



E-ISSN: 2278-4136

P-ISSN: 2349-8234

www.phytojournal.com

JPP 2020; 9(5): 3091-3093

Received: 18-07-2020

Accepted: 20-08-2020

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Yield and economics of fenugreek (*Trigonella foenum graecum* L.) as Influenced by irrigation and weed management practices

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Abstract

A field investigation was conducted during Rabi season of 2016-17 and 2017-18 at Rajasthan College of Agriculture, MPUAT Udaipur to study the productivity and economic efficiency of fenugreek as influenced by irrigation scheduling and weed management. The treatments comprised 4 irrigation levels (0.4, 0.6, 0.8 and 1.0 IW/CPE ratio) as main plots treatment and 4 weed management (weedy check, pre emergence application of pendimethalin + imazethapyr (RM) 0.75 kg ha⁻¹ in conjugation with one hand weeding 40 DAS, imazethapyr 0.075 kg ha⁻¹ fb one hand weeding 40 DAS and two hand weeding 20 and 40 DAS) as sub plot treatments. The experiment was laid out in a split plot design with 4 replications. The yield attributes, seed and haulm yield of fenugreek were significantly highest when irrigation applied at 1.0 IW/CPE ratio, however, its effect was statistically at par with 0.8 IW/CPE ratio on two year mean basis. The additional income of Rs 25680 and 53090 was realized with 0.8 IW/CPE ratio compared to 0.6 and 0.4 IW/CPE ratio on pooled basis. Significantly more number of number of pods plant⁻¹, number of seeds pods⁻¹, weight of seeds pod⁻¹, 1000 seed weight and seed weight plant⁻¹ as well as seed and haulm yield were recorded with pre emergence application of pendimethalin + imazethapyr (RM) 0.75 kg ha⁻¹ in conjugation with one hand weeding 40 DAS followed by two hand weeding.

Keywords: Yield and economics, Influenced by irrigation, Fenugreek

Introduction

Fenugreek (*Trigonella foenum graecum* L.) is an annual seed spice crop. The seeds of fenugreek are used as a condiment and seasoning agent for garnishing and flavouring dishes. Numerous studies have been carried out to reveal the therapeutic potential of fenugreek in various pathological conditions such as diabetes mellitus, cancer, hypertension, cataract, gastric disorders and obesity. It is mainly grown in Rajasthan, Gujarat, Madhya Pradesh, Maharashtra, Haryana, Punjab, Bihar and Andhra Pradesh. Water is an indispensable factor for every metabolic activity of plant and limited quantity of water available for irrigation calls for scheduling of irrigation to improve water productivity of fenugreek. Recently irrigation is being scheduled on the basis of climatological approach which is now considered as most scientific, since it integrate all weather parameters giving them natural weightage in a given climate-plant continuum (Parihar *et al.*, 1976) [4]. Weed is an important factor responsible for causing tremendous loss in fenugreek owing to initial slow growth which leads to severe crop-weed competition and reduces growth and yield by as high as 91.4% (Mehta *et al.*, 2010) [1]. Weeds in a crop field compete with crop and reduce the yield, increase evapo-transpiration, water needs and decrease water use efficiency. Hand weeding is a common method of weed control adopted by farmers but it is costly and time consuming method. The problem assumes added significance due to non-availability of adequate labour during peak period of operation. In such situations, the use of herbicides is the way to eliminate the weed crop competition. The information on weed and water interaction and its effect on crop growth and yield are meager. Hence, there is urgent need to generate precise information on irrigation requirement and weed management in fenugreek.

Material and Methods

A field experiment was conducted at Instructional Farm of Rajasthan College of Agriculture, MPUAT Udaipur geographically situated at 24° 35'N latitude and 74° 42' E longitude during Rabi seasons of 2016-17 and 2017-18 on different field each year. The soil of the experimental field of both the location was clay loam in texture having pH (8.1 and 8.0), electrical conductivity (0.89 and 0.84 dS/m), low in organic carbon (0.76 and 0.68) available nitrogen (400.5 and 372.80 kg ha⁻¹), low in available P₂O₅ (24.80 and 20.70 kg ha⁻¹) and high in

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available K₂O (378.20 and 342.40 kg ha⁻¹), respectively during 2016-17 and 2017-18. The experiment was laid out in split-plot design with four replications, keeping four levels of irrigation [0.4, 0.6, 0.8 and 1.0 IW/CPE ratio] in main plot and four weed control treatments (weedy check, pre emergence application of pendimethalin + imazethapyr (RM) 0.75 kg ha⁻¹ in conjugation with one hand weeding 40 DAS, imazethapyr 0.075 kg ha⁻¹ fb one hand weeding 40 DAS and two hand weeding 20 and 40 DAS) in sub plots. Fenugreek (RMT-305) was sown in lines 30 cm apart on 21 and 15 October in 2016 and 2017, respectively using a seed rate of 25 kg /ha. A full dose of 40 kg N and 40 kg P was drilled manually through urea and DAP at the sowing (after adjusting the quantity on nitrogen supplied through DAP). Cumulative pan evaporation was taken as the sum of the daily pan evaporation from USWB Class-A open pan evaporimeter. Irrigation water was measured by Parshall flume installed in the field channel. Application of pendimethalin + imazethapyr (RM) @ 0.75 kg ha⁻¹ was done on second day after irrigation with knapsack sprayer fitted with flat-fan nozzle with a spray volume of 600 liters ha⁻¹. At maturity crop was harvested by removing two border rows from both the sides of plot and produce from net plot was recorded and expressed as kg ha⁻¹. The economics of the treatment was calculated based on prevailing prices of input and output. Benefit: cost ratio was calculated by dividing net return with cost of cultivation. The trend of response of irrigation scheduling as well as weed control methods was same during both the years, therefore, the pooled results are presented for drawing valid conclusion.

Results and Discussion

Effect on yield attributes and yield

Yield attributes, seed and straw yields of fenugreek were significantly affected by irrigation schedules and weed management practice during both the years and on pooled basis. In case of irrigation schedules, significantly higher pods plant⁻¹, seed pod⁻¹, test weight, seed yield plant⁻¹, pod length and seed weight pod⁻¹ as well as seed and haulm yield were recorded when the crop was irrigated at 0.8 IW/CPE ratio, however, its effects was statistically at par with 1.0 IW/CPE ratio during 2016-17, 2017-18 and on pooled basis. Data further reported that IW/CPE ratio 0.8 recorded higher yield attributing character and yield i.e. 35.86 and 17.99 per cent higher pods per plant, 42.02 and 28.03 per cent higher seed per pod, 51.34 and 24.33 per cent higher 1000 seed weight, 160.96 and 68.64 per cent higher seed yield per plant, 14.71 and 7.34 per cent higher pod length, 114.02 and 59.55 per cent higher seed weight per pod, 106.49 and 35.34 per cent higher seed yield, 50.37 and 14.35 per cent higher haulm yield, 65.67 and 20.71 per cent higher biological yield over 0.4 and 0.6 IW/CPE ratio on pooled basis. This proves that IW/CPE ratio of 0.8 maintained most optimum soil moisture for better growth parameters i.e. dry matter accumulation, plant height, branches per plant, crop growth rate, relative growth rate, leaf area index, nodule per plant; result in better yield attributes and yield performance of fenugreek crop during both the years of investigation and pooled basis. No

doubt, weed density and weed dry weight increased steadily with increasing in number of irrigation but at the same time seed yield was also increased. This suggests that increasing irrigation numbers might have caused faster growth of fenugreek plants and inhibited weed seed germination and the growth of early emerged weeds, which in turn, reduced the weed-crop competition resulting into higher seed yield. These findings are in close agreement with those of Nemichand *et al.* (2007) [3] and Mehta *et al.* (2010) [1] who reported significant improvement in yield attributes and yield of respective crops with increase in IW/CPE ratio or irrigation levels. All the weed management treatments significantly influenced all the growth and related parameters compared to weedy check, which in turn increased all the yield attributes *viz.*, number of pods plant⁻¹, number of seeds pods⁻¹, weight of seeds pod⁻¹, 1000 seed weight and seed weight per plant which ultimately reflected into significantly higher seed, haulm and biological yield. Highest yield attributing characters *viz.* number of pods plant⁻¹, number of seeds pods⁻¹, weight of seeds pod⁻¹, 1000 seed weight and seed weight per plant were recorded under pre emergence application of pendimethalin + imazethapyr (RM) in conjugation with one hand weeding (60.2, 16.5, 0.341, 17.86 and 15.12 g plant⁻¹, respectively) as well as seed, haulm and above biological yield of 3142, 6264 and 9406 kg ha⁻¹, respectively on pooled basis which was found statistically at par with two hand weeding. The magnitude of increase in average pods per plant, seed pod⁻¹, test weight, seed weight per plant, weight of seeds pod⁻¹ and pod length under pre-emergence application of pendimethalin + imazethapyr (RM) fb one hand weeding 40 DAS over weedy check was 34.68, 36.36, 44.26, 109.42, 100.59 and 15.69 per cent, respectively on pooled basis. It is an established fact that least crop weed competition under pre emergence application of pendimethalin + imazethapyr (RM) in conjugation with one hand weeding and two hand weeding during critical phase of crop growth exert an important regulation function on complex process of yield formation due to better availability of water, space and nutrient to the crop plant. It also helps in improving aeration and nutrient uptake by fenugreek plant resulting in higher metabolic activity. It was well emphasized that reduced weed competition under pre emergence application of pendimethalin + imazethapyr (RM) along with hand weeding markedly influenced 'source' by virtue of higher photosynthesis and metabolic activity which is turn improved growth crop and consequently yield components. The adverse effect of weed competition under present investigation is clearly reflected under weedy check, where is dense population of weed reduced crop growth compared to pre emergence application of pendimethalin + imazethapyr (RM) along with hand weeding thus ultimately reduced yield attributes *viz.* number of pods plant⁻¹, number of seeds pods⁻¹, weight of seeds pod⁻¹, 1000 seed weight and seed weight per plant. Nutrient stress caused by weeds might have also affected the seed bearing capacity of each pod. Thus, the weeds were able to adversely affect vegetative as well as reproductive parts of crop plant ultimately crop yield.

Table 1: Effect of irrigations and weed management practices on yield attributes of fenugreek (Two year mean data)

Treatments	Pods plant ⁻¹	Seed pod ⁻¹	Test weight	Seed yield plant ⁻¹	Pod length	Seed weight pod ⁻¹
Irrigation management						
I ₀ (0.4 IW/CPE ratio)	44.9	11.9	11.92	6.43	10.2	0.164
I ₁ (0.6 IW/CPE ratio)	51.7	13.2	14.51	9.95	10.9	0.220
I ₂ (0.8 IW/CPE ratio)	61.0	16.9	18.04	16.78	11.7	0.351

I ₃ (1.0 IW/CPE ratio)	61.8	17.2	18.28	17.23	11.8	0.354
SEm.±	0.6	0.2	0.10	0.16	0.1	0.004
CD (P=0.05)	1.7	0.7	0.30	0.49	0.3	0.011
Weed management						
W ₀ (Weedy check)	44.7	12.1	12.38	7.22	10.2	0.170
W ₁ (Pendimethalin + imazethapyr (RM) + HW 40 DAS)	60.2	16.5	17.86	15.12	11.8	0.341
W ₂ (Imazethapyr along with one hand weeding 40 DAS)	54.9	14.4	14.85	13.10	10.9	0.245
W ₃ (Two HW 20 and 40 DAS)	59.6	16.2	17.67	14.95	11.7	0.334
SEm.±	0.3	0.1	0.09	0.11	0.1	0.003
CD (P=0.05)	0.7	0.4	0.26	0.30	0.2	0.008

Table 2: Effect of irrigations and weed management practices on yield and economics of fenugreek (Two year mean data)

Treatments	Seed yield (kg ha ⁻¹)	Haulm yield (kg ha ⁻¹)	Biological Yield (kg ha ⁻¹)	Harvest index (%)	Net Return (Rs)	BC ratio
Irrigation management						
I ₀ (0.4 IW/CPE ratio)	1571	4191	5762	26.83	27689	0.90
I ₁ (0.6 IW/CPE ratio)	2397	5511	7908	29.96	55099	1.72
I ₂ (0.8 IW/CPE ratio)	3244	6302	9546	33.57	80779	2.38
I ₃ (1.0 IW/CPE ratio)	3312	6427	9739	33.59	82168	2.35
SEm.±	52	79	122	0.33	1719	0.06
CD (P=0.05)	154	236	363	0.97	5108	0.17
Weed management						
W ₀ (Weedy check)	1642	4107	5750	28.23	31578	1.09
W ₁ (Pendimethalin + imazethapyr (RM) + HW 40 DAS)	3142	6264	9406	32.74	78267	2.35
W ₂ (Imazethapyr along with one hand weeding 40 DAS)	2648	5863	8511	30.33	61336	1.79
W ₃ (Two HW 20 and 40 DAS)	3092	6196	9288	32.66	74554	2.11
SEm.±	30	50	57	0.31	915	0.03
CD (P=0.05)	84	139	161	0.86	2570	0.08

Effect on economics

Each higher IW/CPE ratio up to 0.8 recorded significantly higher pooled net return and benefit cost ratio but IW/CPE ratios 0.8 and 1.0 were indifferent. IW/CPE ratio 0.8 recorded significantly higher pooled net return registering an increase of Rs 25680 and 53090 over 0.6 and 0.4 IW/CPE ratio, respectively which can be ascribed to variations in pooled seed and haulm yield under different irrigation levels. Amongst weed management treatments pre-emergence application of ready mix pendimethalin + imazethapyr along with hand weeding 40 DAS was found most remunerative, as it fetched the highest net return (Rs 78267) and BC ratio (2.35). The low investment under integrated management coupled with a good economic yield might be the reason for higher net monetary return and BC ratio.

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