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RESEARCH PAPER

Effect of silicon against pink bollworm, (*Pectinophora gossypiella*) in *Bt* cotton

CHINNU S. KASAVANNAVAR[1*], S. V. HUGAR[1], S. S. UDIKERI[1] AND VITTAL B. KULIGOD[2]

[1]Department of Entomology, [2]Department of Soil Science and Agril. Chemistry, College of Agriculture, Dharwad
University of Agricultural Sciences, Dharwad - 580 005, India
*E-mail: kasavannavarchinnu@gmail.com

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Abstract: Cotton (*Gossypium hirsutum* L.) stands as the primary fibre crop globally, particularly vital for the textile industry across numerous nations. However, cotton is notorious for its susceptibility to various insect pests and diseases and *Bt* cotton, in particular faces challenges from pink bollworm. Addressing this issue, the application of silicon-based fertilizers has gained attention for enhancing plant tolerance to insect feeding, thereby reducing damage. Although, Silicon (Si) is the second most abundant element in the earth's crust, to benefit plants, it must be absorbed in the form of silicic acid, which, upon absorption, forms hard structures known as phytoliths within plant tissues. These phytoliths fortify cell walls throughout the plant, increasing toughness and defending against both biotic and abiotic stressors. Thus, investigation on the impact of silicon on pink bollworm incidence in cotton during the *kharif* 2023-24 was conducted at Main Agricultural Research Station, Dharwad. The results revealed that among the silicon-based treatments, soil application of calcium silicate at a rate of 200 kg/ha followed by foliar application of silicic acid at 0.50 per cent, showed less significant effect with a mean average of 8.37 per cent flower damage, 41.28 per cent green boll damage and 10.88 number of larvae per ten bolls. Conversely, soil application of calcium silicate at 100 kg/ha and foliar application of silicic acid at 0.25 per cent were found to be the least effective with respect to pink bollworm incidence. However, there was higher reduction of pink bollworm incidence in chemical treatments compared to silicon-imposed treatments. Notably, soil application of calcium silicate at a rate of 200 kg/ha followed by foliar application of silicic acid at 0.50 per cent exhibited the highest silicon content in flower (1.52 g/kg) and cotton boll rind (1.65 g/kg), while the control and chemical check treatments showed lower silicon levels.

Key words: Cotton, Calcium silicate, Silicon, Silicic acid, Sucking pests

Introduction

Cotton (*Gossypium hirsutum* L.) is one of the most important fibre and cash crop of the world and plays a dominant role in the industrial and agricultural economy of the country. It provides the basic raw material (cotton fibre) to cotton textile industry. Its production provides income for more than 250 million people worldwide and employs almost 7 per cent of all labour in developing countries. In the vast canvas of cotton fields spanning 32.6 million hectares worldwide, with a yield reaching a staggering 116.10 million bales. India emerges as the star player, reigning supreme with 130.61 lakh hectares and a bale count of 343.47 lakh, each weighing 170 kg with the productivity of 445 kg lint per hectare (COCPC, 2023).

Despite India's high cotton production, there are still a number of production-related challenges, including pests, diseases, weeds and physiological disorders. A total of 1326 species of insects have been recorded on cotton throughout the world. In India alone, 130 insect pests ravage the cotton crop (Parmar and Patel, 2016). The pest spectrum of cotton crop is quite complex comprising of several species of the insects. However, main losses in cotton production are due to its susceptibility to about 162 species of insect pests. The sucking pests and bollworm complex account for a considerable yield loss up to 36.2 per cent. Chemical insecticides, are being used extensively for control of these insect pests, but after the introduction of *Bt* cotton the use of pesticides minimized and the problem of bollworms was solved, later in the year 2009-10, but from last few years, field-evolved resistance of pink bollworm to Cry1Ac (Dhurua and Gujar, 2011 Cry1Ab+Cry2Ab (Naik *et al*., 2018 and Rakhesh *et al*., 2024) have been recorded. Though the use of insecticides is one of the best methods to manage the pests, but there are incidences of insecticide resistance in key insect pests which has become a significant problem in crop production. So, there is a need for more effective with non-chemical and sustainable ways of management. This could be made possible by the application of silicon-based fertilizers to improve plant tolerance to insect feeding, thus reducing damage.

Material and methods

The field experiment was conducted during *kharif*, 2023-24 at Main Agricultural Research Station (M.A.R.S.), UAS Dharwad. The experiment was laid out in a randomized block design with 10 treatments replicated thrice. Each treatment plot accommodated six rows with a row length of 5.4m. The popular *Bt* cotton hybrid (Jadoo BG II) was raised as per the recommended package of practices except the insect protection measures. The spacing maintained was 90 × 60 cm. The details of treatments are given in Table 1.

The sowing of cotton was done on August 10th, 2023 in deep black soil by dibbling method. For treatment imposition, silicon was applied as basal soil application in the form of calcium silicate at the rate of 0.216 kg per plot which is equal to a dosage of 100 kg per hectare at the time of sowing for T_1, T_5 and T_6 treatment block and at the rate of 0.432 kg per plot which is

Table 1. Treatment details

Tr.No.	Treatment Combination
T_1	Soil application of calcium silicate @ 100 kg/ha
T_2	Soil application of calcium silicate @ 200 kg/ha
T_3	Foliar application of silicic acid @ 0.25%
T_4	Foliar application of silicic acid @ 0.50%
T_5	T_1 followed by Foliar application of silicic acid @ 0.25% (T_3)
T_6	T_1 followed by Foliar application of silicic acid @ 0.50% (T_4)
T_7	T_2 followed by Foliar application of silicic acid @ 0.25% (T_3)
T_8	T_2 followed by Foliar application of silicic acid @ 0.50% (T_4)
T_9	Chemical check *i.e.* Thiamethoxam 25 WG (at 40 DAS) + Profenophos 50 EC (at 65 DAS) + Chlorantraniliprole 18.5 SC (at 80 DAS) + Spinetoram 11.7 SC (at 95 DAS)
T_{10}	Untreated control

equal to a dosage of 200 kg per hectare for T_2, T_7 and T_8 treatment block. Observations were recorded before first foliar spray and was considered as the effect of soil application of calcium silicate.

Foliar application of silicic acid with desired concentrations *i.e.,* for T_3, T_5 and T_7 treatment block were sprayed with 31.5 g of silicic acid dissolved in 15 litres of water and for T_4, T_6 and T_8 were sprayed with 63 g of silicic acid dissolved in 15 litres of water. Silicic acid was sprayed on cotton plants at 45 and 70 days after sowing. Further, a treatment with chemical check was followed as per package of practices of UAS Dharwad. A day before spray and at five days after the foliar spray, five leaves randomly from the middle part of the plant was collected and used for analysing the silicon uptake by the plant. Silicon content in soil was also analysed a day before sowing and after harvest.

Observations recorded

Observation on flower damage by selecting 25 flowers from each treatment and later per cent flower damage were calculated. And also, observation on pink bollworm larvae, *gossyipiella* were recorded by collecting 10 bolls from each treatment from five randomly selected plants and later per cent green boll damage were worked out.

$$\text{Flower damage (\%)} = \frac{\text{No.of rosette flowers}}{\text{Total no.of flowers}} \times 100$$

$$\text{Green boll damage (\%)} = \frac{\text{No.of damaged green bolls}}{\text{Total No. of green bolls}} \times 100$$

Results and discussion

Effect of silicon on the incidence of pink bollworm

According to the present investigation, the chemical check *i.e.,* Thiamethoxam 25 WG (sprayed at 40 DAS), Profenophos 50 EC (sprayed at 65 DAS), Chlorantraniliprole 18.5 SC (sprayed at 80 DAS), and Spinetoram 11.7 SC (sprayed at 95 DAS) recorded the highest reduction over control in per cent flower damage with 68.66 per cent reduction over control after second spray (Table 2). The findings are in acceptance with Pathan *et*

Table 2. Effect of silicon on pink bollworm incidence in cotton

Treatments	Flower damage (%)										Overall mean	%ROC
	First spray					Second spray				`		
	Pre count	7 DAS	14 DAS	21 DAS	Mean	Pre count	7 DAS	14 DAS	21 DAS	Mean		
T_1	11.71 (20.01)^{abc}	10.46 (18.87)^{c}	9.34 (17.80)^{c}	8.09 (16.52)^{c}	9.90 (18.34)^{c}	12.59 (20.78)^{c}	9.84 (18.28)^{d}	9.09 (17.55)^{c}	8.24 (16.68)^{c}	10.69 (19.08)^{c}	10.30 (18.71)^{c}	27.87
T_2	11.63 (19.94)^{a}	9.78 (18.22)^{bc}	8.66 (17.11)^{bc}	7.41 (15.80)^{bc}	9.37 (17.82)^{bc}	10.91 (19.29)^{bc}	9.16 (17.62)^{bcd}	8.41 (16.86)^{bc}	7.56 (15.96)^{bc}	9.01 (17.47)^{bc}	9.19 (17.65)^{bc}	35.56
T_3	13.69 (21.72)^{e}	10.54 (18.94)^{c}	9.42 (17.87)^{c}	8.17 (16.61)^{c}	10.46 (18.87)^{c}	11.67 (19.98)^{c}	9.92 (18.36)^{d}	9.17 (17.63)^{c}	8.32 (16.76)^{c}	9.77 (18.21)^{c}	10.11 (18.54)^{c}	29.14
T_4	13.61 (21.65)^{de}	9.63 (18.08)^{bc}	8.51 (16.96)^{bc}	7.26 (15.63)^{bc}	9.75 (18.20)^{bc}	10.41 (18.82)^{bc}	9.11 (17.57)^{bcd}	8.36 (16.81)^{bc}	7.51 (15.91)^{bc}	8.59 (17.04)^{bc}	9.18 (17.63)^{bc}	35.71
T_5	11.74 (20.04)^{abc}	9.19 (17.65)^{b}	7.97 (16.40)^{b}	6.72 (15.02)^{b}	8.91 (17.36)^{b}	10.22 (18.64)^{b}	9.07 (17.53)^{bcd}	8.32 (16.76)^{bc}	7.47 (15.86)^{bc}	8.77 (17.23)^{bc}	8.84 (17.29)^{bc}	38.01
T_6	11.67 (19.98)^{abc}	9.22 (17.68)^{b}	8.00 (16.43)^{b}	6.75 (15.06)^{b}	8.91 (17.37)^{b}	10.25 (18.67)^{b}	9.00 (17.46)^{bcd}	8.25 (16.69)^{bc}	7.40 (15.79)^{bc}	8.73 (17.18)^{bc}	8.82 (17.27)^{bc}	38.15
T_7	11.45 (19.78)^{abc}	8.72 (17.18)^{b}	7.60 (16.00)^{b}	6.35 (14.60)^{b}	8.53 (16.98)^{b}	9.85 (18.29)^{b}	8.70 (17.15)^{bc}	7.95 (16.38^{b}	7.10 (15.45)^{b}	8.40 (16.85)^{b}	8.47 (16.91^{b}	40.61
T_8	11.23 (19.58)^{abc}	8.68 (17.13)^{b}	7.56 (15.96)^{b}	6.31 (14.55)^{b}	8.45 (16.89)^{b}	9.81 (18.25)^{b}	8.56 (17.01)^{b}	7.81 (16.23)^{b}	6.96 (15.30)^{b}	8.29 (16.73)^{b}	8.37 (16.81)^{b}	41.30
T_9	12.33 (20.56)^{bcd}	5.03 (12.96)^{a}	3.91 (11.40)^{a}	2.66 (9.39)^{a}	5.98 (14.16)^{a}	4.16 (11.77)^{a}	3.11 (10.16)^{a}	2.56 (9.21)^{a}	1.71 (7.51)^{a}	2.89 (9.78)^{a}	4.43 (12.16)^{a}	68.66
T_{10}	12.63 (20.82)^{cde}	13.45 (21.51)^{d}	14.23 (22.16)^{d}	13.63 (21.67)^{d}	13.49 (21.54)^{d}	14.90 (22.71)^{d}	16.15 (23.70)^{e}	15.40 (23.11)^{d}	14.55 (22.42)^{d}	15.25 (22.99)^{d}	14.37 (22.27)^{d}	-
S. Em ±		0.44	0.29	0.28	0.27	0.28	0.34	0.32	0.29	0.26	0.17	0.33
C.D. @ 5 %		1.31	0.88	0.83	0.82	0.84	1.03	0.95	0.87	0.79	0.51	0.98
C.V. (%)		10.31	9.96	8.61	10.37	9.31	8.83	10.42	8.65	10.97	9.71	10.25

Pre count; DAS-Days after spray; ROC-Reduction over untreated control; SA- Soil application; FA- Foliar application; First and second spray @ 45 and @ 70 days after sowing respectively; Figures in parenthesis are square root transformed values. Means showing same alphabets do not differ significantly by DMRT (p=0.05). Here, Chemical check (T_9) includes Thiamethoxam 25 WG (at 40 DAS), Profenophos 50 EC (at 65 DAS), Chlorantraniliprole 18.5 SC (at 80 DAS), and Spinetoram 11.7 SC (at 95 DAS).

Table 3. Effect of silicon on larval incidence and green boll damage by pink bollworm in cotton.

Treatments	Second spray											
	PBW incidence (No. of Larvae /10 bolls)						Green boll damage (%)					
	pre count	7 DAS	14 DAS	21 DAS	mean	%ROC	pre count	7 DAS	14 DAS	21 DAS	mean	% ROC
T_1	14.39	13.14	11.99	12.34	12.97	15.54	45.75	44.20	44.65	47.90	45.63	33.44
	(3.86)^{de}	(3.69)^{de}	(3.53)^{c}	(3.58)^{cd}	(3.67)^{c}		(42.56)^{d}	(41.67)^{de}	(41.93)^{d}	(43.80)^{d}	(42.49)^{e}	
T_2	13.51	12.26	11.11	11.46	12.09	21.27	44.35	43.30	43.75	47.00	44.60	34.94
	(3.74)^{c}	(3.57)^{c}	(3.41)^{c}	(3.46)^{c}	(3.55)^{c}		(41.76)^{d}	(41.15)^{de}	(41.41)^{cd}	(43.28)^{cd}	(41.90)^{d}	
T_3	14.27	13.02	11.87	12.22	12.85	16.32	44.45	42.90	43.35	46.60	44.33	35.34
	(3.84)^{de}	(3.68)^{de}	(3.52)^{c}	(3.57)^{cd}	(3.65)^{c}		(41.81)^{d}	(40.92)^{d}	(41.18)^{d}	(43.05)^{cd}	(41.74)^{de}	
T_4	13.56	12.31	11.16	11.51	12.14	20.94	44.36	42.81	43.26	46.51	44.24	35.47
	(3.75)^{c}	(3.58)^{c}	(3.41)^{c}	(3.47)^{c}	(3.55)^{c}		(41.76)^{d}	(40.87)^{d}	(41.13)^{cd}	(43.00)^{cd}	(41.69)^{d}	
T_5	12.72	11.67	10.52	10.87	11.45	25.44	43.42	42.27	42.72	45.97	43.60	36.40
	(3.64)^{b}	(3.49)^{b}	(3.32)^{b}	(3.37)^{b}	(3.46)^{b}		(41.22)^{c}	(40.55)^{c}	(40.81)^{c}	(42.69)^{c}	(41.32)^{c}	
T_6	12.65	11.60	10.45	10.80	11.38	25.90	43.05	42.50	42.95	46.20	43.68	36.29
	(3.63)^{b}	(3.48)^{b}	(3.31)^{b}	(3.36)^{b}	(3.45)^{b}		(41.01)^{c}	(40.69)^{c}	(40.95)^{c}	(42.82)^{c}	(41.37)^{c}	
T_7	12.39	11.34	10.19	10.54	11.12	27.59	42.01	41.46	41.91	45.16	42.64	37.80
	(3.59)^{b}	(3.44)^{b}	(3.27)^{b}	(3.32)^{b}	(3.41)^{b}		(40.40)^{bc}	(40.08)^{bc}	(40.34)^{b}	(42.22)^{b}	(0.76)^{bc}	
T_8	12.15	11.10	9.95	10.30	10.88	29.15	41.85	40.30	39.85	43.10	41.28	39.79
	(3.56)^{b}	(3.41)^{b}	(3.23)^{b}	(3.29)^{b}	(3.37)^{b}		(40.31)^{b}	(39.41)^{b}	(39.14)^{b}	(41.03)^{b}	(39.98)^{b}	
T_9	10.02	2.87	5.02	1.52	4.86	68.36	24.42	19.57	21.32	16.07	20.35	70.32
	(3.24)^{a}	(1.84)^{a}	(2.35)^{a}	(1.42)^{a}	(2.31)^{a}		(29.61)^{a}	(26.26)^{a}	(27.50)^{a}	(23.63)^{a}	(26.81)^{a}	
T_{10}	14.05	15.10	15.85	16.40	15.35	-	52.50	61.75	72.10	87.85	68.55	-
	(3.81)^{e}	(3.95)^{e}	(4.04)^{d}	(4.11)^{e}	(3.98)^{d}		(46.43)^{e}	(51.80)^{f}	(58.12)^{e}	(69.60)^{e}	(55.89)^{f}	
S.Em ±		0.48	0.43	0.4	0.42	0.42		0.93	0.82	0.79	0.76	0.79
C.D. @ 5 %		1.44	1.29	1.2	1.26	1.26		2.79	2.46	2.37	2.28	2.37
C.V. (%)		10.95	9.55	11.74	10.85	10.71		12.14	11.78	10.51	11.78	10.91

Pre count; DAS-Days after spray; ROC-Reduction over untreated control; SA- Soil application; FA- Foliar application; First and second spray @ 45 and @ 70 days after sowing respectively; Figures in parenthesis are square root transformed values (except % green boll damage which is arcsine transformed). Means showing same alphabets do not differ significantly by DMRT (p=0.05). Here, Chemical check (T_9) includes Thiamethoxam 25 WG (at 40 DAS), Profenophos 50 EC (at 65 DAS), Chlorantraniliprole 18.5 SC (at 80 DAS), and Spinetoram 11.7 SC (at 95 DAS).

al. (2021) concluded that chlorantraniliprole 18.5 SC found most effective for control of rosette flower (73.32% ROC) and followed by spinetoram 11.7 SC and lambda cyhalothrin 5 EC.

Among the silicon-applied treatments, Soil application of calcium silicate at 200 kg/ha followed by foliar application of silicic acid at 0.50 per cent recorded the 41.30 per cent reduction in flower damage over control after second spray followed by Soil application of calcium silicate at 200 kg/ha followed by foliar application of silicic acid at 0.25 per cent with 40.61 per cent reduction in whitefly population over control after second spray which were on par with other silicon based treatments. However, there is non-significant difference among silicon-based treatments and untreated control.

The results of the present study indicated that, the chemical check *i.e.,* Thiamethoxam 25 WG (40 DAS), Profenophos 50 EC (65 DAS), Chlorantraniliprole 18.5 SC (80 DAS), and Spinetoram 11.7 SC (95 DAS) proved superior over the silicon-based treatments and untreated control in PBW larval population. Mean larval population per ten bolls in chemical check is 4.86 per 10 bolls with 68.36 per cent reduction over control (Table 3). The present findings on larval population of P. *gossypiella* per ten bolls are in line with the results of Divya *et al.* (2020), who found that the chlorantraniliprole 18.5 SC recorded the lowest larval population. Pathan *et al.* (2021) concluded that chlorantraniliprole 18.5 SC found most effective for control of PBW larval population (81.04% ROC) and followed by spinetoram 11.7 SC (72.97%). Among silicon-based treatments, the PBW larval population was ranged from 10.88 to 12.97 which were statistically non-significant among each other.

The mean per cent green boll damage due to pink bollworm in chemical check is 20.35 per cent which were significantly superior over silicon-based treatments (ranged between 41.28 to 45.63%) and untreated control (68.55%) in reduction of green boll damage. The findings are in line with Pathan *et al.* (2021) showed that among tested insecticides, chlorantraniliprole 18.5 Sc induced highest effect (73.13%) reduction in green boll damage over control, followed by spinetoram 11.7 SC (70.20) and lambda cyhalothrin 5 EC (67.01%) which were on par with each other. Manik Rao (2017) who reported that minimum green boll damage by larvae was recorded in chlorantraniliprole 18.5 SC treated plots. Among silicon-based treatments, the per cent green boll damage was ranged from 41.28 to 45.63 per cent which was statistically non-significant among each other.

This is in harmonious with findings of Rojanaridpiched *et al.* (1984) who showed that resistance of maize to European corn borer, *O. nubilalis* damage was significantly correlated with the silicon content in the sheath and collar tissue. Alyousuf *et al.* (2022) who reported that foliar spray of silicic acid was more effective in reducing the population density of the tomato leaf miner and whitefly compared to Si- soil drench application

Table 4. Silicon concentration in cotton flower and boll as influenced by silicon application

Tr No.	Treatment details	Si conc. in flower (g/kg) First spray		Si conc. incotton boll (g/kg) Second spray	
		DBS	5DAS	DBS	5DAS
T_1	SA of calcium silicate @ 100 kg/ha	0.74abc	0.95 de	0.86c	1.08d
T_2	SA of calcium silicate @ 200 kg/ha	0.77 abc	0.98de	0.89c	1.21cd
T_3	FA of silicic acid @ 0.25%	0.52c	0.93e	0.94bc	1.29bcd
T_4	FA of silicic acid @ 0.50%	0.54bc	1.05cde	0.98bc	1.36abcd
T_5	T_1 + FA of silicic acid @ 0.25%	0.75abc	1.20bcd	1.17abc	1.40abcd
T_6	T_1 + FA of silicic acid @ 0.50%	0.78abc	1.29abc	1.25ab	1.47abc
T_7	T_2 + FA of silicic acid @ 0.25%	0.81ab	1.43ab	1.33a	1.57ab
T_8	T_2 + FA of silicic acid @ 0.50%	0.84a	1.52a	1.42a	1.65a
T_9	Chemical check	0.51c	0.55f	0.48d	0.51e
T_{10}	Untreated check	0.52c	0.57f	0.51d	0.55e
S. Em ±		0.02	0.02	0.03	0.03
C.D. at 5%		0.07	0.08	0.09	0.09
C.V. (%)		6.78	6.77	6.8	6.81

DBS-Day before spray; DAS-Days after spray; SA- Soil application; FA - Foliar application; First and second spray @ 45 and @ 70 days after sowing respectively; Here, Chemical check includes Thiamethoxam 25 WG (at 40 DAS), Profenophos 50 EC (at 65 DAS), Chlorantraniliprole 18.5 SC (at 80 DAS), and Spinetoram 11.7 SC (at 95 DAS).

and they concluded that the foliar spray of silicic acid contain stabilized silicic acid in which polymerization of silicon is halted but the Si- soil drench application may lead to polymerisation of silicon without getting converted into available form.

Reduced damage of stem borers owing to application of silicon was attributable to reduced impediment in larval penetration due to accumulation of higher silicon content in maize stem which may result in reduced feeding owing to reduced damage to the maize crop. The above arguments are supported by Ma and Yamaji (2006) who reported that Si get deposited in the cell wall of leaves, stem and hulls in the hydrated polymeric form of silica in the crop after its translocation from root system and it gets more and more concentrated in aerial parts by transpiration.

There was a less significant effect of silicon on the pink bollworm population. This might be due to pink bollworm predominantly consumes cotton seeds by penetrating the boll, where silicon accumulation is less in cotton boll rind (1.65 g/kg) compared to the leaves and stems of cotton plants. Additionally, the larvae of pink bollworm tunnels into boll and feed exclusively within cotton seeds, which minimizes their exposure to silicon stored primarily in other parts of the cotton plant, such as leaves and stems.

Since there were no reviews related to seed-feeding insects when compare to foliage-feeding insects like the fall armyworm feeds on maize leaves and other plant parts, where silicon concentrations, especially in leaves and husks, are generally higher with respect to mortality.

Silicon concentration in soil and cotton leaf, flower, boll as influenced by application of silicon

The present investigation showed that the treatments supplemented with soil application of calcium silicate @ 200 kg/ha and foliar application of silicic acid @ 0.50 per cent recorded higher Si content (2.66 g/kg) when compared to other silicon treatments in cotton leaves, higher Si content (1.52 g/kg) in cotton flower and higher Si content (1.65 g/kg) in cotton boll (Table 4). Our findings are in line with the reports of De Souza (2022) reported that SiK @ 0.25 and @ 0.50 per cent recorded silicon concentration of 1.55 and 2.68 g/kg respectively. Sanjay and Kuligod (2020) noticed silicon content (169.43 g/kg) in Ap horizon (0-12 cm). Anand (2020) who recorded the highest Si content (3.03%) in treatment amended with Soil application of calcium silicate at 200 kg/ha followed by foliar application of silicic acid at 0.50 per cent at 100 days after transplanting in rice. Likewise, Shinde (2017) reported the level of calcium silicate at 150 kg/ha and silicic acid spray at 3 ppm recorded significantly highest silicon content (9.25 kg/ha) over other silicon treatments. Abbasi *et al.* (2022) reported that foliar application in non-*Bt* cotton shows the highest silicon content in leaves (632.22 µg/g), while drenching had lower levels (494.33 µg/g).

Conclusion

Among the silicon-based fertilisers, all the four dosages of combination of soil application of calcium silicate with foliar application of silicic acid and sole application of either calcium silicate or silicic acid could show limited significance in reducing the incidence of pink bollworm. However, it has given a clue for proper exploitation of this principle with enhanced usage of silicon within agronomic requirements.

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