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Effect of silicon and organic manures on yield and quality of wheat

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Abstract
The pot experiment was carried out at the Department of Agricultural Chemistry and Soil Science, College of Agriculture, Junagadh Agricultural University, Junagadh to asses four levels of silicon (0, 100, 200 and 300 kg/ha^{-1}) and three different organic manures [No organic manures (control), FYM, vermicompost and city compost each 10 t/ha^{-1}] on wheat by adopting factorial CRD with three replications. The experimental results indicated that application of vermicompost 10 t/ha^{-1} showed its superiority over rest of organic manures by significantly increasing growth parameter viz., plant height, number of effective tillers per plant; yield attributes viz., length of spike, number of spiklets per spike, number of grains per spike and quality parameter viz., protein content and 100 seed weight as well as grain yield. While, number of tillers per plant and straw yield were obtained significantly higher with application of 10 t FYM ha^{-1}. In case of silicon treatments, significantly higher growth parameter viz., plant height, number of tillers per plant and number of effective tillers per plant; yield attributes viz., length of spike, number of spiklets per spike, number of grains per spike; quality parameter viz., protein content and 100 seed weight as well as grain yield and straw yield were recorded with application of silicon 300 kg/ha^{-1}. The interaction effects between vermicompost 10 t/ha^{-1} and silicon level 300 kg/ha^{-1} exhibited their significant effect on length of spike (11.08 cm), grain yield (2.126 g plant^{-1}) whereas, 10 t FYM ha^{-1} and 300 kg silicon ha^{-1} exhibited their significant effect on straw yield (3.470 g plant^{-1}).

Keywords: Wheat, organic manures, silicon, vermicompost, FYM, city compost

1. Introduction
Wheat (*Triticum aestivum* L.) is most vital cereal crop of the globe and is staple food of millions of people. This crop would provide groceries and nutrition to majority about two third of the world's populations. In world, wheat ranked second after rice crop in food grain production and it was grown in 220.4 million hectare area with the production of 768.49 million tonnes. With respect to global wheat production, India stands second position after China. Wheat stands second to rice in terms of food grain production, grown on 30.55 million hectare area with production of 107.18 million tonnes and productivity 3508 kg/ha^{-1} (Anon., 2019) [2]. In India, Gujarat state takes seventh position in wheat production and it is cultivated in 3.20 million hectare area with the production of 10.57 million tonnes and having productivity of 3501 kg/ha^{-1} (Anon., 2019) [2].

In agriculture, Si is utilized in the form of fertilizer which may influence increased yield, enhanced disease and insect-pest resistance and tolerance to stresses such as cold, drought and toxic metals. The beneficial effects of Si are particularly distinct in plants exposed to abiotic and biotic stresses (Liang *et al*., 2007) [10]. Si can increase plants capabilities stand with water stress because it decreasing the rate of transpiration process. Transpiration from the leaves mainly occurs through the stomata and partly through the cuticle of the leaves forming a silicon-cuticle double layer, the transpiration through cuticle may decrease due to silica deposition (Ma, 2004) [12].

The food crises all over the world and increasing population pressure demand urgent need to increase the quantity and improve the quality of grains. To meet the demand yield increase per unit area can be achieved by balanced and judicious use of chemical fertilizers in conjunction with manures like farmyard manure, vermicompost, city compost etc. The organic manures have been used by farmers from ancient times. They increase the efficiency of applied nutrients in a rice-wheat system (Singh, 2012) [18]. The use of organic manures has beneficial effects on soil health by improving the physicochemical properties of soil besides supplying macronutrients and increasing the availability of micronutrients (Dhaliwal *et al.*, 2019) [4]. The use of organic manures improve the biological activity in the soil system and hence the crop

yield also increased.

2. Materials and Methods

The pot experiment was carried out during the *rabi* season of the year 2019-20 at the Department of Agricultural Chemistry and Soil Science, College of Agriculture, Junagadh Agricultural University, Junagadh. The pot experiment was laid out in completely randomized design (factorial concept) with three repetitions. Total sixteen treatments comprising of four levels of silicon (0, 100, 200 and 300 kg/ha^{-1}) and three different organic manures [No organic manures (control), FYM, vermicompost and city compost each 10 t/ha^{-1}] were tested in wheat variety GW 366. The experimental soil was clayey in texture and slightly alkaline in reaction with pH 7.9, electrical conductivity 0.28 dS m^{-1}and bulk density 1.57 g cc^{-1}. The soil was medium in available nitrogen (252 kg/ha^{-1}), phosphorus (32.20 kg/ha^{-1}) and sulphur (12.36 mg/kg^{-1}) and high in available potassium (316 kg/ha^{-1}). Micronutrient status was medium in DTPA-extractable iron (5.03 mg/kg^{-1}) and zinc (0.71 mg/kg^{-1}), high in manganese (12.6 mg/kg^{-1}) and copper (2.16 mg/kg^{-1}) and high in silicon (294.45 mg/kg^{-1}). Si treatments were applied in the form of SiO_2 (65% Si) after calculating the proper quantities to be applied as per the treatment. Recommended dose of fertilizers like phosphorus and potash (60:60 kg/ha^{-1}, P_2O_5:K_2O) were applied in the form of Diammonium phosphate (18% N and 46% P_2O_5) and Muriate of potash (60% K_2O), respectively as a basal and nitrogen (120 kg/ha^{-1}) was applied in three different splits each given at, 25% at basal, 50% at 20 to 25 DAS and 25% at 35 to 40 DAS in form of urea and diammonium phosphate. Observation of growth and yield attributes parameters viz., plant height, number of tillers per plant, number of effective tillers per plant, length of spike, number of spiklets per spike and numbers of grains per spike are taken at harvesting stage. Whereas quality parameter viz., protein content and 100 seed weight as well as grain yield and straw yield taken after harvest. The data recorded on various parameters were subjected to statistical analysis as per the procedure suggested by Panse and sukhatme (1985) [13].

3. Results and Discussion

3.1 Effect of organic manures

With the administration of organic manures, plant height, number of tillers per plant and effective tillers per plant were increased (Table-1). The application of 10 t vermicompost ha^{-1} resulted significantly highest plant height (79.70 cm) and number of effective tillers per plant (2.37). However, the highest number of tillers per plant (4.03) was observed with treatment of FYM 10 t/ha^{-1}. The increase in growth parameter with increasing dose of organic manure is related to the rapid conversion of synthesised carbohydrates into protein, which leads to an increase in the number and size of developing cells and ultimately higher growth parameters. These results are supported by the findings of Sarwer *et al.* (2008) [14], Singh *et al.* (2011) [15] and Ahmad *et al.* (2013) [1] who reported that the use of organic manures in combination with mineral fertilizers maximized the plant growth. Significantly the highest yield attributes and yield viz., length of spike (9.94 cm), number of spiklets per spike (15.52), number of grains per spike (44.64) and grain yield (1.880 g plant^{-1}) was recorded by treatment 10 t vermicompost ha^{-1}. While, treatment 10 t FYM ha^{-1} resulted in the highest straw production (3.119 g plant^{-1}). Rich nutrients in vermicompost gradually make them available to plants and also improving the physical and chemical properties of the soil. As a result, higher nutrient utilisation may also contribute to increased yield and yield attributes (Singh, 2004) [19]. The results were confirmed with finding of Babaria *et al.* (2010) [3]. In wheat, the maximum protein value (13.56%) and 100 seed weight (4.26 g) were attained in the application of vermicompost 10 t/ha^{-1}. The yield, yield contributing characters and protein content of wheat increased with increase in the levels of organic composts with fertilizer (Islam, 2002) [8]. The results were confirmed with finding of Singh *et al.* (2009) [16] and Hellal *et al.* (2012) [7].

3.2 Effect of silicon level

Different level of silicon manifested their significant influence on plant height, number of tillers per plant and numbers of effective tillers per plant were influenced by silicon levels (Table-1). The highest plant height at harvest (80.07 cm), number of tillers per plant (4.01) and effective tillers per plant (2.35) were observed with application of 300 kg silicon ha^{-1}. Silicon assists in the development of larger and stronger phloem and xylem in the stem structure. Plants can translocate more nutrients and water at a faster rate because of this, plants absorb more elements that are difficult to assimilate (e.g., calcium). These revelations come from Hameed *et al.* (2005) [6] and Gong *et al.* (2003) [5]. Significantly the highest yield attributes viz., length of spike (9.90 cm), number of spiklets per spike (15.75), number of grains per spike (45.34) and quality parameter viz., protein content (14.71%) and 100 seed weight (4.38 g) as well as grain yield (1.945 g plant^{-1}) and straw yield (3.238 g plant^{-1}) were also recorded with application of 300 kg silicon ha^{-1}. This might be due to application of silicon, as it enhanced the sturdiness in plant and helps to grow erect without lodging. The erectness increased the amount of plant parts that were exposed to sunlight, improved photosynthetic activity, and made it easier for photosynthate to move from source to sink. These effects improved carbohydrate assimilation, increased the number of filled grains, and helped the crop grow, develop, and be of higher quality. The crop grows vigorously and utilized the nutrient and moisture from soil, which are turned into the economic yield of wheat. These findings are near to the findings of Singh *et al.* (2007) [17] and Liu *et al.* (2017) [11].

3.3 Interaction effect

The interaction effect of OM and Si produced the significant effect on length of spike, grain and straw yield of wheat at harvest. The highest spike length (11.08 cm) and grain yield (2.126 g plant^{-1}) was found with Si_{300} (300 kg/ha^{-1}) × VC (10 t/ha^{-1}). While, maximum straw yield (3.470 g plant^{-1}) was recorded with Si_{300} (300 kg/ha^{-1}) × FYM (10 t/ha^{-1}) treatment combination. The interaction impact of varied organic manures and silicon treatment makes some insoluble form of element available and adds some important macro, micro and beneficial element in soil, which improves plant growth and has a positive influence on plant biological and economic yield. These findings are backed up by Hellal *et al.* (2012) [7], Janmohammadi *et al.* (2016) [9] and Tripathi *et al.* (2018) [20].

Table 1: Effect of different organic manures and silicon levels on growth, yield, yield attributes and quality parameters of wheat

Treatments	Plant height at harvest (cm)	No. of tillers per plant	No. of effective tillers per plant	Length of spike (cm)	No. of spikelets per spike	No. of grains per spike	Grain yield (g plant^{-1})	Straw yield (g plant^{-1})	100 seed weight (g)	Protein content (%)
OM levels										
OM: 0 t/ha^{-1}	69.09	3.24	1.55	7.67	13.72	39.73	1.603	2.400	3.90	12.80
FYM:10 t/ha^{-1}	77.09	4.03	2.26	9.10	14.74	42.71	1.756	3.119	4.16	13.49
VC: 10 t/ha^{-1}	79.70	3.95	2.37	9.94	15.52	44.64	1.880	2.841	4.26	13.56
CC: 10 t/ha^{-1}	73.58	3.80	2.16	8.74	14.39	41.60	1.823	2.717	4.08	12.67
S.Em.±	0.91	0.05	0.04	0.15	0.19	0.51	0.023	0.031	0.05	0.16
CD at 5%	2.63	0.15	0.10	0.44	0.55	1.47	0.066	0.089	0.15	0.47
Silicon levels										
Si_0: 0 kg/ha^{-1}	68.54	3.33	1.81	8.05	13.21	38.42	1.589	2.423	3.76	11.52
Si_{100}: 100 kg/ha^{-1}	73.98	3.72	2.03	8.41	14.26	41.35	1.712	2.574	4.03	12.73
Si_{200}: 200 kg/ha^{-1}	76.87	3.98	2.15	9.09	15.15	43.56	1.818	2.842	4.24	13.56
Si_{300}: 300 kg/ha^{-1}	80.07	4.01	2.35	9.90	15.75	45.34	1.945	3.238	4.38	14.71
S.Em.±	0.91	0.05	0.04	0.15	0.19	0.51	0.023	0.031	0.05	0.16
CD at 5%	2.63	0.15	0.10	0.44	0.55	1.47	0.066	0.089	0.15	0.47
OM × Si										
S.Em.±	1.83	0.11	0.07	0.30	0.38	1.02	0.046	0.062	0.10	0.32
CD at 5%	NS	NS	NS	0.88	NS	NS	0.134	0.178	NS	NS
CV %	4.23	4.85	5.73	5.95	4.52	4.19	4.55	3.87	4.26	4.26

Table 2: Interaction effect of different organic manures and silicon levels on spike length (cm) of wheat

Si Levels OM levels	Si_0	Si_{100}	Si_{200}	Si_{300}	Mean
OM_0	7.53	7.56	7.62	7.99	7.67
FYM_{10}	8.07	8.44	9.20	10.67	9.10
VC_{10}	8.76	9.55	10.35	11.08	9.94
CC_{10}	7.86	8.07	9.17	9.86	8.74
Mean	8.05	8.41	9.09	9.90	
OM x Si	S.Em.±		CD at 5%		
	0.30		0.88		

Table 3: Interaction effect of different organic manures and silicon levels on grain yield (g plant^{-1}) of wheat

Si Levels OM levels	Si_0	Si_{100}	Si_{200}	Si_{300}	Mean
OM_0	1.499	1.605	1.633	1.675	1.603
FYM_{10}	1.535	1.748	1.794	1.950	1.756
VC_{10}	1.674	1.735	1.985	2.126	1.880
CC_{10}	1.648	1.760	1.859	2.028	1.823
Mean	1.589	1.712	1.818	1.945	
OM x Si	S.Em.±		CD at 5%		
	0.046		0.134		

Table 4: Interaction effect of different organic manures and silicon levels on straw yield (g plant^{-1}) of wheat

Si Levels OM levels	Si_0	Si_{100}	Si_{200}	Si_{300}	Mean
OM_0	2.105	2.212	2.436	2.848	2.400
FYM_{10}	2.866	2.985	3.154	3.470	3.119
VC_{10}	2.483	2.644	2.970	3.267	2.841
CC_{10}	2.238	2.454	2.810	3.366	2.717
Mean	2.423	2.574	2.842	3.238	
OM x Si	S.Em.±		CD at 5%		
	0.062		0.178		

4. Conclusion

The notable findings of the present investigation concluded that the application of 10 t/ha^{-1} vermicompost treatment enhanced various growth parameters, yield attributes and yield (grain and straw). Application of 300 kg/ha^{-1} silicon exhibited a superior significant effect on various growth parameters, yield and yield attributes, quality parameters. Therefore, the application of vermicompost 10 t/ha^{-1} along with Si_{300} (300 kg/ha^{-1}) was found effective for obtaining the higher yield of wheat under medium black calcareous soil.

5. References

1. Ahmad M, Afzal M, Ahmad A, Ahmad AUH, Azeem MI. Role of organic and inorganic nutrient sources in improving wheat crop production. Cercetari agronomice in Moldova. 2013;44(1):153.
2. Anonymous. Indiastat. https://www.indiastat.com. 2019; Accessed on, 2021 June 8.
3. Babaria NB, Shalini Kumari, Rajani AV, Sakarvadia HL. Effect of balanced fertilization on yield, nutrient content and uptake in the Bt. cotton (*Gossypium hirsutam* L.) of south saurashtra. Agriculture-Towards a New Paradigm of Sustainability; Excellent Publishing House, New Delhi, 2010. ISBN, 978-93-83083-64-0:238-244.
4. Dhaliwal SS, Naresh RK, Mandal A, Walia MK, Gupta RK, Singh, R, *et al*. Effect of manures and fertilizers on soil physical properties, build-up of macro and micronutrients and uptake in soil under different cropping systems, a Review. Journal of Plant Nutrition. 2019;42:2873-2900.
5. Gong H, Chen G, Wang, S, Zhang C. Effects of silicon on growth of wheat under drought. Journal of Plant Nutrition. 2003;26(5):1055-1063.
6. Hameed E, Shah WA, Shad AA, Bakht J, Muhammad T. Effect of different planting dates, seed rate and nitrogen levels on wheat. Asian Journal of Plant Science. 2005;2(6):467-474.
7. Hellal FA, Zeweny RM, Yassen AA. Evaluation of nitrogen and silicon application for enhancing yield, production and nutrient uptake by wheat in clay soil. Journal of Applied Sciences and Research. 2012;8(2):686-692.
8. Isalam MR. Effect of different levels of chemical and organic fertilizers on growth, yield and protein content of wheat. Journal of Biological Sciences. 2002;10:304-306.
9. Janmohammadi M, Amanzadeh T, Sabaghnia N, Ion V. Effect of nano-Silicon foliar application on Safflower growth under organic and inorganic fertilizer regimes. Botanica Lithuanica. 2016;22(1):53-64.
10. Liang YC, Sun WC, Zhu YG, Christie P. Mechanisms of silicon-mediated alleviation of abiotic stresses in higher

plants: A review. Environmental Pollution. 2007;147(2):422-428.
11. Liu Q, Zhou X, Sun Z. Application of silicon fertilizer affects nutritional quality of rice. Chilean Journal of Agricultural Research. 2017;77(2):163-170.
12. Ma JF. Role of silicon in enhancing the resistance of plants to biotic and abiotic stresses. Journal of Soil Science and Plant Nutrition. 2004;50(1):11-18.
13. Panse VG, Sukhatme PV. Statstical methods for Agricultural Workers. Indian Council of Agricultural Research, New Delhi, 1985, 361.
14. Sarwar GH, Schmeisky N, Hussain S, Muhammad M, Ibrahim Safdar E. Improvement of soil physical and chemical properties with compost application in rice-wheat cropping system. Pakistan Journal of Botany. 2008;40(1):275-282.
15. Singh CM, Sharma PK, Kishor P, Mishra PK, Singh AP, Verma R, *et al*. Impact of integrated nutrient management on growth, yield and nutrient uptake by wheat (*Triticum aestivum* L.). Asian Journal of Agricultural Research. 2011;5(1):76-82.
16. Singh G, Marwaha TS, Kumar D. Effect of resource conserving techniques on soil microbiological parameters under long term maize (*Zea mays* L.)-wheat (*Triticum aestivum* L.) crop rotation. Indian Journal of Agricultural Sciences. 2009;79(2):94-100.
17. Singh K, Singh R, Singh KK, Singh Y. Effect of silicon carriers and time of application on rice productivity in a rice-wheat cropping sequence. IRRN. 2007;32(1):30-31.
18. Singh R. Effect of silicon and nitrogen on yield and nutrients composition of wheat (*Triticum aestivum* L.) grown on typic ustochrepts soil. M.Sc. Thesis (Unpublished), Anand Agricultural University, Gujarat. 2012;79-148.
19. Singh Y, Singh S, Ladha JK, Khind CS, Khera TS, Bueno CS. Effects of residue decomposition on productivity and soil fertility in rice-wheat rotation. Soil Science Society of America Journal. 2004;68:854-864.
20. Tripathi LK, Ghosh SK, Patra PK, Gupta AK. Efficacy of organic and inorganic amendments on Sulphur availability in relation to growth and yield of rice in an Alfisol soil. International Journal of Chemical Studies. 2018;6(2):2992-2997.