

EFFECT OF ORGANIC MANURES AND LEVELS OF INORGANIC FERTILIZERS WITH AND WITHOUT BANANA SAP ON YIELD, QUALITY AND ECONOMICS OF SUMMER PEARL MILLET (*Pennisetum glaucum* L.) UNDER SOUTH GUJARAT CONDITION

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Abstract: A field experiment was conducted at College Farm, N.M. College of Agriculture, Navsari Agricultural University (Gujarat) during summer season of 2015 to find out the effect of different organic manures and levels of inorganic fertilizers with and without banana sap on summer pearl millet (*Pennisetum glaucum* L.) under south Gujarat condition. The experiment comprising of twelve treatment combinations viz., three levels of inorganic fertilizers 50% RDN (Recommended dose of nitrogen) through chemical fertilizer, 75% RDN through chemical fertilizers and 100% RDN through chemical fertilizers) and two levels of organic manures (10 t FYM ha⁻¹ and 2 t Castor cake ha⁻¹) and two levels of foliar sprays of banana sap (without banana sap and with 1% foliar spray of banana sap) were evaluated in factorial randomized block design. Results revealed that higher grain and fodder yield, protein content as well as net returns of summer pearl millet can be secured by the application of 120 kg N (100% RDN) through chemical fertilizers and 2 t castor cake ha⁻¹ with two foliar sprays of 1% banana sap at tillering and ear head initiation stages under south Gujarat condition.

Keywords: Pearl millet, banana sap, organic manures, inorganic fertilizers, foliar spray.

INTRODUCTION

Millet is collective term referring to number of small-seeded annual grain crops belonging to family poaceae. Pearl millet (*Pennisetum glaucum* L.) is the fourth most important cereal crop in India. India is the largest producer of pearl millet in Asia both in terms of area (9.61 million ha) and production (10.37 million tonnes) with an average productivity of 1079 kg per hectare. Major pearl millet growing states in India are Rajasthan, Maharashtra and Gujarat^[13].

Fertilizer management is one of the important cost effective factors known to augment the crop production. But, inadequate or excess supply of any plant nutrient limits the crop production. Among the plant nutrients, nitrogen is the most important and expensive nutrient effect on the plant growth in cereal crops. Due to increasing demands for food supply by the

ever growing population, production systems using chemicals fertilizers were adopted. This has dramatic effect on the enhancement of production and productivity, but not without a cost. Land degradation, decline in factor productivity and above all health hazards are observed, which attracted the attention calling for integrated management for sustainable production. With the present scenario with environment pollution which is detrimental to the sustainability there is an urgent need for adoption of farming practice which ensures soil health, human health, animal health and environmental health. Integrated Nutrient Management (INM) involves the use of organic manures and novel organic fertilizer with a view to reduce the quantity of inorganic sources nutrients.

MATERIALS AND METHODS

The experiment was conducted at College Farm, N.M. College of Agriculture, Navsari Agricultural University (Gujarat) during summer season of 2014-15. Navsari is placed in south Gujarat heavy rainfall zone. The soil of experimental plot was clayey in texture with 7.98 pH, low in available nitrogen (176 kg/ha), medium in available phosphorus (38 kg/ha), fairly rich in available potassium (379 kg/ha). There were twelve treatment combinations consisting of three levels of inorganic fertilizers *viz.*, 50% RDN through chemical fertilizers, 75% RDN through chemical fertilizers and 100% RDN through chemical fertilizers and two organic manures (10 t FYM ha⁻¹ and 2 t Castor cake ha⁻¹) and two levels foliar sprays of banana sap (without banana sap and with banana sap (1% foliar spray at tillering and ear head initiation) were evaluated in factorial randomized block design with three replications. The seeds of pearl millet variety GHB-744 were shown on 13th February, 2015 at a row spacing of 60 X 15 cm using seed rate of 4kg/ha treated with thiom @ 3 g/kg and *Azospirillum* 10 ml/kg seed before sowing. The recommended dose of fertilizers was 120-60-00 kg N-P₂O₅-K₂O ha⁻¹. The experimental plots were fertilized as per treatments. The entire dose of phosphorus were applied as basal application in form of DAP at just before sowing in the furrows and nitrogenous fertilizer was calculated and half of it was applied as basal and remaining half dose of nitrogen was top dressed in the form of urea as per treatment. Recommended practices of the region were followed for raising the crop.

RESULTS AND DISCUSSION

Effect of inorganic fertilizers

The results revealed growth and yield attributing characters of summer pearl millet like, Plant height, number of effective tillers per plant, ear head length, ear head girth, and test weight were significantly influenced by different levels of nitrogen. Significantly higher plant height

was recorded with application of 100% RDN through chemical fertilizers (186.75 cm) followed by 75% RDN (Table 1). The increase in plant height might be due to the positive effect of nitrogen on growth character due to augment of cell division and cell expansion. The study is in close conformity as observed by ^[4]. Significantly the highest effective tillers per plant (4.7), ear head length (21.99 cm), ear head girth (3.68 cm) and test weight (8.96 g) was recorded by the treatment receiving 100% recommended dose of nitrogen. The increase in test weight due to highest level of nitrogen might be attributed to the better filling of grains resulting into bold sized seeds and consequently highest test weight as well as all yield attributes were remarkably improved and gave significant response to nitrogen application. The beneficial effects of nitrogen on yield attributes were also reported by ^[8] and ^[16].

The grain and fodder yields (Table 1) of pearl millet were also increased with increase in nitrogen levels. Significantly higher grain (3284 kg ha⁻¹) and fodder yield (6476 kg ha⁻¹) was recorded with application of 100% RDN as compared to 75% and 50% RDN. The increase grain and fodder yield could be due to the cumulative effect of improvement in yield attributes *viz.*, number of effective tillers per plant, ear head length and thickness and test weight. The improvement in fodder yield was mainly on account of increase in the growth parameters due to nitrogen application. These results are also in agreement with findings of ^[1], ^[2], ^[5]. An application of 100% RDN through chemical fertilizer to summer pearl millet crop significantly increased the protein content (9.44%) and protein yield (310.31 kg ha⁻¹) as compared to other treatments. Nitrogen is a component of protein and nucleic acids, which constitutes building blocks of protein. The results are in accordance with the results reported by ^[7], ^[5], ^[10]. Data presented in table 2 further indicated that different treatments of nitrogen levels gave better net return and benefit cost ratio. Application of 100% RDN through chemical fertilizers was found superior to all treatments. It was recorded highest value of net returns (₹ 17232.04 ha⁻¹) and BCR (1.49) followed by treatment (75% RDN) through chemical fertilizer of pearl millet during experiment.

Effect of organic manures

The data presented in Table 1 revealed that organic manures had significant influence on plant height and number of effective tillers per plant. An application of 2 t castor cake ha⁻¹ recorded significantly higher plant height (183 cm) and number of effective tillers per plant (5.51) as compared 10 t FYM ha⁻¹ (173.04 cm and 5.06). Increase in plant height due to application of organic manures was also observed by ^[3], ^[12]. An application of 2 t castor cake ha⁻¹ remarkably increased number of effective tillers per plant (4.43), ear head length (21.72

cm), ear head girth (3.51 cm) and test weight (8.67 g) of summer pearl millet (Table 1). Organic manures create favorable effects on soil physical, chemical and biological properties and also provide more major nutrients to plants which ultimately results in increase in yield attributes. Rise in different yield attributing characters were also recorded by Singh *et al.* (2013).

Grain and fodder yield of pearl millet were also influenced significantly with different organic manures. Application of 2 t Castor cake ha⁻¹ recorded significantly higher grain (3137.31 kg ha⁻¹) and fodder (6206.98 kg ha⁻¹) yield over other treatment of organic manures. The higher grain yield of pearl millet seemed to be the cumulative effect of yield attribute which was booted by balanced nutrients supply. Likewise, fodder yield was also increased significantly due to significant response of plant growth parameters *viz.*, plant height and number of tillers per plant. The findings of present investigation are supported by those of [6], [17]. Data presented in table 2 indicated that application of castor cake gave significantly higher protein content and protein yield over FYM. Application of castor cake might be attributed to increase the nitrogen content in plants as nitrogen is an integral part of protein. It might be also attributed to increased availability of phosphorus as it is structural element of certain co-enzyme involved in protein synthesis. These findings are in close vicinity with the findings by [9]. It is clear from data presented in table 2 that application of 2 t castor cake ha⁻¹ recorded higher net returns and B: C ratio from pearl millet over rest of the treatments.

Effect of banana sap

The present study indicated that spraying of banana sap significantly increased the growth and yield parameters *viz.*, plant height, number of total tillers per plant, number of effective tillers per plant, ear head length, ear head girth and test weight as compared to control (Table 1). Wherein, an application of banana sap (1% foliar spray at tillering and ear head initiation stage) recorded significantly higher plant height (182.25 cm) and number of effective tillers plant⁻¹ (5.47) of pearl millet over control. The enriched banana pseudo stem sap contains essential plant nutrients along with growth regulators such as GA3 and cytokinin and trace of micronutrients, which boosts the plant growth. An increase in plant height and number of effective tillers per plant due to application of banana sap was also observed by [14], [15]. Fertilizing the crop with banana sap significantly increased the yield attributes such as number of effective tillers per plant (4.37), ear head length (21.66 cm), ear head girth (3.49 cm) and test weight (8.64 g) of pearl millet crop. Banana pseudo stem sap contains higher amount of majority of essential nutrients especially N and K, which ultimately increase yield

attributes were also recorded by ^[11], ^[15]. Data further showed that banana sap caused a remarkable effect on grain and fodder yield of pearl millet over control wherein, application of 1% foliar spray produced significantly higher grain yield (3140 kg/ha) and fodder yield (6190 kg/ha) of pearl millet over control. Hence experiments were concluded to use the sap directly as a liquid fertilizer initially in different crops through soil and foliar application. In response to its positive effect in enhancing the yield of the crop, Enrichment process was standardized and tested in different crops at NAU, Navsari by ^[11].

The data in Table 2 indicates that effect of banana sap had significant influence on protein content. Application of 1% foliar spray of banana sap recorded significantly highest protein content (8.65%) and protein yield (273.75 kg/ha). An application of 1% foliar spray of banana sap was found superior by recording the higher value of net returns (₹ 14879.47 ha⁻¹) and BCR (1.42).

On the basis of the experimental results it can be concluded that for obtaining potential production and higher net profit from summer pearl millet cv. GHB 744, the crop should be fertilized with 120 kg N through inorganic fertilizer (100 % RDN) and 2 t castor cake ha⁻¹ with two foliar sprays of banana sap at tillering and earhead initiation stages along with 60 kg P₂O₅ ha⁻¹

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Table 1. Effect of inorganic fertilizers, organic manures and banana sap on growth and growth attributes of summer pearl millet

Treatments	Plant height (cm)	Number of total tillers plant ⁻¹	Number of effective tillers plant ⁻¹	Earhead length (cm)	Earhead girth (cm)	Test weight (g)	Grain yield (kg ha ⁻¹)	Fodder yield (kg ha ⁻¹)	Grain: fodder ratio
(A) Inorganic fertilizers (N)									
N ₁ - 50% RDN Through chemical fertilizer	172.68	4.89	3.84	18.82	3.17	7.92	2809 b	5682 a	0.50
N ₂ - 75% RDN Through chemical fertilizer	174.64	5.26	4.17	21.66	3.31	8.31	3007 b	5863 a	0.52
N ₃ - 100% RDN Through chemical fertilizer	186.75	5.70	4.70	21.99	3.68	8.96	3284 a	6476 b	0.51
S.Em. ±	3.41	0.11	0.10	0.44	0.08	0.14	75.32	140.15	0.01
C.D. at 5%	9.99	0.31	0.30	1.28	0.22	0.40	220	411	NS
(B) Organic manures (O)									
O ₁ - FYM 10 t/ha	173.04	5.06	4.04	19.93	3.26	8.12	2930 a	5807 a	0.47
O ₂ - Castor cake 2 t/ha	183.00	5.51	4.43	21.72	3.51	8.67	3137 b	6206 b	0.54
S.Em. ±	2.78	0.09	0.08	0.36	0.06	0.11	61.50	114.44	0.01
C.D. at 5%	8.16	0.26	0.25	1.04	0.18	0.33	180	335	0.03
(C) Banana sap (B)									
B ₁ - Without banana sap	173.80	5.10	4.10	19.99	3.28	8.16	2927 a	5824 a	0.50
B ₂ - With banana sap (1% foliar spray at tillering and ear head initiation)	182.25	5.47	4.37	21.66	3.49	8.64	3140 b	6190 b	0.51
S.Em. ±	2.78	0.09	0.08	0.36	0.06	0.11	61.50	114.44	0.01
C.D. at 5%	8.16	0.26	0.25	1.04	0.18	0.33	180	335	NS

Table 2. Effect of inorganic fertilizers, organic manures and banana sap on yield, yield attributes and quality of summer pearl millet

Treatments	Grain yield (kg ha ⁻¹)	Straw yield (kg ha ⁻¹)	Gross return (₹ ha ⁻¹)	Cost of cultivation (₹ ha ⁻¹)	Net Return (₹ ha ⁻¹)	BCR	Protein content (%)	Protein yield (kg ha ⁻¹)
(A) Inorganic fertilizers (N)								
N ₁ - 50% RDN Through chemical fertilizer	2809.41	5682.11	45077.14	34328	10749.14	1.31	7.28	206.07
N ₂ - 75% RDN Through chemical fertilizer	3007.47	5863.36	47816.36	34732	13084.36	1.38	8.13	244.87
N ₃ - 100% RDN Through chemical fertilizer	3284.61	6476.86	52369.04	35137	17232.04	1.49	9.44	310.31
S.Em. ±	---	---	---	---	---	---	0.17	7.87
C.D. at 5%	---	---	---	---	---	---	0.50	23.07
(B) Organic manures (O)								
O ₁ - FYM 10 t/ha	2930.34	5807.90	46779.88	34232	12547.55	1.37	8.06	238.91
O ₂ - Castor cake 2 t/ha	3137.31	6206.98	50061.68	35232	14829.35	1.42	8.51	268.59
S.Em. ±	---	---	---	---	---	---	0.14	6.42
C.D. at 5%	---	---	---	---	---	---	0.41	18.84
(C) Banana sap (B)								
B ₁ - Without banana sap (control)	2927.62	5824.16	46779.76	34282	12497.76	1.36	7.92	233.75
B ₂ - With banana sap (1% foliar spray at tillering and ear head initiation)	3140.03	6190.72	50061.8	35182	14879.47	1.42	8.65	273.75
C.D. at 5%	---	---	---	---	---	---	0.41	18.84