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“Bridging the gap between increasing knowledge and decreasing resources”

Analysis of Energy and Economic Efficiency of Irrigated Canola Production in Brazilian Central-West Region

EDER PEREIRA GOMES¹, CAROLINA BILIBIO¹, OLIVER HENSEL², ARTHUR CARNIATO SANCHES¹, CESAR JOSÉ DA SILVA¹, DHIONES DIAS¹

¹Federal University of Grande Dourados, Dept. of Agricultural Engineering, Brazil

²University of Kassel, Agricultural Engineering, Germany

Abstract

Energy efficiency, defined as the ratio of energy produced to energy consumed, is a major tool to assess sustainability of agricultural activities. However, other areas such as economy and water use should be included. Thus, we developed a study to assess energy and economic efficiency of irrigated off season crop canola (*Brassica napus* L.) in the Central West region of Brazil. First, a study was conducted on the campus of the Federal University of Grande Dourados over two years, 2012 and 2013, to evaluate the effect of different irrigation frequencies on grain yield of canola. We used a split plot, randomised block design with four replications. Treatments in the plot consisted of three (3) irrigation frequencies: no irrigation - SI, weekly irrigation - IS, irrigation three times a week - I3S. Different irrigation frequencies significantly affected grain yield (kg ha^{-1}) on average of both seasons. The highest yields were obtained with irrigation performed three times a week, corresponding to $2,983 \text{ kg ha}^{-1}$. Economic analysis showed that non irrigated crop had a loss of $\text{BRL } 558.22 \text{ ha}^{-1}$ ($\text{BRL } 1 = \text{USD } 0,48$), while irrigation applied three times a week generated the highest total operating profit (LOT), which totalled $\text{R\$ } 736.15 \text{ ha}^{-1}$. Energy analysis showed that the energy used (EU) for crop production without irrigation (SI) was $8,695 \text{ MJ ha}^{-1}$, followed by $14,097 \text{ MJ ha}^{-1}$ (IS) and $14,561 \text{ MJ ha}^{-1}$ (I3S), while the energy extracted (EE), corresponding to energy from grain, followed the order: $17,038 \text{ MJ ha}^{-1}$ (SI); $55,236 \text{ MJ ha}^{-1}$ (IS) and $71,589 \text{ MJ ha}^{-1}$ (I3S). Therefore, the maximum energy efficiency was achieved with irrigation performed three times a week, reaching a coefficient of 4.92 (I3S), followed by 3.92 (IS) and 1.96 (SI). Moreover, the specific energy obtained was 4.88 (I3S), 6.13 (IS) and 12.25 (SI) MJ kg^{-1} of grains. It is concluded that absence of irrigation made it economically unfeasible to produce off season canola in the Central-West region of Brazil, while irrigation promoted energy and economic viability. In addition, the most frequent irrigation, three times a week, produced the best results.

Keywords: Energy balance, irrigation management, off season production, production cost