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Fenugreek Yield Influenced by Weed Control Measure

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A B S T R A C T

Field experiment was conducted at the Instructional Farm, Collage of Agriculture Bikaner, S. K. Rajasthan Agricultural University, Bikaner during *Rabi* 2017-18. The results reveled that plant height, branches/plant and periodical dry matter production, pods per plant, seeds per pod, pod length, seed yield biological yield and harvest index in plots treated with pendimethalin + imazethapyr at 0.80 kg ha^{-1} as PPI, followed pendimethalin at 0.75 kg/ha as PPI, pendimethalin at 0.75 kg/ha as PE, pendimethalin + imazethapyr at 0.80 kg/ha as PE, imazethapyr at 50 g/ha (3-4 leaf stage 25 DAS), imazethapyr + imazamox at 50 g/ha (25 DAS), imazethapyr at 70 g/ha (25 DAS) and imazethapyr + imazamox at 70 g/ha (25 DAS). Among the weed control measures, weed free treatment was most effective in reducing the dey weight of weeds and recorded the highest weed control efficiency followed by pendimethalin + imazethapyr at 0.80 kg/ha (Dry). However, the maximum net retunes were obtained under weed free (29752 ₹/ha followed by pendimethalin + imazethapyr at 0.80 kg/ha as PPI (27610 ₹/ha).

Key words: Fenugreek, Imazethapyr, Pendimethalin, Imazamox, Weed control efficiency

Fenugreek (*Trigonella foenum - graecum* L.), commonly known as Methi, is an important seed spice. Fenugreek is an annual plant belonging to sub family Papillionaceae of the family Leguminoceae. It was named, Trigonella, from Latin language that means ‘‘little triangle” due to its yellowish-white triangular flowers. Fenugreek, like other legumes, is a worthy source of dietary protein for feeding by man and animals. Seeds of fenugreek are used as a yellow dye, in cosmetics industry, for medicinal commitments, condiment and seasoning agent for garnishing and flavoring dishes. Its fresh tender leaves and pods are consumed as vegetable being rich in iron, calcium, protein and vitamins. Its chopped leaves are mixed in flour to prepare “Parantha”, grains are also used to prepare concentrate feed for animals. It is also used to prepare carminative mixture. The important steroid saponins and diosgenin content in seed is used for the synthesis of sex hormones and oval contraceptives. Its seeds are bitter in taste due to presence of alkaloid “Trigonellin”. Trigocoumarin, trimethyl coumarin and nicotinic acid mucilage are prominent constituents of seed. Its roots are endowed with nitrogen fixing ability, which further adds to its merit. Fenugreek is a good soil renovator and commonly used as a green manure. Being a legume crop, fenugreek has high nutritive value which contains 26.2% protein, 5.8% fat, 3.0% mineral matter and 4.41%, carbohydrate, 160 IU carotene per 100 gm. In India, fenugreek occupies an area of about 93000 ha with annual production of about 113000 tonnes having average productivity 1215 kg/ha. In Rajasthan, it is cultivated mainly in Sikar, Nagaur, Jaipur, Kota and Pali districts occupying an area of about 67657 ha with production of 95960 tonnes exhibiting productivity of about 1418 kg/ha in 2017 – 18 (GOR 2019).

Weeds are one of the important factors responsible for low productivity of fenugreek which is responsible for reducing crop growth by two mechanism, i.e. completion for resources, such as light, space, water, nutrients etc. and allelopathic effect. In the initial growth of crop there is relatively shallow canopy and it slowly shades the inter-row area, which allows bumper weeds growth and thus

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fenugreek becomes more susceptible to weed crop competition in the earlier growth period of the crop. Herbicides are most effective and economic weed control measures but always use of herbicides is not feasible due to some unavoidable circumstances like unavailability of proper herbicides, cropping system requirement and problem of weed flora shift due to continuous use of same group of herbicides. Thus, it is necessity to explore and test other alternative and economical methods of weed control. In view of above fact study on weed control measures was carried out for identifying most effective and economically viable method of weed control for harvesting higher yield of fenugreek.

MATERIALS AND METHODS

The field experiment was conducted at Instructional Farm, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan, India (28° 01'N latitude and 73° 22'E longitude at an altitude of 234.70 meters above mean sea level) during *Rabi* season of 2017-18. The soil of experimental field was loamy-sand, alkaline in reaction (pH 8.5) having 118 kg/ha available N (Alkaline permanganate method (Subbiah and Asija 1956), low level of available phosphorus (15.1 kg/ha, Olsen's method (Olsen *et al*. 1954 and medium in available potassium (173.7 kg/ha, Flame photometric method (Metson 1956) in 0-15 cm soil depth at the start of the experiment. The experiment was laid out in randomized block design with three replications. There were 12 weed control treatments viz. weedy check, weed free, pendimethalin at 0.75 kg/ha (Dry), pendimethalin + imazethapyr at 0.80 kg/ha (Dry), pendimethalin at 0.75 kg/ha as PPI, pendimethalin + imazethapyr at 0.80 kg/ha as PPI, pendimethalin at 0.75 kg/ha as PE, pendimethalin + imazethapyr at 0.80 kg/ha as PE, imazethapyr at 50 g/ha (3-4 leaf stage 25 DAS), imazethapyr + imazamox at 50 g/ha (25 DAS), imazethapyr at 70 g/ha (25 DAS) and imazethapyr + imazamox at 70 g/ha (25 DAS). The required quantity of herbicides was worked out and was mixed with water and sprayed uniformly at different stages of crop growth with knapsack sprayer fitted with flat fan nozzle at a spray volume of 500 l/ha. Fenugreek cultivar 'RMT - 305' was sown in lines 30 cm apart during first week of November in each experimental unit. All the recommended package of practices was followed to raise the crop. The crop was harvested during second week of March, 2018.

Table 1 Effect of weed control measures on growth, yield attributes, yield and net returns of fenugreek

Treatment	Plant height (cm)	No. of branches/ plants	Dry weight (g/plant)	Yield attributes				Yield (kg/ha)			Harvest index (%)	Net returns (₹/ha)
				No. of pods per plant	No. of seeds per pods	Pod length (cm)	Test weight (g)	Seed	Straw	Biological		
Weedy check	46.6	3.0	14.1	19.0	10.0	9.0	13.3	603	2785	3387	17.7	-1463
Weed free	56.4	7.0	22.5	28.0	16.0	13.5	14.3	1970	3348	5318	37.0	29752
Pendimethalin at 0.75 kg/ha (Dry)	40.7	3.5	14.5	15.7	10.1	7.3	11.1	624	2175	2799	22.4	-1820
Pendimethalin+ imazethapyr at 0.80 kg/ha (Dry)	39.3	3.3	13.3	17.5	10.3	7.8	10.2	531	1878	2408	22.6	-4473
Pendimethalin at 0.75 kg/ha as PPI	54.1	6.4	21.2	27.7	14.0	12.0	13.4	1720	3405	5126	34.7	25588
Pendimethalin + imazethapyr at 0.80 kg/ha as PPI	55.2	6.4	21.3	27.7	15.7	13.0	13.2	1814	3357	5171	35.3	27610
Pendimethalin at 0.75 kg/ha as PE	53.9	5.8	21.0	27.1	13.7	11.9	13.6	1545	3488	5033	31.0	21205
Pendimethalin + imazethapyr at 0.80 kg/ha as PE	53.7	5. 6	20.1	26.6	13.3	11.8	13.6	1631	3456	5086	32.5	23027
Imazethapyr at 50 g/ha (3-4 leaf stage 25 DAS)	50.3	5.2	16.6	26.2	12.7	10.5	12.9	1302	3296	4597	28.5	15162
Imazethapyr + imazamox at 50 g/ha (25 DAS)	50.0	5.2	18.0	26.3	11.0	11.0	13.6	1265	3487	4752	26.7	13547
Imazethapyr at 70 g/ha (25 DAS)	48.6	4.7	16.8	26.0	12.3	10.1	13.5	1241	3182	4423	28.1	13617
Imazethapyr + imazamox at 70 g/ha (25 DAS)	48.1	4.4	19.0	25.8	12.0	10.0	13.2	1181	3209	4390	27.0	11147
SEm ±	1.7	0.4	1.3	1.8	1.0	0.9	0.6	55	299	288	2.66	1374
CD at 5%	5.7	1.4	4.4	5.8	3.4	2.9	2.1	176	959	924	8.53	4403

RESULTS AND DISCUSSION

Effect on crop

Effect of different weed control measures was also observed on growth parameters like plant height, branches per plant and periodical dry matter production, yields attributing character *viz.* pods per plant, seeds per pod, pod length, test weight, seed, straw biological yield and harvest index. Significantly lower values of plant height, branches per plant and periodical dry matter production, pods per plant, seeds per pod, pod length, test weight, seed, straw biological yield and harvest index were recorded under weedy check and highest values of these were recorded in weed free plot (Table 2).

Among herbicidal treatments significantly higher values of growth parameters like plant height, branches per plant and periodical dry matter production in plots treated with pendimethalin + imazethapyr at 0.80 kg/ha as PPI, followed pendimethalin at 0.75 kg/ha as PPI, pendimethalin at 0.75 kg/ha as PE, pendimethalin + imazethapyr at 0.80 kg/ha as PE, imazethapyr at 50 g/ha (3-4 leaf stage 25 DAS), imazethapyr + imazamox at 50 g/ha (25 DAS), imazethapyr at 70 g/ha (25 DAS) and imazethapyr + imazamox at 70 g/ha (25 DAS). This might have resulted in better availability of moisture and nutrients to the crop in absence of weeds. Moreover, increased nutrient and water uptake by crop, which could be increased photosynthates which supply more carbohydrates, resulted in increased cell division and elongation of cells resulted to increase plant height and number of branches.

Significantly higher pods per plant, seeds per pod, pod length, test weight, seed, straw biological yield and harvest index obtained with weed free treatments. Among herbicidal treatments maximum pods per plant, seeds per pod, pod length, seed yield biological yield and harvest index in plots treated with pendimethalin + imazethapyr at 0.80 kg/ha as PPI, followed by pendimethalin at 0.75 kg/ha as PPI, pendimethalin at 0.75 kg/ha as PE, pendimethalin + imazethapyr at 0.80 kg/ha as PE, imazethapyr at 50 g/ha (3-4 leaf stage 25 DAS), imazethapyr + imazamox at 50 g/ha (25 DAS), imazethapyr at 70 g/ha (25 DAS) and imazethapyr + imazamox at 70 g/ha (25 DAS). Maximum test weight was recorded in plots treated with pendimethalin at 0.75 kg/ha as PE, pendimethalin + imazethapyr at 0.80 kg/ha as PE and imazethapyr + imazamox at 70 g/ha (25 DAS). Maximum straw yield (2175 kg/ha) was recorded with pendimethalin at 0.75 kg/ha as PE which was significantly higher than all other herbicidal treatments. It is an established fact that least crop weed competition during critical phase of crop growth exerts an important regulation function on complex process of yield formation due to better availability of water, space and nutrients to the crop plant. It also helps in improving aeration and nutrient uptake by plant resulting in higher metabolic activity (Lalitha Bai and Sinha 1993).

Effect on weeds

The most important weed species in the experimental field throughout the growing period were *Cyperus rotundus* L., *Melilotus indica*, *Chenopodium album*, *Chenopodium murale*, Convolvulus *arvensis*, *Cynodon dactylon*, *Rumex dantatus* and *Avena fatua.*

Table 2 Effect of weed control measures on weed dry weight, weed control efficiency and weed index

Treatment	Weed dry weight (g/m^2)									Weed control efficiency (%)	Weed index (%)
	Dicots			Monocots and Sedges			Total				
	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest	30 DAS	60 DAS	At harvest		
Weedy check	2.74 (7.01)	5.06 (25.10)	9.69 (93.45)	2.77 (7.19)	3.96 (15.23)	4.24 (17.55)	3.83 (14.20)	6.64 (43.66)	10.56 (111)	0.00	69.5
Weed free	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.71 (0.00)	0.17 (0.00)	100.00	0.0
Pendimethalin at 0.75 kg/ha (Dry)	1.57 (1.96)	2.93 (8.12)	5.67 (31.66)	1.32 (1.28)	1.84 (2.90)	2.25 (4.55)	5.67 (3.24)	3.62 (11.02)	6.06 (36.22)	91.61	68.2
Pendimethalin+ imazethapyr at 0.80 kg/ha (Dry)	1.54 (1.88)	2.93 (8.08)	5.53 (30.07)	1.14 (0.83)	1.77 (2.65)	2.01 (3.55)	1.79 (2.71)	3.64 (10.73)	5.84 (33.62)	92.67	73.2
Pendimethalin at 0.75 kg/ha as PPI	1.66 (2.26)	3.14 (9.35)	5.82 (33.32)	1.53 (1.87)	2.30 (4.78)	2.63 (6.43)	2.15 (4.13)	4.04 (15.87)	6.34 (39.75)	85.93	12.5
Pendimethalin + imazethapyr at 0.80 kg/ha as PPI	1.63 (2.15)	3.10 (9.12)	5.76 (32.64)	1.53 (1.86)	2.24 (4.55)	2.61 (6.33)	2.12 (4.01)	3.95 (15.21)	6.28 (38.97)	86.56	7.8
Pendimethalin at 0.75 kg/ha as PE	1.74 (2.52)	3.30 (10.38)	5.95 (34.87)	1.64 (2.19)	2.40 (5.32)	2.80 (7.33)	2.28 (4.71)	4.16 (16.94)	6.53 (42.20)	82.88	21.6
Pendimethalin + imazethapyr at 0.80 kg/ha as PE	1.72 (2.46)	3.15 (9.45)	5.87 (34.02)	1.63 (2.18)	2.33 (5.00)	2.73 (6.95)	2.26 (4.64)	4.11 (16.45)	6.44 (40.97)	83.06	17.2
Imazethapyr at 50 g/ha (3-4 leaf stage 25 DAS)	2.05 (3.72)	3.56 (12.17)	6.20 (37.99)	1.85 (2.94)	2.61 (6.34)	2.89 (8.00)	2.67 (6.66)	4.60 (20.73)	6.82 (45.99)	78.03	33.8
Imazethapyr + imazamox at 50 g/ha (25 DAS)	1.96 (3.34)	3.40 (11.05)	6.09 (36.64)	1.74 (2.55)	2.54 (5.95)	2.75 (7.13)	2.53 (5.89)	4.34 (18.46)	6.65 (43.77)	80.38	35.7
Imazethapyr at 70 g/ha (25 DAS)	2.03 (3.64)	3.50 (1172)	6.20 (37.97)	1.82 (2.82)	2.58 (6.15)	2.86 (7.66)	2.64 (6.46)	4.45 (19.39)	6.79 (45.64)	78.65	37.0
Imazethapyr + imazamox at 70 g/ha (25 DAS)	1.92 (3.18)	3.37 (10.88)	6.07 (36.40)	1.74 (2.54)	2.47 (5.66)	2.73 (6.96)	2.49 (5.72)	4.26 (17.79)	6.62 (43.36)	81.26	40.0
SEm ±	0.03	0.05	0.07	0.09	0.11	0.11	0.30	0.79	1.15	1.77	2.94
CD at 5%	0.11	0.17	0.22	0.30	0.34	0.36	0.98	2.52	3.69	5.67	9.43

The highest dry weight of weeds (14.2, 43.66 and 111 g/m^2) were found in the weedy check (control), which was statistically higher over rest of treatments at 30, 60 DAS and at harvest (Table 2). Weed free treatment recorded the lowest dry weight of weeds (2.71. 10.73 & 37.62 g/m^2) at 30, 60 DAS and at harvest. The treatment pendimethalin+ imazethapyr at 0.80 kg/ha (Dry) resulted significantly lowest dry weight of weeds as compared to rest of treatments except weed free condition at 30, 60 DAS and at harvest. The results of study also corroborate with the finding of Kumar *et al.* (2004). Imazethapyr applied at 3-4 leaf stage (25 DAS) @ 50 g/ha was found less effective in reducing dry weight of weeds and weed control efficiency due to less control of weeds as compared to rest of chemical treatments. The highest weed control efficiency was observed in weed free plot (100 per cent) due to continuous removal of weeds during crop period. Among all the chemical weed control measures, maximum weed control efficiency (92.67 per cent) was recorded in pendimethalin+ imazethapyr at 0.80 kg/ha (Dry) which was statistically at par with pendimethalin at 0.75 kg/ha (Dry). The lowest weed control efficiency (78.03 per cent) was recorded in Imazethapyr at 50 g/ha (3-4 leaf stage 25 DAS).

The highest weed index was observed in pendimethalin+ imazethapyr at 0.80 kg/ha (Dry) (73.2 per cent) which was statistically at par with weedy check and pendimethalin at 0.75 kg/ha (Dry) due to the lower seed yield recorded in these treatments as compared to rest of treatments. Minimum weed index was recorded in pendimethalin + imazethapyr at 0.80 kg/ha as PPI (7.8 per cent) and pendimethalin at 0.75 kg/ha as PPI (12.5 per cent) due to higher seed yield recorded in these treatments as compared to rest of treatments. This might be due to elimination of weeds by manual weeding and interculturing or by herbicides. The integrated effect on dry weight of weeds and seed yield under these treatments might have been responsible for excellent weed indices. These findings are akin to report of Bhandari *et al*. (2004) in summer blackgram.

Economics

The comparative economics of various weed control treatments is presented in (Table 1). Data of the present investigation revealed that to raise an economical crop of fenugreek, proper weed management is must. Weed free gave the highest net return (29752 ₹/ha) over weedy check followed by Pendimethalin + imazethapyr at 0.80 kg/ha as PPI (27610 ₹/ha).

On the basis of present experiment, it may be concluded that pendimethalin+ imazethapyr at 0.80 kg/ha (dry), pendimethalin at 0.75 kg/ha (dry) provided excellent control of weeds and highest weed control efficiency. Maximum growth attributes, yield attributes and yield were recorded in weed free plots which were significantly higher overall herbicidal treatments. Among herbicidal treatments pendimethalin + imazethapyr at 0.80 kg/ha as PPI were superior as compared to rest of treatments in case of growth attributes, yield attributes and yield of fenugreek.

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