

Research Application Summary

Linkages between crop residues, termite prevalence, crop lodging and subsequent crop yield under conservation agriculture in Zimbabwe

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Abstract

Farmers believe that addition of residues to fields in conservation agriculture (CA) attract termites hence increase lodging, although they are beliefs that termites prefer feeding on dry matter and leave the crop. This study carried out in Kadoma and Chikombedzi, Zimbabwe established links between crop residues, termite prevalence, crop lodging and yield. Results from Kadoma showed that in 2008/9, 4t/ha of residue had significantly more termites compared to conventional mouldboard plough systems (CMP). In 2009/10, 4 and 6t/ha residues resulted into a significantly higher termite compared to CMP. In both seasons in Chikombedzi, results were similar with those of Kadoma. In Chikombedzi in 2009/10, lodging in CA was significantly higher compared to CMP. In Kadoma 2008/09, yields (2900-3348kg/ha) were significantly higher under CA compared to CMP (2117kg/ha). Similar results were obtained at Chikombedzi. A significant and positive relationship was observed between percentage soil moisture and termite numbers, suggesting that CA attract termites although it also increases yields. It is therefore necessary to integrate termite control measures in maize production under conservation agriculture systems.

Key words: Humus, nutrient cycling, organic carbon, soil cover, soil fertility, stover

Résumé

Les agriculteurs croient que l'addition des résidus aux champs dans l'agriculture de conservation (CA) attire les termites et par conséquent favorise leur séjour, bien qu'ils croient que les termites préfèrent s'alimenter en nourriture dans la matière sèche et laissent la récolte. Cette étude effectuée à Kadoma et Chikombedzi, au Zimbabwe, a établi des liens entre les résidus de récolte, la prédominance de termite, le logement de récolte et le rendement. Les résultats de Kadoma ont prouvé qu'en 2008/2009, 4t/ha de résidu ont eu sensiblement plus des termites comparés aux systèmes conventionnels de charrue de lame

(CMP). En 2009/2010, des résidus de 4 et 6t/ha ont résulté vers un termites sensiblement plus haut comparé au CMP. Dans les deux saisons à Chikombedzi, les résultats étaient semblables à ceux de Kadoma. A Chikombedzi en 2009/2010, le logement dans l'agriculture de conservation CA était sensiblement plus haut comparé au CMP. A Kadoma en 2008/2009, les rendements (de 2900 à 3348kg/ha) étaient sensiblement plus élevés sous l'agriculture de conservation CA comparé au CMP (2117kg/ha). Des résultats semblables ont été obtenus à Chikombedzi. On a observé un rapport significatif et positif entre l'humidité de sol et les nombres de termites, suggérant que l'agriculture de conservation CA attire les termites bien qu'il augmente également des rendements. Il est donc nécessaire d'intégrer des mesures de contrôle de termites dans la production de maïs sous les systèmes d'agriculture de conservation.

Mots clés: Humus, cycle nutritif, carbone organique, couverture de sol, fertilité du sol, brûleur

Background

Conservation Agriculture (CA) seeks to achieve sustainable and profitable agriculture and to improve the livelihoods of farmers through the application of three principles: minimal soil disturbance; permanent soil cover and crop rotations (PFA, 2007). Provision of soil cover through crop residues ultimately results in a more favourable environment beneficial to soil fauna, which in turn enhances soil fertility. In spite of their known benefits, many farmers believe retention of crop residues contributes to increased termite prevalence in semi-arid regions. This is more apparent towards the end of the rainy season where resultant lodging contributes to yield losses. On the other hand, some scientists suggest that the presence of dry crop residues may actually reduce termite attack on growing crops as they are thought to prefer dry stover as compared to fresh biomass (Nhamo, 2007). This study was carried out at one residue amount level. This study therefore sought to establish the linkages between termite prevalence and crop lodging at different residue amounts commonly found in smallholder farmers' fields.

Literature Summary

When left in fields after harvest, crop residues play important roles in nutrient cycling, erosion control, water conservation and maintenance of favourable soil physical properties (Moyo, 2003). Beneficial effects of residues depend on distribution, orientation, quality and quantity of residues. Studies have shown that in CA, runoff could be reduced by 62%, soil loss by 96.3%, total

organic carbon increased by 91.4%, nitrogen by 84.3%, phosphorus by 94% and potassium by 68.1% relative to measured values on conventional plots (Kertesz *et al.*, 2007). Locally, studies at Domboshawa showed a decline in organic carbon of 64 % under conventional mouldboard ploughing system compared to 50 % under CA and mean annual run-off lost of the seasonal rainfall was 21% under conventional ploughing system compared to 4 % under CA (Nyagumbo 2002).

Macrofauna communities, dominated by termites, are the main agents of decomposition of surface mulches under CA (Nhamo, 2007). The resulting humus plays an important role in soil aggregation, allowing aeration and water infiltration through the structure and channels made by burrowing fauna (Waters and Oades, 1982). Termites prevail under diverse environmental conditions but are largely affected by biophysical site characteristics and management factors. It has been identified by farmers that major factors affecting prevalence and activities are tillage operations, temperature, humidity, water, soil moisture and soil types. However, relationships of termite prevalence and crop lodging whilst varying the crop residue amount remains unknown since the majority of smallholder farmers in Zimbabwe still classify termites as pests.

Study Description

This work was carried out on two sites namely Kadoma and Chikombedzi. Kadoma is in NR III receiving an annual rainfall range of 650-800 mm, where semi intensive mixed farming is generally practiced. The soils are dominated by kaolinitic fersiallitic soils, red clay soils derived from mafic rocks (Nyamapfene, 1991). The other site, namely Chikombedzi, is in NRV, receiving less than 450 mm annual rainfall and is mainly dominated by semi-intensive livestock farming (Nyamapfene, 1991). The soils are mainly calcimorphic vertisols. Sorghum is the major cereal grown, hence sorghum residue was used there in contrast to maize residues in Kadoma.

Experiments. A Complete Randomised Block Design (CRBD) experiment with 4 replicates per treatment was laid out. Five treatments of surface residue cover amounts of (0, 2, 4 and 6 t ha⁻¹) and a control (conventional mouldboard ploughing treatment), were randomly allocated to plots in each of the four blocks. CA Plots with applied residues were planted using basins prepared by hand hoes and manually weeded twice or more per season. Plot sizes of 5 x 6 m were laid out in the experiment

with an inter-block spacing of 1m. Three farmer fields were used for analysis in each site per season.

Research Application

Termite abundance/prevalence. Generally conventional ploughing had the lowest termite abundance but differences were only significant between conventional ploughing and CA-4t/ha and / 6t/ha in both sites for both seasons.

Crop lodging. The addition of residues under CA across the sites had no significant impact on crop lodging. Generally lodging was lower under CMP than CA while lodging on sorghum crops (Chikombedzi) was lower than on maize crops (Kadoma).

Yield. Generally CA had significantly higher maize grain yield compared to CMP, although residue amount under CA did not influence yield. In 2008/9 in Chikombedzi, a significant farmer x treatment interaction ($p < 0.001$) was observed, an effect attributed to management factors (especially weeding) and rainfall regimes.

Termite numbers versus % soil moisture content. The results shows that an increase in soil moisture content from about 20% to 34 % results in increased termite abundance.

Recommendation

At high field crop residue levels, crops may succumb to termite attack under conservative agriculture. This situation can be worsened when soil moisture is high as is likely to be in wetter areas like Kadoma. From this study we therefore conclude that indeed crop residues at amounts in excess of 4 t/ha increases termite attack on crops. Therefore, if high amounts of crop residue must be used, there is need to consider integrating into the production system a termite control measure.

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