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Effect of krishisol on growth, yield and quality of chickpea (*Cicer arietinum* L.)

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Abstract
A field experiment was conducted at Agricultural Research Station, Anand Agricultural University, Derol, Gujarat, India during, *Rabi*- 2018-19to study the effect of krishisol on growth, yield and quality of chickpea (*Cicer arietinum* L.). Application of krishisol along with fertilizer, as well as spray of krishisol with various doses to improve the yield and yield attributing characters of chickpea crop. The number of pods per plant recorded significantly highest (70.9 pods/plant) in T_3 (RDF + Krishisol@1250 mlha^{-1}) and remained at par with treatment T_2 (RDF) (66.3 pods/plant). Treatment T_3 (RDF + Krishisol@1250 mlha^{-1}) recorded significantly the highest seed yield (2804 kg/ha) and haulm yield (2268 kg/ha) of chickpea. As far as soil fertility status is concerned, the highest K_2O content in soil was recorded under the treatment T_3 (RDF + Krishisol@1250 mlha^{-1}). Whereas, highest silicon content in soil was recorded under the treatment T_6 (Only Krishisol@1250 mlha^{-1}).

Keywords: Krishisol, growth, yield, quality, chickpea, *Cicer arietinum* L.

Introduction
Pulses play an important role in Indian agriculture for the sustainable production, improvement in soil health and nutrient safety. India is largest producer and consumer of the pulses in the world and found that it is a cheaper source of quality protein to overcome malnutrition among human being. Chickpea is the important pulse crop contain high amount of quality protein cultivated during post rainy season under rainfed condition as well as under assured irrigation condition. The area under chickpea cultivation in India is 105.60 lakh hectare, whereas its production is 113.79 lakh tones with productivity of 1078 kg/ha. (Anonymous, 2017-18) [1]. In Gujarat, chickpea is cultivated during *rabi* season with an area of 2.93 lakh hectare with a production of 3.77 lakh tones having an average productivity of 1285 kg/ha (Anonymous, 2017-18) [1].

Chickpea is also adapted to the heavier alkaline soil types of the region and are able to tolerate relatively high temperatures during the flowering and grain filling period. Itcontributesin the profitability of farmers through the ability of fixing nitrogen and provide weed and disease breaks for winter season crops.

Krishisol is silicon, humic and fulvic acid containing material. In which, silicon is not considered an essential nutrient, but it is typically abundant in soils and can be taken up in large amounts by plants. Silicon is known to have beneficial effects including disease and pest resistance, structural fortification and regulation of the uptake of other ions. Silicon increased water use efficiency in corn by up to 36%. (Kaerlek, 2012) [4]. Humic compounds such as humic acid and fulvic acid have been shown to stimulate plant growth in terms of increasing plant height and dry or fresh weight as well as enhancing nutrient uptake. These effects seem to depend on the concentration and source of the substance and on the plant species. Humic and fulvic acids are the most characteristic compounds of soil humic substances. Humic substances are formed through the microbial degradation of plant material and the brown to black substances are the primary constituents of soil organic matter. Humic substances have the ability to hold seven times their volume in water, a greater water holding capacity than clay soils. Water stored within the topsoil enables plant roots to quickly access available nutrients required for plant growth and yield (David & Andrew, 2013) [2]. Therefore, the present investigation was conducted to find the effect of krishisol on growth, yield and quality of chickpea (*Cicer arietinum* L.)

Materials and Methods

A field experiment was conducted at Agricultural Research Station, Anand Agricultural University, Derol, (Gujarat) during *rabi* season of the year 2018-19. The soil of the experimental field was loamy sand in texture having low in available nitrogen and medium in available phosphorus and high in potassium with pH 7.35. The experiment was laid out in randomized block design with four replications. Eight treatment comprised *viz.*, Absolute control (T_1), RDF (20:40:00 NPK kg/ha) (T_2), T_2 + Krishisol 1250 ml/ha (T_3), T_2 + Krishisol 1000 ml/ha (T_4), T_2 + Krishisol750 ml/ha (T_5), Only Krishisol 1250 ml/ha (T_6), Only Krishisol 1000 ml/ha (T_7), Only Krishisol 750 ml/ha (T_8).

First spray of krishisol was carried at the time of soil preparation *i.e.* krishisol was applied in plot area before 48 hrs of sowing and quantity of water was used 400 L/ha. Second and third spray was carried out at 30 days' interval.Chickpea cv. GG 5 was sown manually keeping the distance of 45 cm between two rows during experimentation. The plot size was 3.60 x 5.00 m. All the package of practices as well as plant protection measures followed as per general recommendation. For analysis of chemical parameters like, pH, EC, organic carbon, P_2O_5, K_2O and micronutrients including silicon, soil samples (0-15 cm) were collected randomly from experimental site for initial and after harvest of the crop using standard methods. All plots were harvested and threshed manually. Data of seed yieldand haulm yield were recorded from individual plot and converted on hectare basis. Harvest index was calculated by grain yield divided by biological yield. The harvest index for each treatment was worked out by using the formula given by (Donald and Hamblin, 1976) [3].

$$\text{Harvest index (\%)} = \frac{\text{Economic yield (kg ha}^{-1})}{\text{Biological yield (kg ha}^{-1})} \text{ X } 100$$

Results and Discussion

Periodic plant height of chickpea recorded at 30, 60 DAS andat harvest as influenced by different treatments are presented in Table1. The data on plant height at 30, 60 DAS and harvest found significant. The higher plant height at 30, 60 DAS and harvest was recorded significant under treatment T_3 (RDF + Krishisol 1250 ml /ha). For plant height at 30 DAS, it remained at par with treatment T_4 (RDF + Krishisol1000 ml/ha), whereas for plant height at 60 DAS, it remained at par with treatmentsT_4 (RDF + Krishisol 1000 ml/ha) and T_5 (RDF + Krishisol 750 ml/ha), while at harvest, it remained at par with treatments T_2, T_4, T_5, T_6 and T_7. Among the different treatment, treatment T_3 (RDF + Krishisol 1250 ml/ha) recorded significantly maximum number of branches per plant and remained on par with treatment T_4 (Krishisol 1000 ml/ha) and T_5 (RDF + Krishisol 750 ml/ha). The data on number of pods per plant recorded at harvest are presented in Table 1 indicated that treatment T_3 (RDF + Krishisol 1250 ml/ha) recorded significantly higher (70.9) pods/plant and remained at par with treatment T_2 (RDF) (66.3pods/plant). There were no any significant differences observed among the treatments with respect to the data on 100 seed weight and on protein content.

Seed yield of chickpeais an important parameter which decides the efficiency and superiority of particular treatment. The data on seed yield presented in Table 1 indicated that treatment T_3 (RDF + Krishisol 1250 ml/ha) recorded significantly the highest seed yield (2804 kg/ha) than rest of the treatments. Significantly lower seed yield (1531 kg/ha) was recorded under absolute control. Experimental result showed that treatment T_3 (RDF + Krishisol 1250 ml/ha) recorded significantly the highest haulm yield (2268 kg/ha) as compared to other treatments. Lowest haulm yield (1177 kg/ha) was recorded in treatment T_1 (absolute control). The data of harvest index indicated that the difference among the treatment was found non- significant (Table-1).

The data presented on soil organic carbon (%), P_2O_5, soil pH and soil EC (Table 2) revealed that non-significant differences found among the treatments with respect to organic carbon content, available P_2O_5, soil pH and electrical conductivity of soil. Whereas, the highest K_2O content (468.50 kg/ha) in soil was recorded under the treatment T_3 (RDF + Krishisol 1250 ml/ha) which was remained at par with treatment T_4 (RDF + Krishisol 1000 ml/ha) (421.50 kg/ha).

The data presented on micronutrient status of soil after harvest in table 2 indicated that none of the treatment exert significant difference on micronutrient content of soil except Silicon. The highest Silicon content (14 mg/kg) in soil was recorded under the treatment T_6 (Only Krishisol 1250 ml/ha), which was remained at par with treatment T_7 (Only Krishisol 1000 ml/ha), T_8 (Only Krishisol 750 ml/ha) and T_3 (RDF + Krishisol 1250 ml/ha) respectively. The lower silicon content was recorded under the treatment T_1 (control) (9.25 mg/kg).

Table 1: Growth yield and yield attributing characters of chickpea as influenced by various treatments

Sr. No.	Treatments	Plant height (cm)			No. of branches/ plant	No. of pods/ plant	Seed Test wt. (g)	Protein content (%)	Seed yield (kg ha^{-1})	Haulm yield (kg ha^{-1})	Harvest index (%)
		30 DAS	60 DAS	At Harvest							
T_1	Absolute control	16.8	40.1	48.2	3.1	43.7	21.5	20.1	1531	1177	56.6
T_2	RDF (20:40:00 NPK kg /ha)	18.2	42.1	51.8	3.7	66.3	22.1	21.1	2271	1604	58.7
T_3	T_2 + Krishisol 1250 ml/ha	20.1	45.9	55.2	4.3	70.9	22.5	21.3	2804	2268	55.4
T_4	T_2 + Krishisol 1000 ml/ha	19.0	44.4	55.2	3.9	64.4	22.4	21.5	2543	1948	56.7
T_5	T_2 + Krishisol 750 ml/ha	18.6	42.6	54.3	3.9	60.7	22.1	21.5	2515	1914	56.8
T_6	Only Krishisol 1250 ml/ha	18.1	42.0	53.9	3.7	56.5	22.4	21.3	1830	1313	58.5
T_7	Only Krishisol 1000 ml/ha	17.2	41.8	51.2	3.2	53.1	21.3	21.4	1810	1259	59.3
T_8	Only Krishisol 750 ml/ha	17.0	41.0	50.4	3.1	49.1	22.0	21.0	1677	1172	58.7
S.Em. ±		0.58	1.11	1.60	0.19	2.17	0.61	0.32	83	102	1.87
CD at 5%		1.70	3.28	4.70	0.55	6.38	NS	NS	243	299	NS
CV%		6.40	5.25	6.09	10.46	7.47	5.58	3.03	7.77	12.89	6.50

Table 2: Organic carbon, P, K, soil EC, soil pH and micronutrient influenced by various treatment in chickpea

Sr. No.	Treatment	Organic carbon (%)	Available P (kg/ha)	Available K (kg/ha)	Soil pH	Soil EC	Fe (mg kg^{-1})	Mn (mg kg^{-1})	Zn (mg kg^{-1})	Cu (mg kg^{-1})	Si (mg kg^{-1})
	Initial	0.45	9.66	313	7.35	0.13	10.65	10.40	1.60	1.28	11.50
T_1	Absolute control	2.15	15.64	319.25	7.84	0.14	11.78	10.99	1.84	1.25	9.25
T_2	RDF (20:40:00 NPK kg /ha)	3.12	21.52	361.00	7.90	0.14	11.57	12.06	1.96	1.38	9.50
T_3	T_2 + Krishisol 1250 ml/ha	2.29	15.13	468.50	7.80	0.13	11.85	12.84	2.15	1.36	12.25
T_4	T_2 + Krishisol 1000 ml/ha	4.99	25.21	421.50	7.84	0.14	11.96	12.45	1.87	1.30	11.50
T_5	T_2 + Krishisol 750 ml/ha	3.62	11.06	341.00	7.82	0.14	11.16	11.57	1.81	1.40	10.88
T_6	Only Krishisol 1250 ml/ha	5.08	12.45	318.75	7.66	0.14	11.80	11.31	2.11	1.28	14.00
T_7	Only Krishisol 1000 ml/ha	3.35	22.15	292.50	7.71	0.16	11.69	11.20	1.87	1.24	13.63
T_8	Only Krishisol 750 ml/ha	1.85	24.10	328.25	7.88	0.17	11.79	11.40	1.99	1.35	13.38
S.Em. ±		1.23	4.06	22.98	0.07	0.01	0.45	0.52	0.12	0.10	0.61
CD at 5%		NS	NS	67.59	NS	NS	NS	NS	NS	NS	1.79
CV%		74.58	44.16	12.90	1.73	19.29	7.71	8.84	12.12	14.92	10.30

Conclusion

From the above results, it can be concluded that application of recommended dose of fertilizer (20:40:00 NPK kg/ha) along with three spray of krishisol 1250 ml/ha at soil preparation, 30 DAS and at 60 DAS found effective for growth and yield of chickpea.

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