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To study the effect of integrated nutrient management on leaf area index (LAI) and crop growth rate (CGR) of summer maize (*Zea mays* L.) in Chhattisgarh plains

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Abstract
A study entitled "Studies on integrated nutrient management on productivity of summer maize in Chhattisgarh plains" was conducted in 2016-17 during the *summer* season at the Research Farm of Bairister Thakur Chhedilal (BTC) College of Agriculture & Research Station (CARS) Bilaspur (C.G.). To study the effect of integrated nutrient management on growth parameters of summer maize in Chhattisgarh plains. The experiment was laid out in RBD design with three replications keeping 10 treatments. The recommended dose of fertilizers for maize was 120: 60: 40 kg ha^{-1} N, P_2O_5 and K_2O, respectively and applied through urea, single super phosphate, muriate of potash, FYM and vermicopost respectively. Crop was sowing on 28 Jan 2017 and harvested on 18 May 2017. The results revealed that Application of 75% RDFN + 25% N through vermicompost recorded maximum Leaf area index (LAI) and crop growth rate (CGR) at 30, 60 and 90 days after sowing and at harvest.

Keywords: integrated nutrient management, LAI, CGR, of *summer* maize

Introduction

Maize (*Zea mays* L.) is the third most important cereal in India after Rice and wheat. Currently it is cultivated over 8.33 million ha. with 16.68 million tonnes production having an average productivity of 2002 kg ha^{-1}. In Chhattisgarh, maize occupies an area of 1.83 million ha. with an annual production of about 2.44 million tonnes and an average productivity of 1333.33 kg ha^{-1}, contributing nearly 8 % in the national food basket. In the commands areas of Chhattisgarh, where summer/ rabi rice is being grown, needs to be substituted by winter maize, because of its lower water need, compared to rice and higher productivity.Now-a-days, chemical fertilizers are abundantly supplied but their cost has increased considerably resulting in low net return. Chemical fertilizers give high production during initial few years, but productivity declines in subsequent years. Further, continuous application of chemical fertilizer alone in a system deteriorates soil health and affects crop productivity (Singh *et al*., 2010) [1].

Mathod and Materials

The statistical comparisons among treatments were worked out tried in Randomized Block Design (RBD) with ten treatments and three replications. The seeds of maize (*Zea mays* L.) variety (Hybrid Pro Agro-4212). Lengths of all the fully opend leaf lamina per plant were measured from the base to the tip of the leaf. Breadth was taken at the widest point of the leaf lamina. The products of leaf length and breadth were multiplied by the factor 0.75 (Saxena and Singh, 1965) [5]. Further LAI was calculated by the following formula.

$$\text{LAI} = \frac{\text{Leaf area plant}^{-1}}{\text{Ground area covered by plant}}$$

Crop growth rate is defined as "dry weight accumulated per unit of land area per unit of time" (Hunt, 1978). It was calculated from two randomly selected plants for dry matter determination at 30, 60 and 90 days after sowing and harvest stage using the following equation.

$$\text{CGR (g day}^{-1}) = \frac{W_2 - W_1}{t_2 - t_1}$$

Where,
W_1= Total dry matter of plant at time t_1
W_2= Total dry matter of plant at time t_2
t_1 = Time of first observation
t_2 = Time of second observation

Results and Discussion

1. Leaf Area Index (LAI): Leaf area index was estimated at 30, 60 and 90 DAS and at harvest. The data are presented in Table No. 1, LAI is a measure of proportionate canopy coverage over ground. In general, leaf area index increased from 30 DAS to 60 DAS and decreased thereafter upto at harvest that might be due to the senescence of older leaves.

Maximum Leaf area index recorded At 60 DAS significantly superior LAI (5.55) was noted under treatment T_5 (75% RDFN+25% N through Vermicompost.) which was at par with the treatment T_8 (75% RDFN+12.5%N through FYM+12.5% N through Vermicompost.), T_9 (50% RDFN+25% N through FYM + 25 % N through Vermicompost.), T_6 (50% RDFN+50% N through Vermicompost.), T_2 (75% RDFN+25%N through FYM.), and T_{10} (25% RDFN+37.5 % N through FYM + 37.5 % N through Vermicompost.). The LAI increased up to 60 DAS and afterwards, it declined. The higher Leaf Area Index at 60 DAS might be due to more light interception and Enhanced photosynthetic rate, which ultimately resulted in higher dry matter production these Results are in conformity with the findings of Basavaraju S. D. (2007) [4] in Maize.

2. Crop growth rate (CGR): Crop growth rate of maize was computed at 30, 60, 90 DAS and at harvest and data are presented in Table No. 2 The trend showed that the crop growth rate increased up to 30 to 60 DAS and declined thereafter 90 DAS to at harvest. Different treatment combination significantly affected the crop growth rate during 30 DAS, 60 DAS, 90 DAS and at harvest. Maximum Crop Growth Rate observed At 30 DAS the maximum crop growth rate (6.60 g day^{-1}) was observed under the treatment T_5 (75% RDFN+25% N through vermicompost). Overall improvement in crop growth under the influence of vermicompost appears to be better due to nutritional availability in the crop root zone and plant system as vermicompost is known to improve the physical and biological properties of soil including supply of almost all the essential plant nutrients for growth and development of the plant. These results confirm the findings of Panchal Bharatkumar Harilal (2010).

Table 1: Effect of Integrated nutrient management (INM) on Leaf area index (LAI) at different growth stages of summer maize (*Zea mays* L.)

Treatment	Leaf Area Index (LAI)			
	30 DAS	60 DAS	90 DAS	At harvest
T_1- 100% RDFN	0.91	3.97	3.45	3.40
T_2- 75% RDFN+25%N through FYM.	1.25	4.56	3.72	3.52
T_3- 50% RDFN+50%N through FYM.	0.86	3.77	3.27	3.28
T_4- 25% RDFN+75%N through FYM.	0.88	3.89	3.29	3.32
T_5- 75% RDFN+25% N through vermicompost.	1.57	5.55	4.83	4.63
T_6- 50% RDFN+50% N through vermicompost.	1.10	4.74	3.99	3.50
T_7- 25% RDFN+75% N through vermicompost.	0.94	4.31	3.56	3.37
T_8-75% RDFN+12.5%N through FYM+12.5% N through vermicompost.	1.39	4.97	4.52	4.18
T_9- 50% RDFN+25% N through FYM. + 25 % N through vermicompost.	1.20	4.87	4.02	3.71
T_{10}-25% RDFN+37.5 % N through FYM + 37.5 % N through vermicompost	1.02	4.42	3.59	3.38
SEm. ±	0.205	0.469	0.221	0.307
CD (P=0.05)	0.610	1.392	0.656	0.913

Table 2: Effect of Integrated Nutrient Management (INM) on Crop Growth Rate (g day^{-1}) at different growth stages of Summer Maize (*Zea mays* L.)

Treatment	Crop Growth Rate (g day^{-1}) for different growth stages of maize			
	0-30 DAS	30-60 DAS	60-90 DAS	90-At harvest
T_1- 100% RDFN	4.15	2.22	2.06	1.63
T_2- 75% RDFN+25%N through FYM.	4.40	2.36	1.99	1.56
T_3- 50% RDFN+50%N through FYM.	2.98	1.89	1.89	1.47
T_4- 25% RDFN+75%N through FYM.	3.06	2.28	1.98	1.53
T_5- 75% RDFN+25% N through vermicompost.	6.60	3.09	2.23	1.79
T_6- 50% RDFN+50% N through vermicompost.	4.43	2.48	2.06	1.68
T_7-25% RDFN+75% N through vermicompost.	4.06	2.41	2.03	1.50
T_8-75% RDFN+12.5%N through FYM+12.5% N through vermicompost.	4.96	2.96	2.19	1.73
T_9- 50% RDFN+25% N through FYM. + 25 % N through vermicompost.	4.84	2.52	2.18	1.70
T_{10}-25% RDFN+37.5 % N through FYM + 37.5 % N through vermicompost	4.30	2.66	2.19	1.66
SEm ±	0.116	0.282	0.076	0.043
CD (P=0.05)	0.344	0.837	0.225	0.128

Conclusion

Results presented in this study indicated that for obtaining maximum Leaf area index and Crop growth rate in Maize, it needs to be fertilized with 75% RDFN + 25 % N through vermicompost. However, before giving final recommendations, the investigation needs to be carried out at different agro-climatic regions of the Valley to arrive at final conclusions.

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