

**ASSESSMENT OF SOIL TEST CROP RESPONSE ON SOIL PROPERTIES AND
YIELD ATTRIBUTES OF MUSTARD (*Brassica juncea* L.)
var. Krishna**

ABSTRACT

The experiment in the field was conducted at central research farm of department of soil science and agricultural chemistry, Sam Higginbottom University of Agriculture, Technology and Sciences, Prayagraj during kharif season 2022-23. The soil in the experimental area was characterized by a sandy loam texture. The soil at the experimental site was characterized as sandy loam. A randomized block design was used for the experiment, incorporating different levels of NPK (80:40:40), vermicompost, and two levels of sulfur (50% and 100%). The results obtained with treatment T₉ (STCR+ 5t ha⁻¹ Vermicompost+ 100% S) demonstrated that although there was a slight decrease in pH, bulk density, and particle density, there was a significant increase in pore space, water holding capacity, electrical conductivity (EC), organic carbon, and the availability of nitrogen, phosphorus, and potassium. Additionally, improvements were observed in plant growth and yield attributes, which showed the best results in terms of plant height, number of siliquae per plant, and total mustard yield. Under control conditions, no significant changes were noted in the yield and growth of mustard. However, the use of organic manures and their combination with a full NPK treatment significantly enhanced the growth and overall yield attributes of mustard.

Keywords: *NPK: Nitrogen, Phosphorus, Potassium, Sulphur, Vermicompost.*

1. INTRODUCTION

"Soil, whether deep or shallow, red or black, sandy or clayey, serves as the crucial link between the rocky core of Earth and the living organisms on its surface. It provides the foundation for the plants we cultivate, which is the primary reason for our interest in soil," remarked **Simonson (1989)**. Soil quality is pivotal for ensuring sufficient food production for sustainable life, influenced by various factors such as climate, topography, and parent material, by **James (1975)**.

The targeted yield model represents a practical method for the efficient utilization of fertilizers. Initially proposed by **Troug (1960)** and later refined by **Ramamoorthy *et al.* (1967)** as the Inductive-cum targeted yield model, this approach combines the use of inorganic and organic nutrients through site-specific integrated nutrient management (SSINM) to achieve balanced fertilization. This method incorporates the soil test crop response (STCR) strategy, which is critical for prescribing precise fertilizer doses to achieve desired crop yields.

Mustard (*Brassica juncea* L.), ranks as the world's third largest oilseed crop, following soybeans and palm oil, accounts for 28.6% of India's total oilseed production (**Shekhawat *et al.*, 2012**). Ranking second only to groundnut in India's edible oilseed sector, mustard is cultivated primarily in Rajasthan, Uttar Pradesh, Haryana, Punjab, and Madhya Pradesh. This versatile crop produces not only seeds but also edible leaves, stems, and roots, serving as a significant source of food and fodder. Despite its importance, India's average mustard yield of 1190 kg/ha is well below that of industrialized nations (2500-3000 kg/ha) and the global average of approximately 1900 kg/ha. (**Agriculture and Cooperation report, ministry of agriculture, government of India 2013-14**).

Sulphur is viewed as the fourth major plant nutrient, following nitrogen, phosphorus, and potassium. It plays a vital role in enhancing the uptake of phosphorus and is essential for the synthesis of nitrogen in proteins. Sulphur is crucial for producing key amino acids such as cysteine and methionine and participates in various metabolic processes within plants, including being a component of glutathione—a compound linked to plant respiration and essential oil synthesis. It also significantly contributes to chlorophyll formation. Various factors, including depleted soil nutrients from continuous cropping, lead to reduced crop yields. Restoring soil fertility is essential for sustaining and improving crop yields, and can be effectively achieved through integrated nutrient management. However, the lack of knowledge regarding the methods and timing of manure and fertilizer application has led to increased cultivation costs. Maintaining soil fertility requires a thorough understanding of soil nutrient status, fertilizer effectiveness, and the appropriate times and methods for applying fertilizers

The Soil Test Crop Response (STCR) model, suggested by Ramamoorthy *et al.*, provides a method to determine balanced and efficient fertilizer applications based on soil test values to optimize crop yield. Utilizing the STCR approach to determine plant nutrient needs has notably enhanced both crop yields and soil health, crucial for sustainable yields and reducing fertilizer expenses. Adopting the STCR methodology in Chhattisgarh could lower cultivation costs and promote intelligent, strategic nutrient management. The targeted yield strategy posits a linear relationship between a crop's grain yield (economic output) and its nutrient uptake. This model adeptly balances "fertilizing the crop" with "fertilizing the soil," making it adaptable to specific field conditions. It also provides a dependable method for estimating regional fertilizer needs to reach certain crop production goals. By fine-tuning fertilizer application and yield targets, this approach aims to maximize profitability from fertilizer investments while maintaining soil health. The targeted yield method has been widely employed to develop fertilizer recommendations nationwide.

2. MATERIALS AND METHODS

During the Rabi season of 2022-2023, a mustard experiment involving three distinct factors was initiated at the central experimental farm of Department Soil Science and Agricultural Chemistry at Sam Higginbottom University of Agriculture Technology and Sciences, Prayagraj. The area is situated on the South of Prayagraj - Rewa National Highway 27, is nearly 6 Km away from the Prayagraj city. It is located at a latitude of 25°24'23" N and a longitude of 81°50'38" E, with an altitude of 98 meters above minimum sea level. The experiment was organized using a randomized block design and included three replications. There were 27 unit plots in total, with each plot sized at 2 X 2 meters. The irrigation layout consisted of a main channel that was 1 m wide and sub-irrigation channels were 0.5 m wide. According to the World Reference Base classification (FAO, 2014), the soil of the experimental farm is Inceptisol, with a sandy loam texture. Nutrient management practices were **T1**- Absolute Control, **T2**- RDF +5t ha⁻¹ Vermicompost + 50 % S, **T3**- STL + 5t ha⁻¹ Vermicompost +50 % S, **T4**- FP+ 5t ha⁻¹ Vermicompost +50% S, **T5**- STCR + 5t ha⁻¹ Vermicompost +50% S, **T6**- RDF 100% + 5t ha⁻¹ Vermicompost + 100% S, **T7**- STL 100% + 5t ha⁻¹ Vermicompost + 100 % S, **T8**- FP +5t ha⁻¹ Vermicompost + 100%S, **T9**- STCR+ 5t ha⁻¹ Vermicompost+ 100% S. where, RDF- Recommended dose of fertilizers (80:40:40 kg ha⁻¹), STL- Soil Test Levels (80:28:28 kg ha⁻¹), FP- Farmer's Practice (50:30:30 kg ha⁻¹),

STCR- Soil Test Crop Response (40:15:15 kg ha⁻¹). All experimental plants were subjected to the same cultural techniques during the study, which included applying fertilizer, watering, filling in gaps, earthing up, controlling weeds, haulm pruning, and taking precautions against damage to the plants. Soil samples were collected from each plot at a depth of 0-15 cm at various stages of the experiment, then air-dried, finely ground, and sieved through a 2 mm mesh before storage in polythene bags. These stored samples were analyzed for a range of physico-chemical properties and changes in available nutrients such as nitrogen, phosphorus, potassium, sulfur, and % organic carbon content. Analyses conducted on the soil included bulk density, particle density, % pore space, soil texture, pH, and levels of available N, P, K, and S.

2.1 Treatments of the Investigation

STCR approach: For Mustard, the STCR equation that follows was utilized to reach the 25 quintal per hectare yield target.

With Vermicompost

1. Nitrogen (kg ha⁻¹) $-12.27T-0.56SN-0.09VC-N$
2. Phosphorus (kg ha⁻¹) $4.60T-3.29SP-0.06VC-P$
3. Potassium (kg ha⁻¹) $=4.69T-0.24K-0.05VC-K$

Where, T= Yield target (q ha⁻¹), SN= Alkaline KMnO₄-N, SP= Olsen's P (kg ha⁻¹) and Sk + Amm. Ac.- K (kg ha⁻¹).

The equations for adjusting fertilizer requirements were prepared to determine the necessary amounts for achieving specific yield targets in mustard, such as 25 quintals per hectare, with variations based on soil test values. The findings indicate that the amount of fertilizer needed varies depending on the soil test results for a given yield target. Similar result was also shown by Mishra *et al.* and Singh *et al.* (2010)

2.2 Nutrient Requirement

- a) N Kg required per quintal of seed production = $\frac{\text{Total uptake of N (kg ha}^{-1}\text{)}}{\text{Seed yield (q ha}^{-1}\text{)}}$
- b) P Kg required per quintal of seed production = $\frac{\text{Total uptake of P (kg ha}^{-1}\text{)}}{\text{Seed yield (q ha}^{-1}\text{)}}$
- c) K Kg required per quintal of seed production = $\frac{\text{Total uptake of K (kg ha}^{-1}\text{)}}{\text{Seed yield (q ha}^{-1}\text{)}}$

2.3 Plant Content and Nutrient Uptake Analysis

When grain samples were taken from each treatment at harvest, the chemical analysis of the plants was carried out to determine the nutrient content, including the concentrations of nitrogen, phosphorous, potassium and sulphur concentration (%) and their uptake (kg ha^{-1}). The plant material was oven-dried, ground, and analyzed using specific methods: nitrogen by micro-Kjeldahl, phosphorus by vanado-molybdo phosphoric acid method, potassium via flame photometry, and sulfur through the Turbidometric Method. Nutrient uptake was calculated using established formulas based on the concentration and dry weight of the plant material.

$$\text{Nutrient uptake (N, P, K kg ha}^{-1}\text{)} = \frac{\text{Nutrient content in grain (\%)} \times \text{Yield (kg ha}^{-1}\text{)}}{100}$$

2.4 Nutrient response ratio ($\text{kg yield kg nutrient}^{-1}$)

The calculation was performed using the following equation provided by the Indian Society of Agronomy, New Delhi.

$$\text{NRR} = \frac{\text{Yield(kg)}}{\text{Amount of nutrient applied (kg)}}$$

3. RESULTS AND DISCUSSION

3.1 Physical Properties of Soil

The data shown in Table 1 reveals that there were no significant changes in the bulk and particle density of the soil across various fertilizer recommendation levels based on soil test values. The highest bulk density (1.303 Mg m^{-3}) and particle density (2.535 Mg m^{-3}) were observed in treatment T1, while the lowest bulk density (1.281 Mg m^{-3}) and particle density (2.510 Mg m^{-3}) were noted in treatment T9. These results are consistent with findings reported by Nagar *et al.* and Sahu *et al.* Conversely, significant differences were observed in soil pore space and water retaining capacity (WRC) at different fertilizer levels. The maximum soil pore space (49.06%) and WRC (46.79%) were recorded in treatment T9, with the minimum values (48.54% pore space and 45.25% WRC) in treatment T1. These outcomes align with studies by Ahmadi and David, and Alam *et al.*

3.2 Chemical Properties of Soil

Table 2 illustrates that increasing fertilizer levels as recommended by soil tests significantly enhances the availability of nutrients such as nitrogen (N), phosphorus (P), potassium (K), and sulfur (S) in the soil. The highest levels of available nutrients - N (271.13 Kg ha⁻¹), P (22.73 Kg ha⁻¹), K (210.3 Kg ha⁻¹), and S (18.47 Kg ha⁻¹) - were recorded in treatment T9. Conversely, the lowest levels - N (233.15 Kg ha⁻¹), P (22.14 Kg ha⁻¹), K (189.7 Kg ha⁻¹), and S (11.20 Kg ha⁻¹) - were observed in treatment T1. These results are consistent with findings from previous research by Upadhyay *et al.*, Rajput *et al.*, and P. Dey.

3.3 Seed Yield (q ha⁻¹)

Table 3 shows a significant increase in mustard seed yield correlating with higher amounts of fertilizer prescribed based on soil test readings. The maximum seed yield, reaching 11.53 q ha⁻¹, was recorded in treatment T9, while the minimum yield of 7.33 q ha⁻¹ was observed in treatment T1. The findings of the current investigation are also consistent with those of Kumar *et al.* and Pal and Pathak.

3.4 Plant Nutrient Concentration

A detailed analysis of the data present in Table 4 indicates that the concentrations of nutrients such as nitrogen (N), phosphorus (P), potassium (K), and sulfur (S) in the grain significantly increased with higher levels of fertilizer application, as recommended based on soil test values. The highest nutrient concentrations - N (1.73%), P (0.23%), K (1.47%), and S (3.9%) were observed in treatment T9, which was notably higher than in any other treatment combination. In contrast, the lowest concentrations - N (1.05%), P (0.14%), K (1.08%), and S (2.83%) - were recorded in treatment T1. These findings are consistent with previous research by Bharose *et al.* and Chaurasia *et al.*

3.6 Nutrient Response Ratio (kg kg⁻¹)

The data in Table 5 clearly shows that the nutrient response ratio (kg kg⁻¹) significantly increased with the elevation of fertilizer recommendation levels, as determined by soil test values. The highest total nutrient response ratio was observed in treatment T9, recording 336.36 kg kg⁻¹, while the lowest was noted in treatment T1, at 146.22 kg kg⁻¹. Similar findings were reported by Yadav *et al.* (2017), Singh *et al.* (2017).

4. CONCLUSION

It is being revealed by the trial that application of Vermicompost and inorganic fertilizers in treatment T9 was found best in increasing growth and yield of mustard. The findings from this study suggest that the Soil Test Crop Response (STCR) based Integrated Nutrient Management (INM) approach not only boosts mustard crop yields but also substantially enhances the nutrient content and absorption in the plants, contributing to nutrient enrichment in mustard seeds. Additionally, the results underscore the effectiveness of the STCR-IPNM strategy in sustaining soil health. Consequently, it is recommended that the STCR-IPNM method be utilized as an effective tool for balanced fertilization in agricultural practices.

ACKNOWLEDGEMENT

I would like to convey my gratitude to the head of the department and staff of the Department of Soil Science and Agricultural Chemistry at Sam Higginbottom University of Agriculture, Technology and Sciences in Prayagraj, Uttar Pradesh, for their unwavering support, encouragement, and keen interest throughout my research and studies.

COMPETING INTERESTS

The authors have stated that there are no conflicting interests.

REFERENCES

1. Ahmadi SA, David AA. Effect of nitrogen and zinc on Physico-chemical properties of soil of Allahabad Uttar Pradesh India. *International Journal of Multidisciplinary Research and Development*. 2016;(3); 5:288-290 ISSN: 2349-4182.
2. Alam, Md. S, Mishra AK, Singh K, Singh SK, David AA. Response of sulphur and FYM on soil physico-Chemical Properties and Growth, Yield and Quality of Mustard (*Brassica Nigra L.*) *Journal of Agricultural Physics*. 2014;(14), No. 2, ISSN 0973-032X:156-160.
3. Anonymous. *Agricultural Statistics at a glance*. Directorate of Economics & Statistics, Ministry of Agriculture, Govt. of India; 2017.
4. Bardsley CE, Lancaster JD. Determination of reserve sulphur and soluble sulphates in soil. *Soil Sci. Soc. Amer. Proc*. 1960; 24:265- 268.
5. Bharose R, Chandra S, Thomas T, Dhan D. Effect of different levels of phosphorus and sulphur on yield and availability of NPK protein and oil content in Toria (*Brassica sp.*)

- VAR. P.T.–303. ARPN Journal of Agricultural and Biological Science. 2011;(6):2.
6. Bouyoucos GJ. The hydrometer as a new method for the mechanical analysis of soil. *Soil Sci.* 1927;23343-353.
 7. Chaurasia A, Singh SB, Namdeo KN. Integrated nutrient management in relation to nutrient contents and uptake of Ethiopian mustard (*Brassica carinata*). *Research on Crops.* 2009;10(2): 246-249.
 8. Dey P. Soil health management. *Soil Health.* 2016;79.
 9. Dhruw TK, Sharma GK, Joshi SK. Effect of soil test based nutrient management on crop yield, nutrient requirement and relationship between nutrient uptake and yield of mustard (*Brassica campestris*) in Alfisol. *IJCS.* 2019;6(6):2022-2024.
 10. Gilluly, James. "Estimation of Micronutrients in Soil Using Geo-Statistical Approach." *The Pharma Journal*, 1975
 11. Jackson ML. *Soil Chemical Analysis*, Prentice Hall of India Private Limited, New Delhi; 1973.
 12. Joshi SK, Nag GP, Singh DP, Sahu YK, Kumawat N. Long-term effect of nutrient management on active organic pools: A review. *International Journal of Chemical Studies.* 2017;5(4):576-579.
 13. Kumar V, Nath P, Kumar R, Kumar V, Verma JK, Naresh RK. Interactive effect of sulphur and nitrogen on growth, yield and quality of Indian Mustard (*Brassica juncea* L.). *I.J.S.N.* 2016;7 (1):57-61 ISSN 2229 – 6441.
 14. Muthuval P, Udaysoorian C, Natesan R, Ramaswami PP. *Introduction to Soil analysis*, Tamil Nadu Agricultural University, Coimbatore. 1992;641002.
 15. Nagar KC, Meena H, Swaroop N. Effect of different levels of inorganic fertilizer and sulphur on physico-chemical properties of soil, and yield of mustard (*Brassica juncea* L.). *An Asian Journal of Soil Science.* 2015;(10):ISSN–0976–7231.
 16. Olsen SR, Cole CV, Watnahe FS, Dean LA. Estimation of available phosphorous in soil by extraction with sodium bicarbonate U.S. Dept. Agr. Cric. 1954;939.
 17. Pal RL, Pathak J. Effect of integrated nutrient management on yield and economics of mustard. *Indian Journal of Science and Nature.* 2016;(7) ISSN 2229 – 6441
 18. Puri G, Jaipurkar SA. Evaluating the effects of soil fertility variables on the yield of mustard (*Brassica compestris*) on swell shrink soil (Vertisol) of central India accepted for presentation. In 15th International Congress of Soil Science. 1994;45-49.
 19. Raghavendra Rao KN, Wani SP, Ravi MV, Veeresh H, Channabasavanna AS, Swamy M. Effect of soil test based nutrient management approaches on grain yield and nutrient

uptake of Dry DSR-mustard cropping system. Agriculture Update Volume 12 | TECHSEAR-5 |. 2017; 1286- 1290

20. Rajput PS, Srivastava S, Sharma BL, Sachidanand B, Dey P, Aher SB, Yashona DS. Effect of soil-test-based long-term fertilization on soil health and performance of rice crop in Vertisols of central India. *International Journal of Agriculture, Environment and Biotechnology*. 2016;9(5):801-806.
21. Ramamoorthy B, Narasimhan RL, Dinesh, R. S. Fertilizer recommendations based on fertilizer application for specific yield of Sonara-64. *Indian Farming*. 1967;17(443): 51.
22. Sahu YK, David AA, Upadhyay Y, Dhruw SS, Sidar RS. Influence of organic manure and various level of NPK on soil physicochemical properties of Mustard (*Brassica juncea* L.) cv. Euro Shakti. *International Journal of Agricultural Science and Research (IJASR)*. 2015;(5),ISSN(P): 2250-0057.
23. Saxena AK, Singh S, Srivastava A, Gautam P. Yield target approach under integrated nutrient management for assessing fertilizer requirements of onion in Mollisols of Uttarakhand. *Indian Journal of Horticulture*. 2008;65(3):302-306.
24. Shekhawat, K., Rathore, S. S., Premi, O. P., Kandpal, B. K. and Chauhan, J. S. (2012). Advances in agronomic management of Indian mustard (*Brassica juncea* (L.) Czernj. Cosson): an overview. *International journal of Agronomy*, 2012.
25. Simonson, R. (1989). Historical Highlights of soil survey and soil classification with emphasis on the United States
26. Singh M, Kumar M. Effect of nitrogen and sulphur levels on seed yield and some other characters in mustard [*Brassica juncea* (L.) Czern and Coss]. *International Journal of Agricultural Sciences*. 2014; (10): 449-452.
27. Subbiah BV, Asija CL. A rapid procedure for the estimation of available nitrogen in soil, *Current Sci*. 1956;25:259-260.
28. Toth SJ, Prince AL. Estimation of cation exchange capacity and exchangeable Ca K and Na Content of Soil by Flame photometer technique. *Soil Sci*. 1949;67: 439-445.
29. Truog, E. (1960). Fifty years of soil testing, Proc. Trans 7th International congress soil science. Vol. III Commission IV. Paper No. 7, 46-53
30. Upadhyay Y, Swaroop N, Sahu YK, Dhruw SS, Verma PD. Interaction effects of different doses of sulphur and zinc with NPK on physico -chemical properties of soil in yellow mustard (*Brassica compestris* L.) Cv. Krishna Super Goldi. *International Journal of Agricultural Science and Research (IJASR)*. 2016;(6)ISSN (P):2250- 0057.
31. Verma TS, Bhagat RH. Nitrogen use efficiency as affected by time variant nitrogen

application to wetland rice. *Oryza*. 1995; 32:276-279.

32. Verma M, Singh YV, Dey P, Babu A. Soil test based fertilizer recommendation for mustard (*Brassica juncea* L.) in Eastern Plain Zone of Uttar Pradesh, India. *International Journal of Current Microbiology and Applied Science*. 2017;6(2):155-161.

Table 1. Response of Vermicompost and inorganic fertilizers based on STCR of mustard on physical properties of soil after crop harvest

Treatment	Bulk Density (Mg m ⁻³)	Particle Density (Mg m ⁻³)	Pore space (%)	WRC (%)
T ₁	1.30	2.53	48.54	45.25
T ₂	1.30	2.53	48.57	45.38
T ₃	1.29	2.52	48.67	45.43
T ₄	1.29	2.52	48.71	45.53
T ₅	1.29	2.52	48.67	45.83
T ₆	1.29	2.52	48.83	46.32
T ₇	1.28	2.52	48.94	46.73
T ₈	1.28	2.51	48.02	46.74
T ₉	1.28	2.51	49.06	46.79
F-test	NS	NS	S	S
S.Em. (±)	0.01728	0.04261	0.88487	0.21578
C.D. (P= 0.05)	0.05202	0.12828	2.66372	0.70139

Table 2. Response of Vermicompost and inorganic fertilizers based on STCR of mustard on Chemical Properties of soil after crop harvest

Treatment	Available Nitrogen (kg ha ⁻¹)	Available Phosphorous (kg ha ⁻¹)	Available Potassium (kg ha ⁻¹)	Available Sulphur (Kg ha ⁻¹)
T ₁	233.15	22.14	189.7	11.20

T ₂	236.33	22.63	198.6	13.73
T ₃	243.35	22.46	202.0	13.97
T ₄	249.44	22.71	203.0	14.40
T ₅	250.31	22.78	205.3	14.54
T ₆	258.40	22.49	205.6	17.40
T ₇	262.20	22.56	206.7	17.87
T ₈	264.42	22.60	209.0	18.23
T ₉	271.13	22.73	210.3	18.47
F-test	S	S	S	S
S.Em. (±)	4.62058	1.05795	4.79221	0.15423
C.D. (P= 0.05)	9.83537	0.49702	10.2007	3.19254

Table 3. Response of Vermicompost and inorganic fertilizers based on STCR of mustard on Chemical Properties of mustard after crop harvest

Treatment	Seed Yield (q ha ⁻¹)
T ₁	7.33
T ₂	9.47

T ₃	9.50
T ₄	9.53
T ₅	9.53
T ₆	9.67
T ₇	9.70
T ₈	11.13
T ₉	11.53
F-test	S
S.Em. (±)	0.394
C.D. (P= 0.05)	1.284

Table 4. Response of Vermicompost and inorganic fertilizers based on STCR of mustard on concentration of Nitrogen (%), Phosphorus (%), Potassium (%) and Sulphur (%) of Grain.

Treatment	N%	P%	K%	S%
T ₁	1.05	0.14	1.08	2.83
T ₂	1.14	0.15	1.11	3.01
T ₃	1.17	0.16	1.15	3.10
T ₄	1.40	0.17	1.17	3.24
T ₅	1.50	0.18	1.21	3.35
T ₆	1.53	0.18	1.26	3.45
T ₇	1.57	0.19	1.32	3.52
T ₈	1.61	0.21	1.39	3.64
T ₉	1.73	0.23	1.47	4.02
F-test	S	S	S	S
S.Em. (±)	0.08	0.01	0.06	0.14
C.D. (P=0.05)	0.25	0.03	0.19	0.21

Table 5. Response of Vermicompost and inorganic fertilizers based on STCR of mustard on the nutrient response ratio (kg kg⁻¹) at 90 DAS.

Treatment	Nitrogen Response ratio	Phosphorous Response ratio	Potassium Response ratio	Total Response
-----------	----------------------------	-------------------------------	-----------------------------	-------------------

	(kg kg ⁻¹)	(kg kg ⁻¹)	(kg kg ⁻¹)	ratio (kg kg ⁻¹)
T ₁	-	-	-	-
T ₂	30.82	48.74	48.74	146.22
T ₃	30.83	61.65	61.65	154.13
T ₄	31.08	62.17	62.17	155.42
T ₅	31.45	83.10	83.11	206.96
T ₆	48.74	88.07	88.07	211.15
T ₇	49.86	88.86	88.85	216.06
T ₈	66.65	89.85	89.85	244.37
T ₉	68.90	103.73	103.73	336.36
F-test			S	
S.Em. (±)			16.62	
C.D. (P=0.05)			35.23	