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Effect of Vermicompost and Ghanjeevamrit on Growth, Yield Attributes and Productivity of Maize (*Zea mays* L.)

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***Abstract*— *A field experiment was conducted at the Instructional Farm, Rajasthan College of Agriculture, MPUAT, Udaipur, during the Kharif season of 2024 to study the effect of vermicompost and ghanjeevamrit on maize (Zea mays L.) growth, yield attributes and productivity. The trial was designed in a factorial randomized block design, with sixteen treatments replicated three times. The treatments involved two factors that is vermicompost and ghanjeevamrit. The experimental soil was clay loam in texture, low in available nitrogen, medium in phosphorus, and high in potassium with adequate levels of DTPA-extractable micronutrients (Zn, Fe, Mn and Cu). The application of 75% RDN by vermicompost led to a significant enhancement in plant height at harvest at 60 DAS (111.57 cm) and at Harvest (218.02 cm), number of cobes plant^{-1} (1.82), number of grains row^{-1} at (39.48), number of row cob^{-1} (14.95), cob length (24.09), seed index (256.73 g), seed yield (3524 kg ha^{-1}) and biological yield (9720 kg ha^{-1}). These values significantly outperformed the absolute control treatment (V_0). Similarly in ghanjeevamrit @750kg ha^{-1} significantly enhancement in plant height at 60 DAS (112.02 cm) and at Harvest (218.99 cm), number of cobes plant^{-1} (1.82), number of grains row^{-1} at (39.49), number of row cob^{-1} (15.39), cob length (24.41), seed index (256.79 g), seed yield (3454 kg ha^{-1}) and biological yield (9639 kg ha^{-1}). These values significantly outperformed the absolute control treatment (G_0). The results emphasize the advantage of nutrient synergy in vermicompost and ghanjeevamrit systems, highlighting their potential to enhance crop productivity through sustainable and balanced nutrient inputs.*

***Keywords*— Vermicompost, Ghanjeevamrit, RDN, Biological yield.**

I. INTRODUCTION

Among cereal crops, maize (*Zea mays* L.) is considered the third most important cultivated grain worldwide owing to its improved adaptability to a wide spectrum of arid and semi-arid conditions (Shahzad *et al.*, 2020). It is basically consumed for three uses- as food, as feed for animals and as raw material for industry (Parveen and Ashraf, 2010). India has 4th rank in terms of area under organic land over the world and 1st in terms of number of organic producers in the world. Organic agriculture is practised in 188 countries and more than 96 million hectares of agricultural land are managed organically by at least 4.5 million farmers. In 2023, there were 4.3 million organic producers worldwide. India remains the country with the most organic producers (2.36 million). India's rank 2nd in terms of World's Organic Agricultural land and 1st in terms of total number of producers (FIBL & IFOAM, 2024). The total area under organic certification in India is 7.3 million hectares. The certified area includes 4.4 million hectares under cultivation and 2.8 million hectares under wild harvest collection. India has produced near 3.6 million MT of certified organic products during 2023-2024 (APEDA, 2023-24).

Using organics improves soil health by increasing organic matter, physiochemical characteristics and beneficial bacteria. Organic manure, such as vermicompost, farmyard manure and cow urine, plays a vital role in maintaining soil fertility and crop productivity. Fermented liquid organics, such as cow urine, jeevamrit and ghanjeevamrit, include nutrients, growth-promoting chemicals and beneficial bacteria that improve plant metabolism, growth, development and resistance to diseases and pests.

II. MATERIALS AND METHODS

2.1 Field location and materials:

The experiment was carried out in the Field no. D_{4a}, Organic Farming Unit, Instructional Farm (Agronomy), Rajasthan College of Agriculture, MPUAT, Udaipur (Rajasthan), located at an elevation of 581.44 meter above mean sea level, 24º34'N latitude and 73º42'E longitude. The region falls under the agro-climatic zone IVa (Sub-humid Southern Plain and Aravalli Hills) of Rajasthan.The soil of the experimental field was clay loam, slightly alkaline in reaction (pH 8.04) with low available nitrogen (204.47 kg ha^{-1}), medium phosphorus (20.09 kg ha^{-1}), and high potassium (319.58 kg ha^{-1}).

2.2 Experimental detail:

The experiment was conducted using a Factorial Randomized Block Design (RBD) with 16 treatments and three replications. The treatments included different combinations of organic input. The test crop was maize (*Zea mays* L.), PHM-6, sown on 18th July 2024 at a spacing of 60×25 cm using a seed rate of 25 kg ha^{-1}. Sixteen treatments were evaluated in the experiment. There are two factors one is vermicompost in which V_0 is control, V_1 is 100% RDN by vermicompost, V_2 75 % RDN by vermicompost and V_3 that is 50 % RDN by vermicompost and other one is ghanjeevamrit which is apply at the rate of 750kg ha^{-1} in G_3, G_2 500kg ha^{-1}, G_1 is 250kg ha^{-1} and G_0 is absolute control. Standard recommendations for cultural and plant protection practices were followed throughout the crop season.

2.3 Determination methods:

Field data were recorded during experimentation, to assess the effect of different treatments on growth and yield performance of maize. For measuring plant height at 30 DAS, 60 DAS and at harvest, five plants were randomly selected and tagged in each plot. The height was measured from the base to the tip of the main shoot using a meter scale, and the average was computed. To determine the number of cobes plant^{-1}, five randomly selected plants plot^{-1} and the cobes were counted and averaged. For yield attributes, the number rows cob^{-1} were counted from the same tagged plants, and number of grains row^{-1} were determined by counting seeds from ten randomly selected cob plot^{-1}. Seed Index weight was calculated by counting and weighing 1000 seeds taken from each treatment and expressed in grams. Seed yield (kg ha^{-1}) was obtained by harvesting and threshing produce from the net plot area and converting it to per hectare basis. Haulm yield was calculated by subtracting seed yield from the corresponding biological yield, which was recorded by weighing the sun-dried total biomass from each net plot. Finally, the harvest index (%) was computed using the formula given by Donald and Hamblin (1976), i.e.,

$$\text{Harvest Index (\%)} = \frac{\text{Economic yield}}{\text{Biological yield}} \times 100$$

Where:
Economic yield = Seed yield (kg ha^{-1})
Biological yield = Seed yield + Haulm yield (kg ha^{-1})

III. RESULT AND DISCUSSION

4.1 Effect of vermicompost and ghanjeevamrit on Growth, Yield Attributes and Productivity of maize

Data given in table 1 illustrated significant increase in number of grains row^{-1} with various levels of RDN through vermicompost over control. The data demonstrated that number of grains row^{-1} increased upto 100% RDN through vermicompost which was significantly higher over 50% RDN through vermicompost and control by 4.62 and 6.70 per cent, respectively. Although, number of grains row^{-1} observed with 75% RDN through vermicompost (39.48) was found at par with 100% RDN through vermicompost (39.62). Vermicompost enhances the physical and biological properties of the soil, leading to improved availability of almost all essential nutrients needed for plant growth and development. The findings of this study are consistent with those reported by Yadav *et al.* (2017) and Joshi *et al*. (2023).

Table 1: Effect of vermicompost and ghanjeevamrit on yield attributes of maize

Treatments	Cob length (cm)	No of cobs plant^{-1}	Number of row cob^{-1}	No of grains row^{-1}	Seed index (g)
Vermicompost					
V_0	22.82	1.55	14.78	37.13	242.62
V_1	24.93	1.88	14.47	39.62	257.58
V_2	24.09	1.82	14.95	39.48	256.73
V_3	21.14	1.62	15.11	37.87	247.09
SEm±	0.45	0.03	0.31	0.36	2.17
C.D. at 0.05	**1.29**	**0.10**	**0.89**	**1.04**	**6.26**
Ghanjeevamrit					
G_0	22.54	1.67	14.41	37.24	243.26
G_1	22.98	1.66	15.08	38.42	250.34
G_2	23.04	1.71	14.43	38.96	253.62
G_3	24.41	1.82	15.39	39.49	256.79
SEm±	0.45	0.03	**0.31**	0.36	2.17
C.D. at 0.05	**1.29**	**0.10**	**0.89**	**1.04**	**6.26**

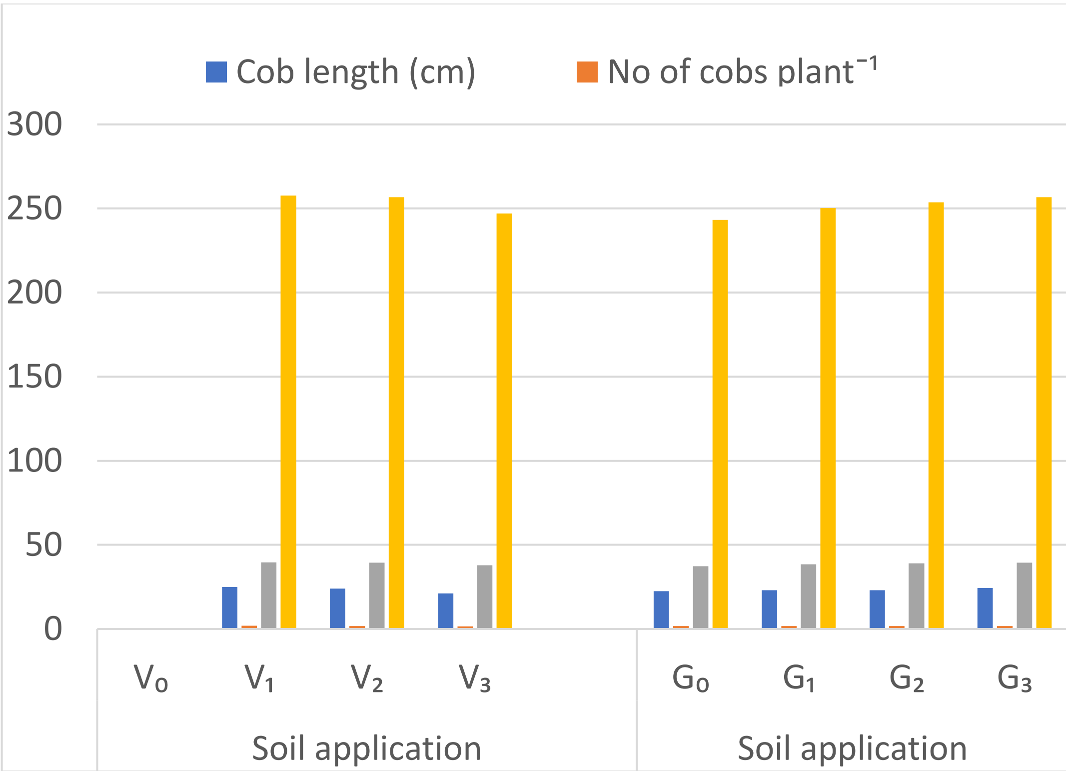

Fig. 1: Effect of vermicompost and ghanjeevamrit on yield attributes of maize

4.1.1 Growth Parameters

A critical examination of data given revealed that different levels of RDN applied through vermicompost significantly increased cob length of maize crop over the control treatment. It was seen that 100% RDN through vermicompost recorded significantly higher cob length (24.93 cm) over 50 % RDN through vermicompost and control by 17.92 and 9.24 per cent, respectively. However, this treatment remained at par with application of 75% RDN through vermicompost. Ghanjeevamrit @ 750 kg ha^{-1} recorded the highest cob length (24.41 cm) which was significantly higher over ghanjeevamrit 250 kg ha^{-1} and control treatment by 6.22 and 8.29 per cent, respectively. However, the cob lenght registered by ghanjeevamrit @ 500 kg ha^{-1} (23.04 cm) was found at par with ghanjeevamrit @ 750 kg ha^{-1}.The enhanced plant height observed under ghanjeevamrit application could be attributed to improved soil fertility, better nutrient availability, and stimulation of beneficial microbial activity in the root zone. Ghanjeevamrit enhances the solubilization of nutrients, particularly nitrogen and phosphorus, which are essential for vegetative growth, cell elongation, and division, leading to taller and more vigorous plants. Similarly, the increase in the number of cobs per plant can be linked to improved plant health and balanced nutrition throughout the crop growth stages, which supports not only vegetative growth but also the development of reproductive structures. The similar findings were concluded by Awasthi *et al*. (2020) and Rathore *et al.* (2023).

4.1.2 Yield Attributes

Grain yield of maize significantly increased with the increasing levels of RDN through vermicompost over control. Application of 100% RDN through vermicompost recorded significantly higher grain yield over control and 50% RDN through vermicompost by 51.48 and 7.012 per cent, respectively. However, it was observed from the table that grain yield at 100% RDN through vermicompost (3534.67 kg ha^{-1}) was found at par with application of 75% RDN through vermicompost (3524.44 kg ha^{-1}). A perusal of data revealed that significant changes in grain yield with regard to ghanjeevamrit application was recorded over control, wherein ghanjeevamrit @ 750 kg ha^{-1} recorded the highest grain yield (3454 kg ha^{-1}). However, ghanjeevamrit @ 750 kg ha^{-1} resulted significantly higher grain yield by 17.12, 10.81 and 9.00 per cent over control, ghanjeevamrit @ 250 kg ha^{-1} and ghanjeevamrit @ 500 kg ha^{-1} treatments, respectively. The beneficial effects of vermicompost on these yield parameters could be attributed to its ability to supply essential nutrients and enhance the solubility of native soil nutrients. Additionally, improved nutrient transformation and efficient metabolite partitioning towards developing plant parts may have contributed to these improvements. the present findings are supported by similar studies conducted by Chaudhari *et al.* (2013), Tyagi and Upadhyay (2013), Ramawtar *et al.* (2013), Kumar *et al.* (2016) and Sharma *et al.* (2018).

4.1.3 Productivity

Table 3 show the biological yield of maize crop was significantly influenced by different ghanjeevamrit levels. Ghanjeevamrit @ 750 kg ha^{-1} recorded significantly higher biological yield (9639 kg ha^{-1}) over previous treatments and the magnitude of increase in biological yield due to this treatment over control and ghanjeevamrit @ 250 kg ha^{-1} was 27.46 and 9.29 per cent, respectively. However, ghanjeevamrit @ 750 kg ha^{-1} was at par with ghanjeevamrit @ 500 kg ha^{-1} with respect to biological yield of maize. Maize responded significantly to increasing levels of vermicompost for applying RDN upto 100%. Application of 100 % RDN through vermicompost recorded maximum biological yield (10198 kg ha^{-1}) which also increased the biological yield by 47.73, and 17.16 per cent over control and application of 50% and through vermicompost, respectively. The increased biomass accumulation in stems, leaves and other plant parts directly contributed to higher stover yield. Consequently, the combined increase in grain and stover yields led to a significant improvement in the biological yield of maize. The biological yield represents the total above-ground biomass and the enhancement in this parameter suggests that Ghanjeevamrit effectively supports both vegetative and reproductive growth. This indicates an improved source-sink relationship in maize, where the efficient photosynthetic machinery and nutrient availability supported the growth of both economic (grain) and non-economic (stover) parts of the plant.These findings are consistent with earlier studies by Anusha *et al.* (2018), Nasratullah (2020) and Tiwari *et al.* (2022) which reported that organic formulations like ghanjeevamrit significantly enhance overall crop productivity by improving soil fertility, microbial activity and nutrient cycling.

Table 2: Effect of vermicompost and ghanjeevamrit on plant height of maize

Treatments	**Plant height (cm)**		
Vermicompost	**30 DAS**	**60 DAS**	**Harvest**
V_0	58.04	96.22	200.76
V_1	59.85	113.25	219.30
V_2	59.71	111.57	218.02
V_3	59.51	106.94	214.46
SEm±	0.75	1.92	3.68
C.D. at 0.05	**NS**	**5.54**	**10.63**

Ghanjeevamrit			
G_0	58.01	95.67	203.44
G_1	59.46	108.87	214.69
G_2	59.51	110.47	215.97
G_3	60.13	112.97	218.44
SEm±	0.75	1.92	3.68
C.D. at 0.05	**NS**	**5.54**	**10.63**

Table 3: Effect of vermicompost and ghanjeevamrit on yield and productivity

Treatments	**Yield (kg ha^{-1})**			
Vermicompost	**Grain yield (kg ha^{-1})**	**Stover yield (kg ha^{-1})**	**Biological yield (kg ha^{-1})**	**Harvest index (%)**
V_0	2333	4563	6896	34.18
V_1	3534	6664	10198	34.83
V_2	3524	6196	9720	36.55
V_3	3299	5383	8683	38.63
SEm±	55.08	160.46	170.188	0.833
C.D. at 0.05	**159.08**	**463.45**	**491.539**	**2.405**
Ghanjeevamrit				
G_0	2949	4615	7565	39.50
G_1	3117	5701	8819	35.20
G_2	3169	6306	9475	33.31
G_3	3454	6185	9639	36.18
SEm±	55.08	160.46	170.188	0.833
C.D. at 0.05	**159.08**	**463.45**	**491.539**	**2.405**

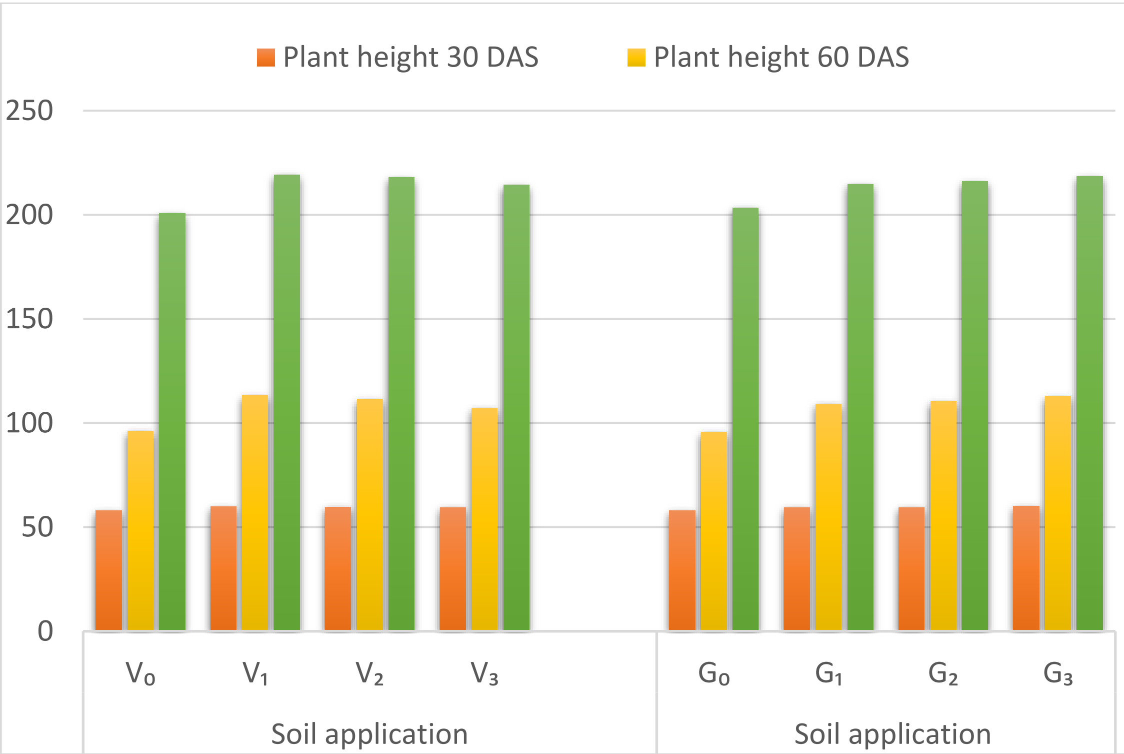

Fig. 2: Effect of vermicompost and ghanjeevamrit on plant height of maize

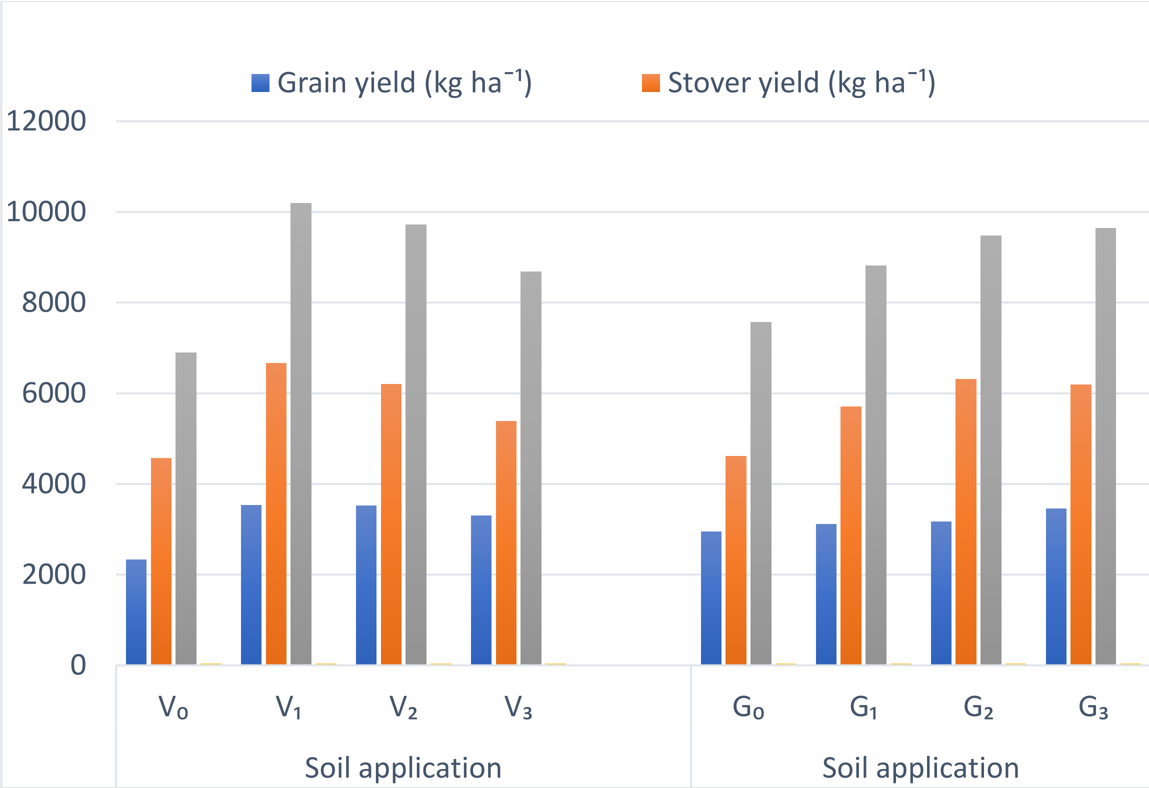

Fig.3: Effect of vermicompost and ghanjeevamrit on yield and productivity

IV. CONCLUSION

With the application of 100% RDN through vermicompost followed by 75% RDN through vermicompost yield determining features of maize, such as cob length, number of row cob^{-1}, number of grains row^{-1} and seed index, increased significantly.Application of 100% RDN through vermicompost recorded significantly higher grain (3534 kg ha^{-1}), stover (6664 kg ha^{-1}) and biological (10198 kg ha^{-1}) yields of maize over preceding levels, while found at par with 75% RDN through vermicompost application. Application of ghanjeevamrit @750 kg ha^{-1} significantly increased the growth attributes of maize *viz.* Number of cobs plant^{-1}, plant height (at 60 DAS and harvest) and dry matter accumulation g plant^{-1} at different plant growth stages over preceeding treatment, however it was significantly at par with ghanjeevamrit @500 kg ha^{-1} application. Yield determining characters of maize *viz.*, cob length, number of cobs plant^{-1}, number of grains row^{-1} and seed index increased significantly with the application of ghanjeevamrit @750 kg ha^{-1} but it remained at par with ghanjeevamrit @500 kg ha^{-1}. Application of ghanjeevamrit @750 kg ha^{-1} significantly increased the grain, straw and biological yields of maize crop (3454, 6185 and 9639 kg ha^{-1} respectively. Based on the results of the trial conducted during *kharif*, 2024 it can be concluded that the combined application 75% RDN through vermicompost and ghanjeevamrit @750 kg ha^{-1} was more effective in achieving significantly higher productivity and improved quality with optimum B-C ratio in maize crop under the prevailing agro-climatic conditions of zone IVa (Sub-Humid Southern Plain and Aravali Hills) of Rajasthan. However, these findings are simply indicative and require further investigation to reach a more consistent and definite conclusion.

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