

# **Silicon Nutrition for Sugarcane**

Sugarcane is an important cash crop & plays an important role in the country's Agril. economy. But day by day due to various reasons sugarcane productivity is going down, on the other side, production cost is increasing heavily due to increase in fertilizer cost, Labour cost, electricity charges, etc. Deteriorating soil health is also one of the concerns of low cane yields.

Sugarcane is silicon (Si) accumulating crop and responds very well for silicon fertilization. Deficiency of silicon to sugarcane is also one of the prime reasons for low cane yields & low sugar recovery.

Silicon (Si) is abundantly available Nutrient in the Earth's crust & is second to oxygen. It's content in soils vary greatly and ranges from less than 01% to 45% by dry weight. silicon is supposed to be beneficial element for the plants & not as an essential element. However Si has enhanced the growth, development & yield of many crops. The content of Si in many plants is more than N, P & K supplied through fertilizers. Plants may not be that much foolish to accumulate an element without any specific role in nutrition or physiology. Perhaps with the available knowledge man is not able to pin point it's exact role, requirement etc. even though he could observe it's beneficial effects on crop growth, pests & disease suppression yield etc. Man ignored exogenous application of this element with the belief that the soil itself can sustain it's supply. Unfortunately the silica that occurs in soil is in an unavailable polymerized form & for its absorption by plants it has to be depolymerized and rendered soluble by means of biological or chemical reaction in the soil.

Sugarcane being Si accumulating crop and it absorbs silicon more than N, P & K. According to Samuels (1969) 12 month old sugarcane crop of 100 MT / ha. absorbs about 400 Kg. Si; 205 Kg. N; 55 kg. P and 275 Kg. K per ha. It has been observed that one of the reasons for low yields of sugarcane is lack of Si fertilization to the crop. In the year 1937 Agril. Scientist from Mauritius Dr. Hotman has proved that sugarcane crop needs silicon in large quantity & shown the increase in cane yield from 30 to 60 MT per ha. by using silicon fertilizer. Now a days many cane growing countries like Brazil, Australia, South Africa, Mauritius etc. are using silicon fertilizers on large scale not only to sugarcane but for all the crops and harvesting the benefits of silicon. The productivity of sugarcane depends on mainly soil fertility, cane variety, No. of tillers, cane weight, water management, use of organic & chemical fertilizers in balance proportion, management of pests & diseases, time of harvesting etc. It can be seen from the following that how use of silicon can help positively in respect to above stated factors.

**Soil Fertility & Silicon:** - Soil helps mainly for root development, Nutrient availability, moisture conservation & supply, maintaining balance proportion of water & air etc. The use of silicon helps in improving soil health i.e. soil porosity, water holding capacity, buffering capacity, root development, root canal strengthening etc. It also improves nutrient uptake, soil aeration and provides favorable condition for the development of beneficial organisms.

**Silicon for Balanced fertilizer use:** - The use efficiency of fertilizers used for sugarcane is around 35% to 40%. It means about 60% to 65% nutrients in the fertilizers are lost due to various reasons like leaching, loss due to surface run off, evaporation and fixation of phosphates in the soil etc. Use of silicon helps preventing loss of Nitrogenous fertilizers to the extent of 40%, it also prevents phosphate fixation & makes available phosphates fixed in the soil & thus availability of phosphatic fertilizers can be increased by 40 to 70%. It also helps in increasing

availability of potash to the extent of 20%. Thus overall nutrient availability is increased to a greater extent which helps in better crop growth & better yields, increasing length & diameter of cane etc. It also strengthens the crop and thereby reduces lodging. It reduces toxic effects of over use of Nitrogen and toxicity caused due to Aluminum & Iron.

**Silicon for Disease & Pest management:** - Silicon helps in reducing attack of many insects like Woolly Aphids, Pyrilla, stem borer etc. as well as reduces infection of diseases like Rust, Ring spot, Leaf freckling etc. Use of silicon helps in strengthening cell walls & thereby making leaves hard & stiff. The sucking insects find difficulty in penetrating their trunk in the leaf and their mandibles get injured & thus reduces attack of many insects. The hard surface of leaf does not permit easy germination of spores of many diseases & prevents attack of above said diseases, which has been reported by Jones & Handrik (1967).

It has been observed that damage caused by sugarcane stalk borer (*Eldana saccharina*) is reduced to the greater extent by silicon use to sugarcane. White fly (*Bemisia tabaci*) is an important pest affecting several crops like cotton, sugarcane, tomato, Grapes & many other vegetables. Feeding & excreted honey dew of this insect leads to the formation of sooty moulds which reduces photoreception mechanically & thus reduces yields. These insects also transmit viral diseases. Infestation by this pest can significantly inhibit plant growth leading to plant death. Both soil & Foliar application of silicon increased mortality of nymphs of white fly.

The mechanism for silicon - Induced resistance to diseases is due to - I) Si acting as a physical barrier and II) soluble Si acting as a modulator of host resistance to pathogen. Si is deposited beneath the cuticle to form a cuticle - Si double layer which mechanically impedes penetration of fungi & thus disrupts the infection process.

Naidoo P. V., Caldwell P. M. and McFarlane S. from university of Kwa Zulu - Natal, South Africa have proved that the Brown rust disease (*Puccinia Melanocephala*) of sugarcane can be brought under control, by using potassium silicate as foliar spray.

**Prevention of Inversion of Sugar:** - This process is reported in sugarcane after maturity of cane. The Sucrose is converted in other forms of sugar compounds, which reduces cane weight and sugar contents. Use of silicon for sugarcane helps in formation & storage of sugar & prevents inversion of sugar in different sugar compounds. (Alexandar - 1971) which helps in reduction of sugar loss and cane weight.

**Water Economy and tolerance to drought stress:** - Improved silica nutrition reduces excessive leaf transpiration. The rate of transpiration is influenced by the amount of silica gel associated with cellulose in the cell walls of epidermal cells. Hence a well thickened layer of silica gel helps to retard water loss. In today's changing climatic conditions & water scarcity it is very important to improve water economy of the field crops facing water shortages. The scientists from Agril. and Life science, Gyeongsang National University, Jinju Korea, have conducted field experiments on various crops and proved that tolerance to high temperature & drought stress of Si treated plants is more than non treated plants.

**Reducing lodging & Improving Erectness:** - Erectness under field conditions particularly in dense stands of sugarcane, silica stimulates growth and yield by improving leaf erectness, which decreases susceptibility to lodging. Leaf erectness is an important factor affecting light interception in dense plant population and hence photosynthesis.

**Enhancement of photosynthesis:** - Silicon application increases physical leaf area index and there by more area is exposed to sunlight, allowing increased rates of carbon assimilation, under more than sufficient solar radiation. This helps plants to conserve more Nitrogen to keep leaf active by reducing loss of Nitrogen from Leaf surface.

**Increase in yields:** - It has been proved that sugarcane yield can be increased with the application of silicon fertilizers. Which has been observed under trials conducted at various locations in South Africa, Brazil, China, Australia etc.

It has been proved that sugarcane yield can be increased with the application of silicon fertilizers, which has been observed under the trials conducted at various locations in South Africa, Brazil, China, Australia, India etc. It has been also observed by the experiments conducted by Dr. N. K. Sawant that Si application has helped to increase cane yield from 10 to 50% and sugar yields up to 22% in plant cane.

The trials of Agrosil silicon fertilizer were conducted at Mahatma Phule krishi Vidyapeeth, Rahuri, District - Ahmednagar during the year 2011-12 and the data generated shows encouraging results in respect to yields, plant height, cane weight, sugar percentage etc. Agrosil use for sugarcane also shows that organic carbon content of soil is increased along with increase in available contents of N & P. This has helped in increasing yield and quality of sugarcane along with increase in sugar yields too.

Result of Trials of Agrosil silicon conducted at Mahatma Phule Krishi Vidyapeet Rahuri on sugarcane (Suru Crop - Phule - 265 variety).

Parameter of Assessment	Data of Parameters	
	T2 - 100% RDF through N:P:K (300:140:140)	T3 - 100% RDF through N:P:K + 100% RD of silicon i.e. 400 kg. per ha (500 kg. Vedant Agrosil )
1) No. of Tillers	6.8	7.7
2) Malleable cane height (cm)	301	351
3) No. of internodes	22.80	25.15
4) Girth of internode (cm)	11.58	12.79
5) Length of internode (cm)	14.30	15.23
6) Yield (t / ha)	162	176
7) Brix (%)	21.74	22.44
8) CCS (%)	11.16	11.72
9) CCS Yield (t / ha)	18.06	20.67

From the above data it is observed that additional 400 kg. silicon (500 kg Vedant Agrosil) can increase the cane yield by 14 MT per ha. Cost of Vedant Agrosil for 500 kg. is Rs. 6875=00. In other way with additional expenses of Rs. 6875/- additional yield of 14 MT per ha can be achieved along with additional sugar yield of 2.61 MT per ha.

The trails conducted at Vasant Dada Sugar Institute Manjri, Pune have shown positive effect of silicon use for sugarcane and cane yield of 18.3 MT & Sugar yield of 2.8 MT per ha. have been found increased by using 400 Kg. silicon fertilizers per ha.

Below given data of the trials conducted at Krishi Vigyan Kendra Kalwade, Taluka - Karad, District - Satara shows positive effect of Agrosil Silicon fertilizer use in sugarcane.

**Results of Trials of Agrosil Silicon fertilizers on Sugarcane - At Kalwade, Tal. Karad, Dist. - Satara**

Parameter of Assessment	Data on the Parameter	
	Trial - 1 (SAU RDE)	Trial - 2 (SAU RDF with 400 Kg. Agrosil)
1. Average No. of canes.	96048.94	103151.02
2. Average weight of cane (kg.)	1.280	1.480
3. Average No. of Internodes	22.11	25.50
4. Average diameter of Internodes (cm)	8.25	9.43
5. Average cane yield (MT / ha.)	123.33	152.83
6. Gross Expenditure Rs. / ha.	95576.65	105829.07
7. Net return Rs. / Unit	163423.65	215109.10
8. Net Profit Rs. / ha.	67847.00	109280.03
9. B : C Ratio	2.71	3.03

Trial 1: - State Agriculture University Recommended dose of fertilizers (SAU RDF)

Trial - 2 = SAU RDF with 400 kg. Agrosil silicon per ha.

From the above data it is seen that use of Agrosil silicon 400 kg. per ha. has increased sugarcane yield by 29.5 MT per ha. and net profit of Rs. 41433.00 per ha. Many farmers have gained additional cane yield of 30 to 35 MT per ha. by applying these fertilizers.

Many developed countries are studying silicon effects on various crops since more than last twenty years. So far five International Silicon Conferences have been held. The first International Silicon Conference was held at Florida in USA in the year 1999 and all the research data was compiled & published in the book titled "Silicon in Agriculture" by Datnaff, Corndorfer and Synder. Thereafter second world conference on silicon was held in Japan in the year 2002. The third one in Brazil (2005), the fourth one in South Africa (2008) & the fifth one in China (2011). Besides this University of Agril. Sciences, Bangalore have organized one International workshop on Silicon in Agriculture in the year 2010. It is very unfortunate that our Research Institutes have very little awareness about the importance of Silicon in Agriculture and worldwide research going on Silicon. Where as it is a fact that in the changing atmosphere Silicon in Agriculture will definitely gain an Importance.

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