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Effect of fertigation on growth and fruit yield of cucumber (*Cucumis sativus* L.) grown under open ventilated polyhouse condition

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Abstract
An experiment was conducted during *kharif*, 2017 in polyhouse, Department of Agriculture, Mata Gujri College, Fatehgarh Sahib to study the effect of different level of fertigation on growth, and fruit yield of cucumber (*Cucumis sativus* L.). The experiment was laid out in randomized block design with seven fertigation treatments *viz.* T_1 - 120% RDF, T_2 - 110% RDF, T_3 - 100% RDF, T_4 - 90% RDF, T_5 - 80% RDF, T_6 - 70% RDF and T_7 - Control. The treatments were replicated thrice. On the basis of results summarized that maximum plant height (cm), days to first flowering, days to 50% flowering, days to first picking, number of primary branches, harvest duration (days) and harvest index (%) were recorded with the application of 100% RDF (T_3) which was statistically at par with application of 110% RDF (T_2) and yield attributes *viz.* average fruit weight (g), number of fruits per plant, fruit diameter (cm), fruit length (cm), fruit yield per plant (kg) and fruit yield per hectare (t) with application of 100% RDF (T_3). Thus, drip fertigation helped to improve the cucumber plant growth and fruit yield, particularly the composition 100% RDF/ha compared to others.

Keywords: Fertigation, growth, yield attributes, NPK

Introduction
Cucumber (*Cucumis sativus* L.) is most profitable vegetable crop grown under protected cultivation system all over the world and belongs to family Cucurbitaceae (El-Wanis *et al*., 2012) [3]. It comprises of 117 genera and 825 species in warmer parts of the world. The crop is the fourth most important vegetable after tomato, cabbage and onion. It is thought to be one of the oldest vegetable crops and has been found in cultivation for over 3000 years in India (Tekale *et al*., 2014) [11]. It is a warm season crop and susceptible to frost. The growth and development are favoured by temperature above 20°C. The optimum temperature for growth is between 20- 30°C. It has large nutritional values consists of energy, fat, protein, carbohydrate, dietary fiber, calcium, magnesium and potassium (Hashem *et al*., 2011) [5].
Cucumber is grown on an area of 2144 thousand hectares with a production of 80616 thousand metric tonnes and productivity of 37.600 metric tonnes per hectare in the world (Anonymous, 2017[a]) [1]. In India, it is grown on an area of 74 thousand hectares with a production of 1142 thousand million tonnes and productivity of 15.02 tonnes per hectare (Anonymous, 2017[b]) [2]. It is an important cash crop of Punjab. Cucumber occupies an area of 2.28 thousand hectares with a production of 35.09 metric tonnes in the state (Anonymous, 2017[b]) [2]. Although it is one of the major vine crop grown, its yield is quite low (Jilani *et al*., 2009) [7]. Increase in cucumber production can be achieved either bringing more area under its cultivation or by adopting improved varieties and better cultural practices. The second approach is more often preferred and among various cultural practices, fertilizer application is one of the quickest and easiest ways of increasing the yield per unit area under cucumber (Natsheh and Mousa, 2014) [8]. Fertigation is supplying fertilizers along with irrigation is one of the most effective and convenient method of supplying nutrients with water according to the specific requirements of

The crop to maintain optimum soil fertility and to increase the quality of the produce. Fertigation is the most efficient method of fertilizer application, as it ensures application of the fertilizers directly to the plant roots (Rajput and Patel, 2002) [9]. Fertilizer management is the most important agro-technique, which controls development, yield and quality of a crop. Every attempt is therefore necessary in achieving this objective of higher water and fertilizer use efficiency. Under these circumstances, fertigation is known to be hi-tech and efficient way of applying fertilizers through irrigation system as a carrier.

Materials and Methods

An experiment was conducted during *kharif*, 2017 in polyhouse, Department of Agriculture, Mata Gujri College, Fatehgarh Sahib to study the effect of different level of fertigation on growth, yield and fruit quality of cucumber (*Cucumis sativus* L.). The experiment was laid out in randomized block design with seven fertigation treatments *viz.* T_1 - 120% RDF, T_2 - 110% RDF, T_3 - 100% RDF, T_4 - 90% RDF, T_5 - 80% RDF, T_6 - 70% RDF and T_7 - Control. The treatments were replicated thrice. The soil texture of experimental site was having sandy loam with pH (8.21). It was moderately fertile, with available nitrogen (176.65kg ha^{-1}), available phosphorus (28.40kg ha^{-1}), available potassium (128.48kg ha^{-1}), organic carbon (1.27%) and electrical conductivity (0.59dS m^{-1}). The parthenocarpic cucumber hybrid variety Multi star was transplanted at a spacing of 60cm×60cm. The recommended dose of fertilizers for cucumber are 100, 50, 50 kg of N, P_2O_5 and K_2O ha^{-1}, respectively. The experimental site was kept free from weeds by manual weeding and hoeing. Plant protection measures and irrigation whenever required were provided in same manner for all the treatments. Manual harvesting was done when fruits reached at maturity stage. After that fruits of different treatments were collected separately. Yield attributes were recorded at every harvesting of crop. Thus, fruit yield of each plant was recorded as kg $plant^{-1}$ and then converted into tonnes ha^{-1}. Statistical data was analysed by standard procedure.

Result and Discussion

The result of the present study (Table-1) indicated that growth parameters such as plant height, days to first flowering, days to 50% flowering, days to first picking, number of primary branches, harvest duration and harvest index of cucumber were significantly influenced by different fertigation levels. Among the different treatments, the maximum plant height (4.54 m) was recorded in application of 100% RDF (T_3) followed by 110% RDF (T_2). Among the treatments the minimum days to first flowering (28.58) and days to 50% flowering (39.50) were recorded with application of T_3 - 100% RDF followed by T_2 - 110% RDF. The minimum days to first picking (39.50) was recorded with application of T_3 - 100% RDF followed by treatment T_2 - 110% RDF and T_4 - 90% RDF. Among the treatments, the maximum number of primary branches (12.35) and harvest duration (47.40) and harvest index (65.49) were recorded with application of T_3 - 100% RDF followed by T_2 - 110% RDF. Application of 100% RDF (T_3) gave best results in growth parameters might be due to better nutritional environment in the root zone for growth and development of plants as N and P are considered as one of the major nutrients required for proper growth and development of plant. Beside this, nitrogen is main constituent of protoplasm, cell nucleus, amino acids, chlorophyll and many other metabolic processes like transpiration (Godara *et al*., 2013) [4].

The possible reason for minimum days to first and 50% flowering can be discussed in the light of fact that fertigation plays an important role in plant metabolism by virtue of being an essential constituent of diverse type of metabolically active compounds like amino acids, proteins, nucleic acids, prophytins, nucleotide and co- enzymes and promote early flowering. The higher dose of NPK promotes vegetative growth and improves vegetation and delay flower initiation and application of 100% RDF might have provided balanced nutrition and brought better growth, development and promoted early picking (Shree *et al*., 2018) [10].

Maximum number of primary branches might be due to frequent and increased application of fertilizers directly in the vicinity of the root zone increases the availability and uptake of nutrients which leads to increase the cell size and cell elongation resulted in healthy and vigorous plant growth. The maximum harvest duration and harvest index was due to the better utilization and uptake of nutrients and excellent soil-water and air relationship with higher oxygen concentration in the root zone. It may be due to the optimum moisture conditions in the entire root zone of the crop which reflected in better physiological activities of plants resulting into increased dry matter accumulation (Godara *et al*., 2013) [4].

Yield attributes, which determine yield, is the resultant of the vegetative development of the plant. The data pertaining to yield attributes presented in Table 2 revealed significant differences among various treatments. Maximum average fruit weight (180.87g), number of fruits per plant (16.05), fruit diameter (13.04 cm), fruit length (18.09 cm), fruit yield per plant (2.90 kg) and fruit yield per hectare (72.62 t) were recorded with application of 100% RDF (T_3). The maximum weight of fruit, diameter and length of fruit which was may be due to enhanced supply of nutrients through increased fertigation level in the root vicinity of plant maintain optimum nutrient concentration in the root zone throughout the crop growth period, which increased the uptake of moisture and nutrients resulted in increasing all the growth attributes of cucumber which increases the photosynthetic rate and absorption of photosynthetically active radiation (APAR) resulted in more translocation of photosynthates towards reproductive organ (sink) which ultimately increases the yield attributes of cucumber. Present findings are accordance with Janapriya *et al*. (2010) [6] who found that significantly higher fruit yield under increased fertigation level.

Table 1: Effect of different level of fertigation on growth attributes of cucumber

Treatments	Plant height (m)	Days to first flowering	Days to 50% flowering	Days to first picking	Number of primary branches	Harvest duration (Days)	Harvest index (%)	Days to first picking
T1: 120%RDF	4.25	31.54	43.95	48.60	11.82	44.20	63.26	48.60
T2: 110%RDF	4.38	30.68	42.74	46.49	11.96	46.53	63.43	46.49
T3: 100%RDF	4.54	28.58	39.50	44.09	12.35	47.40	65.49	44.09
T4: 90% RDF	3.56	32.56	44.82	49.36	10.64	43.30	52.74	49.36
T5: 80% RDF	3.50	34.39	45.42	51.42	9.98	42.13	49.8	51.42
T6: 70% RDF	3.44	35.81	46.65	53.58	9.72	40.27	45.76	53.58

T7: Control	2.81	37.96	48.25	55.96	8.57	39.17	42.47	55.96
SE (m) ±	0.11	0.38	0.64	0.51	0.28	0.67	0.75	0.51
$CD_{(0.05)}$	0.33	1.17	1.96	1.56	0.86	2.06	2.32	1.56

Table 2: Effect of different level of fertigation on yield attributes of cucumber

Treatments	Average fruit weight (g)	Number of fruits per plant	Fruit diameter (cm)	Fruit length (cm)	Fruit yield per plant (kg)	Fruit yield per hectare (t)
T1: 120% RDF	168.93	14.18	11.82	16.21	2.40	59.88
T2: 110% RDF	175.93	15.28	12.83	17.25	2.69	67.24
T3: 100% RDF	180.87	16.05	13.04	18.09	2.90	72.62
T4: 90% RDF	163.57	14.04	10.97	15.88	2.30	57.39
T5: 80% RDF	159.07	13.73	10.38	15.01	2.18	54.58
T6: 70% RDF	154.93	12.16	10.16	14.63	1.88	47.10
T7: Control	143.43	11.36	9.78	14.06	1.63	40.73
SE (m) ±	2.16	0.36	0.25	0.29	0.08	1.98
$CD_{(0.05)}$	6.66	1.12	0.76	0.90	0.25	6.25

Conclusion

On the basis of results summarized above, it can be concluded that out of different treatments evaluated application of 100% RDF gave best results with respect to all growth and yield parameters. Thus, drip fertigation helped to improve the cucumber plant growth and fruit yield, particularly the composition 100% RDF/ha compared to others. Therefore, be recommended to the growers after on-farm testing in multi-location trials for optimum growth, higher yield in cucumber grown under open ventilated poly house condition.

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