The Pharma Innovation Journal 2022; SP-11(3): 1718-1723

www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2022; SP-11(3): 1718-1723

www.thepharmajournal.com
Received: 23-01-2022
Accepted: 25-02-2022

Abhilash Singh
Department of Vegetable Science, GBPUA&T, Pantnagar, Udham Singh Nagar Uttarakhand, India

Dhirendra Singh
Department of Vegetable Science, GBPUA&T, Pantnagar, Udham Singh Nagar Uttarakhand, India

Lalit Bhatt
Department of Vegetable Science, GBPUA&T, Pantnagar, Udham Singh Nagar Uttarakhand, India

PK Singh
Department of Irrigation & Drainage Engineering, GBPUA&T, Pantnagar, Udham Singh Nagar, Uttarakhand, India)

Poonam Gautam
Department of Soil Science, GBPUA&T, Pantnagar, Udham Singh Nagar, Uttarakhand, India

Corresponding Author
Abhilash Singh
Department of Vegetable Science, GBPUA&T, Pantnagar, Udham Singh Nagar Uttarakhand, India

Effect of fertigation and scheduling on growth attributes of cucumber under polyhouse

Abhilash Singh, Dhirendra Singh, Lalit Bhatt, PK Singh and Poonam Gautam

Abstract
The experiment was carried out during two consecutive seasons of 2020 and 2020-2021 (*i.e.* summer and winter respectively) at Vegetable Research Centre of G.B. Pant University of Agriculture and Technology, Pantnagar, Uttarakhand (India), to study the effect of NPK fertigation and scheduling on growth attributes of cucumber (*Cucumis sativus* L.) under polyhouse. The experiment consisted of four levels of fertigation (120:60:60, 100:50:50, 80:40:40 and 60:30:30 N, P_2O_5 and K_2O kg ha^{-1}, respectively) and two levels of scheduling which were based on growth curve of cucumber S_1 [25 per cent of each N, P_2O_5 and K_2O at 30 day interval after first fertigation, respectively] and S_2 [25% of N, P_2O_5 and K_2O, 25% N, 15% P_2O_5 and 20% K_2O, 40% N, 15% P_2O_5 and 25% K_2O, 20% N, 50% P_2O_5 and 40% K_2O and 15% N, 20% P_2O_5 and 15% K_2O at each 30 days interval after first fertigation] *i.e.* eight treatments with one extra treatment (recommended dose of fertilizer through traditional methods). It consists of total nine treatments. The experiment was laid out in factorial Randomized Block Design (FRBD) with three replications. The results from the study revealed early flowering recorded with 60 percent of RDF through fertigation, maximum number of tendrils (40.55 and 41.02) and nodes (28.57 and 29.53) were recorded with plant receiving 120 per cent fertigation. Among scheduling maximum number of tendrils (39.14 and 40.27) and nodes at final harvest (28.20 and 28.81) were recorded. From the study, it was concluded that fertigation of 120 kg N, 60 kg P_2O_5 and 60 kg K_2O ha^{-1} with S_2 can be recommended for cucumber cultivation under polyhouse condition.

Keywords: Cucumber, fertigation, growth, polyhouse

Introduction
Cucumber (*Cucumis sativus* L. 2n = 14) one of the popular and widely grown vegetable crop in the world, is the oldest cultivated vegetable crop grown by early man (Eifediyi & Remison, 2010) [2], which is considered one of the main greenhouse crop among vegetables. Whereas, cucumber fruit is a moisturizer for the human body and reduces the need for water in human's body. Fertilizer is a major part of the crop expenses for cucumber production, and it is critical for successful crop yields and high fruit quality. Fertilizer necessities of cucumber are quite high due to its high yielding potential per unit area and time. Consequently, mineral nutrition with suitable levels of nitrogen (N), phosphorus (P) and potassium (K) had a key role for improving the growth and fruit yield of cucumber, as well as influencing the cucumber plant's ability to resist against negative effects from pests, water, temperature, and other stresses. N, along with P and K, are classified as primary macronutrient, these are needed in relatively large quantities and are often deficient in crops not receiving fertilizer application (Marschner, 1986) [7]. Use of drip irrigation within vegetable production, under the greenhouse, causes restriction of the plant root system spread and concentrated only in the wetness root zone. For this reason frequent supply of irrigation water and fertilizers (fertigation) for the root zone soil (rhizosphere) is required (Kohzushka and Romanets, 1994; Qasim *et al.*, 2008) [5, 8]. However, the excessive use of NPK fertilizers create pollution of agro-ecosystem through contamination of underground water with nitrate (NO_3) and increasing NO_3 accumulation in food chain causing hazardous effects, as well as destroy micro-organisms and friendly insects, making the crop more disposed to diseases and reduced soil fertility (Fischer and Richter, 1984; Mahdi *et al.*, 2010) [4, 6]. Moreover, most NPK fertilizers possess high solubility and the crop uses about 50 of the amount applied especially in the sandy soil and the rest lost by lixiviation, or goes into the atmosphere. Therefore, improving the agricultural practices of cucumber crop production under drip fertigation are of great economic interest. Fertigation has been found to be one of the most successful way for application of water and nutrient, particularly, N, K and

micronutrient. The appropriate combination of water and nutrients in fertigation program is the key for high yield and quality of cucumber. Considerable amounts of investigations were done to determine the impact of the NPK fertigation rates on the growth and fruit yield of the cucumber and other vegetables (Feleafel and Mirdad, 2013) [3]. In India, most of the cucumber farmers do not use any soil or water analysis for planning their program of fertigation. They usually depend on their own expertise. Moreover, fertilization recommendations, based on research conducted regionally or locally, showed their variations between the different regions of the country. Therefore, it is important to recognize these regional differences when formulating the program of fertigation. In addition, few studies reported the effect of drip fertigation rate and it's scheduling on the growth, fruit yields, and mineral contents of cucumber. This research is an attempt to form strong roots in the early growth stages by using fertilizers on the basis of growth curve of cucumber and thus increase the NPK fertigation use efficiency through planning strategic program for irrigation water and fertigation rates. The aim of this study was to investigate the effect of the NPK fertigation rates and its scheduling on growth, fruit yield, and minerals contents of cucumber plants grown an under polyhouse.

Materials and Methods

An experiment was carried out at cucumber cultivation under polyhouse. The study was taken up at Vegetable Research Centre (VRC) of G.B. Pant University of Agriculture and Technology, Pantnagar, U.S. Nagar (Uttarakhand) India having two consecutive seasons *i.e.* summer (2020) and winter (2020-2021). The size of raised beds was prepared 20.0 m in length, 0.60 m in width. The seeds were sown with spacing of 0.60 x 0.50 m spacing with 2-2.5 cm of depth. The experiment was laid out in factorial randomized block design (FRBD) with one additional treatment. The experiment was designed with 4 fertigation levels and 2 scheduling of fertigation levels which was based on growth curve of cucumber, with one additional treatment [Soil application of RDF with surface irrigation (flooding)]. The nitrogen, phosphorus and potassium were applied in the form of NPK (19:19:19), urea, single super phosphate (SSP) and muriate of potash (MOP). All the cultural practices were done at regular intervals with the requirement of crop during the course of investigation. Similarly, plant protection measures were also done with spraying fungicides and insecticides like mancozeb, monocrotophos and thiamethexon. During experimentation, various observations on growth parameters with were recorded during whole of the cropping period. The data on various parameters studied during the course of investigation was statistically analysed by applying two stage method of control vs rest analysis suggested by Rangaswamy (2015). Total number of treatments was nine with three replications. The treatment details are given following:

Treatment details

A) Fertigation levels : 4

F_1: 120 per cent of RDF
F_2: 100 per cent of RDF
F_3: 80 per cent of RDF
F_4: 60 per cent of RDF

B) Scheduling of fertigation levels throughout the growth period: 2

1. **S_1:** 25 per cent of each N, P_2O_5 and K_2O between 5-35 days after sowing (DAS), 36-65 DAS, 66-95 DAS and 96-125 DAS, respectively
2. **S_2:** 25, 15 and 20 per cent N, P_2O_5 and K_2O of fertigation levels between 05 to 35 DAS, respectively, 40, 15 and 25 per cent N, P_2O_5 and % K_2O of fertigation levels between 36 to 65 DAS, respectively, 20, 50 and 40 per cent N, P_2O_5 and % K_2O of fertigation levels between 66 to 95 DAS, respectively, 15, 20 and 15 per cent N, P_2O_5 and % K_2O of fertigation levels between 96 to 125 DAS, respectively.

C) Soil application of RDF with surface irrigation (flooding)

*RDF: Recommended dose of fertilizer

Results and discussion

Emergence (%)

The emergence per cent was calculated by number of seed germinated multiply by 100 and divided by number of seed sown. It is evident from data (Table 1) that the effect of fertigation levels and scheduling was found non-significant on emergence per cent of cucumber in both seasons (*i.e.* summer and winter season, respectively) of experiment. There was also no significant difference between control and fertigation treatments with respect of said treatment. Also no significant interaction was recorded between fertigation levels and scheduling. These observations obtained during course of investigation were similar to the findings of Rehman *et al.* (1995) in cucumber.

Days to 50% germination

As evident from Table 1, there was no significant variation of fertigation levels and scheduling on days taken to 50 per cent germination. Besides this, statistical similarity was also evident between control and other fertigation treatments as 50 per cent of seed almost germinated together in all the treatments. Also, no interaction was analyzed between fertigation levels and its scheduling during both summer (first season) and winter season (second season) of experiment.

Days to first flower appearance

Perusal of data depicted in Table 1, clearly revealed that NPK fertigation levels had a significant impact on days taken to first flower appearance in plant, while scheduling and the interaction effect of these two factors were found to be non-significant for the said parameter.

During the first season (summer) of trial, among the fertigation levels studied minimum days taken to appear first flower were counted in application of 60 per cent of RDF through fertigation (34 days) followed by F_3 (35 days), whereas maximum days taken to appear first flower were counted in plants receiving fertigation at 120 per cent of RDF (40 days). Similar to first season, second season data revealed the minimum number of 32 days taken to appear first flower recorded under treatment F_4 and maximum days were observed in F_1 (38 days).

The difference in days taken to first flower appearance between the soil application of RDF with surface irrigation (control) and rest of the fertigation treatments was found significant for both the season of study. The days taken to first flower appearance under control were recorded to be 40 and 39 days in summer season and winter season, respectively. While, under fertigation treatments the days taken to appear first flower were 37 and 35 days in first and second season,

respectively.

Under reduced level of fertigation crop experienced, the nutrient stress during the initial stage because of that the vegetative growth of crop was inhibited. The judicious and frequent application of nutrients to crop extended the vegetative phase of crop results in more number of days required to first flower initiation. Similar trend was noticed by Umamaheswarappa *et al.* (2005) [10] and Tiwari (2013) [9] in cucumber.

Table 1: Effect of fertigation levels (NPK) and its scheduling on emergence (%), days to 50% of germination and days to first flowering of cucumber

Treatments	Emergence (%)		Days to 50% germination		Days to first flowering	
	Summer season	Winter season	Summer season	Winter season	Summer season	Winter season
Fertigation levels						
F_1	98.04	99.02	10	9	40	38
F_2	97.89	98.44	10	9	37	35
F_3	97.69	98.03	10	9	35	33
F_4	97.30	97.64	11	10	34	32
SEm±	0.49	0.36	0.28	0.36	0.30	0.94
CD (5%)	NS	NS	NS	NS	0.89	2.82
Scheduling						
S_1	97.70	98.25	10	9	37	35
S_2	97.76	98.31	10	9	36	35
SEm±	0.34	0.25	0.20	0.25	0.21	0.67
CD (5%)	NS	NS	NS	NS	NS	NS
Control vs Rest						
Control	97.21	97.55	11	10	40	39
Rest	97.73	98.28	10	9	37	35
SEm±	0.52	0.38	0.29	0.38	0.32	1.00
CD (5%)	NS	NS	NS	NS	0.95	2.99
Interaction (F × S)						
SEm±	0.69	0.50	0.39	0.51	0.42	1.33
CD (5%)	NS	NS	NS	NS	NS	NS

Number of tendrils per vine

The perusal of data presented in table no. 2 indicated that number of tendrils per vine of cucumber was significantly influenced by both the factors, *i.e.* different NPK drip fertigation levels and its scheduling, while the interaction of these two factors was observed to be non- significant.

In the summer season of study, at 30 DAS, out of the different fertigation (NPK) levels tested, maximum number of tendrils was recorded in F_1 (7.76) which is *at par* with F_2 (7.03). Similarly during winter season (in second season) maximum number of tendrils (8.81) was recorded with fertigation of 120 percent of RDF which was *at par* with F_2 (8.11). Minimum value was recorded in plants receiving fertigation at 60 percent of RDF (F_4) *i.e.* during both summer and winter season, respectively under polyhouse. At 60 DAS in summer season, highest number of tendrils were recorded in F_1 (21.59) and it was found *at par* with F_2 (20.66). In winter season, F_1 (22.89) found superior over all other fertigation levels. At 90 DAS, maximum number of tendrils of 33.09 and 34.39 was recorded in F_1 followed by 30.87 and 32.53 in F_2 while minimum number of tendrils (27.84 and 30.04) recorded in F_4 during both summer season and winter season, respectively.

Similarly at the time of harvesting, maximum number of tendrils [40.55 (summer season) and 41.02 (winter season)] was recorded in F_1 which were found *at par* with F_2 [38.68 (summer season) and 39.02 (winter season)] while lowest value were recorded in F_4 [34.88 (summer season) and 39.02 (winter season)].

At 60 DAS, 90 DAS and at the time of final harvesting, among the two scheduling methods studied, data of both the seasons indicated significantly maximum number of tendrils in S_2 *i.e.* 21.19 and 22.09 followed by S_1 (19.01 and 20.59) during summer and winter season, respectively. Similar trends also were recorded at 90 DAS and at harvesting during both summer (first season) and winter season (second season) of investigation.

The difference in number of tendrils/vine between the farmer's practices (control) and rest of the fertigation treatments was also found significant for both the seasons of study. At 30 DAS, number of tendrils recorded in control treatment was 5.51 and 6.34 as compared to 6.83, and 7.78 under other fertigation treatments at summer season and winter season, respectively.

Table 2: Effect of fertigation levels (NPK) and its scheduling on number of tendrils/vine of cucumber

Treatments	Total number of tendrils/vine							
	30 DAS		60 DAS		90 DAS		At final harvest (125 DAS)	
	Summer season	Winter season	Summer season	Winter season	Summer season	Winter season	Summer season	Winter season
Fertigation levels								
F_1	7.76	8.81	21.59	22.89	33.09	34.39	40.55	41.02
F_2	7.03	8.11	20.66	21.53	30.87	32.53	38.68	39.02
F_3	6.46	7.35	19.66	20.92	29.61	31.49	36.28	37.00
F_4	6.05	6.96	18.48	20.02	27.84	30.04	34.88	35.75
SEm±	0.39	0.36	0.38	0.28	0.39	0.32	1.07	0.89
CD (5%)	1.16	1.08	1.13	0.83	1.17	0.97	3.21	2.67
Scheduling								
S_1	6.80	7.78	19.01	20.59	29.26	31.36	36.06	36.13
S_2	6.85	7.83	21.19	22.09	31.45	32.86	39.14	40.27
SEm±	0.27	0.25	0.27	0.20	0.28	0.23	0.76	0.63
CD (5%)	NS	NS	0.80	0.59	0.83	0.69	2.27	1.89
Control vs Rest								
Control	5.51	6.34	18.02	19.34	26.03	27.86	31.50	32.00
Rest	6.83	7.81	20.10	21.34	30.35	32.11	37.60	38.20
SEm±	0.41	0.38	0.40	0.29	0.42	0.34	1.14	0.95
CD (5%)	1.23	1.14	1.19	0.88	1.24	1.03	3.41	2.83
Interaction (F × S)								
SEm±	0.55	0.51	0.53	0.39	0.55	0.46	1.52	1.26
CD (5%)	NS	NS	NS	NS	NS	NS	NS	NS

Table 3: Effect of fertigation levels (NPK) and its scheduling on number of nodes/vine of cucumber

Treatments	Number of nodes/vine							
	30 DAS		60 DAS		90 DAS		At final harvest (125 DAS)	
	Summer season	Winter season	Summer season	Winter season	Summer season	Winter season	Summer season	Winter season
Fertigation levels								
F_1	8.98	9.02	18.48	18.67	24.24	25.95	28.57	29.53
F_2	8.05	8.37	17.70	17.79	23.79	24.94	27.99	28.37
F_3	7.16	7.40	16.52	17.10	22.26	22.91	25.92	26.41
F_4	6.13	6.85	15.69	16.52	21.07	21.59	24.56	25.04
SEm±	0.17	0.04	0.18	0.19	0.37	0.42	0.71	1.09
CD (5%)	0.51	0.12	0.55	0.57	1.12	1.26	2.14	3.28
Scheduling								
S_1	7.59	7.90	16.58	16.83	21.93	22.69	25.31	25.87
S_2	7.57	7.92	17.62	18.21	23.76	25.00	28.20	28.81
SEm±	0.12	0.03	0.13	0.13	0.26	0.30	0.51	0.77
CD (5%)	NS	NS	0.39	0.40	0.79	0.89	1.52	2.32
Control vs Rest								
Control	5.70	6.19	15.19	15.82	20.03	20.22	22.35	23.54
Rest	7.58	7.91	17.10	17.52	22.84	23.84	26.76	27.34
SEm±	0.18	0.04	0.20	0.20	0.40	0.45	0.76	1.16
CD (5%)	0.54	0.12	0.59	0.60	1.19	1.34	2.27	3.48
Interaction (F × S)								
SEm±	0.24	0.05	0.26	0.27	0.53	0.59	1.01	1.55
CD (5%)	NS	NS	NS	NS	NS	NS	NS	NS

Similar findings were also observed at 60, 90 DAS as well as at the time of final harvesting during both of the season of experiment, respectively.

Number of tendrils was found to increase with increasing fertigation levels which may be due to the fact that application of increasing levels of fertigation attributed to better nutritional environment in the root zone as well as in the plant system which ultimately increase the number of tendrils. Similar findings also were observed by Anjanappa *et al.* (2012) in cucumber.

Number of nodes/vine

Influence of different NPK fertigation levels and its scheduling on the number of nodes/vine of cucumber were found significant at different stage of growth studied however, there were non-significant effect of the interaction of these two factors during both the seasons of study (Table 3). It is evident from the data that number of nodes vine^{-1} increased with increasing the fertigation levels. At 30 DAS, data revealed that among the different fertigation levels tested, significantly maximum number of nodes vine^{-1} of 8.98 and 9.02 was observed in F_1 followed by F_2 (8.05 and 8.37). Similar trend also were observed at 60 DAS during both seasons. At 90 days after sowing, maximum number of node 24.24 and 25.95 recorded in F_1 and was found *at par* with F_2 (23.79 and 24.94) in summer and winter season, respectively. Likewise at the time of harvesting, summer and winter season's data showed the maximum number of nodes/vine in F_1 28.57 and 29.53 whereas it was found *at par* with F_2 (27.99 and 28.37) during both summer and winter season, respectively.

The scheduling of fertigation levels also had a significant effect on number of nodes/vine at all the stages of growth except 30 DAS in both seasons. Significantly, maximum number of nodes vine^{-1} in S_2 (17.62 and 18.21) followed by S_1 (16.58 and 16.83) recorded at 60 DAS. At 90 DAS, maximum number of nodes vine^{-1} of 23.76 and 25.00 were observed under scheduling S_2 during summer and winter season of investigation, respectively. Likewise at final harvesting also, S_2 registered the maximum number of nodes/vine of 28.20 and 28.81 in both the seasons of study, respectively.

The comparison between control (soil application of RDF with surface irrigation) and fertigation treatments revealed that they differ significantly in both the seasons of study with respect to number of nodes. At 30 DAS, data of both seasons indicated that the minimum number. of nodes vine^{-1} (5.70 and 6.19) was observed under control treatment as compared to 7.58 and 7.91 under fertigation treatments. Similar observations were recorded at 60 and 90 DAS during both seasons. Similarly, at the time of harvest control registered a minimum number of nodes/vine of 22.35 and 23.54 as compared to 26.76 and 27.34 under fertigation treatments in both summer and winter season, respectively.

Internodal length was significantly influenced by different levels of fertigation. Significantly longer internodal length was produced in higher fertigation may be due to better availability of sufficient quantity of nutrients especially the applied higher dosage of N responsible for cell division and cell elongation during the vegetative growth. Adesina and Benjamin (2016) [1] have also reported similar findings in cucumber.

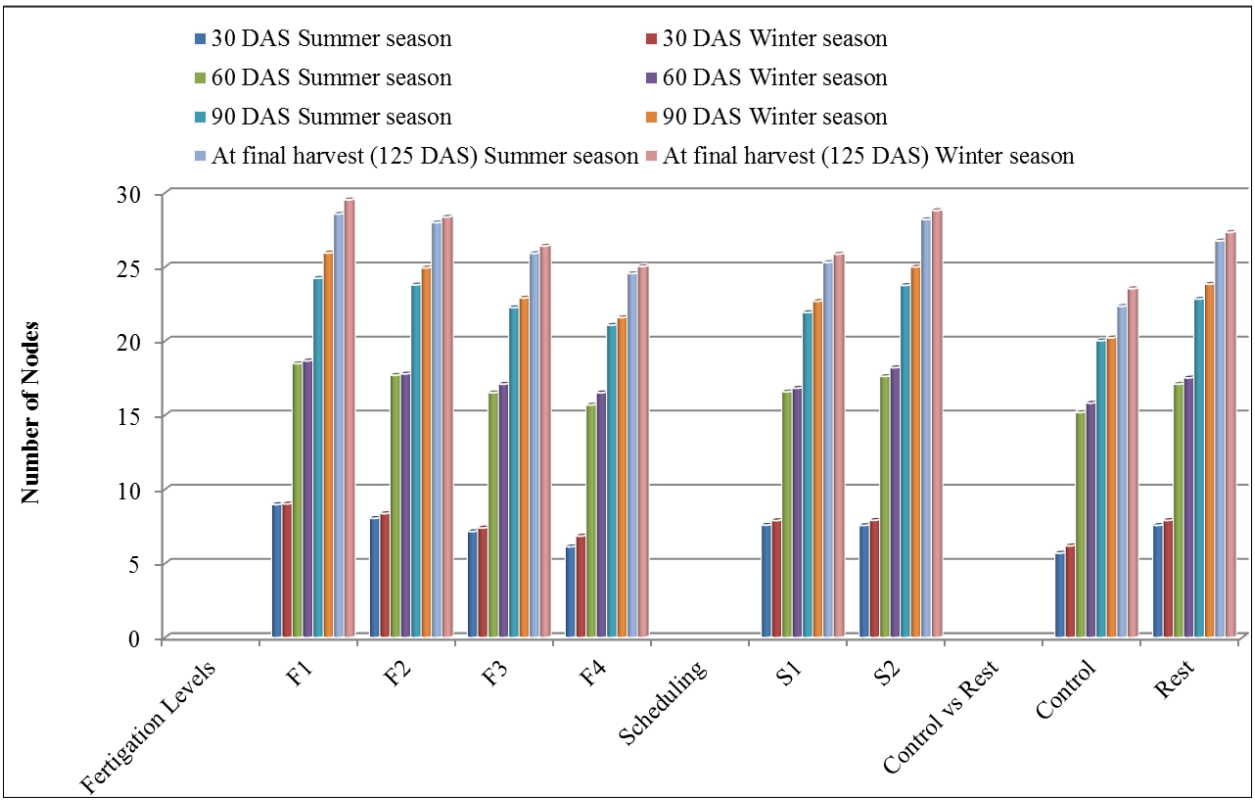

Fig 1: Effect of fertigation levels (NPK) and its scheduling on number of nodes/vine of cucumber

Conclusion

On the basis of two season of experiment, it was concluded that fertigation of cucumber during summer as well as in winter season with 120:60:60 kg N, P_2O_5 and K_2O ha^{-1} through scheduling S_2 (25, 15 and 20 per cent N, P_2O_5 and K_2O of fertigation levels between 06 to 35 days after sowing (DAS), respectively, 40, 15 and 25 per cent N, P_2O_5 and K_2O of RDF between 36 to 65 DAS, respectively, 20, 50 and 40 per cent N, P_2O_5 and K_2O of RDF between 66 to 95 DAS, respectively, 15, 20 and 15 per cent N, P_2O_5 and K_2O of RDF between 96 to 125 DAS, respectively) gives best results under polyhouse.

References

1. Adesina JM, Benjamin AT. Varietal productivity and planting date effect on the growth and yield of cucumber (*Cucumis sativus* L.). International Journal of Horticulture. 2016;6(23):1-9.
2. Eifediyi EK, Remison SU. Growth and yield of cucumber (*Cucumis sativus* L.) as influenced by farm yard manure and inorganic fertilizer. Journal of Plant Breeding and Crop Science. 2010;2:216-220.
3. Feleafel MN, Mirdad ZM. Optimizing the nitrogen, phosphorus and potash fertigation rates and frequency for eggplant in arid regions. International Journal of Agriculture and Biology. 2013;15:737-742.
4. Fischer A, Richter C. Influence of organic and mineral fertilizers on yield and quality of potatoes. The Fifth IFOAM International Scientific Conference at the University of Kassel, Germany, 1984, 37.
5. Kohzushka LF, Romanets V. Ecological and economic efficiency of mineral fertilizer application as a component of irrigation water. 17th ICID European Regional Conference on Irrigation and Drainage, 1994 May 16-22, 209-213.
6. Mahdi SS, Hassan GI, Samoon SA, Rather HA, Dar SA, Zehra B. Bio-fertilizers in organic agriculture. Journal of Phytological Research. 2010;2:42-54.
7. Marschner H. Mineral nutrition of higher plants. San Diego, California: Academic Press, 1986.

8. Qasim M, Ahmad I, Ahmad T. Optimizing fertigation frequency for Rosa hybrid. Pakistan Journal of Botany. 2008;40:533-545.
9. Tiwari SP. Impact of different fertigation levels on morpho-physiological traits and yield of cucumber under greenhouse condition. HortFlora Research Spectrum. 2013;2(2):180-181.
10. Umamaheswarappa P, Gowda VN, Murthy PV, Krishnappa KS. Growth, yield and quality of cucumber (*Cucumis sativus* L.,) as influenced by varying levels of nitrogen, phosphorus and potassium. Karnataka Journal of Horticulture. 2005;1(4):71-77.