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Influence of conservation tillage practices and nutrient management on growth of greengram in greengram-wheat cropping sequence

SB Salgar, SS Ilhe, SC Patil and PP Kharche

Abstract
An investigation was carried out at Post Graduate Institute Research Farm, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra (India) on "Influence of conservation tillage practices and nutrient management on soil health and productivity of greengram– wheat cropping sequence" was conducted during 2019-20 and 2020-21. The soil of experimental field was sandy loam in texture. The experiment was laid out in split plot design during *kharif* season and split-split plot design during *rabi* season with three replications. The treatment consists of six main plot treatments of conservation tillage practices *viz*., T_1– Convectional tillage with crop residue, T_2 – Convectional tillage without crop residue, T_3 – Minimum tillage with crop residue, T_4 – Minimum tillage without crop residue, T_5 – Zero tillage with crop residue, T_6 – Zero tillage without crop residue and two sub plot treatments of nutrient management *viz*., F_1 – 75% GRDF, F_2 – 100% GRDF for *kharif* greengram during two consecutive years. The result revealed that mean higher growth attributes *viz*., plant height (7.71/7.91, 20.51/22.27, 37.61/40.16, 55.49/58.33 and 55.49/58.33 cm during 2019 and 2020 at 15, 30, 45, 60 and at harvest respectively), number of branches plant^{-1} (1.84/2.04, 3.41/4.61, 4.52/5.49, 5.58/6.59 and 5.58/ 6.59 during 2019 and 2020 at 15, 30, 45, 60 and at harvest respectively), number of leaves plant^{-1} (2.70/3.45, 8.58/10.04, 19.06/20.85, 14.72/16.60 and 8.22/ 10.45 during 2019 and 2020 at 15, 30, 45, 60 and at harvest respectively), leaf area plant^{-1} (0.16/0.18, 1.51/2.02, 4.37/5.39, 8.72/10.19 and 3.86/5.32 dm^2 during 2019 and 2020 at 15, 30, 45, 60 and at harvest respectively) and dry matter plant^{-1} (3.59/4.39/3.99, 11.56/14.25/12.90, 20.93/23.01/21.97 and 30.28/32.09/31.19 g during 2019 and 2020 at 30, 45, 60 and at harvest and on pooled mean basis respectively) recorded under conservation tillage practice minimum tillage with crop residue with 100% GRDF to *kharif* greengram.

Keywords: Tillage, nutrient, management, greengram, sequence

Introduction
Greengram (*Vigna radiata* L. Wilczek) is one of the important pulse crop in India. It is also known as mungbean, moong and golden gram. mainly cultivated in arid and semi arid region. It is believed that greengram is a native of India and Central Asia and grown in these. Greengram is a protein rich staple food. It contains about 25% protein, which is almost three times that of cereals. It supplies protein requirement of vegetarian population of the country. It is particularly rich in Leucine, Phenylalanine, Lysine, Valine, Isoleucine, etc. In addition to being an important source of human food and animal feed, it also plays an important role in sustaining soil fertility by improving soil physical properties and fixing atmospheric nitrogen. The leading greengram producing states in India are Rajasthan, Maharashtra and Andhra Pradesh.

Conservation agriculture offers a new paradigm for agricultural research and development different from the conventional one, which mainly aimed at achieving specific food grains production targets in India. A shift in paradigm has become a necessity in view of widespread problems of resource degradation, which accompanied the past strategies to enhance production with little concern for resource integrity. Integrating concerns of productivity, resource conservation and soil quality and the environment is now fundamental to sustained productivity growth. Developing and promoting conservation agriculture systems will be highly demanding in terms of the knowledge base. This will call for greatly enhanced capacity of scientists to address problems from a systems perspective be able to work in close partnerships with farmers and other stakeholders and strengthened knowledge and information-sharing mechanisms.

Conservation agriculture offers an opportunity for arresting and reversing the downward spiral of resource degradation, decreasing cultivation costs and making agriculture more resource-use-efficient, competitive and sustainable "Conserving resources – enhancing productivity" has to be the new mission (Bhan and Behera, 2014). Hence there is scope for obtaining sustainable production by growing predominant pulse crop greengram during *kharif* season. Therefore, effort has been made to plan and examine an experiment on "Influence of conservation tillage practices and nutrient management on soil health and productivity in greengram – wheat cropping sequence".

Material and Methods

The field experiment was conducted during *kharif* season 2019 and 2020 at the Research Farm of Post Graduate Institute, Mahatma Phule Krishi Vidyapeeth, Rahuri (M.S.), situated at 19^0 48'N and 19^0 57'N Latitude and 74^0 32'E and 74^0 19'E longitude and altitude is 511 m above mean sea level. The topography of experimental field was levelled and well drained. The meteorological data on important weather parameters during the crop growth period for the year 2019 and 2020 was recorded at Meteorological Observatory located at AICRP on Irrigation Water Management Project, M.P.K.V., Rahuri. The experiment was conducted in split plot design with three replications during *kharif* season in a fixed layout. The treatment consists of six main plot treatments of conservation tillage practices *viz*., T_1– Convectional tillage with crop residue, T_2 – Convectional tillage without crop residue, T_3 – Minimum tillage with crop residue, T_4 – Minimum tillage without crop residue, T_5 – Zero tillage with crop residue, T_6 – Zero tillage without crop residue and two sub plot treatments of nutrient management *viz*., F_1 – 75% GRDF, F_2 – 100% GRDF for *kharif* greengram during two consecutive years. In case of conventional tillage one ploughing, disking and planking and in case of minimum tillage disking was carried out. The gross plot size was 8.10 m x 4.80 m. The greengram variety Phule Vaibhav was grown at row to row spacing 30 cm and plant to plant spacing 10 cm by using seed rate 15 kg ha^{-1}. The 5 t FYM was applied before sowing, while recommended dose of fertilizer @ 20:40:00 kg N, P_2O_5, K_2O ha^{-1} given in the form of urea and single super phosphate respectively during 2019 and 2020. In greengram Pendimethalin 30 EC @ 1 to 1.5 kg a.i. ha^{-1} was applied as pre-emergence followed by two hand weeding at 15 DAS and 35 DAS followed by application of Imazethapyr 10% SL @ 0.1 to 0.15 kg a.i. at 21 DAS in zero tillage plot during both the years of study. The various growth parameters *viz*., plant height (cm), number of branches $plant^{-1}$, number of leaves $plant^{-1}$, leaf area $plant^{-1}(dm^2)$, dry matter $plant^{-1}$ (g) in greengram were recorded on five randomly selected plants. The leaf area was calculated using the formula suggested by Jain and Misra (1966) [5]. The growth observations were recorded at an interval of 15 days commencing from 15 DAS till 60 DAS and at harvest during both years.

Result and Discussion

Plant height (cm)

Effect of conservation tillage practices

The Conservation tillage practice minimum tillage with crop residue (T_3) to greengram recorded significantly higher plant height at 15, 30, 45, 60 DAS and at harvest than rest of the conservation tillage practices at all the crop growth stages during both the years (Table 1). However, it was at par with conservation tillage practice conventional tillage with crop residue (T_1) at 45 and 60 DAS and at harvest during second year. It is due to favorable seed bed, adequate aeration, maximum storage and conservation of moisture as compared to other treatments. Adequate availability of soil moisture in root zones with this treatment might have increased the soil mineralization which resulted improved soil nutrient availability, thereby increasing cell division cell expansion, which in turn increased the plant height. The results were supported by Banjara *et al.* (2017) [2], Abid *et al.* (2018) [1] and Shilpa *et al*. (2021) [13].

Effect of nutrient management

The 100% GRDF (F_2) recorded significantly higher plant height at 15, 30, 45, 60 DAS and at harvest respectively than 75% GRDF (F_1) at all the crop growth stages during both the years (Table 1). The higher plant height was recorded under 100% GRDF (F_2) might be due to supply of chemical fertilizer in adequate amount to the crop is crucial for the establishment and initial growth of plants in terms of plant height. These results are in accordance with those reported by Shete *et al.* (2010) [12], Jat *et al.* (2012) [6] and Patel *et al*. (2018) [8].

Number of branches $plant^{-1}$

Effect of conservation tillage practices

The number of branches $plant^{-1}$ in greengram was influenced significantly due to different treatments of conservation tillage practices during both the years (Table 2). Conservation tillage practice minimum tillage with crop residue (T_3) to greengram crop registered significantly higher number of branches $plant^{-1}$ at 15, 30, 45, 60 DAS and at harvest respectively than rest of the conservation tillage treatments at all the crop growth stages during both the years. However, it was at par with conservation tillage practice conventional tillage with crop residue (T_1) at 30 DAS during both years. The maximum number of branches $plant^{-1}$ with conservation tillage practice minimum tillage with crop residue (T_3) might be due to good availability of moisture helps for absorption of more nutrient to crops results in better growth of plants. These results are in the line of Prajapati *et al*. (2020) [9] and Yadav *et al*. (2020) [16].

Effect of nutrient management

Data presented in Table 2 revealed that number of branches $plant^{-1}$ of greengram was recorded significantly higher in 100% GRDF (F_2) at 15, 30, 45, 60 DAS and at harvest respectively than 75% GRDF (F_1) at all the crop growth stages during both the years. This might be due to more nutrient availability to the crop resulted into increased conversion of carbohydrates into protein which in turn elaborated into protoplasm and cell wall material increased the size of the cell, which expressed morphologically in terms of number of branches. These results are in accordance with those reported by Sindhi *et al*. (2016) [14] and Kalsaria *et al*. (2017) [7].

Number of leaves $plant^{-1}$

Effect of conservation tillage practices

Data presented in Table 3 revealed that Conservation tillage practice minimum tillage with crop residue (T_3) to greengram crop recorded significantly maximum number of leaves $plant^{-1}$

than rest of the conservation tillage treatments. However, it was at par with conservation tillage practice conventional tillage with crop residue (T_1) at 60 DAS during first year and at 45 and 60 DAS during second year of study. This might be due to favourable environment that supports the establishment and development of greengram crops in terms of soil moisture and nutrients. These results were confirmed by Banjara *et al*. (2017) [2] and Abid *et al*. (2018) [1].

Effect of nutrient management

Data presented in Table 3 implicited that the 100% GRDF (F_2) recorded significantly higher number of leaves plant^{-1} than 75% GRDF (F_1) at all the crop growth stages during both the years. This might be due to N, P and K are major plant nutrients causing increased meristematic activity of the plant as a result of proportionate increase in growth attributes in terms of number of leaves plant^{-1}.These results are in conformity with those reported by Gosavi *et al.* (2010) [4] and Dongare *et al*. (2016) [3].

Leaf area plant^{-1} (dm^2)

Effect of conservation tillage practices

The leaf area plant^{-1} in greengram was registered significantly higher under Conservation tillage practice minimum tillage with crop residue (T_3) than rest of the conservation tillage practices. This might be due to there was enough moisture available throughout the vegetative growth phase and additionally, more nutrients may have been absorbed due to the loose and porous seed bed in the root zone for longer period, which may have increased the number leaves which in turn resulted in more leaf area plant^{-1} through the process of greater cell elongation, cell multiplication and higher rate of photosynthesis. These results are supported by Abid *et al*. (2018) [1].

Effect of nutrient management

Data presented in Table 4 expressed that maximum leaf area plant^{-1} in greengram recorded under The 100% GRDF (F_2). This might be due to increased nutrient availability to crops due to increased fertilizer doses favour crop growth and development. These results are in conformity with those reported by Rathod and Gawande (2014) [10] and Dongare *et al*. (2016) [3].

Dry matter (g) plant^{-1}

Effect of Conservation tillage practices

Data presented in Table 5 revealed that Conservation tillage practice minimum tillage with crop residue (T_3) to greengram crop registered significantly higher dry matter plant^{-1}. However, it was at par with conservation tillage practice conventional tillage with crop residue (T_1) 30 DAS during first year and at harvest during second year. This might be due to minimum tillage conserved more soil moisture and crop residues have potential to increase of soil organic matter and nutrient levels, moderation of soil temperature and augmented soil biological activity, which provided better growing environment for increased all the growth attributes *viz*. plant height, number of leaves plant^{-1}, leaf area plant^{-1} and number of branches which ultimately reflected in higher dry matter than other treatments. These results are in agreement with those reported by Saravanan (2018) [11] and Shilpa *et al*. (2021) [13].

Effect of nutrient management

The 100% GRDF (F_2) practice recorded significantly higher dry matter plant^{-1}. This might be due to higher fertilizer application rate causes crops to absorb more essential nutrients, which aids in crop growth, which increases light absorption for higher photosynthesis and the development of photosynthates, which are transported to plant reproductive and vegetative organs which enhances biomass production by plant. These results are in accordance with Sindhi *et al*. (2016) [14], Kalsaria *et al*. (2017) [7] and Thesiya *et al*. (2019) [15].

Table 1: Periodical plant height of greengram as influenced by different treatments

Treatment	Plant height (cm)									
	2019					2020				
	15 DAS	30 DAS	45 DAS	60 DAS	At harvest	15 DAS	30 DAS	45 DAS	60 DAS	At harvest
Conservation tillage practices – (T)										
T_1: Conventional tillage with crop residue	8.53	22.37	39.97	57.18	57.18	9.05	23.98	44.55	60.18	60.18
T_2: Conventional tillage without crop residue	6.65	18.85	34.42	53.73	53.73	6.88	20.93	36.82	55.82	55.82
T_3: Minimum tillage with crop residue	9.33	24.35	43.03	60.90	60.90	9.42	26.70	46.02	62.65	62.65
T_4: Minimum tillage without crop residue	7.57	19.68	37.47	54.07	54.07	7.68	21.19	38.98	58.23	58.23
T_5: Zero tillage with crop residue	7.73	20.92	39.20	56.85	56.85	7.82	22.93	40.97	59.35	59.35
T_6: Zero tillage without crop residue	6.47	16.87	31.58	50.22	50.22	6.63	17.90	33.67	53.72	53.72
SE. m. (±)	0.18	0.22	0.92	1.14	1.14	0.10	0.45	0.50	0.87	0.87
C.D. at 5%	0.56	0.71	2.88	3.61	3.61	0.33	1.43	1.59	2.76	2.76
Nutrient Management – (F)										
F_1: 75% GRDF	7.43	19.89	36.34	53.68	53.68	7.52	20.96	38.41	57.15	57.15
F_2: 100% GRDF	7.99	21.12	38.88	57.30	57.30	8.31	23.59	41.92	59.50	59.50
SE. m. (±)	0.13	0.31	0.22	0.81	0.81	0.14	0.28	0.19	0.70	0.70
C.D. at 5%	0.41	0.97	0.66	2.48	2.48	0.42	0.85	0.59	2.15	2.15
Interactions (T x F)										
Between two sub plots means at same level of main plot means										
SE. m. (±)	0.32	0.76	0.52	1.97	1.97	0.33	0.67	0.46	1.70	1.70
C.D. at 5%	NS	NS	1.62	NS	NS	NS	NS	1.43	NS	NS
Between two main plots means at same level of sub plot means										
SE. m. (±)	0.38	0.66	1.62	2.42	2.42	0.29	0.91	0.93	1.93	1.93
C.D. at 5%	NS	NS	5.12	NS	NS	NS	NS	2.92	NS	NS
General mean	7.71	20.51	37.61	55.49	55.49	7.91	22.27	40.16	58.33	58.33

Table 2: Periodical number of branches plant^{-1} in greengram as influenced by different treatments

Treatment	Number of branches plant^{-1}									
	2019					2020				
	15 DAS	30 DAS	45 DAS	60 DAS	At harvest	15 DAS	30 DAS	45 DAS	60 DAS	At harvest
Conservation tillage practices – (T)										
T_1: Conventional tillage with crop residue	2.30	4.13	5.10	6.30	6.30	2.43	5.20	5.98	6.97	6.97
T_2: Conventional tillage without crop residue	1.43	2.70	3.83	4.90	4.90	1.73	3.90	4.90	5.83	5.83
T_3: Minimum tillage with crop residue	2.47	4.37	5.57	6.87	6.87	2.63	5.40	6.27	7.57	7.57
T_4: Minimum tillage without crop residue	1.67	3.23	4.50	5.27	5.27	1.83	4.67	5.40	6.70	6.70
T_5: Zero tillage with crop residue	1.87	3.53	4.77	5.53	5.53	2.03	4.83	5.77	6.97	6.97
T_6: Zero tillage without crop residue	1.30	2.50	3.37	4.60	4.60	1.57	3.63	4.63	5.50	5.50
SE. m. (±)	0.05	0.12	0.08	0.12	0.12	0.03	0.12	0.09	0.16	0.16
C.D. at 5%	0.14	0.37	0.24	0.39	0.39	0.09	0.37	0.28	0.51	0.51
Nutrient Management – (F)										
F_1: 75% GRDF	1.64	3.03	4.39	5.20	5.20	1.92	4.13	5.02	6.13	6.13
F_2: 100% GRDF	2.03	3.79	4.66	5.96	5.96	2.16	5.08	5.96	7.04	7.04
SE. m. (±)	0.07	0.10	0.07	0.12	0.12	0.04	0.10	0.07	0.13	0.13
C.D. at 5%	0.21	0.30	0.21	0.36	0.36	0.12	0.32	0.23	0.41	0.41
Interactions (T x F)										
Between two sub plots means at same level of main plot means										
SE. m. (±)	0.16	0.24	0.16	0.28	0.28	0.09	0.25	0.18	0.32	0.32
C.D. at 5%	NS	NS	0.50	NS	NS	NS	NS	0.56	NS	NS
Between two main plots means at same level of sub plot means										
SE. m. (±)	0.14	0.26	0.17	0.29	0.29	0.08	0.26	0.20	0.36	0.36
C.D. at 5%	NS	NS	0.54	NS	NS	NS	NS	0.63	NS	NS
General mean	1.84	3.41	4.52	5.58	5.58	2.04	4.61	5.49	6.59	6.59

Table 3: Periodical number of leaves plant^{-1} in greengram as influenced by different treatments

Treatment	Number of leaves plant^{-1}									
	2019					2020				
	15 DAS	30 DAS	45 DAS	60 DAS	At harvest	15 DAS	30 DAS	45 DAS	60 DAS	At harvest
Conservation tillage practices – (T)										
T_1: Conventional tillage with crop residue	3.00	9.33	21.33	16.67	9.40	4.13	11.23	23.23	18.57	12.10
T_2: Conventional tillage without crop residue	2.37	7.57	17.53	13.33	6.93	2.80	8.87	19.87	15.03	8.93
T_3: Minimum tillage with crop residue	3.37	9.83	22.07	17.43	10.17	4.67	12.13	24.03	19.30	13.13
T_4: Minimum tillage without crop residue	2.57	8.53	18.43	14.30	7.73	3.20	9.10	20.20	16.23	9.63
T_5: Zero tillage with crop residue	2.80	8.97	19.13	15.10	8.73	3.53	10.20	21.10	17.10	10.50
T_6: Zero tillage without crop residue	2.10	7.23	15.83	11.50	6.33	2.37	8.70	16.67	13.37	8.40
SE. m. (±)	0.08	0.15	0.18	0.30	0.21	0.16	0.25	0.29	0.67	0.27
C.D. at 5%	0.27	0.46	0.56	0.95	0.68	0.50	0.78	0.92	2.11	0.84
Nutrient Management – (F)										
F_1: 75% GRDF	2.51	7.73	17.97	13.52	7.44	2.67	9.11	19.49	14.34	9.20
F_2: 100% GRDF	2.89	9.42	20.14	15.92	8.99	4.23	10.97	22.21	18.86	11.70
SE. m. (±)	0.06	0.17	0.24	0.27	0.18	0.18	0.23	0.45	0.34	0.33
C.D. at 5%	0.18	0.53	0.75	0.83	0.55	0.54	0.70	1.38	1.05	1.01
Interactions (T x F)										
Between two sub plots means at same level of main plot means										
SE. m. (±)	0.14	0.42	0.59	0.65	0.43	0.43	0.55	1.09	0.83	0.80
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Between two main plots means at same level of sub plot means										
SE. m. (±)	0.17	0.39	0.52	0.69	0.48	0.40	0.58	0.92	1.30	0.73
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
General mean	2.70	8.58	19.06	14.72	8.22	3.45	10.04	20.85	16.60	10.45

Table 4: Periodical leaf area plant^{-1} in greengram as influenced by different treatments

Treatment	Leaf area plant^{-1} (dm^2)									
	2019					2020				
	15 DAS	30 DAS	45 DAS	60 DAS	At harvest	15 DAS	30 DAS	45 DAS	60 DAS	At harvest
Conservation tillage practices – (T)										
T_1: Conventional tillage with crop residue	0.18	1.60	5.51	9.50	4.41	0.20	2.40	6.24	11.14	6.00
T_2: Conventional tillage without crop residue	0.13	1.39	3.52	7.76	3.44	0.15	1.56	4.97	9.19	4.26
T_3: Minimum tillage with crop residue	0.21	1.82	6.16	10.14	5.00	0.23	2.98	7.15	12.13	7.02
T_4: Minimum tillage without crop residue	0.16	1.44	3.63	8.35	3.69	0.17	1.79	5.02	9.75	5.08
T_5: Zero tillage with crop residue	0.17	1.56	4.52	9.32	4.10	0.19	2.00	5.22	10.08	5.67
T_6: Zero tillage without crop residue	0.12	1.23	2.87	7.24	2.53	0.13	1.41	3.77	8.87	3.91
SE. m. (±)	0.01	0.06	0.19	0.16	0.18	0.01	0.15	0.14	0.16	0.26
C.D. at 5%	0.02	0.18	0.59	0.51	0.56	0.02	0.48	0.44	0.51	0.81
Nutrient Management – (F)										
F_1: 75% GRDF	0.13	1.38	3.95	8.27	3.34	0.16	1.61	4.49	9.22	4.20
F_2: 100% GRDF	0.19	1.63	4.78	9.17	4.38	0.20	2.44	6.30	11.16	6.44
SE. m. (±)	0.01	0.08	0.21	0.23	0.16	0.01	0.12	0.16	0.17	0.17
C.D. at 5%	0.04	0.23	0.64	0.70	0.49	0.02	0.37	0.50	0.53	0.53
Interactions (T x F)										
Between two sub plots means at same level of main plot means										
SE. m. (±)	0.028	0.18	0.50	0.55	0.39	0.016	0.29	0.39	0.42	0.42
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Between two main plots means at same level of sub plot means										
SE. m. (±)	0.023	0.16	0.48	0.48	0.41	0.016	0.33	0.37	0.40	0.53
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
General mean	0.16	1.51	4.37	8.72	3.86	0.18	2.02	5.39	10.19	5.32

Table 5: Periodical dry matter plant^{-1} of greengram as influenced by different treatments

Treatments	Dry matter (g) plant^{-1}											
	30 DAS	30 DAS	Pooled mean	45 DAS	45 DAS	Pooled mean	60 DAS	60 DAS	Pooled mean	At harvest	At harvest	Pooled mean
	2019	2020		2019	2020		2019	2020		2019	2020	
Conservation tillage practices – (T)												
T_1: Conventional tillage with crop residue	4.10	5.15	4.63	13.64	16.03	14.83	23.00	24.37	23.69	32.15	34.82	33.48
T_2: Conventional tillage without crop residue	3.20	3.60	3.40	9.63	11.63	10.63	19.51	20.92	20.22	28.49	29.80	29.15
T_3: Minimum tillage with crop residue	4.30	5.52	4.91	15.06	19.13	17.09	24.30	26.05	25.17	34.20	36.08	35.14
T_4: Minimum tillage without crop residue	3.34	4.27	3.81	10.29	13.36	11.82	20.40	22.90	21.65	29.53	31.83	30.68
T_5: Zero tillage with crop residue	3.67	4.36	4.02	11.86	14.43	13.14	21.46	23.87	22.66	30.45	32.31	31.38
T_6: Zero tillage without crop residue	2.90	3.41	3.16	8.86	10.92	9.89	16.92	19.96	18.44	26.88	27.73	27.30
SE. m. (±)	0.09	0.10	0.08	0.32	0.35	0.29	0.27	0.41	0.30	0.43	0.49	0.40
C.D. at 5%	0.28	0.31	0.24	1.00	1.10	0.85	0.86	1.28	0.88	1.35	1.55	1.18
Nutrient Management – (F)												
F_1: 75% GRDF	3.39	4.25	3.66	10.44	13.49	11.71	20.21	21.69	20.69	29.38	30.99	30.12
F_2: 100% GRDF	3.78	4.52	4.15	12.67	15.00	13.84	21.65	24.34	22.99	31.18	33.20	32.19
SE. m. (±)	0.05	0.07	0.04	0.53	0.31	0.31	0.40	0.30	0.25	0.48	0.61	0.39
C.D. at 5%	0.15	0.22	0.13	1.64	0.94	0.90	1.24	0.93	0.73	1.48	1.87	1.13
Interactions (T x F)												
Between two sub plots means at same level of main plot means												
SE. m. (±)	0.11	0.17	0.10	1.30	0.74	0.75	0.98	0.73	0.61	1.17	1.48	0.94
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
Between two main plots means at same level of sub plot means												
SE. m. (±)	0.17	0.21	0.13	1.07	0.80	0.67	0.84	0.87	0.60	1.11	1.35	0.87
C.D. at 5%	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS
General mean	3.59	4.39	3.99	11.56	14.25	12.90	20.93	23.01	21.97	30.28	32.09	31.19

Conclusion

Based on two years of experimentation it could be concluded that the Conservation tillage practice minimum tillage with crop residue (T_3) and 100% GRDF (F_2) to *kharif* greengram obtained higher growth parameters *viz*., plant height (cm), number of branches plant^{-1}, number of leaves plant^{-1}, leaf area plant^{-1} (dm^2) and dry matter plant^{-1} (g) in greengram-wheat cropping sequence.

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