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Effect of drip fertigation on growth and yield of oriental pickling melon (*Cucumis melo* var. *conomon* (L.) Makino) under high density planting

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Abstract- A field experiment was conducted at the Kerala Agricultural University during December 2012 to March 2013 to standardize drip fertigation under high density planting in summer grown oriental pickling melon. The experiment was laid out in Randomised Block Design (RBD) with three replications. The treatments consisted of combinations of four irrigation levels (50, 75 and 100 % Ep through drip irrigation and farmers practice of pot irrigation) and three fertilizer levels (100, 150 and 200 % Recommended dose of fertilizer). Irrigation levels significantly influenced the growth characters *viz*., length of vine, number of leaves per vine, number of branches per vine, LAI and shoot dry matter production. The highest values of vegetative characters were observed under drip fertigation with 100 per cent Ep combined with 200 per cent of RDF. The number of fruits and fruit characters like weight of fruit and volume of fruit were significantly influenced by the levels of irrigation. Maximum number of fruits as well as the weight and volume of fruits were observed at 100 per cent Ep given through drip irrigation and was significantly superior to all other irrigation levels. Fertilizer levels also significantly influenced both vegetative parameters and yield attributes. The highest growth parameters and yield attributes were observed with 200 per cent RDF. Highest fruit yield of 72.4 tonnes per hectare was obtained by drip fertigation with the 100 percent Ep combined with 200 per cent of recommended dose of fertilizer.

Index Terms- Fertigation, oriental pickling melon, high density planting, yield.

I. INTRODUCTION

Among the cucurbits cultivated in Kerala, Oriental pickling melon occupies an important place. It is mainly cultivated in the summer rice fallows as an irrigated crop. The average yield of oriental pickling melon in the state is about 25-30 tonnes per hectare under the recommended spacing of 2m x 1.5m (Anoop, 2009). Preliminary studies have indicated the possibility raising the per hectare yield of op melon to 70-75 tonnes per hectare by high density planting with short duration, less vigorous varieties (Jamuna devi, 2001 and Rajees, 2013). Oriental pickling melon variety "Saubhagya" is a short duration, less vigorous high yielding variety, maturing in 65-70 days and is suitable for high density planting. Other good qualities of Saubhagya, like concentrated fruiting and small attractive fruits, led to its wide acceptance among the vegetable growers of Kerala state.

High density planting needs more nutrients than the crop planted at the normal recommended spacing. Conventional application of nutrients has very low use efficiency. Improved methods of nutrient application through drip fertigation almost double the nutrient use efficiency. Drip fertigation, which is the application of fertilizer through drip irrigation, is one of the most efficient and convenient means of supplying both nutrients and water, according to the specific requirements of the crop, also results in higher productivity and better quality of produce (Greef, 1970). The main constraint for production of oriental pickling melon in the summer rice fallows is the scarcity of water for irrigation. Therefore a study was undertaken in summer grown op melon under high density planting to estimate the water and nutrient requirement through drip fertigation.

II. MATERIALS AND METHODS

The field experiment was conducted from December 2012 to March 2013 at the Agricultural Research Station, Kerala Agricultural University, Mannuthy, Thrissur. The experimental site is situated at 12º 32' N latitude and 74º 20' E longitude at an altitude of 22.5 m above mean sea level. The area enjoys a typical warm humid tropical climate. The experimental site is a double crop paddy wet land in which a semi dry sown crop (April - September) and a transplanted wet crop (September - December) of rice are regularly cultivated. The land is usually left fallow during summer season. Soil type of the experimental field is sandy clay loam. Saubhagya variety of op melon maturing in about 65 days was planted at a spacing of 1.00 m x 0.30 m in channels accommodating 33,333 plants per hectare. The treatments consisted of combinations of four irrigation levels (50 (I_1), 75(I_2) and 100 % Ep (I_3) through drip irrigation and farmers practice of pot irrigation @ 10 litres per plant on alternate days from flowering to maturity and half of this quantity from 10 DAS to flowering) and three fertilizer levels (100 (F_1), 150 (F_2) and 200 % (F_3) as recommended by the KAU, PoP). Entire dose of phosphorus through S.S.P was applied basal and incorporated into soil. Nitrogen and potassium were applied through drip irrigation in six split doses at weekly interval from 10 DAS to 40 DAS through urea and muritae of potash. The quantities of water used were in the order of 185, 257, and 329 mm in I_1, I_2 and I_3 levels of drip irrigation and 706 mm in farmer's practice of irrigation.

III. RESULTS AND DISCUSSION

Growth parameters

Growth parameters like length of vine, number of leaves per vine, number of branches per vine, leaf area index and shoot dry matter production at harvest increased significantly with increase in drip irrigation level from 50 to 100 per cent Ep. A high irrigation level with pot watering totaling 706 mm was inferior to both 75 and 100 per cent Ep through drip irrigation (Table 1). As the growth parameters showed linear relationship with increasing levels of drip irrigation, the study reveals the necessity for trying higher levels of drip irrigation over 100 per cent Ep under high density planting.

Length of vine, number of leaves per vine, number of branches per vine, LAI and shoot dry matter production increased significantly with increase in fertilizer levels from 100 to 200 per cent RDF. As these growth factors showed linear increase with increase in fertilizer levels from 100 to 200 per cent RDF, higher levels of fertilizer above 200 per cent RDF are to be tried under high density planting. Similar results have also been reported by Jaksungnaro *et al*. (2001) in cucumber and Alemeyhu (2001) in oriental pickling melon.

Interaction effect of irrigation and fertilizer was significant on vegetative characters like length of vine, number of leaves per vine, number of branches per vine, LAI and shoot dry matter production. The highest values of these parameters were recorded by the treatment combination of 100 per cent Ep given through drip irrigation with 200 per cent RDF.

The increase in length of vine, number of leaves per vine, number of branches per vine, LAI and shoot dry matter production in I_3 over I_1 is in the order of 18, 21, 57, 41 and 55 per cent respectively. Similarly the increase of the above parameters under F_3 level of fertilizer over F_1 level of fertilizer (RDF) is in the order of 12, 18, 39, 27 and 38 per cent respectively. The increase of the above parameters under I_3F_3 over I_1F_1 is in the order of 29, 47, 114, 88 and 107 per cent respectively. Over I_4F_1, the above parameters increased in I_3F_3 in the order of 28, 24, 125, 48 and 116 per cent respectively.

While the interaction between irrigation levels of 75 and 100 per cent Ep through drip irrigation and fertilizer levels responded positively on growth parameters (Table 2), such a strong interaction could not be seen at the lowest level of drip irrigation with 50 per cent Ep or at the highest level of irrigation (706 mm) with pot. The results obtained in this study are in conformity with the results of Bach and Hruska (1981) in cucumber and Sharda *et al.* (2006) in onion.

Both days to flowering and harvesting did not show significant change under irrigation or fertilizer levels. The interaction between them also was not significant. In general, days taken to flowering were 23 in the case of drip irrigation and 24 in pot irrigation. Days to harvest as lesser in drip irrigated plots than pot irrigated plots. Similar results were also recorded by Anoop (2009) in oriental pickling melon.

Table 1. Influence of irrigation and fertilizer levels on vegetative growth parameters Figures with same alphabets in superscript do not differ significantly at 5 % level in DMRT

Treatment	Length of vine (cm)	Number of leaves per vine	Number of branches per vine	Leaf Area Index	Shoot dry matter (kg/ha)	Days to first flowering
Irrigation						
I_1	114.9^{d}	15.1^{c}	2.3^{c}	1.48^{c}	1059.0^{d}	23.0^{b}
I_2	133.1^{b}	17.5^{ab}	2.8^{b}	1.78^{b}	1353.0^{b}	23.0^{b}
I_3	135.6^{a}	18.3^{a}	3.6^{a}	2.08^{a}	1642.0^{a}	23.0^{b}
I_4	122.3^{c}	17.3^{b}	2.2^{c}	1.81^{b}	1144.0^{c}	24.0^{a}
Fertilizer						
F_1	119.0^{c}	15.6^{c}	2.3^{b}	1.58^{c}	1100.0^{c}	23.25^{a}
F_2	126.9^{b}	17.2^{b}	2.6^{b}	1.78^{b}	1284.0^{b}	23.25^{a}
F_3	133.6^{a}	18.4^{a}	3.2^{a}	2.00^{a}	1515.0^{a}	23.25^{a}
SEm ±	1.13	0.18	0.06	0.02	17.68	0
I x F	Sig	Sig	Sig	Sig	Sig	NS

Table 2. Interaction effect of irrigation and fertilizer levels on vegetative growth parameters

Treatments	Length of vine (cm)	Number of leaves per vine	Number of branches per vine	Leaf Area Index	Shoot dry matter (kg/ha)
I_1F_1	110.0^{f}	13.5^{g}	2.1^{fg}	1.28^{e}	988.3^{i}
I_1F_2	114.3^{e}	15.3^{f}	2.4^{e}	1.55^{d}	1043.0^{h}
I_1F_3	120.3^{d}	16.7^{d}	2.6^{de}	1.60^{d}	1146.0^{fg}
I_2F_1	125.8^{c}	15.7^{ef}	2.4^{e}	1.61^{d}	1176.0^{f}
I_2F_2	136.8^{b}	17.9^{c}	2.7^{cd}	1.75^{c}	1400.0^{d}
I_2F_3	136.8^{b}	18.8^{b}	3.3^{b}	1.99^{b}	1484.0^{c}
I_3F_1	128.5^{c}	16.9^{d}	2.9^{c}	1.80^{c}	1288.0^{e}
I_3F_2	136.0^{b}	18.1^{c}	3.3^{b}	2.05^{b}	1596.0^{b}
I_3F_3	142.3^{a}	19.9^{a}	4.5^{a}	2.40^{a}	2043.0^{a}
I_4F_1	111.5^{ef}	16.0^{e}	2.0^{g}	1.62^{d}	947.7^{i}
I_4F_2	120.4^{d}	17.6^{c}	2.2^{f}	1.80^{c}	1096.0^{gh}
I_4F_3	135.0^{b}	18.2^{c}	2.6^{de}	2.02^{b}	1388.0^{d}

Figures with same alphabets in superscript do not differ significantly at 5 % level in DMRT

Yield attributes

Yield attributes like number of fruits per plant, average weight of fruit, mean volume of fruit, fruit dry matter and fruit yield increased significantly with increase in drip irrigation level from 50 per cent Ep to 100 per cent Ep. A high level of irrigation through pot watering (706 mm) was inferior to both 75 and 100 per cent Ep through drip irrigation. (Table 3). The results indicated the superiority of drip irrigation at 100 per cent Ep (329 mm) to enhance yield and yield attributes under high density planting of op melon and the inefficiency of high level of irrigation water applied through pot watering (706 mm). As there was linear increase in yield and yield attributes due to increasing level of drip irrigation, higher levels of Ep above 100 per cent needs to be tried under higher density planting. Lower levels of drip irrigation with 50 per cent Ep as well as higher level of pot irrigation (706 mm) are not beneficial to promote yield attributes and yield of op melon. The study clearly indicated water requirement of above 100 per cent Ep through drip irrigation for op melon under high density planting. But a high level through

pot watering was ineffective. The beneficial effect of drip irrigation are due to a high water use efficiency because of application of water at the root zone of the crop, reduced seepage, percolation and evaporation losses and maintenance of an ideal moisture/oxygen relationship in the root zone which is highly essential for vegetative and reproductive growth. Results of several studies have indicated the water saving in drip irrigation is 30 to 70 per cent (Shinde and Malunjkar, 2010).

Mean fruit yield per hectare increased significantly with increase in irrigation level up to 100 per cent Ep through drip irrigation and then decreased under pot watering. The increases in per hectare fruit yield in I_3 over I_1 and I_2 was in the order of 18.7 and 36.0 per cent respectively. The increase in fruit yield of op melon in I_2 and I_3 over pot irrigation (I_4) was in the order 10 and 26 per cent respectively. Better growth expressions under I_2 and I_3 were responsible for more fruit yield under these treatments. I_4, which is the farmer's practice of irrigation, recorded significantly lower fruit yield than I_2 and I_3 because of lower production of vegetative parameters, number of fruits per plant and average fruit weight.

Number of fruits per plant, average fruit weight and mean fruit yield increased significantly with increase in fertilizer level from 100 to 200 per cent. Increase of fruit yield per hectare in F_2 and F_3 over F_1 was in the order of 7 and 19 per cent respectively. As the response of fruit yield to fertilizer level was linear in nature, it indicates that under high density planting, which has 33,333 plants per hectare, a fertilizer dose more than 200 per cent of the recommended dose for the normal population of 10,000 plants per hectare is needed.

Among the yield attributes and yield interaction between irrigation and fertilizer level was significant only on mean fruit yield. I_3F_3 recorded the highest fruit yield of 72.4 tonnes per hectare (Fig. 1). The increase in fruit yield in I_3F_3 over I_1F_1 and I_4F_1 was in the order of 61 and 48 per cent respectively. Higher level of irrigation through farmers practice and lower level of drip irrigation with 50 per cent Ep did not interact favourably with fertilizer levels under high density planting. The result clearly indicates that a favourable interaction between water and nutrients occurs only at a suitable level of moisture in the root zone of the crop. The positive interaction between irrigation and fertilizer level on enhancing the fruit yield in various vegetables has been reported by Alemeyhu (2001) and Jamuna devi (2003). Highest fruit yield in I_3F_3 was due to the best expression of growth parameters like length of vine, number of leaves per vine, number of branches per vine and leaf area index. As all the growth parameters increased linearly with increase in drip irrigation up to 100 per cent Ep and fertilizer level up to F_3, best growth was expressed in I_3F_3. The expression of yield attributes and yield followed the same trend shown by the vegetative parameters. The study clearly indicated the superiority of drip fertigation over conventional irrigation and manurial practices by the farmers. As the plant population in the trial was 33,333 per hectare compared to the normal recommended population of 10,000 plants per hectare, the water and nutrient requirement through drip fertigation under high density planting was found to be more than the tried maximum level of 100 per cent Ep and 200 per cent RDF tested in the trial. Therefore, further studies are required to standardize the drip fertigation requirement of op melon at high density planting.

Table 3. Influence of irrigation and fertilizer levels on fruit characters, yield and days to harvest

Treatment	No. of fruits per plant	Average weight of one fruit (g)	Volume of one fruit (cm^3)	Mean fruit yield (t/ha)	Days to harvest	Fruit dry matter (kg/ha)
Irrigation						
I_1	2.3^d	624.9^b	637.3^b	49.1^d	65.0^b	4414.0^d
I_2	2.7^b	638.9^b	652.8^b	58.3^b	65.0^b	5248.0^b
I_3	2.8^a	710.2^a	724.4^a	66.8^a	65.0^b	6010.0^a
I_4	2.5^c	626.8^b	639.3^b	52.9^c	67.0^a	4757.0^c
Fertilizer						
F_1	2.4^c	638.7^b	652.2^b	52.3^c	65.50^a	4707.0^c
F_2	2.6^b	645.4^b	658.2^b	56.0^b	65.50^a	5031.0^b
F_3	2.7^a	666.7^a	680.0^a	62.0^a	65.50^a	5584.0^a
SEm ±	0.039	9.31	9.71	0.479	0	61.90
I x F	NS	NS	NS	Sig	NS	NS

Figures with same alphabets in superscript do not differ significantly at 5 % level in DMRT

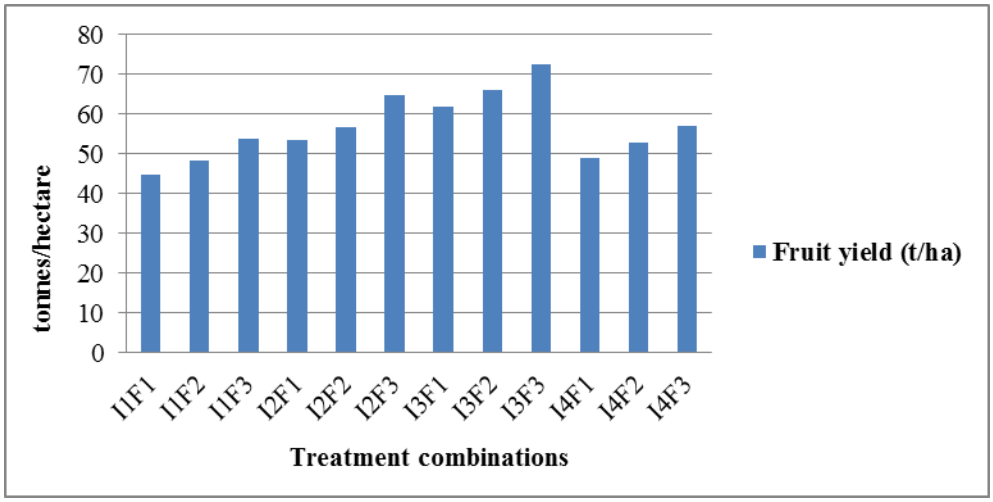

Fig 1. Interaction effect of irrigation and fertilizer levels on fruit yield

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