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Naresh Kumar SharmaDepartment of Agronomy,
Rajasthan College of Agriculture,
MPUAT, Udaipur, Rajasthan,
India**SL Mundra**Department of Agronomy,
Rajasthan College of Agriculture,
MPUAT, Udaipur, Rajasthan,
India

Influence of irrigation and weed management practices on nodulation and yield of fenugreek (*Trigonella foenum graecum* L)

Naresh Kumar Sharma and SL Mundra

Abstract

A field trial was conducted in *Rabi* season of 2016-17 and 2017-18 at MPUAT, Udaipur to study effect of irrigation and weed management practices on nodulation and yield of fenugreek. The experiment consisting of four levels of irrigation (0.4, 0.6, 0.8 and 1.0 IW/CPE ratios) 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 was laid in split plot design with four replications. Irrigation at 0.8 IW/CPE ratio gave significantly more number of nodules per plant and their dry weight at 40, 60 and 75 DAS and leaf chlorophyll content in fresh leaf at 60 and 75 DAS as well as seed, straw and biological yields over 0.6 and 0.4 IW/CPE ratio. Significantly more number of nodules per plant and their dry weight at 40 and 60 DAS and leaf chlorophyll content, higher seed yield, straw yield and biological 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 which were statistically at par with each other in this regard.

Keywords: Irrigation, weed management, *Trigonella foenum graecum*, MPUAT

Introduction

Seed spices "*High value low volume crop*" are the most remunerative commodities of the arid and semi-arid region of India and play an important role in national economy. Fenugreek (*Trigonella foenum graecum* L.) popularly known by its vernacular name "methi" is an important annual herbaceous multipurpose condiment legume which is grown during winter season mainly in the state of Rajasthan, Gujarat and Uttar Pradesh. It occupies prime position among seed spices grown in India which has medicinal value with carminative, aromatic, tonic and galactagogue properties. Fenugreek is known to have hypoglycemic, and hypocholesterolaemic effects and anti-inflammatory effects. Agriculture's share of fresh water supply is likely to decline by 8 to 10 per cent because of increasing competition from the urban and industrial sector (Seckler *et al.*, 1998) [4]. Moreover, water is an indispensable factor for every metabolic activity of plant. In the world, specifically in arid and semi-arid regions water is an important limiting factor for crop production. Judicious use of water along with suitable agronomic techniques at appropriate crop growth stages would substantially increase both plant growth and yield. Increasing use of fertilizer and irrigation water would also increase manifold weed problem. Therefore, application of irrigation water in proper amount and proper time will go a long way in arresting the problem created by weeds. Fenugreek is slow growing crop during its initial stage and getting severe competition from the weeds during this stage. If unchecked, it may reduce the seed yield to the tune of 14.2 to 69.0 % depending upon their density and duration of competition (Chovatia *et al.*, 2010). Sometimes, scarcity of labour does not permit mechanical weeding to keep the field weed free. In such situations, the use of herbicides is the way to eliminate the weed crop competition. Information on effect of irrigation levels and weed control measures on growth and yield of fenugreek is scanty; therefore, present study was under taken.

Material and methods

The field experiment was conducted at Agronomy Instructional Farm of Rajasthan College of Agriculture, MPUAT Udaipur during *Rabi* season of 2016-17 and 2017-18. The experiment was laid on different sites in both the years. The soil of the experimental field of both the location was clay loam in texture having pH (8.1 and 8.0), electrical conductivity (0.12 and 0.11 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 available K₂O

Corresponding Author:**Naresh Kumar Sharma**Department of Agronomy,
Rajasthan College of Agriculture,
MPUAT, Udaipur, Rajasthan,
India

(378.20 and 342.40 kg ha⁻¹) respectively during 2016-17 and 2017-18. The experiment consisting four levels of irrigation (0.4, 0.6, 0.8 and 1.0 IW/CPE ratios) 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 in *fb* one hand weeding 40 DAS and two hand weeding 20 and 40 DAS) in sub plots was laid in split plot design with four replications. Fenugreek variety RMT-305 was used as test crop and test crop was raised as per package of practices recommended for this agro climatic zone. 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 the help of knapsack sprayer with a spray volume of 600 liters ha⁻¹. In manual weed control treatments, weeds were uprooted and removed at 20 and 40 DAS. Soil around five randomly selected plants, was moistened and dugout carefully from each plot, washed and used to count the total nodules from each plant roots. The weight of dried nodules per plant was recorded by electronic balance and expressed as mg plant⁻¹. Fresh leaf samples were collected at 60 and 75 DAS from each net plot for estimation of total chlorophyll spectrophotometrically by Arnon's method (1949). 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.

Results and discussion

Effect of irrigation levels

Number of nodules and their dry weight per plant at 40, 60 and 75 DAS, chlorophyll content of fresh leaf at 60 and 75 DAS, as well as seed, straw and biological yields were recorded significantly higher with application of irrigation at 0.8 IW/ CPE ratio. The higher values of these parameters with irrigation at 0.8 IW/CPE ratio might be due to optimum moisture availability which exhibited better bacterial activity leading to higher root nodulation. Similarly higher total chlorophyll contents in fresh leaf at 60 and 75 DAS with irrigation at higher levels might be due to increased availability of water with frequent irrigations in fenugreek led to better absorption of nutrients along with maintaining optimum turgidity of cells resulted in more chlorophyll synthesis. The higher seed, straw and biological yields of fenugreek with increasing levels of irrigation seems to be due to the fact that frequent irrigations under this treatment facilitated maintenance of optimum moisture level in soil as well as in plant during entire growth period. These findings are in close agreement with those of Nemichand *et al.* (2007) [3] and Mehta *et al.* (2010) [2] who reported significant improvement in yield attributes and yield of respective crops with increase in IW/CPE ratio or irrigation levels.

Effect of weed management practices

The study of different weed control techniques revealed that the higher number of nodules per plant⁻¹ and their dry weight plant⁻¹ and total chlorophyll content in fresh leaf at 60 and 75 DAS were recorded with pre emergence application of pendimethalin + imazethapyr (RM) @ 0.75 kg ha⁻¹ *fb* one hand weeding 40 DAS, however, its effect was statistically at par with two hand weeding. On account of less weed-crop completion due to effective control of the same resulted in creating congenial condition in rhizosphere, which facilitates higher absorption of nutrients and water by plants thereby maintaining favourable water status in leaf, which would have enhanced synthesis of chlorophyll. Similarly, bacterial activity was also increased under these treatments which might have enhanced nodulation and nodule weight in fenugreek. Significantly the highest seed, straw and biological yield of fenugreek were recorded with pre emergence application of pendimethalin + imazethapyr (RM) @ 0.75 kg ha⁻¹ *fb* one hand weeding 40 DAS followed by two hand weeding 20 and 40 DAS which were statistically at par with each other in this regard. Higher seed yield of fenugreek seems to be due to cumulative effect of growth and yield attributes which were recorded significantly higher in pre emergence application of pendimethalin + imazethapyr (RM) @ 0.75 kg ha⁻¹ *fb* one hand weeding 40 DAS and two hand weeding 20 and 40 DAS. The least weed population under these treatments was also responsible for better seed yield, straw and biological yield.

Interaction effect of irrigation and weed management practices

Seed, straw and biological yields were significantly influenced with interaction effect between irrigation levels and weed management practices. Application of irrigation at 0.8 IW /CPE ratio along with pre emergence application of pendimethalin + imazethapyr (RM) @ 0.75 kg ha⁻¹ *fb* one hand weeding 40 DAS resulted significantly highest seed, straw and biological yield which were at par with irrigation at 1.0 IW/CPE ratio + pre emergence application of pendimethalin + imazethapyr (RM) @ 0.75 kg ha⁻¹ *fb* one hand weeding 40 DAS and two hand weeding with both 0.8 and 1.0 IW/CPE ratio in this regard. The lowest seed, straw and biological yields were obtained by irrigation at 0.4 IW/CPE ratio with weedy check followed by 0.4 IW/CPE ratio with weedy check combination (Table 2). Effective weed control with pre emergence application of pendimethalin + imazethapyr (RM) @ 0.75 kg ha⁻¹ in combination with one hand weeding 40 DAS and two hand weeding at 20 and 40 DAS along with adequate availability of moisture at 0.8 IW/CPE ratio resulted better nodulation and chlorophyll synthesis which in turn gave higher seed, straw and biological yields. The results are in close conformity with those reported by Mehta *et al.* (2010) [2] in fenugreek.

Table 1: Number of nodules and their dry weight per plant, leaf chlorophyll content, seed yield, straw yield and biological yields as influenced by irrigation levels and weed management practices (Pooled of 2016-17 and 2017-18)

Treatments	Nodule plant ⁻¹			Nodule dry weight plant ⁻¹			Total chlorophyll content		Seed yield (kg ha ⁻¹)	Haulm yield (kg ha ⁻¹)	Biological yield (kg ha ⁻¹)
	40 DAS	60 DAS	75 DAS	40 DAS	60 DAS	75 DAS	60 DAS	75 DAS			
Irrigation management											
I ₀ (0.4)	12.31	21.60	18.00	27.33	51.05	49.34	2.19	2.29	1571	4191	5762
I ₁ (0.6)	16.51	24.52	19.71	39.12	69.53	51.69	2.39	2.47	2397	5511	7908
I ₂ (0.8)	19.74	26.05	21.15	45.03	81.41	67.66	2.52	2.63	3244	6302	9546
I ₃ (1.0)	20.15	26.70	21.43	46.29	82.29	68.72	2.54	2.65	3312	6427	9739
SEm.±	0.20	0.26	0.20	0.57	0.45	0.57	0.01	0.02	52	79	122
CD (P=0.05)	0.60	0.77	0.58	1.71	1.32	1.70	0.04	0.05	154	236	363

Weed management											
W ₀	11.78	19.49	18.41	25.24	57.20	48.08	2.22	2.39	1642	4107	5750
W ₁	20.01	27.91	20.98	46.02	75.63	64.77	2.53	2.61	3142	6264	9406
W ₂	16.48	23.15	19.58	39.54	70.32	59.14	2.37	2.45	2648	5863	8511
W ₃	20.44	28.33	21.32	46.98	81.13	65.41	2.51	2.60	3092	6196	9288
SEm.±	0.18	0.16	0.14	0.35	0.44	0.32	0.01	0.01	30	50	57
CD (P=0.05)	0.52	0.45	0.40	0.97	1.22	0.91	0.03	0.04	84	139	161

Table 2: Seed, straw and biological yields as influenced by interaction effect between irrigation levels and weed management practices (Pooled of 2016-17 and 2017-18)

Weed management	Irrigation management			
	I ₀ (0.4 IW/CPE ratio)	I ₁ (0.6 IW/CPE ratio)	I ₂ (0.8 IW/CPE ratio)	I ₃ (1.0 IW/CPE ratio)
Seed yield				
W ₀ (Weedy check)	1146	1490	1952	1983
W ₁ (Pendimethalin + imazethapyr (RM + HW 40 DAS))	1837	2854	3913	3965
W ₂ (Imazethapyr alone with hand weeding 40 DAS)	1482	2436	3289	3384
W ₃ (Two HW 20 and 40 DAS)	1818	2810	3822	3918
SEm.±	60			
CD (P= 0.05)	169			
Haulm Yield				
W ₀ (Weedy check)	3605	3999	4396	4430
W ₁ (Pendimethalin + imazethapyr (RM + HW 40 DAS))	4425	6124	7200	7309
W ₂ (Imazethapyr alone with hand weeding 40 DAS)	4262	5800	6654	6738
W ₃ (Two HW 20 and 40 DAS)	4473	6122	6960	7230
SEm.±	99			
CD (P= 0.05)	289			
Biological yield				
W ₀ (Weedy check)	4751	5489	6348	6412
W ₁ (Pendimethalin + imazethapyr (RM + HW 40 DAS))	6262	8977	11113	11274
W ₂ (Imazethapyr alone with hand weeding 40 DAS)	5745	8236	9943	10122
W ₃ (Two HW 20 and 40 DAS)	6291	8932	10781	11148
SEm.±	155			
CD (P= 0.05)	322			

Conclusion

However, higher yield of fenugreek may be obtained with the application of irrigation at 0.8 IW/CPE ratio along with weed control by pre emergence application of pendimethalin + imazethapyr (RM) @ 0.75 kg ha⁻¹ in combination with one hand weeding 40 DAS.

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