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RESEARCH ARTICLE

EFFECT OF LIQUID ORGANIC SUPPLEMENTS ON GROWTH AND YIELD OF MAIZE (*ZEA MAYS* L.)

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ABSTRACT

A field experiment was conducted during July to October, 2015 under deep clay soil at the Experimental farm, Faculty of Agriculture, Annamalai University to study effect of foliar nutrition on growth and yield of maize. The experiment was conducted in randomized block design and replicated thrice. The experiment comprised of ten treatments *viz.,* control (water spray), liquid organic supplements Jeevamrutha, Beejamrutha, Vermiwash at 3 and 5% concentration applied 3 times on 20, 40 and 60 DAS. The results of the experiment showed that foliar spray of 5 % Jeevamrutha on 20, 40 and 60 DAS significantly recorded higher growth, yield attributes and yields of maize *viz.,* plant height, leaf area index (LAI), dry matter production (DMP), cob length and cob diameter, number of grains cob^{-1}, test weight, grain and stover yield. Significantly lowest values for growth attributes, yield attributes, grain and stover yields of maize were recorded under control. Based on the above, it could be concluded that, foliar spray of 5% jeevamrutha on 20, 40 and 60 DAS would help to increase productivity and profitability of maizeunder Cauvery delta region of Tamil Nadu.

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INTRODUCTION

Maize (Zea mays L.) is an important and versatile cereal grown over diverse environment and geographical ranges for human food, feed and fodder for livestock. It also serves as a basic raw material as an ingredient to thousands of industrial products that includes starch, oil, protein, alcoholic beverages, food sweeteners, pharmaceutical, cosmetic, film, textile, gum, package and paper industries etc. (Arvaidya *et al.*, 2012). In terms of global production, Maize (*Zea mays* L.) is largest grown cereal in the world and comes third in terms of consumption after rice and wheat. Maize, popularly known as "Queen of Cereals" is a miracle crop grown in more than 130 countries of different continents (Preetha and Stalin. 2014). Worldwide maize is grown over an area of 168 million hectares with a production of 945.8 million tonnes and with the productivity of 5.7 t ha^{-1}. In India, maize occupies an area of 9.43 million hectares with a production of 24.35 million tonnes and the productivity of 2.54 t ha^{-1}. In Tamil Nadu, it is cultivated in an area of 0.22 million hectares with production of 0.81 million tonnes and a productivity of 3.7 t ha^{-1}. The current global scenario firmly emphasizes the need to adopt eco-friendly agricultural practices for sustainable food production.

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The use of liquid organic manures such as Beejamrutha, Jeevamruthaand Vermiwashresults in higher growth, yield and quality of crops. Beejamruthaand jeevamrutha contains macro nutrients, essential micro nutrients, many vitamins, essential amino acids, growth promoting factors like IAA, GA and beneficial microorganisms (Table A and B) (Gadewar *et al*., 2013).Vermiwash is a liquid fertilizer collected after the passage of water through a column of worm activation. It is a collection of excretory and secretory products of earthworms, along with major micronutrients of the soil and soil organic molecules that are useful for plants (Kaur *et al*., 2015). Several strategies were initiated to boost the productivity of maize. One amongthem being the efficient way is foliar application of liquid organicmanures for exploiting the maximum genetic potential of the crop. Recently, many studies have reported that beejamrutha, jeevamrutha and vermiwash as foliar spray is effective. But research studies on different doses of aforesaid liquid manures on maize crop were meagre. Therefore, the present study was undertaken to find out the response of different concentration of beejamrutha, jeevamrutha and vermiwash on growth and grain yield of maize in Cauvery delta region of Tamil Nadu.

MATERIALS AND METHODS

Field experiment was conducted at the Experimental Farm, Department of Agronomy, Annamalai University, Annamalainagar and Tamil Nadu to study the influence of

Chemical composition ofJeevamrutha, Beejamurtha and Vermiwash

Parameters	Beejamurtha	Jeevamrutha	Vermiwash
pH	8.2	7.07	7.11
Soluble salt (EC) dSm-1	5.5	3.40	2.11
Total Nitrogen (PPM)	40	770	6.3
Total Phosphorus (ppm)	155.4	166	48.86
Total Potassium (ppm)	252.0	126	245.67
Total Zinc (ppm)	2.96	4.29	0.03
Total Copper (ppm)	0.52	1.58	0.35
Total Iron (ppm)	15.35	282	2.21
Total Manganese (ppm)	3.32	10.7	0.04
IAA (ppm)	7.1	7.9	5.43
GA_3 (ppm)	3.9	4.5	3.5

Microbial population in Jeevamrutha, Beejamurtha and Vermiwash

Organisms	Beejamurtha	Jeevamrutha	Vermiwash
	(cfu /ml)	(cfu /ml)	(cfu /ml)
Bacteria	15.40×10^5	19.70×10^5	2.40×10^6
Fungai	10.50×10^3	13.40×10^3	9.46×10^4
Actinomycetes	6.80×10^3	3.50×10^3	2.0×10^3
Free living nitrogen fixers	3.10×10^2	4.60×10^2	3.0×10^3
Phosphate solubilising organisms	2.70×10^2	4.20×10^2	7.3×10^4

Table 1. Effect of liquid organic supplements on growth and yield of maize

Treatments	Plant height (cm)	Leaf area index	DMP (kg ha^{-1})	Cob length (cm)	Cob girth (cm)	Number of grains cob^{-1}	100 grains weight (g)	Grain yield (Kg ha^{-1})	Stover yield Kg ha^{-1})	Harvest index
T_1	125.48	5.02	8365	13.82	8.73	272.78	25.49	3637	5245	40.95
T_2	161.60	6.46	10773	17.80	11.24	351.30	26.93	4684	6629	41.40
T_3	159.22	6.37	10615	17.54	11.08	346.13	26.75	4615	6547	41.35
T_4	150.21	6.01	10014	16.55	10.45	327.55	26.42	4354	6196	41.27
T_5	202.57	8.09	13485	22.38	14.07	438.73	28.93	5863	8119	41.93
T_6	197.65	7.91	13177	21.77	13.75	429.68	28.62	5729	7954	41.87
T_7	187.58	7.50	12505	20.66	13.05	407.78	28.09	5437	7587	41.75
T_8	176.81	7.07	11788	19.48	12.30	384.38	27.68	5125	7197	41.59
T_9	174.40	6.94	11560	19.10	12.06	377.15	27.44	5026	7074	41.54
T_{10}	163.94	6.56	10930	18.06	11.40	356.40	27.11	4752	6717	41.43
SEd	3.65	0.12	257	0.41	0.24	8.63	0.18	122	144	1.25
CD (P=0.05)	7.42	0.26	526	0.83	0.52	17.54	0.39	246	296	NS

T_1 – control (water spray),T_2 - foliar spray of 3 % jeevamrutha on 20, 40 and 60 DAS, T_3 - foliar spray of 3 % beejamrutha on 20, 40 and 60 DAS,T_4 - foliar spray of 3 % vermiwash on 20, 40 and 60 DAS, T_5 - foliar spray of 5 % jeevamrutha on 20, 40 and 60 DAS,T_6- foliar spray of 5% beejamrutha on 20, 40 and 60 DAS, T_7- foliar spray of 5 % vermiwash on 20, 40 and 60 DAS, T_8 – foliar spray of 8 % jeevamrutha on 20, 40 and 60 DAS, T_9 – foliar spray of 8 % beejamrutha on 20, 40 and 60 DAS, T_{10} – foliar spray of 8 % vermiwash on 20, 40 and 60 DAS

different organic growth substances on growth and yield of performance in maize. The experimental farm is geographically located at 11°24'N latitude, 79° 44'E longitude and +5.79 m above mean sea level. The experimental soil was clay loam in texture with pH 7.8, EC 0.45 dsm^{-1}, organic carbon 0.55 and low N (227.0 Kg ha^{-1}), medium in P (23 Kg ha^{-1}) and high in K (254 Kg ha^{-1}). The experiment comprising of ten treatments *viz.,* T_1 - control (water spray), T_2 - foliar spray of 3 % Jeevamrutha on 20, 40 and 60 DAS, T_3 - foliar spray of 3 % Beejamrutha on 20, 40 and 60 DAS, T_4 - foliar spray of 3 % Vermiwash on 20, 40 and 60 DAS, T_5 - foliar spray of 5 % Jeevamrutha on 20, 40 and 60 DAS, T_6- foliar spray of 5 % Beejamrutha on 20, 40 and 60 DAS, T_7- foliar spray of 5 % vermiwash on 20, 40 and 60 DAS, T_8- foliar spray of 8 % Jeevamrutha on 20, 40 and 60 DAS, T_9 – foliar spray of 8 % Beejamrutha on 20, 40 and 60 DAS and T_{10}- foliar spray of 8 % vermiwash on 20, 40 and 60 DAS. The experiment was laid out in a randomized block design with three replications. The maize hybrid Pioneer 30B07 was chosen for the study. The recommended seed rate of 20 kg ha^{-1} was used for the experiment. The seeds were sown by dibbling with a spacing of 60 X 20 cm. The fertilizers were applied to the experimental field as per the recommended manurial schedule of 135:62.5:50 kgs of N, P_2O_5 and K_2O ha^{-1}. The entire dose of phosphorus, potassium and half dose of nitrogen was applied as basal. The remaining half dose of nitrogen was top dressed in two equal splits at 25 and 45 days after sowing. As per treatment schedule liquid organic manures were applied. All necessary management practices were carried out as per standard recommendation for maize crop. The growth and yield attributing characters such as plant height, LAI, DMP, number of grains cob^{-1}, cob length, cob girth and test weight of maize were recorded from 5 randomly selected plants. Grain and stover yields were also recorded from each plot. The crop was harvested manually at full maturity. The harvested crop of the plot was bundled separately, tagged properly and bring to the clean threshing floor. The data on various studies recorded during the investigation were subjected to statistical scrutiny suggested by Gomez and Gomez (1984).

Chemical composition of the liquid organic manures: The chemical composition of the liquid organic manures chosen in the study was analyzed using standard methodologies (Cappuccino, 2014). The parameters tested includes, pH, conductivity (EC), Total N, P, K, Ca, Mg, Fe, Zn, Indole acetic acid (IAA) and gibberellic acid (GA). All three liquid manures were also tested for specific group microbes that includes bacteria, fungi, actinomycetes, phosphate solubilizers and free-living nitrogen fixers using standard microbiological enumeration techniques (Cappuccino, 2014).

RESULTS AND DISCUSSION

Effect of growth attributes: All the treatments significantly influenced the growth attributes of maize. Among the treatments, foliar spray of 5 % jeevamrutha on 20, 40 and 60 DAS (T_5) recorded significantly higher plant height (202.57cm) and LAI (8.09). This could be attributed to greater potential of growth promoting substances in Jeevamrutha which helps to enhance carbohydrate synthesis and effective translocation of photosynthates which would contribute to improvement in growth attributes. Similar findings have also been reported by Suresh Dhapke*et al*.(2013). The same treatment alsoregistered significantly higher dry matter production of 13485 kg ha^{-1}. This might be due to availability of significant quantity of vitamins and natural phytoregulators in Jeevamrutha in a balanced form resulting in increased DMP. The results were in accordance with the report of Amareswari Uma and Sujathamma (2014). The least values of growth attributes were registered under control (T_1).

Effect on yield and yield components: The yield potential of maize is determined by yield attributes and the values of yield attributes were in accordance with that of growth parameters. Among the various treatments, foliar spray of 5 % jeevamrutha on 20, 40 and 60 DAS (T_5) registered significantly higher cob length (22.38 cm) and cob girth (14.07 cm) and hundred grains weight (28.93 g). Higher availability of growth promoting substances such as IAA, GA, cytokinin, kinetin, essential plant nutrients, effective microorganisms were present in jeevamrutha that directly influenced LAI, increased photosynthetic activity and assimilate partitioning from source to sink might be attributed to increased yield attributes in this treatments. These results were in agreement with the findings of Sreenivasa*et al.* (2010).The control plot (T_1) recorded the least values of yield attributes. In respect of grain and stover yield, foliar spray of 5 % jeevamrutha on 20, 40 and 60 DAS (T_5) significantly registered higher grain yield (5863 kg ha^{-1}) and stover yield (8119 kg ha^{-1}). However it was on par with foliar spray of 5 % beejamrutha on 20, 40 and 60 DAS. Foliar sprayingwith jeevamrutha could have created stimuli in the plant system which in turn increased the production of growth regulator in cell system and the action of growth regulators in plant system stimulated the necessary growth and development, leading to better yield. Besides the easy transfer of nutrients and growth stimulants to plants through foliar spray of optimum dose of jeevamrutha might be the reason for enhancement in grain yield.The results confirm the findings of Sridar*et al*. (2011)**.**Harvest index parameter was also registered higher value under this treatment. However it was not significantly superior over other treatments. The least grain yield (3637 kg ha^{-1}) and stover yield (5245 kg ha^{-1}) was registered under T_1 (control) (Table 1). Thus, on the basis of the experimental findings, it can be concluded that foliar spraying of 5 % jeevamrutha on 20, 40 and 60 DAS may be taken up to get higher grain yield of maize. If the availability of jeevamrutha is limited, foliar spraying with 5 %Beejamurtha can also be recommended for getting higher yield in maize under Cauvery delta region of Tamil Nadu.

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