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THIRD AFRICA CONGRESS ON CONSERVATION AGRICULTURE
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Tillage and Crop Rotation Effects on Selected Soil Chemical Properties and Wheat Yield in an Oakleaf Soil Form in the Eastern Cape, South Africa

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Theme:
Building a Resilient Future in Africa
through Conservation Agriculture and Sustainable Mechanization

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Introduction

- Soil degradation is leading to general poor soil fertility and crop yield reduction
- Farmers' practice of conventional tillage (CT) without residue retention promotes the reduction of SOM
- Most soils in the Eastern Cape are reported to have less than 1% SOC, far below the critical level of 2% by which soil quality declines
- Research has shown that SOC can be increased over time through changes in the management practices of arable soils
- Conservation agriculture (CA) is one such technology, which plays an important role in sustainable soil productivity

Introduction cont..

- Little information is available on the effects of CA on soil chemical properties, particularly in rotations that involve wheat in the Eastern Cape Province
- Planting a winter crop such as wheat is believed to result in timely utilization of available water, reduce soil erosion, and build organic matter in the soil
- Longer rotation including wheat often aids in weed management by suppressing the common winter weeds
- CA practices need to be determined for improved wheat yield and sustainable soil fertility in semi-arid environments such as those experienced in the Eastern Cape

Materials and Methods

Experimental site

- The field trial was established at the University of Fort Hare research farm (UFH) in the Eastern Cape
- UFH site (32°47′ S and 27°50′ E) is at an altitude of 508 metres above sea level
- It is in a semi-arid area and receives an average of 575 mm annual rainfall
- Has Oakleaf soil form (Soil Classification Working Group, 1991)

Experimental design

- 2 × 4 factorial experiment laid out in randomized complete block design

Materials and Methods

Experimental design

- Main plots were allocated to no-till and conventional tillage (CT)
- Main plots were split into four crop rotations; maize-fallow-maize (MFM), maize-fallow-soybean (MFS), maize-winter wheat-maize (MWM) and maize-winter wheat-soybean (MWS)
- Main plot sizes were 32.5m × 10 m, sub plots were 7m × 10 m
- Net plot size was 3 m × 4 m

Materials and Methods

Field and laboratory measurements

- Early maturing spring wheat cultivar (SST015) was planted in winter at a seeding rate of 100 kg/ha
- Soybean cultivar (PAN 5409RG) was sown in summer targeting a population of 250,000 plants/ha
- Short season and prolific maize cultivar (BG 5785BR) was planted in summer targeting a population of 25,000 plants/ha
- Five soil cores were collected randomly to make a composite sample from each plot

Materials and Methods

Field and laboratory measurements

- SOC, Ammonium-N (NH4-N) and nitrate-N (NO3-N) were analysed following the methods in Okalebo et al. (2002)
- Olsen P, Extractable K and Ca were determined using a continuous flow analyzer
- Soil pH was determined using a WTW pH 526 meter
- Grain yield was collected after threshing the adjusted to 12.5% moisture content
- A JMP statistical package version 13.1 was used for the analysis of variance

Results and discussion

Table 1: ANOVA results for soil chemical properties at UFH experimental site

Treatments	SOC	NH_4-N	NO_3-N	Total Mineral-N	P	K	Ca	Mg	Zn	pH	EC
0-5 cm depth											
Tillage	*	*	*	**	ns	**	ns	ns	ns	ns	**
Crop rotation	*	ns	ns	ns	*	*	**	**	ns	ns	ns
Tillage × crop rotation	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
5-10 cm depth											
Tillage	**	*	ns	*	*	ns	**	ns	*	ns	ns
Crop rotation	*	ns	ns	ns	*	**	**	ns	ns	ns	ns
Tillage × crop rotation	ns	ns	ns	ns	ns	ns	**	ns	ns	ns	ns
10-20 cm depth											
Tillage	ns	*	ns	*	*	ns	ns	ns	ns	ns	ns
Crop rotation	*	ns	ns	**	*	ns	ns	ns	ns	ns	**
Tillage × crop rotation	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns

Results and discussion

Table 4: Tillage and crop rotation effect on wheat grain yield (tons/ha) at UFH experimental site

	No-till	CT	Means
MWM	3.13	3.35	3.24
MWS	3.33	3.18	3,26
Means	3.23	3.27	3,25
$LSD_{0.05}$	0.48		
ANOVA	p-value		
Tillage	0.77 ^{ns}		
Crop rotation	0.91 ^{ns}		
Tillage × crop rotation	0.16 ^{ns}		
CV %	9. 47		

Conclusion

- The combined effect of no-till and crop rotations was critical in improving soil chemical properties in this short-term study
- The results indicate that rotation of cereal with legumes under no-till hold the key in ensuring wheat yield stability
- Therefor, this rotational system can be promoted as an entry point for the farmers who wish to practice CA in the Eastern Cape, South Africa

Thank you for your attention

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