Evaluation of energy efficiency in conservation agricultural system in temperate-cold climatic zone of Mashhad

A.A. Moayedi[1] , S. Zareh[2*]

1. Faculty Member of seed and plant improvement Department, Khorasan Razavi Agricultural and Natural Resources Research and Education Center, AREEO, Mashhad, Iran.
2. Faculty Member of Khorasan Razavi Agricultural and Natural Resources Research and Education Center, AREEO, Mashhad, Iran.(Corresponding author)

Received: February 2019 - Accepted: May 2019 - DOI: 10.22092/aj.2019.125011.1378

Extended Abstract

Moayedi, A.A., Zareh, S., Evaluation of energy efficiency in conservation agricultural system in temperate-cold climatic zone of Mashhad
Applied Research in Field Crops Vol 32, No. 01, 2019- Page: 04-06: 13-27(in Persian)

Introduction

Modern agriculture has had positive effects on human welfare and prosperity by increasing food output, However, it has had negative impacts on non-renewable energy resources, leading to an increase in energy consumption in agriculture (Mohammadi *et al.,* 2008). This system is based on the increased use of external inputs, chemical fertilizers, water and energy (Ghorbani *et al.,* 2011; Mohammadi *et al.,* 2010). Due to the use of traditional tillage and residue removal practices in the farms all over Iran, soil is lost through erosion and has been physically, chemically and biologically degraded. As a result, improved or new varieties of crops (such as wheat) as well as other on-farm inputs are not able to deliver their potential contribution. The term conservation agriculture removes the emphasis from the tillage component and addresses an enhanced concept of the complete agricultural system; it involves major changes in many aspects of the farm cropping operation. Normally, conservation agriculture begins with reduced or zero tillage, and progresses to the retention of adequate levels of crop residue on the soil surface, and then to appropriate crop/cultivar selection and rotations.

Material and Methods

This investigation was carried out to study the impact of different tillage methods and rate of crop residue retention on energy efficiency of different crops under two different crop rotation systems at the agricultural research station of

Email address of the corresponding author: shojaat_z@yahoo.com

Torogh, Mashhad during 2011-16 growing seasons. The first crop rotation was conventional, which was similar to crop rotation adopted by farmers that consisted of wheat-corn-wheat-melon-wheat. The second crop rotation was more diverse, which included sustainable crop rotation recommended to the region, that consisted of wheat-rapeseed-wheat-clover-tomato-wheat. The statistical layout of this experiment was split-plot based on a completely randomized block design with 3 replications. Three tillage methods (conventional tillage (CT), reduced tillage (RT) and no tillage (NT)) were allocated to the main plots and three residue management treatments (zero (R0), 30% (R1) and 60% (R2) of the residue retention) were assigned to the sub plots. Experimental treatments were compared using energy productivity and energy efficiency indices.

Results and Discussion

The results showed that for the both crop rotations systems (conventional and sustainable), the portion of human power, with an average of 0.44%, had the lowest energy use and water and straw each with 30% had the highest level of energy consumption, which were followed by machinery equipment and fertilizer use. The response of plant to different tillage systems can vary depending on soil type, plant species, rainfall, and climate. Therefore, the general trend of the effects of different tillage methods and their interaction with the climate conditions varies according to the yield per hectare of different crops, so that the long-term comparisons of soil tillage systems with respect to different plants, particularly, in temperate regions, shows that the annual pattern of the climate relative to the soil tillage systems is more effective on yield. This study showed that in the both crop rotations, NT + R0 treatment had the highest level of energy efficiency and treatments RT + R0 and CT + R0 were in the second and third ranks, respectively. However, energy productivity of conventional crop rotations was higher than that of sustainable crop rotation. In each of the tillage treatments, the highest energy efficiency was related to the treatment without residues (R0). Increasing the residues to 60%, although led to increased yield per hectare and energy, energy productivity was reduced by up to 50% compared to without residues (R0). Increasing soil tillage activities from non-plowing to conventional, although reduced energy efficiency, the amount of produced energy was increased, partly due to increased yield, because increase in yield was not observed in all treatments. However, increase in the yield of some products was enough to raise the production energy of conventional tillage treatments.

Keywords: Rresidue, energy productivity, rotation, sustainability, wheat

References

Ghorbani, R., Mondani, F., Amirmoradi, S., Feizi, H,. Khorramdel, S., Teymouri, M.S., Sanjani, S., Anvarkhah, S., and Aghel, H. 2010. Energy use and economical analysis of irrigated and dryland wheat production systems in North Khorasan province of Iran. *Applied Energy*, 88: 283-288.

Mohammadi, A., Tabatabaeefar, A., Shahin, S., Rafiee, S., and Keyhani, A. 2008. Energy use and economical analysis of potato production in Iran a case study: Ardabil province. *Energy Conversion and Management*, 49 (12): 3566-3570.

Mohammadi, A., Rafiee, S.S., Mohtasebi, S.S., and Rafiee, H. 2010. Energy inputs – yield relationship and cost analysis of kiwifruit production in Iran. *Renewable Energy,* 35(5): 1071–1075.