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Response of Cucumber (*cucumis sativus*) to different Irrigation Levels under Polyhouse

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Abstract

An experiment was conducted on cucumber cultivation, in naturally ventilated polyhouse (NVP) at Jabapur in the month of August-December for two consecutive years 2014 and 2015 with gynoecious cucumber variety – Sandhya, F_1 hybrid. Irrigation levels significantly affected ($P < 0.05$), cucumber plant height, number of fruits/plant and yield. Fruit length and fruit girth were not affected by irrigation levels but fruit weight was affected. Highest plant height (440.9 cm), maximum number of fruits/plant (14.11) and highest cucumber yield (55.09 tonnes/ha) was achieved in 100% CPE treatment.

Key words: *Naturally ventilated polyhouse (NVP), Cumulative pan evaporation (CPE), Drip irrigation, Gynoecious cucumber, Cucumber yield.*

Introduction

Water is an important input for cucumber cultivation in NVP because irrigation is the only source for application of water to the plants. Several efforts have been mode to use irrigation as efficient as possible under protected cultivation system[1]. The use of drip irrigation saves water and gives better yield and quality as it reduces the humidity build up inside NVP after irrigation due to precise application of water to the root zone of the crop[2]. For the efficient use of water in cucumber cultivation under NVP, the knowledge of irrigation levels is necessary. So, an experiment was conducted in agro climatic conditions of central Madhya Pradesh, to find out the optimum irrigation level for cucumber cultivation in NVP when water is applied via drip irrigation system.

Materials and methods

A study was carried out in Jawaharlal Nehru Krishi Vishwa Vidyalaya (JNKVV), Jabalpur, Madhya Pradesh on cucumber cultivation under polyhouse. The study was taken up at Hi Tech Horticulture Farm of JNKVV in Naturally ventilated polyhouse (NVP) for two consecutive years, 2014 and 2015. Ridge and furrow type polyhouse was used for the study. The polyhouse structure was constructed with G.I. pipes and oriented in north-south direction. Ultra-violet stabilized polythene film of 200 micron thickness was used to cover the G.I. pipes structure. Insect proof net was also provided in the sidewall and roof for proper ventilation. The cultivable floor area of polyhouse was around 1000 m^2. The highly porous and well drained raised beds was prepared in polyhouse by red soil (250 m^3), FYM (2 tonnes), rice husk (45 m^3) and gravel sand (10 m^3).

The drip unit of experimental set up contains all the necessary equipments and accessories required for irrigation and fertigation. It made of filtering unit (sand filter

and screen filter), conveyance unit (main, sub mains and in-line laterals) and fertigation unit (ventury meter with booster pump). A 5 HP submersible pump was used to lift water from the underground RCC tank and supply it to the drip irrigated plots. The underground main and sub main pipelines used for drip irrigation were made of PVC pipes of 75 mm and 63 mm diameter respectively. LLDPE laterals of 16 mm diameter were used. This lateral line had in-line drippers of 2 lph discharge at 20 cm spacing. The flow control valves were provided in the sub mains and at the head of each lateral.

Cucumber seedlings were prepared in trays inside NVP. Sandhya variety (F_1 hybrid) was used for nursery rising and 15 day old seedlings were transplanted on raised beds. Raised beds were prepared by porous soil media and were 18.0 m in length, 0.70 m in width and 0.25 m in height. Working path spacing of 0.40 m was maintained between the beds. Area of each bed/treatment was 20 m^2. Forty cucumber seedlings were transplanted in a single row on each bed/treatment in zigzag pattern at 0.45 m apart. Cucumber seedlings were transplanted on 13 and 25 September in 2014 and 25 respectively. All cultural operations were same for all the treatments and were attended regularly, except irrigation and fertigation. First picking of cucumber fruits was done at 30 Days After Transplanting (DAT). The subsequent pickings were done at an interval of 5 to 7 days. Last (9^{th}) picking was done on 4 and 18 December in 2014 and 2015 respectively.

The experiment was laid out in factorial randomized block design (FRBD) with three replications in naturally ventilated polyhouse (NVP). Experiment was designed with 4 irrigation levels and 4 fertigation levels, and in all consist 16 treatments. Irrigation water application was based on the actual evaporation, which was recorded daily in the meteorological observatory at College of Agricultural Engineering, JNKVV, Jabalpur. The daily evaporation readings were noted and irrigation was applied, on alternate day, according to cumulative pan evaporation (CPE) of two days. The four irrigation levels (treatments) were 100% CPE, 80% CPE, 60% CPE and 40% CPE. The total amount of water applied during cucumber cultivation in different treatments is given in Table 1.

Table 1 Total water applied in different treatments

Year	Depth of Irrigation (mm)				No of Irrigations
	40% CPE	60% CPE	80% CPE	100% CPE	
2014	108.36	159.04	209.72	260.40	41
2015	99.72	146.08	192.44	238.80	42

Growth of cucumber plants, quality of cucumber fruits and cucumber yield were studied by this experiment. Plant height and flower appearance observations were recorded for growth study. Observations related with length, girth and weight of fruits were recorded for fruit quality study. For cucumber yield study, observations related with numbers of fruits per plant, fruit yield per plant and fruit yield per hectare were recorded. Standard procedures were used for recording observations. Statistical analysis of the individual year data was performed using FRBD with three replications. Pooled analysis of two year data was also performed to identify the average effect of irrigation over two years. The level of the significant difference (LSD at $P < 0.05$) was used in the ANOVA to test the effect of irrigation levels on different response variables.

Results and Discussion

Height of cucumber plants at harvest stage, in 2014 and 2015 and their mean is given in Table 2. Plant height of cucumber varied significant according to irrigation levels

in NVP. Highest plant height (440.9 cm) was found in 100% CPE, which was at-par with 80% CPE (401.5 cm). Plant height of 100% CPE treatment was and significantly higher over 60% and 40% CPE treatment (354.2 and 339.9 cm respectively) (Fig. 1a). Flower appearance after transplanting was also observed in all treatments. Irrigation levels were not affected the flower appearance (Table 2). Flower appearance is predominantly a varietal characteristic, probably so it was not affected by irrigation levels. The earliest flower appearance was in 100% CPE (20.8 Days After Transplanting - DAT) and the lasts flower appearance was observed in 80% CPE (21.9 DAT) (Fig. 1b).

Table 2 – Plant height (at harvest) and flower appearance of cucumber as influenced by irrigation levels inside NVP

		40% CPE	60% CPE	80% CPE	100% CPE	CD (0.05)
Plant height (cm)	**2014**	353.0	366.6	404.2	448.4	49.95
	2015	326.8	341.7	398.7	433.5	42.28
	Mean	**339.9**	**354.2**	**401.5**	**440.9**	**S**
Flower appearance (Days After Transplanting)	**2014**	21.3	21.6	21.5	20.8	1.59
	2015	21.5	21.2	22.3	20.8	2.00
	Mean	**21.4**	**21.4**	**21.9**	**20.8**	**NS**

S - Significant, NS - Non Significant

Length, girth and weight of cucumber fruits were taken at 2nd, 5th and 8th pickings. On the analysis of these data we found that, length and girth of fruit was unaffected by irrigation levels at all the pickings. Weight of five fruits of cucumber was affected significantly by irrigation levels at 5th picking stage. Difference in fruit weight according to irrigation levels was also existed at 2nd and 8th pickings, but it was below the least critical difference. Length, girth and weight of five fruits of cucumber at 5th picking stage, is given in Table 3 and effect of irrigation levels on these parameters is illustrated by Fig. 2(a, b, c). Highest fruit length (15.0 cm) was found in 100% CPE, which was at-par with other treatments. Similarly highest fruit girth (14.6 cm) was also found in 100% CPE, which was at-par with other treatments. Weight of five fruits of cucumber was found highest (1.09 kg) in 100% CPE, which is significantly superior over 40% and 60% CPE and at par with 80% CPE.

Table 3 – Length, girth and weight of cucumber fruits as influenced by irrigation levels inside NVP

		40% CPE	60% CPE	80% CPE	100% CPE	CD (0.05)
Fruit length (cm)	**2014**	14.5	14.8	14.8	15.1	1.07
	2015	14.4	14.8	14.8	14.9	0.99
	Mean	**14.5**	**14.8**	**14.8**	**15.0**	**NS**
Fruit girth (cm)	**2014**	13.7	14.2	14.4	14.5	0.92
	2015	14.2	14.2	14.6	14.7	0.84
	Mean	**14.0**	**14.2**	**14.5**	**14.6**	**NS**
Weight of five fruits of cucumber (kg)	**2014**	0.99	1.04	1.06	1.06	0.05
	2015	1.01	1.05	1.09	1.12	0.06
	Mean	**1.00**	**1.04**	**1.07**	**1.09**	**S**

S - Significant, NS - Non Significant

Table 4 – Number of fruits/plant, fruit yield/plant and fruit yield/ha of cucumber as influenced by irrigation levels inside NVP

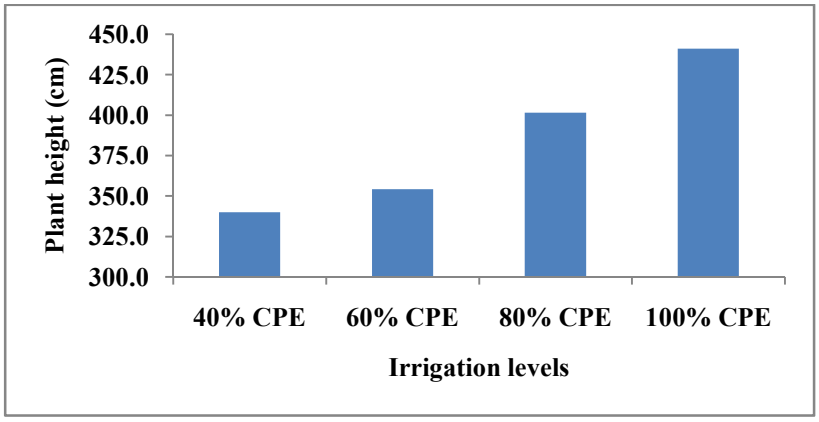
		40% CPE	60% CPE	80% CPE	100% CPE	CD (0.05)
Number of fruits/plant	**2014**	8.88	10.61	12.58	13.75	1.53
	2015	9.70	11.64	13.11	14.48	1.41
	Mean	**9.29**	**11.12**	**12.85**	**14.11**	**S**
Fruit yield/plant (kg)	**2014**	1.64	1.99	2.36	2.63	0.28
	2015	1.76	2.19	2.58	2.88	0.26
	Mean	**1.70**	**2.09**	**2.47**	**2.75**	**S**
Fruit yield/ha (tonnes)	**2014**	32.75	39.76	47.23	52.54	5.65
	2015	35.19	43.78	51.61	57.64	5.09
	Mean	**33.97**	**41.77**	**49.42**	**55.09**	**S**

S - Significant, NS - Non Significant

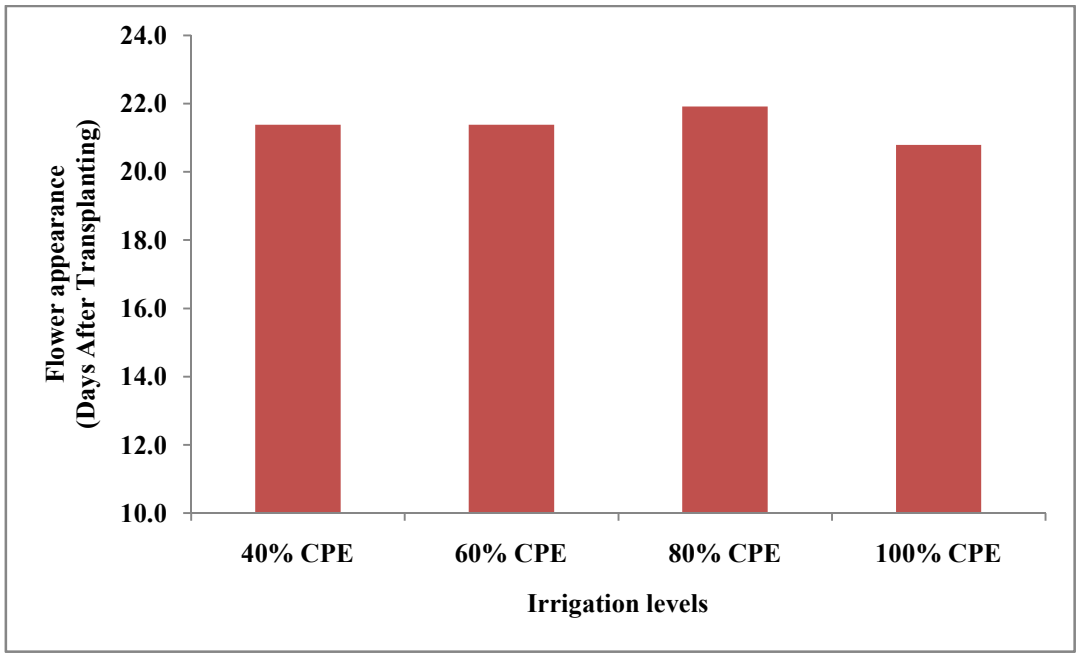
Yield of cucumber in NVP was greatly affected by irrigation levels. All the yield parameters, number of fruits/plant, fruit yield/plant and fruit yield/ha were recorded maximum in 100% CPE irrigation level. Number of fruits/plant was found maximum in 100% CPE (14.11 fruits), which was significantly higher over 40% CPE (9.29 fruits) and 60% CPE (11.12 fruits) and at-par with 80% CPE (12.85 fruits) (Table 4, Fig. 3a). Fruit yield/plant was found maximum in 100% CPE (2.75 kg), which was significantly higher over 40% CPE (1.70 kg), 60% CPE (2.09 kg) and 80% CPE (2.47 kg) (Table 4, Fig. 3b). Similarly fruit yield/ha was found maximum in 100% CPE (55.09 tonnes), which was significantly higher over 40% CPE (33.97 tonnes), 60% CPE (41.77 tonnes) and 80% CPE (49.42 tonnes) (Table 4, Fig. 3c).

Conclusion

Water management is important for achieving higher cucumber yield, especially in cultivation of cucumber under polyhouse. In NVP, we can not only maintain optimal features of cucumber growth, but also maintain cucumber yield and improve fruit quality by irrigation. Based on the results of the present study, it can be concluded that the alternate day irrigation water application, based on 100% of cumulative pan evaporation of two days, was recommended for cucumber grown under polyhouse in order to get higher yield and uniform fruit size for the agro-climatic conditions of central Madhya Pradesh.

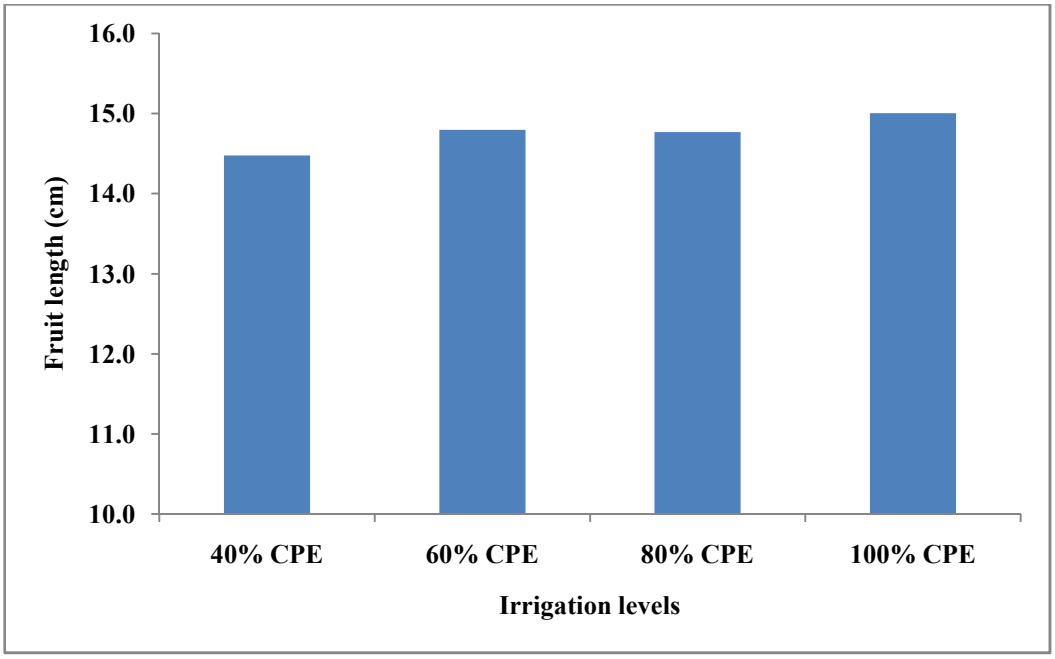


1(a)

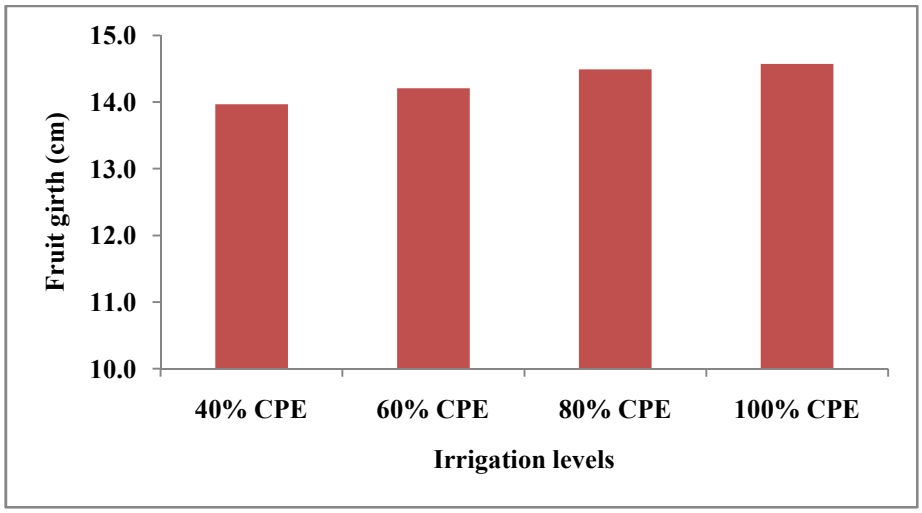


1(b)

Fig. 1(a, b) – Effect of irrigation levels on growth parameters of cucumber plant



2(a)



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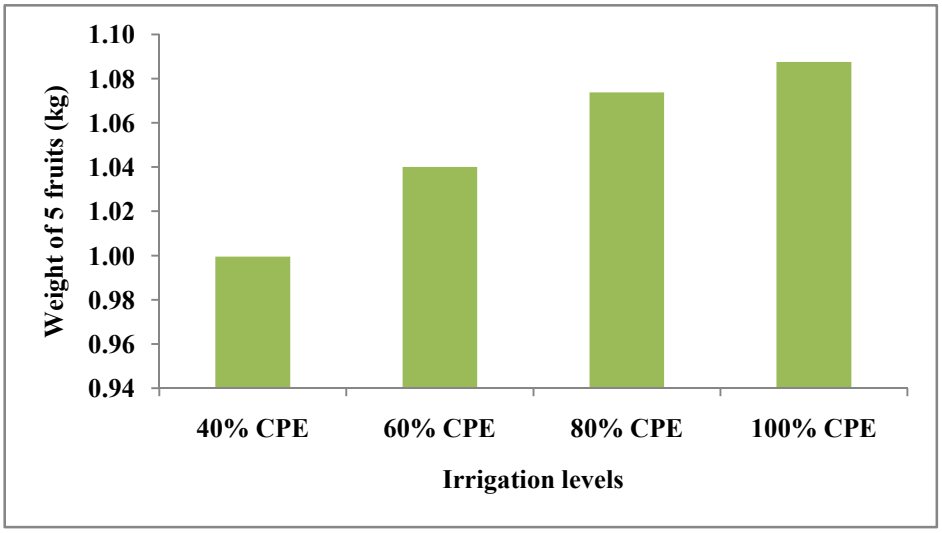
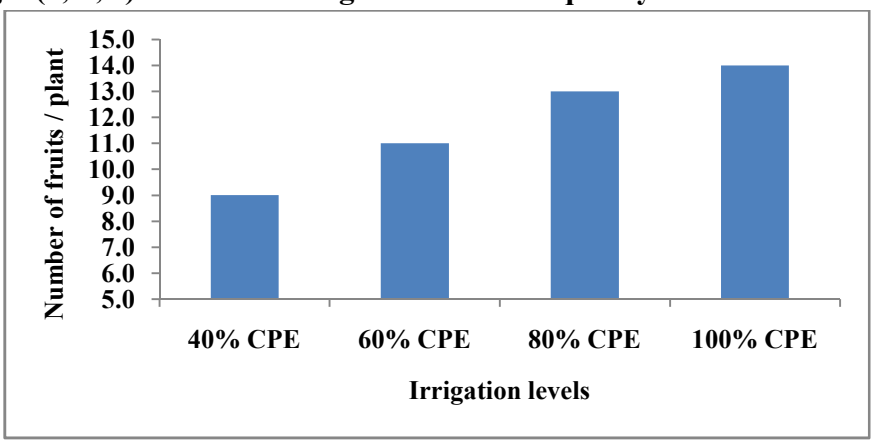
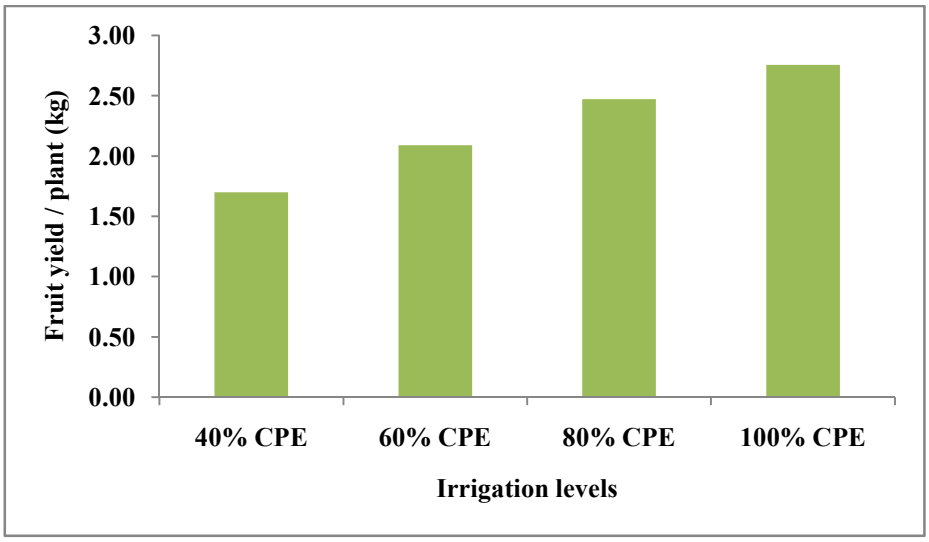


2(c)

Fig. 2(a, b, c) – Effect of irrigation levels on quality of cucumber fruits



3(a)



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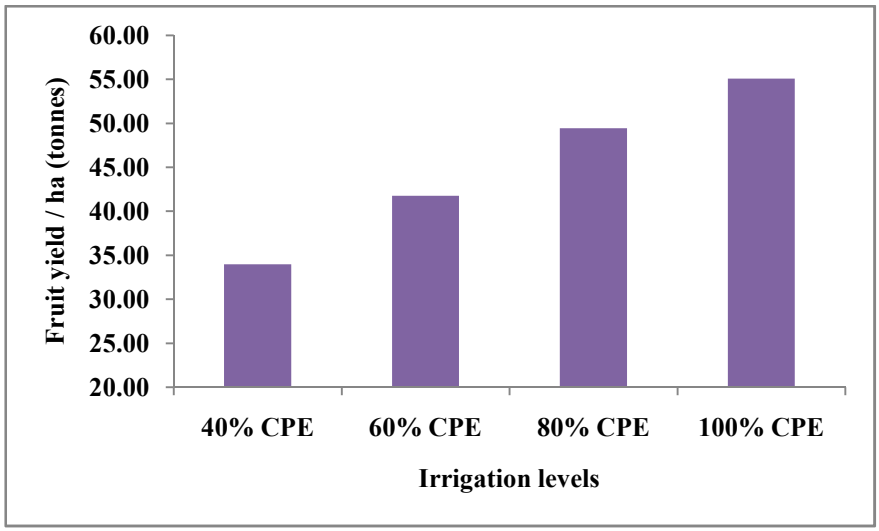

3(c)

Fig. 3(a, b, c) – Effect of irrigation levels on cucumber yield inside NVP

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