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Mayuri R More
M.Sc. Scholar, Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dhule, MPKV, Rahuri, Maharashtra, India

KB Patil
Assistant Professor, Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dhule, MPKV, Rahuri, Maharashtra, India

AD Jagdhani
Assistant Professor, Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dhule, MPKV, Rahuri, Maharashtra, India

RB Shitole
M.Sc. Scholar, Department of Animal Husbandry and Dairy Science, College of Agriculture, Dhule, MPKV, Rahuri, Maharashtra, India

PS Patil
M.Sc. Scholar, Department of Horticulture, College of Agriculture, Dhule, MPKV, Rahuri, Maharashtra, India

Corresponding Author:
Mayuri R More
M.Sc. Scholar, Department of Soil Science and Agricultural Chemistry, College of Agriculture, Dhule, MPKV, Rahuri, Maharashtra, India

Response of Bio-NP consortium along with iron on nutrient content and nutrient uptake of kharif pearl millet in inceptisol

Mayuri R More, KB Patil, AD Jagdhani, RB Shitole and PS Patil

Abstract
An investigation on "Response of bio-NP consortium along with iron on nutrient content, uptake and quality of kharif pearl millet in inceptisol" under Northern Maharashtra was carried out during Kharif season 2022 at the Division of Soil Science and Agricultural Chemistry, in College of Agriculture Dhule, under Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra. There were 9 treatments each replicated thrice. The experiment was laid out in Randomized Block Design. Pearl millet variety "Phule Adishakti" was grown by adopting recommended package of practices. The result showed that application of 100% NP + bio- NP consortia @ 6 ml + 30 kg ha^{-1} $FeSO_4$ (T_5) recorded highest nitrogen, phosphrous and potassium content in grain of kharif pearl millet i.e., 1.493%, 0.495% and 0.829%, respectively, however it was at par with treatment T_3 (100% NP + bio-NP consortia @ 4 ml + 30 kg ha^{-1} $FeSO_4$). Similar trend was observed in the stover nutrient content of pearl millet crop i.e., 1.121, 0.354 and 1.42%, respectively in treatment T_5. Maximum iron content (52.2 mg kg^{-1}) was recorded with application of treatment T_5 (100% NP + bio- NP consortia @ 6 ml + 30 kg ha^{-1} $FeSO_4$) followed by T_3 (51.6 mg kg^{-1}). Similarly, application of treatment (T_5) recorded significantly higher iron content (mg kg^{-1}) 32.7 in straw of pearl millet. However, it was at par with treatment (T_3) also recorded the high iron content in stover (32.1 mg kg^{-1}). Application of T_5 (100% NP + bio- NP consortia @ 6 ml + 30 kg ha^{-1} $FeSO_4$) recorded highest total nitrogen, phosphorus and potassium uptake by grain of pearl millet 59.61, 19.76 and 33.10 kg/ha, respectively followed by T_3 (100% NP + bio-NP consortia @ 4 ml + 30 kg ha^{-1} $FeSO_4$). Similar trend was observed in the stover nutrient content of pearl millet crop i.e., 76.09, 24.02, 96.38 kg/ha, respectively in treatment T_5. Maximum iron uptake by grain and straw of kharif pearl millet i.e., 208.43 g ha^{-1} and 221.96 g ha^{-1}, respectively observed in treatment T_5.

Keywords: Pearl millet, nutrients, iron, stover and significant

Introduction
Today, global agriculture is at crossroads because of climate change, increased population Pressure and detrimental environmental impacts. Increased population needs more food to live on the earth. Indian agriculturalists are in a position to increase our food production within the available cultivated land. Application of commercial fertilizers to soil is more expensive and also resulted in soil degradation. Therefore, vertical expansion of food production and Judicious use of fertilizers is necessary. Though the benefits of green revolution have been reaped by us in terms of production, the other side of it, i.e., over usage of chemical fertilizers and subsequent deterioration of soil health has been realised these days. Hence awareness of Practicing microbial inoculation has been taken to various spheres and products of microbial Culture are fetching up huge market.

Biofertilizers are the safe alternative to the use of chemical fertilizers because they are environmental friendly, do not have any adverse effect on soil, animals, human beings and they also Help in the reduction of pollution in the environment and bringing down the cost of chemical Fertilizers. Various free-living bacteria are beneficial for the growth of plant and yield which are known as plant growth promoting rhizobacteria PGPR. If Biofertilizer applied to any crop, it improves the absorption availability of many nutrients to plant, create resistance to root diseases and reduce 25% of nitrogen requirement to the plants (Kannaiyan, 2002) [7]. The combined application of Azospirillum and Azotobacter significantly increased all the growth characters and yield in wheat (Chapke *et al*., 2018) [2].

Pearl millet (*Pennisetum glaucum* L.) is multipurpose cereal crop belongs to the Poaceae family. It is commonly called as Bajra, Bajri, Sajje, Kambu, Kamban, Sajjalu etc. in variour Indian local Languages. It is commonly used for food, feed, and forages purpose (Gopalan *et al.*, 2007) [4]. This millet cultivated mostly in semi-arid part of Africa and Asia. India is the largest producer of pearl millet having 10.0 million ha area with an annual production of 10.3 million tones and productivity of 1391 kg ha^{-1}during 2020-21.

The principal pearl millet growing states are Rajasthan, Maharashtra, Uttar Pradesh, Gujarat, Hariana and Tamil Nadu contributing to 90 percent of total production in the country.

This crop has a capability to grow at very high temperature with low water requirement where other crops like rice, wheat, maize fail to grow. It has also advantageous physiological characteristics When compared to other cereals as it is resistant to drought, low Soil fertility and high salinity (Railey *et al*., 2008) [11]. Pearl millet grain content 75% endosperm, 17% germ, and 8% bran. The pearl millet germ proportion is thus about twice that of sorghum, it is a factor that contributes to the higher nutritive value of pearl millet grain. Protein content in pearl millet is higher (Tylor and Emmabux, 2008) [18] and it is also a good source of vitamin-B, Vitamin-A, folic acid, calcium and magnesium.

Iron plays a role in the formation of plant chlorophyll. Iron-containing plant haemoglobins are another promising target for altering Fe content in plant-based foods. Plant haemoglobin is similar to the human haemoglobin, with Fe binding capacity and is most commonly found in nodulating legumes (nitrogen fixing plants) (Golada *et al*., 2012) [3]. Iron is an essential micronutrient for almost all living organisms because of it plays critical role in metabolic processes such as DNA synthesis, respiration, and photosynthesis. Further, many metabolic pathways are activated by iron, and it is a prosthetic group constituent of many enzymes. An imbalance between the solubility of iron in soil and the demand for iron by the plant are the primary causes of iron chlorosis. In plants, iron is involved in the synthesis of chlorophyll, and it is essential for the maintenance of chloroplast structure and function (Rout and Sahoo, 2015) [14].

Material and Methods

A field experiment was conducted to study the "effect of bio-np consortium along with iron on growth and yield of kharif pearl millet in inceptisol" during kharif season of 2022 at the Division of Soil Science and Agricultural Chemistry, in College of Agriculture Dhule which located at geographical coordinates 20.4 ^{0}N latitude and 74 ^{0}E longitudes. The altitude is 258 m above mean sea level. The experimental soil contained 0.65% organic carbon, soil pH and EC 7.6 and 0.33 dS/m, respectively. with pH 7.6. Treatments comprised of T_1: Absolute control, T_2: 100% NP + bio-NP consortia @ 4 ml + 15 Kg ha^{-1} $FeSO_4$, T_3: 100% NP + bio-NP consortia @ 4 ml + 30 Kg ha^{-1} $FeSO_4$, T_4: 100% NP + bio-NP consortia @ 6 ml + 15 Kg ha^{-1} $FeSO_4$, T_5: 100% NP + bio-NP consortia @ 6 ml + 30 Kg ha^{-1} $FeSO_4$, T_6: 75% NP + bio-NP consortia @ 4 ml + 15 Kg ha^{-1} $FeSO_4$, T_7: 75% NP + bio-NP consortia @ 4 ml + 30 Kg ha^{-1} $FeSO_4$, T_8: 75% NP + bio-NP consortia @ 6 ml + 15 Kg ha^{-1} $FeSO_4$, T_9: 75% NP + bio-NP consortia @ 6 ml + 30 Kg ha^{-1} $FeSO_4$. The experiment was laid out in Randomized Block Design. The parameters *viz*., nutrient content, nutrient uptake and quality parameters with standard process were recorded data and was statistically analyzed with, Analysis of Variance (ANOVA) as applicable to Randomized Block Design (Panse and Sukhatme, 1967) [9]. The grain and straw samples were digested in H_2SO_4 for determination of N and di-acid mixture of HNO_3 and $HClO_4$ (2:5) for P and K estimation. The nutrient content was estimated by standard methods and Plant uptake of N, P, K and Fe were computed by multiplying the yield with the respective nutrient content. After harvest of the crop, the composite surface (0-15 cm) soil samples from each plot of the experimental field were analyzed for pH, EC, OC by standard procedures. Statistical analysis of the individual data of various characters studied in the experiment was carried out using standard statistical procedures as described by. Standard error of mean, critical difference (C.D.) at 5 percent level of probability and coefficient of variance were worked out for the interpretation of the results.

Results and Discussion

Nutrient content in grain of pearl millet

Data on nitrogen content in grain of pearl millet crop presented in Table-1 showed that nitrogen content was found in range of 1.208 to 1.493 percent in different treatments. Maximum nitrogen (1.493%) content was recorded with treatment T_5 (100% NP + bio-NP consortia @ 6 ml + 30 Kg ha^{-1} $FeSO_4$) However, it was at par with 100% NP + bio-NP consortia @ 4 ml + 30 kg ha^{-1} $FeSO_4$ (T_3) also recorded the high nitrogen content (1.477%).

Phosphorus content in grains ranged from 0.439 to 0.495 percent in different treatments. Maximum phosphorus content in grain (0.495%) was recorded with T_5 (100% NP + bio-NP consortia @ 6 ml + 30 Kg ha^{-1} $FeSO_4$) followed by T_3 (100% NP + bio-NP consortia @ 4 ml + 30 Kg ha^{-1} $FeSO_4$). Phosphorus content in grain was highly significant with T_5 over all treatments. The close finding was also reported by Rathore *et al*. (2006) [12], Rekha *et al*. (2018) [13] and Singh (2020) [17] in pearl millet.

From the data summarized in Table-1and 2 it appeared that the potassium content of grain and stover after harvest of pearl millet as influenced by the application of bio-NP consortium, along with iron was found non-significant.

Iron content in grain presented in Table-1 showed that iron content ranged from 40.7 to 52.2 mg kg^{-1} in different treatments. Maximum iron content (52.2 mg kg^{-1}) was recorded in T_5 (100% NP + bio-NP consortia @ 6 ml + 30 Kg ha^{-1} $FeSO_4$) followed by treatment T_3 (51.6 mg kg^{-1}). Minimum iron content (40.7 mg/kg) was recorded in treatment T_1 (Absolute control). It is clearly evident that application of T_5 (100% NP + bio-NP consortia @ 6 ml + 30 Kg ha^{-1} $FeSO_4$) significantly increased iron content in grain over all treatments. Comparable outcomes have been reported by Jain *et al*. (2018) [5], Kadivala *et al*. (2018) [6] in pearl millet.

Nutrient content in stover of pearl millet

Data on nitrogen and phosphrous content in pearl millet stover (Table-2) revealed that Treatment T_5 (100% NP + bio-NP consortia @ 6 ml + 30 Kg ha^{-1} $FeSO_4$) significantly increased NP content in stover 1.121% and 0.354%, respectively and followed by treatment T_3 (1.119% and 0.352%, respectively and both were significantly superior over rest of the treatments. The results of present experiment confirmed the finding of Rathore *et al*. (2006) [12], Poonia and Narolia (2011) [10] and Shrivastava and Arya (2017) [16] in pearl millet.

Table-2 revealed that iron content in stover ranged from 22.4 mg/kg to 32.7 mg/kg in different treatments. It is clearly evident that iron content in (T5) followed by treatment 100% NP + bio-NP consortia @ 4 ml + 30 Kg ha^{-1} $FeSO_4$ (T_3) over rest of the treatments. These results corroborate the finding of Meena *et al*. (2018) [8], Sharanappa *et al*. (2019) [15]. The findings confirm the results of Anandhan *et al*. (2021) [1] in pearl millet.

Nutrient uptake by grain of pearl millet

Data on total nitrogen uptake by pearl millet crop (grain) are presented in Table -3. Nitrogen uptake by pearl millet crop was increased in all treatments as compared to treatment (T1) i.e., absolute control. In all treatments the total nitrogen uptake by grain was found in range of 16.57 to 59.61 kg/ha. Application of T_5 (100% NP + bio-NP consortia @ 6 ml + 30 Kg ha^{-1} $FeSO_4$) recorded highest total nitrogen uptake (59.61 kg/ha), followed by T_3 (100% NP + bio-NP consortia @ 4 ml + 30 Kg ha^{-1} $FeSO_4$). Application of bio-NP consortium influences positively on the population of soil beneficial microbes in root zone and in the presence of root exudates which leads to increased nitrogen uptake by the plant. Any nutrient's availability in the root zone and stage of the plant's growth has an impact on the quantity of it is assimilated by the plant. This might be because applying nitrogen in two separate doses of 100% RDF by chemical fertilizers may have given pearl millet roots more chances to absorb nitrogen from the soil. The similar findings were also reported by Rathore *et al*. (2006) [12], Rekha *et al*. (2018) [13] and Singh (2020) [17] in pearl millet.

Phosphorus uptake by pearl millet crop was found in the range of 11.29 to 19.76 kg/ha in different treatments. Application of T_5 (100% NP + bio-NP consortia @ 6 ml + 30 Kg ha^{-1} $FeSO_4$) recorded significantly highest total phosphorus uptake by pearl millet crop, followed by treatment T_3 (100% NP + bio-NP consortia @ 4 ml + 30 Kg ha^{-1} $FeSO_4$) and both were superior over rest of the treatments. With the application of 100% RDF, there was a larger uptake of phosphorus by grain and stover. This may be because there was more phosphorus available during the early stages of plant growth, which may have promoted the development of newer roots and increased nutrient uptake from the soil. These findings were also supported by Rathore *et al.* (2006) [12], Poonia and Narolia (2011) [10] and Shrivastava and Arya (2017) [16] in pearl millet.

From the data summarized in Table-3 and 4 it appeared that the potassium uptake of grain and stover after harvest of pearl millet as influenced by the application of bio-NP consortium, along with iron was found non-significant.

Total iron uptake by pearl millet crop (grain) as influenced by different treatments given in Table-3, revealed that maximum total iron uptake (208.43 g/ha) was recorded with application of treatment T_5 (100% NP + bio-NP consortia @ 6 ml + 30 Kg ha^{-1} $FeSO_4$), followed by T_3 (191.74 g/ha) and both were superior over rest of the treatments. These findings are were also confirmed by Jain *et al*., (2018) [5], Kadivala *et al*. (2018) [6], Meena *et al.* (2018) [8] in pearl millet.

Nutrient uptake by stover of pearl millet

Data on nitrogen and phosphrous uptake by pearl millet stover (Table-4) revealed that Treatment T_5 (100% NP + bio-NP consortia @ 6 ml + 30 Kg ha^{-1} $FeSO_4$) significantly increased NP uptake by stover 76.09 Kg ha^{-1} and 24.02 Kg ha^{-1}, respectively and followed by treatment T_3 (70.68 Kg ha^{-1} and 22.23 Kg ha^{-1}, respectively and both were significantly superior over rest of the treatments. The results of present experiment confirmed the finding of Rathore *et al.* (2006) [12], Poonia and Narolia (2011) [10] and Shrivastava and Arya (2017) [16] in pearl millet.

Table-4 revealed that iron content in stover ranged from 55.30 g/ha to 221.96 g/ha in different treatments. It is clearly evident that iron content in (T5) followed by treatment 100% NP + bio-NP consortia @ 4 ml + 30 Kg ha^{-1} $FeSO_4$ (T_3) over rest of the treatments. These results corroborate the finding of Meena *et al.* (2018) [8], Sharanappa *et al.* (2019) [15]. The findings confirm the results of Anandhan *et al.* (2021) [1] in pearl millet.

Table 1: Effect of Bio-NP consortia along with iron on N, P, K and Fe content in grain of pearl millet

Treatments	Treatment combinations	Grain Content (%)			Fe (mg kg^{-1})
		N	P	K	
T_1	Absolute control	1.208	0.439	0.815	40.7
T_2	100% NP + bio-NP consortia @ 4 ml + 15 kg ha^{-1} $FeSO_4$	1.465	0.487	0.827	47.9
T_3	100% NP + bio-NP consortia @ 4 ml + 30 kg ha^{-1} $FeSO_4$	1.477	0.492	0.828	51.6
T_4	100% NP + bio-NP consortia @ 6 ml + 15kg ha^{-1} $FeSO_4$	1.469	0.488	0.827	48.2
T_5	100% NP + bio- NP consortia @ 6 ml + 30 kg ha^{-1} $FeSO_4$	1.493	0.495	0.829	52.2
T_6	75% NP + bio-NP consortia @ 4 ml + 15 kg ha^{-1} $FeSO_4$	1.376	0.458	0.821	47.2
T_7	75% NP + bio-NP consortia @ 4 ml + 30 kg ha^{-1} $FeSO_4$	1.379	0.460	0.821	50.8
T_8	75% NP + bio-NP consortia @ 6 ml + 15 kg ha^{-1} $FeSO_4$	1.382	0.463	0.822	47.4
T_9	75% NP + bio-NP consortia @ 6 ml + 30 kg ha^{-1} $FeSO_4$	1.389	0.467	0.823	51.0
	SE (m) ±	0.008	0.014	0.024	0.979
	C.D. (P= 0.05)	0.024	0.041	NS	2.946

Table 2: Effect of Bio-NP consortia along with iron on N, P, K and Fe content in stover of pearl millet

Treatments	Treatment combinations	Stover Content (%)			Fe (mg kg^{-1})
		N	P	K	
T_1	Absolute control	0.989	0.319	1.29	22.4
T_2	100% NP + bio-NP consortia @ 4 ml + 15 kg ha^{-1} $FeSO_4$	1.116	0.345	1.40	30.7
T_3	100% NP + bio-NP consortia @ 4 ml + 30 kg ha^{-1} $FeSO_4$	1.119	0.352	1.41	32.1
T_4	100% NP + bio-NP consortia @ 6 ml + 15kg ha^{-1} $FeSO_4$	1.118	0.348	1.40	30.8
T_5	100% NP + bio- NP consortia @ 6 ml + 30 kg ha^{-1} $FeSO_4$	1.121	0.354	1.42	32.7
T_6	75% NP + bio-NP consortia @ 4 ml + 15 kg ha^{-1} $FeSO_4$	1.105	0.329	1.32	30.1
T_7	75% NP + bio-NP consortia @ 4 ml + 30 kg ha^{-1} $FeSO_4$	1.106	0.331	1.34	31.9
T_8	75% NP + bio-NP consortia @ 6 ml + 15 kg ha^{-1} $FeSO_4$	1.108	0.335	1.35	30.5
T_9	75% NP + bio-NP consortia @ 6 ml + 30 kg ha^{-1} $FeSO_4$	1.109	0.338	1.37	32.0
	SE (m) ±	0.001	0.002	0.039	0.606
	C.D. (P= 0.05)	0.003	0.005	NS	1.835

Table 3: Effect of Bio-NP consortia along with iron on N, P, K and Fe uptake by grain of pearl millet

Treatments	Treatment combinations	Grain Uptake (Kg ha^{-1})			Fe uptake (g ha^{-1})
		N	P	K	
T_1	Absolute control	16.57	11.29	20.96	55.84
T_2	100% NP + bio-NP consortia @ 4 ml + 15 kg ha^{-1} $FeSO_4$	51.93	17.26	29.31	169.80
T_3	100% NP + bio-NP consortia @ 4 ml + 30 kg ha^{-1} $FeSO_4$	54.88	18.28	30.76	191.74
T_4	100% NP + bio-NP consortia @ 6 ml + 15kg ha^{-1} $FeSO_4$	52.28	17.36	29.43	171.54
T_5	100% NP + bio- NP consortia @ 6 ml + 30 kg ha^{-1} $FeSO_4$	59.61	19.76	33.10	208.43
T_6	75% NP + bio-NP consortia @ 4 ml + 15 kg ha^{-1} $FeSO_4$	42.33	14.09	25.26	145.23
T_7	75% NP + bio-NP consortia @ 4 ml + 30 kg ha^{-1} $FeSO_4$	42.87	14.30	25.52	157.93
T_8	75% NP + bio-NP consortia @ 6 ml + 15 kg ha^{-1} $FeSO_4$	44.92	15.01	26.72	154.09
T_9	75% NP + bio-NP consortia @ 6 ml + 30 kg ha^{-1} $FeSO_4$	46.50	15.53	27.55	170.74
	SE (m) ±	2.324	0.497	2.913	6.079
	C.D. (P= 0.05)	7.034	1.503	NS	18.397

Table 4: Effect of Bio-NP consortia along with iron on N, P, K and Fe uptake by stover of pearl millet

Treatments	Treatment combinations	Stover Uptake (Kg ha^{-1})			Fe uptake (g ha^{-1})
		N	P	K	
T_1	Absolute control	43.23	13.94	56.39	55.30
T_2	100% NP + bio-NP consortia @ 4 ml + 15 kg ha^{-1} $FeSO_4$	67.25	20.78	84.36	184.90
T_3	100% NP + bio-NP consortia @ 4 ml + 30 kg ha^{-1} $FeSO_4$	70.68	22.23	89.06	202.77
T_4	100% NP + bio-NP consortia @ 6 ml + 15kg ha^{-1} $FeSO_4$	67.63	21.05	84.7	186.34
T_5	100% NP + bio- NP consortia @ 6 ml + 30 kg ha^{-1} $FeSO_4$	76.09	24.02	96.38	221.96
T_6	75% NP + bio-NP consortia @ 4 ml + 15 kg ha^{-1} $FeSO_4$	57.79	17.20	69.03	157.42
T_7	75% NP + bio-NP consortia @ 4 ml + 30 kg ha^{-1} $FeSO_4$	58.45	17.49	70.81	168.59
T_8	75% NP + bio-NP consortia @ 6 ml + 15 kg ha^{-1} $FeSO_4$	61.22	18.51	74.60	168.54
T_9	75% NP + bio-NP consortia @ 6 ml + 30 kg ha^{-1} $FeSO_4$	63.11	19.23	77.96	182.11
	SE (m) ±	2.171	0.622	8.502	6.993
	C.D. (P= 0.05)	6.570	1.883	NS	21.163

SE: Standard Error; CD: Critical Difference.

Conclusion

On the basis of research result, it may be concluded that the concentration of N, P and Fe in grain and stover of pearl millet and uptake of N, P and Fe by grain and stover of pearl millet was found significantly higher with application of 100% NP + bio- NP consortia @ 6 ml + 30 kg ha^{-1} $FeSO_4$.

References

1. Anandhan J, Shamugasundaram R, Saravana Pandian P, Swaminathan C, Vanniarajan C, Govindaraj M. Influence of soil application of iron and zinc on their content, uptake and total dry matter yield of pearl millet cultivars. The Pharma Innovation Journal. 2021;10(4):98-104.
2. Chapke RR, Prabhkar, Shyamprasad G, Das IK, Tonapi VA. Improved millet production technologies and their impact. Technology Bulletin, ICAR-Indian Institute of Millets Research, Hyderabad 500030, India; 2018:84.
3. Golada SL, Patel BJ, Sharma GL. Effect of FYM, nitrogen and Azospirillium inoculation on yield and quality of forage pearl millet. Agricultural Science Digest - A Research Journal. 2012;32(3):237-240.
4. Gopalan C, Sastri B, Balasubramaniam S. Nutritive value of Indian foods. National Institute of Nutrition, Indian Council of Medical Research, Hyderabad; c2007.
5. Jain AK, Shrivastava S, Arya V. Response of organic manure, zinc and iron on soil properties, yield and nutrient uptake by pearl millet crop grown in Inceptisol. International Journal of Pure Applied Biosciences. 2018;6(1):426-435.
6. Kadivala VH, Ramani VP, Patel PK. Effect of micronutrient on yield and uptake by summer pearl millet (*Pennisetum glaucum* L.). International Journal of Chemical Studies. 2018;6(3):2026-2030.
7. Kannaiyan S. Biotechnology of Biofertilizers. Alpha Sci. Inter. Ltd., P. O. Box 4067 Pang Bourene R.G8, UK; 2002:1-375.
8. Meena BL, Kumar P, Kumar A, Meena RL, Kaledhonkar MJ, Sharma PC. Zinc and iron nutrition to increase the productivity of pearl millet-mustard cropping system in salt-affected soils. International Journal of Current Microbiology and Applied Sciences. 2018;7(8):3201-3211.
9. Panse VG, Sukhatme PV. Statistical methods agricultural workers. New Delhi (India): Indian Council of Agricultural Research; 1967.
10. Poonia BL, Narolia RS. Growth dynamics, yield and economics of pearl millet (*Pennisetum glaucum* L.) as influenced by vermicompost and fertilizers. Annals of Arid Zone. 2011;50(2):145-149.
11. Railey K. Whole Grains Millet (Gramineae/ Poaceae). http/chetday.bcom. Retrieved on 17-June 2009; 10p.
12. Rathore VS, Singh P, Gautam RC. Productivity and water use efficiency of rainfed pearl millet (*Pennisetum glaucum* L.) as influenced by planting patterns and integrated nutrient management. Indian Journal of Agronomy. 2006;51:46-48.
13. Rekha D, Lakshmipathy R, Vijaya Gopal A. Effect of integrated use of biofertilizers, chemical fertilizers and farmyard manure on soil health parameters of pearl millet (*Pennisetum glaucum* L.). Journal of Soil Science and Plant Health. 2018;2(2):21-27.
14. Rout GR, Sahoo S. Role of iron in plant growth and metabolism. Reviews in Agricultural Science. 2015;3:1-24.
15. Sharanappa, Latha HS, Desai BK, Koppalkar BG, Ravi MV. Effect of agronomic biofortification with zinc and

iron on yield and quality of pearl millet [*Pennisetum glaucum* (L.)] genotypes. International Journal of Current Microbiology and Applied Sciences. 2019;8(9):1312-1321.
16. Shrivastava S, Arya V. Effect of integrated application of inorganic and organic sources of manures on test weight, length of ear head and available soil micronutrient under pearl millet crop. International Journal of Pure and Applied Bioscience. 2017;5(5):720-724.
17. Singh V. Effect of integrated nutrient management on yield and uptake of nutrients in pearl millet (*Pennisetum glaucum* L.)- mustard (Brassica juncea) crop sequence. Annals of Plant and Soil Research. 2020;22(4):349-353.
18. Taylor JRN, Emmambux MN. Products containing other specialty grains: sorghum, the millets and pseudo cereals. In: Technology of Functional Cereal Products. University of Pretoria, South Africa; c2008. p. 290.