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Integrated Nutrient Management in Summer Pearl Millet [*Pennisetum glaucum* (L) R. Br. Emend Stuntz]

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A field experiment entitled "Integrated nutrient management in summer pearl millet [*Pennisetum glaucum* (L) R. Br. Emend Stuntz]" was conducted during summer 2012 at Agronomy Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari. Sixteen treatment combinations comprising three types of manure with their specific dose *viz.* 10 t FYM ha^{-1} (M_1), 2.5 t vermicompost ha^{-1} (M_2) and 1.0 t castor cake ha^{-1} (M_3) along with control *viz.*, without manure (M_1) and four levels of fertilizer *viz.* control (F_1), 50 % RDF (F_2), 75 % RDF (F_3) and 100 % RDF (F_4) were evaluated in factorial randomized block design with three replications. Application of 2.5 t vermicompost ha^{-1} (M_3) recorded significantly higher grain (5893 kg ha^{-1}) and straw yields (9941 kg ha^{-1}) of summer pearl millet. These were 87.44 and 47.69 per cent higher over M_1 (control), respectively. An application of 100% RDF (F_4) to summer pearl millet resulted in significantly the higher grain (6166 kg ha^{-1}) and straw yields (9935 kg ha^{-1}). However it was at par with application 75 % RDF (F_3). The increase in grain yield was 79.30 and 71.71 per cent higher with treatment F_4 and F_3 over F_1 (control), respectively. The interaction effect of different types of manure and fertilizer levels on all parameters under study was found non-significant.

Key words: FYM: Farm yard manure, RDF: Recommended dose of fertilizer

Pearl millet [*Pennisetum glaucum* (L) R. Br. Emend Stuntz] is the fourth most important food grain crop after rice, wheat and sorghum in India. As an arid and semi-arid crop, traditionally it is the component of dry land system, usually grown on the soil with depleted fertility which receives rainfall of 15-75 cm per annum. In India, pearl millet popularly known as "Bajri" or "Bajra" is an important staple food crop. The nutritive value of grains of pearl millet is fairly high. It contains 9-15, 5 and 2-7 per cent protein, fat and mineral matter, respectively. It is also rich in vitamins A and B, thiamine and riboflavin contents, and imparts substantial energy to the body with easy digestibility. In addition to grains the crop also yields fair quality of dry fodder in large bulk for milch and draft animals. In India, 86.48 lakh hector area were under cultivation of pearl millet in the year 2010-11 which was 1.4 per cent higher than the year 2009-10 with annual production of about 10 million tonnes (Anonymous, 2011a). Rajasthan, Maharashtra, Gujarat, and Uttar Pradesh are the major pearl millet growing states of India. Gujarat ranks third and first with respect to area (4.81 lakh ha) and production (4.80 lakh tonnes), respectively with productivity of 998 kg ha^{-1} (Anonymous, 2011b). Banaskatha, Junagadh, Jamnagar, Rajkot, Mehsana, Kheda, Amreli and Kutch are the major pearl millet growing districts of Gujarat. The concept of Integrated Nutrient Management (INM) is a continuous improvement of soil productivity on long term basis through appropriate use of fertilizers and organic manures for optimum growth,

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yield and quality of different crops and cropping systems in specific agro-ecological situations. A judicious combination of chemical fertilizers, organic manures and bio-fertilizers should be formulated for crops and cropping system within the ecological, social and economic possibilities. FYM increased the N-use efficiency of the crop and the status of organic carbon, available N, P and trace elements in the soil. FYM also improves the physical condition of the soil. Vermicompost is a prime source due to the presence of readily available plant nutrients and plant growth enhancing substances such as auxins and number of beneficial micro organisms like nitrogen fixing, P - solubilizing and cellulose decomposing organisms. Castor cake is very useful manure which is suitable for any type of soil. Castor cake provides almost all the nutrients necessary for better plant growth. It also helps in increasing the nutrient uptake by plants. Castor cake improves the soil fertility and productivity without causing any damage to crop as well as soil. A proper understanding of the nutrient management of summer pearl millet crop is requires to enhance production.

MATERIAL AND METHOD

A field experiment was conducted at Agronomy Farm, N. M. College of Agriculture, Navsari Agricultural University, Navsari to find out the "Integrated nutrient management in summer pearl millet [*Pennisetum glaucum* (L) R. Br. Emend Stuntz] under South Gujarat condition" during summer season of 2012. The experiment consist of sixteen treatment combination comprise of three types of manure with their specific dose *viz.* 10 t FYM ha^{-1} (M_1), 2.5 t vermicompost ha^{-1} (M_2) and 1.0 t castor cake ha^{-1} (M_3) along with control *viz.*, without manure (M_1) and four levels of fertilizer *viz.* control (F_1), 50 % RDF (F_2), 75 % RDF (F_3) and 100 % RDF (F_4) were evaluated in factorial randomized block design with three replications. The soil of experimental site was clayey in texture having good drainage capacity with pH 7.4. It was medium in available nitrogen (268 kg ha^{-1}) and phosphorus (41 kg ha^{-1}) and higher in available potash (354 kg ha^{-1}). The required quantity of FYM (10 t ha^{-1}), vermicompost (2.5 t ha^{-1}) and castor cake (1 t ha^{-1}) manually applied in opened furrows at 6o cm spacing as per treatments and incorporated with soil before sowing. The required quantity of inorganic fertilizer was applied through urea and single super phosphate as per treatment. Half of nitrogen and full dose of phosphorus was applied as basal at the time of sowing in previously opened furrow and the remaining half dose of nitrogen was applied as top dressing at 30 days after sowing.

RESULTS

Effect of manures

A perusal of data on grain and straw yields indicates that application of vermicompost 2.5 t ha^{-1} (M_3) produced significantly higher grain and straw yield of pearl millet crop over rest of the treatments. Yield of the crop is a function of several yield components which are dependent on complementary interaction between vegetative and reproductive growth of the crop. As these growth and yield attributes showed significantly positive correlation with grain and straw yield, evidently resulted in higher yields with vermicompost. Significant increase in grain yield under vermicompost appears to be on account of their influence on dry matter production and indirectly via increase in plant height. The present findings are in close agreement with the results obtained by Kapila *et al.* (2004), Jat and Ahlawat (2004), and Meena *et al.* (2007).

Results revealed that different manure treatments exerted their significant influence on Growth and yield attributes. Treatment M_3 (2.5 t vermicompost ha^{-1}) produced significantly higher plant height (78.30 cm, 151.03 cm and 179.08 cm at 30, 60 DAS and at harvest, respectively) but it remained at par with the treatment M_2 (10 t FYM ha^{-1}). Application of 2.5 t vermicompost ha^{-1} (M_3) recorded significantly higher earhead length (26.52 cm), which was remained at par with treatment M_2 (10 t FYM ha^{-1}). Yield attributes *viz.*, earhead length and grain yield per plant were significantly influenced by various treatments of manure. The earhead length, test weight and grain yield per plant were recorded significantly higher with application of vermicompost 2.5 t ha^{-1} (M_3). While reverse trend was observed for treatment M_1 (control). The vermicompost did bring about significant improvement in overall growth of the crop

expressed in terms of plant height and dry matter accumulation by virtue of increased photosynthetic efficiency. Thus greater availability of photosynthesis, metabolites and nutrients to development reproductive structures seems to have resulted in increased in earhead length and grain yield per plant. The present findings are in close agreement with the results obtained by Kapila *et al*. (2004) and Meena *et al.* (2007).

Effect of fertilizers levels

The results on grain and straw yields of pearl millet (table 1) indicated that the difference due to different fertilisers levels were found significant. An appraisal of data in Table 1 revealed that the grain and straw yields of pearl millet displayed on increasing trend with increase in RDF levels from 50 to 100 percent significantly the maximum grain (6166 kg ha^{-1}) and straw (9935 kg ha^{-1}) yields were registered under the treatment F_4 (100% RDF) and it was at par with treatment F_3. The increase in grain yield of pearl millet under treatment F_4 ,F_3 and F_2 were the extent of 79.30, 71.71and 32.59% respectively as compared to control. The increase in straw yield of pearl millet under the treatment F_4, F_3 and F_2 were at the extent of 50.44, 41.40 38.85, respectively compared to F_1 (control). It might be due to adequate supply of nutrients throughout the entire growth period which resulted into better growth and yield attributing characters. The better growth of crop ultimately diverted more energy under sink source relationship which helped in producing more yields. The present findings are in close agreement with the results obtained by Khistariya *et al.* (1998) and Chaudhari *et al*. (2002).

Growth parameters *viz.*, plant height at 30, 60 DAS and harvest were significantly influenced by fertility levels. The higher values of these growth attributes were observed with application of 100 % RDF (F_4), which remained statistically at par with application of 75 % RDF (F_3). The improvement in growth parameters with application of 75 % or 100 % RDF might have resulted in easy and adequate availability of N and P for their utilization. The yield attributes *viz.*, earhead length and grain yield per plant were significantly influenced by fertility levels, whereas number of seeds per earhead remained unaffected due to different fertility levels. Significantly higher earhead length and grain yield per plant were observed with application of 100 % RDF (F_4), which remained statistically at par with application of 75

Table 1. Effect of manures and fertilizers on growth parameters as well as grain and straw yields of pearl millet

Treatments	Plant height (cm)			Earhead length (cm)	Number of seeds per earhead	Grain yield per plant (g)	Grain yield (kg ha^{-1})	Straw yield (kg ha^{-1})	Harvest index (%)
	At 30 DAS	At 60 DAS	At harvest						
Manures (M)									
M_1 – Control	67.52	136.40	164.03	19.49	656	43.31	3144	6731	34.93
M_2 – 10 t FYM ha^{-1}	77.13	145.89	173.92	25.29	685	49.42	5771	9835	37.83
M_3 – 2.5 t Vermicompost ha^{-1}	78.30	151.03	179.08	26.52	696	50.65	5893	9941	38.02
M_4 – 1.0 t Castor cake ha^{-1}	74.74	143.56	171.59	22.47	657	46.38	5263	8342	39.55
S.Em. ±	1.11	2.12	2.52	0.69	15.56	0.75	148	263	1.13
C.D. at 5%	3.20	6.13	7.27	1.98	NS	2.16	427	760	NS
Fertilizers levels (F)									
F_1 – Control	67.72	136.92	164.58	19.09	650	42.81	3439	6604	36.14
F_2 – 50% RDF	74.43	143.75	171.30	22.96	653	46.97	4560	8972	36.47
F_3 – 75% RDF	76.86	146.16	173.87	25.33	690	49.46	5905	9338	39.08
F_4 – 100% RDF*	78.70	150.05	178.87	26.40	699	50.53	6166	9935	38.64
S.Em. ±	1.11	2.12	2.52	0.69	15.56	0.75	148	263	1.13
C.D. at 5%	3.20	6.13	7.27	1.98	NS	2.16	427	760	NS
Interaction (M x F)									
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS
C.V.%	5.16	5.10	5.07	10.14	8.01	5.46	10.21	10.46	10.44

* 100% RDF= 120-60-0 NPK kg/ha

% RDF (F_3). The fertility levels of 100% and 75% RDF did cause about significant improvement in overall growth of the crop expressed in terms of plant height and dry matter accumulation by virtue of increased photosynthetic efficiency. Thus greater availability of photosynthesis, metabolites and nutrients to develop reproductive structures seems to have resulted in increased earhead length, test weight and grain yield per plant with these fertility levels. The present findings are within the close vicinity of those reported by Jadhav *et al.* (1995) and Munirathnam and Gautam (2002).

Interaction effect

Data revealed that the interaction effects between different types of manure and fertilizer levels were found non-significant for all the parameters under study.

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