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Evapotranspiration partitioning, crop coefficients, tuber yield and irrigation water productivity for a potato crop under water-limited conditions in southern Chile.

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INTRODUCTION

The evapotranspiration (ET) process is essential for many agricultural water management studies on tuber yield and its partitioning into soil evaporation (E) and plant transpiration (T) is key for optimizing the irrigation water use under scarce water resources.

MATERIALS AND METHODS

Location: Research Center Carillanca (INIA), La Araucanía Región, Chile (38° 41' S, 72° 24' W, 188 m.a.s.l.). A drip-irrigated potato crop (var. Puyehue INIA) was used during 2020/2021 season (planting on October 26, 2020). **Irrigation management:** three different irrigation levels (IL) were applied as IL_1 (full irrigation), IL_2 (75% of IL_1) and IL_3 (60% of IL_1) in a surface area of 300 m^2 each. **Measurements:** in each IL micrometeorological, morphological, physiological measurements were done. Pots installed in-row for transpiration (T) and PVC microlysimeters for soil evaporation (E). ET and ET_o were used in the soil water balance (WB) and FAO56 methods, respectively **(Figure 1).** The yield tuber and irrigation water productivity (IWP) were determined at harvest.

Figure 1. Measurements of soil, plant, and atmosphere on potato crop

RESULTS AND DISCUSSION

The partitioning of T/ET was higher than E/ET for IL_1, while for IL_2 and IL_3 the ratios were similar. The same tendency was observed by T/ETo compared to E/ETo **(Table 1).** The K_c values for IL_1, IL_2 and IL_3 were between 0.43-0.90, 0.30-0.85, and 0.26-0.75, respectively **(Figure 2)**. Haverkort and MacKerron (2006) observed average K_c values between 0.75 and 1.13 (crop development-harvest). IWP was close to 20, 25, and 29 kg/m^3 for IL_1, IL_2 and IL_3, respectively **(Table 2).**

Table 1. Partitioning of Evapotranspiration for each IL condition.

Irrigation levels	Months	Es (mm)	Tc (mm)	ETc_WB (mm)	ETo (mm)	Es/ETc (-)	Tc/ETc (-)	Es/ETo (-)	Tc/ETo (-)
IL_1	December	1.74	1.32	3.47	4.07	0.50	0.38	0.43	0.32
	January	1.48	1.81	3.54	4.73	0.42	0.51	0.32	0.38
	February	1.14	2.08	3.45	4.49	0.33	0.60	0.25	0.46
		1.45	**1.74**	**3.49**	**4.43**	**0.42**	**0.50**	**0.33**	**0.39**
IL_2	December	1.34	1.19	2.88	4.07	0.47	0.41	0.33	0.29
	January	1.55	1.31	3.13	4.73	0.50	0.42	0.33	0.28
	February	1.28	1.83	3.18	4.49	0.40	0.56	0.28	0.39
		1.39	**1.44**	**3.06**	**4.43**	**0.45**	**0.46**	**0.32**	**0.32**
IL_3	December	1.44	1.03	2.72	4.07	0.53	0.36	0.35	0.26
	January	1.43	1.24	2.85	4.73	0.51	0.44	0.30	0.26
	February	1.33	1.54	2.89	4.49	0.45	0.50	0.29	0.32
		1.40	**1.27**	**2.82**	**4.43**	**0.50**	**0.43**	**0.32**	**0.28**

Table 2. General values of tuber yield, irrigation water applied and Irrigation water productivity (IWP).

	Tuber yield kg/ha	Irrigation applied (m^3/ha)	IWP (kg/m^3)
IL_1	62869	3085	20
IL_2	58001	2314	25
IL_3	54575	1851	29

CONCLUSIONS

E_s increased due to the major exposed soil surface under the IL_3 condition during the maximum water demand from the atmosphere. Therefore, preliminarily we recommend K_c values obtained in IL_1 and IL_2 due to the highest tuber yield and intermediate IWP values.

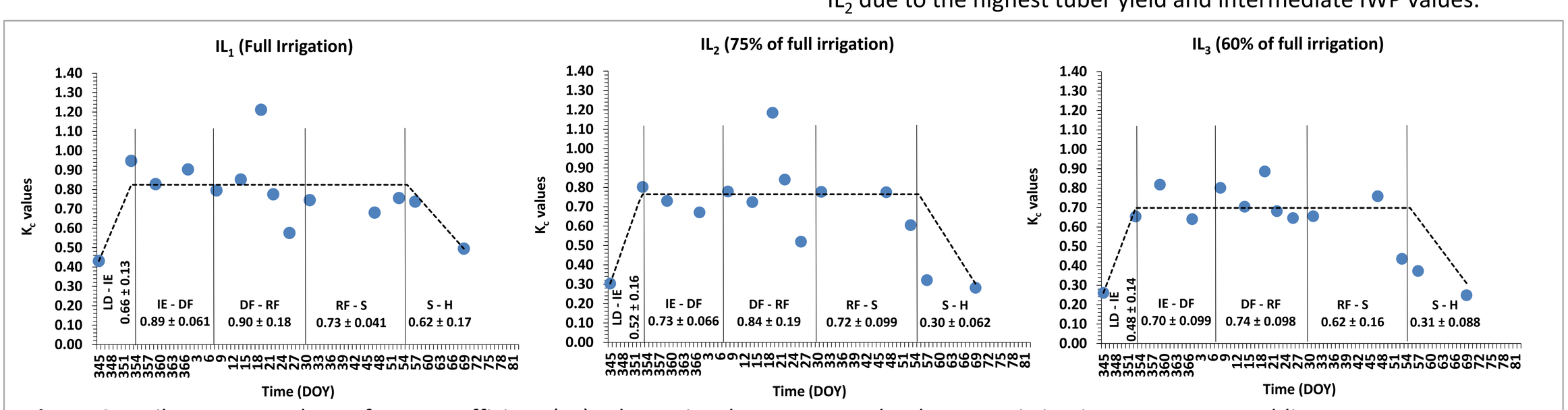

Figure 2. Daily average values of crop coefficient (Kc). Blue point denote a Kc value between irrigation events. Dotted line represent an average value of Kc during the evaluated period. LD: Leaf development; IE: Inflorescence emergence; DF: Development of fruit; RF: Ripening of fruit; S: Senescence; H: Harvest.

Haverkort, A.J., and D.K.L. MacKerron. 2006. Management of nitrogen and water in potato production. 353 p. Wageningen Pers, Wageningen, The Netherlands. https://doi.org/10.3920/978-90-8686-503-1.

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