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Triple-row system with a wider drip-line lateral spacing for two drip-irrigated sweet corn cultivars

Abstract – The objective of this work was to evaluate the use of both single- and triple-row production systems in two drip-irrigated sweet corn cultivars under dry Mediterranean climate conditions. A two-year field experiment (2017 and 2018) was carried out in clay loam soil. The following three combinations spacing between crop rows and drip-line lateral spacing, with three replicates for each cultivar, were applied: single rows at 75 cm spacing, with one drip-line lateral spacing for each crop row; single rows at 75 cm row spacing, with one drip-line lateral spacing for three crop rows; and triple rows, 37.5 cm apart, on 225 cm centers, with one drip-line lateral spacing for each triple row. The responses of both cultivars were similar. In addition, husked cob yield and irrigation water use efficiency (IWUE) significantly reduced as the drip-line lateral spacing increased in single rows. Yield loss was 35.2% in relation to the 75 cm spacing. However, when the triple-row system with 225 cm drip-line lateral spacing was adopted, yield and IWUE were noticeably improved, and the yield loss was moderated to 16%, due to the improvement in soil water conditions in the triple rows. For improved yield and IWUE, the combination of triple rows with the 225-cm drip-line lateral spacing is an efficient drip-irrigated planting pattern for sweet corn production in dry Mediterranean climate conditions.

Index terms: *Zea mays*, clay loam soil, husked cob yield, irrigation water use efficiency, single-row system.

Sistema de fileira tripla com maior espaçamento lateral para duas cultivares de milho-doce irrigadas por gotejamento

Resumo – O objetivo deste trabalho foi avaliar o uso de sistemas de produção em fileira única e tripla para duas cultivares de milho-doce irrigadas por gotejamento, em condições de mediterrâneo seco. Um experimento de campo foi realizado por dois anos (2017 e 2018) em solo argiloso. As seguintes três combinações de espaçamento entre culturas e espaçamentos laterais foram utilizadas, com três repetições para cada cultivar: linhas simples com espaçamento de 75 cm nas linhas, com uma lateral para cada linha de cultivo; linhas simples com espaçamento entre linhas de 75 cm, com uma lateral, para três linhas de cultivo; e linhas triplas, separadas por 37,5 cm, em centros de 225 cm, com uma lateral para cada linha tripla. As respostas de ambas as cultivares foram semelhantes. Além disso, o rendimento da espiga descascada e a eficiência de uso da água de irrigação (IWUE) reduziram-se significativamente à medida que o espaçamento lateral aumentava em fileiras simples. A perda de rendimento foi de 35,2% em relação ao espaçamento de

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75 cm. No entanto, quando o sistema de linha tripla, com espaçamento lateral de 225 cm, foi adotado, o rendimento e o IWUE melhoraram visivelmente, e a perda de rendimento foi moderada para 16%, em razão da melhoria nas condições da água no solo, nas linhas triplas. Para melhores rendimento e IWUE, a combinação de linhas triplas com o espaçamento lateral de 225 cm é um padrão eficiente para o plantio irrigado por gotejamento de milho-doce, em condições de clima mediterrâneo seco.

Termos para indexação: *Zea mays*, solo argiloso, rendimento de espigas descascadas, eficiência de uso da água de irrigação, sistema de fileira única.

Introduction

Crop production and in-field water use efficiency have been proved to be enhanced under drip-irrigation methods compared with others (Goyal, 2014, 2015; Venot et al., 2017). Nonetheless, one of the main disadvantages of this technique is its high initial cost of installation, limiting its widespread adoption by the farmers. The pipes account for about 45% of the total cost, but only 30% for the irrigation control head (Phocaides, 2007).

In this context, reducing the number of drip-line laterals per unit area, by increasing the drip-line lateral spacing would be one of the most valuable practices for reducing the total costs (Himanshu et al., 2012; Couto et al., 2013; Chen et al., 2015; Zhou et al., 2017, 2018; Al-Hurmuzi & Topak, 2018). However, because of the lack of rainfall in dry regions, and the inability of drip irrigation with wider drip-line lateral spacing to wet the soil surface away from drip-line laterals, seed germination may be a problem, and the early growth period could be limited by water stress, especially in sandy soils and in soils with large cracks, which restricts the horizontal infiltration of drip irrigation as capillary barrier (Qi et al., 2020). In this case, excessive pre-planting irrigations will not be feasible, and a backup irrigation system is required to support seed germination. Even in regions showing reliable rainfall, the yield reduction due to row-to-row variation may increase under wider lateral spacing (Lamm et al., 1997; Bozkurt et al., 2006; Chen et al., 2015; Fischer et al., 2019; Lv et al., 2019).

The multiple-row pattern is a production system for planting crops in strips (ranges or bands) of two or more rows, and the spaces between the adjacent strips remain unplanted. The multiple-row production system has been used as a technique to improve crop yield in comparison to single-row system, for soybean (Bruns, 2011), sugarcane (Ehsanullah et al., 2011), groundnut (Mandal et al., 2019), onion and tomato (Wondatir & Belay, 2020), and corn (Bruns et al., 2012; Al-Hurmuzi & Topak, 2018). In multi-rows, the speed of canopy closure improves the light interception and, consequently, the plant growth rates, besides reducing weed competition and soil-water evaporation (Fanadzo et al., 2010; Liu et al., 2011; Saudy, 2013; Williams & Boydston, 2013).

The use of twin rows for drip-irrigated sweet corn production has been documented (Al-Hurmuzi & Topak, 2018; Mubarak, 2020). However, to the best of our knowledge, there is almost none available information on the combined use of triple rows with wider drip-line lateral spacing for sweet corn production. Under such planting arrangement, crop rows are brought closer and grouped into strips with triple rows, and one drip-line lateral serves each strip. Using one drip-line lateral for three crop rows reduces the number of drip-line laterals needed per unit area and, therefore, its initial cost, to a third, as compared with the conventional planting/drip-line pattern (one drip-line lateral for each crop row). Herein, a triple-row system is proposed for drip-irrigated sweet corn crop. Plants are planted in triple-rows, with one drip-line lateral located at the center of each strip. Under such planting and irrigation pattern, crop rows are closer to the wetting zone (drip-line laterals) than those of single-rows in the same drip-line lateral spacing. Therefore, drip-irrigated triple rows may improve the crop yield by reducing the row-to-row variation, so that crop production might be not insufficiently diminish to justify the high cost of a conventional, closer drip-line lateral spacing.

The objective of this work was to evaluate the use of both single- and triple-row production systems in two drip-irrigated sweet corn cultivars under the dry Mediterranean climate conditions.

Materials and Methods

Field experiments were implemented during 2017 and 2018 at the Agricultural Experiment Station, Deir Al-Hajar, Damascus Countryside in Syria (33°20'N, 36°26'E, at 600 m altitude). The hot and dry steppe climate, BSh climate, according to the

Köppen-Geiger's climate classification, dominates the study area (Kottek et al., 2006). The yearly potential evapotranspiration (ET_0) exceeds 2,000 mm (estimated using the FAO Penman-Monteith equation), and the annual precipitation is about 120 mm. Some meteorological data of the study site, which were collected during both tested growing seasons, and those for the past 20-year average are presented (Table 1). The soil is most likely Aridisols (classified as Camborthids), with a clay loam texture of 295 g kg^{-1} clay, 427 g kg^{-1} silt, 278 g kg^{-1} sand, 1.35 g cm^{-3} bulk density, and <1% organic matter, according to the wet oxidation method (Jackson, 1985).

Field experiments were carried out with the sweet corn (*Zea mays* L.) cultivars 'Silver Queen' and 'White Kokab' (a local cultivar). Two different row production systems with two different drip-line lateral spacing (75 and 225 cm) were studied for each cultivar. The experiments were arranged in a split-plot design with two corn cultivars as main plots, and three combinations of crop rows and drip-line lateral spacing as subplots, with three replicates. The treatments were evaluated as the following description. Treatment DS75 was performed in single-rows at 75 cm, with one drip-line lateral for each crop row, and the experimental unit contained five crop rows of 75 cm spacing and drip-line laterals. DS225 was performed in single-rows at 75 cm, with one drip-line lateral for three crop rows located at the central row; therefore, the drip-line lateral spacing was 225 cm; its experimental unit contained nine 75 cm rows, and three 225 cm drip-line laterals. DS225-T was performed in a triple-row system, with rows brought closer (37.5 cm) and grouped into strips (ranges or bands) with triple rows. In other words, corn was planted in triple rows with 37.5 cm apart, in 225 cm centers. The experimental unit contained three strips spaced at 225 cm apart, and one drip-line lateral served each triple row.

The length of each experimental unit was 5 m. The number of crop rows per hectare and, therefore, the plant density (about 67,000 plants ha^{-1}) were maintained equal for all treatments.

The field was traditionally prepared, that is, disked and ploughed before sowing. A sufficient spacing (about 2 m) was maintained between experimental units to minimize water intervention among treatments. Corn was sown on April 18th in 2017, and on April 3rd in 2018. Another lateral move irrigation system, which is available in the experimental station, was used early in each season, in order to germinate the seed. It was also used two times during the 1st month, with 100 mm water applied. After that, the drip irrigation treatments were applied. Lateral drip-lines of 16 mm diameter, with a built-in 40 cm emitter spacing of 4 L per hour discharge were used. The experimental field was fertilized in early winter, before each cropping season, with 46 kg ha^{-1} P_2O_5 as triple super phosphate. However, N fertilizer as urea (150 kg ha^{-1} N) was surface-applied as solution, in two equally split applications: at the sowing day, and two weeks later. Thus, all plants received the same quantities of both chemical fertilizers.

The initial, development, mid-season and late season growth stages for sweet corn crop were 20, 30, 40, and 10 days, respectively (Allen et al., 1998). The crop coefficient values were 0.3, 1.15, and 1.05, respectively, for initial, mid-season and late season periods. Daily crop water requirement (crop evapotranspiration,

Table 1. Some meteorological parameters for the study site during both growing seasons 2017 and 2018, and the average of last 20 years.

Year	Parameter	April	May	June	July
2017	T_{min} (°C)	9.7	14.4	17.2	20.6
	T_{max} (°C)	26.2	31.6	35.7	40.6
	T_{mean} (°C)	19.2	24.9	28.4	31.1
	RH (%)	63.1	57.9	56.3	56.0
	ET_0 (mm day^{-1})	5.7	7.6	9.0	10.3
	Rain (mm)	0.0	0.0	0.0	0.0
2018	T_{min} (°C)	10.0	15.6	18.2	19.8
	T_{max} (°C)	27.2	31.5	34.6	36.9
	T_{mean} (°C)	19.9	25.7	27.7	28.8
	RH (%)	54.8	51.5	59.6	55.6
	ET_0 (mm day^{-1})	6.8	7.8	8.8	10.3
	Rain (mm)	14	0.0	0.0	0.0
Last 20 years	T_{min} (°C)	10.1	14.1	17.6	19.3
	T_{max} (°C)	25.3	30.4	35.0	37.4
	T_{mean} (°C)	18.1	23.6	27.7	29.4
	RH (%)	60.9	56.5	56.3	60.7
	ET_0 (mm day^{-1})	5.6	7.5	9.4	10.4
	Rain (mm)	5.9	4.2	0.0	0.0

T_{min}: minimum temperature, T_{max}: maximum temperature, T_{mean}: average temperature, RH: relative air humidity, ET_0: reference evapotranspiration.

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ETc) was calculated by multiplying the daily ET_0 by Kc for each growth stage. The weekly sum of daily ETc values was used to adjust the schedule for the next week. All treatments received the same irrigation water depth (amount per unit area): about 753 in the 2017 season, and 700 mm in the 2018 season. However, because of different drip-line lateral spacing (DLLS), the treatments differed for irrigation durations, as calculated by the equation

$$\text{Irrigation time (hr)} = \frac{\text{DLLS(cm)} \times \text{emitter spacing(cm)} \times \text{irrigation water depth(mm)}}{10{,}000 \times \text{emitter rate(L/hour)}}$$

The durations of the total drip irrigation applied to the DS75, DS225, and DS225-T treatments were 49, 147, and 147 hours in the 2017 season, and 45, 135, and 135 hours in the 2018 season, respectively.

For the monitoring of soil-water content [θ(z)], access tubes of in-situ calibrated neutron scattering probe (Model 503 Hydroprobe, CPN International, Martinez, CA, USA) were installed in the crop rows only for 'Silver Queen' plots. Measurements were conducted about 72 hours after each irrigation. For both DS225 and DS225-T treatments, two soil profiles were probed: the nearest and the furthest rows from drip-line laterals. The total soil-water storage (SWS) from the soil surface to a specific depth was calculated as follows:

$$SWS = \int_0^{Zm} \theta(z)\,dz$$

in which: z is the soil depth (m); θ is the soil-water content ($cm^3\ cm^{-3}$); and Zm is the root zone depth (1.2 m).

In order to check soil-water stress in the root zone, the function for water stress response as suggested by Feddes et al. (1978) was used. That function is characterized by several root-water uptake parameters (h_2, h_3, and h_4). Root-water uptake is considered optimal between two pressure heads h_2 and h_3, whereas for soil-water pressure heads between h_3 and h_4, water uptake decreases. It is also considered to be zero for soil-water pressure heads less than the wilting point pressure head ($<h_4$). Volumetric soil-water contents corresponding to those root-water uptake parameters are 0.445, 0.232, and 0.136 $cm^3\ cm^{-3}$, respectively, for sweet corn crop and for the clay loam soil texture, using the van-Genuchten-Mualem relationship (van Genuchten, 1980). Soil-water storages corresponding to these values and changes over time, in observed SWS, are jointly plotted for the purpose of comparison.

The fresh marketable product was harvested at the milky stage, with seed-water content of about 70-75% occurring 100 days after sowing, for both cultivars and growing seasons. A 200 cm row length (10 plants) from the center of each plot was chosen. For both DS225 and DS225-T treatments, two adjacent rows corresponding to the nearest and the furthest rows from drip-line lateral were chosen to calculate the integrated measured parameters, and to assess row-to-row variations for yields. Weight, length, and diameter of all husked cob with well-filled grains and longer than 10 cm were measured. Aboveground, vegetative parts of selected plants were also gathered, and then oven dried at 70°C until constant mass was obtained for dry matter (DM) determination. The weight of husked cobs and vegetative parts were converted into unit area yields ($Mg\ ha^{-1}$). Irrigation water use efficiency (IWUE, $kg\ m^{-3}$) was determined by dividing yield by irrigation water volume (m^3). IWUE was calculated for both husked cob yield ($IWUE_{hc}$) and DM yield ($IWUE_{dm}$).

The measured parameters were subjected to the analysis of variance, using the DSAASTAT add-in (Onofri, 2007). A combined analysis of data over both tested years was performed according to Gomez & Gomez (1984), in order to recognize the treatment whose average effect over years was high and stable. The mean comparison was done after combined analysis, using the least significant difference test (LSD) at the 5% probability.

Results and Discussion

There were no significant interactions between year and treatment, or between cultivar and crop row/ drip-line lateral spacing. Therefore, the effects of tested factors on the measured parameters were averaged over both seasons (Table 2). Moreover, the analysis of variance showed that crop row/drip-line lateral spacing, but not the cultivar, significantly influenced the measured parameters. Although numerous factors affect the crop response, this indicates that the planting arrangement plays an important role on sweet corn production.

Soil-water storages in the rows next to drip-line laterals varied from one treatment to another, but still remained between SWS(h_2) and SWS(h_3), where root-water uptake is maximal (Figure 1). This indicated no water stress throughout the whole growing season for the closer rows. However, soil-water storages remarkably decreased at the distant rows in the DS225. From the 60th day after planting on, their values soon went down below the lower limit of optimal range of root-water uptake, SWS(h_3). The degree of water stress excessively increased during the reproductive stage towards the harvest, but without declining below the lowest limit SWS(h_4). This can be attributed to the spatially variable soil-water conditions under the drip irrigation, resulting in insufficient supply of water to the points of the root zone away from the drip-line lateral. However, when using triple rows with 225 cm drip-line lateral spacing (DS225-T), the irrigation maintained SWS under both the closest and furthest crop rows at a fairly constant and high level. These results with similar behavior, in both growing seasons, indicate that the DS225-T treatment adequately provided the crop water needs. Plants grown in triple-rows increased the speed of canopy closure and, consequently, reduced the water losses by soil evaporation. Similar findings were reported by previous works on sweet corn crop with twin-row production system (Mubarak, 2020).

The yield of both tested cultivars seemed to be similar in the treatments evaluated (Figure 2). Moreover, yield decreased as the distance between drip-line lateral and crop row increased in the single-row DS225, but not in the triple-row DS225-T treatment. In the DS225, the row-to-row yield variation was 61.7 and 67.9% for 'Silver Queen' and 'White Kokab' cultivars, respectively. Conversely, yield was found to decrease when the crop rows were moved closer to drip-line laterals in the triple-row DS225-T treatment. The

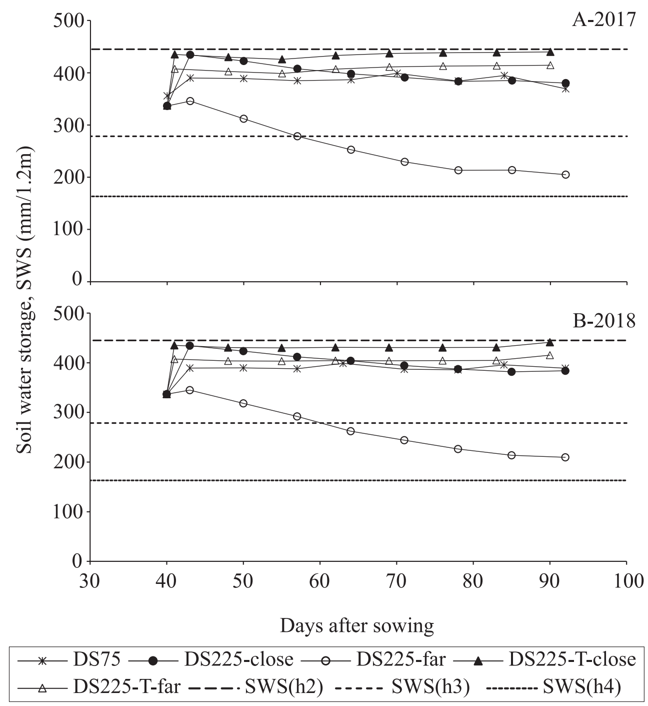

Figure 1. Changes over time in soil water storages in 120 cm soil profile for both growing seasons, respectively, for 'Silver Queen' cultivar. Dashed lines represent soil water storages at h_2, h_3, and h_4 corresponding to the root water uptake parameters for sweet corn crop as suggested by Feddes et al. (1978). DS75, DS225, and DS225-T represent treatments. 'Close' and 'far' represent the row next to the lateral and the distant row from the lateral, respectively.

Table 2. Mean comparisons of crop responses as function of both corn cultivar and crop row/lateral spacing(1).

Factor	Husked cob length (cm)	Husked cob diameter (cm)	Husked cob weight (g)	Dry matter yield (Mg ha^{-1})	Husked cob yield (Mg ha^{-1})	$IWUE_{dm}$ (kg m^{-3})	$IWUE_{hc}$ (kg m^{-3})
Cultivar							
Silver Queen	18.0a	4.6a	236.4a	8.49a	11.51a	1.17a	1.59a
White Kokab	17.6a	4.5a	225.7a	8.75a	11.28a	1.21a	1.55a
$LSD_{0.05}$	1.05	0.1	29.7	0.67	1.40	0.09	0.19
Crop row/lateral spacing							
DS75	18.8a	4.8a	244.3a	8.07b	13.75a	1.11b	1.89a
DS225	15.8b	4.2c	223.4a	8.32b	8.92c	1.15b	1.23c
DS225-T	18.6a	4.7b	225.4a	9.46a	11.51b	1.30a	1.59b
$LSD_{0.05}$	0.8	0.1	23.1	0.80	1.00	0.11	0.13

(1)In each column and for each tested factor, means followed by different letters are significantly different according to LSD test at 5% level. $IWUE_{dm}$ = irrigation water use efficiency for dry matter, and $IWUE_{hc}$ = irrigation water use efficiency for husked cob yield.

exterior rows produced 21.1 and 23.7% more than the interior ones in 'Silver Queen' and 'White Kokab', respectively. Furthermore, the husked cob yield of interior rows (rows located next to drip-line laterals) in DS225 was higher than those of DS75 and DS225-T at 14.2 and 49.6%, respectively (Figure 2).

These row-to-row variations were associated with the spatially variable soil-water conditions under the drip irrigation method. In plots with wider drip-line lateral spacing in single rows, the furthest crop rows were more water stressed than rows adjacent to the drip-line lateral, but not in the triple rows (Figure 1). These results are in agreement with those of Lamm et al. (1997), who reported that the row-to-row variation in corn crop could reach more than 67 and 41% for 230 and 300 cm lateral spacing, respectively. These yield losses could attain 95% under deficit irrigation conditions. Nonetheless, Bozkurt et al. (2006) documented that corn yield from the 210 cm lateral spacing was only 8.2 and 9.6% lower than that of 140 cm lateral spacing for the closest and furthest crop rows, respectively. In addition, Murley et al. (2018) found that integrated corn crop yield was not affected by the distance between crop row and lateral, because the closer rows compensated the yield losses in distant rows.

For DM yield and $IWUE_{dm}$, no significant differences were found between DS75 and DS225 (Table 2). However, when rows were brought closer under the triple-row treatment, both parameters considerably enhanced, and recorded the highest values, whatever the tested corn cultivar. As well, both the mean value of husked cob yield and $IWUE_{hc}$ significantly decreased, as the drip-line lateral spacing increased in both single- and triple-row treatments. The maximum values were found in the conventional treatment DS75. The mean value in DS225 was severely reduced by about 35%. Nevertheless, both parameters' losses were significantly attenuated to only about 16%. However, no yield advantage of triple-rows over the conventional 75 cm rows were observed. This could be related to yield losses in plant rows next to the drip-line laterals due to excess irrigation. This result well agreed with the findings of Nafziger (2006), for whom, the early, higher-light interception in twin rows, compared with the 75 cm rows, did not contribute to the increase of

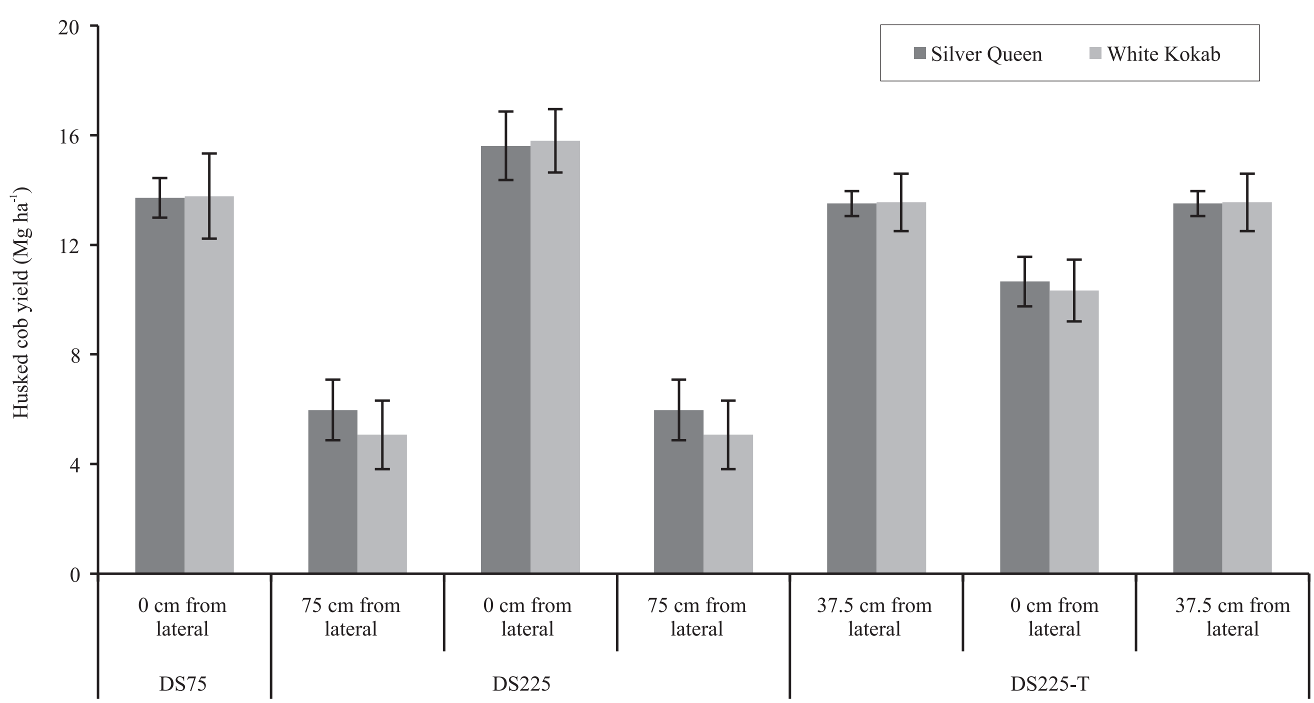

Figure 2. Husked cob yield distribution according to the distance from lateral for the combined data of both growing seasons, and for both tested cultivars. Individual crop row yields are mirrored about the lateral in each treatment for display purposes. DS75, DS225, and DS225-T represent treatments. Error bars represent the standard deviations.

light interception during the grain filling stage and, therefore, to a higher production.

The enhancements of both yields and IWUEs obtained in triple-rows could be related to the enhanced status of soil-water in the root zone. This more convenient soil-water status in the triple-row treatment may stimulate roots to grow up and to consume more nutrients. Muhumed et al. (2014) indicated that the soil-water deficit reduces the uptake of macronutrients and, therefore, limits the sweet corn growth, but the full irrigation enables the roots to absorb the required nutrients from the soil. Moreover, Santos et al. (2018) cited that nutrients reach roots by mechanisms directly related to the water availability in the soil; therefore, sweet corn expresses its maximum production potential in a favorable soil-water status. In addition, the speed of canopy closure in triple rows improved the light interception, rising plant growth rates. Liu et al. (2011) report a similar result for corn crop grown in narrow-wide planting patterns. The earlier canopy closure may reduce weeds and competition (Fanadzo et al., 2010; Saudy, 2013; Williams & Boydston, 2013). As well, several studies reported similar mean yields, as that of Ertek & Kara (2013), who reported 14.74 Mg ha^{-1} fresh cob yields of sweet corn, and the report by Mubarak (2020), who documented similar values of yields and IWUEs of both tested sweet corn cultivars in a twin-row production system. In a subsurface drip irrigation, mean corn yields were 13.6, 12.8, and 12.2 Mg ha^{-1} for 150, 230, and 300 cm lateral spacing, respectively (Lamm et al., 1997). However, mean corn yields were 8.57 and 8.92 Mg ha^{-1} for 70 and 210 cm lateral spacing, respectively, with a total irrigation depth of 750 mm, as mentioned by Bozkurt et al. (2006). This indicates that the tested planting arrangement provides favorable growth conditions under which sweet corn crop shows its maximum yield potential.

Both length and diameter of husked cobs significantly decreased as drip-line lateral spacing increased in the single-row treatment. The traditional 75 cm treatment produced cobs considerably taller and larger by about 20 and 16%, respectively, than those in DS225. However, a significant enhancement in husked cob size (length and diameter) could be obtained, when changing to the triple row treatment with 225 cm drip-line lateral spacing, due to the enhancement of the soil-water status in the root zone, as above mentioned (Table 2). Although no research findings are available on sweet corn response to the same tested planting arrangement, some findings were reported for sweet corn crop by previous works. Mubarak (2020) reports similar values for both tested sweet corn cultivars, under single- and twin-row treatments, as follows: cob lengths between 17.5-18.8 cm; cob diameters between 4.8-4.9 cm; cob weights between 210-251 g. The 75 cm lateral spacing produced cobs considerably longer than those in the 150 cm lateral spacing with single rows, but, similar to those of the 150 cm lateral spacing with twin rows. Al-Hurmuzi & Topak (2018) found no significant difference between two drip-line spacing of 70 and 140 cm for weight and length of sweet corn husked cob. However, they found that the 70 cm spacing produced larger cobs, as compared with the 140 cm spacing, even in the twin-row treatment. For corn crop, Bozkurt et al. (2006) found no considerable effects of different drip-line lateral spacing (70, 140, and 210 cm) on cob length.

For one hectare (100 × 100 m^2), about 13,334 m of drip-line laterals are needed, when the current lateral spacing 75 cm is used. However, one third of this quantity (about 4,445 m) is only needed for one hectare, if the 225 cm lateral spacing is used. In other words, the 225 cm drip-line lateral spacing provides 66.7% less lateral quantity per unit area. The yield loss in the triple-rows with 225 cm drip-line lateral spacing was only 16%, and it did not seem to be sufficient to justify an additional cost of a closer drip-line lateral spacing (75 cm). This in agreement with other published studies on multiple-row production systems (Lamm et al., 1997; Wang et al., 2014; Al-Hurmuzi & Topak, 2018; Mubarak, 2020).

From the environmental point of view, reducing the drip-line lateral quantity per unit area to a third may reduce the quantity of related plastic fittings and the size of both main and submain pipes, reducing the harmful environmental impacts from damaged plastic pieces.

Conclusions

1. The yields of sweet corn (*Zea mays*) 'Silver Queen' and 'White Kokab' (a local cultivar), their cob characteristics, and irrigation water use efficiency are similar.

2. The water distribution in the 225 cm drip-line lateral spacing in single rows is not suitable for sweet

corn production, even with the same quantity of irrigation water added.

3. Fresh cob yield and irrigation water use efficiency significantly decrease as drip-line lateral spacing increases; the nonuniformity of yield with the distance from the drip-line lateral negatively affects the total yield in single rows. However, both parameters are regained in the 225 cm lateral spacing when switching to the triple-row treatment.

4. The combined use of triple-rows with one drip-line lateral per each triple-row represents an economic drip-irrigated planting pattern for the sustainable sweet corn crop production in the dry Mediterranean area.

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