Original Research Article

Effect of Iron Nutrition on Growth, Quality and Yield of Soybean (*Glycine Max*. L.) Grown on Problematic Inceptisol.

ABSTRACT

Aims: To study the effect of soil and foliar application of iron on growth parameters, yield and quality of soybean (Glycine max.L.).

Study of design: The experiment was laid out in randomized block design with three replications.

Place and duration of the study: Agricultural Research Station, Kasbe Digraj, Dist: Sangli (MS) India. The study was conducted during kharif 2018-19.

Methodology applied: At present in research, the eight treatment consist of absolute control, general recommended dose of fertilizer (GRDF), GRDF + soil application of $FeSO_4$ @ 10 and 20 kg ha^{-1} with and without two foliar sprays of chelated Fe @ 0.2 per cent at 30 and 50 days after sowing (DAS) , GRDF + soil application of $FeSO_4$ @ 20 kg ha^{-1}, GRDF + $FeSO_4$ @ 10 kg ha^{-1} + cow dung slurry @ 500 litre ha^{-1}.

Results. The basal application of $FeSO_4$ @ 10 or 20 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2 per cent at 30 and 50 days after sowing improved growth parameters of soybean viz; chlorophyll content, average number of days to 50 per cent flowering, plant height, number of branches, number of pods and effective root nodules as compare to only soil application or foliar spray of iron. Significantly higher grain yield , straw yield, 100 grain weight oil and crude protein yield of soybean were obtained in soil applied of $FeSO_4$ @ 20 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2% at 30 and 50 days after sowing.

Conclusion: Integrated approach of iron nutrition in soybean both as soil and foliar application could result in better growth and enhanced yield of soybean.

Keywords: Iron Growth, Quality, Soil and Foliar fertilization, Soybean, Yield.

1.INTRODUCTION

Soybean (*Glycine max* L.) is leguminous crop and it belongs to family papillionaceae, sub family of leguminoaceae, originally a crop of China. Soybean is cultivated for more than 3000 years in South-Eastern Asia [1]. Soybean stands first in the world as edible oil and occupies important place in the economy. Globally legumes play a vital role in human nutrition as these are rich sources of protein, calories, certain minerals and vitamins. Among legumes, soybean is the largest source of protein and vegetable oil with poly-unsaturated fatty acids specially Omega 6 and Omega 3 [2].

Soybean is cultivated on 124 million ha area in the world. India ranks fifth in area and production after USA, Brazil, China and Argentina. All world estimated area and production of soybean in *Kharif*- 2017 was 10.60 million ha and 8.00 million MT respectively [3]. The area under soybean cultivation is increasing due to some reason such as soybean is short duration crop (90-110 days), good market price with its higher productivity as compared to other pulses. It can be processed easily for different products *viz*., soy cheese, soy milk, soy protein, soy yogurt, soybean oil, soy nut. Soybean also used for making the soy ink, soy paint and soy molasses. It is a potential crop that can boost the food-processing industry in rural areas. Soybean production is affected by many factors such as climatic and edaphic factors which severely affect its production; According to Turner 1991, performance of this crop is highly affected by the availability of trace elements such as Molybdenum and Iron. Besides, iron deficiency of Mn and Zn can also affect the production of soybean crop [4]. Deficiency of micronutrient and low availability of other essential nutrients or imbalance use of fertilizers emerged as the important constraint in soybean production. Hence a balanced nutrient application is must to increase the productivity of soybean crop. Among micronutrients, iron plays vital role in a structural component of porphyrin molecules, cytochromes, heams, hematin, ferrichrome and leghaemoglobin. These substances are involved in oxidation-reduction reactions in respiration and photosynthesis. It is also an important part of the enzymes, including amino levlinic acid synthetase and co-proporphyrin ogenoxidase, which is essential for nitrogen fixation in nitrogen fixing microorganisms. Iron in chloroplasts reflects the presence of cytochromes for performing various photosynthetic reduction processes and of ferrodoxin as an electron acceptor. The ferrodoxins are Fe-S proteins and are the first stable redox compound of the photosynthetic electron transport chain. Iron deficiency is usually observed in soybean grown in calcareous or alkaline soils. In calcareous soil, iron availability is restricted due to conversion of ferrous to ferric and showed deficiency of Fe manifest into yellowish inter-venal paling of younger leaves (commonly referred as iron chlorosis) and soil conditions such as high soil pH found in large areas of the Great Plains may decrease the plant availability of some macro and micronutrients. This may be corrected through initially application at time of sowing and foliar fertilizer application of combination of starter and booster dose of fertilizer. Supplementary foliar application of N, P, K and micronutrients for deficient soils can help to enhance the crop yields under these conditions. Foliar application of micronutrient in high pH saline soils is more beneficial in terms of growth and yield of crop [4]. Foliar application of micronutrient is more beneficial as compare to soil application as the application rate of nutrient is comparatively lesser, nutrient absorption is more moreover, when roots cannot provide necessary nutrients, foliar application is always a compatible alternative [5]. There is an increasing interest from producers about the potential benefits of foliar application of nutrients as compliment of their fertilization programs to maximize yields. Keeping this in view, the present investigation was undertaken to study the effect of soil and foliar application of iron on nutrient availability, uptake, yield and quality of soybean (*Glycine max.* L.).

2.MATERIAL AND METHODS

3.1 Experimental site and soil

The field experiment was conducted at Agricultural Research Station, Kasbe Digraj, Dist: Sangli Maharashtra, India during *kharif* season of the year 2018. This study area is located in Deccan plateau, hot semi arid eco región, in the western Maharashtra plane zone (Zone VI) and is situated at $16^0$08' North latitude, $74^0$08' East longitude and at an altitude of 580 m above mean sea level (MSL). The experimental soil (0-15 cm soil depth) had alkaline pH, electrical conductivity (EC) 0.18 dS m^{-1}, calcium carbonate ($CaCO_3$) 6.80 g kg^{-1}, clayey in texture, bulk density (BD) 1.25 Mg m^{-3} and organic carbon 4.50 g kg^{-1}. The soil available nitrogen, and potassium contents were 170, 7.50, 433 kg ha^{-1} respectively, and soil DTPA iron, zinc, copper and manganese contents were 4.05, 0.35, 0.40 and 2.52 ppm respectively.

3.2 Experimental details

The experiment was laid out in randomized block design with eight treatments and three replications in *kharif*, 2018. The treatments were absolute control (T_1), general recommended dose of fertilizer (GRDF) *i.e.*50:75:45 kg ha^{-1} N:P_2O_5:K_2O + 10 t ha^{-1} FYM (T_2), GRDF + soil application of $FeSO_4$ @ 10 kg ha^{-1} (T_3), GRDF + soil application of $FeSO_4$ @ 20 kg ha^{-1} (T_4), GRDF + $FeSO_4$ @ 10 kg ha^{-1} + cow dung slurry @ 500 liters ha^{-1} (T_5), GRDF + two foliar sprays of chelated Fe @ 0.2% at 30 and 50 days after sowing (DAS) (T_6), GRDF + soil application of $FeSO_4$ @ 10 kg ha^{-1} + two foliar sprays of chelated Fe @ 0.2% at 30 and 50 DAS (T_7) and GRDF + soil application of $FeSO_4$ @ 20 kg ha^{-1} + two foliar sprays of chelated Fe @ 0.2% at 30 and 50 DAS (T_8) . The soybean crop was fertilized with 50 kg N, 75 kg P_2O_5 ha^{-1}and 45 K_2O for treatment GRDF as a basal dose of N, P_2O_5 and K_2O was applied through urea, single super phosphate and muriate of potash to treatment T_2 to T_8 at the time of sowing. The treatments wise quantity of ferrous sulfate was incubated in well decomposed FYM for four days and then applied to treatment $T_{3,}$ $T_{4,}$ T_7 and T_8 at the time of sowing. The foliar sprays of chelated Fe at the rate of 0.2 per cent at 30 and 50 DAS as were applied to treatments $T_{3,}$ $T_{4,}$ $T_{6,}$ T_7 and $T_{8.}$ The cow dung slurry (125 kg cow dung + 500 liters water) with $FeSO_4$ @ 10 kg ha^{-1} were incubated for one week and applied to the treatment T_5 during first irrigation. The seeds of soybean variety *Phule Sangam* (KDS 726) were inoculated with *Rhizobium* and phosphate solubilizing bacteria @ 250 g per 10 kg of seeds and used for sowing. The three irrigations were given during the crop growth period. The soybean crop was sown in monsoon (*kharif*) season with 30 cm row spacing.

3.3.Growth parameters

Five plants of soybean were selected randomly from each net plot by using random numbers. The selected plants were marked by fixing pegs. All the observations were recorded on these plants. The days were counted required for soybean to attain 50 % flowering. The plant height of five plants were measured from the ground level up to the growing point of plant and the average height of plant was expressed in centimetres. The number of branches plant^{-1} were recorded at pod filling stage. Randomly selected five plants used for counting the number of pods plant^{-1} at harvest. Then pods from each plant were removed, separated, counted and recorded under the respective treatments and then the mean was computed. The two plants were randomly selected used for counting the number of effective nodules and non effective plant^{-1} and counted the nodule on root.

3.4. Chlorophyll content

The chlorophyll content was obtained by 30 DAS and 50 DAS of green plant samples. Chlorophyll of fresh plant leaves (4th leaf) at flowering stage extracted in 85 per cent acetone and the absorbance values at 660 nm and 642.5 nm wavelength were recorded on spectro photometer [6].

3.5. Harvesting

The soybean crop was harvested at physiological maturity when the pods turned yellow colour with matured seeds. The border line plants were removed first to eliminate border effect. The crop from net plot was cut close to the ground and kept in respective plots for sun drying. The plot wise threshing of soybean was done. The grains were separated from plant by mechanical thresher. The straw yield and soybean grain yield were recorded by weighing as per the treatments. One hundred seeds were randomly collected from the net plot yield, counted, weighed and expressed as test weight in grams.

3.7. Quality parameters:

The protein content in the seeds was analyzed by indirect method. First, the per cent nitrogen content of the sample was estimated by microkjeldahl method [7]. Then the nitrogen value was multiplied by a factor

5.71 to get the protein content of the sample and expressed in percentage [8]. Oil percentage of grain was determined by Soxhlet extractor using petroleum ether as a solvent.

3.8 Statistical Analysis

The experimental data were analysed statistically by applying the technique of “Analysis of variance” and significance was tested by variance ratio i.e. F value at 5 per cent level of significance [9]. Standard error of mean (S.Em.) and critical difference (CD) was worked out to evaluate differences between treatment means.

3 Results and Discussion

3.1 Chlorophyll content at 30 and 50 DAS

Chlorophyll content in leaves differed significantly due to soil application of iron and foliar sprays treatments. The soil application of $FeSO_4$ @ 20 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2% (T_8) had recorded significantly the highest chlorophyll content at 30 and 50 DAS (20.28 mg g^{-1}) and (21.95 mg g^{-1}) respectively, over the rest of treatments however, it was at par with soil application $FeSO_4$ @ 10 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2% at 30 DAS (19.49 mg g^{-1}) and 50 DAS (21.15 mg g^{-1}) and soil application of $FeSO_4$ @ 20 kg ha^{-1}. The soil application of $FeSO_4$ @ 10 or 20 kg ha^{-1} and foliar application of chelated Fe 0.2% were found higher chlorophyll content at 30 and 50 DAS as compare to GRDF (T_2) and absolute control (T_1).This might due to the beneficial effect of $FeSO_4$ application to soil along with foliar spray increased iron availability in soil and ferrous iron (Fe^{2+}) uptake by plant leaves in foliar resulting in better absorption and translocation of iron. Which in turn might have helped the cellular activity and also directly or indirectly participate in the formation of chlorophyll and thus increasing photosynthesis. The results are in agreement with that of Kandoliya *et al* [10] who reported increase in total chlorophyll content due to iron nutrition in wheat crop.

3.2 Days to 50% flowering

Days to 50 per cent flowering also differed significantly due to different treatment application of iron through soil and foliar. The significantly higher average number of days to 50 per cent flowering (44.33) was noticed in soil application of $FeSO_4$ @ 20 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2% at 30 and 50 DAS (44.33) over the rest of other treatments. The T_8 was at par with T_7 at 30 and 50 DAS (43.66). The treatments T_2 to T_7 were at par with each other for average number of days to 50 per cent flowering. The application of Fe fertilizer with FYM took longer period for average number of days to 50 per cent flowering. This might be due to the $FeSO_4$ along with FYM treatments enhances the growth by mineralization and availability of essential nutrients to soybean and increases the uptake of nutrients and more vegetative growth of soybean. The findings of Maheswari and Karthik [11] also confirmed the results of present study.

3.3 Plant height

The plant height of soybean crop was significantly influenced by iron application through soil and foliar treatments. The treatment T_2 recorded significantly higher plant height as compare to control. The application of chemical fertilizers along with FYM resulted in the increase in growth attributes this may be due to better uptake and translocation of plant nutrients to growing plants and more photosynthesis which in turn promoted more number of leaves, leaf area and dry matter production and found beneficial effect on plant height of soybean. The soil application of $FeSO_4$ @ 20 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2% at 30 and 50 DAS (T_8) was noticed the significantly higher plant height (86.33 cm) than the rest of treatments. The treatment T_8 was on par with T_7 for plant height (85.00 cm), T_4 (83.33 cm) and T_6 (84.00 cm). It clearly indicated that GRDF along with soil application of $FeSO_4$ @ 10 and 20 kg ha^{-1} with two sprays of chelated Fe 0.2 % treatments were found higher plant height. The application of Fe resulted in the increase in chlorophyll content and more photosynthesis also FYM had more beneficial and significant effect on plant height. Similar results were also reported by Balachander *et al*. [12].

3.4 Number of branches per plant

The number of branches per plant of soybean was influenced by various the treatments found to be statistically significant. The significant highest number of branches (11.0 $plant^{-1}$) was recorded in soil application of $FeSO_4$ @ 20 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2% over the rest of treatments. The treatments $T_{8,}$ T_7, T_4, T_6 and T_5 were at par with each other for more number of branches per plant. The higher number of branches in soybean exhibited by treatment receiving soil application of $FeSO_4$ @ 10 or 20 kg ha^{-1} and two sprays of chelated Fe @ 0.2% might be due to the combined application of Fe with recommended dose of other major nutrients which in turn might have increased uptake of nutrients in the plants leading to enhanced chlorophyll content and carbohydrate synthesis and thus helped in increased number of branches per plant of soybean. Similar results were also noticed by Kumar *et al.* [13] and Kunjammal and Sukumar [14].

3.5 Number of pods per plant

The number of pods per plant differed significantly due to iron application through soil and foliar sprays. The soil application of $FeSO_4$ @ 20 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2% (T_8) obtained the significantly more number of pods (44.0 $plant^{-1}$) over the rest of treatments. The treatment T_8 was at par with T_7 (43.33 $plant^{-1}$) and T_4 (41.33 $plant^{-1}$) for number of pods. The highest pods $plant^{-1}$ was produced due to foliar application could be attributed to significant effect iron on reproductive organs, such as stamens and pollens [15]. The increase in number of pods of soybean was confirmation of the translocation of photosynthates to the productive sink. Application of Fe increases the number of pods per plant in mothbean [16].

3.6 Root nodules per plant

Significantly more number of effective root nodules (44.33) was noticed in soil application of $FeSO_4$ @ 20 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2% treatment than the rest of remaining treatments. Iron is required for the synthesis of Fe containing proteins in the host including leghaemoglobin and in bacteriods for nitrogenase and cytochromes of electron transport chain. Similar results were also observed by Shukla and Shukla [17]. The soil application of $FeSO_4$ @ 20 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2% was found non-significant effect with soil application $FeSO_4$ @ 10 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2% at 30 and 50 DAS (T_7) and soil application of $FeSO_4$ @ 20 kg ha^{-1} (T_4). It clearly indicated that basal application $FeSO_4$ @ 10 or 20 kg ha^{-1} were increased the nodule count. The soil application of $FeSO_4$ @ 10 or 20 kg ha^{-1} and foliar application of chelated Fe 0.2% at 30 and 50 DAS treatments were found higher number of effective root nodules at 30 and 50 DAS as compare to GRDF (T_2) and absolute control (T_1). The soil application of ferrous sulphate at 25 kg ha^{-1} to soybean crop increased nodulation, nodules dry weight per plant as compared to control [18].The reverse trend was observed in respect of non-effective root nodules per plant of soybean.

3.7 100 grain weight

The findings regarding 100 grain weight revealed that the treatments receiving iron nutrition either through soil, foliar or combination of both recorded higher grain weight. Soil application of $FeSO_4$ @ 20 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2% showed significantly higher 100 grain weight (19.20 g) over GRDF (T_2) and control (T_1) however, this value was at par with all the other treatments of iron nutrition. The reason for increased 100 grain weight could be attributed to enhanced photosynthetic activity due to increased chlorophyll content in leaves due to iron application. This might have resulted in the production and accumulation of carbohydrates in 100 grain weight development. Similar results were also recorded by Mohammad *et al.* [19] foliar spray of micronutrient had a significant effect on 1000 seed weight safflower. Rubens *et al.,*[20] reported increased in soybean grain weight due to micronutrient fertilization.

3.8 Grain yield

The significantly higher grain yield (24.93 q ha^{-1}) was observed with treatment receiving soil application of $FeSO_4$ @ 20 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2% (T_8) over the rest of treatments which was estimated to be 14 per cent higher compared to T_2 and 81 per cent over T_1. Treatments receiving iron nutrition irrespective of method of application demonstrated increment in soybean grain yield as compared treatments without iron supplement could be due to quicker availability of iron to plants, soil applied $FeSO_4$ and FYM might have resulted increased concentration of plant available iron and formation of metalo-organic complexes of higher extractability and helped in continuous supply of iron and this in turn increases chlorophyll content and accumulate more carbohydrates, which seems to be associated with increase in flowering and pod development ultimately increasing grain yield of soybean. While foliar application of iron might have resulted in direct absorption of the foliage sprayed with Fe solution. The results are in conformity to that of Sale *et al.* [21] who observed increased in soybean yields due to foliar nutrition of Fe and Zn. Similarly, Moosavi and Ronaghi [22] also reported substantial increase in soybean yield in response to foliar and soil iron nutrition.

3.9 Oil content and oil yield

The oil content in seed was not influenced significantly due to various treatments. Nevertheless, treatment receiving iron fertilization along with major nutrients revealed slight increase in oil content. Significantly difference was noticed in case of oil yield, application of $FeSO_4$ @ 20 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2% (T_8) recorded the significantly higher oil content (19.46%) and oil yield (485 kg ha^{-1}) over the rest of treatments. The soil application of $FeSO_4$ @ 20 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2% was at par with soil application of $FeSO_4$ @ 10 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2% at 30 and 50 DAS for oil yield (T_7 446 kg ha^{-1}) and soil application of $FeSO_4$ @ 20 kg ha^{-1} (T_4 444 kg ha^{-1}). The soil application of $FeSO_4$ @ 10 or 20 kg ha^{-1} and foliar application of chelated Fe 0.2% at 30 and 50 DAS and GRDF treatments recorded higher oil yield over the control. It clearly indicated that the application of iron through soil and foliar was beneficial for increasing oil yield of soybean. Ferrous sulphate also contains sulphur in addition to iron. Sulphur is one of the important secondary nutrients required by the crops, sulphur along with iron might have helped to obtain higher oil yield of soybean. Higher oil yield may be due to higher iron availability in alkaline soils, which ensured better biosynthesis of oil in groundnut [23].

3.10 Crude protein content and protein yield

Protein content in seed and protein yield were significantly influenced by various treatments. The application of Fe either through soil as well as foliar sprays recorded higher values of crude protein content and protein yield of soybean as compare to control. Significantly lower crude protein (27.16%) and crude protein yield (372 kg ha^{-1}) were recorded in without FYM and fertilizers over the rest of treatments. However, the significantly higher crude protein (32.24%) and crude protein yield (807 kg ha^{-1}) noticed in treatment soil application of $FeSO_4$ @ 20 kg ha^{-1} along with two foliar sprays of chelated Fe @ 0.2% as compare to rest of treatments. The treatments T_2 to T_7 were at par with each other for crude protein content in soybean. The treatment T_8 was at par with T_7 (746 kg ha^{-1}) and T_4 (746 kg ha^{-1}) for crude protein yield of soybean. It clearly indicated that application of iron is beneficial for increasing crude protein content and crude protein yield of soybean, this might be due to iron is essential for nitrogen fixation and better availability of nitrogen and it absorption ultimately increases in protein content in grain of soybean. Similar results were close in conformity with Sale *et al.* [21].

4.Conclusions

The application of 50:75:45 $N:P_2O_5:K_2O$ kg ha^{-1} + 10 t FYM ha^{-1} and soil application of $FeSO_4$ @ 20 kg ha^{-1} alongwith two foliar sprays of chelated Fe @ 0.2% at 30 and 50 DAS to soybean in iron deficient soil recorded higher growth parameters, grain and straw yield, quality parameters, nutrient uptake by soybean. The residual soil fertility was improved in treatments received GRDF alongwith Fe as compare to initial soil fertility status.

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Table 1 Effect of soil and foliar application of iron on chlorophyll content and number of days to 50 percent flowering of soybean

Treatments	**Chlorophyll content (mg g^{-1})**		**Days to 50 percent flowering**
	30 DAS	**50 DAS**	
T_1	16.11	16.45	38.68

T_2	17.25	17.26	42.00
T_3	17.62	18.02	42.68
T_4	18.21	18.88	43.00
T_5	17.76	18.26	42.00
T_6	16.92	20.05	41.66
T_7	19.49	21.15	43.66
T_8	20.28	21.95	44.33
SE±	0.71	0.59	0.54
CD at 5 %	2.17	1.81	1.66

Table 2 Effect of soil and foliar application of iron on growth parameters of soybean

Treatments	Plant height at flowering stage (cm)	Number of branches plant^{-1} at flowering stage	Number of pods plant^{-1} at harvest	Number of root nodules plant^{-1} at flowering	
				Effective	Non-effective
T_1	75.00	8.00	29.33	31.33	16.33
T_2	80.00	8.66	37.66	36.66	15.00
T_3	81.00	9.33	38.66	38.00	13.00
T_4	83.33	10.00	41.33	40.66	12.33
T_5	81.66	9.66	40.66	38.33	11.33
T_6	84.00	10.00	40.66	39.33	12.33
T_7	85.00	10.66	43.33	42.33	7.00
T_8	86.33	11.00	44.00	44.33	8.00
SE±	0.97	0.54	0.93	1.50	0.82
CD at 5 %	2.95	1.66	2.85	4.55	2.50

Table 3 Effect of soil and foliar application of iron on grain, straw yield and yield contributing parameter of soybean

Treatments	Grain yield (q ha^{-1})	Straw yield (q ha^{-1})	100 grain weight (g)
T_1	13.72	20.70	17.1
T_2	21.80	33.05	17.7
T_3	22.12	34.79	18.2
T_4	23.14	36.33	18.9
T_5	22.37	35.28	18.7
T_6	22.19	35.20	18.3
T_7	23.24	36.38	19.0

T_8	24.93	37.79	19.2
SE±	0.70	1.52	0.40
CD at 5 %	2.12	4.62	1.23

Table 4 Effect of soil and foliar application of iron on quality parameters of soybean

Treatments	**Oil (%)**	**Oil yield (kg ha^{-1})**	**Crude protein (%)**	**Crude protein yield (kg ha^{-1})**
T_1	18.40	252	27.16	372
T_2	18.83	410	30.78	671
T_3	19.00	420	30.88	684
T_4	19.20	444	32.31	746
T_5	19.40	434	31.38	705
T_6	19.06	422	31.91	707
T_7	19.20	446	32.17	746
T_8	19.46	485	32.24	807
SE±	0.28	15.89	0.80	31.30
CD at 5 %	NS	48.20	2.43	94.94