Feasibility and Benefits of Subsurface Drip Irrigation in Vineyards (A case study: Malekan region)

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Presenting by:
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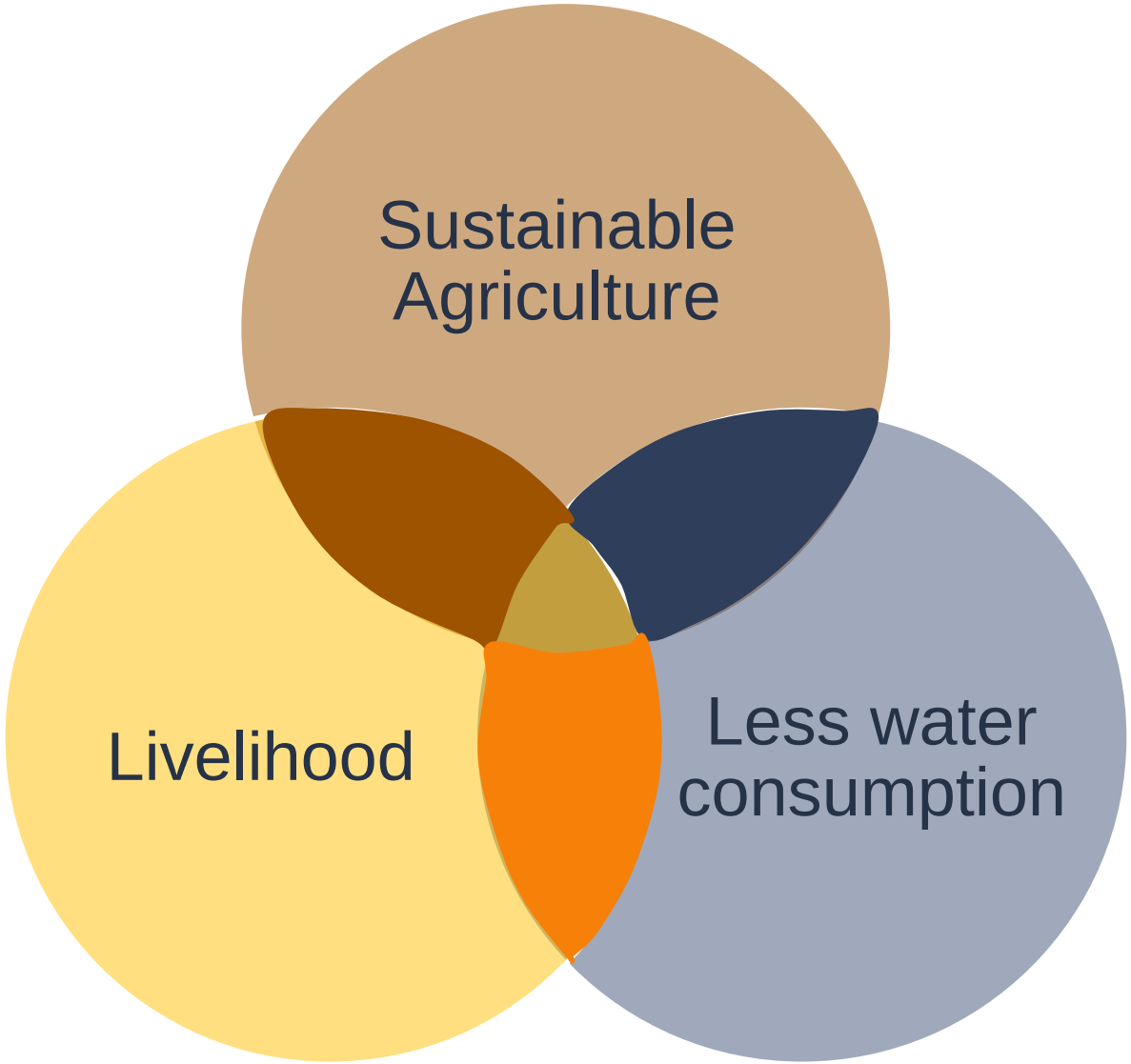
Introduction

17 June 2021

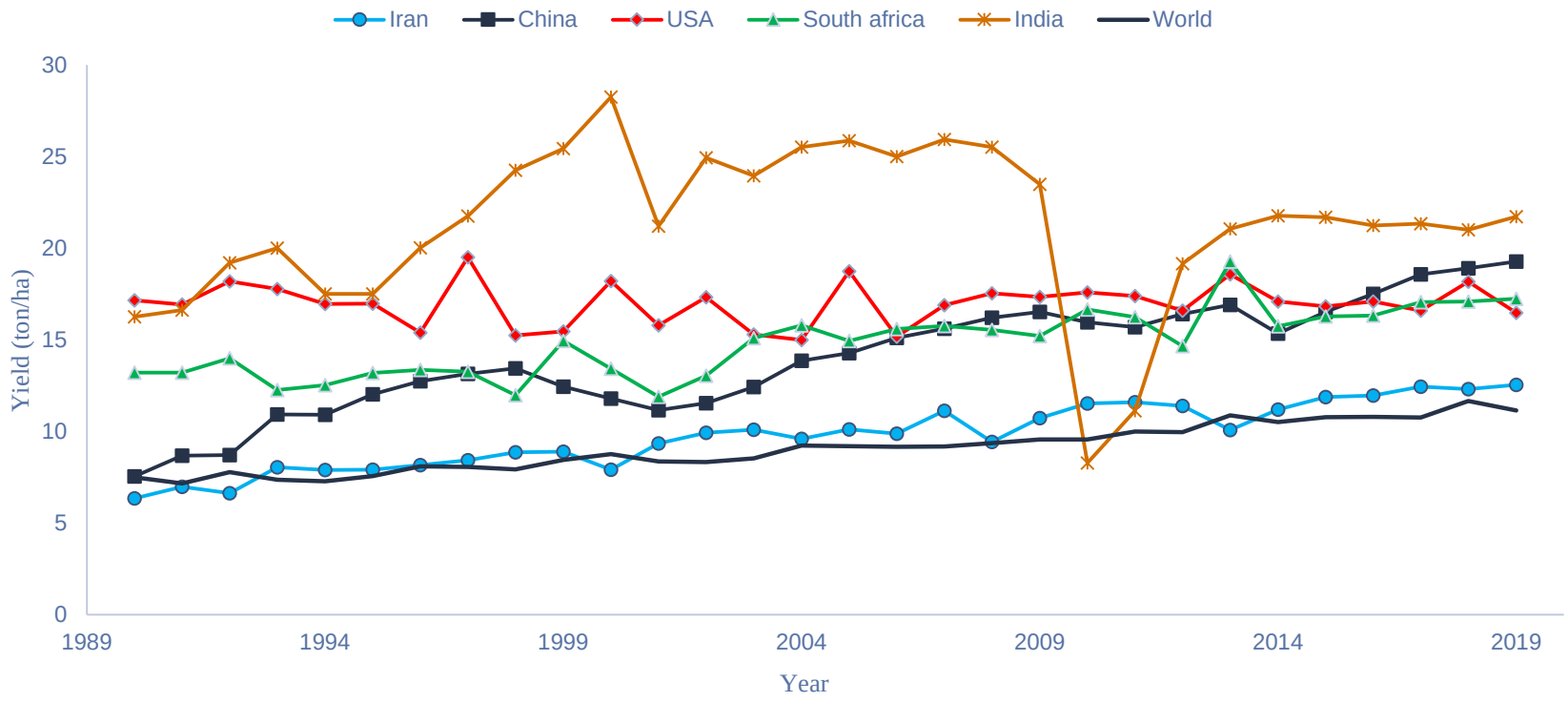
Modeling Local Community Participation in Lake Urmia Restoration Via Establishment of Sustainable Agriclture


Sustainable Agriculture
Livelihood
Less water consumption


نوارهای آبیاری شاهد
تیمارهای مربوط به کاهش عرض نوار

Grapes

- About 221,000 ha of irrigated fields in Iran are dedicated to cultivating fertile grapes.
- Iran is ranked 11th in the world with 1945 thousand tons of grapes per year.
- Grape yield in Iran over the past 30 years has been higher than the global average.

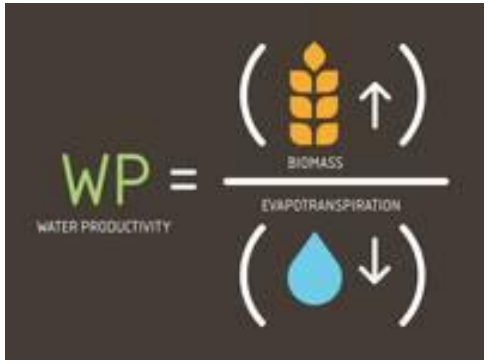


Cultivated area, production and yield of grapes in different provinces in 2020

Provinces	Infertile grapes area			Fertile grapes area			Total area	Production			Yield	
	Irrigated	Dryland	Total	Irrigated	Dryland	Total		Irrigated	Dryland	Total	Irrigated	Dryland
East Azerbaijan	522	1	522	16,953	16	16,969	17,491	260,029	141	260,169	15,338	9,084
West Azerbaijan	1,157	299	1,456	14,545	5,114	19,659	21,115	161,694	22,419	184,113	11,117	4,384
Ardebil	47	27	74	2,181	42	2,223	2,297	22,914	48	22,962	10,506	1,143
Isfahan	352	37	389	5,982	6	5,988	6,377	60,778	12	60,790	10,160	2,182
Alborz	61	1	62	2,099	43	2,142	2,203	39,459	215	39,674	18,803	5,000
Ilam	177	52	228	1,117	41	1,157	1,386	7,793	157	7,950	6,978	3,860
Bushehr	5	0	5	8	0	8	12	56	0	56	7,480	-
Tehran	77	0	77	4,236	0	4,236	4,313	69,907	0	69,907	16,503	-
Chaharmahal and Bakhtiari	124	79	203	4,105	184	4,289	4,492	51,260	652	51,912	12,488	3,543
South Khorasan	131	13	144	1,747	854	2,601	2,745	15,293	1,061	16,354	8,754	1,243
Khorasan Razavi	1,484	762	2,246	19,944	6,982	26,926	29,171	345,611	11,414	357,026	17,329	1,635
North Khorasan	504	250	754	10,761	5,376	16,137	16,891	86,685	25,304	111,989	8,055	4,707
Khuzestan	146	6	152	649	1	650	802	5,669	2	5,671	8,735	2,000
Zanjan	468	31	499	15,223	243	15,466	15,965	229,702	553	230,255	15,089	2,276
Semnan	1,006	0	1,006	4,155	0	4,155	5,162	134,400	0	134,400	32,343	-
Sistan and Baluchestan	766	0	766	3,241	0	3,241	4,007	36,955	0	36,955	11,402	-
Fars	959	983	1,942	22,025	28,869	50,895	52,837	372,659	92,304	464,962	16,920	3,197
Total	**7,986**	**2,541**	**10,525**	**128,971**	**47,771**	**176,742**	**187,266**	**1,900,864**	**154,282**	**2,055,145**	**228,000**	**44,254**

Feasibility evaluation index:

- Determination and comparison of grapes ETC_A in two irrigation systems (SDI and furrow).
- Assessment of the effect of SDI system on vineyards WP.
- Assessment of the effect of SDI system on some physiological characteristics such as number of clusters, number of berries in cluster, cluster length and berries weight.



Methodology

Location: Malekan region, east Azerbaijan province, Iran.

Research time: Spring and Summer of 2020.

Experimental design template: Complete randomized.

Grapes variety: sultana

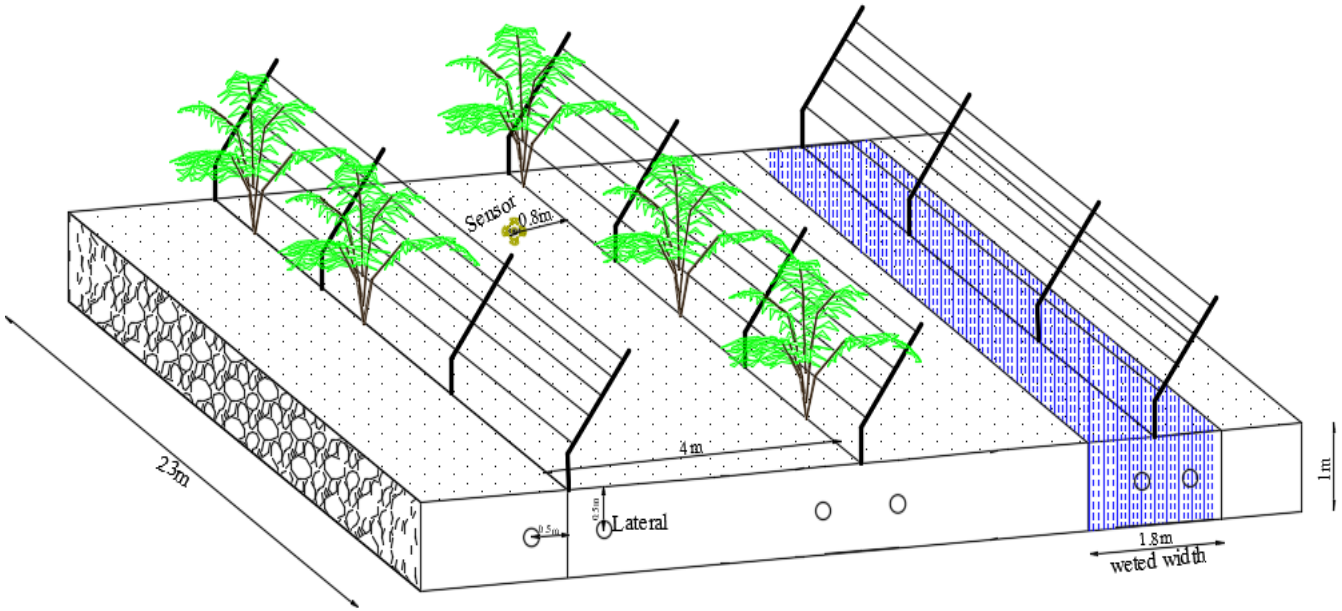
The experiments were performed in two adjacent vineyards with bowed trellis (A) and creeping (B) cultivation systems.

Treatments:

1. **SDI system in vineyard A (T1).**
2. **Furrow system in vineyard A (C1).**
3. **SDI system in vineyard B (T2).**
4. **Furrow system in vineyard B (C2).**

Vineyard A:

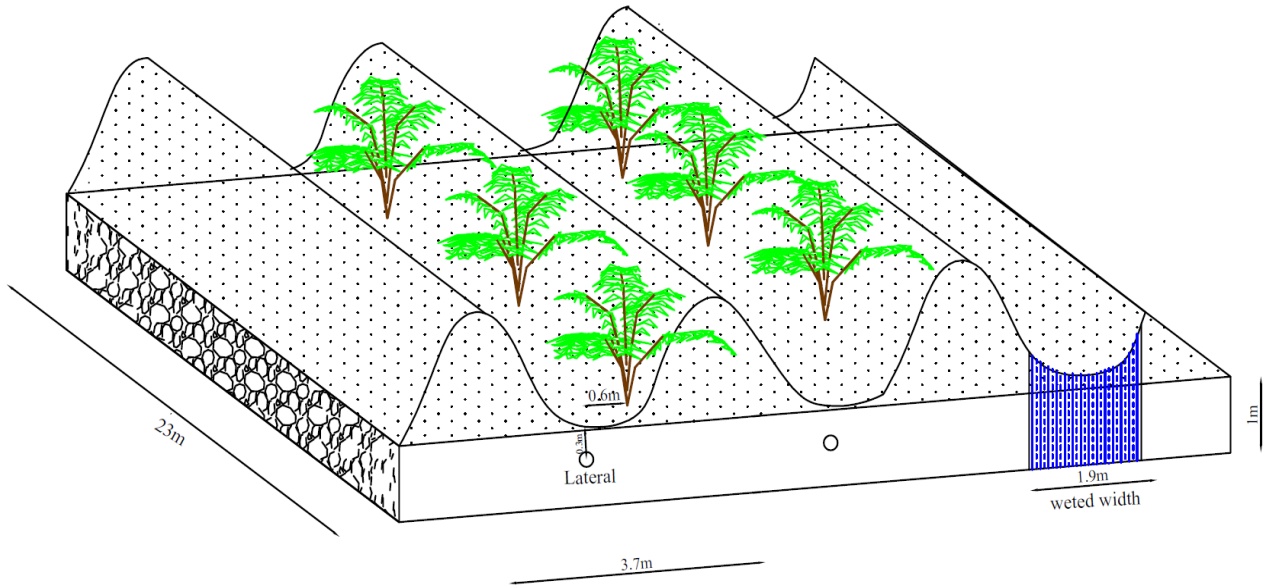
- **Row space : 4m**
- **Plant space: 0.8m**
- **Row length: 23m**
- **Age: 8 years old**
- **Lateral layout: double lateral for each row**
- **Lateral plantation depth from soil surface: 0.5m**
- **Lateral distance of cultivation row: 0.5m**
- **Emitters space: 0.75m**
- **Emitters discharge: 2.1 L.h^{-1}**



The end of furrows was closed and runoff did not occur.

Vineyard B:

- **Row space : 3.7m**
- **Plant space: 2m**
- **Row length: 25m**
- **Age: 35 years old**
- **Lateral layout: single lateral for each row**
- **Lateral plantation depth from soil surface: 0.3m**
- **Lateral distance of cultivation row: 0.6m**
- **Emitters space: 0.37m**
- **Emitters discharge: 2.1 L.h^{-1}**



The end of furrows was closed and runoff did not occur.

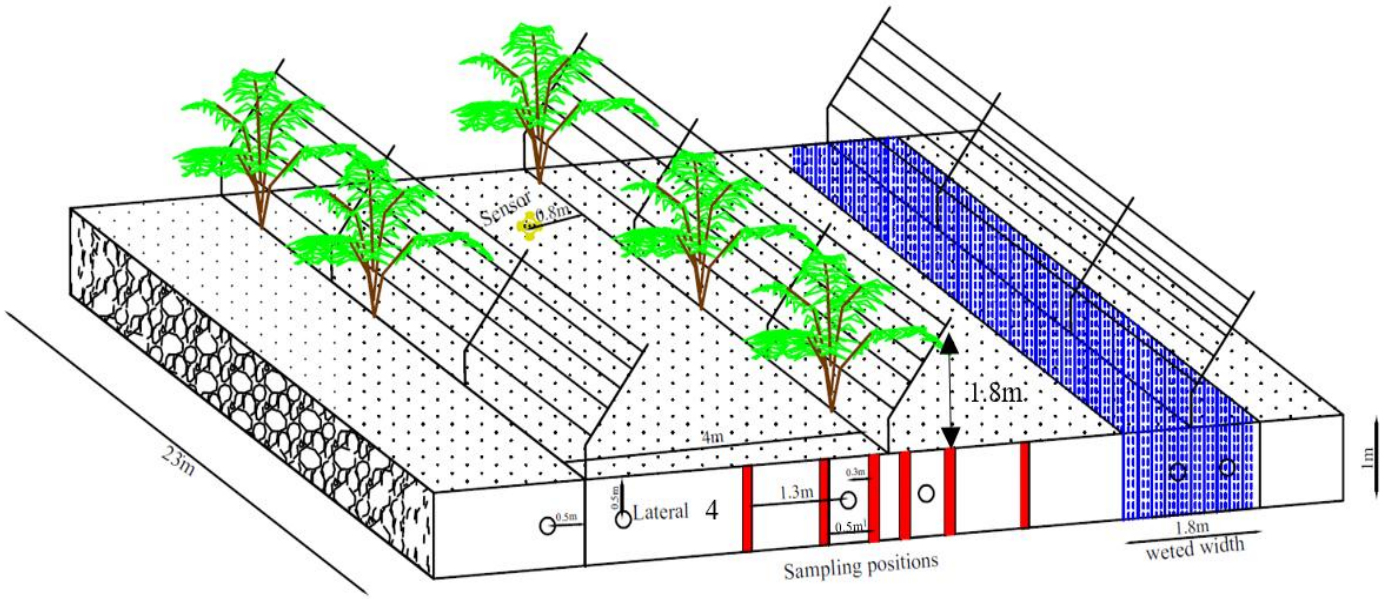
Soil and irrigation water samples analysis:

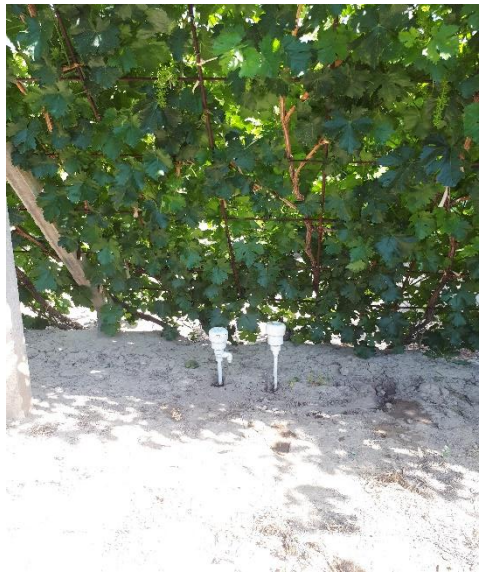
بافت خاک Soil texture	مشخصات بافت Texture characteristics (%)			Pwp (%) (cm3/cm3)	FC (%) (cm3/cm3)	PH of paste	ECe (ds/m)	عمق خاک(سانتی متر) Soil depth(cm)	
	sand	silt	clay						
loam	32	43	25	14.40	29.2	7.9	1.57	0-30	باغ A
loam	32	43	25	13.62	28.65	7.8	1.84	30-60	Vineyard
loam	50	36	14	13.38	28.15	7.8	1.91	60-90	A
				13.80	28.66	7.83	1.77	Mean	
loam	45	40	15	12.1	26.6	7.95	1.67	0-30	باغ B
Sandy loam	70	20	10	10.7	21.8	7.86	1.96	30-60	Vineyard
Sandy loam	69	19	12	10.7	22.5	7.75	2.14	60-90	B
				11.2	23.6	7.85	1.92	Mean	

Anion(meq/l)		Cation(meq/l)			PH	EC (ds/m)	منبع آب Water source
Cl^{-}	Hco^{3-}	Na^{+}	mg^{2+}	ca^{2+}			
2.80	4	0.46	4.20	3.92	7.10	0.866	Water well

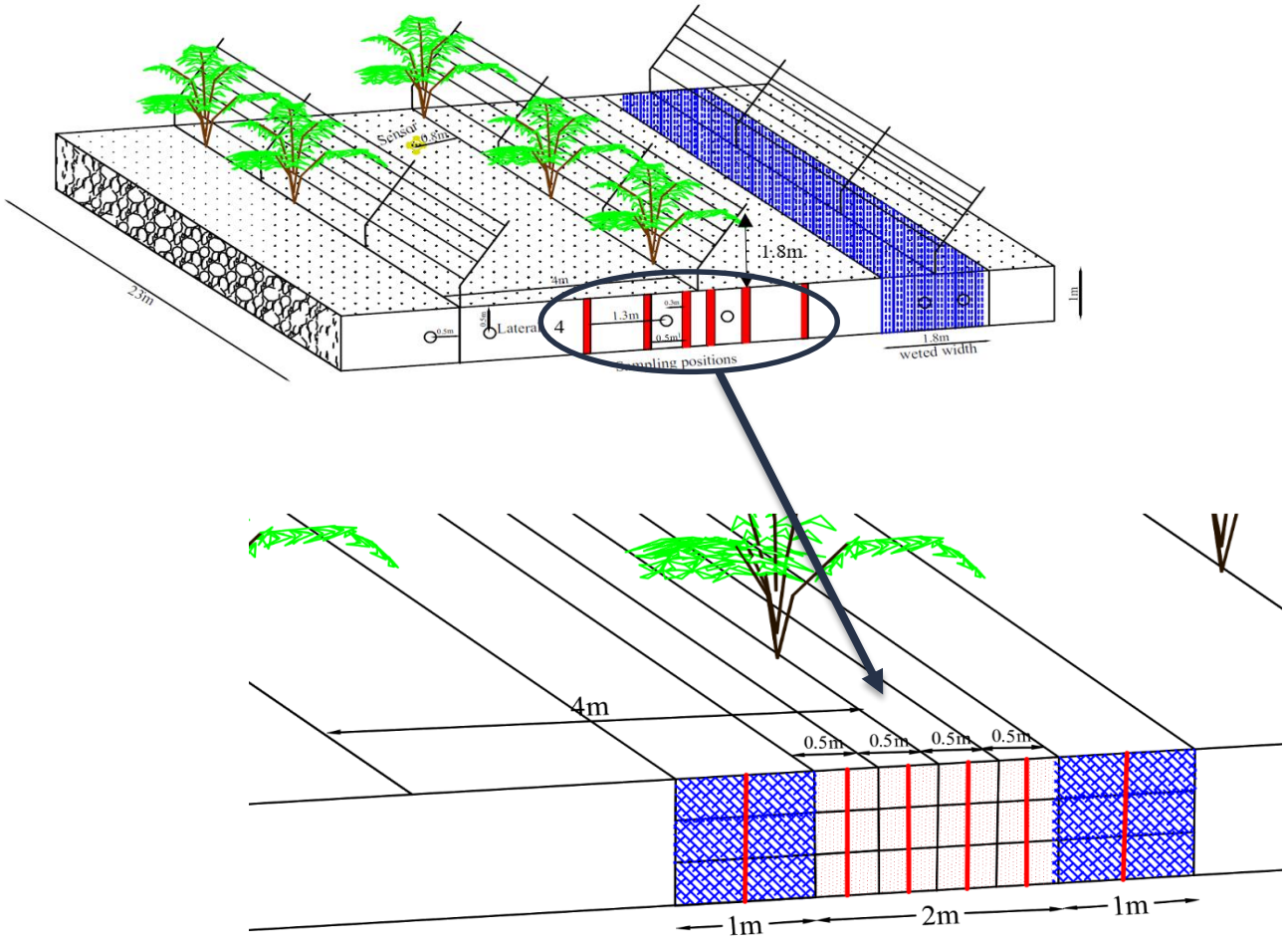
All fertilization, spraying, weed control, and pruning operations on the trees of all treatments were performed equally by vineyards owners during the experiment.

Soil water content (SWC) was measured to irrigation management and determine ETC_A during the growing season.





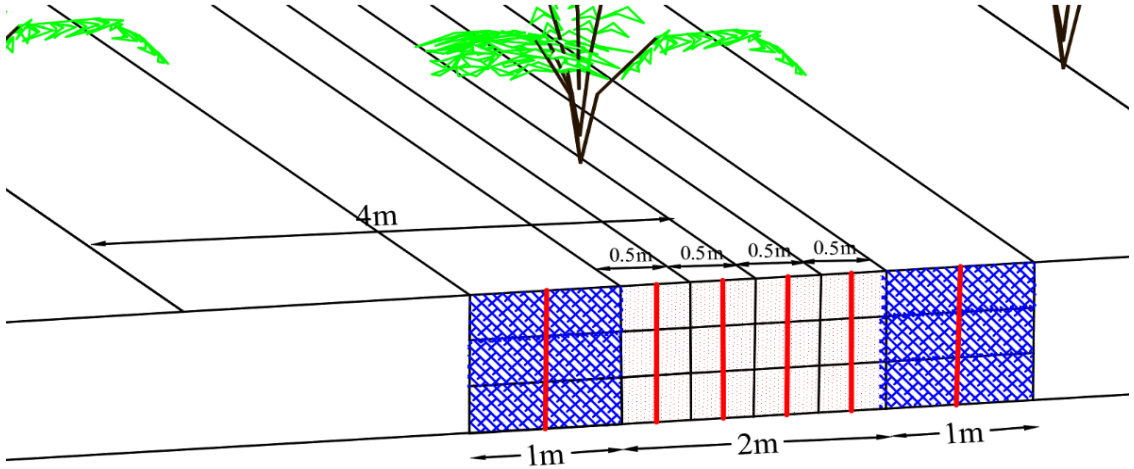
To calculate the irrigation depth (In), the cross-section of the cultivation row was networked, and the irrigation depth was calculated using the following equation.



$$I_n = \sum_{j=1}^{n} \left(\sum_{i=1}^{m} (w_{fci} - w_{Bi}) \times D_i \right) j$$

Irrigation volume was measured in treatments by water meter in SDI treatments and Parshall flume WSC.

To calculate ETC_A the cross-section of the cultivation row was networked, and ETC_A was calculated using the soil water balance equation.

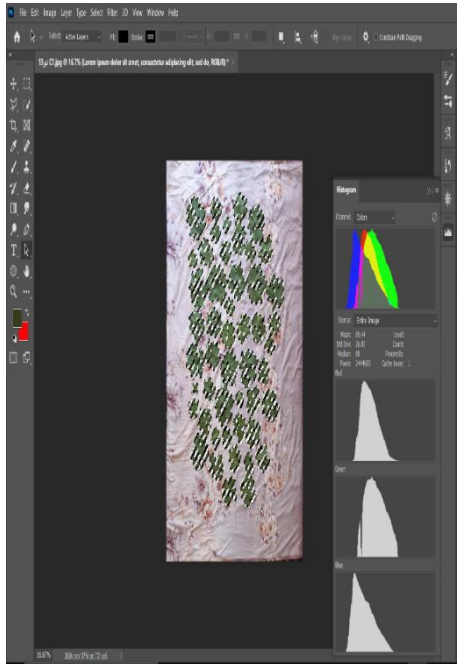


$$ETC_A = P + I \pm \Delta S - DP - RO$$

$$\Delta S = \sum_{j=1}^{n} (\sum_{i=1}^{m} (w_2 - w_1) \times D_i) j$$

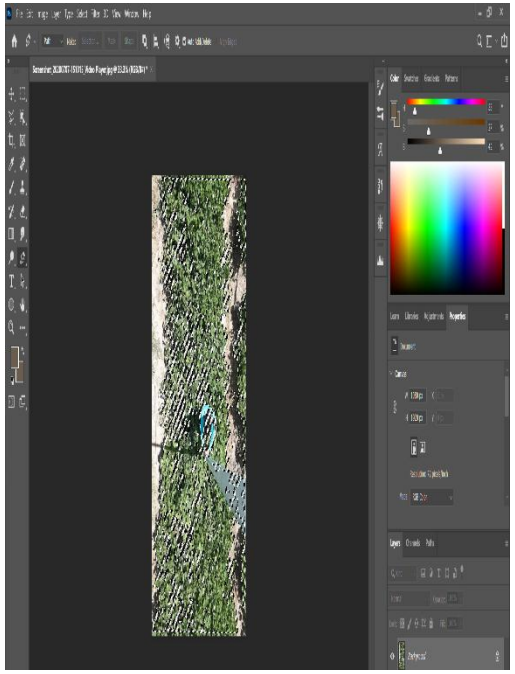
The LAI was measured every 10 days by destructive method.

To measure LAI, a camera and Adobe Photoshop software were used.



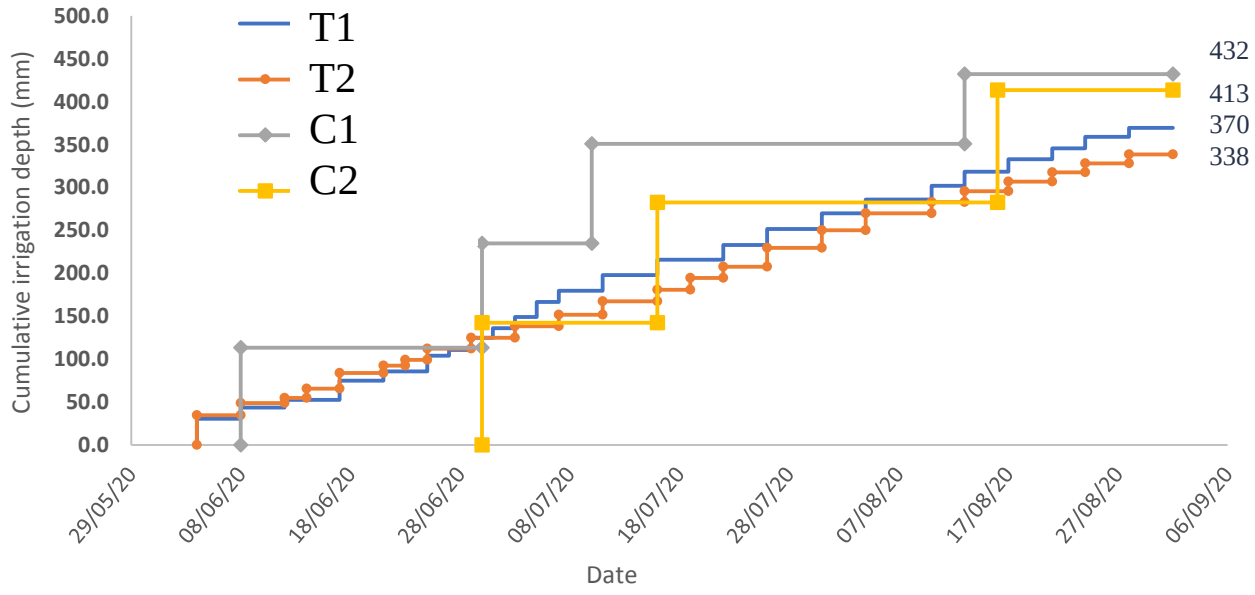
The Cc was measured every 10 days.

To measure Cc, a camera was placed at the height of eight meters above the treatments.

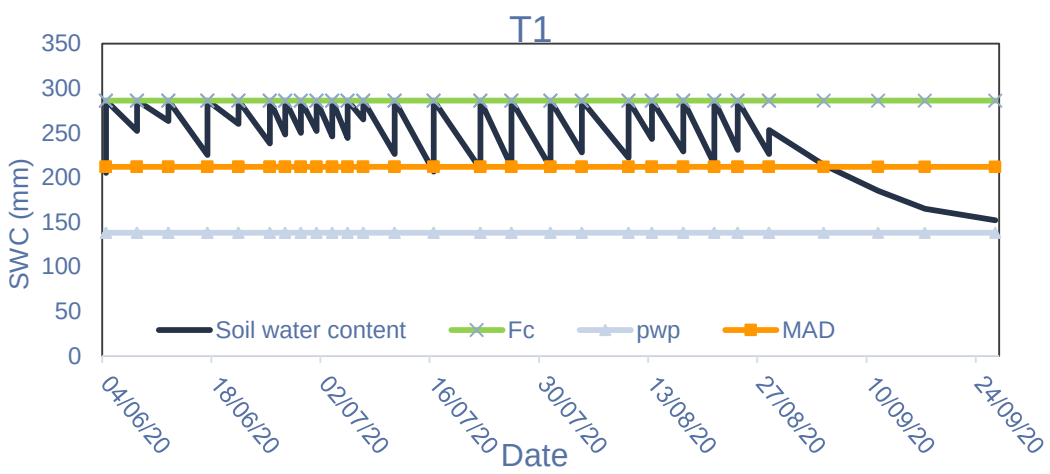


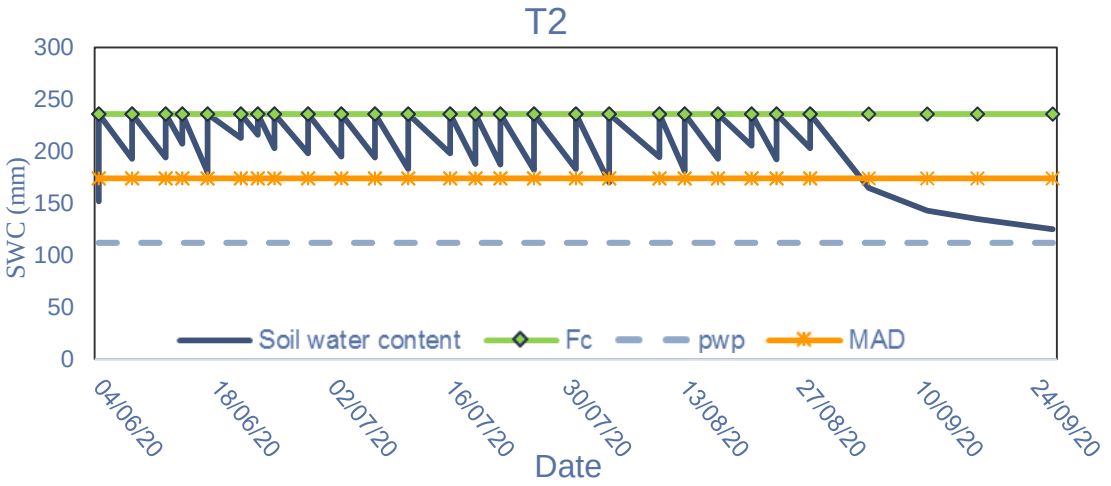
Results

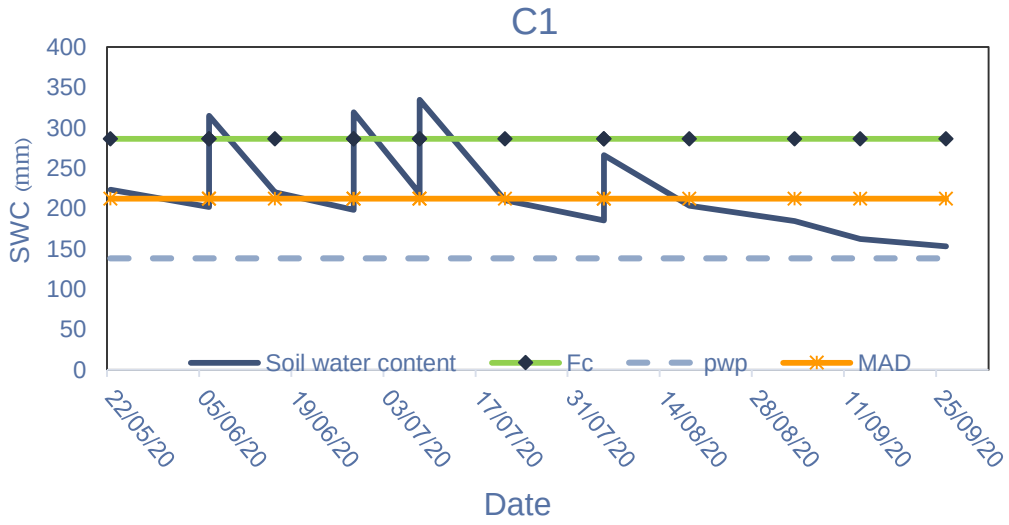
Irrigation depth in treatments:

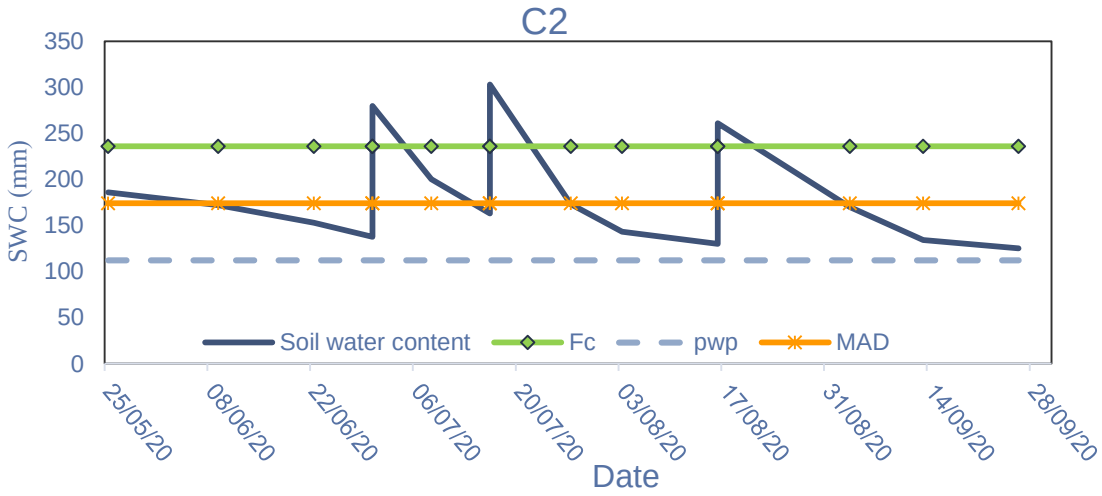


Soil water content (SWC) variation:

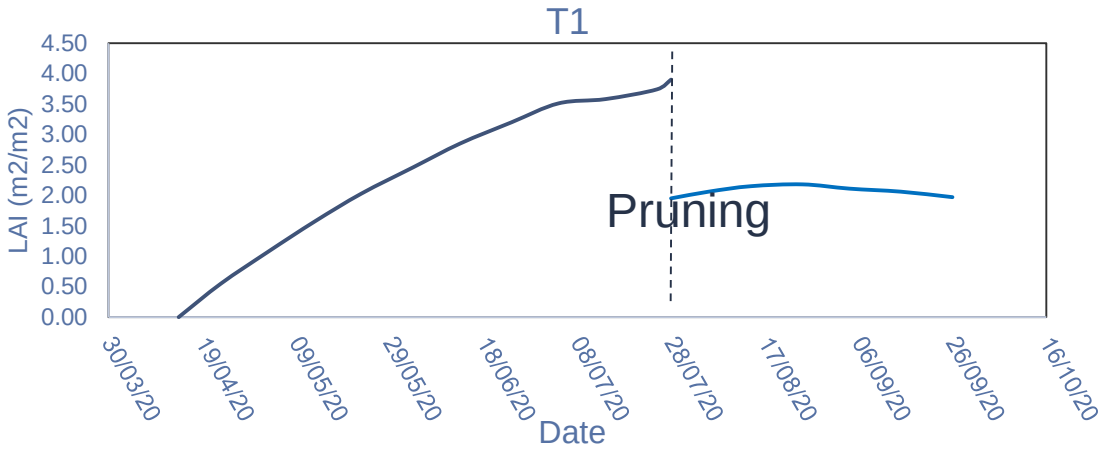


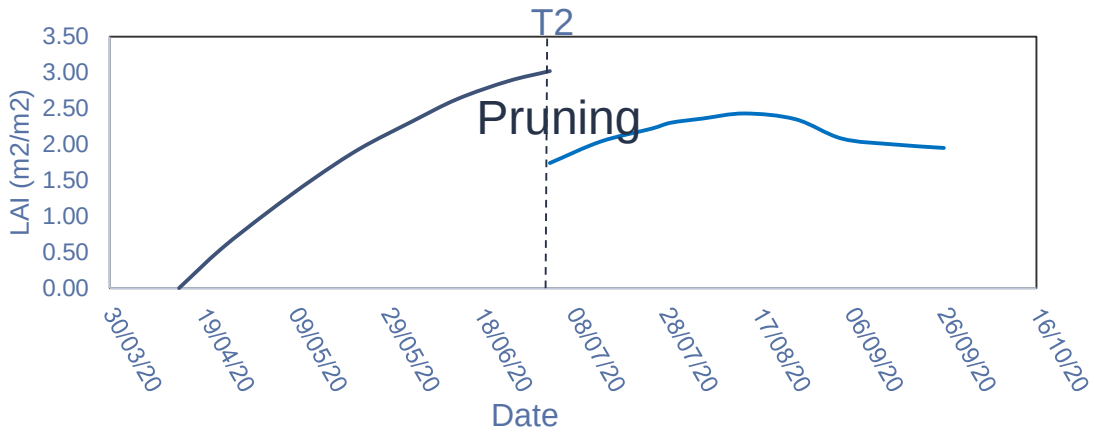


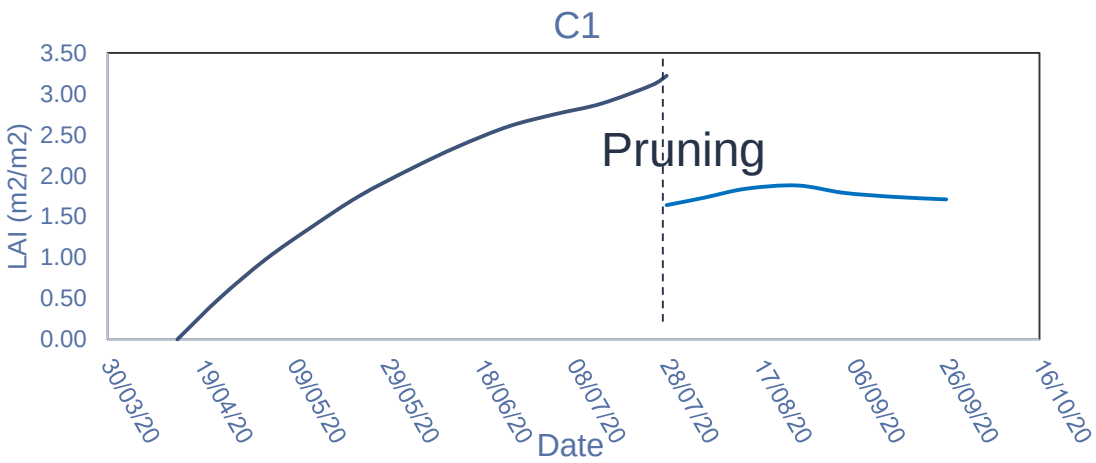


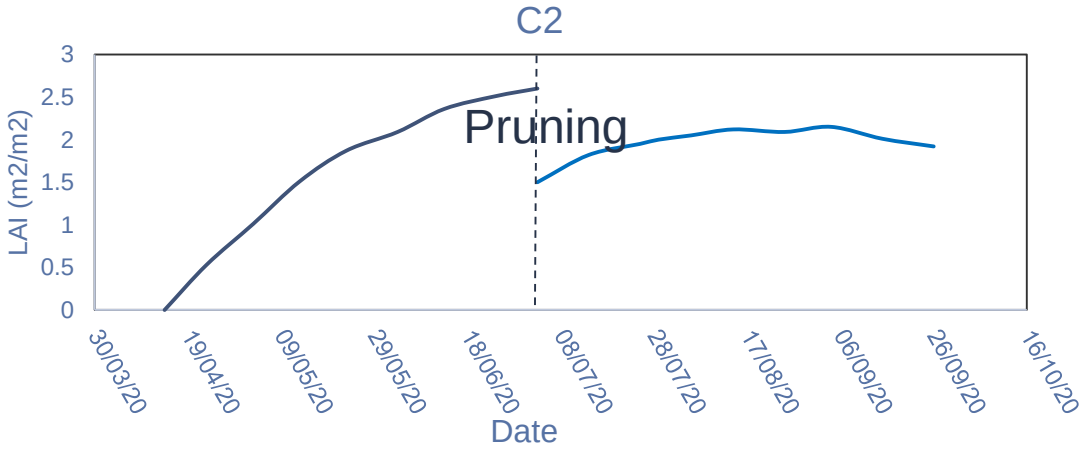


LAI variation:

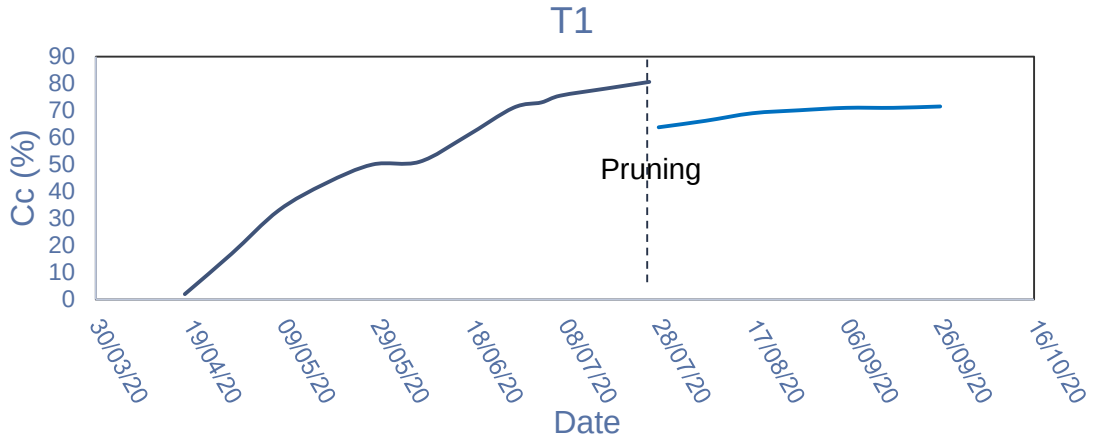


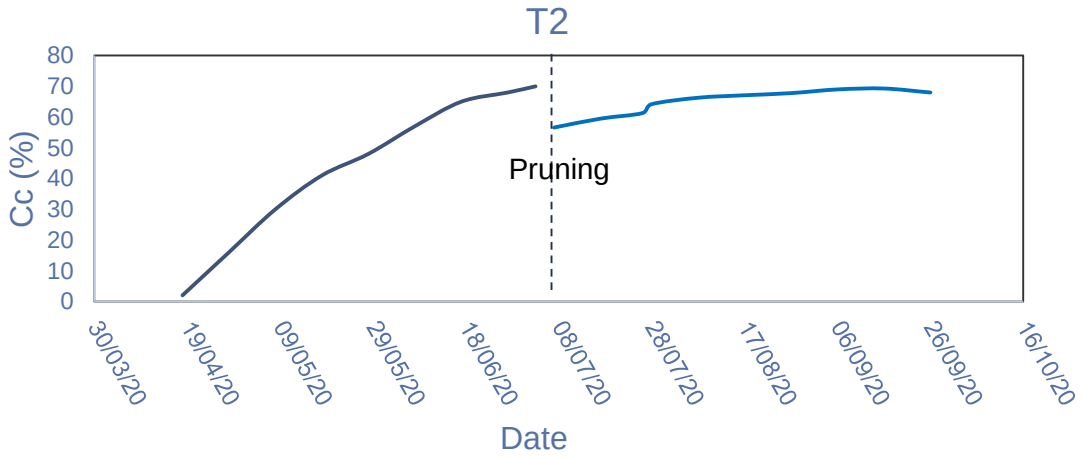


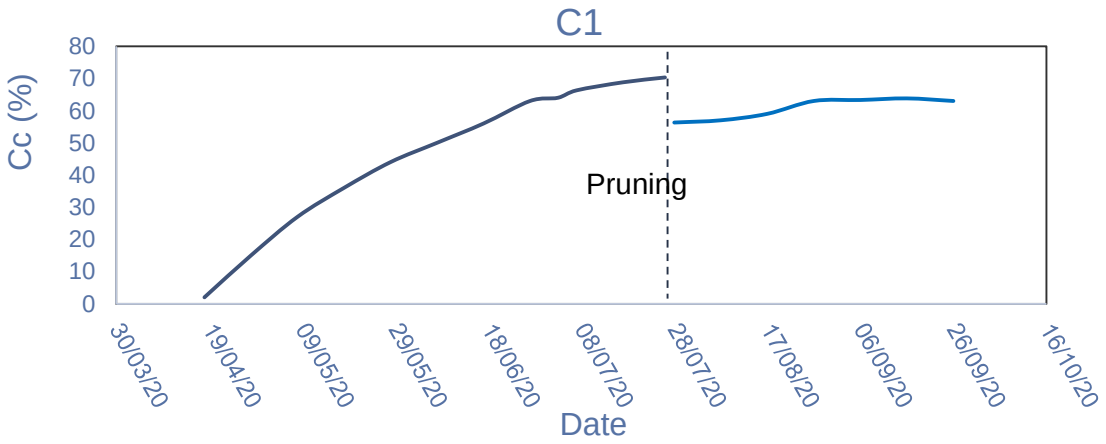


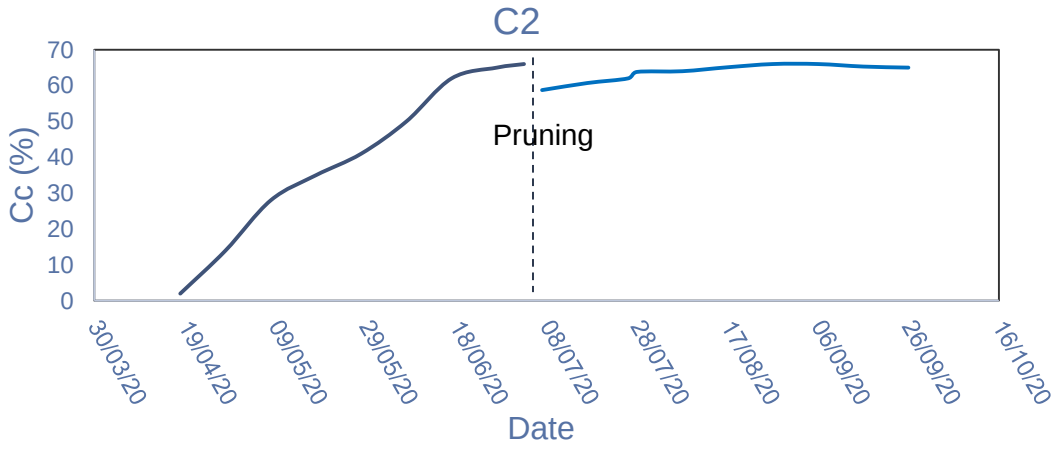


Cc variation:

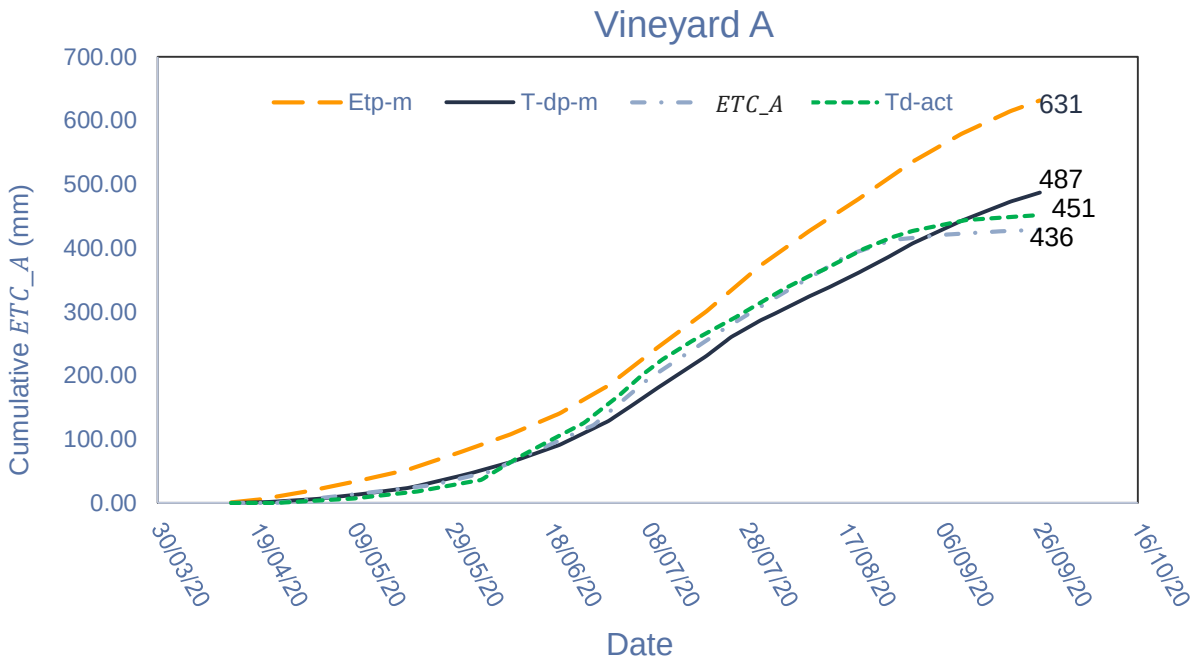


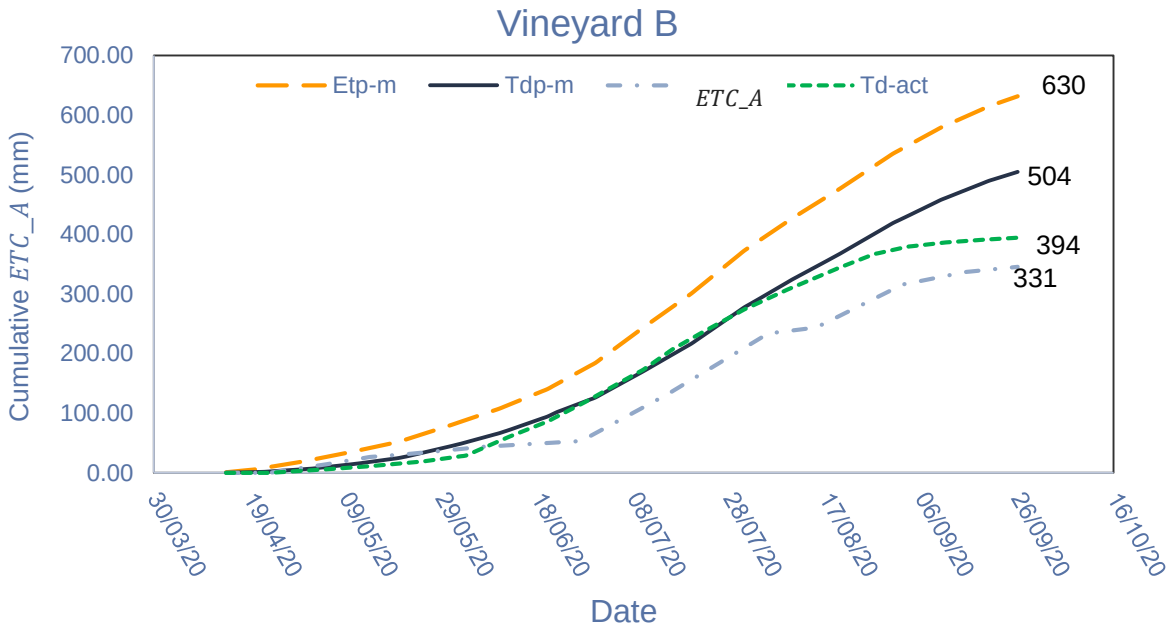




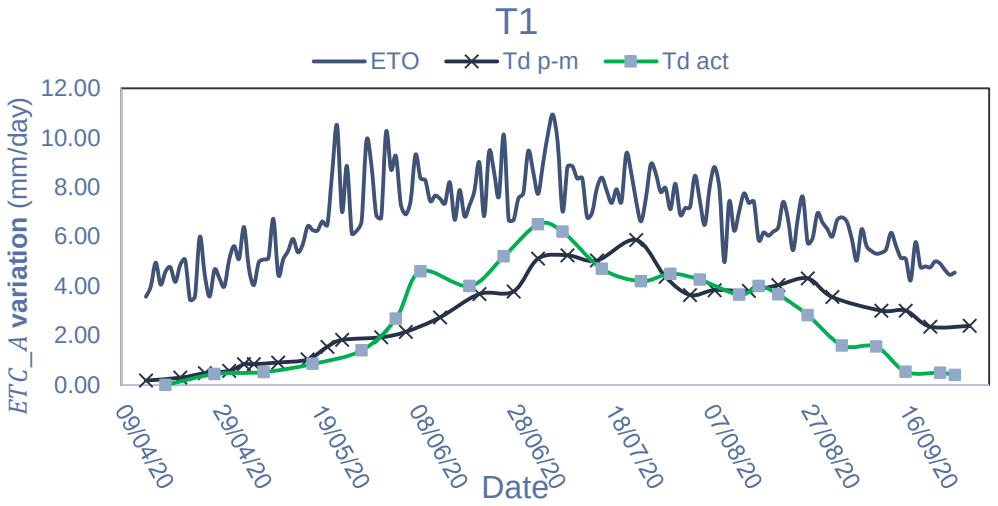


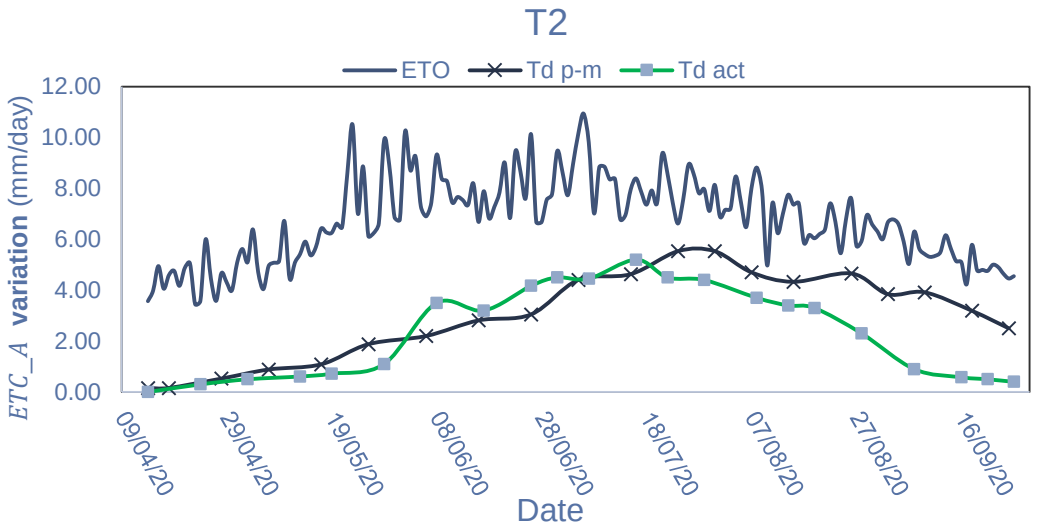
Actual evapotranspiration (ETC_A):

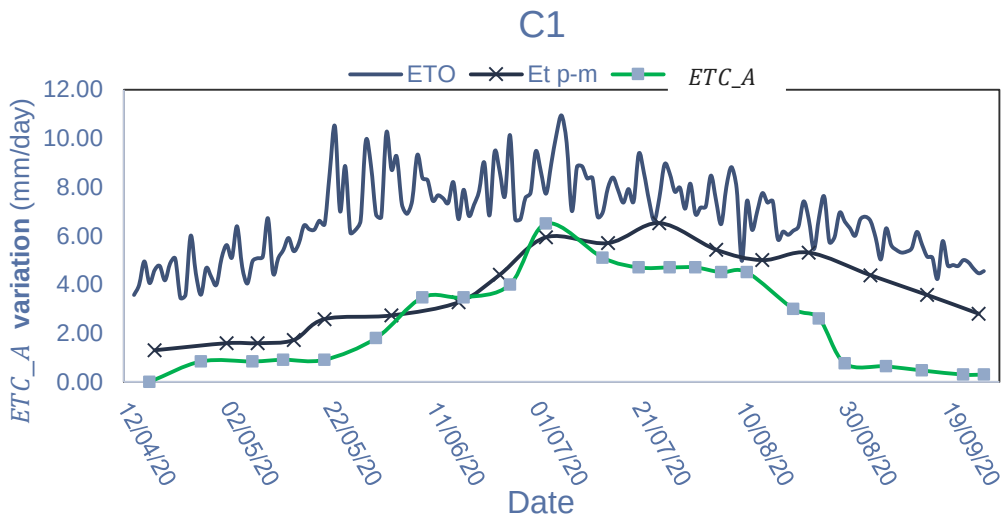


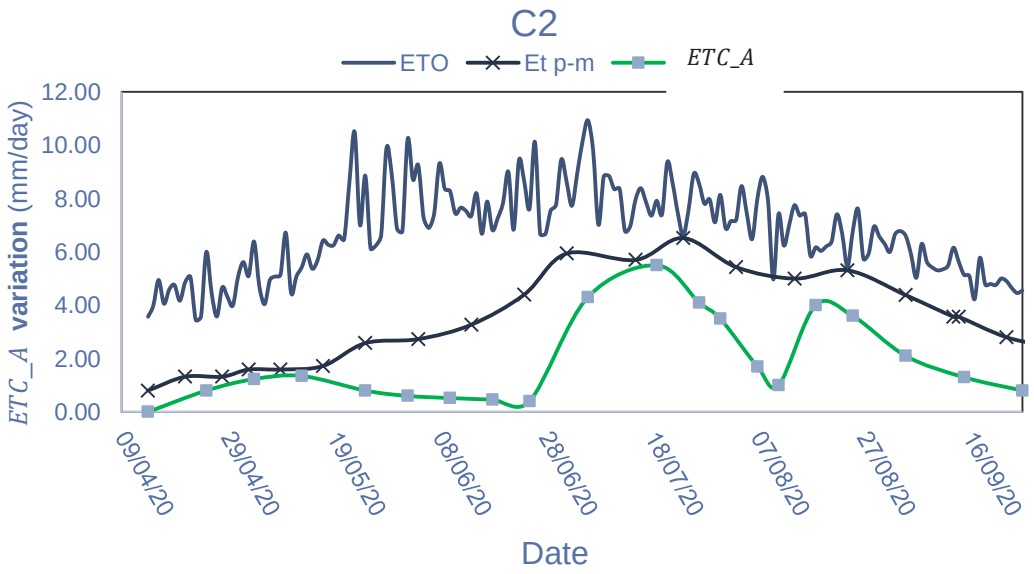


Actual evapotranspiration (ETC_A) variation:

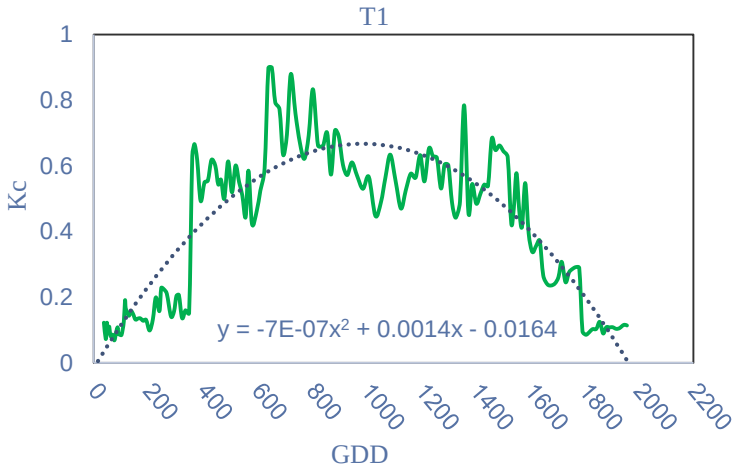


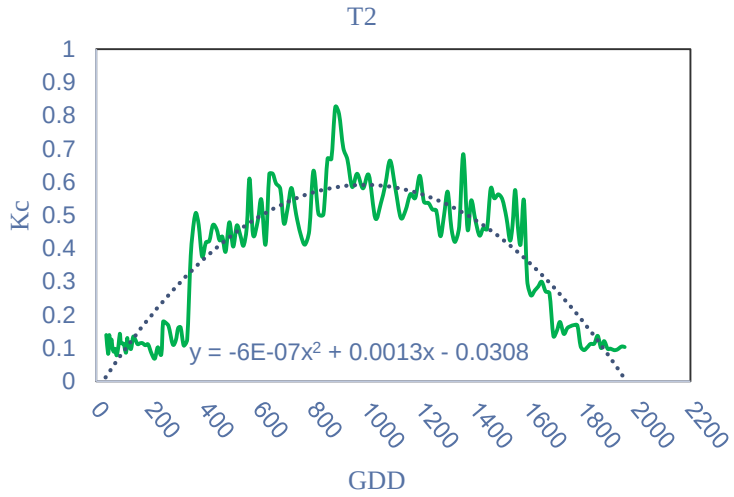


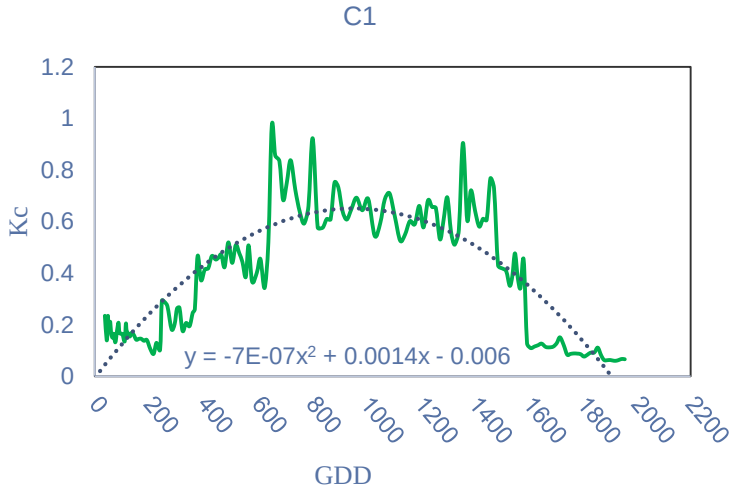


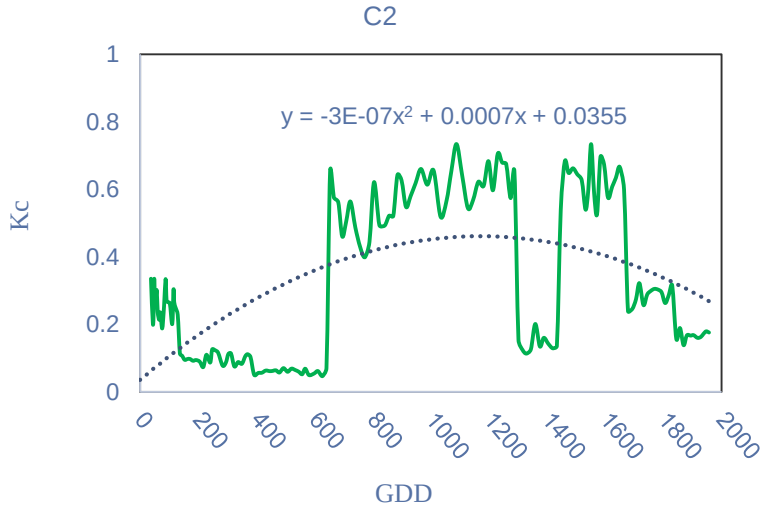


Crop coefficient (Kc) variation:

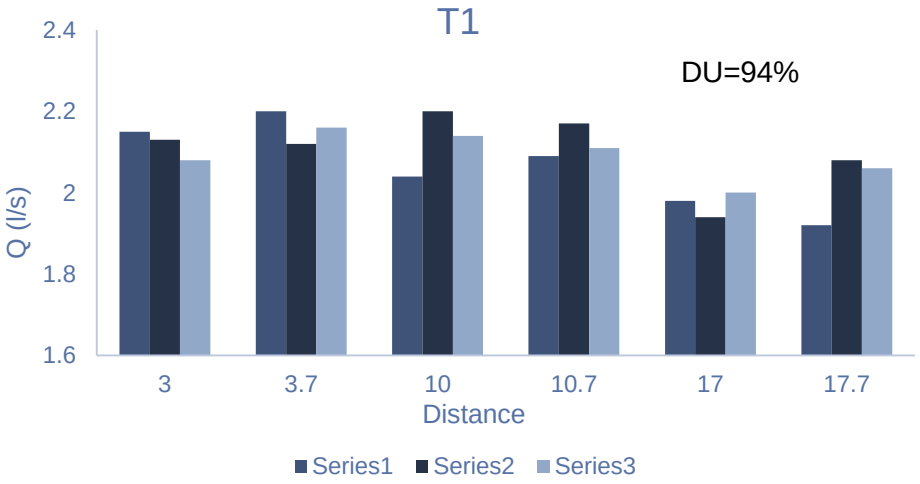


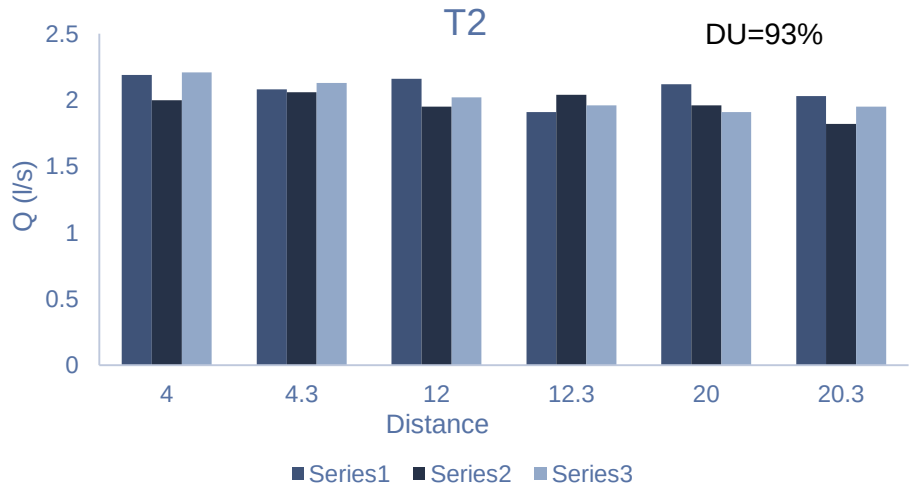






Distribution uniformity (DU) in treatments:





$$DU = \frac{\bar{q}_{25}}{\bar{q}} \times 100$$

Relation between Kc and LAI:

	TREATMENT	Number of clusters	Number of berries in cluster	Weight of 100 berries (gr)	Cluster length (cm)	Yield (ton/ha)	WP_I (Kg/m3)	WP_{ETC_A} (Kg/m3)	ETC_A (m3)
Vineyard A	**T1**	39^{a}	343^{a}	109^{c}	27^{a}	26.4^{a}	7.1^{a}	5.7^{a}	4631
	C1	33^{ab}	312^{a}	106^{c}	23^{ab}	21.3^{b}	4.9^{b}	4.9^{a}	4346
Vineyard B	**T3**	46^{a}	251^{a}	140^{a}	24.8^{a}	23.9^{a}	7^{a}	5.5^{a}	4345
	C3	33^{b}	240^{a}	139^{a}	24.1^{b}	15.2^{b}	3.7^{b}	4.6^{b}	3304

Remarks

- ETC_A was higher under SDI where higher WP concluded.
- SDI improved physiological characteristics of vineyards including number of clusters, number of berries in cluster, cluster length and berries weight.
- SDI has concluded a feasible irrigation method for vineyards with higher productivity.

Thank You For Your Attention!