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Research Article

Effect of Integrated Nutrient Management on Growth Parameters of Pearlmillet in Pearlmillet-Wheat Cropping System

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ABSTRACT

A field experiment was conducted during the two consecutive years 2015-16 and 2016-17 at Research Farm of Agronomy of CCS Haryana Agricultural University, Hisar (India). The experiment was laid out in randomized block design with three replications and consisting of twelve treatments. Plant height and dry matter accumulation of pearlmillet was recorded highest in treatment T_6, where 50 % RD-NP + 50 % N through FYM in pearlmillet and 100 % RD-NP in wheat supplied through fertilizers while minimum plant height and dry matter obtained in control during both years of the experiment. The use of inorganic fertilizers in combination with organic manures has been found more advantageous than either of them alone for sustainable agriculture on long term basis. Integrated nutrient management is followed for enhancing crop productivity of intensive cropping systems, nutrient availability, biological properties and soil carbon pools for long term.

Key words: *Cropping system, INM, NPK, Pearlmillet, Wheat*

INTRODUCTION

Pearlmillet [*Pennisetum glaucum* (L.)] and Wheat (*Triticum aestivum*) cropping systems is one of the most popular cropping system of arid and semi-arid areas of India. This cropping system is very exhaustive resulting in decline in fertility of soil. The continuous application of all plant required nutrients through chemical fertilizers has deleterious effect on soil health leads to unsustainable yields. Since, the nutrients turnover in soil-plant system is considerably high under intensive cropping system, so, neither the chemical fertilizers nor the organic sources of nutrients alone can achieve sustainability of the system. The balance use of N, P and K fertilizers in long term studies, higher yield levels could not be maintained for years because of emergence of secondary and micro-nutrient deficiency and deterioration in the soil physical conditions.

Application of organic manure in combination with inorganic fertilizers is known to have favorable effect on soil environment, microbial population and rectify marginal deficiency of secondary and micro-nutrients and enhance the fertilizer use efficiency of applied nutrients.

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It is being realized that system based research on nutrient application would be more advantageous for optimizing the use of different sources of plant nutrients. Therefore, the present study was carried out at Research Farm of Department of Agronomy, CCS Haryana Agricultural University, Hisar with the objective to study the effect of combination of organic and inorganic sources of nutrients on growth parameters of pearlmillet in pearlmillet-wheat cropping system.

MATERIAL AND METHODS

The experiment was carried out in randomized block design with twelve treatments and replicated thrice. The soil of the experimental site was sandy loam in texture, having pH 7.87, poor in available nitrogen, medium in phosphorus and rich in potassium. The treatments were: T_1 - Control (no fertilizer); T_2 - 50 per cent recommended NP to pearlmillet and wheat through fertilizers; T_3 - 50 per cent recommended NP to pearlmillet and 100 per cent recommended NP to wheat through fertilizers; T_4 - 75 per cent recommended NP to pearlmillet and wheat through fertilizers; T_5 - 100 per cent recommended NP to pearlmillet and wheat through fertilizers; T_6 - 50 per cent NP through fertilizers + 50 per cent N (farmyard manure) to pearlmillet and 100 per cent NP to wheat through fertilizers; T_7 - 75 per cent NP through fertilizers + 25 per cent N (farmyard manure) to pearlmillet and 75 per cent NP to wheat through fertilizers; T_8 - 50 per cent NP + 50 per cent N (wheat straw) to pearlmillet and 100 per cent NP to wheat through fertilizers; T_9 - 75 per cent NP + 25 per cent N (wheat straw) to pearlmillet and 75 per cent NP to wheat through fertilizers; T_{10} - 50 per cent NP + 50 per cent N (*Sesbania spp.)* to pearlmillet and 100 per cent NP to wheat through fertilizers; T_{11} - 75 per cent NP + 25 per cent N (*Sesbania spp.)* to pearlmillet and 75 per cent NP to wheat through fertilizers and T_{12}-farmers' practice.

The recommended levels of nitrogen and phosphorus were 125 and 62.5 kg ha^{-1} for pearlmillet and 150 and 60 kg ha^{-1} for wheat. The pearlmillet, variety HHB 223 was sown with 5 kg seed ha^{-1}, keeping row spacing of 45 cm. In wheat, variety WH 711 was sown with 120 kg seed ha^{-1} keeping row spacing of 20 cm. The nitrogen content in different organic materials was determined each year and the amount of these materials required for substituting a specified amount of nitrogen as per the treatment was calculated. Organic sources of nutrients *viz.*, FYM, wheat straw and green manure were incorporated in the soil 63, 58 and 31 days, respectively before sowing of pearlmillet crop in 2015 and during 2016 , the organic sources of nutrients viz., FYM, wheat straw and green manure were incorporated in soil 53, 47 and 29 days before sowing of pearlmillet. According to the package of practices of CCS Haryana Agricultural University, Hisar, recommended nitrogen (125 kg/ha and 150 kg/ha) and phosphorus (62.5 kg/ha and 60 kg/ha) were applied through urea and diammonium phosphate (DAP) in pearlmillet and wheat, respectively. Two post sowing irrigations were applied during 2015 but in 2016, only one post sowing irrigation was applied, because sufficient moisture was available due to rain. Recommended package of practices of HAU were followed in both the crops for other agronomic operations.

RESULTS AND DISCUSSION

Plant height

The data related to plant height (cm) in pearlmillet recorded at different stages of crop growth as influenced by integrated nutrient management are given in Table 1. The plant height continued to increase with the advancement of crop age. The maximum rate of increase in plant height was observed between 20 and 40 DAS, and then, it improved gradually up to harvest. The plant height at 20 DAS, 40 DAS, 60 DAS and at harvest, it was significantly influenced by different nutrient treatments. Height of the plants was recorded maximum in treatment T_6 (50 % RD-NP + 50 % N through FYM in pearlmillet and 100 % RD-NP in wheat) during both the years.

During first year the plant height ranged 27.28-30.56 cm at 20 DAS and 124.70-175.63 cm at 20 to 40 DAS of the crop. At maturity, the maximum plant height was recorded in treatment T_6 (216.66 cm) followed by T_5 (210.00 cm) and the minimum height was recorded in T_1 (150.63 cm). At maturity treatment T_5 was statistically at par with T_{10} and T_8 and significantly better over rest of the treatments.

Table 1: Periodical changes in plant height (cm) of pearlmillet as influenced by various nutrient treatments

Treatments	2015				2016			
	20 DAS	40 DAS	60 DAS	At harvest	20 DAS	40 DAS	60 DAS	At harvest
T_1	27.28	124.70	148.78	150.63	27.21	124.45	148.78	150.24
T_2	28.26	154.37	186.65	190.75	28.78	157.59	188.81	192.34
T_3	28.53	155.23	188.35	192.49	28.81	158.71	190.67	195.63
T_4	28.56	157.74	190.52	194.63	28.87	159.55	194.67	198.65
T_5	30.12	170.67	204.35	210.00	30.27	173.52	208.69	214.27
T_6	30.56	175.63	209.65	216.66	30.89	177.67	214.70	221.83
T_7	29.86	164.63	197.53	203.52	30.11	165.56	200.43	204.65
T_8	30.13	167.84	200.37	205.33	30.20	168.55	203.61	207.64
T_9	29.67	159.75	192.22	197.15	29.78	162.68	197.96	201.60
T_{10}	30.16	169.74	202.85	207.66	30.21	171.56	205.67	211.75
T_{11}	29.78	162.55	195.41	201.04	30.08	164.57	199.67	203.65
T_{12}	29.98	165.70	198.15	199.78	30.16	166.56	201.75	205.69
SEm±	0.51	0.87	1.01	1.96	0.54	1.04	1.09	1.63
CD at 5%	1.50	2.56	2.65	5.67	1.57	3.12	3.25	4.85

During second year of the study the plant height was recorded height within the range of 27.21-30.89 cm at 20 days after sowing and 124.45-177.67 cm from 20 to 40 DAS of the crop. At physiological maturity, the maximum plant height was observed in treatment T_6 (221.83 cm) followed by T_5 (214.27 cm) and significantly better over all other treatments while treatment T_5 was statistically at par with T_{10}. Among the inorganic treatments T_5 was significantly better over the T_2, T_3 and T_4. At maturity the minimum height was found in T_1 (150.24 cm). Supplying full dose of recommended nutrients through inorganic sources provide these in readily available form to the crop. This is in agreement with the findings of Jain and Poonia[2], Kundu *et al.*[3], and Dahiya *et al.*[1], who also reported higher response to inorganic sources than to organic sources.

Table 2: Effect of different nutrient treatments on periodical changes in dry matter accumulation (g/mrl) of pearlmillet

Treatments	2015				2016			
	20 DAS	40 DAS	60 DAS	At harvest	20 DAS	40 DAS	60 DAS	At harvest
T_1	8.56	37.68	136.41	150.67	8.12	36.78	134.45	147.56
T_2	11.23	56.34	177.41	200.67	12.27	57.23	179.45	202.67
T_3	11.89	58.45	181.78	206.98	12.91	59.46	183.42	208.45
T_4	12.03	60.78	184.78	210.78	13.05	61.34	186.53	212.56
T_5	13.64	71.35	203.41	241.00	14.67	73.56	206.71	244.67
T_6	14.56	73.67	208.01	248.00	15.45	76.42	212.56	252.41
T_7	12.78	66.56	194.56	225.17	13.89	68.34	197.34	228.61
T_8	13.12	68.28	198.41	232.02	14.47	70.45	201.25	235.67
T_9	12.48	63.25	189.69	218.30	13.48	65.34	192.78	221.45
T_{10}	13.45	69.78	201.61	237.22	14.56	71.36	204.67	240.57
T_{11}	12.56	64.78	191.78	221.39	13.76	66.51	194.73	224.34
T_{12}	13.01	67.45	196.71	228.32	14.12	69.53	199.45	231.38
SEm±	0.6	0.79	1.19	1.76	0.57	0.8	1.14	1.94
CD at 5%	1.81	2.35	3.54	5.25	1.71	2.41	3.41	5.78

Dry matter accumulation per meter row length

The data pertaining to dry matter accumulation per meter row length at various growth stages as influenced by different treatments are presented in Table 2. The perusal of data in the Table indicates that the dry matter accumulation per meter row length increased progressively with the advancement of crop age up to harvest of the crop. At harvest, highest dry matter accumulation was recorded in treatment T_6 (50 % RD-NP + 50 % N through FYM in pearlmillet and 100 % RD-NP in wheat) during both the years.

During the first year of experiment, the rate of increase in dry matter from 21 to 40 DAS was maximum (8.56 to 14.56 to 37.68 to 73.67 g/mrl), followed by 41 to 60 DAS period (37.68 to 73.67 and 136.41 to 208.01 g/mrl), however, the minimum improvement in dry matter was noticed from 61 DAS up to harvest. At harvest, treatment T_6 was significantly superior over all the treatments. Among inorganic fertilizer treatments maximum dry matter accumulation at maturity was recorded in T_5 and it was significantly better over T_2, T_3, and T_4. Treatment T_5 was at par with T_{10} while T_{10} was statistically at par with T_8 and significantly better over other treatments during first year. At harvest, treatment T_6 was closely followed by T_5 and significantly superior over the other treatments while T_5 was statistically at par with T_{10} during second year of the experiment. The ability of a plant to produce dry matter depends upon the size, efficiency and duration of photosynthetic apparatus. The total dry matter production in a plant often indicates its potentiality for yield but its mobilization towards the grain development is an important factor for realization in economic yield. The results are in conformity with those of El-Lattief.[4], FYM and mineral NPK fertilizers together improve the soil physical and chemical properties, or to a higher mineralization of FYM which it due to mineral NPK inputs. It increased the availability of plant macro and micronutrients which leads to high vegetative growth and more absorption of NPK. These results are in agreement with Bilal *et al*[5].

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