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Effect of Water Regime and Soil Maintenance Mode on Vegetative Growth and Peach Tree Production

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ABSTRACT

The peach tree is a very water-demanding species that is affected by water stress, which is worsening due to global warming. The soil environment is also influenced by tillage and cropping methods, which affect the water content, temperature, aeration, and organic matter of the soil. Weed control is one of the most crucial cultural practices in arboriculture since weeds can compete with fruit trees for resources. This paper aims to measure the impact of water stress combined with different soil maintenance methods on vegetative growth and peach tree production. Different evapotranspiration conditions (ETc) were used. Two irrigation doses R1 (80% of ETc) and R2 (100% of ETc) were combined with three soil maintenance modes T1 (Sapping), T2 (Sickle tillage), and T3 (Chemical maintenance). The findings highlighted water stress reduces the growth and development of the peach tree but did not have a significant impact on yield when the irrigation dose was reduced by 20%. The sapping and sickle maintenance modes recorded the best results for most of the parameters, while the chemical maintenance mode had a positive effect on the total number of fruits and yield under the 100% of ETc water regime.

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1. INTRODUCTION

Fruit is one of the important foods in our life, making many researches been developed to increase quality and quantity of fruits (Mudzakir *et al*., 2022; Jelita *et al*., 2023; Hitalia *et al*., 2021; Magno *et al*., 2022; Silverio & Ramoran, 2022; Sitanggang *et al*., 2021a; Trianadewi *et al*., 2023; Sitanggang *et al*., 2021b; Silverio & Ramoran, 2022; Anshar *et al*., 2021). The peach is a fruit that is highly valued by consumers for its attractive fragrance, savory taste, and digestive quality. It is also in high demand in the national and international markets (Aguayo-Mendoza *et al*., 2020). However, the peach tree, which is a very water-demanding species, is affected by water stress, which is worsening due to global warming. To increase yield and enhance fruit quality farmers have started to explore alternate ways to reduce the effects of climate change (Rahmati *et al*., 2018). Production techniques are constantly evolving to adapt to changing ecological, social, and political framework conditions, while farmers face a major challenge and need forward-looking strategies to maintain their long-term production (Parmesan *et al*., 2006; Edwards *et al*., 2016).

In supporting the fruit production, soil structure has been well-research (Martin & Rahmat, 2017; Rahayu, 2019; Mutolib *et al*., 2023; Ebulue, 2023a; Ebulue & Ebulue, 2022; Ebulue 2023b; Hirawan *et al*., 2022). The soil structure, which influences the quantity and quality of the crop produced, can be damaged by excessive loads or improper tillage. Soil factors such as water availability, nutrient content, temperature, aeration, and organic matter are also affected by tillage and cropping methods. A decision support tool is required to estimate and analyze field conditions so that tillage activities are carried out at the proper time to achieve the greatest outcomes (Al-Kaisi *et al*., 2005; McGonigle *et al*., 1990). This will increase the soil structure during planting (Edwards *et al*., 2016; Bryla *et al*., 2005).

In addition to soil, weed control is one of the most fundamental cultural practices in arboriculture since weeds can compete with fruit trees for resources. Thus, arborists are increasingly resorting to regulating the invasion of weeds in the row, for several reasons is the weed flora can negatively influence yield and quality due to the competition it exerts on the crop plant in terms of water and nutrients (Din *et al*., 2016; Abouatallah *et al*., 2012). This makes weed becomes important to be considered in research (Malaguial *et al*., 2021). These negative effects are more pronounced in young plantations, because the root system of the plants is not well developed yet, while they require an adequate supply of nutrients and water for their good vegetative growth. That is the main reason for the important consideration regarding water and nutrients (Fatimah *et al*., 2018). Studies have shown that the competition exerted by weeds on the tree row can adversely affect the fruit size and tree growth (Mirás-Avalos *et al*., 2013). A certain degree of weed ground cover can be tolerated without negative consequences for the crop, but this depends on the age of the trees, the location of the plot, the soil structure, and the rainfall pattern. It is therefore difficult to give a general rule that is valid in all situations. In addition to these reasons that favor weed regulation, another aspect that can be important, especially during late frosts in spring should be mentioned. A bare ground loses much more heat by radiation than a vegetated surface (Zheng *et al*., 2014; Kladivko, 2001). Although this radiation does not warm the trees in the row, its effect can provide a few degrees that will protect the flowers during frosty nights (Kladivko, 2001).

This paper aims to measure the impact of water stress combined with different soil maintenance methods on vegetative growth and peach tree production. Different evapotranspiration conditions (ETc) were used. Two irrigation doses R1 (80% of ETc) and R2 (100% of ETc) were combined with three soil maintenance modes T1 (Sapping), T2 (Sickle tillage), and T3 (Chemical maintenance). The findings highlighted water stress reduces the growth and development of the peach tree but did not have a significant impact on yield when the irrigation dose was reduced by 20%. The sapping and sickle maintenance modes recorded the best results for most of the parameters, while the chemical maintenance mode had a positive effect on the total number of fruits and yield under the 100% of ETc water regime.

2. METHODS

The current study was carried out during the 2018–2019 agricultural season, in an orchard located 14 km from Meknes and 21 km from Ain Jemaa, at an altitude of 488 m, a latitude of N is the 33°54 '46.5 and longitude of W is the 5°39'26.5 in the Sais plain (Fez-Meknes region). The plant material consisted of the peach variety Agate Monag grafted on the GF 677 rootstock (Conejero *et al*., 2011). The orchard was planted in 2014; the management adopted a double Y goblet, with a density of 666 trees/ha corresponding to a spacing of 3-meter between trees and 5-meter between rows. The trial involved 42 trees spread over 2 rows of planting (i.e., 21 trees per row). For each row, one of the two irrigation doses was combined with the three soil maintenance modes applied randomly for each block. The controlled trees were 9 per row. Thus, the experimental design adopted was a randomized block design in which each treatment appeared once in each block because the study concerned two factors (irrigation and soil maintenance) (Guan *et al*., 2014). Given that we could not distribute one of the factors completely at random in all the units of the block, we developed a "Split-plot" design (Zhang *et al*., 2021; Lisiecka *et al*., 2011), which consisted of studying two variable factors with three repetitions (r = 3) (**Table 1**). In short, we used different evapotranspiration conditions (ETc):

(i) The first factor is the Water regime variable at p = 2 levels R1 (80% of ETc) and R2 (100% of ETc);
(ii) The second factor is the Soil maintenance methods at q = 3 levels T1 (Sapping), T2 (Sickle tillage) (21), and T3 (Chemical maintenance).

The plot was divided into 3 blocks according to the first factor (water regime), with an equal number of trees for each block (six trees per regime per block). The second factor (Soil maintenance) was randomized within sub-blocks. Thus, each block has a random allocation of the treatments (T1, T2, and T3). Each sub-block contained two trees that received the same soil maintenance method and water regime. Statistical analysis of the 2018 and 2019 data was carried out using the Statistical Package for the Social Sciences (SPSS) software, and the resulting data were subjected to ANOVA (Analysis of Variance). The significance of the differences between the means was tested by the Student, Newman, and Keuls (S-N-K) multiple comparisons of means test at the 5% threshold.

Table 1. Illustration of the "Split-plot" design used in the experiment.

Water Regime	Bloc 1	Bloc 2	Bloc 3
R1	*T1 T2 T3*	*T2 T3 T1*	*T3 T1 T2*
R2	*T1 T3 T2*	*T3 T1 T2*	*T3 T2 T1*

Note: R1 is 80% of ETc, and R2 is 100% of ETc. T1 is the Sapping, T2 is the Sickle tillage, and T3 is the Chemical maintenance.

3. RESULTS AND DISCUSSION

3.1. Effects of water Regime and Soil Maintenance Mode on Vegetative Parameters

Several parameters are in the following:

(i) Shoot length. Statistical analysis of shoot length of the year measurements revealed no significant effects of water regime, soil maintenance mode, or their interaction on the growth of these shoots. The longest shoots (18.71 cm) were recorded in trees managed under the *R2* water regime (100% of ETc) combined with the sapping soil maintenance mode, while the shortest shoots (15.13 cm) were recorded in trees managed under the *R1* water regime (80% of ETc) combined with the same soil maintenance mode (**Table 2**).

(ii) Shoot diameter. Statistical analysis of shoot diameter of the year measurements revealed no significant effect of water regime or soil maintenance mode on the growth of these shoots. However, the interaction between the water regime and soil maintenance mode had a significant effect on the increase in shoot diameter. The *R1* water regime recorded the highest averages of 0.81 and 0.82 cm, respectively, in combination with the sickle tillage mode and with chemical treatment; the lowest average was recorded with the sapping soil maintenance mode. For the *R2* water regime, the highest value of 1.4 cm was attributed to the sapping soil maintenance mode, and the lowest value of 0.68 cm to the chemical treatment mode (**Table 2**).

(iii) Leaf area. The leaf area was not affected by the water regime, soil maintenance mode, or their interaction (**Table 2**). The average values of leaf area were similar for both water regimes. For the *R1* water regime, the leaf area ranged from 11861.42 mm² in trees whose soil was chemically maintained to 12146 mm² in trees maintained with a sickle. For trees that received an irrigation dose of 100% (*R2*), the leaf area was larger in trees whose soil was maintained chemically (12180.83 mm²) and with a sickle (12166.75 mm²); it was smaller in trees that underwent sapping tillage with an average area of 11831.75 mm².

Table 2. Effects of the soil maintenance mode under two water regimes on vegetative parameters of peach tree (agricultural year 2018-2019).

Parameter	*R1*			*R2*		
	T1	***T2***	***T3***	***T1***	***T2***	***T3***
SL	16.70 ᵃ	15.13 ᵃ	17.59 ᵃ	15.54 ᵃ	18.71 ᵃ	17.00 ᵃ
SD	0.82 ᵃ	0.67 ᵃ	0.81 ᵃ	0.68 ᵃ	1.40 ᵃ	0.76 ᵃ
LA	11861.42 ᵃ	12057.17 ᵃ	12146.00 ᵃ	12180.83 ᵃ	11831.75 ᵃ	12166.75 ᵃ

Note: *SL* is the Shoot length in cm, *SD* is the Shoot diameter in cm, and *LA* is the Leaf area mm². *R1* is the 80% of ETc, *R2* is the 100% of ETc, *T1* is the Sapping, *T2* is the Sickle tillage, and *T3* is the Chemical maintenance. In each line the values followed by the same letter are not significantly different at 5% probability according to the student–Newman–Keuls test.

3.2. Effects of Water Regime and Soil Maintenance Mode on Physiological Indicators

Several parameters are in the following:

(i) Chlorophyll content. The statistical analysis of the average values of the chlorophyll content revealed that the soil maintenance mode and the interaction between the water regime and the soil maintenance mode did not have a significant effect on this parameter. In addition, for the trees subjected to the *R1* water regime, the chlorophyll content values ranged from a minimum of 15.13 CCI for the trees with sickle-maintained soil to a maximum of 19.65 CCI for the trees with sapping-maintained soil. For the trees subjected to the *R2* water regime, the chlorophyll content values ranged from a minimum of 19.36 CCI for the trees with chemically maintained to a maximum of 20.61 CCI for the trees with sapping-maintained mode (**Table 3**).

(ii) Temperature difference. The statistical analysis revealed that the soil maintenance mode had a highly significant impact on the temperature difference ($T_{air} – T_{foliage}$) between the air and the foliage, while the interaction between the water regime and soil maintenance

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mode did not affect this parameter significantly. According to the results of the analysis of variance results, the trees that received an irrigation dose of 80% of ETc recorded a temperature difference r from 1.06 °C for sapping tillage mode to 2.87°C for sickle tillage mode (**Table 3**). In addition, the values of the temperature difference between the air and the foliage ranged from 0.25 to 1.73°C respectively for the sapping tillage mode and the sickle tillage mode, for the trees that were subjected to the 100% of ETc water regime. The student–Newman–Keuls (SNK) test revealed two homogeneous groups. The first group consisted of the sapping soil maintenance mode with averages of 1.06°C under the *R1* water regime and 0.25°C under the *R2* water regime. The second group consisted of the chemical soil maintenance mode with averages of 2.22 °C under the *R1* water regime and 1.04°C under the *R2* water regime, and sickle maintenance mode with an average of 2.87 °C under the *R1* water regime and 1.73°C under the *R2* water regime.

Table 3. Effects of soil maintenance mode under two water regimes on physiological indicators of peach tree (agricultural year 2018-2019).

Parameter	*R1*			*R2*		
	T1	*T2*	*T3*	*T1*	*T2*	*T3*
CCI	16.07 [a]	19.65 [a]	15.13 [a]	19.36 [a]	20.61 [a]	20.32 [a]
$T°_{A-F}$	2.22 [a]	1.06 [b]	2.87 [a]	1.04 [a]	0.25 [b]	1.73[a]

Note: *CCI* is the Chlorophyll content index, and *FT* is the Foliage temperature. *R1* is the 80% of ETc, *R2* is the 100% of ETc, *T1* is the Sapping, *T2* is the Sickle tillage, and *T3* is the Chemical maintenance. In each line the values followed by the same letter are not significantly different at 5% probability according to the student–Newman–Keuls test.

3.3. Effects of water regime and soil maintenance mode on production parameters

Several parameters are in the following:

(i) Total number of fruits. Statistical analysis showed a significant effect of soil maintenance mode on the total number of fruits per tree, but not of water regime or the interaction between water regime and soil maintenance mode. The total number of fruits ranged from an average of 148.67 fruits (sapping tillage) to an average of 164.5 fruits (chemical treatment) for trees irrigated with 80% of Etc. (**Table 4**). For trees irrigated with 100% of ETc, the number of fruits per tree varies ranging from 140 fruits (sapping tillage) to 177.33 fruits (Sickle tillage). The SNK test revealed two homogeneous groups. The first group consisted of the soil maintenance mode by sapping, with averages of 148.67 fruits for the *R1* water regime and 140 fruits for the *R2* water regime.

(ii) Fruit yield per tree. The findings showed that the style of soil maintenance had a substantial impact on the average fruit output per tree. In addition, water regime and the interaction between water regime and soil maintenance did not affect yield. The yield varied from 22.3 kg/tree (sapping tillage) to 24.68 kg/tree (chemical treatment) for trees irrigated with 80% of ETc (**Table 4**). For trees irrigated with 100% of ETc, the yield varied from 21 kg/tree (sapping tillage) to 26.6 kg/tree (Sickle tillage). The average yield was 24 kg/tree or 16 tons/ha. The SNK test revealed two homogeneous groups. The first group consisted of the soil maintenance mode by sapping, with averages of 22.3 kg/tree under the 80% of ETc regime and 21 kg/tree under the 100% of ETc regime. The second group consisted of the soil maintenance modes by chemical and by sickle, with averages of 24.68 and 24.08 kg/tree under the 80% of ETc regime, and 25.05 kg/tree and 26.6 kg/tree under the 100% of ETc regime, respectively.

(iii) Fruit weight at harvest. Statistical analysis revealed a significant effect of water regime and the interaction between water regime and soil maintenance mode on fruit weight

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at harvest, but not of soil maintenance mode alone. The fruit weight varied from 142.2 g (sapping tillage) to 152 g (chemical treatment) for trees irrigated with 80% of ETc, and from 153.6 g (Sickle tillage) to 179 g (sapping tillage) for trees irrigated with 100% of ETc (**Table 4**).

(iv) Fruit flesh weight. The results of the analysis of variance revealed a highly significant effect of the interaction between water regime and soil maintenance mode on fruit flesh weight, while the water regime and soil maintenance alone did not affect this parameter. The fruits with the highest average flesh weight were obtained from trees irrigated with 100% of ETc, with averages ranging from 146.8 g (Sickle tillage) to 172.1 g (sapping tillage) (**Table 4**). On the other hand, the fruits from trees irrigated with 80% of ETc had the lowest average flesh weight, ranging from 136 g (sapping tillage) to 145.3 g (chemical treatment).

(v) Fruit Stone Weight. Statistical results showed no significant effect of any factor on fruit stone weight. However, it was higher in trees that received the 100% of ETc irrigation dose, with averages ranging from 6.8 g for the soil maintenance mode by sickle to 6.9 g for the soil maintenance modes by chemical and sapping (**Table 4**). The trees irrigated with 80% of ETc, the average stone weight ranged from 6.1 g for the soil maintenance mode by sapping to 6.7 g for the soil maintenance mode by chemical.

(vi) Fruit length at harvest. Mean fruit length at harvest was not affected by any factor. Mean fruit length values fluctuated between a minimum of 61.6 mm for the soil maintenance mode by sapping and a maximum of 64.5 mm for the soil maintenance mode by chemical for peaches from trees irrigated with 80% of ETc (**Table 4**). They also varied, between a minimum of 64.4 mm for the sickle tillage mode and a maximum of 66.2 mm for the sapping tillage mode in trees irrigated with 100% of ETc.

(vii) Fruit diameter at harvest. Statistical analysis of the results revealed a significant effect of the water regime on fruit diameter at harvest, but it is not on soil oil maintenance mode or the interaction between the water regime and soil maintenance mode. The average fruit diameter recorded at harvest varies from 63.6 mm for the soil maintenance mode by sapping and 65.3 mm for the soil maintenance mode by chemical for peach trees irrigated with 80% of ETc, while it ranged from 66.8 mm for the sickle tillage mode and 68.80 mm for the sapping tillage mode for peach trees irrigated with 100% of ETc (**Table 4**).

Table 4. Effects of the soil maintenance mode under two water regimes on production parameters of peach tree (agricultural year 2018-2019).

Parameter	*R1*			*R2*		
	T1	***T2***	***T3***	***T1***	***T2***	***T3***
FN	164.50 [a]	148.67 [b]	160.50 [a]	167.00 [a]	140.00 [b]	177.33 [a]
FY	24.68 [a]	22.30 [b]	24.08 [a]	25.05 [a]	21.00 [b]	26.60 [a]
FWH	152.00 [a]	142.20 [a]	149.1 [a]	164.20 [a]	179.00 [a]	153.60 [a]
FFW	145.30 [a]	136.00 [a]	142.7 [a]	157.30 [a]	172.10 [a]	146.80 [a]
FSW	6.70 [a]	6.10 [a]	6.3 [a]	6.90 [a]	6.90 [a]	6.80 [a]
FFL	64.50 [a]	61.60 [a]	62.9 [a]	65.00 [a]	66.20 [a]	64.40 [a]
FD	65.30 [a]	63.60 [a]	64.2 [a]	67.40 [a]	68.80 [a]	66.80 [a]

Note: *FN* is the Fruit number, *FY* is the Fruit yield in kg/tree, *FWH* is the Fruit weight at harvest in grams, *FFW* is the Fruit flesh weight in grams, *FSW* is the Fruit fresh weight in grams, *FL* is the Fruit length in mm, and *FD* is the Fruit diameter in mm. *R1* is the 80% of ETc, *R2* is the 100% of ETc, *T1* is the Sapping, *T2* is the Sickle tillage, and *T3* is the Chemical maintenance. In each line the values

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followed by the same letter are not significantly different at 5% probability according to the Student–Newman–Keuls test.

(viii) Fruit color. The frequency of fruit coloration depended on the combinations between the water regime and soil maintenance mode (**Figure 1**). The statistical analysis showed a slight difference in fruit color according to the treatments. The *C3* and *C2* colors were present in a large percentage, while the *C1* and C5 colors were rare in all treatments, except for the soil maintenance mode by sickle under 100% of ETc water regime where the *C4* color represented 24%. The *C1* color reached a significant value in trees whose soil maintenance mode was carried out by chemical or by sickle and which received the irrigation dose of 80% of ETc.

Figure 1. Classification of peach fruit by color (C1, C2, C3, C4, and C5).

3.4. Effects of Water Regime and Soil Maintenance Mode on Qualitative Parameters

Several parameters are in the following:

(i) Sugar content

(ii) The analysis of variance revealed no significant effect of the irrigation regime, the soil maintenance mode, or the interaction between them on sugar content. The Brix degree of trees irrigated with 80% of ETc ranged from 12.5 °Bx for the chemical and sapping soil maintenance modes to 12.63 °Bx for the soil maintenance mode by sickle (**Table 5**). For trees subjected to the 100% of ETc irrigation dose, the Brix degree varies between a minimum of 12.33 °Bx for the soil maintenance mode by sickle and a maximum of 12.67 °Bx for the soil maintenance mode by chemical.

(iii) Total acidity. The interaction between soil maintenance mode and water regime had a very significant impact on total acidity. The laboratory analysis of one liter of peach quantified the total acidity, which ranged from 2.7 g/L for the soil maintenance mode by sapping to 3 g/L for the soil maintenance mode by chemical for trees having followed a water regime of 80% of ETc (**Table 5**). The trees irrigated with 100% of ETc had higher levels, varying between 3.2 g/L for the soil maintenance modes by chemical and by sapping and 3.8 g/L for the soil maintenance modes by sickle. The SNK test of comparison of means revealed two homogeneous groups. The first group consisted of the soil maintenance modes by chemical and by sapping for trees irrigated with both water regimes (80% and 100% of ETc), while the second group consisted of the soil maintenance modes by chemical and by sickle for trees irrigated with both water regimes.

(iv) Sugar/acidity ratio. Statistical analysis revealed a significant effect of the water regime on the sugar/acidity ratio, while soil maintenance mode and the interaction between them

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had no significant effect. The Sugar/acidity ratio recorded in the peaches from the trees selected for the experiment varied between an average of 42.1% for the soil maintenance mode by chemical and an average of 45.8% for the soil maintenance mode by sickle under the water regime of 80% of ETc (**Table 5**). For the 100% of ETc water regime, the values varied between an average of 32.7% for the soil maintenance mode by sickle and an average of 40% for the soil maintenance mode by chemical.

(v) pH condition. Statistical analysis did not show a significant effect on the pH of peach juice. The pH values obtained were around 3.7 for the soil maintenance mode by sapping and 3.8 for the soil maintenance mode by chemical, for peaches from trees irrigated with 80% of ETc (**Table 5**). For peaches from trees irrigated with 100% of ETc, the pH varied between a minimum of 3.7 for the soil maintenance mode by sapping and 3.8 for the soil maintenance mode by sickle.

(vi) Juice content. Analysis of variance showed that juice content was not significantly affected by any factor. The average percentage of peach juice depended on the different methods of soil maintenance used in combination with the water regimes. The juice content was logically higher in peaches from trees irrigated with 100% of ETc, varying slightly from 53% for the soil maintenance mode by sickle and 54.5% for the soil maintenance mode by chemical (**Table 5**). As for the peaches from trees subjected to the 80% of ETc water regime, the juice content varied between 43.6% for the soil maintenance mode by sickle and 45.6% for the soil maintenance mode by chemical.

Table 5. Effects of the soil maintenance mode under two water regimes on qualitative parameters (agricultural year 2018-2019).

Parameters	***R1***			***R2***		
	T1	***T2***	***T3***	***T1***	***T2***	***T3***
SS	12.5 [a]	12.5 [a]	12.6 [a]	12.7 [a]	12.6 [a]	12.3 [a]
TA	3.0 [ab]	2.7 [b]	2.8 [a]	3.2 [ab]	3.2 [b]	3.8 [a]
SAR	4.2 [a]	4.6 [a]	4.6 [a]	4.0 [a]	3.9 [a]	3.3 [a]
pH	3.8 [a]	3.7 [a]	3.8 [a]	3.7 [a]	3.7 [a]	3.8 [a]
JC	45.6 [a]	44.5 [a]	43.6 [a]	54.5 [a]	53.1 [a]	53.0 [a]

Note: *SS* is the Soluble sugar in °Bx, *TA* is the Titratable acidity in g/L, *SAR* is the Sugar/acid ratio, pH is the Potential of Hydrogen, and *JC* is the Juice content in %. *R1* is the 80% of ETc, *R2* is the 100% of ETc, *T1* is the Sapping, *T2* is the Sickle tillage, and *T3* is the Chemical maintenance. In each line the values followed by the same letter are not significantly different at 5% probability according to the test Student–Newman–Keuls test.

3.5. Discussion

The findings confirm the effect of water stress on the growth and development of the peach tree and suggest that the soil maintenance method has a favorable impact on some parameters. The values recorded under the 80% of ETc water regime showed an improvement in fruit length and diameter and titratable acidity under the effect of the soil mode of maintenance by sapping. The soil maintenance mode by sickle recorded an improvement in the number of fruits and yield, while the soil maintenance mode by chemical had a positive impact, like sapping, on fruit length and diameter as well as on sugar content and titratable acidity. The results of a study based on the effects of rotary tillage on biomass and grain yield through controlling root growth and nutrient uptake in summer maize are similar to those of the impact of sapping maintenance on vegetative parameters. The present study showed that the 100% of etc water regime recorded the best values for the other parameters (Guan et al., 2014).

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Soil maintenance by sapping and sickle are therefore more beneficial than chemical weeding. This observation is broadly consistent with the conclusions of the work of Gaviglio in 2006 where he stated that mechanical tillage is the best soil maintenance strategy to ensure the control and good management of the orchard. In addition, this mode allows for avoiding the systematic use of herbicides, which also reduces the number of chemical interventions and inputs.

Regarding production parameters, chemical treatment increased the number and weight of fruits per tree and improved yield and fruit acidity (Latiza *et al*., 2022; Altaf *et al*., 2022; Mennan *et al*., 2006). In general, similar results were obtained by Nagacevschi and Gritcan (2016), where the average production is higher in trials treated with mulch herbicide that reaches up to 16 kg/tree. Not only the number of fruits per tree is important, but also the weight and the size of the fruit indicate a suitable quantitative and qualitative quality for a good appreciation of the products (Nagacevschi & Gritcan, 2016).

The results concerning the quality parameters obtained in this study showed that the water regime can manipulate parameters, such as Brix degree, total acidity, and juice content. These results are in agreement with other experiments carried out by Lorette et al in 2007, where they explained that the state of stress in the tree causes the accumulation of soluble sugars (increase in Brix degree) in the fruits, which helps the plant to cope with external environment stresses (Lorrette et al., 2007; Razouk et al., 2013).

4. CONCLUSION

The fact that reducing the irrigation rate by 20% compared with the tree's needs did not affect yield highlights the impact of water stress on peach tree growth and development. The combination of three soil maintenance modes with two water regimes showed that the soil maintenance modes by sapping and stickle recorded the best results for most of the parameters, while the effect of the soil maintenance mode by chemical stood out, especially under 100% of ETc water regime on total number of fruits and consequently on yield. However, the present study has certain limitations that will need to be considered in future research. Firstly, the experiment was conducted in a single location and for a single peach variety, which may limit the generalizability of the results to other contexts and cultivars. Secondly, the experiment did not consider other factors likely to affect peach tree growth and quality, such as pest and disease control, pruning, fertilization, and climatic conditions. Consequently, future research should replicate the experiment in different locations and with different peach varieties and include other agronomic and environmental factors likely to influence the response of peach trees to water stress and soil maintenance practices.

5. AUTHORS' NOTE

The authors declare that there is no conflict of interest regarding the publication of this article. The authors confirmed that the paper was free of plagiarism.

6. REFERENCES

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