The Pharma Innovation Journal 2023; 12(2): 705-710

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(2): 705-710

www.thepharmajournal.com
Received: 25-11-2022
Accepted: 28-12-2022

Ghodke SD
Agril Microbiology Section, Vasantdada Sugar Institute, Manjari (BK) Pune, Maharashtra, India

Jadhav DS
Agril Microbiology Section, Vasantdada Sugar Institute, Manjari (BK) Pune, Maharashtra, India

Corresponding Author:
Ghodke SD
Agril Microbiology Section, Vasantdada Sugar Institute, Manjari (BK) Pune, Maharashtra, India

Potential of consortium of iron and zinc solubilizing microorganisms along with graded levels iron & zinc sources on yield and quality of sugarcane

Ghodke SD and Jadhav DS

Abstract
A Multilocational field research trial was conducted to evaluate potential of iron and zinc solubilizing microorganisms along with graded levels of iron and zinc source on yield and quality of sugarcane under iron and zinc deficient soil at Bhimashankar SSK Ltd., Pune, SM Bhausaheb Thorat SSK Ltd., Ahmednagar, Datta SSSK Ltd., Kolhapur and Pandurang SSK, Ltd., Solapur during 2020-2021 in Maharashtra. The field research trial at each location was conducted under graded levels of Iron and Zinc source (0, 50 and 100%) and iron and zinc solubilizing microorganisms (2.5, 3.75 and 5.0 lit/ha) with three replications. The data revealed that soil application of 12.5 kg $FeSO_4$ and 10 kg $ZnSO_4$ ha^{-1} by mixing with 500 Kg FYM along with GRDF (250:115:115 kg N: P_2O_5: K_2O and 20 t FYM ha^{-1}) and drenching of consortium of iron and zinc solubilizing microbial liquid bioinoculant @ 5.0 lit/ha in 500 lit of water at the time of planting can be done for improvement of Iron and Zinc status, saving of 50% recommended dose of Fe and Zn source, higher cane yield (135.65 t/ha) and sugar yield (15.56 t/ha) as compared to control i.e. 100% NPK (110.12 t/ha) and (11.87 t/ha) respectively in *Suru* sugarcane under iron and zinc deficient soil of Maharashtra.

Keywords: Iron and zinc source, iron and zinc solubilizers, microorganisms, sugarcane

Introduction
Sugarcane requires continuous supply of essential micronutrients like Iron and Zinc, for obtaining the expected yield. Microorganisms play important roles in solubilization of iron by producing organic acids which reduces ferric iron as electron acceptor to a ferrous state directly in catabolising organic matter or indirectly by forming a reductant such as hydrogen sulfide. Solubilization can be accomplished by a range of mechanisms, which include excretion of metabolites such as organic acids, proton extrusion or production of chelating agents (Sayer and Gadd, 1997; Nahas, 1996) [11, 7]. The production of gluconic acid solubilizes mineral phosphates. Other mechanisms includes production of other inorganic acids such as sulphuric acid, nitric acid and carbonic acid have also been reported (Rodriguez and Reynaldo, 1999; Seshadre *et al*., 2002) [8, 10].
Deficiency of Zn is world widely known. Zn plays a important role in the solubilization, transport and deposition of metals and minerals in the environment. Microorganisms transforms the unavailable form of metal to available form depending upon the reactions involved and the products formed (Lovely, 1991) [5]. The secretion of organic acids appears to be the functional metal resistance mechanism that chelates the metal ions extracellularly (Li *et al*., 2007) [4]. The ability to dissolve appreciable amount of zinc phosphate is not common feature amongst the culturable bacteria on the soil surface (Di Simine *et al*., 1998) [3].
The attempt was to study the potential of consortium of iron and zinc solubilizing microorganisms along with graded levels of iron & zinc sources on yield and quality of sugarcane. The results revealed that the maximum cane & sugar yield was obtained where drenching of consortium of Iron & Zinc solubilizing microorganisms @ 5.0 lit/ha with 100% NPK & 100% Iron & Zinc sources i.e. 25 kg/ha & 20 kg/ha gave significantly higher cane yield 138.96 t/ha followed by 135.65 t/ha where 5.0 lit/ha iron & zinc solubilizing bioinoculant with 50% Iron & Zinc i.e. 12.5 kg/ha & 10 kg/ha was applied over control (110.12 t/ha) where 100% NPK was applied. The B:C ratio significantly higher 1: 2.77 was also found in same treatment.

Materials and Methods

Organic acid producing microorganisms were procured from biofertilizers production unit of the Agril. Microbiology section. For evaluation of effect of graded levels of Iron and Zinc source and iron and zinc solubilizing microorganisms on yield and quality of sugarcane, multilocation trial at 4 sugar mills in Maharashtra state was conducted during 2020-2021. The experiment was laid out in a Split plot Design with 12 treatments and 3 replications. The experimental plot with Inceptisol order, deficient in Fe & Zn and low status of organic carbon content, black soil was selected for trial. Composite soil sample from the experimental site was collected and processed for analysis of soil properties and fertility. After collection of soil, it was air dried under diffused sunlight and processed for initial & at harvest chemical properties. The location wise initial soil status of experimental plot is presented in Table no. 1

Table 1: Soil analysis at initial stage (before planting)

Sugar Mills	pH	EC ds m^{-1}	Organic carbon (%)	Available N (Kg/ha)	Available P (Kg/ha)	Available K (Kg/ha)	DTPA extractable Zn (mg/kg)	DTPA extractable Fe (mg/kg)
Bhimashankar SSK, Pune	7.6	0.25	0.35	266.00	11.2	196	0.51	3.24
Pandurang SSK, Solapur	8.42	0.28	0.39	213.40	43.40	387	0.54	2.18
Datta SSK, Kolhapur	8.18	0.48	0.91	419.40	36.70	605	0.12	4.20
SMBT, SSK, A'nagar	8.78	0.26	0.45	238.33	43.79	596.96	0.37	2.89

The experiments at each location were conducted under graded levels of Fe and Zn source (0, 50 & 100%) and iron & zinc solubilizing microorganisms (2.5, 3.75 & 5.0 lit/ha) with three replications with following treatments.

The main treatments were levels of Fe and Zn ($FeSO_4$ & $ZnSO_4$) i.e. 0%, 50% (12.5+10 kg/ha) & 100% (25+20 kg/ha) and sub treatments were levels of Iron & Zinc solubilizing microorganisms i.e. 2.5 lit/ha, 3.75 lit/ha & 5.0 lit/ha

Fe & Zn solubilizing microorganisms were applied as soil application at the time of planting by drenching. Fe & Zn source applied by mixing with 500 kg FYM. 100% NPK & FYM @ 20 t/ha was applied to all treatments.

Soil analysis for chemical & microbial count at initial, earthing up & at harvest. Observations were recorded for Germination% 45 DAP, Tillering count at 120 DAP. Growth parameters for No. of Millable canes, Millable Height cane, Girth, No. of Internodes, Length of internodes at 10 months age, Cane yield kg/plot, Cane yield t/ha. Analyzed Pol%, Brix%, CCS%, Purity%, CCS yield (t/ha). Cost of Cultivation, Gross Monitory returns & B:C ratio. Microbial count was conducted by serial dilution and standard plate count method.

Results

The data on different growth parameters, cane and sugar yield are presented in table 2 &3. It was observed that Iron & zn solubilizing microorganisms in sugarcane improved cane & sugar yield of sugarcane as compared to control where only NPK fertilizer was applied. Moreover, the pooled data of all experiments revealed that application of Iron & Zinc solubilizing microorganisms @ 5.0 lit/ha with 100% NPK & 100% Iron & Zinc sources i.e. 25 kg/ha & 20 kg/ha gave significantly higher cane yield 138.96 t/ha and sugar yield 15.75 t/ha followed by cane yield 135.65 t/ha and sugar yield 15.56 t/ha where 5.0 lit/ha iron & zinc solubilizing microorganisms with 50% Iron & Zinc i.e. 12.5 kg/ha & 10 kg/ha was applied over control cane yield 110.12 t/ha and sugar yield 11.87 t/ha where 100% NPK was applied.

Economics returns of sugarcane due to microorganisms were worked out according to prices of fertilizer and sugarcane during 2020-21. It was evident that maximum cost benefit ratio (1: 2.78) was obtained where microorganisms @ 5.0 lit/ha with 100% Iron & Zinc source (25 kg/ha & 20 kg/ha) was used. Soil & leaf analysis conducted at harvest, the results revealed that the highest soil Fe (3.92 mg/kg) & leaf Fe (636.94 ppm) and soil Zn(0.75mg/kg) & leaf Zn (14.53 ppm) recorded where application of Iron & Zinc solubilizing microorganisms @ 5.0 lit/ha with 100% Iron & Zinc source i.e.25 kg/ha & 20 kg/ha as compared to control Fe(3.12 mg/kg) leaf Fe (337.46 ppm) and soil Zn(0.38 mg/kg) & leaf Zn(8.48 ppm). The same results were reported by L. Arrieta & R. Grez in 1971 related to iron solubilization by soil microorganisms and by Di Simine CD, Sayer JA, Gadd GM. (1998) related to zinc solubilization of zinc phosphate by strain of *Pseudomonas fluorescens* isolated from forest soil. Initial microbial count was Bacteria ($1X10^5$) and Fungi ($2X10^5$) which became $1X10^8$ and $2X10^6$ $2x10^8$ & $1X\ 10^8$ bacteria & fungi respectively at harvest with 100% Fe & Zn source and microorganisms @ 5. 0 lit/ha & 50% Fe & Zn source and consortium @ 5.0 lit/ha respectively. In control at harvest it was Bacteria ($12X10^{5)}$ and Fungi ($3X10^5$). The same trend was observed by Arigela Kiran *et al.* in 2019 [1]. The data is presented in Table 6.

Table 2: Effect of Iron& Zinc solubilizing microorganisms on growth & yield of sugarcane (Pooled data).

<table>
<tr><th>Tr. No.</th><th colspan="2">Cane Yield (t/ha)</th><th colspan="2">CCS Yield (t/ha)</th><th colspan="2">N.M.C. (‘000/ha)</th><th colspan="2">Millable Height (Cm)</th><th colspan="2">Girth (Cm)</th><th colspan="2">No. of internodes</th><th colspan="2">B:C Ratio</th><th colspan="2">Tillering ratio</th><th colspan="2">Germi nation%</th><th colspan="2">CCS %</th><th colspan="2">Purity %</th></tr>
<tr><td>Control</td><td colspan="2">110.12</td><td colspan="2">11.87</td><td colspan="2">70.17</td><td colspan="2">236.33</td><td colspan="2">9.45</td><td colspan="2">21.99</td><td colspan="2">2.23</td><td colspan="2">6.19</td><td colspan="2">61.30</td><td colspan="2">11.87</td><td colspan="2">88.66</td></tr>
<tr><td>FeZnSB @ 2.5 lit/ha</td><td colspan="2">122.09</td><td colspan="2">13.56</td><td colspan="2">72.85</td><td colspan="2">241.55</td><td colspan="2">9.49</td><td colspan="2">22.22</td><td colspan="2">2.50</td><td colspan="2">6.70</td><td colspan="2">64.42</td><td colspan="2">13.56</td><td colspan="2">89.50</td></tr>
<tr><td>FeZnSB @ 3.75 lit/ha</td><td colspan="2">132.57</td><td colspan="2">14.50</td><td colspan="2">73.41</td><td colspan="2">242.24</td><td colspan="2">9.62</td><td colspan="2">22.54</td><td colspan="2">2.66</td><td colspan="2">6.17</td><td colspan="2">62.67</td><td colspan="2">14.50</td><td colspan="2">89.17</td></tr>
<tr><td>FeZnSB @ 5.0 lit/ha</td><td colspan="2">133.59</td><td colspan="2">14.88</td><td colspan="2">73.66</td><td colspan="2">243.76</td><td colspan="2">9.80</td><td colspan="2">22.70</td><td colspan="2">2.75</td><td colspan="2">6.21</td><td colspan="2">58.37</td><td colspan="2">14.88</td><td colspan="2">89.57</td></tr>
<tr><td>Fe+Zn (100%)</td><td colspan="2">127.95</td><td colspan="2">14.18</td><td colspan="2">73.12</td><td colspan="2">248.19</td><td colspan="2">9.80</td><td colspan="2">22.45</td><td colspan="2">2.53</td><td colspan="2">6.23</td><td colspan="2">62.99</td><td colspan="2">14.18</td><td colspan="2">88.74</td></tr>
<tr><td>Fe+Zn (100%)+ FeZnSB @ 2.5 lit/ha</td><td colspan="2">133.82</td><td colspan="2">15.16</td><td colspan="2">73.84</td><td colspan="2">251.61</td><td colspan="2">9.93</td><td colspan="2">22.77</td><td colspan="2">2.57</td><td colspan="2">6.31</td><td colspan="2">62.73</td><td colspan="2">15.16</td><td colspan="2">89.35</td></tr>
<tr><td>Fe+Zn (100%) FeZnSB @ 3.75lit/ha</td><td colspan="2">128.96</td><td colspan="2">14.34</td><td colspan="2">74.93</td><td colspan="2">249.53</td><td colspan="2">10.00</td><td colspan="2">23.18</td><td colspan="2">2.58</td><td colspan="2">6.20</td><td colspan="2">64.12</td><td colspan="2">14.34</td><td colspan="2">89.33</td></tr>
<tr><td>Fe+Zn (100%) FeZnSB @ 5.0 lit</td><td colspan="2">138.96</td><td colspan="2">15.75</td><td colspan="2">76.53</td><td colspan="2">255.14</td><td colspan="2">10.09</td><td colspan="2">23.47</td><td colspan="2">2.78</td><td colspan="2">6.11</td><td colspan="2">60.31</td><td colspan="2">15.75</td><td colspan="2">88.60</td></tr>
<tr><td>Fe + Zn (50%)</td><td colspan="2">118.30</td><td colspan="2">13.38</td><td colspan="2">68.44</td><td colspan="2">245.31</td><td colspan="2">9.74</td><td colspan="2">22.18</td><td colspan="2">2.36</td><td colspan="2">6.14</td><td colspan="2">58.81</td><td colspan="2">13.38</td><td colspan="2">89.18</td></tr>
<tr><td>Fe+Zn (50%+ FeZnSB @ 2.5 lit/ha</td><td colspan="2">131.45</td><td colspan="2">15.07</td><td colspan="2">72.05</td><td colspan="2">249.06</td><td colspan="2">10.01</td><td colspan="2">22.38</td><td colspan="2">2.59</td><td colspan="2">6.35</td><td colspan="2">60.31</td><td colspan="2">15.07</td><td colspan="2">89.28</td></tr>
<tr><td>Fe+Zn (50%) FeZnSB @ 3.75 lit/ha</td><td colspan="2">134.21</td><td colspan="2">15.03</td><td colspan="2">72.45</td><td colspan="2">251.19</td><td colspan="2">9.96</td><td colspan="2">22.94</td><td colspan="2">2.70</td><td colspan="2">6.30</td><td colspan="2">58.13</td><td colspan="2">15.03</td><td colspan="2">89.22</td></tr>
<tr><td>Fe+Zn (50%) FeZnSB @ 5.0 lit</td><td colspan="2">135.65</td><td colspan="2">15.56</td><td colspan="2">74.54</td><td colspan="2">250.67</td><td colspan="2">10.03</td><td colspan="2">23.26</td><td colspan="2">2.77</td><td colspan="2">5.96</td><td colspan="2">60.93</td><td colspan="2">15.56</td><td colspan="2">89.63</td></tr>
<tr><td></td><td>CD at 5%</td><td>SE (m) ±</td><td>CD at 5%</td><td>SE (m) ±</td><td>CD at 5%</td><td>SE (m) ±</td><td>CD at 5%</td><td>SE (m) ±</td><td>CD at 5%</td><td>SE (m) ±</td><td>CD at 5%</td><td>SE (m) ±</td><td>CD at 5%</td><td>SE (m) ±</td><td>CD at 5%</td><td>SE (m) ±</td><td>CD at 5%</td><td>SE (m) ±</td><td>CD at 5%</td><td>SE (m) ±</td><td>CD at 5%</td><td>SE (m) ±</td></tr>
<tr><td>Main treatment</td><td>9.10</td><td>3.03</td><td>1.23</td><td>0.41</td><td>8.04</td><td>2.62</td><td>9.14</td><td>3.05</td><td>0.21</td><td>0.073</td><td>1.74</td><td>0.079</td><td>0.23</td><td>0.079</td><td>0.54</td><td>0.17</td><td>NS</td><td>0.70</td><td>0.41</td><td>1.23</td><td>1.27</td><td>0.41</td></tr>
<tr><td>Sub treatment</td><td>11.68</td><td>4.14</td><td>1.49</td><td>0.52</td><td>3.63</td><td>1.20</td><td>11.97</td><td>4.24</td><td>0.33</td><td>0.11</td><td>0.84</td><td>0.098</td><td>0.27</td><td>0.098</td><td>NS</td><td>0.17</td><td>NS</td><td>0.74</td><td>0.52</td><td>1.49</td><td>NS</td><td>0.33</td></tr>
<tr><td>Interaction</td><td>19.74</td><td>6.92</td><td>2.55</td><td>0.89</td><td>6.18</td><td>2.09</td><td>22.41</td><td>7.35</td><td>0.57</td><td>0.19</td><td>0.21</td><td>0.16</td><td>0.47</td><td>0.16</td><td>NS</td><td>0.34</td><td>NS</td><td>1.29</td><td>0.89</td><td>2.55</td><td>NS</td><td>0.66</td></tr>
</table>

Table 3: Effect of Iron & Zinc solubilizing microorganisms on Cost Benefit ratio (Pooled data)

Treatment Details	Cane Yield (t/ha)	Monetary returns (Rs/ha)	Cost of Agronomic cultivation (Rs.)	Cost of fertilizers	Cost of Fe source	Cost of Zn source	Cost of liquid FeZnS	Total cost of cultivation (Rs/ha)	Net Profit (Rs.)	Cost Benefit Ratio
Control	110.12	284295.06	113660	15578	0	0	0	129238	129301.2	2.07
FeZnSB @ 2.5 lit/ha	122.09	320698.40	113660	15578	0.00	0.00	500	129738	156322.5	2.28
FeZnSB @ 3.75 lit/ha	132.57	339842.56	113660	15578	0	0	750	129988	180194.1	2.47
FeZnSB @ 5.0 lit/ha	133.59	352186.98	113660	15578	0	0	1000	130238	182281.6	2.49
Fe + Zn (100%)	127.95	324287.75	113660	15578	225	820	0	130283	169540.1	2.39
Fe + Zn (100%) +FeZnSB @ 2.5 lit/ha	133.82	329829.77	113660	15578	225	820	500	130783	182547.5	2.49
Fe + Zn (100%) FeZnSB @ 3.75 lit/ha	128.96	332564.27	113660	15578	225	820	750	131033	171100.2	2.39
Fe + Zn (100%) FeZnSB @ 5.0 lit	138.96	357910.82	113660	15578	225	820	1000	131283	193855.4	2.57
Fe + Zn (50%)	118.30	301819.14	113660	15578	112.5	410	0	129760.5	147725.5	2.21
Fe + Zn (50%) +FeZnSB @ 2.5 lit/ha	131.45	332543.83	113660	15578	112.5	410	500	130260.5	177485.2	2.45
Fe + Zn (50%) FeZnSB @ 3.75 lit/ha	134.21	346302.06	113660	15578	112.5	410	750	130510.5	183582.2	2.50
Fe + Zn 50%) FeZnSB @ 5.0 lit	135.65	356754.01	113660	15578	112.5	410	1000	130760.5	186628.1	2.52

Table 4: Effect of Iron & Zinc solubilizing microorganisms on soil chemical parameters at harvest (Pooled data)

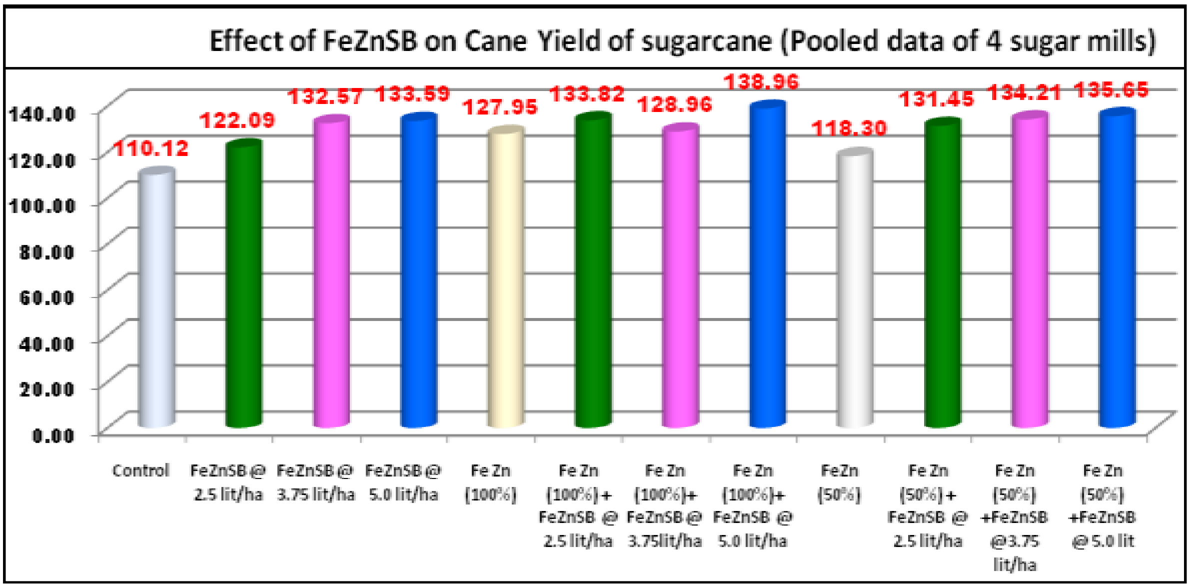
Treatment Details	DTPA extractable Fe (mg/kg)		DTPA extractable Zn(mg/kg)	
	At harvest		At harvest	
Initial	3.12		0.38	
Control	3.05		0.45	
FeZnSB @ 2.5 lit/ha	3.39		0.50	
FeZnSB @ 3.75 lit/ha	3.45		0.57	
FeZnSB @ 5.0 lit/ha	3.50		0.59	
Fe + Zn (100%)	3.67		0.63	
Fe + Zn (100%) +FeZnSB @ 2.5 lit/ha	3.73		0.64	
Fe + Zn (100%) FeZnSB @ 3.75 lit/ha	3.91		0.71	
Fe + Zn (100%) FeZnSB @ 5.0 lit	3.92		0.75	
Fe + Zn (50%)	3.30		0.65	
Fe + Zn (50%) +FeZnSB @ 2.5 lit/ha	3.53		0.66	
Fe + Zn (50%) FeZnSB @ 3.75 lit/ha	3.75		0.66	
Fe + Zn 50%) FeZnSB @ 5.0 lit	3.85		0.68	
	SE (m) ±	CD at 5%	SE (m) ±	CD at 5%
Main treatment	0.19	0.57	0.63	1.89
Sub treatment	0.23	0.69	0.55	1.65
Interaction	0.40	1.20	1.10	3.30

Table 5: Effect of Iron& Zinc solubilizing microorganisms on leaf Fe & Zn at harvest (Pooled data)

Treatment Details	Leaf Fe (ppm)		Leaf Zn(ppm)	
Control	337.46		8.48	
FeZnSB @ 2.5 lit/ha	329.17		9.51	
FeZnSB @3.75 lit/ha	338.97		10.59	
FeZnSB @ 5.0 lit/ha	356.47		10.73	
Fe + Zn (100%)	538.04		12.68	
Fe + Zn (100%)+FeZnSB @ 2.5 lit/ha	559.16		13.51	
Fe + Zn (100%) FeZnSB@ 3.75 lit/ha	544.69		13.64	
Fe + Zn (100%) FeZnSB@ 5.0 lit	636.94		14.53	
Fe + Zn (50%)	427.10		11.45	
Fe + Zn (50%) +FeZnSB @ 2.5 lit/ha	456.12		13.50	
Fe + Zn (50%) FeZnSB @3.75 lit/ha	539.02		14.15	
Fe + Zn 50%) FeZnSB @ 5.0 lit	619.88		14.46	
	SE (m) ±	CD at 5%	SE (m) ±	CD at 5%
Main treatment	3.53	10.58	0.05	0.15
Sub treatment	6.83	13.62	0.06	0.18
Interaction	8.06	23.00	0.11	0.33

Table 6: Microbial count in soil (Pooled data)

	Microbial count (CFU/gm of soil)			
	At Earthing up		At harvest	
Treatment	**Bacteria**	**Fungi**	**Bacteria**	**Fungi**
Control	$3.0 X10^5$	$1.0 X10^5$	$12.0 X10^5$	$3.0 X10^5$
FeZnSB @ 2.5 lit/ha	$5.0 X10^6$	$2.0 X10^6$	$2.0 X 10^8$	$3.0 X10^6$
FeZnSB @ 3.75 lit/ha	$4.0 X 10^8$	$1.0 X10^8$	$16.0 X10^8$	$4.0 X10^6$
FeZnSB @ 5.0 lit/ha	$4.0 X 10^8$	$2.0 X10^8$	$21.0 X10^8$	$7.0 X10^6$
Fe + Zn (100%)	$4.0 X10^6$	$2.0 X10^6$	$1.0 X10^6$	$1.0 X 10^4$
Fe + Zn (100%) + FeZnSB @ 2.5 lit/ha	$5.0 X 10^8$	$4.0 X10^6$	$9.0 X 10^6$	$12.0 X10^5$
Fe + Zn (100%)+FeZnSB @ 3.75lit/ha	$9.0 X10^6$	$1.0 X10^6$	$20.0 X10^5$	$4.0 X10^5$
Fe + Zn (100%) +FeZnSB @ 5.0 lit	$1.0 X 10^{12}$	$6.0 X10^8$	$2.0 X10^{10}$	$1.0 X 10^8$
Fe + Zn (50%)	$9.0 X10^6$	$1.0 X10^6$	$9.0 X10^6$	$29.0 X 10^4$
Fe + Zn (50%) + FeZnSB @ 2.5 lit/ha	$2.0 X 10^{10}$	$3.0 X10^8$	$23.0 X10^8$	$2.0 X10^6$
Fe + Zn (50%) +FeZnSB @3.75 lit/ha	$14.0 X10^6$	$2.0 X10^6$	$1.0 X 10^6$	$4.0 X 10^4$
Fe + Zn (50%) +FeZnSB @ 5.0 lit	$1.0 X 10^{10}$	$2.0 X10^8$	$1.0 X10^8$	$2.0 X 10^6$



Graph 1: Effect of Iron& Zinc solubilizing microorganisms on yield of sugarcane under iron & zinc deficient soil

Image 1: Effect of Iron& Zinc solubilizing microorganisms on yield of sugarcane

Conclusion

The Multilocational field research trial showed that the maximum cane & sugar yield was obtained where drenching of Iron & Zinc solubilizing microorganisms @ 5.0 lit/ha with 100% NPK & 100% Iron & Zinc sources i.e. 25 kg/ha &20 kg/ha gave significantly higher cane yield 138.96 t/ha followed by 135.65 t/ha where 5.0 lit/ha iron & zinc solubilizing microorganisms with 50% Iron & Zinc i.e. 12.5 kg/ha & 10 kg/ha was applied over control (110.12 t/ha) where 100% NPK was applied. The B:C ratio significantly higher 1: 2.77 where application of Iron & Zinc solubilizing microorganisms @ 5.0 lit/ha with 50% Iron & Zinc source i.e. 12.5 kg/ha & 10 kg/ha)) was used. This may summarize that, due to application of iron & zinc solubilizing microorganisms @ 5lit/ha may increase Fe & Zn status of soil, which will reflect in increasing cane & sugar yield of sugarcane crop in Maharashtra and also may save 50% recommended dose of Fe & Zn source.

Acknowledgement

The authors are thankful to the Advisor & Director General of the Vasantdada Sugar Institute, Manjari (BK), Pune for providing necessary facilities for conducting this field research work.

References

1. Arigela Kiran, Kadu PP. Effect of Seed Inoculation of Zinc and Iron Solubilizing Microorganisms on Soil Microbial Count as Influenced by Different Treatments at Panicle Initiation and Harvest Stage of Wheat in Inceptisol. Int. J Curr. Microbiol. App. Sci. 2019;8(4):814-821.
2. Antoniadis V, Alloway BJ. The role of dissolved organic carbon in the mobility of Cd, Ni and Zn in sewage sludge- amended soils. Environ. Pollut. 2002;117:515-521.
3. Di Simine CD, Sayer JA, Gadd GM. Solubilization of zinc phosphate by strain of *Pseudomonas fluorescens* isolated from forest soil. Biol. Fertil. Soils, 1998;28:87-94.
4. Li TG. *et al.* Distribution and Composition of Extracellular Polymeric Substances in Membrane-Aerated Biofilm. Journal of Biotechnology, in revised form.[17], 2007.
5. Lovely DR. Dissimilatory Fe (III) and Mn(IV) reduction. Microbial. Rev. 1991;55:259-287.
6. Luis Arrieta, Renato Grez. Solubilization of Iron-Containing Minerals by Soil Microorganisms. Applied microbiol. AEM. 1971;22(1):487-490

7. Nahas E. Factors determining rock phosphate solubilization by microorganisms isolated from soil. World J. Microbiol. Biotechnol. 1996;12:567-572.
8. Rodriguez H, Reynaldo F.. Phosphate solubilizing bacteria and their role in plant growth promotion. Biotechnol. Adv. 1999;17:319-339.
9. Sadaf Shahab, Nuzhat Ahmed. Effect of various parameters on the efficiency of zinc phosphate solubilization by indigenous bacterial isolates. African Journal of Biotechnology, 7(10), 1543-1549.
10. Seshadre S, Muthukumarasamy R, Lakshminarasimhan C, Ignaacimuthu S. Solubilization of inorganic phosphates by *Azospirillum halopraeferans*. Curr. Sci. 2002;79(5):565- 567.
11. Sayer JA, Gadd GM. Solubilization and transformation of insoluble metal compounds to insoluble metal oxalates by *Aspergillus niger*. Mycol. Res. 1997;101:653-651.
12. Sunitha Kumari K, Padma Devi SN, Vasandha S, Anitha S. Microbial Inoculants- A Boon to Zinc Deficient Constraints in Plants: A Review. International Journal of Scientific and Research Publications, 2014, 4(6).