WATER REQUIREMENT OF OILSEED RADISH (*Raphanus sativus* L.) IN MATO GROSSO DO SUL STATE, BRAZIL

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ABSTRACT: The aim of this work was to determine the water requirement of oilseed radish (*Raphanus sativus* L.) considering the climatic conditions of Dourados, Mato Grosso do Sul State, Brazil. The experiment was carried out at *Embrapa Agropecuária Oeste* Research Station in Dourados. The crop evapotranspiration was measured by a weighing lysimeter and the reference evapotranspiration was estimated by the FAO Penman-Monteith method. Crop coefficients were also determined. Highest values of crop evapotranspiration and crop coefficients occurred in the period between the beginning bloom and the full bloom (reproductive stage) and the lowest ones occurred in the vegetative and near the maturity stages.
KEYWORDS: crop coefficient, reference evapotranspiration, lysimeter

INTRODUCTION: The oilseed radish (*Raphanus sativus* L. var.*oleiferus* Metzg) is a species known a long time ago as a cover crop and at this time is one of the best options for oil extraction and bioenergy production in Brazil´s South Central region. Considering the crop adaptability, the oilseed radish is better than canola and other crucifers and can be cultivated, with good results, under great variation in climatic conditions, from tropical to temperate zones. Mato Grosso do Sul State has great potential for oilseed radish production, mainly in autumn/winter seasons when 600,000 hectares are available (uncultivated or sub-used). The oilseed radish doesn't demand many crop managements and also doesn't have problems with pests and diseases (COSTA, 1992). However, its grain yield is between 600 and 800 kg ha^{-1} (PITOL, 2006) with 30-43% of oil yield. Due its crop advantages (rusticity, adaptability and oil yield), SÁ (2005) concludes that oilseed radish is one of the best alternatives to biofuel production. The aim of this work was to determine the crop water requirement of oilseed radish considering the climatic conditions of Mato Grosso do Sul State, Brazil.

METHODOLOGY: The experiment was carried out at *Embrapa Agropecuária Oeste* Research Station in Dourados, Mato Grosso do Sul State, Brazil. The area is located at latitude 22°16' S and longitude 54°49' W, and has a mean altitude of 452 m. According to Köppen's classification, the region climate is of *Cwa* type (mesothermal, tropical with rainy summer and dry winter). The experimental unit had 4,000 m^2 irrigated by a conventional sprikler irrigation system. A weighing lysimeter with 0,80 m of depth and an effective area of 2.0 m^2 (1.35 x 1.54 m) was mounted in the center of this area. More information about the lysmeter is presented by FIETZ et al. (2007). The reference evapotranspiration (ET_0) was estimated by the FAO Penman-Monteith method (ALLEN et al., 1998). An automatic weather station, located at 300 m of the experimental unit, was used to collect the meteorological elements (air temperature, air humidity, wind speed at two meters and net radiation) necessary to the ET_0 estimation. The crop coefficients were determined by the ET_C/ET_0 relation. The variety used in this work was the CATI AL 1000, sown in May 31, 2007, after what, reached a mean population of 250,000 plants ha^{-1}. The crop evapotranspiration was determined in four phenological periods: emergence (E), beginning bloom (BB), full bloom (FB), beginning seed (BS), full seed (FS) and maturity (M).

RESULTS AND DISCUSSION: The grain yield of oilseed radish was 1,187 kg ha^{-1} (Table 1), much higher than the values cited by PITOL (2006) (i.e. 600-800 kg ha^{-1}). The main reason for the difference is the irrigation use (no water deficit) that allowed the maximum crop efficiency. Another explanation for the highest grain yield is the variety used (CATI AL 1000). This variety was improved aiming grain production instead of biomass (cover crops).

TABLE 1. Plant height (H), plant dry matter (DM), number of siliquae per plant (NSP), number of seeds per siliquae (NSS), 100-seed weight, grain yield and oil yield referring to the oilseed radish variety CATI AL 1000.

H (m)	**DM (g plant^{-1})**	**NSP**	**NSS**	**100-seed weight (g)**	**Grain yield (kg ha^{-1})**	**Oil yield (kg ha^{-1})***
1.34	46.1	233.15	6.44	1.17	1,187	404*

*Considering a oil yield of 34% in the grains (SÁ, 2005).

According to SÁ (2005), the oil yield of the CATI AL 1000 variety is about 34% of the grains. Thus, it was possible to estimate the oil production in 404 kg ha^{-1}. This is a substantial result if we consider the low production cost and the possibility of utilization of available areas during the autumn/winter seasons.

The daily values of crop evapotranspiration (ET_m) and reference evapotranspiration (ET_0) are showed in Figure 1. The tendency of a values increment in the ET_m was observed from emergence phase (E) to bloom. In the successive stages the observed trend was a decrease in the ET_m, with minimal values in the sub-period FB-M. The maximum water requirement was of 6.8 mm day^{-1} and occurs 27 days after emergence (sub-period BB-FB).

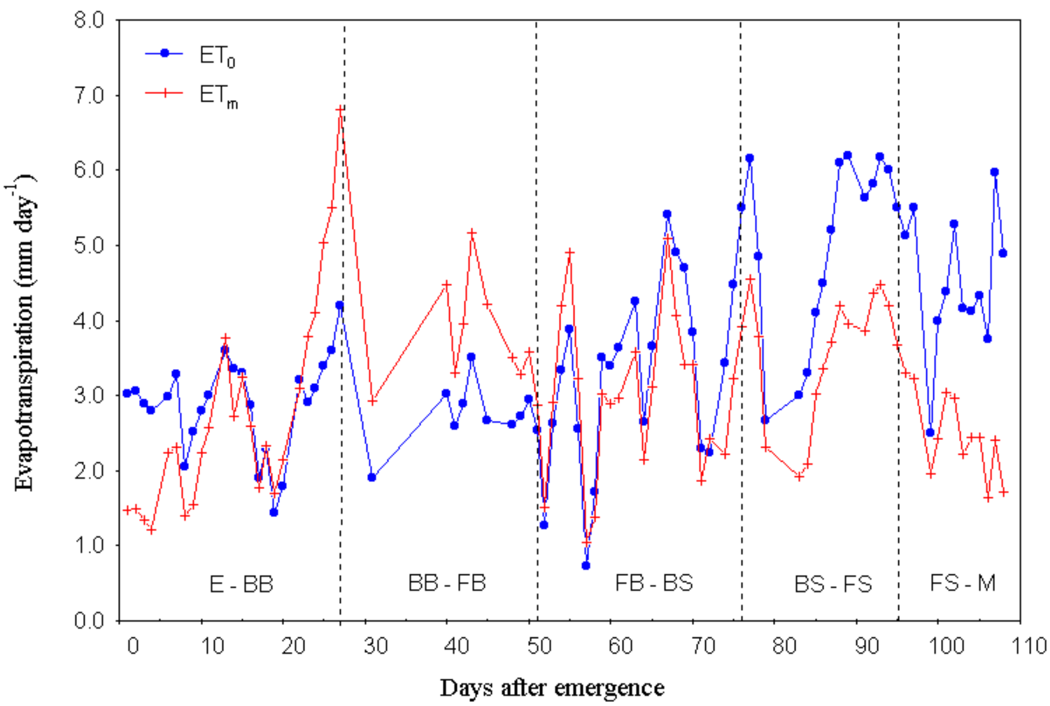

FIGURE 1. Daily values of crop evapotranspiration (ET_m) and reference evapotranspiration (ET_0) for oilseed radish.

The crop coefficients varied from 0.35 in the maturity (M) to 1.62 in the beginning bloom (BB). With the variation in ET_m and ET_0 values, crop coefficients (Kc) also presented a trend increasing from emergence to bloom, decreasing after this (Figure 2). This behavior allowed the coefficient crop adjust, using days after emergence, to an exponential equation with three parameters: ($K_C = 0.129\ DAE^{0.945}\ e^{(-0.029\ DAE)}$, $R^2 = 0.783$).

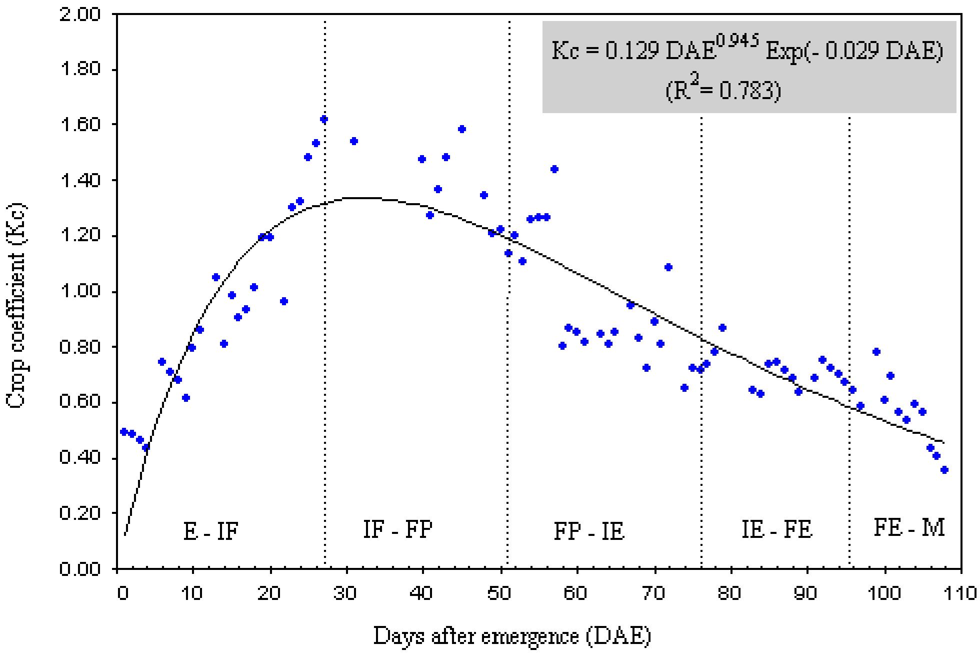

FIGURE 2. Crop coefficients (Kc) during the oilseed radish cycle.

The mean values of ET_0, ET_m and K_C of the oilseed radish in different phenological sub-periods are showed in Table 2. The highest crop coefficient occurred in the period between beginning bloom and full bloom ($K_C = 1.42$) due the elevated ET_m in this sub-period. The mean K_C values was lower in the sub-periods E – BB (0.91) and FS – M (0.56). Although these sub-periods have shown similar values of ET_m, the ET_0 was higher in FS – M period, resulting in lowest mean K_C value (0.56).

TABLE 2. Mean values for reference evapotranspiration (ET_0), maximum evapotranspiration (ET_m) and crop coefficients (K_C) of oilseed radish crop.

Stages	**Number of days**	**ET_0 (mm dia^{-1})**	**ET_m (mm dia^{-1})**	**K_c**
E - BB	27	2,83	2,59	0,91
BB – FB	21	2,91	4,12	1,42
FB – BS	26	3,23	2,98	0,92
BS – FS	20	5,01	3,58	0,71
FS - M	14	4,58	2,57	0,56
E - M	108	3,60	3,05	0,85

* Phenological periods: emergence (E), beginning bloom (BB), full bloom (FB), beginning seed (BS), full seed (FS) and maturity (M).

CONCLUSION: Highest values of crop evapotranspiration and crop coefficient occurred in the period between beginning bloom and full bloom (reproductive stage) and the lowest ones occurred in the vegetative stages and near the maturity stage.

REFERENCES:

ALLEN, R. G.; PEREIRA, L. S.; RAES, D.; SMITH, M. **Crop evapotranspiration:** guidelines for computing crop water requirements. Rome: FAO, 1998. 297 p. (FAO. Irrigation and drainage paper, 56).

COSTA, M. B. B. da (Coord.). **Adubação verde no sul do Brasil**. Rio de Janeiro: AS-PTA, 1992. 346 p.

FIETZ, C. R.; CAMPECHE, L. F.; SILVA, M. P. da. Avaliação de dois lisímetros de pesagem para medida da evapotranspiração de culturas anuais. In: CONGRESSO BRASILEIRO DE AGROMETEOROLOGIA, 15., 2007, Aracaju. **Efeito das mudanças climáticas na agricultura**: anais. Aracajú: SBA: Embrapa Tabuleiros Costeiros, 2007. 1 CD-ROM.

PITOL, C. Biodiesel: culturas, sistemas de produção e rotação de culturas. In: TECNOLOGIA e produção: culturas de safrinha e inverno 2007. Maracaju: Fundação MS: COOAGRI, 2006. p. 57-59.

SÁ, R. O. de. **Variabilidade genética entre progênies de meios irmãos de nabo forrageiro (*Raphanus sativus* L. var. *Oleiferus*) cultivar CATI AL 1000.** 2005. 39 f. Dissertação (Mestrado em Agronomia) – Faculdade de Ciências Agronômicas, Universidade Estadual Paulista "Júlio de Mesquista Filho", Botucatu.