International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
www.chemijournal.com
IJCS 2020; 8(4): 2192-2194

Received: 22-05-2020
Accepted: 24-06-2020

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Influence of various zinc and iron treatments on yield and yield attributes of pear millet

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DOI: https://doi.org/10.22271/chemi.2020.v8.i4x.9954

Abstract
The field study on "Influence of various zinc and iron treatments on yield and yield attributes of pear millet" was carried out during *kharif* season of the year 2016 at College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand. The results of the experiment indicated that plant height at harvest was significantly higher with application of 25 kg $ZnSO_4$ ha^{-1} + 1.5 kg Chelated Fe ha^{-1} (T_9) resulted in 5.84 percent increase in plant height over control. The number of tillers $meter^{-1}$ at 45 DAS, at harvest and number of effective tillers at harvest were not significantly altered due to different treatments of zinc and iron application. Significantly higher grain (3085 kg ha^{-1}) and total yield (9266 kg ha^{-1}) were obtained when 25 kg $ZnSO_4$ ha^{-1} + 50 kg $FeSO_4$ ha^{-1} (T_{10}) applied followed by 1.5 kg Chelated Zn ha^{-1} + 50 kg $FeSO_4$ ha^{-1} (T_5). Treatment 1.5 kg Chelated Zn ha^{-1} + 50 kg FeSO4 ha^{-1} (T_5) produced significantly higher straw yield followed by 25 kg $ZnSO_4$ ha^{-1} + 50 kg $FeSO_4$ ha^{-1} (T_{10}).

Keywords: Pearl millet, zinc, iron, yield attributes

Introduction

Pearl millet (*Pennisetum glaucum* (L.) is one of the important food grain crop of India ranking fourth in average to rice, wheat and sorghum in that order. Its common name over a large part of India is *bajra* or *bajri*. Pearl millet cultivation is mainly confined to the arid and semi - arid zones prehistoric time. The nutritive value of pearl millet is fairly high. Gujarat ranks third in the production of pearl millet in India whereas Rajasthan tops the list and Uttar Pradesh is in second position. It is cultivated over an area of 0.39 million hectares in Gujarat. The total production is 0.79 million tones and the productivity is 2004 kg ha^{-1} (Anon., 2016-17) [1]. It contains 5 per cent fat (either extract), 9.15 per cent protein, 2.7 per cent mineral matter and gives 360 calorie per 100 g with high amount of vitamins A and B, it imparts substantial energy to the body with easy digestibility. In addition on grain, it also supplies fair quality dry fodder in large bulk.

The nutritive value of pearl millet crop is fairly high. It contains 12.4% moisture, 11.6% protein, 5% fat, 67% carbohydrates and about 2.7% minerals.it is also rich in Vit-A, Vit-B and impart substantial energy for baby (360 calories $100g^{-1}$) (Malik, 2015) [11]. Pearl millet grains are eaten cooked like rice or "chapaties" are prepared out of flour like maize or sorghum flour.

Agricultural produces, lower in micronutrient content, failed to meet up its (Zn) requirements for human nutrition (Singh and Prasad, 2014) [15]. Continuous reliance on high proportion of cereals-based foods with low amount and availability of Zn appears to be the major reason for the widespread occurrence of the Zn deficiency problem in human.

Iron (Fe) plays an important role in the plant growth. It is a cofactor for approximately 140 enzymes that catalyze unique biochemical reactions. Deficiency or low activity of iron in the plant causes chlorophyll is not produced in sufficient quantities and the leaves are pale. It helps in the formation of chlorophyll and is constituent of enzyme systems which bring about oxidation reductions in plants. Fe is essential for respiration, photosynthesis and fixation of atmospheric nitrogen by nitrogen fixing organisms.

Scenario of micronutrient deficiency in north India in early eighties was different than now after four decades. Zinc deficiency remained a major problem all over country. Zinc deficiency has increased from 44% to 48% and expected to further increase up to 63% by 2025 as most of the marginal soil are showing higher response to added zinc. (Singh 2006) [14].

Material and Methods

The field study was planned during *kharif* season of the year 2016 at the College Agronomy Farm, B. A. College of Agriculture, Anand Agricultural University, Anand. The experimental plot was prepared as per the method described by Bhuriya *et al.* (2019) [2]. Total 10 treatments were included in the present investigation treatments were comprised of Zn and Fe fertilizers application through $ZnSO_4$ and $FeSO_4$ as well as chelated forms of Zn and Fe.T_1 0 kg Zn ha^{-1} + 0 kg Fe ha^{-1} (control) ,T_2 0 kg Zn ha^{-1}+ 50 kg $FeSO_4$ ha^{-1}, T_3 0.5 kg Chelated Zn ha^{-1}+ 50 kg $FeSO_4$ ha^{-1} ,T_4 1.0 kg Chelated Zn ha^{-1} + 50 kg $FeSO_4$ ha^{-1} ,T_5 1.5 kg Chelated Zn ha^{-1} +50 kg $FeSO_4$ ha^{-1} ,T_6 25 kg $ZnSO_4$ ha^{-1} + 0 kg Fe ha^{-1}, T_7 25 kg $ZnSO_4$ ha^{-1} + 0.5 kg Chelated Fe ha^{-1},T8 25 kg $ZnSO_4$ ha^{-1}+1.0 kg Chelated Fe ha^{-1}, T_9 25 kg $ZnSO_4$ ha^{-1}+1..5 kg Chelated Feha^{-1},T_{10} 25 kg $ZnSO_4$ ha^{-1}+ 50 kg $FeSO_4$ ha^{-1}.

Zn_0, $Zn_{0.5}$, $Zn_{1.0}$ and $Zn_{1.5}$: 0.0, 0.5, 1.0 and 1.5 kg Zn Chelated
Fe_0, $Fe_{0.5}$, $Fe_{1.0}$ and $Fe_{1.5}$: 0.0, 0.5, 1.0 and 1.5 kg Fe Chelated
Zn_{25}: $ZnSO_4$25 kgha^{-1}
Fe_{50}: $FeSO_4$50 kgha^{-1}

Plant height was measured from base of the plants up to growing tip of leaves and average plant height was calculated by taking the mean of five observations and expressed in centimeter (Bhuriya, *et al.*, 2015) [3]. The number of tillers meter^{-1} raw length were calculated by counting the number of tillers of plants from one-meter area of each plot. Test weight was taken by weighing 1000 grains from each plot, while grain yield was measured from the net plot after sundering the ear heads and stover yield was measured after sun drying the straw for 10 days.

Result and discussion

Plant height of pearl millet (cm)

Plant height at 30 was not significantly influenced by different treatments but significantly differed at harvest. The plant height at harvest was significantly higher due to treatment T_9 (25 kg $ZnSO_4$ ha^{-1} + 1.5 kg Chelated Fe ha^{-1}) followed by T_{10} (25 kg $ZnSO_4$ ha^{-1} + 50 kg $FeSO_4$$ha^{-1}$) and T_7 (25 kg $ZnSO_4$ ha^{-1} + 0.5 kg Feha^{-1}). The magnitude of increases in percentage of plant height was 5.85% under T_9 (25 kg $ZnSO_4$ ha^{-1} + 1.5 kg Chelated Fe ha^{-1}) over no application of Zn and Fe treatment T_1 (Table 1). These findings are in line with those reported by Choudhary *et al.* (2005) [5]. Dadhich and Gupta (2003) [6] also reported significant increase in plant height of the pearl millet crop due to application of 10 kg Zn ha^{-1}.

Number of tillers meter^{-1} raw length

The number of tillers meter^{-1} at 45 DAS, at harvest and number of effective tillers at harvest were not significantly altered due to different treatments of zinc and iron application. However, maximum number of tillers at 45 DAS (41.17 m^{-1}), at harvest (40.12 m^{-1}) and number of effective tillers at harvest (34.72 m^{-1}) were found under T_6 (25 kg $ZnSO_4$ ha^{-1} + 0 kg Fe ha^{-1}) T_5 (1.5 kg chelated Znha^{-1} + 50 kg $FeSO_4$ ha^{-1}) and T_{10} (25 kg $ZnSO_4$ ha^{-1}+50 kg $FeSO_4$ ha^{-1}) respectively. The increases in number of effective tillers at harvest was 12.69% under T_{10} (25 kg $ZnSO_4$ ha^{-1} + 50 kg $FeSO_4$ ha^{-1}) as compared to T_1 (Table 1). Ram *et al.* (2008) [12] and Khan *et al.* (2008) [10], observed that the application of 7.5 kg Zn ha^{-1} significantly increased the number of effective tillers per meter row length over 2.5 kg.

Test weight (g) (1000 seeds)

The data on 1000 seed weight of pearl millet as affected by different treatments was summarized in Table 1. It is an important yield attributing character which determines the grain size. It is inferred from the data given in Table 1 that though results are non-significant, but the different treatments of zinc and iron were able to improve 1000 grain weight to some extent. Maximum test weight (9.01 g) was noted under application of 25 kg $ZnSO_4$ ha^{-1} + 50 kg $FeSO_4$ ha^{-1} (T_{10}). The similar trend was also reported by Jat *et al.* (2002) in pearl millet.

Grain yield of pearl millet

The grain yield of pearl millet was significant altered with application of zinc and iron treatments. Significantly higher grain yield (3085 kg ha^{-1}) was observed with treatment T_{10} (25 kg $ZnSO_4$ ha^{-1} + 50 kg $FeSO_4$ ha^{-1}), followed by T_5 (1.5 kg Zn ha^{-1} + 50 kg $FeSO_4$ ha^{-1}). The percentage increase in yield due to application of 25 kg $ZnSO_4$ ha^{-1} + 50 kg $FeSO_4$ ha^{-1} (T_{10}) and T_5(1.5 kg Zn ha^{-1} + 50 kg $FeSO_4$ ha^{-1}) was to the tune of 19.20 and 15.96 percent respectively over control (T_1) (Table 1). These results are in close conformity with those of Singh *et al.* (1996) [13], Choudhary *et al.* (1997) and Islam *et al.* (1998) [8].

Stover yield of pearl millet

The stover yield of pearl millet was significantly increased with application of zinc and iron. Significantly higher straw yield (6191 kg ha^{-1}) was recorded under application of T_5 (1.5 kg Chelated Zn ha^{-1} + 50 kg $FeSO_4$ ha^{-1}), followed by 25 kg $ZnSO_4$ ha^{-1} + 50 kg $FeSO_4$ ha^{-1} (T_{10}) which was at par with all treatments barring T_1, receiving only NPK fertilization (0 kg Zn ha^{-1} + 0 kg Fe ha^{-1}). Treatments T_5 and T_{10} produced 18.58 and 18.39 percent more straw yield as compared to control (Table 1). Dhillon and Dhillon (1983) [7] showed that application of Zn as $ZnSO_4$ in a chelated form significantly increased the dry matter yield of maize and wheat grown in a Zn-deficient alkaline soil.

Table 1: Effect of zinc and iron on yield and yield attributes of pearl millet

Treatments		Plant height (cm)		Number of tillers meter^{-1}		Test weight (g)	Grain yield (kg/ha)	Stover yield (kg/ha)
		At 30 DAS	At harvest	45 DAS	At Harvest			
T_1	Zn_0Fe_0	41.65	171.05	36.82	8.25	8.25	2588	5221
T_2	Zn_0Fe_{50}	41.02	173.70	39.08	8.65	8.65	2784	5835
T_3	$Zn_{0.5}Fe_{50}$	40.64	173.00	38.28	8.68	8.68	2856	5978
T_4	$Zn_{1.0}Fe_{50}$	41.53	178.43	39.10	8.69	8.69	2948	6074
T_5	$Zn_{1.5}Fe_{50}$	41.95	179.08	40.12	8.70	8.70	3001	6191
T_6	$Zn_{25}Fe_0$	41.57	174.18	39.38	8.77	8.77	2825	5938
T_7	$Zn_{25}Fe_{0.5}$	42.08	180.83	39.65	8.78	8.78	2918	6007
T_8	$Zn_{25}Fe_{1.0}$	41.93	178.50	39.07	8.96	8.96	2945	6064
T_9	$Zn_{25}Fe_{1.5}$	39.41	181.05	39.60	8.97	8.97	2901	6058
T_{10}	$Zn_{25}Fe_{50}$	41.58	180.95	39.30	9.01	9.01	3085	6181

SEm ±	0.97	2.16	1.44	1.12	0.15	89.90	174
CD at 5%	NS	6.26	NS	NS	NS	261	505
CV%	4.68	2.44	7.14	5.71	3.45	6.23	5.84

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