

RESPONSE OF TRICKLE IRRIGATED CORIANDER CROP UNDER VARIOUS SOIL MOISTURE STRESS AT MAJOR GROWTH STAGES

VADAR, H. R.; MODHVADIYA, J. M.; PATEL, R. J.; MASHRU, H. H.;
VEKARIYA, P. B.; PARMAR, V. H. AND RANK, H. D.

DEPARTMENT OF SOIL AND WATER ENGINEERING
COLLEGE OF AGRICULTURAL ENGINEERING AND TECHNOLOGY
JUNAGADH AGRICULTURAL UNIVERSITY, JUNAGADH – 362 001, GUJARAT, INDIA

E MAIL: hrvadar@jau.in

ABSTRACT

Coriander (Coriandrum sativum) is an important spice crop grown in many part of the country. Optimal irrigation water requirement based on growth stages using drip irrigation system provides appropriate irrigation scheduling to maximize crop yield and most efficient use. The experiment was conducted during rabi 2015-16 season at Instructional Farm, Department of Soil and Water Engineering, Junagadh Agricultural University, Junagadh. The Coriander (cv. GC-2) was sown at 30 cm row spacing at recommended seed rate. The treatments of growth stage wise stress of 0.4, 0.6 and 0.8 IW/CPE ratios at vegetative stage, flowering stage and seed development and their comparison with surface flood irrigations were subjected to Randomized Block Design (RBD). In the results, plan growth parameters; plant height and numbers of branches was found in treatment T₇ (No stress condition with drip irrigation). The highest grain yield (1785.5 kg/ha), biological yield (3952.7 kg/ha) and water use efficiency (WUE) of 4.04 was noted, when no stress condition was maintained in development and flowering stage and irrigated at 0.6 PEF ratio during grain setting stage by drip system. The harvest index was not affected significantly by the treatment of stage wise stress in irrigation.

KEY WORDS: Coriander, irrigation, water use efficiency

INTRODUCTION

Coriander (*Coriandrum sativum*) is an annual spice crop that grows in many countries. The fresh green herb is called cilantro or Chinese parsley. It is used in exotic foods and for flavouring salads, soups and other products such as curry, gin and prepared meats. Essential oils and oleoresins are extracted and used in flavouring or as aroma additives. Different parts of this medicinal plant are used in most parts of the world. Different parts of the plant, including the fruits and the green herbs are also used for medicinal purposes such as dyspeptic complaints and loss of appetite. Pharmacological studies in animals have shown that coriander has anti-diabetic coriander leaves are used extensively in

Iranian cooking, and its fruits are used as a spice, an essential ingredient in curry powder. Coriander is a heat loving crop that grows on a wide range of soils.

Due to scarce water resource, the favourable soil and climatic conditions as well as low water requirements for the coriander crop, this crop has been widely adopted by the farmers. Irrigation plays an important role in plant growth, increase yield and quality (Singh and Goswami, 2000). As deficit or over irrigation at critical stage of the crop, is the most significant factor restricting plant growth and crop productivity in the majority of crops (Eid *et al.*, 1995 and Hammam, 1996). Identifying growth stages wise water requirement of a particular cultivar under local conditions of climate and

soil condition provides appropriate irrigation scheduling to maximize crop yield and most efficient use (Mahal and Sidhu, 2006; Abdin and Salem, 2009). There are different methods to estimate the irrigation requirements. One of them is using potential evapotranspiration based on class A Pan (Halepyati *et al.*, 1996 and Ruhi *et al.*, 2006).). Irrigation water also affected not only the volatile oil percentage, but also oil composition of coriander fruits (Hassan *et al.*, 2012).

However, the farmers are using surface flood methods and applying the irrigation water higher than its requirements due to lack of knowhow. Surface flood irrigation method causes temporary water logging and increases relative humidity of microclimate, which causes fungal disease like blight and powdery mildew leading to leads to considerable loss of the yield and quality of crop in many cases. If drip irrigation method used, besides water saving it maintains optimal soil moisture conditions and restrict wetted area, evaporation from the soil and thereby less contribute to relative humidity of microclimate. Hence, study may be required for optimal irrigation water requirement based on growth stages using drip irrigation system.

If irrigation water at particular growth stages applied in exact amount needed at proper time may enhance both the quality and yield of crop (Kumar *et al.*, 2008; Kamkar *et al.*, 2011). Demand for water is not met during these periods; it can result in slowed growth, flower abortion and reduced yield. In most crops, the late vegetative and reproduction stages are energy intensive and require a lot of water for maximum growth and production. Hence, study may be required for optimal irrigation water requirement based on growth stages for irrigation scheduling. The stage wise irrigation water applied using drip irrigation method can be the most practicable and effective and efficient water use tool. Hence the study was conducted with objectives; to assess the response of moisture stress on critical stages

and determine the optimal irrigation schedule for drip irrigated coriander crop.

MATERIALS AND METHODS

The experiment was conducted during *rabi* 2015-16 season at Instructional Farm, Department of Soil and Water Engineering, Junagadh Agricultural University, Junagadh, which falls in South Saurashtra Agro climatic Region. The coriander crop (cv. GC-2) was sown at 30 cm row spacing at recommended seed rate as per the treatment details given in Table 1. The Drip system with lateral Size: 16 cm, emitter spacing: 40 cm and emitter discharge: 4.0 lph was used and fitted at spacing of 90 cm providing lateral cock to each lateral in the each of the plot of the size: 2.0 x 1.8 m in the experiment. The observations of plant height (cm), number of branches, seed yield per plant, seed yield, biological yield, 1000 seed weight, harvest index and water used. The experimental design was Randomized Block Design (RBD) with three replications.

RESULTS AND DISCUSSION

Effect on growth parameters

Plant height (cm)

The data on plant height presented in Table 2 revealed that treatment of stage wise deficit irrigation had significant effect on plant height. The highest plant height (58.4 cm) was found with treatment T₇ (No stress condition with drip irrigation) which is significantly higher than treatment T₂, T₃ and T₉, but at par with treatments T₆, T₈, T₁₀, T₅ and T₄. The plant height in most treatment found to be at par with the highest one due to higher moisture regime and more efficient and frequent application water with drip irrigation.

Number of branches

The data on number of branches presented in Table 2 revealed that treatment of stage wise deficit irrigation had significant effect on number of branches. The highest number of branches (6.33 cm) was found with treatment T₇ (No stress condition with drip irrigation) which is significantly higher than treatment T₁, T₃, T₈ and T₉ but at par with treatments T₆, T₂, T₁₀, T₅ and T₄. The number of

branches in the higher moisture regime treatments found to be at par with the highest one.

Yield performance

Number of grains per plant

It is clearly found from the results on number of grains per plant presented in Table 3, that treatment of stage wise deficit irrigation had significant effect on number of grains per plant. The highest number of grains per plant (238.5) was found with treatment T₆ (No stress condition in development and flowering stage and irrigation @ 0.6 IW/CPE ratio at grain setting stage with drip irrigation) which is significantly higher than treatment T₁, T₂, T₃, T₈ and T₉, but at par with treatments T₇, T₅, T₁₀ and T₄. The number of grains per plant in the treatments with higher moisture regime later stage along with surface flood irrigation remained statistically on par with the T₆.

Grain yield (kg/ha)

Data of grain yield (kg/ha) are presented in Table 3 revealed that, treatment of stage wise deficit irrigation had significant effect on number of grain yield of coriander. The highest grain yield (1785.5 kg/ha) was found with treatment T₆ (No stress condition in development and flowering stage and irrigation @ 0.6 IW/CPE ratio at grain setting stage with drip irrigation) which is significantly higher than treatment T₁, T₃ and T₉, but at par with treatments T₈, T₂, T₇, T₅, T₁₀ and T₄. The yield performance in the treatments with lower moisture regime in development and flowering stage affect adversely on yield while on grain setting stage lower moisture regime with drip and surface flood irrigation remained statistically on par with the T₆. These results are in accordance with the results reported by Kamkar *et al.* (2011).

Biological yield (kg/ha)

Data of biological yield (kg/ha) are presented in Table 3 revealed that, treatment of stage wise deficit irrigation had significant effect on number of biological yield of coriander. The highest biological yield (3952.7 kg/ha) was found with treatment T₆

(No stress condition in development and flowering stage and irrigation @ 0.6 IW/CPE ratio at grain setting stage with drip irrigation) which is significantly higher than treatment T₉ but remained at par with treatments rest of the treatments. The biological yield performance in the treatments with moisture stress was not affected adversely except irrigation is stopped after development stage.

Harvest Index (%)

Data of harvest index (%) presented in Table 3 clearly indicated that harvest index (%) was not affected significantly by the treatment of stage wise stress in irrigation in coriander crop. The highest harvest index was found with the treatment T₂ (Irrigation @0.6 IW/CPE ratio in development stage and 0.8 IW/CPE in rest of the period) while the lowest one with T₂ (Irrigation @0.8 IW/CPE ratio in development and grain setting stage and 0.4 IW/CPE in flowering stage), may be due to the more effect of deficit irrigation regime on economic yield of coriander rather than biological yield.

Test weight (weight of 1000 grains)

The data presented in table 3 revealed that treatment of stage wise deficit irrigation had significant effect on test weight of coriander. The highest test weight (13.7g) was found with treatment T₆ (No stress condition in development and flowering stage and irrigation @ 0.6 IW/CPE ratio at grain setting stage with drip irrigation) which is significantly higher than treatment T₁, T₈, T₁₀ and T₉ but at par with treatments T₃, T₂, T₇, T₅ and T₄. The test weight is adversely affected by both treatments with lower moisture regime in development and seed setting stage and surface flood irrigation.

Water Use Efficiency (kg/ha-mm)

Water Use Efficiency (WUE) is computed by grain yield in kg/ha and depth of water applied in mm. Treatment wise data is graphically presented in Figure 1. The highest WUE (4.04) was found with the treatment treatment T₆ (No stress condition in development and flowering stage and irrigation @ 0.6 IW/CPE ratio at grain setting

stage with drip irrigation), which is slightly higher than T₁ (Stress condition i. e. Irrigation @ 0.4 IW CPE in development stage and irrigation @ 0.8 IW/CPE in rest of the period with drip irrigation) The lowest WUE is found with flood irrigation method. Similar results were also reported by Kumar *et al.* (2008) and Kamkar *et al.* (2011).

CONCLUSION

Based on results of the study following conclusions were drawn; the highest number of grains per plant (238.5), grain yield (1785.5 kg/ha) and biological yield (3952.7) kg/ha for coriander crop was obtained when no stress condition was maintained in development and flowering stage and irrigated at 0.6 PEF ratio during grain setting stage by drip system. The lowest WUE was found with flood irrigation method. The Harvest Index was not affected significantly by the treatment of stage wise stress in irrigation in coriander crop. The highest water use efficiency (WUE) of 4.04 was attained with the treatment having no stress condition in development and flowering stage and irrigation at 0.6 PEF ratio at grain setting stage with drip irrigation, which was slightly higher than the treatment having stress condition i. e. irrigation @ 0.4 PEF in development stage and irrigation @ 0.8 PEF during rest of the period with drip irrigation. The lowest WUE was found with flood irrigation method.

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Table 1: Treatment details

Treatment	Irrigation with Drip at given PEF during Different Growth Stages		
	S ₁ (Vegetative Stage)	S ₂ (Flowering Stage)	S ₃ (Seed Development / Fruiting Stage)
T ₁	0.4	0.8	0.8
T ₂	0.6	0.8	0.8
T ₃	0.8	0.4	0.8
T ₄	0.8	0.6	0.8
T ₅	0.8	0.8	0.4
T ₆	0.8	0.8	0.6
T ₇	0.8	0.8	0.8
T ₈	0.8	0.8	No irrigation
T ₉	0.8	No irrigation	No irrigation
T ₁₀	Control (Surface flood irrigation @0.8 IW/CPE)		

S₁=Vegetative Stage (0-55 DAS), S₂ = Flowering stage (56-80 DAS), and S₃= Seed Development / Fruiting Stage (81-105 DAS)

Table 2: Effect of treatment of stage wise stress on plant growth parameters of coriander

Treatment	Plant Height (cm)	Number of Branches
T ₁	48.73	5.07
T ₂	50.67	6.13
T ₃	50.80	4.93
T ₄	55.00	5.67
T ₅	55.07	6.00
T ₆	58.27	6.13
T ₇	58.40	6.33
T ₈	57.53	5.20
T ₉	50.67	4.73
T ₁₀	57.40	6.20
S.Em.±	1.71	0.38
C.D. at 5 %	5.08	1.12
C.V. %	5.46	11.54

Table 3: Effect of treatment of stage wise water stress on yield parameters of coriander

Treatment	Grains per Plant	Grain yield (kg/ha)	Biological yield (kg/ha)	Harvest Index (%)	Test weight (g)
T ₁	175.8	1398.1	3125.3	0.45	11.97
T ₂	196.2	1582.8	3305.7	0.48	12.47
T ₃	194.3	1440.9	3428.3	0.42	12.63
T ₄	204.9	1621.2	3710.7	0.44	13.03
T ₅	214.1	1658.4	3630.0	0.46	12.43
T ₆	238.5	1785.5	3952.7	0.46	13.70
T ₇	227.1	1760.0	3952.7	0.45	13.57
T ₈	191.0	1505.0	3509.0	0.43	11.87
T ₉	159.7	982.4	2178.0	0.46	10.87
T ₁₀	205.5	1559.7	3589.7	0.44	11.37
S.Em.±	11.7	110.7	308.0	0.02	0.526
C.D. at 5 %	34.8	328.8	915.2	NS	1.563
C.V. %	10.1	12.5	15.5	6.88	7.35

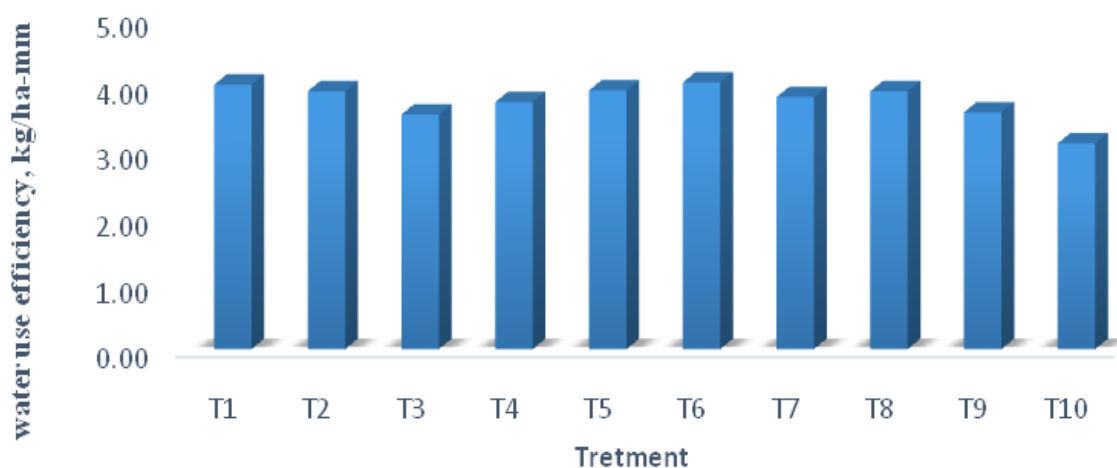


Figure 1: Effect of treatment on water use efficiency of coriander

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