Available online at www.ijpab.com

DOI: http://dx.doi.org/10.18782/2320-7051.7651

ISSN: 2320 – 7051

Int. J. Pure App. Biosci. **7 (3):** 632-636 (2019)

Research Article

Effect of Drip Irrigation with Mulch Cover on Yield and Water Use Efficiency in Pot Culture of Brinjal

Chandan Mahata[1] and Nabanita Sarkar[2*]

[1,2]Research Scholar, Department of Soil and Water Engineering, Faculty of Agricultural Engineering, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Dist. Nadia, Pin-741252, West Bengal, India

*Corresponding Author E-mail: nabanitasarkar84@gmail.com

Received: 7.05.2019 | Revised: 13.06.2019 | Accepted: 18.06.2019

ABSTRACT

The experiment was carried out at the Instructional Farm of Faculty of Agricultural Engineering, BCKV, Nadia, West Bengal during the year of 2016-17. The study was conducted with the objectives to determine the water requirements of Brinjal cultivation under drip irrigation and and yield of Brinjal cultivation under drip irrigation. In the study, there were four irrigation treatments with four replications. The different irrigation treatments were (i) T_1-Conventional (1.1 ET + mulch), (ii) T_2-0.5 E_{Pan} under drip irrigation with mulch,(iii) T_3-0.6 E_{Pan} under drip irrigation with mulch and (iv) T_4-0.8 E_{Pan} under drip irrigation with mulch. It was observed that the irrigation water requirement has found to be lowest at T_2-0.5 E_{Pan} treatments (12cm) under drip irrigation and highest irrigation water requirement at T_1-Conventional (1.1 ET + mulch) treatment (30cm). The average yield at T1, T2, T3 and T4 treatments was found 41.76 t/ha, 81.28 t/ha, 69.26 t/ha and 70.79 t/ha respectively. It was also observed that the water use efficiency was found to be the highest at T_2-0.5 E_{Pan} treatments of drip irrigation was 6.77 t/ha-cm among the all treatments. This indicated that the average yield and WUE were found more under the drip system in compare to conventional system. Due to the decreasing availability of water resources and the increasing competition for water between different users, improving agricultural water use efficiency is vitally important in many parts of the world that have limited water resources. Drip irrigation in brinjal in pots is found much water saving practice. Drip irrigation itself is most water saving technique and cultivating the crops in pots with mulch, further add to water saving since there is possibility of using entire rain water and less evaporation loss.

Key words: *Drip irrigation, Mulch cover, Evapotranspiration, Water use Efficency.*

INTRODUCTION

Brinjal or egg plant belongs to family Solanaceae and it is one of the most common and popular vegetable crop grown in India and other parts of the world. Brinjal is a staple vegetable in our diet. It is quite high in nutritive value and can be compared with tomato. It contains 92.7 % water, 1.4 % protein, 4.0 % carbohydrates, 0.3 % fats, 0.3% minerals, 1.3 % fibre[1].

Cite this article: Mahata, C. and Sarkar, N., Effect of Drip Irrigation with Mulch Cover on Yield and Water Use Efficiency in Pot Culture of Brinjal, *Int. J. Pure App. Biosci.* **7(3):** 632-636 (2019). doi: http://dx.doi.org/10.18782/2320-7051.7651

The total area under brinjal in India is 691.54 thousand ha with the production of 12634.13 thousand metric tons and productivity of 18.27 metric tons/ha. In West Bengal state, it is grown on 158.44 thousand ha with production of 2870.60 thousand tonnes and productivity of 18.11 tons/ha[2]. Water and nutrients are the critical inputs which limits the growth and yield of crops, especially vegetable crop like brinjal. The average yield of brinjal in West Bengal is high as compared to production level of some other states in the country. This is because of water and fertilizers are not scheduled at proper stage of crop growth. Lack of knowledge of suitable water and fertilizer management practices results in either excess or deficit water and fertilizers resulting in high production. Irrigation is one of the essential inputs for brinjal cultivation where there is little or no rain during the growing season. Water being a limited resource, its efficient use is a basis for survival of agriculture all over the world. Indian farmers are mostly adopting conventional method of irrigation i.e. surface irrigation and due to this the available water resource are not being used judiciously. There are more losses of water during conveyance in open channels. Prolonged application of excess water not only spoils productive lands but also causes loss of costly fertilizers by the way of leaching. Under conventional method of irrigation, fertilizer use efficiency is also less as considerable amount of fertilizers is lost by leaching.

Drip irrigation is an efficient method of application of water at the plant bottom at a rate nearly equal to the consumptive use rate of the plant[3]. Drip irrigation, also called trickle irrigation or micro- irrigation, is a localized irrigation method that slowly and frequently provides water directly to the plant root zone. In this system, the irrigation efficiency can be achieved to the extent of 90 per cent while 30 to 40 percent in conventional method of irrigation. If pot experiments are carried out correctly, drainage and subsequent leaching of elements can be avoided. The latter can be problematic and difficult to quantify under field conditions. Low volume application of water to plant roots maintains a desirable balance of air and water in the soil. Plants grow better with this favorable air-water balance and even soil moisture. Water is applied frequently at low flow rates with the goal of applying only the water plants need[4]. By applying water directly to the pot, the rest of the plant remains dry. Additionally, pesticides which are applied to the foliage are not washed off by daily watering. This can reduce the need for spraying - further lowering production costs– and decrease run-off contamination[5]. Keeping this above fact in view, a field study was conducted with the objectives of estimation of water requirements, yield and water use efficiency of drip irrigation following pot culture.

MATERIALS AND METHODS

Daily Meteorological data from 1st February to 28th May 2017 were collected from Agricultural Meteorology and Physics Department, B.C.K.V. Mohanpur, Nadia. The meteorological station of the department is at Instructional Farm of Faculty of Agricultural Engineering which is near by the experimental site. The soils physical characteristics were analyzed for soil's bulk density, porosity, textural class and water holding capacity and soil moisture versus tension.

Soils were mixed with cow dung properly and sun dried before it was used for pot filling. Pots were filled with soil up to 2.5" to 3'' below the top of the pots. After filling the pots with soil water was applied in good quantity for settlement of the soil in the pots. Brinjal plant (cv. Krishna hybrid variety) of 3 weeks old was cultivated in the pots. A mulch layer of material applied to the surface of soil. In this study mulching of plant residue has been used. The drip irrigation system was installed at the experimental site soon after transplanting of brinjal plants in pots. The drip unit consisted of 50 mm outer diameter (OD) PVC pipeline, valve, pressure gauge etc. The mainline was of 50 mm OD and sub-main was of 40 mm OD. Lateral lines (16 mm OD LDPE) were laid from the sub-mains parallel to the plant roots in each pots. In-line emitters with a spacing of 45 cm and discharge of 4

lp/h were used in the lateral line. The water source for drip system was from a tube well located near the experimental site. After transplanting, one light irrigation of 20 mm depth was given for uniform establishment of the plants.

Irrigation treatments

Irrigation was done by taking evaporation reading on daily basis. In the study, there were four irrigation treatments with four replications. The different irrigation treatments were as follows:

1. T_1- Conventional (1.1 ET + mulch).
2. T_2 - 0.5 ET under drip irrigation with mulch.
3. T_3 - 0.6 ET under drip irrigation with mulch.
4. T_4 - 0.8 ET under drip irrigation with mulch.

Formula used for the calculation of volume of water required at different irrigation treatments with respect to time were as follows:

We assume that 2 cm amount of irrigation water is applied to each treatments for computing the cumulative pan evaporation.

- At T1- volume of water (V_1) = 1.1* E_{pan} (mm) * Kp * Kc* a. (At IW/CPE=1.1; water was applied when CPE = 1.81cm)
- At T2- volume of water (V_2) = 0.5* E_{pan} (mm) * a. (At IW/CPE=0.5; water was applied when CPE = 4cm)
- At T3- volume of water (V_3) = 0.6* E_{pan} (mm) * a. (At IW/CPE=0.6; water was applied when CPE = 3.33cm)
- At T4- volume of water (V_4) = 0.8* E_{pan} (mm) * a. (At IW/CPE=0.8; water was applied when CPE = 2.5cm)

Where, a= area of the pots (sq.cm)

- When rainfall occurred due to some losses 50% of rainfall is considered.

Fruit yield

The first picking was done 90 days after the planting and thereafter further pickings were done as the fruits mature at 4-5 days intervals. The number of fruits from observational plants was counted for each picking and average number was taken. The weight of harvested fruits per pot was obtained by summing the fruit yield obtained at all pickings from each pot up to the end of the experiment. The fruit yield were worked out for yield/plant, yield/ha and water use efficiency. The projected yields are also taken assuming the crop period from March to May.

Water Use Efficiency

Water use efficiency was calculated by the following formula for different treatment and expressed as WUE= Yield of rice / Water requirement (t/ha-cm)[6].

RESULTS AND DISCUSSION

Soil Parameters

The Bouyoucous Hydrometer method of determination of soil texture revealed that the relative portions of soil particles for the examined sample were: 34.8% of clay content, 28.0% of silt content and 37.5% of sand content. These percentages were located on a Soil Texture Triangle and the soil was classified as clay loam. The analysis of physical soil characteristics using the Keen Raczkowski box yielded the following results: bulk density of 1.29 g/cm3, particle density of 2.6 g/cm3, porosity of 51.15% and Maximum Water Holding Capacity of 52.3%.

Comparison of water requirements of brinjal under drip and conventional irrigation

It was found that water requirements under drip irrigation for all the treatments were less as compared to conventional irrigation (**Table1**). In conventional irrigation method, the requirement of irrigation water was almost double compare to drip irrigation. It was found that the amount of water requirement for brinjal was 30 cm in conventional (T_1) irrigation system where as it was 12 cm at T_2

treatment, 18 cm at T_3 treatment and 22 cm at T_4 treatment under drip irrigation.

Table 1: Amount of irrigation of brinjal at conventional irrigation and under Drip Irrigation at different treatments

Treatments	Amount of irrigation (cm)
T_1	30
T_2	12
T_3	18
T_4	22

The amount of irrigation water required under drip irrigation at 0.5 Epan treatments has been found lowest i.e., 12 cm and highest value was 30 cm at 1.1 Epan treatments it was due to application of different treatments.

Comparison of Yield between the Drip and Conventional system

The fruit yield of brinjal as influenced by different treatments is presented in Table 2.The yield of brinjal was influenced significantly due to different irrigation levels. Treatment T_2 as per growth stages recorded significantly higher yield (81.28 tones/ha) over treatments T_1, T_2 and T_3.

Table 2: Yield of brinjal in different treatments

Treatments	Yield (t/ha)
T_1	41.76
T_2	81.28
T_3	69.26
T_4	70.79

Water Use Efficiency

From the **Table 3.**the water use efficiency was found to be the highest at the treatment of T_2 (0.5 E_{pan}) of drip irrigation.

Table 3: Water use efficiency in different treatment

Treatments	Water Use Efficiency(t/ha-cm)
T_1	1.39
T_2	6.77
T_3	3.84
T_4	3.21

SUMMARY AND CONCLUSION

From the experimental data it was observed that use of pot under drip irrigation system in different treatments of brinjal cultivation gave higher yield with less application of water significantly as compared to conventional irrigation. In drip irrigation system usually less water is available to weeds, high efficiency in fertilizers use, less weed growth so low labour and relatively low operation cost and less evaporation losses of water as compared to conventional irrigation. The amount of irrigation water required under drip irrigation at 0.5 E_{pan} treatments with drip irrigation has been found lowest i.e., 12 cm and highest value was 30 cm at 1.1 E_{pan} treatments with conventional irrigation it was due to application of different treatments, so it can be said that the water saving in 0.5 E_{pan} has found almost 60% in compare to conventional brinjal cultivation in pot culture. Similarly yield was found highest at 0.5 E_{pan} treatments i.e., 81.28 t/ha and water use efficiency was found highest at 0.5 E_{pan} treatments i.e., 6.77 t/ha-cm. Drip irrigation in brinjal in pots is found much water saving practice. Drip irrigation itself is most water saving technique and cultivating the crops in pots with mulch further add to

water saving since there is possibility of using entire rain water and less evaporation loss. The pot practice does not require the cultivable land and management of entire field. In consideration of all these aspects drip irrigation in pots and brinjal in particular may be a good proposition for cultivation towards saving of water and economic return.

Recommendation

Determining the effects of drip irrigation in brinjal cultivation in field experiments requires an elaborate infrastructure. Pot experiments seem to be an alternative, since these could include a range of different soils. A further advantage which will allow experiments to be continued through out the year if the pots are sheltered from rain. This will reduce the duration of experiments compared to ones carried out in the open field. If pot experiments are carried out correctly, drainage and subsequent leaching of elements can be avoided. In the present study the experiment had been carried out in a very small areas for experimental purpose if the study will carried out with large areas, where water is not available all the time with good and proper management it may give better result.

REFERENCES

1. Aykroyd, W. R., Composition of brinjal fruit. ICMR Special Rept. pp. 42 (1963).
2. Anonymous, Economic Review, Govt. of West Bengal (2010-11).
3. Biswas, R. K., *Drip and Sprinkler Irrigation* **1:** pp. 1-274 (2015).
4. Wilson, C. and Bauer, M., Drip Irrigation for Home Gardens. Colorado Stat University, U. S. Department of Agriculture Extension, Fact Sheet No. 4. 702 (2014).
5. Anonymous - http://www.netafimusa.com/greenhouse/products/bench-pots/multi-outletdripper-assemblies/
6. Boreli, l. A. and Zebri, G., Drip irrigation for sweet paper and egg plant under glass house. Recera scientifica, pp. 219-225 (1988).
7. Yojana, Nadia District, West Bengal by Agricultural Finance Corporation Ltd. Eastern Regional Office, Kolkata (2009).
8. Abd El-Aal, F. S., Abdel Mouty, M. M., Ali, A. H., Combined effect of irrigation intervals and foliar application of some antitranspirants on eggplant growth, fruits yield and its physical and chemical properties. *Res. J. Agric. & Biol. Sci.*, **4(5):** 416-423 (2008).
9. Clough, G. H., Locascio, S. J. and Olson, S. M., Yield of successively cropped polyethylene mulched vegetables as affected by irrigation methods and fertilization management. *Journal of American Society of Horticultural Science* **115:** 884-887 (1990).
10. Cornillon, P. and Douple, P., Influence of irrigation rhythm and water supply on growth, water and yield of egg plant. (*Solanum melongena* L.). *Plant and soil.* **59(3):** 365-379 (1981).
11. Duranti, A. and cuocolo, L., Nitrogen fertilizing of eggplant. *Nauchini Trudovei vissh selskostepanski Institute Vasikolarov*. **26(2):** 91-97 (1982).
12. Farghali, M. A., Growth yield performance of egg plant under drip irrigation system. *J. Agric. Sci*., **26(2):** 23-26 (1998).
13. Graifenberg, A., Patsas, S. and Giustiniani, L., The removal of nutrient element by egg plants. *Inflormatore di-orthrorafrutti colfura*. **24(5):** 17-22 (1983).
14. Padmakumari, O. and Sivanappan, R. K., Studies on drip irrigation to brinjal crop. *Madras agric. J*. **65(9):** 608-609 (1978).
15. Yadav, B. S., Singh, G. R., Mangal, J. L. and Srivastava, V. K., Drip irrigation in vegetable production. *Agric. Res. (Karnal)*. **14(2):** 75-82 (1993).