ACTA SCIENTIFIC AGRICULTURE

Volume 2 Issue 4 April 2018

Conceptual Paper

Increasing Earthworm Activity: A Potential Mechanism for the Rotational Benefits of Oilseed Rape on Rice in No-Tillage Paddy Fields

Min Huang* and Yingbin Zou

Southern Regional Collaborative Innovation Center for Grain and Oil Crops (CICGO), Hunan Agricultural University, Changsha, China

***Corresponding Author:** Min Huang, Department of Agronomy, Hunan Agricultural University, Changsha, China.

Received: January 12, 2018; **Published:** March 26, 2018

Rice is a staple food for more than half of the world's population. Improving rice yield is vitally important to meet the growing demand for food that will result from population growth and economic development. But on the other hand, it is also important to minimize the dependence on external inputs for rice production to reduce adverse environmental impacts, including increased greenhouse gas emissions, soil acidification, surface water eutrophication, and biodiversity loss.

Well-planned crop rotations, as compared to continuous monoculture systems, can be expected to reduce the dependence on external inputs through promoting nutrient cycling efficiency, effective use of natural resources, maintenance of the long-term productivity of the land, control of diseases and pests, and consequently increasing crop yields and sustainability of production systems. Rice-oilseed rape rotation is a major rice-based cropping system in China. Our previous study suggests that long-term rice-oilseed rape rotation can increase soil fertility and hence reduce the dependence on external nitrogen inputs and adverse impacts on the environment. This supports the viewpoint that oilseed rape is an excellent and sustainable rotation crop for cereals.

This viewpoint also can be confirmed by our recent observations which showed that in-field earthworm density during the non-rice growing season was doubled by a rotation with oilseed rape as compared to fallow in long-term, no-tillage rice-based fields (data not shown). However, limited information is available on (i) the factors that are critical to the increased earthworm density in the fields rotated with oilseed rape, and (ii) the effect of the increased earthworm density on the subsequent rice crop. Such information would be useful for understanding the potential mechanism for the rotational benefits of oilseed rape on rice in no-tillage paddy fields.

Earthworm density is influenced by several agricultural practices, e.g. soil tillage. The absence or the reduction of soil tillage is favorable to earthworms by providing them with an undisturbed biotope. Earthworm density is also affected by soil properties, especially the soil moisture and temperature, which affects the overall hospitability of the soil system. As compared with simply leaving fields fallow, oilseed rape cultivation may result in changes in soil properties. First, bed cultivation is usually used for cultivating oilseed rape to avoid too high soil moisture. Second, the ground cover that oilseed rape plants provide will help to decrease soil temperature. In addition, it is well recognized that crop residue significantly affects earthworm density due to its function as a food source. In this regard, oilseed rape plants can produce a large amount of litterfall, which provides abundant available food for earthworms. These aspects indicate how rotation of oilseed rape with rice may lead to changes in earthworm density in no-tillage rice fields. Yet specific studies are required to confirm and clarify it.

It is well documented that earthworms can improve soil nutrient cycling directly by consuming organic substrates and releasing nutrients into soils through metabolism processes, and indirectly by altering soil physical properties and creating distinctive structures (such as castings). However, it needs to be considered that in a rice-oilseed rape rotation, earthworms are likely to migrate away from fields during the early stage of rice-growing when rice paddies are flooded since they are aerobes and benefit from the presence of other aerobic organisms. Therefore, the potential changes in earthworm density and activity induced by rotation with oilseed rape could have no direct effect on subsequent rice. But it is should be noted that the nutrient-rich earthworm castings which are produced during oilseed rape-growing season will remain in the fields, where they may affect the subsequent rice crop. This effect warrants further investigation.

In particular, there is evidence that earthworms produce a considerable amount of plant hormones (e.g. auxins and cytokinins) and plant hormone-like substances in their castings. Moreover, the earthworm castings can enhance microbial biomass and activity, and the byproducts of this microbial activity include plant growth-regulating substances such as auxins, gibberellins, cytokinins, ethylene, and abscisic acids. Although limited information is available on the effect of plant hormones or plant hormone-like substances included in the earthworm castings on physiological metabolisms of the rice crop, some related reports have been documented in the other crops such as wild carrot (*Daucus carota*) and common bean (*Phaseolus vulgaris*). This highlights the need for greater fundamental understanding of the effects that earthworm castings can have on microbial and physiological processes governing plant growth and yield formation in rice.

Volume 2 Issue 4 April 2018