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Influence of organic manures and growth regulators on yield and economics of pearl millet (*Pennisetum glaucum* L.) under Eastern UP condition

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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 lit/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 shown significantly higher effect on Number of Effective tillers(3.27), Earhead length (34.23 cm),Test weight (11.11 gm.), Grain yield (4.86 t/ha) and Stover yield (7.94 t/ha) were recorded significantly higher in T_8Vermicompost (100% N) + Sea weed extract. Maximum Gross return (INR 146597.4/ha), Net return (INR 103987.44/ha) and B:C ratio (1.50) were recorded in application of Vermicompost (100% N) + Sea weed extract.

Keywords: pearl millet, organic manures, growth regulators, yield

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 confines 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. Bajra can 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).

FYM not only supplies a variety of plant nutrients but also improves the physico-chemical and biological properties of soil. Low nitrogen losses due to slow release of nutrients from FYM are an added advantage. Vermicompost helps in reducing C:N ratio and in increasing humus content of the soil and provides a wide range of nutrients in the readily available form to plants such as nitrate, soluble phosphorus, exchangeable potassium, calcium, magnesium. The application of organic manure like FYM and Vermicompost have been reported to decrease the bulk density, improved porosity and maximum water holding capacity of soil. Organic foliar nutrition makes plant more efficient in taking nutrients through their stomata in their leaves than root uptake and is safe to crop, natural resources, land and wild life. Seaweed may be a new generation of natural organic fertilizers containing highly effective nutrients and promotes faster germination of seeds and better yield. Natural sort of manures using seaweeds not only supply major nutrients but also add trace elements and metabolites that mimic growth regulators. The increment in growth parameters and yield may be due to that humic acid are extremely important component because they constitute a stable fraction of carbon, thus regulating carbon cycle and release of nutrients, including nitrogen, phosphorus and sulphur with decrease the need for inorganic fertilizers for plant growth. Application of humic acid as foliar sprays can improve the growth of plant foliage, roots and shoots. By increasing plant growth processes within leaves and increase in carbohydrate content of leaves and stem occurs.

These carbohydrates are then transported down to the stem in to the roots where they are in part released from root to provide nutrients for various soil micro-organisms on the rhizoplane and in the rhizosphere (Ghamry, 2009) [4].

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 25o 39' 42''N latitude, 81o67'56" 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 lit/ha/spray) through foliar application and possible treatment combinations were T_1 (FYM (100% N)), T_2 (Vermicompost (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) +Humic acid), 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 35.9ºC, 26.7ºC, 84.9%, 49.4% and 76.71 mm, respectively. Pearl millet was sown at a spacing of 30 x 15 cm^2. The field was already having enough moisture due to rain so, no irrigation were given before sowing. 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) [5], Available nitrogen was estimated by alkaline permanganate method (Subbaiah and Asija, 1956) [14], Available phosphorus by Olsen method (Olsen *et al.*, 1954) [9], available potassium was determined by using leaching outlined by Jackson (1967) [5], available Ph was determined by Glass electrode Ph meter (Jackson, 1967) [5] and Electrical conductivity (EC) was determined by Method No. 4 USDA Hand Book (Richards,1954) [12].

Statistical analysis

The statistical methods given by Panse and Sukhatme (1961) [10] were used for analysis and interpretation of experimental results. In order to evaluate comparative performance of various treatment the data was analyzed by the technique of analysis of variance given by Fischer (1950) [3].

Result and Discussion

Yield

Yield attributes and yield of pearl millet *viz*. Grain yield (t/ha) and Stover yield (t/ha) varied with different treatment presented in Table 1. The treatment T8 (Vermicompost (100% N) + Sea weed extract) resulted significantly higher Grain yield (4.86 t/ha) and Stover yield (7.94 t/ha). The increase in grain and straw yields might be due to adequate quantities and balanced proportions of plant nutrients supplied and in creating congenial atmosphere in the root rhizosphere resulting in favorable increase in yield attributing characters which ultimately led towards a rise in economic yield. Improved physic chemical properties of the soil through the application of Vermicompost and Sea weed extract might be the other possible reason for higher productivity which was reported by Khandal and Nagendra (2000) [6].

Economics

An examination of the data in Table 2. Showed that highest gross return (INR 146597.4/ha), highest net return (INR 103987.44/ha) and highest B:C ratio (1.50) was recorded highest in treatment with application of Vermicompost (100% N) along with Sea weed extract. The most economic returns of a crop could be achieved either by increasing in production through judicious management practices or improving the quality of the product to get the premium price in the market. Application of Sea weed extract enhanced nutrient uptake in Pearl millet due to presence of some macro and micro elements and plant growth regulators, especially cytokinins, IAA, Gibberellic acid in Sea weed extract. Highest Gross and Net returns might be due to the direct influence of higher grain and stover yields. Thus there is a great increase in monetary value of grain and Stover obtained under it. This is in conformity with findings reported by Mahakulkar *et al.* (1998) [8], Kushwaha and Singh (2007) [7], Angadi *et al.* (2010) [1], Sethi and Adhikary (2008) [13]

Table 1: Effect of Organic manures and Growth regulators on Growth and Yield of Pearl millet

Treatments	Yield Attributes			Yield (t/ha)	
	No. of effective tillers	Earhead Length (cm.)	Test Weight(g)	Grain Yield	Stover Yield
FYM (100% N)	22.29	1.73	8.58	3.14	5.41
Vermicompost (100% N)	23.46	1.8	8.91	3.50	5.87
FYM (75% N) + Sea weed extract	25.69	2.07	9.92	3.48	5.94
FYM (100% N) + Sea weed extract	28.09	2.53	10.49	3.89	6.74
FYM (75% N) + Humic acid	24.69	2	9.22	3.61	6.32
FYM (100% N) +Humic acid	27.33	2.33	10.11	3.83	6.58
Vermicompost (75% N) + Sea weed extract	30.5	2.73	10.66	3.56	6.31
Vermicompost (100% N) + Sea weed extract	34.23	3.27	11.11	4.86	7.94
Vermicompost (75% N) + Humic acid	30.3	2.53	10.55	3.95	6.88
Vermicompost (100% N) + Humic acid	32.39	3	10.86	4.80	7.88
SEM (±)	0.44	0.05	0.15	0.07	0.06
CD (P=0.05)	1.3	0.16	0.45	0.20	0.18

Table 2: Effect of Organic manures and Growth regulators on Economics of Pearl millet

Treatments	Economics			
	Cost of cultivation (INR/ha)	Gross return (INR/ha)	Net return (INR/ha)	B:C ratio
FYM (100% N)	57876.00	104549.00	46673.00	0.81
Vermicompost (100% N)	57876.00	106452.89	48576.89	0.84
FYM (75% N) + Sea weed extract	46626.00	106298.41	59672.41	1.28
FYM (100% N) + Sea weed extract	58626.00	119221.02	60595.02	1.03
FYM (75% N) + Humic acid	50376.00	111091.81	60715.81	1.21
FYM (100% N) +Humic acid	62376.00	117127.11	54751.11	0.88
Vermicompost (75% N) + Sea weed extract	46626.00	109928.89	63302.89	1.36
Vermicompost (100% N) + Sea weed extract	58626.00	146597.44	103987.44	1.50
Vermicompost (75% N) + Humic acid	50376.00	121211.20	70835.20	1.41
Vermicompost (100% N) + Humic acid	62376.00	145062.54	82686.54	1.33

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 (Water Holding Capacity) and good root and shoot proliferation which was a direct or indirect effect of vermicompost along with sea weed extract.

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