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ORIGINAL ARTICLE **OPEN ACCESS**

Effect of Integrated Nutrient Management on growth and yield of pearlmillet (*Pennisetum glaucum* L.) under guava based agri-horti system in rainfed condition of Vindhyan region

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ABSTRACT
A field experiment was conducted during kharif season of 2012 at Rajiv Gandhi South Campus (Banaras Hindu University), Barkaccha, Mirzapur to study the effect of integrated nutrient management [100 % farmyard manure (T_1), 100 % poultry manure (T_2), 100 % vermi-compost (T_3), 100 % RDF (T_4), 50 % RDF + 50 % FYM (T_5), 50 % RDF + 50 % Poultry Manure (T_6), 50 % RDF + 50% Vermicompost (T_7) and control (T_8)]on growth and yield of pearlmillet. It is seems to that, integrated nutrient management have better response and recorded higher growth, yield attribute and yield of pearl millet over control treatment under guava based agri-horti system. Significantly highest plant height (205.67 cm), number of tillers plant^{-1} (3.80), dry matter accumulation plant^{-1} (159.77 g) were recorded under 50 % RDF + 50 % Poultry Manure (T_6). This might be due to better nutrient supply. Yield attributes such as diameter of the ear (6.99 cm), ear perimeter (10.92 cm), length of ear (24.63 cm), 1000-seed weight (9.43 g) and yield [Grain yield (22.40 q ha^{-1}), Stover yield (56.71 q ha^{-1}) were recorded highest under 50 % RDF + 50 % Poultry Manure (T_6) while, harvest index (31.48 %) was maximum in control (T_8) and minimum (26.60%) in 100% vermicompost (T_3). This might be due to release of essential nutrients by poultry manure and increase in availability of nutrients and moisture. Net return (Rs 50340.17) and B:C ratio (2.99) were higher in 50 % RDF + 50 % Poultry Manure (T_6). Minimum net return was recorded with control (Rs 40756.67) and B:C ratio (1.63) was lower in 100 % vermi-compost under guava agri-hortisystem.
Key words : *Economics, Growth, Organic manure, Pearl millet, Yield.*

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INTRODUCTION

The greatest challenge before the country during 21st century is to produce enough food, fodder, fibre, fuel and other raw materials for continuously increasing huge human and animal population. Pearl millet is the most widely cultivated cereal in India after rice and wheat. It is grown on more than 9.3 m ha with current grain production of 9.5 m tonnes and productivity of 1044 kg ha^{-1}. Pearl millet can easily provide economical grain yield (600–700 kg ha^{-1}) under marginal and low management conditions with the additional ability to produce a grain yield of 4-5 t ha^{-1} when hybrids of 80-85 days maturity are grown in summer season crop under irrigated and high fertility conditions. (AICPMIP Workshop, Hisar 12-14 March 2011). Pearl millet grain contains 27% to 32% more protein, higher concentration of essential amino acids, twice the extract (fat) and higher gross energy than maize [4]. The use of fertilizer has witnessed a declining trend in recent years. Such a situation, besides, limiting crop yield and mining of crop nutrients, has also led to the degradation of already fragile soils [1-3]. The introduction of conventional inorganic fertilizer has drastically reduced the use of organic manures. Organic manures supply nutrient to the plants, improve physical condition of soil, by organic manures, although in minute amounts. Poultry manure was reported to contain plants nutrients than all other organic manures [1]. Nitrogen (N) is typically the nutrient of most concern because it has a strong influence on cereal crop yields [5]. The use of inorganic fertilizers for the past 50 years without any addition of organic manures resulted in the large scale deficiency of micro nutrients which play an important role in enhancing the quality and quantity of the agriculture produce. Good quality farmyard manure (FYM) is perhaps the most valuable organic manure. Vermicompost has all the characteristic to use it as a most valuable organic manure [6]. Poultry manure is a good source of nutrients for crops. Shankar *et al.* [7] reported that a

judicious use of organic and inorganic combination of fertilizers will maintain long-term soil fertility and sustained higher levels of productivity. Agri-horti system is one of the important components of agroforestry in which the integration of fruit crops in croplands is practiced. Agri-horti system is an improved indigenous cropping system in India for full utilization of the growing season and markedly increasing the return per unit area per unit time.

MATERIALS AND METHODS

The studies pertaining to the effect of integrated nutrient management on growth and yield of pearlmillet (*Pennisetum glaucum* L.) under guava based agri-horti system in rainfed condition of Vindhyan region was conducted at Research Farm of Rajiv Gandhi South Campus (Banaras Hindu University), Barkachha, Mirzapur Uttar Pradesh, India during kharif (rainy) season of 2012. The experimental site was located 25ºNand 85ºE at an elevation of 365 m above mean sea level. The predominant soil in the experimental field was sandy clay loam classified as Inceptisol (Typic Ustochrept) in texture, slightly acidic in reaction (pH 5.6), low in organic carbon content (0.27 kg/ha) and medium in available P and K contents. During the crop season total rainfall received was 1080.00 mm, received during Standard Meteorological Weeks (SMW). The mean maximum temperature during the crop growth season ranged from 28.90-32.50ºC whereas, mean minimum temperate ranged between 23.80-29.00ºC. The maximum and minimum relative humidity varied between 84.00-90.00 per cent and 55.00-85.00 per cent, respectively. The experiment was laid out in a Randomized block design, where agri-horticultural system i.e. Guava (*Psidium guajava*) was assigned. There were 8 treatments combination comprising one control treatment i.e without any application of nutrients, 100 % farmyard manure (T_1), 100 % poultry manure (T_2), 100 % vermi-compost (T_3), 100 % RDF (T_4), 50 % RDF + 50 % FYM (T_5), 50 % RDF + 50 % Poultry Manure (T_6), 50 % RDF + 50% Vermicompost (T_7) and each treatment was replicated thrice. In alleys of guava agri-horti system, certified seed of pearl millet (Kaveri Super Boss) was sown on August 17, 2011. Plot size of guava agri-horti system where, gross plot size 5.0 m x 3.0 m and net plot size 3.2 m x 2.0 m, respectively. High seed rate (5 kg ha^{-1}) of pearl millet was sown at 5 cm depth in open furrows made with a manual single row drill at a row spacing of 45 cm and plant to plant spacing 15 cm, and immediately covered with soil. Before sowing, the fertilizer and manures application was done according to the treatments recommended dose 20 kg N, 60 kg P_2O_5 and 40 kg K_2O in the form of urea, diammonium phosphate (DAP), and muriate of potash (MOP), FYM, poultry manure and vermi-compost respectively. Whole amount of fertilizers were placed below the seed in respective rows at the time of sowing. Crop was harvested on November 15, 2012.

Pearl millet growth parameters such as plant height (cm), number of tillers $plant^{-1}$ and dry matter accumulation $plant^{-1}$ were recorded. Yield attributes such as diameter of the ear (cm), ear perimeter (cm), length of ear (cm), 1000-grain weight (g) and yield [Grain yield, Stover yield (q ha^{-1}), Harvest index(%)] were estimated at harvesting and economics like net return and B:C ratio parameters were recorded for pearl millet. Data were analyzed statistically as per Gomez and Gomez [12]. The treatment differences were tested by 'F' test of significance and Critical differences were worked out at 5 per cent level of probability where 'F' test was significant.

RESULTS AND DISCUSSION

Growth parameters

The plant height(cm), dry matter (g $plant^{-1}$) and number of tillers $plant^{-1}$ varied significantly at 30, 60 DAS and at harvest among the different integrated nutrient management. Application of 50% RDF + 50% poultry manure (T6) recorded maximum plant height, dry matter $plant^{-1}$ and number of tillers $plant^{-1}$ significantly over rest of the treatments (Table.1). The lowest value of the same was recorded with control (T_8). The increase in dry matter was found due to increase in plant height, number of tillers per plant. This might be due to application of poultry manure and fertilizer thereby increase in soil micro-organism and also due to better moisture and nutrient availability. Similar findings were reported by Singh *et al*. [9].

Yield Parameters

The diameter, perimeter, length of ear and test weight of pearl millet depends on the accumulation of photo-assimilates and partitioning in different plant parts. Diameter, perimeter, length of ear, test weight, grain yield, straw yield and harvest index were influenced by different integrated nutrient management practices. The maximum diameter, perimeter, length of ear and test weight were recorded with the application of 50% RDF + 50% poultry manure (T6) and minimum values recorded with control (T_8) (Table 2). Grain yield and straw yield were higher with 50% RDF + 50% poultry manure (T6) and lowest with control (T_8). While, harvest index was maximum with control (T_8) and lowest with 100% vermicompost (T_3) (Table 3). This might be due to the increase in the yield components might be

connected with the release of essential nutrient elements by the poultry litter and increase of nutrient availability. The result were in agreement with the findings of Udom *et. al.,* [11] and Silva, *et al.,* [8].

Economics

Application of 50% RDF + 50% poultry manure (T6) gave maximum (`50340.17) net returns and higher benefit cost ratio (2.99) whereas minimum (40756.67) net return was in control. The minimum (1.63) benefit cost ratio obtained in 100 % vermi-compost ($T_{3)}$ under guava based agri-hortisystem, due to low variable cost and maximum net return (Table 3). The results are in close conformity with the findings of Rajput [10].

Quality parameters

Data related to quality (pH, Electrical conductivity and organic carbon) and nutrients availability in soil under different treatments had showed no any significant differences (Table 4 and 5).

Growth parameters of Guava

Statistically non significant differences observed in the mentioned growth parameters of guava might be due to shorter growth phase of pearl millet which could not realized the noticeable changes in the limited observation period.

Table 1: Effect of integrated nutrient management on growth attributes

Treatment	Plant height (cm)	Number of tillers plant^{-1}	Dry matter accumulation plant^{-1}(g)
100 % farmyard manure (T_1)	179.20	2.41	103.09
100 % poultry manure (T_2)	188.37	2.97	125.57
100 % vermi-compost (T_3)	183.50	2.68	116.46
100 % RDF (T_4)	194.20	3.23	136.80
50 % RDF + 50 % FYM (T_5)	197.73	3.42	145.71
50 % RDF + 50 % Poultry Manure (T_6)	205.67	3.80	159.77
50 % RDF + 50% Vermicompost (T_7)	203.77	3.59	155.01
Control (T_8)	175.40	2.25	86.44
Sem±	0.53	0.04	1.48
CD (P = 0.05)	1.62	0.13	4.49

Table 2: Effect of integrated nutrient management on yield attributes

Treatment	Diameter of the ear (cm)	Ear perimeter (cm)	length of ear (cm)	1000-grain weight (g)
100 % farmyard manure (T_1)	5.76	9.17	15.36	7.07
100 % poultry manure (T_2)	6.11	9.83	17.31	7.83
100 % vermi-compost (T_3)	5.92	9.60	16.32	7.60
100 % RDF (T_4)	6.26	10.15	19.36	8.23
50 % RDF + 50 % FYM (T_5)	6.45	10.43	20.97	8.63
50 % RDF + 50 % Poultry Manure (T_6)	6.99	10.92	24.63	9.43
50 % RDF + 50% Vermicompost (T_7)	6.75	10.72	22.91	9.00
Control (T_8)	5.64	8.74	14.84	6.60
Sem±	0.03	0.06	0.30	0.15
CD (P = 0.05)	0.10	0.18	0.91	0.44

Table 3: Effect of integrated nutrient management on yield and economics of pearl millet.

Treatment	Grain yield(kg ha^{-1})	Stover yield (kg ha^{-1})	Harvest index (%)	Gross return (Rs./ha)	Net return (Rs./ha)	B:C ratio
100 % farmyard manure (T_1)	17.87	41.09	30.32	58742.50	41581.50	2.42
100 % poultry manure (T_2)	18.90	43.36	30.37	60342.50	41140.50	2.14
100 % vermi-compost (T_3)	17.98	49.62	26.60	60988.33	37790.33	1.63
100 % RDF (T_4)	19.96	53.67	27.11	63977.50	47812.50	2.96
50 % RDF + 50 % FYM (T_5)	20.43	55.55	26.89	64913.33	48357.33	2.92
50 % RDF + 50 % Poultry Manure (T_6)	22.40	56.71	28.31	67174.17	50340.17	2.99
50 % RDF + 50% Vermicompost (T_7)	21.26	56.33	27.40	65941.67	46379.67	2.37
Control (T_8)	15.77	34.37	31.48	54961.67	40756.67	2.87
Sem±	0.34	0.73	0.58	-	-	-
CD (P = 0.05)	1.03	2.21	1.74	-	-	-

Table 4: Effect of integrated nutrient management on nutrients availability in soil.

Treatment	Available Nitrogen (kg ha^{-1})	Available Phosphorus (kg ha^{-1})	Available Potassium (kg ha^{-1})
100 % farmyard manure (T_1)	152.67	14.07	143.10
100 % poultry manure (T_2)	152.78	12.83	136.16
100 % vermi-compost (T_3)	151.68	13.33	143.83
100 % RDF (T_4)	162.70	13.03	137.33
50 % RDF + 50 % FYM (T_5)	159.90	13.70	148.23
50 % RDF + 50 % Poultry Manure (T_6)	181.67	12.93	145.40
50 % RDF + 50% Vermicompost (T_7)	163.11	12.93	147.40
Control (T_8)	146.90	14.03	148.10
Sem±	8.97	0.41	4.83
CD (P = 0.05)	NS	NS	NS

Table 5: Effect of integrated nutrient management on quality of soil.

Treatment	pH	Electrical Conductivity (dSm-1)	Organic carbon (%)
100 % farmyard manure (T_1)	5.30	0.31	0.51
100 % poultry manure (T_2)	5.80	0.30	0.47
100 % vermi-compost (T_3)	5.67	0.32	0.46
100 % RDF (T_4)	5.00	0.28	0.57
50 % RDF + 50 % FYM (T_5)	5.26	0.26	0.43
50 % RDF + 50 % Poultry Manure (T_6)	5.33	0.31	0.44
50 % RDF + 50% Vermicompost (T_7)	5.20	0.26	0.41
Control (T_8)	5.30	0.42	0.32
Sem±	1.29	0.03	0.13
CD (P = 0.05)	NS	NS	NS

CONCLUSIONS

On the basis of the findings of the present investigation, it can be concluded that integrated nutrient management of 50% RDF + 50% poultry manure was found most suitable method among all the methods

of integrated nutrient management in guava based agri-horti system under rain fed condition. Since the experiment was conducted for one year only thus needs further investigation to conform the results.

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