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Growth and Yield of Watermelon (*Citrullus lanatus* (Thunb.) with Different Levels of Fertigation and Drip Irrigation

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ABSTRACT

The effects of different levels of fertigation and drip irrigation on growth and yield of watermelon were investigated. The experiment was carried out at Department of Olericulture, College of Agriculture, Vellayani, Kerala. Fertigation treatments were 75, 100 and 125 per cent recommended dose of fertilizers (RD) and irrigation treatments at 0.6 and 0.8 evapotranspiration (ET) rates. One control was taken with surface irrigation and conventional soil application of fertilizers. It was noticed that vine length increased linearly with increase in fertigation and irrigation levels. Increasing irrigation levels increased fruit equatorial and polar diameters. Levels of fertigation and irrigation exerted significant influence on number of fruits/plant and yield/plant. Total yield was highest at 100 per cent RD (91.1 t/ha) compared to 125per cent RD (80.13 t/ha). There was increase in number of fruits/plant and fruit yield with increase in irrigation level from 0.6 to 0.8 ET. Fertigation at 100 per cent RD recorded the highest yield of 8.51 kg/ plant. Fertigation and irrigation levels had no influence on fruit weight and days to first harvest.

Key Words: *Citrullus lanatus*, Watermelon, Fertigation, Irrigation.

INTRODUCTION

Watermelon (*Citrullus lanatus* (Thunb.) is grown in an area of 1.01 lakh hectare with a production of 25.2 lakh tonnes (GOI, 2018).Mineral nutrition is one of the important factors contributing to watermelon yield. However, the suggested rates varied considerably. Goreta *et al* (2005) found that total and marketable yields did not increase with nitrogen rates above 115 kg/ ha. On the contrary, increased use of fertilizer led to rise in yield and dry weight of watermelon fruits (Hendericks *et al*, 2007). Generally, watermelon is cultivated using surface irrigation with soil application of fertilizers. Fertigation is the process of applying fertilizer along with irrigation. It allows placement of nutrients directly into root zone through emitters during critical periods of nutrient requirement. It allows an accurate and uniform application of nutrients to the wetted area where most active roots are concentrated. Fertigation can improve nutrient use efficiency by supplying nutrients and water precisely avoiding excess concentrations of fertilizer in the soil and consequent leaching.The nutrient use efficiency of fertigation is about 90 per cent compared to that of conventional methods, where it is only 40-60 per cent. Drip fertigation is highly profitable as it saves input, labour and energy to about 54 per cent than that of conventional methods. The application efficiency of water and nutrients is improved by drip fertigation. At the same time marketable yield is maintained or improved (Monaghan *et al*, 2010). Under water scarce conditions, fertigation is considered as the most effective tool for managing nutrients and irrigation water.

Watermelon contains more than 91per cent water and therefore, water supply during critical stages of plant growth and fruit development is very important. Water availability for irrigation will be a major constraint for agriculture in coming years. So strategies to reduce water loss are the need of the hour. Use of micro irrigation facilities like drip system can play a major role towards this end. In

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drip irrigation, water is delivered near the plant root zone in a precise quantity so as to maintain soil moisture content close to field capacity. Drip irrigation also increases the uptake of plant nutrients and water use efficiency.Generally, in watermelon marketable yield decreased linearly in response to an increase in water stress (Fernandes *et al*, 2014).

In Kerala, watermelon is cultivated only in a very limited area of 100 ha (GOI, 2018), even though the demand for the fruit is very high. Being a high value crop, its exploitation on commercial scale can generate handsome income to farmers.The effect of irrigation strategies and interaction with fertigation rates is not well investigated in watermelon under sandy clay loam soils of southern Kerala. Hence, this study was carried out to evaluate the influence of different fertigation and drip irrigation levels on growth and yield of watermelon.

MATERIALS AND METHODS

The field experiment with watermelon hybrid Prachi was carried out at Department of Olericulture, College of Agriculture, Vellayani, Kerala Agricultural University during 2015-16. Mechanical composition and moisture characteristics of the soil are provided in Tabl e 1. The treatments were factorial combinations of three fertigation levels (75, 100 and 125 % recommended dose (RD) of 70:50:120 kg NPK/ ha) and two irrigation levels (0.6 and 0.8 evapotranspiration (ET) rates) arranged in randomized block design with three replications and control with surface irrigation and normal soil application of fertilizer.

The experimental area was deeply ploughed up to 50 cm and weeds and stubbles were removed. Farm yard manure @ 25 t/ha was applied before last ploughing. Raised beds of one meter width and one foot height were taken with channels of 50 cm between beds; so that the row to row spacing was 1.5 m. Drip lines were laid with a lateral per bed and drippers with a discharge rate of 2 l/hr spaced every 60 cm. The beds were covered with silver on black polyethylene mulch of 50 μ thickness. Seedlings were raised in protrays using cocopeat and vermicompost as media. Twelve days old seedlings at 2-3 true leaf stage were transplanted to main field at 60 cm spacing. Uniform irrigation was given to the seedlings up to one week after transplanting. Irrigation scheduling was started thereafter. Drip irrigation was scheduled daily to meet the crop water requirement based on the pan evaporation data of previous day from Class A open pan evapo

Table 1. Mechanical composition and moisture characteristics of the soil.

Particular	Value
Mechanical composition	
Coarse sand (per cent)	16.30
Fine sand (per cent)	30.50
Silt (per cent)	25.80
Clay (per cent)	26.10
Textural class	Sandy clay loam
Soil moisture characteristics	
Particle density (g cc^{-1})	2.30
Bulk density (g cc^{-1})	1.40
Maximum water holding capacity (per cent)	23.70
Porosity (per cent)	31.10
Field capacity (per cent)	21.90
Permanent wilting point (per cent)	9.10

Table 2. Effect of fertigation and drip irrigation on growth and flowering characters of watermelon.

Treatment	Vine length (m)	Days to first male flower	Node to first male flower	Days to first female flower	Node to first female flower	Days to first harvest (DAT)
Fertigation						
75% RD	3.41	16.19	5.63	27.63	13.88	51.57
100% RD	3.96	16.25	5.63	27.94	14.38	51.94
125% RD	4.84	17.88	6.38	26.50	13.32	50.57
SE(m)±	0.093	0.431	0.271	0.518	0.372	0.512
CD at 5%	0.288	1.342	NS	NS	NS	NS
Irrigation						
0.6 ET	3.69	16.83	6.08	27.45	13.58	51.50
0.8 ET	4.03	16.70	5.67	27.25	14.13	51.20
SE(m)±	0.076	0.353	0.220	0.424	0.305	0.419
CD at 5%	0.238	NS	NS	NS	NS	NS
Control	3.21	18.50	6.25	29.00	14.50	53.00

NS-Non significant

meter near the trial plot. Total irrigation applied was 184.02 mm, 239.79 mm and 330.86 mm for 0.6 ET, 0.8 ET and control, respectively. Fertigation was done at three days interval using fertigation pump. The data were analysed statistically by applying the techniques of analysis of variance (Panse andSukhatme, 1985).

RESULTS AND DISCUSSION

The Vine length increased linearly with an increase in fertigation level from 75 to 125 per cent RD. Irrigation at 0.8 ET registered longer vine length (4.03 m) than 0.6 ET (3.69 m). Lowest vine length of 3.21 m was noted in control. Cucurbits require considerable amount of moisture during their most vigorous growth phase and it extends up to the maturity of fruits. The reduced growth in basin irrigation could be attributed to the movement of water and nutrients beyond the effective root zone leading to a reduction in the uptake of nutrients (Table 2 &3).

Fertigation treatments significantly influenced male flowering with earliness in male flower anthesis as well as flower production in the lowest node at 75 per cent RD. Irrigation and fertigation levels had no effect on female flowering. With respect to fruit characters the fertilizer levels had no significant influence on fruit equatorial diameter, but 100 per cent RD recorded highest polar diameter of 18.84 cm which was on par with 75 per cent RD (17.69 cm). Irrigation treatments were significant, with irrigation at 0.8 ET recording the highest fruit equatorial and polar diameters. Rind thickness was significantly influenced by fertilizer levels, with the lowest rind thickness of 0.58 cm exhibited by 125per cent RD followed by 100 per cent RD (0.69 cm). Levels of irrigation were also significant, with lowest rind thicknesss (0.63 cm) in 0.8 ET. The treatments as well as control had no effect on number of days to first harvest.

There was significant difference among treatments for number of fruits/plant. Fertigation at 100 per cent RD recorded highest number of 4.13 which was on par with 125 per cent RD (3.76). Among the irrigation treatments, 0.8 ET registered the highest number of fruits/plant. Fruit weight was not influenced by the different treatments. Levels of fertigation and irrigation exerted significant influence on yield/ plant. Fertigation at 100 per cent RD recorded the highest yield of 8.51 kg/plant

Table 3. Effect of fertigation and drip irrigation on fruit characters and yield of watermelon.

Treatments	Fruit equatorial diameter (cm)	Fruit polar diameter (cm)	Rind thickness (cm)	Fruits/ plant	Fruit weight (kg)	Yield/ plant (kg)	Yield (t/ha)
Fertigation							
75% RD	15.08	17.69	0.75	3.59	2.17	7.55	80.41
100% RD	15.71	18.84	0.69	4.13	2.24	8.51	91.10
125% RD	14.64	17.04	0.58	3.76	2.11	7.52	80.13
SE(m)±	0.380	0.427	0.033	0.126	0.097	0.056	2.554
CD at 5%	NS	1.328	0.103	0.393	NS	0.715	7.947
Irrigation							
0.6 ET	14.33	17.27	0.72	3.60	2.06	7.28	77.49
0.8 ET	15.93	18.42	0.63	4.06	2.28	8.42	90.25
SE(m)±	0.309	0.349	0.028	0.101	0.083	0.187	2.085
CD at 5%	0.962	1.085	0.086	0.315	NS	0.582	6.489
Control	12.55	14.85	0.75	3.71	1.51	5.12	52.76

NS-Non significant

followed by 75 per cent RD (7.55 kg) which was at par with 125 per cent RD (7.52 kg). Fertigation at 100 per cent RD significantly increased number of fruits/plant, yield/ plant and yield/ hectare. Nitrogen promotes vegetative growth and P stimulates root development. Better vegetative growth leads to enhanced chlorophyll content along with higher stomatal conductance and thereby increased photosynthesis. Moreover, sufficient availability of K might have encouraged increased transport of photosynthates to the sink leading to higher yield (Maluki *et al*, 2016). Under open condition, fruit weight was not influenced by fertilizer dose. Similar result was reported by Andrade Junior *et al* (2009) where fruit yield was more influenced by number of fruits than fruit weight. The yield attributes like fruit weight, fruits/plant and yield/ plant were decreased at the highest fertilizer level (125 % RD) tried. This might be attributed to early fruit set in lower nodes which resulted in competition between the fruit and vegetative parts during early fruit development. Moreover, early formed fruits also recorded reduced fruit weight (Watanabe, 2014). Increased concentration of soluble fertilizers increases the osmotic potential of soil solution, causing reduction in water uptake by the plant roots (Maluki *et al*, 2016). The application of fertilizer through drip was found superior to conventional solid fertilizer application (Choudhari and More, 2002). Fertigation treatments recorded higher values for number of fruits/plant and fruit weight than conventional soil application of fertilizers. Similar observation was also made by Prabhakar *et al* (2013).

The highest fruit yield of 8.42 kg per plant was recorded at 0.8 ET against 7.28 kg with irrigation at 0.6 ET. Proper balance of moisture in plants not only increases the photosynthesis but also helps in higher uptake of nutrients to meet accelerated rate of growth and ultimately yield.The drip irrigation levels gave higher yield of watermelon than surface irrigation. The increased yield under drip irrigation system might have resulted due to excellent soil-water-air relationship with higher oxygen concentration in the root zone, higher uptake of nutrients and continuous maintenance of higher soil moisture content to fulfil the evapotranspirational need of the crop. Leskovar *et al* (2003) reported highest total yield at 1.0 ET (53.9 t/ ha) compared to 0.5 ET (26.8 t/ ha). Reduction in number of fruits/ plant and total yield caused by deficit irrigation are similar to those obtained by Kirnak and Dogan (2009). However, McCann *et al* (2007) reported that irrigation levels had no significant effect on yield of seedless watermelon.

CONCLUSION

The results of the present study revealed that the yield of watermelon increased under drip irrigation and fertigation than the conventional surface irrigation and soil application of fertilizer. Deficit irrigation will reduce the yield in watermelon. For open precision farming in watermelon, the fertigation level of 70:50:120 kg NPK/ ha was found ideal.

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