

Impact of conservation agriculture on cotton productivity

RESEARCH TEAM:

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INTRODUCTION

- Cotton production is mainly dependent on conventional tillage system in Zimbabwe which exposes the soil to degradation at a wide scale due to slow growing nature of the crop during the first six weeks(Cotton Hand book,1998)
- In order to mitigate the impact of climate variability, technologies such as diversification to drought tolerant crops, conservation agriculture and moisture conservation have been developed.
- It is known that conservation agriculture (CA) is premised on the principles of reduced or no-soil disturbance, provision of soil cover through live or dead mulch (Nhamo, 2007).

Introduction Continue...

- Conservation agriculture is a suite of land, water and crop management practices that aim to improve productivity, profitability and sustainability (Twomlow et al, 2008)

Advantages of CA :

- short term (1-4yrs) - conserves water, farmer can plant with first effective rains, reduced runoff and increased infiltration, mulching reduces evaporation, higher yields
- Long term (>4yrs) - improved soil fertility, reduces weed seeds, stabilises yields, conserves soil moisture, reduces soil erosion, reduces production costs e.tc

Introduction Continue...

- These benefits derived from CA can provide a feasible option for redressing declining productivity in Zimbabwe's cotton under small holder farming, (Nyagumbo, 2008).
- In cotton, little have been done in terms of technologies pertaining to CA.

Objective

- To determine the effects of conservation tillage technologies on seed cotton yield under Zimbabwean rainfed conditions

MATERIALS AND METHODS

- The trial was carried out for three seasons (2015, 2016 and 2017)
- **Table A1. Experimental sites used**

Sites	Altitude	Soil type	Rainfall received 2015 season	Rainfall received 2016 season	Rainfall received 2017 season
Dande	455 m asl	upland loamy sandy soils	879.5mm	447mm	1160mm
Umguza	600 m asl	clayey alluvial soils	487.5mm	435mm	790mm
Shamva	547 m asl	clay loamy soils	783mm	516mm	1139mm
C.R.I	1156 m asl	red clay loamy soils	711 mm	600mm	1332.7mm
Wozhele	1245m asl	alluvial soils	519mm	741mm	1009mm

MATERIALS AND METHODS

The trial had the following treatments;

- a. Conventional tillage practice
- b. Basins
- c. Ripped rows
- d. Dibble made holes

- **Design** – RCBD with five replications
- The gross plot was 64 square metres and the net plot 36 square metres

MATERIALS AND METHODS

- Locally recommended plant spacing of 1m x 0.3m was used in all treatments
- Variety used- CRI MS 2
- The other management practices were done according to Cotton Handbook standards
- Ensured that trash content in conservation plots was at least 30% at all sites and the estimation was done using visual assessment

MATERIALS AND METHODS

Measurements

- Boll weight, plant height and seed cotton yield

Data analysis

- Analysis of variance was performed using GenStat 14th edition for Windows .
- Mean separation among treatment means was done using Fisher Protected Least Significance Difference procedure at 5% significance level.



RESULTS AND DISCUSSION

RESULTS

Boll weight

- Results indicated non-significant interactions at 5% level among the different tillage systems at all sites across all the seasons.

Table A2.Effect of different tillage systems on average boll mass (g)

Treatments	Average boll mass (g)
Conventional tillage practice	6.17
Basins	6.22
Ripped rows	6.84
Dibble made holes	6.29
Mean	6.38
P -value	0.558
L.S.D	1.042
CV (%)	8.8

RESULTS

Plant height

- Results indicated significant interactions at 5% level on plant height among the different tillage systems, sites and seasons .
- Thus the effect of the treatments on plant height varied from season to season and from site to site, hence the results of the interactions on the effects of tillage systems on plant height are presented by site and by season

Table A3. Effect of different tillage systems on plant height (cm) in 2015 season

Treatment	C.R.I	Dande	Shamva	Umguza	Wozhele
Conventional tillage practice	127.8	132.4	127.8	77.0	127.8
Basins	131.0	133.8	131.0	76.2	127.6
Ripped rows	128.4	132.8	128.4	71.0	124.8
Dibber made rows	127.0	133.4	127.0	72.0	134.2
Mean	128.6	133.1	128.6	74.0	128.6
P -value	0.827	0.991	0.827	0.706	0.503
L.S.D	4.49	4.82	4.49	6.14	6.18
CV (%)	5.5	5.7	5.5	13.1	7.6

Table A4. Effect of conservation agriculture on plant height (cm) in 2016 season

Treatment	C.R.I	Dande	Shamva	Umguza	Wozhele
Conventional tillage practice	67.0	93.8	102.8 ^b	83.8	129.2 ^b
Basins	123.0	88.4	101.0 ^b	81.4	122.0 ^a
Ripped rows	116.0	89.4	101.0 ^b	72.8	125.4 ^a ^b
Dibble made holes	123.6	89.4	90.4 ^a	73.8	129.8 ^b
Mean	107.4	90.2	98.8	78.0	126.6
P -value	<0.001	0.741	0.034	0.234	0.039
L.S.D	10.74	11.45	8.70	13.20	5.73
CV (%)	7.3	9.2	6.4	12.3	3.3

Table A5. Effect of conservation agriculture on plant height (cm) in 2017 season

Treatment	C.R.I	Dande	Shamva	Umguza	Wozhele
Conventional tillage practice	193.4b	131.2	152.6	26.0	150.2
Basins	134.8a	133.8	158.6	24.4	157.6
Ripped rows	138.8a	134.0	155.4	25.0	150.8
Dibble made holes	133.6a	127.8	152.4	25.0	157.0
Mean	150.2	131.7	154.8	25.1	153.9
P -value	<0.001	0.673	0.447	0.368	0.566
L.S.D	22.32	12.32	9.20	1.904	14.45
CV (%)	10.8	6.8	4.3	5.5	6.8

RESULTS

Seed cotton yield

- Results indicated significant interactions at 5% level on seed cotton yield among the different tillage systems, sites and seasons .
- Thus the effect of the treatments on seed cotton yield varied from season to season and from site to site, hence the results of the interactions on the effects of tillage systems on seed cotton yield are presented by site and by season.

Table A6. Effect of conservation agriculture on seed cotton yield (kg/ha) in 2015 season

Treatment	C.R.I	Dande	Shamva	Umguza	Wozhele
Conventional tillage practice	1186	2394	2306	973	947
Basins	1191	2498	2280	1138	824
Ripped rows	1013	2203	2221	896	894
Dibble made holes	1230	2226	2088	1037	873
Mean	1155	2330	2224	1011	884
P -value	0.691	0.391	0.753	0.635	0.932
L.S.D	423.3	414.6	471.2	412.5	414.8
CV (%)	26.6	12.9	15.4	29.6	34.0

Table A7. Effect of conservation agriculture on seed cotton yield (kg/ha) in 2016 season

Treatment	C.R.I	Dande	Shamva	Umguza	Wozhele
Conventional tillage practice	983a	733	1820	797b	851
Basins	3002b	523	2174	649ab	667
Ripped rows	2821b	526	1648	555a	666
Dibble made holes	2762b	539	1640	511a	733
Mean	2392	580	1820	628	729
P -value	<0.001	0.344*	0.171	0.031	0.164
L.S.D	277.9	301.5	547.0	191.3	188.2
CV (%)	8.4	6.3*	21.8	22.1	18.7

Table A8. Effect of conservation agriculture on seed cotton yield (kg/ha) in 2017 season

Treatment	C.R.I	Dande	Shamva	Umguza	Wozhele
Conventional tillage practice	2079	2232	1816	908	818
Basins	2093	2469	1565	667	971
Ripped rows	2038	2624	1658	668	789
Dibble made holes	1878	2196	1530	658	1187
Mean	2022	2380	1642	725	941
P -value	0.657	0.614	0.389	0.212	0.082
L.S.D	409.8	791.3	375.6	285.3	332.0
CV (%)	14.7	24.1	16.6	28.5	25.6

DISCUSSION

- In 2015 and 2017, all the treatments performed statistically the same.
- According to literature, the apparent results of conservation tillage are evident after one season of practicing conservation agriculture on a piece of land (Nyagumbo, 2008)
- So that could be the reason why there were no noticeable differences with the conventional practice in 2015.
- In 2017, the amount of rainfall that was received ranged from 770mm to 1332.7mm could have influenced the performance of the treatments since it was excessive.

DISCUSSION

- In 2016, the lowest seed cotton yield of 511kg/ha was produced at Umguza under the conservation treatment with dibble made holes.
- The highest seed cotton yield of 3002kg/ha was achieved under conservation agriculture with basins at C.R.I
- And the yield was comparable to the yield that was produced under the ripped rows and dibble made holes at the same site and during the same season.

CONCLUSION

Conservation agricultural systems with basins produced the highest seed cotton yield in 2016 at CRI only.

RECOMMENDATION

- It was recommended that the project continues and targeting low rainfall receiving cotton growing areas .
- Cost benefit analysis
- Crop rotation (5 years)

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Thank You