Original Research Article

Impact of STCR based nutrient Application on Dry Matter Accumulation, Partitioning of Potassium in Rice (Oryza sativa L.) and Potassium Fractions in Black Cotton Soil of Central India

Abstract

Chemical fertilizers used by the majority of Indian farmers are based on a generalized recommendation that overlooks soil fertility and crop response. These broad recommendations frequently result in under- or over-fertilization, resulting in reduced productivity, efficiency, and environmental pollution. To address these issues, the STCR-target yield approach appears to be promising. However, the dynamics of potassium (K), an important primary essential nutrient, is not fully understood under STCR based approach. Therefore, our current study was aimed to profile the dynamics of potassium in rice parts and its different forms in vertisol. The present study was conducted at the soil science research farm of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, a part of AICRP on the effect of soil test and crop response based nutrient management on potassium partitioning in rice crop and its fractions in vertisol of Madhya Pradesh. The treatments comprised of T_1 : Control (no fertilizer application); T_2 : General recommended dose (120:60:40 N, P_2O_5 and K_2O kg ha^{-1}); T_3 : Targeted Yield 50 q ha^{-1} (115:90:49 N, P_2O_5 and K_2O kg ha^{-1}); T_4 : Targeted Yield 60 q ha^{-1} (157:125:70 N, P_2O_5 and K_2O kg ha^{-1}); T_5 : Targeted Yield 50 q ha^{-1} with 5 t FYM ha^{-1} (115:90:49 N, P_2O_5 and K_2O kg ha^{-1}); and T_6 : Targeted Yield 60 q ha^{-1} with 5 t FYM ha^{-1} (157:125:70 N, P_2O_5 and K_2O kg ha^{-1}). Partitioning of K into different parts of rice was anlaysed and the result showed that T_6 has a significant effect on it. Highest concentration of K in root, leaves, stem, panicle and grain (0.353, 1.730, 2.510, 0.441 and 0.275 %, respectively) was found in T_6. STCR based fertilizer with 5 tonnes FYM ha^{-1} application significantly influenced the different fractions of soil K and the maximum available potassium, which is present in the form of water-soluble, exchangeable, and non-exchangeable forms, equilibrium with each other, were also found to be maximum in treatment T_6. The study based on STCR demonstrated that STCR based integrated use of fertilizers and manure for targeting yield can produce targeted yield without deteriorating soil fertility.

Key words: Rice, STCR, Potassium partitioning, Potassium Fractions, Vertisol

Introduction

Rice (*Oryza sativa L.)* has an enviable place in the world's agricultural food crops. Rice production takes up one-third of the world's agricultural land and accounts for 35-60% of the calories consumed by 2.7 billion people. India is the world's second largest rice producer after China, with a total area of 44.50 million hectares and a total production of 112.90 million tonnes. (MoAFW, 2019). Rice productivity in India increased significantly during the Green Revolution, owing to improved irrigation, chemical fertilizer, and pesticide use. However, the continuous unscientific use of inorganic fertilizers and chemicals has resulted in pollution and degradation of soil fertility, which negatively hampered long-term rice sustainability. In the current agricultural context, the overall negative value of primary nutrients is 19 percent for N, 12 percent for P, and 69 percent for K. (Gurav et al., 2019). With the harvest of one tone rice grain, we remove 15-31 kg N, 1-5 kg P, and 8-35 kg K from the soil. Long-term intensive cropping systems with no or very less K inputs have a negative influence on K supply for plant uptake, resulting in lower crop yields. Native K must be supplemented with organic and inorganic inputs to sustain soil fertility and productivity. Although manure can help improve soil fertility, it is insufficient in delivering the required nutrients for optimal production. As a result, combining organic manure with inorganic fertilizers will help to achieve the production target sustainably.

Potassium (K) is the third most critical component of plant growth, and its importance in agriculture is well known (Kilmar *et al*. 1968; Sparks and Huang 1985). It is important for enzyme activation, osmoregulation, water interactions, photosynthesis, protein and starch synthesis, as well as increased agricultural productivity and sustainability (Mengel, 1985). K availability to plants is typically subject to the different fractions of K *viz.* Water-soluble potassium which is taken directly by plants; exchangeable potassium which is trapped by a negative charge on clay particles and which is accessible to plants and fixed potassium which is stuck within layers of extended lattice clay which is not readily available to the plant. However, the available K contributes only 1-2 percent and occurs in two forms: water-soluble K and exchangeable K which is absorbed on the surface of the soil colloid (Brady and Well, 2002). Both potassium forms always maintain a dynamic equilibrium. In the case of intensive cultivation, the crop extracts the available K and the exchangeable K. Subsequently, more exchangeable K is freed from non-exchangeable type K. Kinetics in soil depend on the availability of potassium and the removal of K from the soil system (Singh et al., 2009).

Rice-wheat and rice monocropping are the dominant cropping systems in vertisols of central India. Resource poor farmers often overlooked the role of K fertilizer and manure in sustaining rice production. Therefore, significant attention has to be given to balanced NPK fertilisers in India. Soil testing is important to balanced fertilizer application. Soil test crop response approach has been given an alternate solution to maintain soil fertility as well as to achieve yield targets (Ramamoorthy *et al*., 1967). This approach takes into account the absolute levels of nutrients in the soil which can reach the target crop yield. However, the K dynamics in soil and its uptake pattern not been described in details earlier. Therefore this study aimed to analyse K uptake and distribution in rice plant parts and the role of different K fractions in relation to the integrated use of fertilizers and manures.

Material and Methods

Experimental site and Climatic conditions

The experiment was laid out at the soil science research farm of Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India. Situated at 23^0 13’ North latitude, 79^0 57’ East longitudes, and at an elevation of 393 meters above mean sea level. The climate of research site is subtropical with hot dry summers and cool dry winters. Maximum and minimum temperatures range from 35^oC to 42^oC in June and 8^0 C to 9 ^0C in January, respectively. The weather data recorded during the period of investigation are depicted in Fig. 1.0. The data show that total rainfall reported during the crop growth cycle *viz.* June to December (*Kharif season*) was 1617.6 mm and mainly obtained between mid-June and the end of September. The maximum temperature ranged from 24.7^{0}C to 41.9^{0}C, whereas, minimum temperature ranged from 27.6^{0}C to 5.5^{o}C in *Kharif* 2016. Maximum relative humidity varied from 94.3 to 54.9 percent and minimum relative humidity varied from 22.3 to 91.0 percent. All-weather conditions were almost identical to the area's average condition, and thus favorable to crop growth and development.

Soil characteristics

The soil of the experimental site was Vertisol (medium black) belongs to *Kheri* series of fine montmorillonitic *hyperthermic* family of *Typic Haplusterts.* The soil, *b*ased on the analytical report of the surface 0-15 cm soil, was slightly alkaline in reaction having pH 7.57 of the saturated paste (1:2.5 soil to water ratio) measured by glass-calomel electrode meter (Jakson, 1973). Soil has 5.41 g kg^{-1} organic C (Walkley and Black, 1934), 217.83 kg ha^{-1} available N (Subbiah and Asija, 1956), 21.45 kg ha^{-1} available P (Olsen et al., 1954) and 311.57 kg ha^{-1} available K (Hanway and Heidel, 1952). The initial level of various forms of K was tested according to Pratt (1982) and Ranganathan and Satyanarayana (1980), highest was Lattice K (5270.62 mg kg^{-1}) followed by Non-exchangeable Potassium (621.38 mg kg^{-1}), Exchangeable Potassium (210.11 mg kg^{-1}) and Water-soluble Potassium (29.20 mg kg^{-1}).

Experimental details

The experiment was laid out in *Kharif* season of 2016 under the on-going research programme of AICRP on STCR. The experiment was consists of six treatments of nutrient management including a control to achieve the targeted yield of rice (variety:- *Kranti*) which were replicated four times in a randomized complete block design (RCBD). Treatment details are given in table 1.0. Based on the targeted yield of rice, doses of fertilizers and manure were calculated and applied as per the agronomic recommendation. For the calculation of fertilizers and manure, standard equations developed by AICRP on STCR were used, which are given below. Treatment $T_{1,}$ was an absolute control without any external nutrient inputs. T_2 received general recommended dose of N-P_2O_5 -K_2O i.e. 120-60-40 kg ha^{-1}. Doses of fertilizers and FYM for remaining treatments were calculated using the target yield concept. The calculated quantity of NPK for T_3 (Targeted yield 50 q ha^{-1}) was 115-90-49 kg ha^{-1}. T_4 with targeted yield of 60 q ha^{-1}, received 157-125-70 kg

ha^{-1}. For T_5 and T_6, NPK quantity was similar to T_3 and T_4 respectively with FYM at the rate of 5 t ha^{-1}. Total doses of phosphorus, potassium and half a dose of nitrogen were added as basal as per the procedure. The remaining half of nitrogen was top-dressed at 30 and 60 DAS, in two split doses. During the crop season, field was irrigated 3 times during the dry spell. As per the normal guideline for this area, certain crop management practices have been carried out.

Fertilizer adjustment equations for rice:

$$FN = 4.25\,T - 0.45\,SN$$

$$FP_2O_5 = 3.55\,T - 4.89\,SP$$

$$FK_2O = 2.10\,T - 0.18\,SK$$

Where,

FN = Fertilizer nitrogen (kg ha^{-1})

FP_2O_5 = Fertilizer phosphorus (kg ha^{-1})

FK_2O = Fertilizer potassium (kg ha^{-1})

T = Desired yield target (q ha^{-1})

SN = Available soil nitrogen (kg ha^{-1})

SP = Available soil phosphorus (kg ha^{-1})

SK = Available soil potassium (kg ha^{-1})

Soil and plant sampling and analysis

Soil samples were collected for nutrient study, using the screw auger from each plot of the experiment. The samples were taken at 60 days after sowing (DAS) and harvesting stage from 0-15 cm soil depth. The soil samples were collected and air-dried, wooden roller grounding, then passed through a 2 mm stainless steel sieve and collected for further examination.

Soil available K was extracted by shaking with neutral standard ammonium acetate for 5 minutes (Hanway and Heidel, 1952), and potassium was measured by flame-photometer in the extract. Different fractions of K were estimated as per Pratt (1982). Three plants per plot were sampled to determine the plant potassium content in different parts. The plant samples were subjected to wet digestion (Di acid mixture of HNO_3 and $HClO_4$) for estimating K content in the root, stem, leaves, panicle, and grain. The crop was harvested and bundled plot-wise for calculating grain and straw yield and allowed to dry in the plot for 2-3 days, and then weighted. Threshing was done manually at each plot, and yields of grain and straw were reported and expressed in kg ha^{-1}.

Statistical analysis

Data were subjected to analysis of variance to examine the impact of treatments on response variables as per the standard procedure of RCBD described by Gomez and Gomez (1984). Variance analysis for randomized block formation was carried out and the relevance of interventions was checked to draw valid conclusions as defined. No transformations were needed to meet ANOVA assumptions. Comparisons between treatment means were made using the least significant difference (LSD). All differences presented in the text are statistically significant at $\alpha=0.05$.

Result and Discussion

Dry matter accumulation and partitioning

Statistics related to the partitioning of seeds, stem and roots hill^{-1} with dry matter as influenced by various treatments are provided in Table 2. Data clearly showed that NPK rates with and without FYM exerted significant variation on the partitioning of dry matter at all crop growth stages. Further, data revealed that well-spoken improvements in dry matter partitioning per hill were recorded with each successive increase in NPK levels with FYM and without FYM at all crop growth stages except at harvest, which was gradually decreased in all treatments. It was also evident from the data on dry matter partitioning hill^{-1} that dry matter of leaves (0.75, 3.37, 4.51, 4.13), stems (0.97, 7.45, 8.35, 7.73), and roots (0.47, 1.09, 1.21, 1.09) were the lowest under absolute control at all the stages *viz.* 30, 60, 90 DAS and harvest stage, respectively, whereas the best performing treatment was T_6. Higher doses of fertilizers along with FYM in T_6 provided favorable conditions for rice growth and development. Among the three different parts of rice at all the growth stages followed the trend of roots>leaves>stem. Similar result on dry matter performance was recorded by Srivastava et al. (2013) and Khidrapure et. al. (2015).

Potassium partitioning in rice

Data concerning potassium partitioning of leaves, stem, root, panicle and grain in dry matter at different stages of growth as affected by different treatments are provided in Table 3. A brief overview of the data shows that the potassium partitioning in dry matter was the highest during the initiation of the panicle to the flowering stage, after which it slowed down as the plant matured.

Leaves

The data presented in Table 3 showed that potassium partitioning in rice plants in different parts was significantly higher than other plant parts except straw in all the treatments. Potassium partitioning was observed to be 1.250 and 1.730 % in leaves at 60 DAS and at harvest of rice plant respectively in T_6, Whereas, minimum potassium content in leaves was 1.050 and 1.210 % at 60 DAS and at harvest of rice plant respectively in control.

Stem

The data presented in Table 3 revealed that K content in stem in T_6 (157:125:70 kg N: P_2O_5: K_2O with 5 t FYM ha^{-1}) was significantly higher than other treatments, it contains maximum potassium as compared to other treatments (1.690 and 2.510 % at 60 DAS and at harvest, respectively). The minimum potassium in the stem was found in T_1 (control) which was 1.470 and 2.130 % at 60 DAS and at harvest, respectively.

Root

Data indicates that T_6 was significantly higher than all other treatments. It contains 0.433 and 0.353 % potassium at 60 DAS and at harvest respectively. The minimum potassium was found in T_1 (control) rice plant (0.389 and 0.276 % at 60 DAS and at harvest, respectively) because of no application of fertilizers and manure.

Panicle and Grain

The rice panicle contains slightly higher potassium than grain. The maximum potassium (0.441 and 0.275 % in panicle and grain respectively) was found in T_6. So, the T_6 was found significantly superior as compared to other treatments and it is was at par with T_5 and T_4. The minimum potassium was found in T_1, 0.363 and 0.265 % in panicle and grain, respectively.

The potassium content in all the parts of the crop increased significantly with increasing levels of NPK with and without FYM. Total uptake of potassium by leaves, stem, root, panicle, and grain was high in T_6 treatment as compared to control. It might be because the balanced use of various fertilizers and manure results in proper absorption, translocation, and assimilation of nutrients, ultimately increasing the dry-matter accumulation and nutrient contents of the crop. These results are in agreement with the findings of Challa Venureddy (2017) and Kafle and Sharma (2015).

Potassium fractions in soil

The soil of two stages of rice field (60 DAS and at harvest) at 0-15 cm depth was taken for analysis and the data obtained from the analysis for different pools of potassium (water-soluble, exchangeable, non-exchangeable, lattice and total potassium) are presented in Table 4. The data at harvest of soil for different K fractions was showing the depletion in potassium pools because of potassium uptake by the plant and other factors.

Water soluble potassium

It is recognized as the Soil Solution Potassium or readily available form of potassium easily taken by the plants. Water-soluble K content at harvest ranged between 12.98 to 27.11 mg kg^{-1} at 60 DAS and 10.3 to 25.79 mg kg^{-1} at harvest stage soil. Water-soluble K increased with the increase in the rate of potassium with farmyard manure. The higher content of water-soluble K (27.11 mg kg^{-1}) at 60 DAS was noted in T_6 with the application of 157:125:70 kg N: P_2O_5: K_2O with 5 t FYM ha^{-1} followed by T_4 with the application of 157:125:70 kg N: P_2O_5: K_2O ha^{-1} alone which was to the extent of 23.27 mg kg^{-1} than T_5, T_3, T_2 and T_1 (21.64, 19.13, 18.25 and 12.98 mg kg^{-1}, respectively) at 60 DAS. Thus, the data of water-soluble reveal that the treatment T_6 showed significantly higher than other treatments and while other treatments were found highly significant as compared to control. Similar results were reported by Thippeswamy *et al.* (2000). An increase in water-soluble K might be due to an increased concentration of K in solution due to increased rate of potassium application with FYM which is attributed to movement of added K to soil solution and to an increase in the K concentration in soil solution. Further, it was concluded that the water-soluble potassium depleted in all the treatments at the harvest stage. The maximum water-soluble potassium was found in T_6 (25.79 mg kg^{-1}) and minimum in T_1 (10.37 mg kg^{-1}) at harvest. It might be due to the uptake of water-soluble K by plant or fixation.

Exchangeable potassium

The exchangeable K content ranged from 153.87 mg kg^{-1} to 209.25 mg kg^{-1} at 60 DAS and 135.73 mg kg^{-1} to 198.44 mg kg^{-1} at harvest soil (Table 4). On comparing the values of treatment T_6 with other treatments, it was found that the treatment which received continuously the NPK fertilizer along with FYM indicated the significant increase in soil exchangeable K. Changes in the status of soil exchangeable potassium which was recorded at two stages as 10.81 mg kg^{-1} in the treatment T_6 from 60 DAS to at harvest, which received the higher dose of NPK with FYM. The lowest exchangeable K concentration was observed under control and highest in T_6 which fertilized with 157:125:70 N: P_2O_5: K_2O with 5 t FYM ha^{-1}. The NPK dose of T_6 with FYM maintained the greatest content, which is significantly more than the other treatments. It may be due to the fact that FYM addition could increase the CEC of soil which was responsible for holding more amount of exchangeable K and helped in the release of exchangeable K from non-exchangeable pool (Kher and Minhas, 1991).

Non-Exchangeable potassium

Non-exchangeable K content varied from 527.68 mg kg^{-1} to 618.49 mg kg^{-1} at 60 DAS soil and 515.47 mg kg^{-1} to 609.13 mg kg^{-1} at harvest soil. Application of 157:125:70 N: P_2O_5: K_2O with 5 t FYM ha^{-1} resulted in significantly greater non-exchangeable K over all other treatments. It was found that non-exchangeable potassium at 60 DAS was maximum in T_6 (618.49 mg kg^{-1}) followed by T_4, T_5, T_3, T_2 and T_1 (607.43, 599.16, 589.17, 576.23 and 527.68 mg kg^{-1}), respectively and at harvest soil maximum non exchangeable potassium in T_6 (609 mg kg^{-1}) followed by T_4, T_5, T_3, T_2 and T_1 (595.73, 586.97, 575.24, 561.57 and 515.47 mg kg^{-1}, respectively). The improvement in the status of non-exchangeable K under T_6 is associated with the larger amount of soil organic carbon which adds an additional amount of K and also provides sorption site for K on application of organic manure along with mineral fertilizer (Singh et al., 2014).

Lattice potassium

Lattice K constituted a dominant fraction of K and water-soluble K proved to be the deciding factor in predicting yield variations (Table 4). Lattice K content varied from 3942.60 mg kg^{-1} to 5274.48 mg kg^{-1} at 60 DAS and 3555.78 mg kg^{-1} to 5164.20 mg kg^{-1} at harvest soil. Variation in the status of soil lattice K over two stages was recorded as 5274.48 and 5164.20 mg kg^{-1} at 60

DAS and at harvest, respectively, in the treatment T_6, which received 157:125:70 kg $N:P_2O_5:K_2O$ with 5 t FYM ha^{-1}. The lowest content of lattice K was recorded with the T_1 (control). Lattice K constituted a dominant fraction of K and water-soluble K proved to be the deciding factor in predicting yield variations. On comparing the values of treatment T_6 with other treatments, it was found that the plots receiving continuously NPK fertilizers along with FYM indicate that significant increase in the lattice K. The contribution of lattice K or mineral K is the dominant K fractions, which contributed substantially to total K. Similar results were also observed by Jadhao *et al.* (2015) who reported that various fertilizer treatments with FYM significantly increased lattice K.

Total potassium

Total K content ranged between 4637.13 to 6129.33 mg kg^{-1} at 60 DAS and 4217.35 to 5997.56 mg kg^{-1} **(**Table 4**).** Total K increased with the increase in the rate of potassium application with manure. Total potassium was significantly higher in T_6 (157:125:70 kg N: P_2O_5: K_2O with 5 t FYM ha^{-1}) as compared to other treatments at both intervals because of the high level of fertilizers application with 5 t FYM. Maximum total potassium was found in T_6 (6129.33 and 5997.56 mg kg^{-1} at 60 DAS and at harvest, respectively) due to high dose of NPK and fertilizers with FYM followed by application of $T_{5,}$ and minimum was found in control. Talashikar *et al.* (2006) and Jadhao *et al.* (2015) reported that various fertilizer treatments significantly increased total potassium.

Conclusion

Based on the results and corroboration with previous studies, It could be concluded that STCR based integrated nutrient management not only gave higher crop yield but also support the potassium content of the soil. Our results also highlight the higher potassium content in grain, leaves, stem and roots in T_6 where fertilizers were supplemented with FYM. Therefore, it demonstrated that the combined use of organic manures and inorganic fertilizers ensures the immediate supply of the nutrients from inorganic fertilizers in the initial stages and from the decomposition of organic manures to cater to the nutrient needs at the later stages of crop growth. The balanced use of various fertilizers and manure also increase the potassium assimilation in different parts and , ultimately increasing the dry-matter accumulation and nutrient contents of crop.

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Table 1. Treatments detail of the experiment

	Treatment details	**Nutrient applied (N: P_2O_5: K_2O, kg ha^{-1})**	**FYM**
T1 :	Control	-	-

T2 :	General recommended dose	120-60-40	-
T3 :	T. Y. 50 q ha^{-1}	115-90-49	-
T4 :	T. Y. 60 q ha^{-1}	157-125-70	-
T5 :	T.Y. 50 q + 5 t FYM ha^{-1}	115-90-49	25-12-25
T6 :	T.Y. 60 q + 5 t FYM ha^{-1}	157-125-70	25-12-25

Table 2. Effect of different treatments on dry mater partitioning in rice

Treatments	**Dry matter partitioning per hill (g)**

	30 DAS			**60 DAS**			**90 DAS**			**At harvest**		
	Leaves	**Stem**	**Roots**	**Leaves**	**Stem**	**Roots**	**Leaves**	**Stem**	**Roots**	**Leaves**	**Stem**	**Roots**
T_1	0.75	0.97	0.47	3.37	7.45	1.09	4.51	8.35	1.21	4.13	7.73	1.09
T_2	0.87	1.13	0.59	3.75	9.33	1.45	5.97	10.63	1.73	5.67	10.17	1.63
T_3	0.91	1.20	0.63	3.93	10.27	1.57	6.55	11.77	1.87	6.29	11.33	1.79
T_4	0.99	1.35	0.71	4.31	11.59	1.81	7.39	13.19	2.15	7.17	12.81	2.11
T_5	0.97	1.31	0.67	4.29	11.35	1.76	7.13	12.85	2.08	6.89	12.45	2.03
T_6	1.03	1.43	0.75	4.63	12.61	1.97	7.86	14.17	2.33	7.75	13.89	2.31
CD ***(p=0.05)***	0.10	0.16	0.08	0.47	1.29	0.19	0.71	1.27	0.21	0.67	1.23	0.20

Table 3. Effect of different treatments on potassium partitioning in rice

Treatments	**Potassium partitioning in Rice plant (%)**

	60 DAS			**At harvest**				
	Leaves	**Stem**	**Roots**	**Leaves**	**Stem**	**Roots**	**Panicle**	**Grain**
T_1	1.050	1.470	0.389	1.210	2.130	0.276	0.363	0.265
T_2	1.170	1.590	0.411	1.470	2.290	0.307	0.399	0.261
T_3	1.190	1.600	0.417	1.580	2.370	0.329	0.417	0.257
T_4	1.230	1.650	0.425	1.660	2.410	0.342	0.430	0.271
T_5	1.220	1.630	0.420	1.640	2.400	0.337	0.425	0.263
T_6	1.250	1.690	0.433	1.730	2.510	0.353	0.441	0.275
CD ***(p=0.05)***	0.072	0.095	0.026	0.088	0.129	0.019	0.024	0.015

Table 4. Effect of different treatments on potassium fractions (mg/kg) of soil

Treatments	**Water soluble K**		**Exchangeable K**		**Non-Exchangeable K**		**Lattice K**		**Total K**	
	60 DAS	**At harvest**	**60 DAS**	**At harvest**	**60 DAS**	**At harvest**	**60 DAS**	**At harvest**	**60 DAS**	**At harvest**
T_1	12.98	10.37	153.87	135.73	527.68	515.47	3942.60	3555.78	4637.13	4217.35
T_2	18.25	15.83	169.73	153.83	576.23	561.57	4351.04	4232.18	5115.25	4963.41
T_3	19.13	16.95	178.68	166.27	589.17	575.24	4461.39	4267.43	5248.37	5025.89
T_4	23.27	21.16	191.77	180.45	607.43	595.73	4603.10	4414.43	5425.57	5211.77
T_5	21.64	19.84	187.32	175.18	599.16	586.97	4917.09	4743.64	5725.21	5525.63
T_6	27.11	25.79	209.25	198.44	618.49	609.13	5274.48	5164.20	6129.33	5997.56
CD *(p=0.05)*	2.31	2.10	13.27	11.78	55.83	53.41	398.24	378.61	449.16	418.67

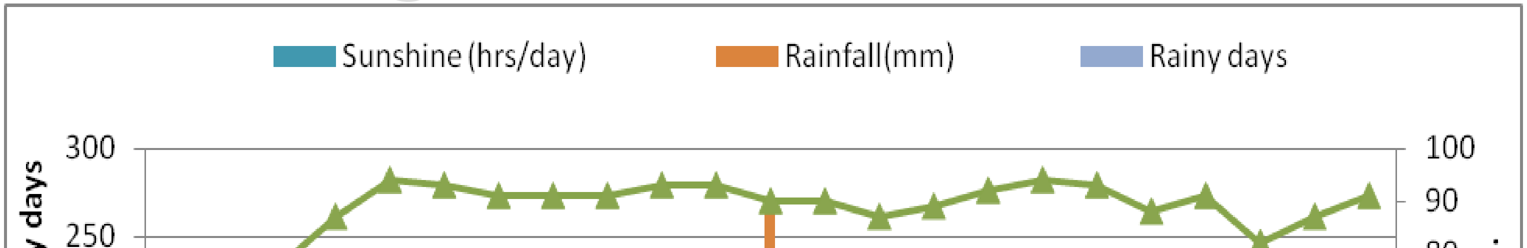

Fig.1.0 Weekly meteorological parameters during *Kharif* season 2016 at Jabalpur (Madhya Pradesh)