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PERFORMANCE OF ORGANIC MANURES AND GROWTH REGULATORS ON GROWTH AND YIELD OF PEARL MILLET (*PENNISETUM GLAUCUM* L.)

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Abstract – A field experiment was conducted at SMOF (SHUATS Model Organic Farm), Department of Agronomy, SHUATS, Allahabad, (U.P.) during *Kharif*-2020. The soil of experimental site was sandy loam in texture, nearly neutral in soil reaction (pH 7.1), EC (0.41 ds/m), available N (225 kg/ha), available P (19.50 kg/ha) and available K (92 kg/ha). The experiment was laid out in randomized block design and having ten treatment consisted of Organic manures, *viz.* Farm Yard Manure (75% N), Farm Yard Manure (100% N), Vermicompost (75% N), Vermicompost (100% N) and growth regulators viz., Sea weed extract (625 ml/ha/spray), Humic acid (2.5 l/ha/spray). The experiment was laid out in Randomized Block Design which are replicated thrice and effect was observed on Manipuri variety of Bajra. The result have shown significantly higher effect of plant height (193.61 cm), Total Dry weight (110.45 g), Number of Effective tillers (3.27), Earhead length (34.23 cm), Testweight (11.11 g), Grain yield (4.86 t/ha) and Stover yield (7.94 t/ha) and were recorded significantly higher in T_8 (Vermicompost (100% N) + Sea weed extract).

INTRODUCTION

Among the coarse cereals grown, pearl millet occupies pivotal position in arid and semi-arid zones of India. Being a drought resistant crop its cultivation is mostly confined to the region receiving inadequate rainfall and also having inadequate irrigation facilities. It belongs to the family Poaceae. Major pearl millet production states in India are: Rajasthan, Maharashtra, Haryana, Uttar Pradesh and Gujarat. Bajracan also use as valuable animal fodder. India is the largest producer of pearl millet, the crop occupied an area of 14.72 million hectares, annual production of 16.14 million tones with an average productivity of 1311 kg/ha. In India major producing state are Rajasthan (46%), Maharashtra (19%), Gujarat (11%), Uttar Pradesh (8%)and Haryana (6%). (*Source:* Department of Food and Public Distribution 2017-18).

Organic manure acts as a nutrient reservoir mainly for nitrogen, phosphorus and potassium and also to other micronutrients. Apart from nutritional role, FYM increase the adsorptive power of soil for cations and anions particularly phosphates and nitrates. These adsorbed ions are released slowly for the benefit of not only to the current crop but also to succeeding crops. Farmyard manure, not only provide nutrition to the plant but also protects the physical properties of soil in terms of improvement in water holding capacity, aeration and permeability, soil and rooting depth, and decrease soil crusting, bulk density, runoff and erosion. It also increases biological and earthworm activity in soil and population of pathogens is reduced.

Vermicompost is an eco-friendly and an effective way to recycle agriculture and kitchen waste. It can also be called biological manure and its application not only adds plant nutrients and growth regulator and also increases soil water retention, nutrient content and organic carbon content of the soil. It is a primary source of macro and micro nutrients in chelated form and fulfills the balanced nutrient requirement of crops for longer period. Vermicompost also helps in reducing C:N ratio and in increasing humus content of the soil and provides a wide range of nutrients in readily available form

to plants, such as nitrate, soluble phosphorus, exchangeable potassium, calcium, magnesium (Talashilkar *et al.,* 1999).

Humic acid (HA) is a principle component of humic substances, which is the major organic constituent of soil (humus), peat and coal. Humic substances are formed by the microbial degradation of dead plant and animal debris. Humic acid can be used as a cheap organic fertilizer source to improve a plant growth and yield. Humic acid is known as black gold of agriculture. In plants, humic acids enhance enzyme activity, metabolic activity and also act as plant growth stimulant and hence it is considered as "plant food". Application of humic acids stimulate plant growth and consequently on yield by acting on various mechanisms such as cell respiration, photosynthesis, protein synthesis, water and nutrient uptake, enzyme activities (Cohncheri *et al.,* 1994; Nardi *et al.,* 2000 and Chen *et al.,* 2004).

Seaweed extract is a new generation of natural organic fertilizers containing highly effective nutrition. The use of seaweed products are well known to improve seeds germination, seedlings development and increase plant tolerance to environmental stresses (Zhang and Ervin, 2004, 2007), and enhance plant growth and yield (Hong *et al.,* 2008; Khan *et al.,* 2009; Craigie. 2011). Unlike chemical fertilizers, extracts derived from seaweeds are biodegradable, non-toxic, nonpolluting and non-hazardous to humans, animals and birds Jensen, (1993) and Noda, (1990) observed the seaweed is rich in mineral elements *viz.,* calcium, magnesium, potassium, chlorine, sulphur, phosphorous, iodine, zinc, copper. Liquid fertilizers derived from natural sources like seaweeds are found to be viable alternatives to fertilizing input for agricultural crops due to its high level of organic matter, micro and macro elements, fatty acids, also rich in growth regulators.

MATERIAL AND METHODS

The experiment was conducted during the *Kharif* season 2020, at the SMOF (SHUATS Model Organic Farm), Department of Agronomy, Naini Agricultural Institute, Sam Higginbottom University of Agriculture, Technology and Sciences (SHUATS), Prayagraj (U.P.) which is located at 25° 39′ 42′′N latitude, 81°67′ 56" E longitude and 98 m altitude above the mean sea level (MSL). The experiment was laid out in Randomized block design comprised of ten treatments which was replicated thrice. The treatment comprised of Organic manures, *viz.* Farm Yard Manure (75% N), Farm Yard Manure (100% N), Vermicompost (75% N), Vermicompost (100% N) and growth regulators viz., Sea weed extract (625 ml/ha/spray), Humic acid (2.5 l/ha/spray) through foliar application and possible treatment combinations were T_1 (FYM (100% N), T_2Vermicompost (100% N)), T_3 (FYM (75% N) + Sea weed extract), T_4 (FYM (100% N) + Sea weed extract), T_5 (FYM (75% N) + Humic acid), T_6 (FYM (100% N) + Humicacid), T_7 Vermicompost (75% N) + Sea weed extract), T_8 Vermicompost (100% N) + Sea weed extract), T_9 Vermicompost (75% N) + Humic acid), T_{10}Vermicompost (100% N) + Humic acid). During the growing season, mean weekly maximum and minimum temperature, relative humidity and rainfall were 35.9 °C, 26.7 °C, 84.9%, 49.4% and 76.71 mm, respectively. Pearl millet was sown at a spacing of 30 x 15 cm^2. Organic manures were applied as basal according to treatment wise in each plot. Growth regulators were sprayed at different growth stages like plant establishment, pre flowering and post flowering stages. Observations on growth parameters, yield attributes and yield of pearl millet was recorded and their significance was tested by the variance ratio at 5% level.

Chemical analysis of soil

Collected soil samples were analyzed for organic carbon by Walkley and Black Method (Jackson, 1967), Available nitrogen was estimated by alkaline permanganate method (Subbiah and Asija, 1956), Available phosphorus by Olsen method (Olsen *et al.,* 1954), available potassium was determined by using leaching outlined by Jackson (1967), available pH was determined by Glass electrode pH meter (Jackson, 1967) and Electrical conductivity (EC) was determined by Method No. 4 USDA HandBook (Richards, 1954).

Statistical analysis

The statistical methods given by Panse and Sukhatme (1961) were used for analysis and interpretation of experimental results. In order to evaluate comparative performance of various treatment the data were analyzed by the technique of analysis of variance given by Fischer (1950).

RESULTS AND DISCUSSION

Growth parameter

Growth parameter of pearl millet viz. Plant height

(cm.), Dry weight (gm.), CGR (g/m^2/day) and RGR (g/g/day) varied with different treatment are presented in Table 1. The treatment T8 Vermicompost (100% N) + Sea weed extract) resulted significantly higher plant height (193.61 cm) and Total Dry weight (110.45 g) where as CGR and RGR were found non-significant. These results showed that increase in growth parameters with the application of Vermicompost 100% N along with Sea weed extract could probably be due to improvement in the physio-chemical properties of soil, increase in enzymatic activity, increase in microbial population and activity and easy availability of macro- and micro-nutrients have helped in higher uptake of nutrients which accelerated the growth of new tissues and development of new shoots that have ultimately increased the plant height and dry matter accumulation by application of vermicompost. Seaweed extract contained components such as macro- and micro element nutrients, amino acids, vitamins, cytokinins and auxins like growth substances in which affect cellular metabolism in treated plants leading to enhanced growth. Similar results were also observed with the finding of Mascolo *et al.,* 1999. Zhang and Schmidt, (1997).

Yield attributes and Yield

Yield attributes and yield of pearl millet viz. Number of Effective tillers (No.), Ear head length (cm), Test weight (g), Grain yield (t/ha), Stover yield (t/ha) and Harvest index (%) varied with different treatment are presented in Table 2. The treatment T (Vermicompost (100% N) + Sea weed extract)

Table 1. Effect of Organic manure and Growth regulator on Growth parameters of Pearl Millet

Treatments	Growth Parameters			
	Plant Height (cm.)	Dry Weight (gm.)	CGR (g/m^2/day) 75 DAS-At harvest	RGR (g/g/day) 75 DAS-At harvest
FYM (100% N)	138.41	89.66	14.1	0.0075
Vermicompost (100% N)	142.71	93.13	14.48	0.0074
FYM (75% N) + Sea weed extract	156.11	94.49	13.01	0.0065
FYM (100% N) + Sea weed extract	172.61	100.27	16.82	0.0079
FYM (75% N) + Humic acid	148.31	94.81	14.09	0.007
FYM (100% N) + Humic acid	162.14	96.56	12.08	0.0059
Vermicompost (75% N) + Sea weed extract	165.97	99.06	13.87	0.0066
Vermicompost (100% N) + Sea weed extract	193.61	110.45	13.65	0.0058
Vermicompost (75% N) + Humic acid	167.03	99.14	16.65	0.008
Vermicompost (100% N) + Humic acid	182.01	104.22	14.76	0.0067
SEm (±)	7.77	1.23	1.62	0.0007
CD (P=0.05)	23.08	3.66	-	-

Table 2. Effect of Organic manure and Growth regulator on Yield and Yield Attributes of Pearl Millet

Treatments	Yield and Yield Attributes					
	Ear Head Length (cm.)	Number of Effective Tillers (No.)	Test Weight (g)	Grain Yield (t/ha)	Stover Yield (t/ha)	Harvest Index (%)
FYM (100% N)	22.29	1.73	8.58	3.14	5.41	36.60
Vermicompost (100% N)	23.46	1.80	8.91	3.50	5.87	37.37
FYM (75% N) + Sea weed extract	25.69	2.07	9.92	3.48	5.94	36.94
FYM (100% N) + Sea weed extract	28.09	2.53	10.49	3.89	6.74	36.59
FYM (75% N) + Humic acid	24.69	2.00	9.22	3.61	6.32	36.37
FYM (100% N) +Humic acid	27.33	2.33	10.11	3.83	6.58	36.77
Vermicompost (75% N) + Sea weed extract	30.50	2.73	10.66	3.56	6.31	36.13
Vermicompost (100% N) + Sea weed extract	34.23	3.27	11.11	4.86	7.94	37.95
Vermicompost (75% N) + Humic acid	30.30	2.53	10.55	3.95	6.88	36.46
Vermicompost (100% N) + Humic acid	32.39	3.00	10.86	4.80	7.88	37.87
SEm (±)	0.44	0.05	0.15	0.07	0.06	0.38
CD (P=0.05)	1.3	0.16	0.45	0.20	0.18	-

resulted significantly higher Number of Effective tillers (3.27), Ear head length (34.23 cm), Test weight (11.11 gm) Grain yield (4.86 t/ha), Stover yield (7.94 t/ha) where as harvest index was found non-significant. The probable reason for significant increase in yield attributes would be the favorable effect of vermicompost in adding organic matter and improving the availability of soil nutrient, which contributed to stimulate dense root and shoot development and resulted in significant positive influence on yield attributes. The findings on yield attributes are in accordance with Ranwa and Singh (1999). Seaweed extract is a biostimulant, which provide micro, macro nutrients and significant amounts of cytokinins, auxins and betaines, ultimately increasing the chlorophyll production by boosting the photosynthetic process, thereby stimulating vegetative growth. Thus, an overall plant performance would be enhanced accordingly and eventually reflecting through an escalated productivity. These findings are in agreement with Jeannin *et al.,* 1991.

CONCLUSION

It can be concluded that for obtaining higher yield components with better quality of pearl millet crop has higher with application of Vermicompost 100% N along with Sea weed extract was found more productive. This may be due to better soil quality, availability of micro and macro nutrient, better photosynthesis, better WHC and good root and shoot proliferation which was a direct or indirect effect of vermicompost along with sea weed extract.

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