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Short Communication

Benefits of rice husk as a mulch in an avocado (*Persea americana* L.) plantation

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ABSTRACT

Rice husk is a by-product of the milling process of ripe rice grains. It provides important nutrients such as phosphorus and potassium and when mixed with soil and fertilizers, it delays soil compaction and hardening, favoring root and plant development. In this study, for the first time in Cuba, the application effect of rice husks as mulch in a three-year-old avocado plantation was evaluated. A notable increase in the number of mycorrhizal fungi spores was obtained, as well as a significant increase in yield, soil moisture retention and a control in the proliferation of unwanted plants.

Key words: ground cover, fruit trees, arbuscular mycorrhizae

INTRODUCTION

Rice husk is a by-product of the milling process of ripe rice grains; it is an agricultural input obtained by separating the rice grain from its husk. According to research on the subject (1), for every 5 tons of rice, 1 ton of husk is generated. It provides important nutrients such as phosphorus and potassium, and when mixed with the soil and fertilizers, it delays soil compaction and hardening, favoring root and plant development (2). It also increases soil microbiological activity, facilitates aeration, moisture absorption and nutrient filtration (1).

Among alternatives for its use, its use has been considered as a cover in fruit plantations where it could prevent surface runoff, regulate soil temperature, conserve humidity and prevent the growth of undesirable plants due to lack of light (3). Moreover, a good mulch slowly supplies nutrients to the soil as it decomposes.

However, it is still unknown what effect it could have on fruit plantations in Cuban soils, which are increasingly affected by water shortages, the deficit of mineral fertilizers and weed proliferation, as well as on populations of arbuscular mycorrhizal fungi (AMF) present.

Taking into account the aforementioned aspects, the aim of this research was to evaluate the effect of rice husk mulching on the development of an avocado plantation in a carbonate brown soil in Los Palacios municipality, Pinar del Río province, Cuba.

MATERIALS AND METHODS

The study was carried out in 2018, in areas of the farm "La Fidelia", Los Palacios, Pinar del Río in an established avocado (*Persea americana* L.) plantation of Julio, Buenaventura and Wilson cultivars.

Avocado plants from the nursery were inoculated with *Glomus cubense* AMF at the time of transplanting, at the rate of inoculum 10 g in the planting niche.

For the experimental setup, 2 ha area was chosen within the farm and a thick layer of rice husk, of approximately 30 cm (Figure 1), was added in an area corresponding to 1 ha within the three-year-old avocado plantation; the remaining hectare was used as a control, following a Completely Randomized Design. The rice husk came from the rice mill belonging to Agroindustrial Company of Grains from Los Palacios, Pinar del Río.

A: application time of rice husk and its distribution in the plantation

B: area of the avocado plantation treated for one year with rice husk as ground cover

Figure 1. Application of rice husks as mulch in an avocado plantation established in a brown carbonated soil in "La Fidelia" farm, CCS "Oscar Núñez", Los Palacios, Pinar del Río

The use of rice husk as a soil mulch in the avocado plantation was carried out for several purposes: to control the growth of weedy plants, to maintain soil moisture in long periods of drought and to increase the availability of nutrients in the soil in the medium term.

On August 2018, one year after the mulch was applied, spore number evaluations were conducted to assess its effect on AMF populations. Soil was extracted at 15 cm depth in the area of avocado plants (Figure 2), which were in soils covered and not covered with rice husk. Six plants per treatment were sampled, taking three samples per plant at three equidistant points on the same circumference, set at a distance from the plant trunk proportional to the crown diameter. Spore extraction was carried out using the wet sieving and decanting technique [(4)]. The performance of avocado plants was also evaluated by comparing those in covered and uncovered soil.

Note the moisture in the soil removed below the cover.

Figure 2. Sampling for mycorrhizal analysis in a soil covered with rice husk in an avocado plantation at "La Fidelia" farm, CCS "Oscar Núñez Gil", Los Palacios, Pinar del Río

RESULTS AND DISCUSSION

The planet's ecosystems are changing at an accelerated pace, as a consequence of global environmental change and changes in land use and land cover [(5)]. The use of various alternatives to protect soils has become an ecologically and economically viable practice that should be extended to all agricultural systems.

When analyzing the effect of rice husk on mycorrhizal populations present in covered soil (Table 1), an increase in the number of AMF spores was detected with respect to uncovered soil. As can be seen in Table 1, the number of spores was higher in the soil where plants were previously inoculated with AMF.

Table 1. Effect of rice husk mulching on the mycorrhizal community present in a three-year-old avocado tree planted in a carbonated mulched brown soil

Treatments		No. of spores 50 g soil^{-1}	Observations
With rice husk	Inoculates	419,0 a	The presence of nematodes was significantly reduced
	Not inoculated	209,6 b	
Without rice husk	Inoculated	80,3 c	-
	Not inoculated	60,6 d	-

Evidently, there was a positive effect of rice husk on AMF populations, although the presence of the inoculated AMF species could not be detected. It is interesting to note, moreover, the depressive effect on nematode populations in the husk-covered soil with respect to the uncovered soil.

Despite the lack of information that appears in the literature on this subject, in particular the use of rice husk as a cover, it is recognized that after a period of time after its application, the macro and microbiological activity of the soil is stimulated, as well as the number of microorganisms present in relation to untreated soils.

In this study, a positive effect on the growth and productivity of avocado plants was observed, which was appreciable from flowering, fruit set and yield. This response was most noticeable after a long period of drought in early 2018.

In that year, harvest was brought forward to June, 35 days earlier than in untreated plants, and yield was increased by 32 % in plants with rice husk cover. Consequently, a reduction in the proliferation of weeds in the covered soil was observed.

Results of this work indicate that the use of rice husks can increase the yield of avocado plants, as well as the retention of moisture in the soil. Similar results were reported when applying rice husk mulch for the production of bunch tomato (*Solanum lycopersicum* L.) cv. Sweet Chelsea, with significant increases in total fruit number and plant yield [(6)].

Consequently, some authors state that the use of ground covers constitutes a promising method for the production of numerous crops [(7)]. Likewise, when applied in tomato in open fields in Cuba, it was reported a favoring in weed control, a decrease in damages caused by bacteriosis in fruits (*Xanthomonas campestris* pv. vesicatoria) and increases in the commercial yield of up to 33 t ha^{-1} [(6)].

Rice husk is a rich source of silica [(8)], which favors plants by guaranteeing greater resistance against insects and microorganisms. In the long term, it becomes a constant source of humus and at the same time helps to correct soil acidity [(9)], so its use should be extended to other crops and production systems.

CONCLUSIONS

The use of rice husks as ground mulch in avocado plantations is an ecological practice with marked benefits in yields, since it constitutes a source of nutrients for the plants, contributes to the control of weeds, maintains soil moisture and prevents erosion. At the same time, it stimulates the proliferation of resident mycorrhizal populations. It can be applied to other plant species and in different production systems as a sustainable land management practice.

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