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Impact of Fertigation and Drip System Layout on Performance of Chilli (Capsicum Annum)

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Abstract:- Field experiment on Impact of fertigation and drip system layout were conducted at KCAET, Tavanur. The experiment were laid out in factorial randomized block design with treatments which included three irrigation levels 85, 75 and 65% of daily irrigation requirement and two different drip system layout which were replicated thrice. In chilli maximum yield of 458 g/plant which is worked out as 18.32 t/ha was observed for the treatment T5. The benefit cost ratio for treatment T5, 85 per cent of the irrigation requirement with one lateral for each row of crop was 3.8 and treatment T6, 85 per cent of the irrigation requirement with one lateral in between two rows of crop was 3.9. Even though the yield for the treatment T5 was high, the benefit cost ratio stands high for treatment T6. The high value of benefit cost ratio for treatment T6 was due to the reduction in the quantity of material for drip irrigation system.

I. INTRODUCTION

Water resources are found to be getting deteriorated in terms of quality as well as quantity. Mark *et al*. (2002) reported that by the year 2025, 33 per cent of India's population will live under absolute water scarcity condition. The per capita water availability in terms of average utilizable water resources in the country was 6008 m^3 in 1947 and is expected to dwindle to 760 m^3 by 2025 (Kumar, 2003). Water is a major input in agriculture. The water use efficiency of the crops has to be increased in order to reduce the water loss from the fields. With drip fertigation, nutrient use efficiency is increased and the loss of nutrients to the ground water is reduced. Soluble chemicals and nutrients move with the wetting front. Hence a precise scheduling of irrigation and fertilizer applications is essential for sustainable crop production.

Vegetable production in Indian agriculture has wider scope for increasing the income of the marginal and small farmers. Vegetables have vast potential in gaining foreign exchange through the export. The vegetable growers are looking for new ways to achieve superior quality produce with higher yields. Among the vegetables grown, chilli is a spice cum vegetable crop of commercial importance.

The important components of a fertigation system include drip irrigation system of suitable layout and fertigation equipment. Crops are raised under fertigation system with the application of suitable mulch materials in order to reduce the water loss and weed infestation. The performance of crop may vary with the application rates and schedule of irrigation. The cost of the system will vary with the layout of the drip irrigation system as the use of laterals in each system of layout may vary.

II. MATERIALS AND METHODS

The present study, ***"Impact of fertigation and drip system on performance of chilli"*** was carried out in KCAET Instructional Farm, Tavanur. The place is situated at 10^0 51' 23" N and 75^0 59'13" E elevation of 29 ft. The experiment was conducted during 2011- 2012 to evaluate the response of chilli to fertigation, drip system layout and mulching.

The soil type of the experiment field was sandy loam. The field was ploughed using tractor drawn disc plough and pulverized using rotavator. The plots of size 5×1 m^2 were drawn forming ridges around plot. A spacing of 45 cm × 45 cm, recommended for chilli in the Package of practices recommendations: Crops (KAU, 2002) was adopted.

2.1 Design and treatments

The experiment was laid out with seven treatments, combination consisting of three irrigation levels and two drip system layout. The experiment was laid out in Randomised Block Design having seven treatment combinations and was replicated thrice. The treatment details is shown in Table.1

Main plots: Irrigation levels

I_1: 65% of the daily irrigation requirement.

I_2: 75% of the daily irrigation requirement.

I_3: 85% of the daily irrigation requirement.

Sub plots Drip system layout

D_1: One lateral in between two rows of crop in a bed.
D_2: One lateral for each row of crop in a bed.

2.2 Irrigation Scheduling

Irrigation schedules were planned to provide the estimated water requirement of the crop. Irrigation was scheduled based on the daily crop water requirement of the crop. In order to determine the optimum water requirement for the crops, three irrigation levels were adopted which were 65, 75 and 85 percent of water requirement of chilli. The discharge rate of the emitter was 4 litres per hour at a nominal pressure of 1.5 kg (f) /cm^2.Time required for each irrigation is shown in Table.2

2.3 Fertigation Scheduling

The fertigation was given at weekly intervals. The entire phosphorous was applied as basal application. Nitrogen and potassium were applied through fertigation with twenty equal splits from third week to tenth week after planting. The recommended soluble fertilizers were applied simultaneously in a combined form to the plant root zone. The calculated amount of phosphorous was applied manually through *Rajphos* as a basal dose. Urea and polyfeed (19:19:19) were the fertilizers applied through fertigation. Fertilizer requirement for chilli is shown in Table.3

2.4 Installation of drip system and fertigation unit.

Irrigation water was pumped through 7.5 kw motor pump set and conveyed through the main line of 63mm diameter PVC pipes after filtering through the screen filter. From the main pipe, sub main of 40mm diameter PVC pipes were installed.

From the sub main, laterals of 14mm diameter LDPE were installed. Each lateral was provided with individual tap control for improving irrigation. Along the laterals, inline drippers were fixed at spacing of 50cm. The number of laterals installed was based on the number of rows of crops grown. The discharge rate of single dripper is 4 litres per hour.

Sub main and laterals were closed at the end with the end cap. Laterals were placed for each row per plot and in between two rows per plot, with eleven emitters in each lateral at a discharge rate of 4 litres per hour. Scheduling of irrigation at 65, 75 and 85 per cent of irrigation requirement for each day was commenced after the transplanting.

III. RESULTS AND DISCUSSION

3.1 Effect of irrigation and drip system layout on Biometric observation

The data on plant height, number of leaves, number of branches and stem girth at 120 and 160 days after planting as influenzed by different treatments, levels of irrigation and drip system layout were observed. The result revealed that the plant height and number of leaves at both stages did not differ significantly with respect to the different levels of irrigation or due to the different drip system layout and fertigation under plastic mulching. Yield in g/plant as influenzed bydifferent treatments, levels of irrigation and drip system layout is shown in Fig.1, 2 and 3.

With respect to the number of branches, it is seen that the maximum number of branches in the case of irrigation level was seen in I_3 (8). In case of number of branches, the level of irrigation I_2 (7) was on par with the irrigation level I_3. The irrigation level I_2 was on par with

Treatment	Description
T_1	65% of the daily irrigation requirement, with one lateral for each row of crops in a bed.
T_2	65% of the daily irrigation requirement, with one lateral in between two rows of crop in a bed.
T_3	75% of the daily irrigation requirement, with one lateral for each row of crops in a bed.
T_4	75% of the daily irrigation requirement, with one lateral in between two rows of crop in a bed.
T_5	85% of the daily irrigation requirement, with one lateral for each row of crops in a bed.
T_6	85% of the daily irrigation requirement, with one lateral in between two rows of crop in a bed.
T_7	Control

Table.1 Treatment details

Treatments	Time required for irrigation, min	Water required for irrigation, l/day
T_1	17.83	1.1
T_2	35.66	1.1
T_3	21.08	1.3
T_4	42.16	1.3
T_5	24.32	1.5
T_6	48.64	1.5

Table.2 Time required for irrigation of each treatments.

(Recommended dose of N: P: K is 75: 45: 20 kgha^{-1})			
Treatment (%)	Fertilizer required (g)		
	Urea	Polyfeed	Rajphos
100	1025	1243	709
Control	220	270	56

Table.3 Fertilizer requirement for Chilli

Treatments	WUE (kg/ha/mm)	NUE (kg kg^{-1})	KUE (kg kg^{-1})
T_1	25	176.42	529.28
T_2	22	156.58	469.76
T_3	23	190.10	570.32
T_4	21	175.60	526.80
T_5	25	244.26	732.80
T_6	24	239.36	718.08

Table.4 WUE, NUE and KUE in Chilli crop

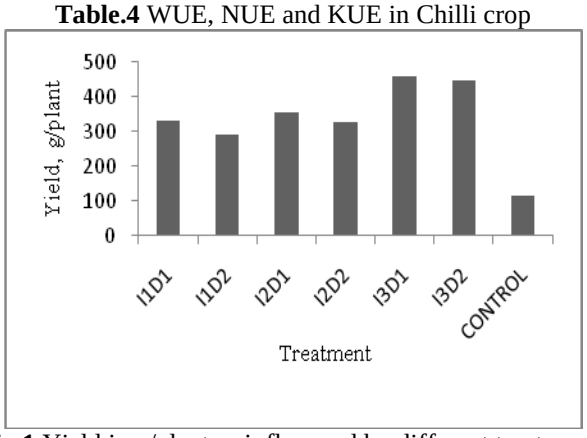

Fig.1 Yield in g/plant as influenced by different treatments

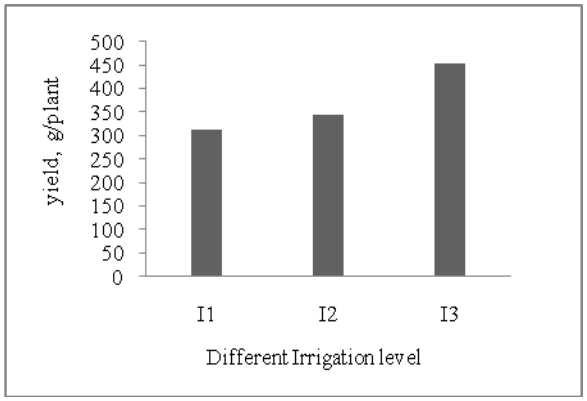

Fig.2 Yield in g/plant as influenced by different levels of irrigation

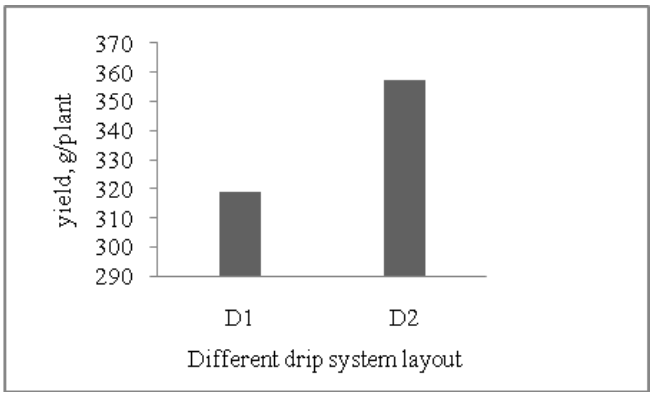

Fig.3 Yield in g/plant as influenced by different drip system layout.

the I_1 (6). The minimum number of branches was observed for the irrigation level I_1 at 120 days after planting. For average yield the different levels of irrigation and the drip system layout showed significant difference. The maximum yield value in the case of irrigation level was seen in I_3 (18.137 t/ha), 85 per cent of the irrigation requirement. The minimum yield was observed for the irrigation level I_1 (12.488 t/ha), 65 per cent of the irrigation requirement. When different drip system layout were taken into consideration, the maximum yield was obtained for the drip system layout D_1 (15.271 t/ha), one lateral for each row of crops and the minimum yield was obtained for the drip system layout, D_2 (14.289 t/ha) one lateral in between two rows of crops. This can be attributed to the fact that high moisture level in one lateral for each row of crops helps in better fruit weight per plant as compared to the plants with one lateral in between two rows of crops.

3.2 Water use efficiency and Fertilizer use efficiency

The highest water use efficiency of 25 kg/ha/mm was recorded in treatment T_5 and T_1. The reason for maximum water use efficiency in T_1 due to lesser water used as compared to T_6. The water use efficiency of 25 kg/ha/mm for treatment T_1 was higher than the water use efficiency of 23 kg/ha/mm for the treatment T_3. This was due to lesser water used as compared with the treatment T_3.

Increased FUE such as Nitrogen use efficiency (NUE) and Pottasium use efficiency (KUE) with the decreased levels of fertilizer doses were observed in the chilli crop. The highest NUE of 244.26 kg of produce / kg of N was recorded in the treatment T_5. Similar findings were observed by Vijayakumar, *et al.* (2010). For the treatment T_6 the NUE of 239.36 kg of produce / kg of N was recorded and for the control was about 60.5 kg of produce / kg of N. The similar trend was observed in KUE in chilli crop. The maximum KUE of 732.8 and 718.08 of kg of produce / kg of K was observed in the case of the treatment T_5 and T_6. The WUE, NUE and KUE in chilli crop is shown in Table.4

IV. CONCLUSION

The effect of different irrigation levels and drip system layout under plastic mulch on the performance of Chilli (*Capsicum annum*), **Ujwala** variety was studied. The number of branches, stem girth and yield showed significant difference between the treatments. The yield showed significant difference with different levels of irrigation and drip system layout. Maximum yield of 458 g/plant which is worked out as 18.32 t/ha was observed for the treatment T_5. The benefit cost ratio for treatment T_5, 85 per cent of the irrigation requirement with one lateral for each row of crop was 3.8 and treatment T_6, 85 percent of the irrigation requirement with one lateral in between two rows of crop was 3.9. Even though the yield for the treatment T_5 was high, the benefit cost ratio stands high for treatment T_6. The high value of benefit cost ratio for treatment T_6 was due to the reduction in the quantity of material for drip irrigation system.

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