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Response of chickpea to different growth parameters under conservation agriculture practices

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Abstract
A field experiment was conducted at Agriculture Research Station, Kalaburagi, University of Agricultural Sciences, Raichur, conducted during *rabi* 2016-17. To study the "Response of chickpea (*Cicer arietinum* L.) on different growth parameters under conservation agriculture practices". The trial was laid out in Split plot design with four replications and six treatments and three main plots and two sub plots. Among all the treatments, Zero Tillage with residue retention significantly recorded higher plant height and total dry matter accumulation, grain and Stover yield, No of pods per plant and test weigh T. It is concluded that the among all treatments zero tillage with residue retention was found best combination for higher chickpea crop yields compared to other of treatments.

Keywords: Conventional tillage, reduced tillage, zero tillage and test weight

Introduction
Conservation agriculture is a management system that maintains a soil cover through surface retention of crop residues with no till/zero and reduced tillage. CA is based on optimizing yields and profits, to achieve a balance of agricultural, economic and environmental benefits. As per FAO definition CA is to achieve acceptable profit high and sustained production levels, and conserve the environment. It aims at reversing the process of degradation inherent to the conventional agricultural practices like intensive agriculture, burning/removal of crop residues. Hence, it aims to conserve, improve and make more efficient use of natural resources through integrated management of available soil, water and biological resources combined with external inputs. It can also be referred to as resource efficient or resource effective agriculture.
Chickpea (*Cicer arietinum* L.) is one of the important legume crop and rich in protein content. Its seeds are used as a vegetable and dry bean. In fact, it is a multipurpose crop used in human diets, animal fodder and industrial purposes. Chickpea is the most important pulse crop cultivated during *rabi* season mainly in semi-arid and warm temperate regions of the world. In India, it is cultivated over an area of 9.93 million hectares with an annual production of 9.53 million tonnes and with a productivity of 960 kg ha^{-1} (Anon, 2015) [1]. The area under chickpea in Karnataka is 0.92 million hectares with 0.57 million tonnes of production and with 622 kg ha^{-1} of productivity (Anon, 2015) [1]. In Karnataka, Kalaburagi district, occupies the first position in chickpea area (0.16 million hectares) with a production of 0.11 million tonnes and productivity (0.74 t ha^{-1}) followed by Vijayapura and Bagalakot districts (Anon, 2015) [1].
The daily per capita availability of chickpea is 14 g, is a source of about 2.3 % energy (56 kcal) and 4.7 % protein (2.7g) to Indian population, besides being an important source of Ca and Fe (10-12%). The chickpea grain contains 21.1 % protein, 61.5 % carbohydrate, 4.5 % fat and also rich in niacin malic and oxalic acids secreted from leaves, stems and pods have medicinal applications for cholera, constipation, diarrhea, digestive disorders, snakebite, sunstroke and warts. These acids are known to lower blood cholesterol level as well. Chickpea is used for human consumption as well as for feeding to the animals. Keeping above facts in consideration a study was conducted on response of chickpea on different growth parameters under conservation agriculture practices.

Material and Methods
A field experiment was conducted at Agriculture Research Station, Kalaburagi, University of Agricultural Sciences, Raichur, conducted during *rabi* 2016-17. To study the "Response of

chickpea (*Cicer arietinum* L.) under conservation agriculture practices". The trial was laid out in Split plot design with four replications and six treatments and three main plots and two sub plots. The treatment details as fallows.

Treatment details

Main plot:

M1: Conventional Tillage
M2: Reduced Tillage
M3: Zero Tillage

Sub Plot:

S1: With residue
S2: Without residue

Main x Sub Plot

M1S1: Conventional Tillage (CT) + with residue
M1S2: Conventional Tillage (CT) + without residue
M2S1: Reduced Tillage (RT) + with residue
M2S2: Reduced Tillage (RT) + without residue
M3S1: Zero Tillage (ZT) + with residue
M2S2: Zero Tillage (ZT) + without residue

Results

Influence of conservation agricultural practices on growth parameters

Plant height

Among main plot tillage treatments, the zero tillage (M3) recorded significantly higher plant height (25.68, 42.94 and 53.19 cm) over conventional tillage (M1) (21.22, 36.58 and 44.70 cm) at 30, 60 days after sowing (DAS) and at harvest, respectively in Table 1. Among sub plot residue treatments, with residue retention (S1) recorded significantly higher plant height (23.97, 39.95 and 50.33 cm**)** over all other treatments. However, significantly lower plant height was recorded in without residue retention (S2) (21.83, 37.86 and 45.58 cm**)** at 30, 60 DAS and at harvest, respectively. Interaction of tillage and residue treatments on plant height at different stages of chickpea differed significantly. Significantly higher plants height (27.20, 45.75 and 58.01 cm**)** was observed in zero tillage along with residue retention (M3S1) as compared to all other treatments. However, Conventional tillage without residue retention (M1S2) recorded lower plants height (20.60, 36.55 and 43.10 cm**)** at 30, 60 DAS and at harvest.

Dry matter accumulation in plant

Among the main plot tillage treatments, zero tillage (M3) recorded significantly higher dry matter accumulation in plant (3.75, 9.46 and 26.10 g plant^{-1}) over conventional tillage (M1) (2.30, 6.08 and 18.20 g plant^{-1}) at 30, 60 DAS and at harvest, respectively (table 2). Among sub plot residue treatments, with residue retention (S1) recorded significantly higher dry matter accumulation in plant (3.09, 8.29 and 22.75 g plant^{-1}**)** over all other treatments. However, without residue retention (S2) recorded lower dry matter accumulation in plants (2.61, 7.07 and 19.73 g plant^{-1}**)** at 30, 60 DAS and at harvest, respectively. Interaction of tillage and residue treatments on dry matter accumulation in plant at different stages of chickpea differed significantly. However, significantly higher dry matter accumulation in plant (4.33, 10.83 and 29.75 g plant^{-1}**)** was observed in zero tillage along with residue retention (M3S1) as compared to all other treatments. Conventional tillage without residue (M1S2) recorded significantly lower dry matter accumulation in plant (2.18, 6.01 and 17.73 g plant^{-1}**)** at 30, 60 DAS and at harvest.

Table 1: Plant height at different growth stages of chickpea as influenced by conservation agriculture

Treatment	Plant height (cm)		
	30 DAS	60 DAS	At harvest
Main plot			
M_1:Conventional Tillage	21.22	36.58	44.70
M_2: Reduced Tillage	21.80	37.20	45.98
M_3:Zero Tillage	25.68	42.94	53.19
S.Em±	0.49	1.16	1.43
CD 5 %	1.70	4.01	4.96
Sub Plot			
S_1:With Residue	23.97	39.95	50.33
S_2:Without Residue	21.83	37.86	45.58
S.Em±	0.47	0.42	1.15
CD 5 %	1.50	1.33	3.69
Main x sub Plot			
M_1S_1	21.85	36.60	46.30
M_1S_2	20.60	36.55	43.10
M_2S_1	22.85	37.50	46.70
M_2S_2	20.75	36.90	45.25
M_3S_1	27.20	45.75	58.01
M_3S_2	24.15	40.13	48.38
S.Em±	0.81	0.72	2.00
CD 5 %	2.61	2.30	6.39

Table 2: Dry matter production at different growth stages of Chickpea as influenced by Conservation agriculture practices

Treatment	Dry Matter Production		
	30 DAS	60 DAS	At harvest
Main plot			
M_1: Conventional Tillage	2.30	6.08	18.20
M_2: Reduced Tillage	2.49	7.50	19.41
M_3:Zero Tillage	3.75	9.46	26.10
S.Em±	0.23	0.43	1.56
CD 5 %	0.81	1.50	5.39
Sub Plot			
S_1:With Residue	3.09	8.29	22.75
S_2:Without Residue	2.61	7.07	19.73
S.Em±	0.04	0.23	0.29
CD 5 %	0.12	0.72	0.92
Main x sub Plot			
M_1S_1	2.43	6.15	18.68
M_1S_2	2.18	6.01	17.73
M_2S_1	2.51	7.90	19.83
M_2S_2	2.47	7.10	19.00
M_3S_1	4.33	10.83	29.75

M_3S_2	3.18	8.10	22.45
S.Em±	0.07	0.39	0.50
CD 5 %	0.21	1.25	1.59

Influence of conservation agricultural practices on yield and yield parameters

Number of pods per plant

Among main plot tillage treatments, zero tillage (M3) recorded significantly higher number of pods per plant (76.06) over conventional tillage (M2) (67.19). Among sub plot residue treatments, with residue retention (S1) recorded significantly higher number of pods per plant (72.98**)** over all other treatments (table 3). However, significantly lower number of pods per plant was recorded in without residue retention (S2) (21.82). Interaction of tillage and residue treatments on number of pods per plant differed significantly. Higher number of pods per plant (80.38**)** was observed in zero tillage with residue retention (M3S1) as compared to all other treatments. Conventional tillage without residue retention (M1S2) recorded significantly lower number of pods per plant (66.43).

Test weight

Among the main tillage plot treatments, zero tillage (M3) recorded significantly higher test weight (22.90) over conventional tillage (M2) (20.17).Among sub plot residue treatments, with residue retention (S1) recorded significantly higher test weight (21.82**)** over all other treatments (table 3). However, significantly lower test weight was recorded in without residue retention (S2) (20.63).Interaction of tillage and residue treatments on test weight differed significantly. However, significantly higher test weight (24.50**)** was observed in zero tillage with residue retention (M3S1) as compared to all other treatments. Conventional tillage without residue retention (M1S2) recorded significantly lower test weight (20.06).

Grain yield

Among main plot tillage treatments, Zero tillage (M3) recorded significantly higher grain yield (1634.25 kg ha^{-1}) over conventional tillage (M2) (1313.75 kg ha^{-1}). Among sub plot residue treatments, with residue retention (S1) recorded significantly higher grain yield (1565.83 kg ha^{-1}**)** over all other treatments (table 3). Without residue retention (S2) recorded significantly lower grain yield (1326.67 kg ha^{-1}).Interaction of tillage and residue retention on grain yield of chickpea at harvest differed significantly. However, significantly higher grain yield (1776.50 kg ha^{-1}**)** was observed in zero tillage with residue retention (M3S1) as compared to all other treatments. Conventional tillage without residue retention (M1S2) recorded significantly lower grain yield (1162.50 kg ha^{-1}).

Stover yield

Among main plot tillage treatments, Zero tillage (M3) recorded significantly higher Stover yield (2791.50 kg ha^{-1}) over conventional tillage (M1) (1933.50 kg ha^{-1}).Among sub plot residue treatments, with residue retention (S1) recorded significantly higher Stover yield (2489.00 kg ha^{-1}**)** over all other treatments (table 3). Without residue retention (S2) recorded significantly lower Stover yield (2214.00 kg ha^{-1}).Interaction tillage and residue retention on Stover yield of chickpea at harvest differed significantly. However, significantly higher Stover yield (2950.00 kg ha^{-1}**)** was observed in zero tillage with residue retention (M3S1) as compared to all other treatments. Conventional tillage without residue retention (M1S2) recorded significantly lower Stover yield (1878.00 kg ha^{-1}) compare to all other treatments.

Table 3: No of pods plant and test plant and test weight (100 seed weight) of chickpea influenced by conservation agriculture practices

Treatments	Yield parameters			
	No of pods per plant	Test weight (g)	Grain yield (kg ha^{-1})	Stover yield (kg ha^{-1})
Main Plot				
M_1:Conventional Tillage	67.19	20.17	1313.75	1933.50
M_2: Reduced Tillage	69.25	20.60	1390.75	2331.50
M_3: Zero Tillage	76.06	22.90	1634.25	279.50
S.Em±	1.72	0.52	69.05	14.29
CD 5 %	5.95	1.79	23.93	49.45
Sub Plot				
S_1:With Residue	72.98	21.82	1565.83	2489.00
S_2:Without Residue	68.69	20.63	1326.67	2214.00
S.Em±	0.54	0.35	46.55	18.67
CD 5 %	1.73	1.12	148.91	59.74
Main x Sub Plot				
M_1S_1	67.95	20.28	1465.00	1989.00
M_1S_2	66.43	20.06	1162.50	1878.00
M_2S_1	70.60	20.68	1456.00	2528.00
M_2S_2	67.90	20.52	1325.50	2135.00
M_3S_1	80.38	24.50	1776.50	2950.00
M_3S_2	71.75	21.31	1492.00	2629.00
S.Em±	0.93	0.60	80.62	32.35
CD 5 %	2.99	1.93	257.93	103.48

Discussion

The results obtained by conducting the experiment revealed that the conservation agricultural practices with different tillage treatments had significant influence on plant height and dry matter productions at different stages of crop growth are presented in (Table 1 and 2, Fig 1 and 2).At harvest, significantly higher plant height and Dry matter production was recorded in Zero tillage + with residue. However, significantly lower plant height and Dry matter production was recorded in conventional tillage + without residue, it might be owing to better availability of soil moisture and nutrients, Increase in dry matter productions in the treatments was attributed to higher photosynthetic capacity of plants, which depends upon number of leaves, plant height and dry matter accumulation in parts. Yield parameters like number of pods per plant, test weight, grain yield, stover yield were significantly higher in zero tillage + with residue and lower recorded in conventional tillage without residue retention. Increasing yield in zero tillage because higher water infiltration, higher storage capacity and less erosion. Similar results were reported by Meena *et al.* (2015) [2]. These observations are also in agreement with the results given by earlier workers (Rathore *et al.,* 1998 and Kumar *et al.,* 2006) [3, 4].

Conclusions

From the results of the present study, it is concluded that the among all treatments zero tillage with residue retention was found best combination for higher chickpea crop yields compared to conevtional tillage without residue.

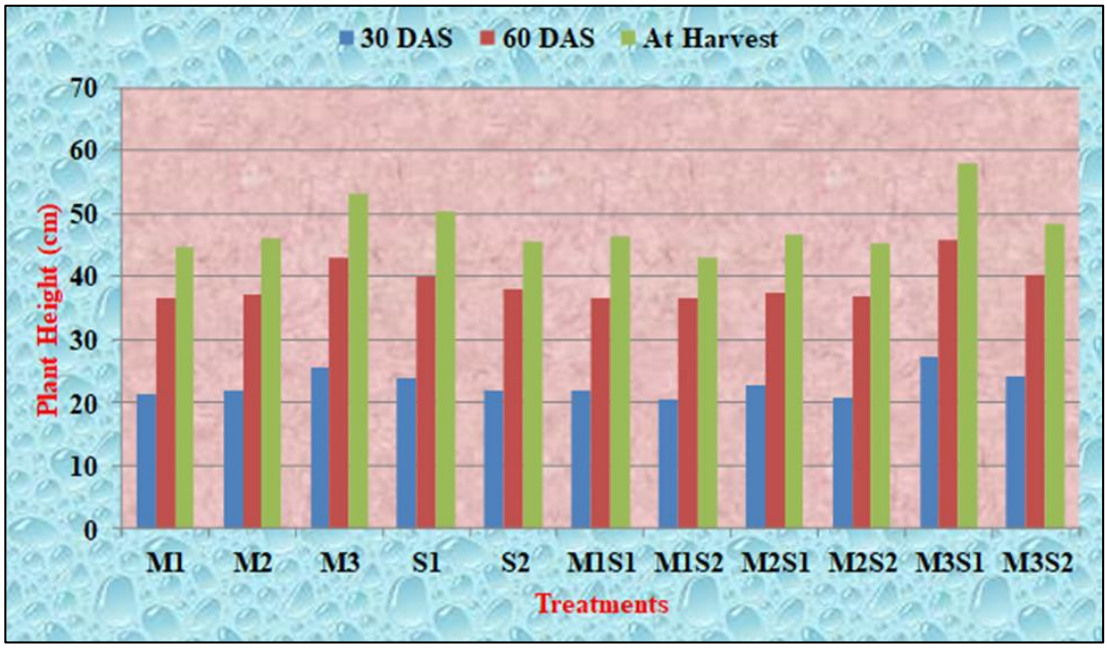

Fig 1: Plant height at different growth stages of chickpea as influenced by conservation agriculture practices

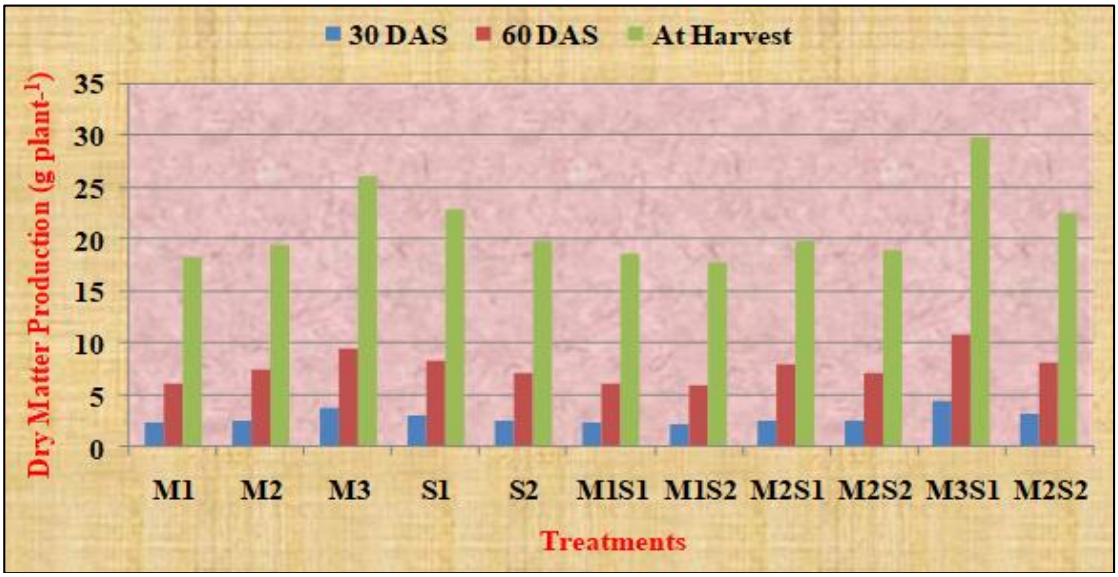

Fig 2: Dry matter production at different growth stages of chickpea as influenced by conservation agricultural practices

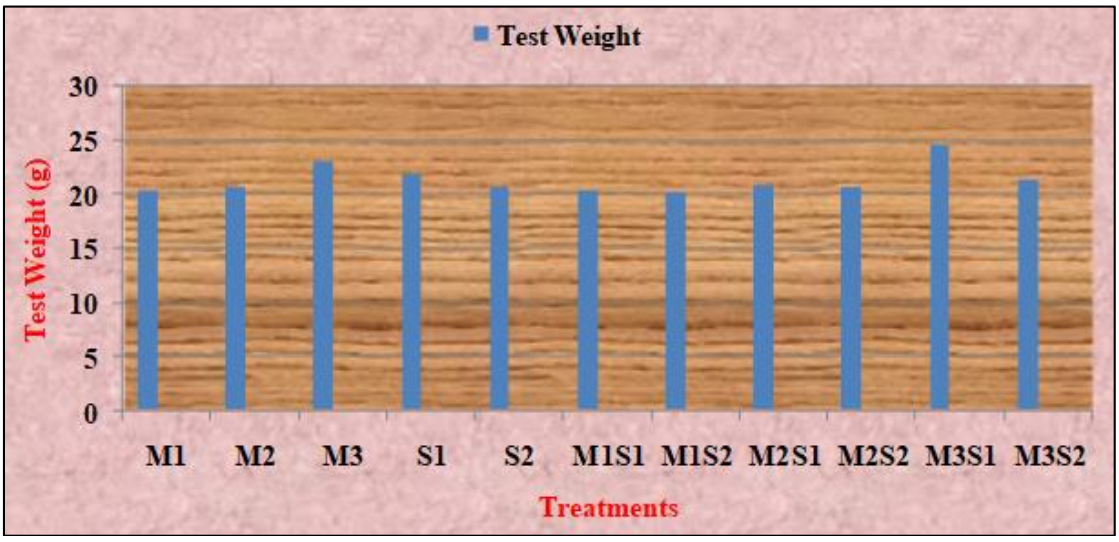

Fig 3: Test weight (100 seed weight) of chickpea influenced by conservation agricultural practices

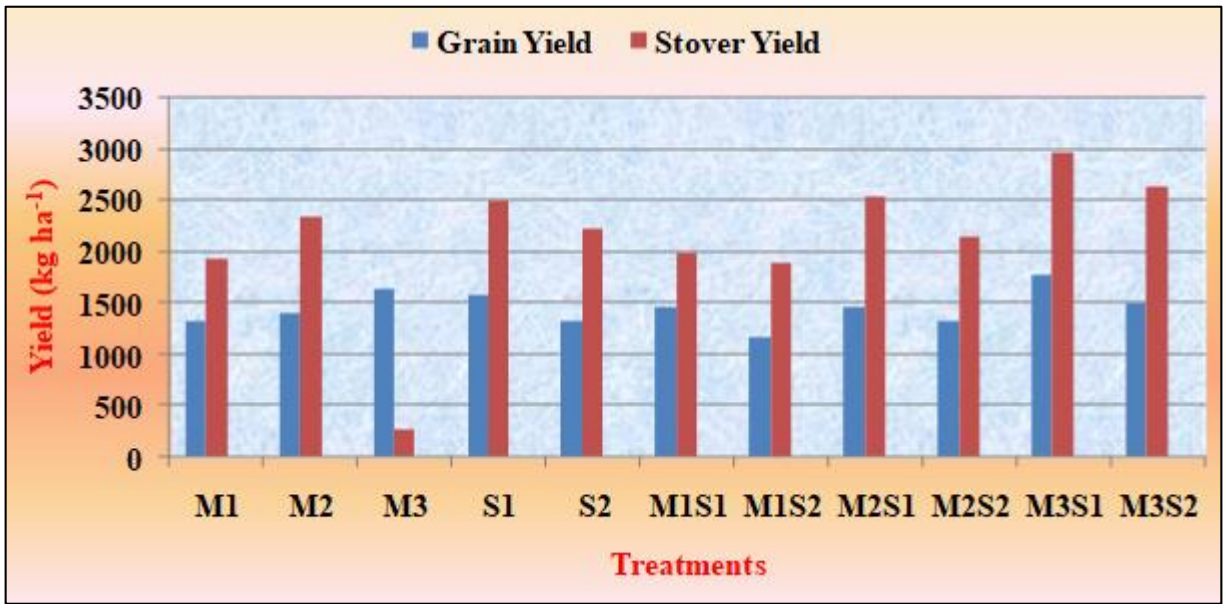

Fig 4: Grain yield, stover yield of chickpea as influenced by conservation agricultural practices

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