [1,12].

4. CONCLUSION

Based on one year field experimental data, it is concluded that amongst the applied INM organic sources of nutrients, 50% RDN by Vermicompost + 50% RDN by poultry manure + *Azotobacter* + PSB (T_9) proved the best treatment for growing maize. var. JM-218 for Kymore plateau (Satna region) of Madhya Pradesh. This treatment recorded maximum growth parameters (plant height, stem girth and leaves/plant), yield-attributes (cobs/plant, Cob length, grains/cob test weight and cob girth). Thus, the maximum seed yield was 39.40 q/ha, net income up to Rs. 178954/ha with 4.36 B:C ratio as well as seed protein was up to 10.46% and followed by organic sources of nutrients were T_8 (50% RDN by VC + 50% RDN by PM) and then T_7 (75% RDN by VC + 25% RDN by FYM + *Azotobacter* and PSB @ 10 ml/kg seed) respectively with respect to above mentioned parameters.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Kandel BP, Kumar S. Performance evaluation of maize hybrids in inner-plains of Nepal. Heliyon. 2020;6(1):05542.
2. Alias A, Usman M, Ullah E, Warraich AE. Effects of different phosphorus levels on the growth and yield of two cultivars of maize (*Zea mays* L.). International Journal of Agriculture & Biology. 2003;5(4):632-634.
3. Mege D, Tara B, Devadas SV, Monlai S, Sharma A. Response of different maize (*Zea mays* L.) varieties to planting densities. Int. J. Curr. Microbiol. App. Sci. 2021;10(02):1278-1284.
4. Khan AM, Abid M, Hussain N, Masood UM. Effect of phosphorous levels on growth and yield of maize (*Zea mays* L.) cultivars under saline conditions.

International Journal of Agriculture & Biology. 2005;7(3):512-514.
5. Pawar VR, Tambe AD, Raut A, Udmale KB. Response of sweet corn (*Zea mays* var. Saccharata) cv. SUGAR 75 to different organic sources. Adv. Res. J. Crop Improv.; 2012;3(2):122-125.
6. Sharma A, Wadhwa M, Singh G, Hundal JS. Adaptability, yield and in vitro evaluation of some promising silage maize (*Zea mays* L.) hybrids under tropical climate. India Joumal of Animal Sciences. 2018;80(6):671-675.
7. Kripa A, Bhandar S, Aryal K, Mahato M, Shrestha J. Effect of different levels of nitrogen on growth and yield of hybrid maize (*Zea mays* L.) varieties. Journal of Agriculture and Natural Resources. 2021;4(2):48-62.
8. Reddy BVU, Reddy PG, Reddy SM, Kavitha P. Effect of different nitrogen and phosphorus levels on growth and Yield of maize during kharif season. Int. J. Curr. Microbiol. App. Sci. 2018;7(1):3548-355.
9. Dragana IM, Jelena V, Dejana T, Zoran D, Marija K, Sofija B. Grain nutrient composition of Maize (*Zea mays* L.) drought tolerant populations. Journal of Agricultural and Food Chemistry. 2015;63 (4):1251-1260.
10. Agricultural Statistics at al. Glance. Government of India, Ministry of agriculture & farmers welfare, department of ministry of agriculture, cooperation & farmers welfare, Directorate Statistics; 2021.
11. AICRP on Maize. In the national symposium on quality protein maize for human nutritional security and development of poultry sector in India. Held at NASC Complex and organized by Directorate of Maize Research (DMR). 2008;5.
12. Kumari AH, Luther MM, Chandrasekhar K, Babu RP, Rani AY. Effect of sources and levels of phosphorus on growth and yield of no-till sorghum in rice-sorghum sequence. Int. J. Curr. Microbiol. App. Sci. 2018;7(11):65-76.

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