Content list available at http://epubs.icar.org.in, www.kiran.nic.in; ISSN: 0970-6429

Indian Journal of Hill Farming

June 2019, Special Issue, Page 10-13

Nitrogen Fertigation in Drip-Irrigated Cucumber Grown in Greenhouse

S.K. Pattanaaik* . P. Debnath . Barun Singh . S.D. Warade . A.K. Pandey

College of Horticulture and Forestry, Central Agricultural University, Pasighat- 791102, Arunachal Pradesh

ARTICLE INFO

Article history:
Received 20 October 2017
Revision Received 26 April 2018
Accepted 4 July 2018

Key words:
Cucumber, Nitrogen fertigation, drip irrigation

ABSTRACT

A study was conducted in greenhouse to evaluate the response of fertigation in cucumber (*Cucumis sativus* L.). The cucumber plants were grown in beds made inside the green house. The experiment was laid out in randomised block design with comprising of four treatments and eight replications. The treatments were T1-5.8 mmol/lt N_2, T_2-11.8 mmol/lt N_2, T_3-17.8 mmol/lt N_2 and T_4-23.8 mmol/lt N_2. The nutrient was applied through drip irrigation at calculated volume to each plant in each treatment. FYM @ 10tonnes per hectare was incorporated in the soil at the time of bed preparation. The total amount of water applied to each plant was 375.69 litres and the total number of fertigation given was 106 times during the entire period of investigation starting form planting (6th February, 2015) to final harvest of crop (12th May, 2015) maximum. Application of nitrogen through drip irrigation showed a positive effect on the fruit yield and number of fruits per plant. The treatment T_3 (17.8 mmol/lt N_2) produced highest yield and number of fruits which was significantly higher than the other treatments. The yield and number of fruits decreased with higher level of N2 application in treatment T_4 (23.8 mmol/lt N_2).

1. Introduction

Cucumber (*Cucumis sativus*) is an important cashl crop grown throughout the world. The crop of cucumber demands high temperature and soil moisture for satisfactory yield; under unfavorable climatic conditions, several problems may occur, such as reduced number of female flowers (Cantliffe, 1981), delay in fruit growth (Liebig, 1981; Marcelis and Baan Hofman-Eijer, 1993; Medany *et al.*, 1999) and mineral disorders (Bakker and Sonneveld, 1988). Therefore, planting in North-Eastern region is usually done during spring to summer season when the weather conditions are favourable for plants growth. The soil environment must be favorable for the roots to develop to their maximum potential. Cucumber is sensitive to wet soil conditions so good drainage is essential. It is a heavy feeder of nutrients and nutrient management practices adopted must be able to supply and maintain an optimum level of nutrient status within the root zone. This can be achieved by adopting new techniques of irrigation. Combined irrigation and fertilization (fertigation) is ideal for this purpose, where the irrigation water acts as mode of transport for the nutrients required by the crops. By adopting this technique, nutrient is supplied directly to the root zone of the plants through frequent application of soluble fertilizers in small quantities through the irrigation system, which achieves highest fertilizer use efficiency. Drip irrigation is the most efficient method of water and nutrient application to the plants. When properly managed it facilitates to grow plant under adverse conditions in North-Eastern region of India in-spite of very heavy rainfall (average annual rainfall @4510mm) during rainy season, water available after monsoon is very difficult further winter is severely windy and the crops are severely water stressed. Greenhouse with drip irrigation is the most suitable option for crop production. The sandy and porous soils can be efficiently applied with water and nutrients by this method only. The stock solution preparation needs utmost care, before it is used for fertigation through drip irrigation.

*Corresponding author: jayalipi_mohanty@rediffmail.com

The maintenance of nutrients at optimum levels within the root sphere of plants is a primary factor governing the efficient use of fertilizers when applied through drip irrigation. This requires plant demand for high yield. Little is known about the levels of fertilizers required for fertigation for protected cultivation of cucumbers in hot humid zone of Arunachal conditions. Taking this into account a study was conducted to standardise the nitrogen requirement of cucumber grown in greenhouse with drip irrigation system with four levels of N fertigation.

2. Materials and Methods

2.1. Study area

The present investigation was carried out in the greenhouse located in the research farm of the College of Horticulture and Forestry, Central Agricultural University of Pasighat, East Siang district of Arunachal Pradesh. The geographical location is between 27.3^0 to 29.42^0 North latitude and 94.42^0 to 95.35^0 East longitude and 155m above mean sea level. The climate of Pasighat is tropical humid during summer and dry mild winter. The average annual rainfall of the East Siang district is 4510mm distributed over the year. The major portion is received during May to September. However, the rain starts here during the last week of March and continues upto September month. The period from October to March is dry with acute shortage of water for irrigation.

The soil is highly porous, having very low water holding capacity, high infiltration rate and high bulk density have adverse effect on soil-water-plant continuum. High permeability of soil causes low nutrient use because of downward migration of available plant nutrients away from the root zone, resulting in low productivity of crops. The soil is also highly acidic. The organic carbon content of the soil ranges from 3.8gm kg^{-1} to 18.3 gm/kg^{-1}, indicating a very high value. Anionic plant nutrients like Nitrogen (N), Sulphur(S), Boron (B) are more prone to leaching losses.

2.2. Cultivation of Cucumber

The soil of the beds was first sterilized by drenching with formalin at the rate of halt 500ml per litre. Then FYM was applied @ of 10 t/ha. One month-old cucumber (parthenocarpic cucumber of variety *Multistar*) seedlings were planted during the first week of February 2015 in the beds prepared inside the naturally ventilated greenhouse. Plants were pruned to a single stem by removing lateral shoots. All the recommended cultural practices were adopted from time to time. Fruits became ready for harvest form 55 days after planting. As a commercial practice, curved or deformed fruits were removed from the plant during pruning operations and marketable immature fruits were harvested in eight pickings at an interval of 2–3 days. Detailed observations were also recorded.

2.3. Layout Drip irrigation

The cucumber was irrigated by drip irrigation system. There were eight beds and each bed had two rows of plants. The plant spacing in each row was 60cm and the row to row spacing was also maintained at 60 cm. Half of the area of each bed was irrigated by separate drip line as shown in figure 1. Each drip line was provided with separate lateral valve as shown in figure 2. The different levels of nitrogen were applied through fertigation, treatment wise by operating the specific valves. The laterals were provided with 2 lph inline drippers. The irrigation schedule was maintained uniform for all the treatments *i.e.* upto 6days of transplanting 30ml per plant/ day, 7-25days 60ml per plant/ day, 26-55days 120ml/plant/day, 56-90days 130ml per plant/day and from 91-110days 140ml per plant/day was given. The fertigation was done in the Ventury, which sucks the stock solution of urea with water. The stock solution was made in a 25 litres PVC container. The treatments details are given in table (1).

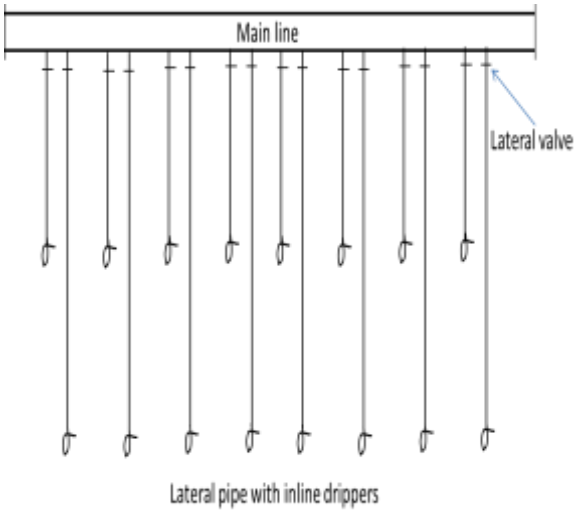

Figure 1. Layout of Drip irrigation system inside the Greenhouse

Water containing nitrogen as mentioned above, were applied to the respective plants under each treatment through the fertigation unit by controlling each lateral valve. Urea was used as the source of nitrogen.

2.4. Observations recorded

The yield was recorded starting from 23rd March 2015 to 12th May 2015. At the time of each harvesting, the yield from each plant was recorded and the total yield per treatment was calculated. The yield was recorded in terms of numbers of fruits and their weight in kg as shown in table 1.

2.5. Statistical analysis

The data was analysed by WASP 1.0 statistical software developed by ICAR, Goa.

Table 1. Details of treatments

Treatments	Details	
T_1	5.8 mmol/lt N_2	4.35gm Urea/25lt
T_2	11.8 mmol/lt N_2	8.7gm Urea/25lt
T_3	17.8 mmol/lt N_2	13.05gm Urea/25lt
T_4	23.8 mmol/lt N_2	17.4 gm Urea/25lt

3. Results and Discussion

The application of fertigation through the trickle irrigation system warrants utmost care when the stock solution enter into the sucking pipe of the ventury which is tied with a PVC filter net. Further filtration was made at the screen filter before the solution enters the main and lateral pipe lines. The total amount of water applied per plant was 375.698 litres and the total amounts of N applied in a cumulative amount of 0.752kg N, 1.503kg of N, 2.255kg of N and 3.007kg of N per plant under the treatments T_1, T_2, T_3 and T_4, respectively. The study revealed that the threshold N level for greenhouse cultivation of cucumber at Pasighat climatic condition was 17.8 mmol/lt N_2. Beyond this level of N in soil decreased the yield and number of

Figure 2. The Drip irrigation system shows the Lateral valves

Figure 3. Trailing of Cucumber plant

fruit per plant. The maximum fruit yield 24.181kg per plant was recorded for the treatment T_3 (17.8 mmol/lt N_2). The highest number of fruits per plant (174.250) was also recorded for T_3. The yield and number of fruits per plant in T_3 were significantly higher than the treatments T_1 (5.8 mmol/lt N_2) and T_2 (11.8 mmol/lt N_2) and T4 (23.8 mmol/lt N_2). However, the decrease in yield and number of fruits per plant in the treatment T_4 may be attributed to the toxic effect of nitrogen as shown in figures 3, 4 and 5. This is in accordance to the findings by Papadorpoulos (1986). It was observed that the yield and number of fruits per plant are positively

Figure 4. Farmers visit for Hitech production of Cucumbers

Figure 5. Fertigation trial in Greenhouse cultivated Cucumber

correlated with co-efficient of determination near to 1 for a given treatment as shown in the figures 5 and 6.

Conclusions

The cultivation of cucumber under greenhouse with fertigation could achieve a considerable yield in the drastic climatic condition of Arunachal. The farmers of the area can be suggested to adopt such technology for commercial cultivation of cucumber and get profit. Application of Nitrogen through drip irrigation showed a positive effect on the fruit yield and number of fruits per plant. The treatment T_3 (17.8 mmol/lt N_2) produced highest yield and highest number of fruits which was significantly higher than the other treatments. The yield and number of fruits decreased with higher level of N_2 application in treatment T_4 (23.8 mmol/lt N_2).

Acknowledgements

The authors are highly grateful to the Central Agricultural University, Imphal, Manipur to provide all facilities to conduct the experiment. The online software facility provided by ICAR, Goa is also duly acknowledged.

Table 2. Yield of drip-irrigated cucumber under greenhouse condition

Treatments	Fruit yield (kg)	Number of fruits
T_1	16.850	130.500
T_2	18.631	141.125
T_3	24.181	174.250
T_4	15.388	127.750
CV	**30.370**	**24.017**
CD @ 5%	**5.926**	**35.820**

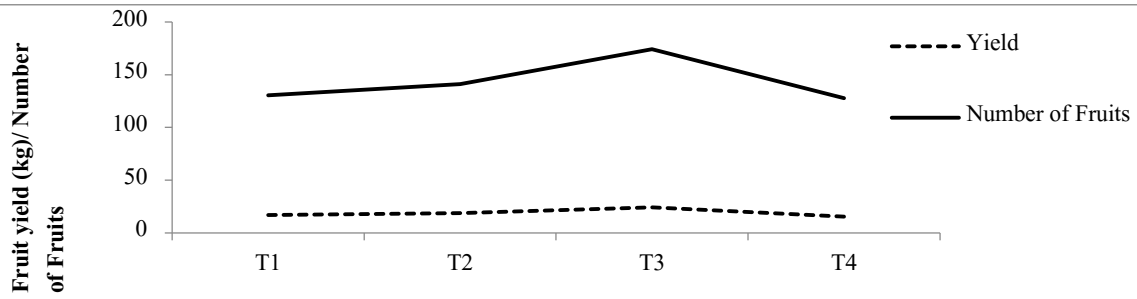

Figure 6. Variation pattern of fruit yield with number of fruits

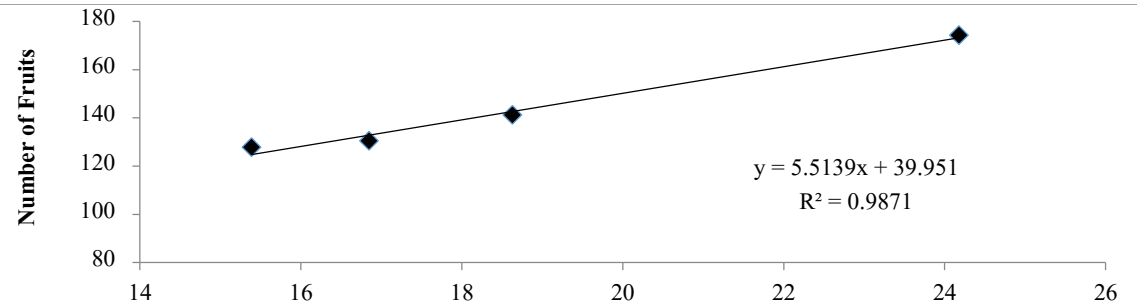

Figure 7. Variation of Fruit yield with Number of fruits

References

Cantliffe D.J. (1981). Alteration of sex expression in cucumber due to changes in temperature, light intensity, and photoperiod. *Journal of the American Society of Horticultural Science, Geneva* 106(2): 133–136

Bakker J.C., C. Sonneveld, (1988). Calcium deficiency of glasshouse cucumber asaffected by environmental humidity and mineral nutrition. *Journal of Horticultural Science, London* 63(2): 241–246

Liebig H.P., (1981). Physiological and economical aspects of cucumber crop density. Acta Horticulturae, *The Hague* 118: 149–164

Marcelis L.F.M., Baan Hofman-Eijer, L.R., (1993). Effect of temperature on the growth of individual cucumber fruits. Physiologia Plantarum, Kobenhavn 87(3): 321–328

Medany M.A., Wadid, M.M., A.F. Abou-Hadid (1999). Cucumber fruit growth rate in relation to climate. Acta Horticulturae, *The Hague* 486: 107–111

Papadorpoulos I., (1986). Nitrogen fertigation of greenhouse-grown cucumber. *Plant and Soil* 93(1): 87-93