International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 10 Issue 11, November-2021

Study on Nutrient Use Efficiency of Okra in Soil and Soil Less Media using Fertigation

*Ann Annie Shaju[1], Aksa V Reji[2], Ayisha Shareena N[3], Dr. Anu Varughese[4]
[1,2,3] : B Tech. Agricultural Engineering
Kelappaji College of Agricultural Engineering & Technology Tavanur
Kerala Agricultural University, Thrissur, Kerala
[4:] Assistant Professor (*Author*)
Department of Irrigation & Drainage Engineering
Kelappaji College of Agricultural Engineering & Technology Tavanur
Kerala Agricultural University, Thrissur, Kerala

***Abstract*:-Strengthening of Agriculture is usually attained through irrigation and fertilizer application. But over irrigation and fertilizer application is harmful and it should be controlled by precise application. This study intended to provide an alternative method by determining proper fertilizer rate for the optimum growth and yield on okra crop. A field experiment was conducted in a naturally ventilated polyhouse and open field in the research plot of the Department of Irrigation and Drainage Engineering, KCAET, Tavanur during October 2017- January 2018 to study the nutrient use efficiency of Okra in soil and soilless media using fertigation. The experiment was done with 12 treatments consisting of combination of 3 fertigation level in soil and soilless media under polyhouse and open field with 3 replications. The maximum yield was observed for the treatment having 100% fertigation in soil outside the polyhouse. The minimum yield was observed for the treatment having 120% fertigation in soilless media outside the polyhouse. It was observed that the biometric parameters do not significantly differ for different fertigation levels. The maximum nutrient efficiency was observed for treatment has 80% fertigation level in soil outside the polyhouse and minimum for treatment having 120% fertilizer recommendation in soilless outside polyhouse. By statistical analysis, it was observed that, the growing environment and the media in which the crop grown influences its yield.**

Key words : Fertigation, Plant Height, Nutrient use Efficiency, Drip Irrigation

INTRODUCTION

Agriculture is the basic source of food supply of all the countries in the world. Strengthening of Agriculture is usually attained through irrigation and fertilizer application. This highlights the importance of optimizing the use of natural resources for crop production in the country. Fertigation allows nutrient placement directly into the plant root zone during critical periods of nutrient demand (Mickkelsen, 1989). Lack of fertilizer and over fertilizing will give a negative effect on the growth of okra plant.

Under open field conditions, it is not possible to have control over light, temperature and air composition and the only possibility is to manipulate the nature of rooting medium by tillage, irrigation, fertilizer application etc. Soil is usually the most common growing medium for plants. Presence of pathogenic organisms and nematodes are a common problem in field soil. Protected cultivation using soilless culture tremendously reduces the water use and improves the water use efficiency. The most common media used in soilless culture include coir pith, vermiculate, perlite etc. The impact of fertigation under different conditions on the performance of the growth and yield of Okra need to be assessed under this context. The aim of this study is to compare the effect of different fertigation treatments on the yield and growth parameters of okra in soil and soilless media inside and outside the poly house. And also to compare fertilizer use efficiency at different levels of fertigation.

MATERIALS AND METHODS

Location

The study was conducted in a naturally ventilated polyhouse and open field in the research plot of the Department of Irrigation and Drainage Engineering, KCAET, Tavanur, Kerala. The open field was taken in the premises of the polyhouse.

Experimental Design

The study was done to the Okra variety *Varsha Upahar* during 16th October 2017 to 1st January 2018 with 3 replications on three raised beds of 10 m length, 1.0 m width and 0.25 m height which made inside the polyhouse and in open field. Spacing of 45×60 cm (package of practice recommendation: crops (KAU 2011) was given. Growing media for the soilless culture includes perlite, vermiculite and coir pith mixed at the ratio of 3:1:1 (by Volume). Soil is mixed with dried cow dung at the ratio of 3:1 (by volume). The fertigation was done with dosmatic pump. The fertilizers used for the study were Rajphos (0:50:0), Urea (46:0:0), Potassium Nitrate (19:19:19), Boon-45 (13:0:45) and Mono Ammonium Phosphate (12:61:0).

Treatment details

The treatments done is given in table 4. The fertigation was done as per the fertilizer recommendation given in Harithagriha krishisahay, State Horticultural Mission, Kerala. The fertigation was scheduled as 17 splits with the frequency of once in three days from 25th day after planting to 76th day after planting.

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Nutrient use efficiency

In this way Nitrogen, Phosphorous, Potassium fertilizer use efficiency was found out.

$$\text{Nutrient use efficiency;} \quad NUE = \frac{Yield\ (Kg\ per\ ha)}{Total\ quantity\ of\ nutrient\ applied\ (Kg\ per\ ha)}$$

Physiological parameters

For recording various observations, three plants were selected randomly for each treatment and tagged for their identification. Observations as plant height, number of leaves and branches per plant, time required to first harvest were recorded.The plant height was measured from the surface of the growing medium to the shoot tip for the selected plants at 30, 40, 50 and 60 days after planting (DAP). The average height was calculated and expressed in centimetres. Number of branches per plant was noted at 10 days interval in selected plants from 30 DAP. Number of leaves per plant was counted in randomly selected 3 plants at 30, 40, 50 and 60 DAP.

Harvesting of the crop was done treatment wise after attaining maturity. After the first harvest, other harvests were done at an interval of two days. The first yield was taken 40th day after planting. Total of the 11 harvests gave the total yield. Light intensity, temperature and relative humidity inside polyhouse and open field was measured in the morning, afternoon, evenings in the months in the months of October, November and December.

RESULTS AND DISCUSSION

Results observed from the field study on the nutrient use efficiency of okra in soil and soilless media under different levels of fertigation in a naturally ventilated polyhouse and open field were analyzed. The results are shown in Fig.1, Fig. 2, and Fig. 3 respectively. It was observed that the first flowering was observed 35 DAP in treatment T_4. The early flowering in T_4 indicates level of fertigation effect on plants. Majority of the plants started flowering 45 days after planting.

The plant height of Okra was significantly influenced by different fertigation treatments. At 30 DAP, plant height was maximum for T_1 and minimum for T_{10}. The maximum plant height was observed in T_3 and minimum in T_{12} at 40 DAP. At 50 DAP, the plant height was maximum for T_3 and minimum for T_{11}. At 60 DAP, the plant height was maximum for T_1 and minimum for T_{10} andT_{11}. At all stages of growth, plant height was significantly higher in polyhouse as compared to open field.

From Fig. 3, it is observed that number of branches is more in open field than in polyhouse at all growth stages. The more number of branches in open field as compared to protected structures was noticed by Rajasekar in which it was reported that cluster bean, bhindi and cucumber had more number of branches per plant in open field than in shade net during both seasons.

The data on number of leaves showed that the number of leaves increased with crop growth and reached maximum value 40 at the maturity stage. At 30 DAP, the maximum number of leaves was observed for the treatment T_1 i.e., 80% fertigation level in soil media inside polyhouse. The minimum number of leaves was observed for the treatments T_7 i.e., 80% fertigation level in soilless media inside the polyhouse and T_8 i.e., 100% fertigation level in soilless media inside the polyhouse. At 40 DAP and 50DAP, maximum number of leaves was observed for treatment T_5 and minimum for treatment T_9 and T_{10}. At 60 DAP, maximum number of leaves was observed for T_5 and minimum for T_7.

Yield parameters

The observation on yield was taken first 40 DAP and later the yield was taken at three days interval. The average yield influenced by different treatments is shown in Fig. 5. The maximum yield was observed for treatment T_5 and minimum for T_{12}. The treatment T_4 was on par with T_5. There was no significant difference in yield of okra in different levels of fertigation under same growing condition. The treatment T_2 was on par with T_3 and treatment T_{10} was on par with T_{12}. In soil, it is observed that the yield of okra was more in open field as compared to polyhouse. But in case of soilless media, the yield was more in polyhouse as compared to open field. The maximum yield was observed for 100% of fertilizer recommendation.

Weather parameters

Light intensity plays a significant role in crop growth and development. The data is given in Table. 2. The maximum light intensity was recorded under open field in the afternoon during fifth week after planting and the minimum was recorded under naturally ventilated polyhouse in the evening seventh week after planting. There is a significant difference between light intensity inside polyhouse and that in the open field. Light intensity in open field is much higher than that inside polyhouse. This may due to shade inside polyhouse. This results in greater difference between yield inside polyhouse and open field.

Naturally ventilated polyhouse recorded the maximum temperature (36.93ºC) in the afternoon (Month of November) and minimum temperature (29.07ºC) was in open field in the evening (Month of December). Temperature inside the polyhouse was slightly higher than that in the open field in the afternoon and evening in all the three months. But during morning, it was vise versa. The higher temperatures inside the polyhouse may be due to greenhouse effect. The data are given in table. 2

Relative humidity increases the net energy of crop growth and prolongs the survival of crops under moisture stress condition, which leads to optimum utilization of nutrients. It also maintains turgidity of cells. From table 3, it is understood that

International Journal of Engineering Research & Technology (IJERT)
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the maximum relative humidity (76.09%) was recorded under open field in the morning during the month of October and relative humidity (50.41%) was recorded under open field in evening during the month of December.

Nutrient use efficiency

From Fig.4, it is clear that nitrogen FUE was highest for T_4 and then for T_5 and T_1. Phosphorus FUE and potassium FUE were also greater in T_4. The figure gives a clear indication on the difference in ranges of each efficiency. Potassium was applied in greater quantities compared to the nitrogen and phosphorus and hence KFUE is in low ranges.

CONCLUSION

The twelve treatments showed significant differences in the case of average yield. It was observed that yield obtained in open field significantly differ from that of polyhouse. The higher yield of Okra in open field may be because of the more number of branches per plant found in open field condition. The increased number of branches in open field may be due to high light intensity in open field condition. Yield obtained in soil was superior over the soilless medium. The combination and proportion of soilless media used need to be modified. The maximum yield was observed for 100% of fertilizer recommendation. Both increased and decreased fertigation levels showed almost equal yield which is significantly less than 100 per cent recommended dose. So 80% recommended dose can be suggested for 20% savings in fertilizers

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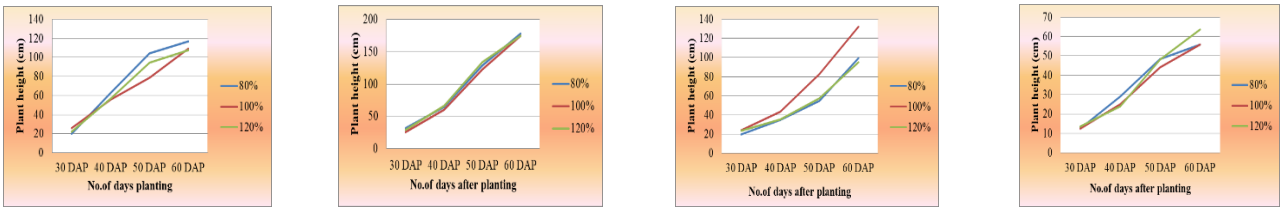
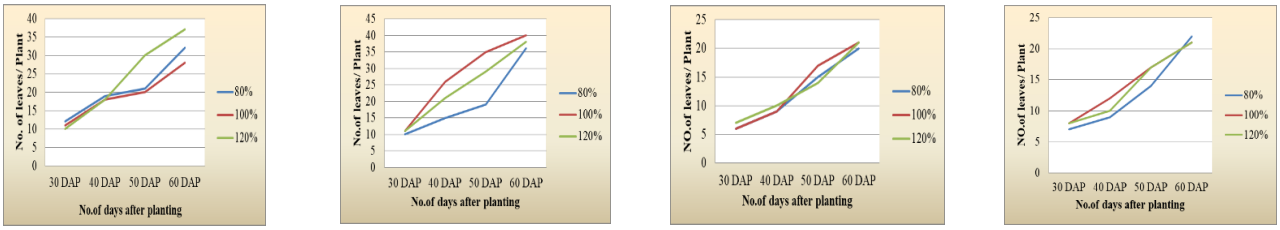


Soil inside polyhouse Soil in open field Soilless inside polyhouse Soilless in open field

Fig.1 Comparison of plant height



Soil inside polyhouse Soil in open field Soilless inside polyhouse Soilless in open field

Fig.2 Comparison on number of leaves

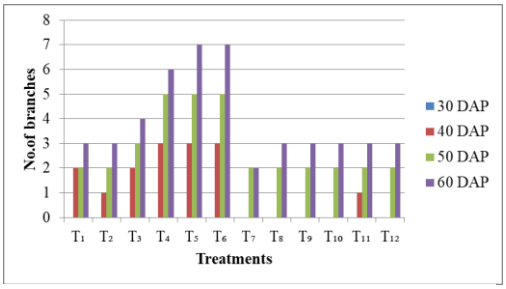


Fig.3 Number of branches as influenced by different treatments

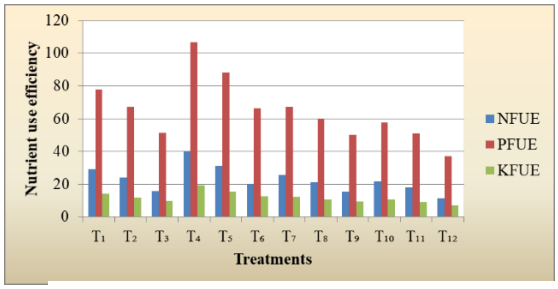


Fig.4 Variation of nutrient use efficiency for different treatments

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 10 Issue 11, November-2021

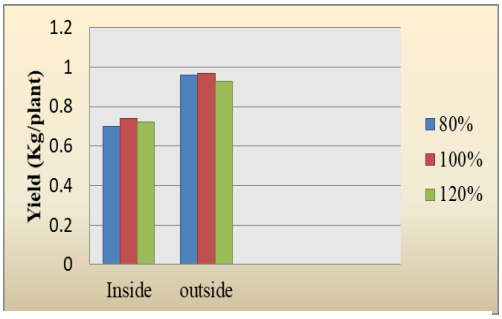


Fig.5 Variation of crop yield between polyhouse and open field in soil

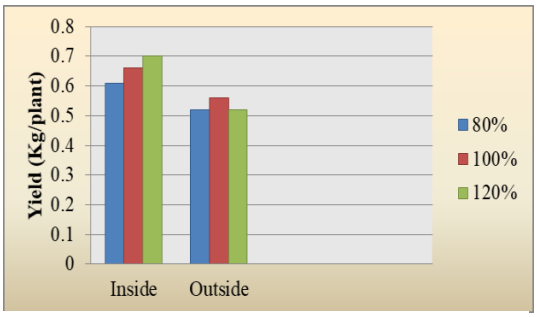


Fig.6 Variation of crop yield between polyhouse and open field in soilless media

Table.1 Light intensity inside polyhouse and open field

Stage	Light intensity (lux)					
	Morning		After noon		Evening	
	Polyhouse	Open field	Polyhouse	Open field	Polyhouse	Open field
1st week	7632.86	30842.86	13572.86	58332.86	4345.71	15468.57
2nd week weewweek week	10276.67	45157.14	18836.19	79014.29	4396.48	14997.14
3rd week	11393.81	35465.71	21064.76	85885.71	3063.33	23297.14
4th week	11054.76	36061.43	17803.33	74428.57	3087.14	11182.86
5th week	10317.62	30450.00	20817.14	92085.71	4149.52	17870.00
6th week	11047.62	34828.57	14820.48	60122.86	4046.19	16204.29
7th week	14548.57	34850.00	12977.62	53800.00	2340.81	7699.143
8th week	10158.38	26688.57	19627.62	73774.29	3049.52	9411.429

Table.2 Mean maximum and minimum temperatures

Month	Time	Temperature (°C)			
		Polyhouse		Open field	
		Maximum	Minimum	Maximum	Minimum
October	Morning	29.84	29.63	30.13	29.83
	Afternoon	34.18	33.80	33.21	32.95
	Evening	30.80	30.60	29.86	29.67
November	Morning	30.40	30.09	31.18	30.76
	Afternoon	36.93	36.40	36.62	36.02
	Evening	31.50	31.30	31.22	30.99
December	Morning	29.80	29.52	30.84	30.65
	Afternoon	36.34	35.80	34.66	34.15
	Evening	30.10	29.90	29.17	29.07

Table 3 Variation of relative humidity inside polyhouse and open field

Month	Time	Relative humidity	
		Polyhouse	Open field
October	Morning	75.43	76.09
	After noon	61.22	64.54
	Evening	72.36	74.12
November	Morning	75.72	72.23
	After noon	50.79	51.60
	Evening	67.43	68.84
December	Morning	73.38	72.85
	After noon	54.56	50.41
	Evening	68.99	71.61

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 10 Issue 11, November-2021

Table 4. Treatment details

T1	80% of fertilizer recommendation and soil inside the polyhouse
T_2	100% of fertilizer recommendation and soil inside the polyhouse,
T3	120% of fertilizer recommendation and soil inside the polyhouse,
T_4	80% of fertilizer recommendation and soil outside the polyhouse
T_5	100% of fertilizer recommendation and soil outside the polyhouse,
T_6	120% of fertilizer recommendation and soil outside the polyhouse
T_7	80% of fertilizer recommendation and soilless media inside the polyhouse
T_8	100% of fertilizer recommendation and soilless media inside the polyhouse
T_9	120% of fertilizer recommendation and soilless media inside the polyhouse
T_{10}	80% of fertilizer recommendation and soilless media outside the polyhouse
T_{11}	100% of fertilizer recommendation and soilless media outside the polyhouse
T_{12}	120% of fertilizer recommendation and soilless media outside the polyhouse