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Influence of integrated nutrient management and split application of fertilizers on yield of cucumber (*Cucumis sativus* L.) under protected condition

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Abstract
A research was conducted at Hi-tech Horticulture Park, College of Horticulture, Junagadh Agricultural University and Junagadh during the year 2021-22. The treatments comprised of four levels of organic and inorganic fertilizer doses (F) *viz.*, F1 = 100 % RDF + 20 t/ha FYM; F2 = 100% RDF + 5t/ha FYM + 1 t/ha Neem cake + 3 Kg/ha biofertilizer; F3 = 75 % RDF + 10 t/ha FYM + 1.5 t/ha Neem cake + 3 Kg/ha biofertilizer and F4 = 50 % RDF + 15 t/ha FYM + 2 t/ha Neem cake + 3 Kg/ha biofertilizer, with three levels of split application (S) *viz.*, S1 = 3 splits; S2 = 4 splits and S3 = 5 splits. Among different treatments, the application organic and inorganic fertilizer doses 75% RDF + 10 t/ha FYM + 1.5 t/ha Neem cake + 3 Kg/ha improved the growth and yield of cucumber. Similarly, 5 split application of soluble chemical fertilizers the improved the growth and yield of cucumber. Thus, the combined application of organic and inorganic fertilizer doses 75% RDF + 10 t/ha FYM + 1.5 t/ha Neem cake + 3 Kg/ha with 5 split applications through fertigation, improved yield attributing characters of cucumber.

Keywords: Cucumber, INM, fertigation, split application, yield

Introduction
Cucumber (*Cucumis sativus* L.) which is known by its vernacular name as "*Khira*". It is an important vegetable crop belongs to the family Cucurbitaceae. It is commonly grown throughout the India in open condition as well as in green houses. Cucumber which comprises of 117 genera and 825 species in warmer parts of the world (Gopalkrishnan, 2007) [4]. 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) [10]. Cucumber is a thermophilic and frost susceptible species growing best at temperature above 20 °C. The crop is the fourth most important vegetable crop after tomato, cabbage and onion in Asia (Singh *et al.*, 2017) [9]. The immature fruits of cucumber are eaten raw as salad and cooked vegetable. It has tremendous economic and dietic importance. Cucumber consists of 95 per cent water, keeping the body hydrated to eliminate toxins and have a cooling effect. It contains an organic substance called cucurbitacin (Bhattacharya *et al.*, 2015) [1]. Among the various advanced techniques developed to achieve breakthrough in productivity of vegetable crops; cultivation of this crop in protected environment (glasshouse, greenhouse or plastic house) has proved, beyond doubt, the vast potential to increase yields in manifold. Use of organic, inorganic and bio-fertilizers have played a very important role in determining the yield of the crop in the recent times. The basic concept of Integrated Nutrient Management (INM) is to maintain or adjust the soil fertility and plant nutrient supply in long run to reach the optimum level for sustaining crop production and optimization of the benefits from all possible sources involving inorganic fertilizers, biological sources and organic manures. The protected vegetable cultivation technology can be utilized for the year-round production of high value quality vegetable crops. Influence of various organic, inorganic and bio-fertilizer source of nutrients with split application of fertilizer at optimum level on growth and yield parameters of cucumber under polyhouse conditions can be utilized for the year-round production of high value quality vegetable crops. Therefore, keeping in view all the perspectives of protected cultivation and fertigation, the present investigation was framed to study the performance of greenhouse cucumber in varying levels of fertilizer doses of split application.

Materials and Methods

The experiment was conducted at Hi-tech Horticulture Park, College of Horticulture, Junagadh Agricultural University, Junagadh during the year 2021-22. Naturally Ventilated Polyhouse (9.5 m x 21.00 m size) erected at Hi-tech Horticulture Park, College of Horticulture, JAU, Junagadh was used to conduct the experiment. U.V. stabilized 200 µm thickness polyhouse film was used as cladding material. It covered ventilators manually operated moveable curtains were provided on sidewalls. For control of temperature and humidity misting system was provided. The treatment was laid out in Completely Randomized Design with factorial concept with twelve treatment combinations with three replications. The treatments comprised of four levels of organic and inorganic fertilizer doses *viz.*, F1 = 100% RDF + 20 t/ha FYM; F2 = 100% RDF + 5 t/ha FYM + 1 t/ha Neem cake + 3 Kg/ha biofertilizer; F3 = 75% RDF + 10 t/ha FYM + 1.5 t/ha Neem cake + 3 Kg/ha biofertilizer and F4 = 50% RDF + 15 t/ha FYM + 2 t/ha Neem cake + 3 Kg/ha biofertilizer, with three levels of split application (S) *viz.*, S1 = 3 splits; S2 = 4 splits and S3 = 5 splits.

All the selected plants were almost uniform in growth and vigour and were given uniform cultural operations. Observations on Fruits Length, Fruit girth, Fruit weight, Number of fruits per vine, Fruits yield (kg/vine, kg/plot, t/ha). Statistical analysis was done by using method of analysis of variance (ANOVA) for FCRD by Panse and Sukhatme (1967) [6].

Results and Discussion

The results were presented that among four different organic and inorganic fertilizer doses, F3 (75 % RDF + 10 t/ha FYM + 1.5 t/ha Neem cake + 3 kg/ha biofertilizer) gave maximum fruit length (19.68 cm), fruit girth (5.31cm), fruit weight (220.69 g), number of fruits per vine (10.89, 12.08 kg/vine, 41.63 kg/plot, 57.76 t/ha). This might be due to Integrated use of biofertilizers, organic manures and chemical fertilizers increased the yield attributes due to the fact that increasing major elements particular N level through biofertilizers and organic manures might have accelerated the synthesis of chlorophyll and amino acids (Develin, 1973) resulting more translocation of photosynthates from leaves to fruits caused increased size and weight of fruits (Singh *et al.* 1997) [8]. More number of fruits per vine may be minimum number of days taken for female flower production apparently leading to highest number of fruits. Similar findings are quoted from the experimental trial conducted by Prabhu *et al.* (2006) [7] and Narayanamma *et al.* (2010) [5] in cucumber. These results indicated that the role of biological components like Azotobacter in faster nitrogen fixation and PSB in phosphorus solubilization in combination with the quick release of available nutrient from the inorganic fertilizers coupled with micronutrients and vitamins from organic manure like neem cake. More number of fruits per plant and fruit weight per plant ultimately resulted in more fruit yield per vine. Present findings are in conformity with the reports of Choudhari and More (2002) [2] in cucumber. The possible reason behind allowing maximum number of female flowers throughout the life span leading to more number of fruits which has ultimately contributed to the highest yield.

Table 1: Effect of organic and inorganic fertilizer doses and split application on physical parameters of cucumber

Treatments	Fruit Length (cm)	Fruit Girth (cm)	Fruit Weight (g)	Number of fruits per vine
Factor A: organic and inorganic fertilizer doses (F)				
F1	13.15	4.68	120.46	8.74
F2	18.04	4.72	169.35	9.66
F3	19.68	5.31	220.69	10.89
F4	16.01	4.71	141.25	9.49
S.Em±	0.247	0.128	3.024	0.175
C.D. at 5%	0.70	0.34	8.61	0.50
Factor B: Split applications (S)				
S1	15.58	4.60	141.25	9.24
S2	16.80	4.99	157.17	9.81
S3	17.78	5.01	190.40	10.04
S.Em±	0.214	0.111	2.619	0.151
C.D. at 5%	0.61	0.31	7.45	0.43
Interaction (F x S)				
S.Em±	0.428	0.221	5.237	0.302
C.D. at 5%	NS	NS	14.90	0.86
C.V. %	4.44	7.87	5.57	5.40

Table 2: Effect of organic and inorganic fertilizer and split application on yield of cucumber

Treatments	Fruit yield (kg/vine)	Fruit yield (kg/plot)	Fruit yield (t/ha)
Factor A: organic and inorganic fertilizer doses (F)			
F1	1.23	24.69	31.78
F2	1.58	34.02	42.15
F3	2.08	41.63	57.76
F4	1.41	28.29	38.11
S.Em±	0.039	0.789	1.041
C.D. at 5%	0.11	2.25	2.96
Factor B: Split applications (S)			
S1	1.46	29.27	40.70
S2	1.50	31.90	41.94
S3	1.76	35.30	44.72
S.Em±	0.034	0.683	0.902
C. D. at 5%	0.10	1.94	2.57
Interaction (F x S)			
S.Em±	0.0670	1.366	1.803
C.D. at 5%	0.19	3.89	5.13
C.V. %	7.36	7.36	7.36

Table 3: Interaction effect of organic and inorganic fertilizers doses and split application on yield parameters and physical parameters of cucumber

Treatment Combinations	Fruit Weight (g)	Number of fruits per vine	Fruit Yield (kg/vine)	Fruit Yield (kg/plot)	Fruit Yield (t/ha)
F1S1	90.43	8.23	1.11	22.13	30.74
F1S2	99.88	8.90	1.14	22.73	31.01
F1S3	171.06	9.09	1.46	29.20	33.61
F2S1	164.59	9.84	1.69	33.80	46.95
F2S2	170.67	9.88	1.34	34.13	37.13
F2S3	172.80	9.25	1.71	34.13	42.38
F3S1	206.64	10.05	1.73	34.62	48.25
F3S2	225.83	10.80	2.14	42.73	59.25
F3S3	229.61	11.83	2.37	47.53	65.77
F4S1	103.35	8.84	1.33	26.53	36.85
F4S2	132.28	9.65	1.40	28.00	40.36
F4S3	188.13	10.00	1.52	30.35	37.11
S.Em±	5.237	0.302	0.0670	1.366	1.803
C.D. at 5%	14.90	0.86	0.19	3.89	5.13
C.V. %	5.57	5.40	7.36	7.36	7.36

Conclusion

It is concluded that the application of organic and inorganic fertilizers 75 % RDF through fertigation + 10 t/ha FYM + 1.5 t/ha Neem cake + 3 kg/ha biofertilizer by soil application; with 5 splits at 12 days interval improved yield and yield attributing in cucumber cultivation.

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