

Effect of inter cropping on termite management of fenugreek under North Gujarat conditions

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Abstract

A field trial was conducted at the Seed Spices Research Station, Jagudan for four consecutive seasons, *Rabi* 2012-13 to 2015-16, to evaluate the different intercropping systems against termite on fenugreek. Seven treatments comprised of fenugreek and ajwain grown in 1:1 ratio, fenugreek and ajwain grown in 2:1 ratio, fenugreek and ajwain grown in 3:1 ratio, fenugreek and ajwain grown in 4:2 ratio, fenugreek and ajwain grown in 5:1 ratio, fenugreek (sole) and ajwain (sole). Fenugreek and ajwain grown in 1:1 ratio (1.91%) had recorded the least infestation of termite in fenugreek in 1 meter row length. Minimum per cent termite damage in net plot at harvest had also recorded in fenugreek and ajwain grown in 1:1 ratio (1.68%). Highest fenugreek equivalent yield had recorded in fenugreek and ajwain grown in 1:1 ratio (1947kg ha⁻¹), whereas, highest total gross realization had recorded in the fenugreek and ajwain grown in 1:1 ratio (Rs. 64,298 ha⁻¹). Ajwain (sole) gave maximum benefit (BCR = 1:3.70) followed by fenugreek and ajwain grown in 1:1 ratio (BCR= 2.59), whereas, fenugreek (sole) has given the lowest benefit (BCR= 1:1.11).

Key words : Ajwain, fenugreek, fenugreek equivalent yield, intercropping, termite,

Introduction

Fenugreek (*Trigonella foenum-graceum* L.), is an important seed spice crop grown in India for domestic and export purposes. It is cultivated for seed, vegetable as well as for medicinal purposes. In India, Rajasthan, Gujarat, Uttaranchal, Uttar Pradesh, Madhya Pradesh, Maharashtra, Haryana and Punjab is the major fenugreek producing states. Among the various bottlenecks for low productivity of fenugreek in Gujarat, attack of insect pests form a major limiting factor, of which fenugreek aphid (*Aphis craccivora*), fenugreek leafhopper (*E. spinosa*), leaf miner (*L. congestra*), lucerne weevil (*H. prostica*) and termite are the major pests of fenugreek crop. Among them, termite is an important pest which feeds on the roots of fenugreek plants and thereby yield is reduced drastically. To avoid such losses, insecticides are mainly used to manage the termite. In order to reduce high cost of insecticides and the adverse effects on the environment, cultural method is an important tool of IPM to manage the termite in fenugreek eco-system. Among different cultural methods, intercropping is an age old practice and attracted world-wide attention owing to yield advantage if the crops selected are compatible. Intercropping system has some of the potential benefits such as increased productivity/unit area/unit time, high

profitability and improvement in soil fertility, efficient use of resources and reducing damage caused by pests, diseases and weeds (Baumann *et al.*, 2000; Hatcher and Melander, 2003; Kenny and Chapman, 1988; Poggio, 2005). It is also cost effective and environment-friendly alternative. Among different seed spices, termite is not attacking in ajwain crop. Keeping these points in view, an investigation was carried out to study the evaluation of different intercropping systems with fenugreek as the main crop and ajwain as an inter-crop. The information on termite management is scanty in general and particularly from North Gujarat conditions. Therefore, the present experiment was conducted during *Rabi* 2012-13 to 2015-16 to find out the optimum row arrangement ratio of ajwain with fenugreek for the termite management in fenugreek.

Materials and methods

A field experiment was laid out at the Seed Spices Research Station, Jagudan, Gujarat during *Rabi* 2012-13 to 2015 -16 to find out the optimum row arrangement ratio of ajwain with fenugreek for the management of termite in fenugreek. A total of seven treatments *viz.*, fenugreek and ajwain grown in 1:1 ratio, fenugreek and ajwain grown in 2:1 ratio, fenugreek and ajwain grown in 3:1 ratios, fenugreek and ajwain grown in 4:2 ratios, fenugreek and ajwain grown in 5:1 ratios, fenugreek (sole) and ajwain

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(sole). The trial was laid out in a randomized block design (RBD) with seven treatments and four replications. The size of each plot measured 4.00m x 3.60m. The varieties of Gujarat fenugreek 2 and Gujarat ajwain 1 were spaced at 30cm and all the recommended agronomic practices were adopted as per package of practices. Observations on termite damage in fenugreek and ajwain crops in 1 metre row length were recorded. Finally, per cent damaged plants of fenugreek and ajwain by termites in net plot at harvest were also recorded. Observations on powdery mildew disease intensity (%) were also recorded. These data were analyzed for its statistical interpretation with necessary data transformation so as to compare the different intercropping treatments. Seed yield of fenugreek and ajwain in kg ha⁻¹ at harvest were recorded and converted them into fenugreek equivalent yield and total gross realization were also worked out for each treatment. Economical analysis of different treatments was also worked out.

Results and discussion

Per cent termite damage in fenugreek plants/meter row length

Four individual years as well as pooled data on per cent termite damaged fenugreek plants per meter row length are presented in table 1. Perusal of the pooled results revealed that the termite damage in fenugreek plants per meter row length differed significantly during individual years as well as in pooled analysis. Fenugreek and ajwain grown in 1:1 ratio had registered the least attack of termite (1.91%) and found significantly superior over rest of the intercropping treatments. Fenugreek and ajwain grown in 2:1 ratio (4.76%) proved second best treatment but it was at par with fenugreek and ajwain grown in 4:2 ratios (5.47%). Fenugreek (sole) had exhibited the highest termite damage (15.31%) and remained significantly inferior over the rest of the treatments, whereas, ajwain (sole) remained free from the termite damage. Meena *et al.*, 2015 reported that inter cropping of fennel with dill in ratio of 2:1 was found most effective to prevent the fennel crop from seed wasp damage. Thus, these findings are more or less similar to the earlier workers.

% termite damage in fenugreek plants per net plot at harvest

The four years as well as pooled data on per cent termite damage in fenugreek plants in net plot at harvest are presented in table 2. Pooled results showed that the termite damage in fenugreek plants in net plot at harvest differed significantly during individual years as well as in pooled analysis. The per cent termite damage in net plot at

harvest had also registered the least in fenugreek and ajwain grown in 1:1 ratios (1.68%) found significantly superior over rest of the intercropping treatments. Fenugreek and ajwain grown in 2:1 ratio (4.21%) ranked in second order but it was remained at par with Fenugreek and ajwain grown in 4:2 ratio (4.50%). Fenugreek (sole) had exhibited the highest termite damage (12.55%) and found significantly inferior over rest of the treatments. Ajwain (sole) had recorded free from the damage due to termite. These results are more or less similar to Reddy *et al.*, 2006 who reported all the intercropped treatments were significantly superior in reducing the sucking pest infestation in chilli and had significantly higher yield compared to sole crop of chilli. Among the intercrops, garlic and onion performed well in reducing the pest load and improving the yield of the main crop. More or less similar results were obtained by Singh and Kothari (1997) who reported fennel intercropped with mustard resulted in a significantly lower aphid infestation in mustard. Thus, the present findings more or less corroborate to the earlier findings.

Powdery mildew disease intensity (%)

The four years' data individually as well as the pooled data on powdery mildew disease intensity presented in table 3 revealed that powdery mildew disease intensity differed significantly during all the four years as well as in pooled analysis. Ajwain (Sole) had found free from the powdery mildew disease intensity, whereas, the treatments comprised of Fenugreek (Sole), Fenugreek and Ajwain grown in 5:1 ratios and Fenugreek and Ajwain grown in 1:1 ratio were equally effective in managing powdery mildew disease intensity and recorded 33.29, 34.81 and 38.02 per cent powdery mildew disease intensity, respectively.

Fenugreek equivalent yield (kg ha⁻¹)

The four years' data individually as well as the pooled data on fenugreek equivalent yield in kg per hectare presented in table 3 revealed that fenugreek equivalent yield of differed significantly due to different intercropping treatments. Among them, ajwain (sole) had recorded significantly the highest (2,490kg/ha) fenugreek equivalent yield. However, all the intercropping treatments found equally effective in terms of fenugreek equivalent yield. Among the different row arrangement, fenugreek and ajwain grown in 1:1 ratio recorded numerically higher fenugreek equivalent yield (1,947kg ha⁻¹) than rest of the intercropping systems, whereas, fenugreek (sole) recorded the lowest fenugreek equivalent yield (964kg ha⁻¹).

Total gross realization (` ha⁻¹)

The four years' data individually as well as the pooled

Table 1. Per cent termite damage in fenugreek plants in 1 meter row length in different treatments

Treatments	2012-13	2013-14	2014-15	2015-16	Pooled
Fenugreek and ajwain grown in 1:1 ratio	8.39* (2.13)	8.53* (2.26)	7.65* (1.76)	7.03* (1.54)	7.93* (1.91)
Fenugreek and ajwain grown in 2:1 ratios	12.84 (4.95)	12.93 (5.05)	12.99 (5.04)	11.59 (4.05)	12.60 (4.76)
Fenugreek and ajwain grown in 3:1 ratio	16.25 (7.83)	14.50 (6.25)	14.47 (6.01)	14.19 (6.01)	14.85 (6.56)
Fenugreek and ajwain grown in 4:2 ratio	13.91 (5.73)	13.17 (5.19)	13.15 (5.17)	13.89 (5.75)	13.53 (5.47)
Fenugreek and ajwain grown in 5:1 ratio	17.41 (8.95)	14.63 (6.36)	14.69 (6.35)	13.69 (5.27)	16.33 (7.91)
Fenugreek (sole)	23.11 (17.40)	23.77 (16.26)	24.27 (16.99)	21.02 (12.87)	23.04 (15.31)
Ajwain(sole)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
S.E.m.s	1.28	1.23	1.11	0.98	0.94
C.D.at 5%	3.81	3.67	3.31	1.73	1.53
C.V.%	19.56	19.72	17.94	9.44	17.29
YXI					NS

* Arcsin transformed values; Figures in parenthesis are retransformed values

Table 2. Per cent termite damaged plants in net plot at harvest in different treatments

Treatments	% termite damaged fenugreek plants/ net plot at harvest				
	2012-13	2013-14	2014-15	2015-16	Pooled
Fenugreek and ajwain grown in 1:1 ratio	9.33* (2.66)	8.16* (2.03)	8.42* (2.04)	4.23* (0.58)	7.56* (1.68)
Fenugreek and ajwain grown in 2:1 ratio	11.06 (3.67)	12.07 (4.36)	12.19 (4.46)	12.04 (4.33)	11.84 (4.21)
Fenugreek and ajwain grown in 3:1 ratio	13.70 (5.61)	14.62 (6.37)	14.70 (6.44)	17.91 (9.46)	15.23 (6.89)
Fenugreek and ajwain grown in 4:2 ratio	14.17 (3.75)	12.25 (4.50)	12.21 (4.47)	13.38 (5.36)	12.25 (4.50)
Fenugreek and ajwain grown in 5:1 ratio	15.40 (7.05)	16.53 (9.15)	16.62 (8.18)	18.37 (10.46)	16.87 (8.42)
Fenugreek (sole)	16.31 (7.89)	18.78 (10.38)	19.33 (10.36)	23.60 (22.91)	20.75 (12.55)
Ajwain (sole)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
S.E.m.	0.40	0.37	0.32	1.10	1.16
C.V. at 5%	1.19	1.08	0.96	3.29	3.45
C.V. %	7.32	6.19	5.44	16.27	10.55
YXI					1.79

Table 3. Fenugreek equivalent yield (kg/ha) in different intercropping treatments

Treatments	Fenugreek equivalent yield (kg/ha)				
	2012-13	2013-14	2014-15	2015-16	Pooled
Fenugreek and ajwain grown in 1:1 ratio	1,619	1,541	1,500	3,127	1,947
Fenugreek and ajwain grown in 2:1 ratios	1,459	1,459	1,435	2,889	1,811
Fenugreek and ajwain grown in 3:1 ratios	1,328	1,387	1,363	2,740	1,704
Fenugreek and ajwain grown in 4:2 ratios	1,555	1,438	1,414	2,974	1,845
Fenugreek and ajwain grown in 5:1 ratios	1,437	1,254	1,229	2,345	1,691
Fenugreek (sole)	1,081	813	804	1,160	964
Ajwain (sole)	1,848	1,840	1,825	4,449	2,490
S.E.m.	114	70	58	123	172
C.V. at 5%	339	299	173	366	512
C.V. %	15.48	10.12	8.51	8.55	10.75
YXI					270

Table 4. Total gross realization (t ha^{-1}) in different intercropping treatments

Treatments	Total Gross Realization (t ha^{-1})				
	2012-13	2013-14	2014-15	2015-16	Pooled
Fenugreek and ajwain grown in 1:1 ratio	40,469	38,524	37,497	1,40,702	64,298
Fenugreek and ajwain grown in 2:1 ratios	36,475	36,471	35,878	1,30,025	59,713
Fenugreek and ajwain grown in 3:1 ratios	33,199	34,666	34,073	1,23,307	56,311
Fenugreek and ajwain grown in 4:2 ratios	38,863	35,946	35,353	1,33,827	60,997
Fenugreek and ajwain grown in 5:1 ratios	35,920	31,358	30,733	1,28,020	56,508
Fenugreek (sole)	27,018	20,334	20,095	52,187	29,909
Ajwain (sole)	46,198	45,989	45,635	2,00,207	84,507
S.Em. \pm	2855	1759	1454	5550	9,072
C.D.at 5%	8483	5226	4320	16491	26,957
C.V.%	15.48	10.12	8.51	8.55	11.28
YXT					9379

Table 5. Economical analysis of different intercropping treatments

Treatments	Fenugreek Equivalent Yield (kg ha^{-1})	Total Gross Realization (₹ ha^{-1})	Total cost of cultivation of inter cropping system (₹ ha^{-1})	Net realization on (₹ ha^{-1})	BCR
1. Fenugreek and ajwain grown in 1:1 ratio	1,947	64,298	24,854	39,444	1:2.59
2. Fenugreek and ajwain grown in 2:1 ratio	1,811	59,713	25,520	34,193	1:2.34
3. Fenugreek and ajwain grown in 3:1 ratio	1,704	56,311	25,836	30,475	1:2.18
4. Fenugreek and ajwain grown in 4:2 ratio	1,845	60,997	25,520	35,477	1:2.39
5. Fenugreek and ajwain grown in 5:1 ratio	1,691	56,508	26,180	30,328	1:2.16
6. Fenugreek (sole)	964	29,909	26,848	3,060	1:1.11
7. Ajwain(sole)	2,490	84,507	22,855	61,652	1:3.70

data on total gross realization (t ha^{-1}) presented in table 4 differed significantly. Among them, ajwain (sole) and fenugreek (sole) were recorded maximum ($\text{t } 84, 507 \text{ ha}^{-1}$) and minimum ($\text{t } 29, 909 \text{ ha}^{-1}$) total gross realization, respectively. Different row arrangement of fenugreek and ajwain intercropping systems were remained at par with each other. However, fenugreek and ajwain grown in 1:1 ratio ($\text{t } 64, 298 \text{ ha}^{-1}$) recorded numerically higher total gross realization than rest of the intercropping systems.

Economics

Economics of different treatments of fenugreek was worked out considering total cost of cultivation of different intercropping systems (Table 5). The gross realization, net realization and Benefit Cost ratio (BCR) were also worked out for different treatments. Looking to the economical

analysis of different treatments, ajwain (sole) gave maximum benefit (BCR = 1:3.70) among all the treatments under experimentation followed by fenugreek and ajwain grown in 1:1 ratio (BCR = 1:2.59) followed by fenugreek and ajwain grown in 4:2 ratio (BCR=1:2.39) followed by fenugreek and ajwain grown in 2:1 ratio (BCR=1: 2.34), whereas, fenugreek (sole) gave the lowest benefit (BCR= 1:1.11).

Overall, fenugreek and ajwain grown in 1:1 ratio (1.91%) as well as fenugreek and ajwain grown in 2:1 ratio (4.76%) had recorded the least infestation of termite in fenugreek in 1 meter row length. Minimum per cent termite damage in net plot at harvest had also recorded in fenugreek and ajwain grown in 1:1 ratio (1.68%). Highest fenugreek equivalent seed yield had registered in fenugreek and ajwain grown in 1:1 ratio (1947 kg ha^{-1}), fenugreek and

ajwain grown in 4:2 ratio (1845kg ha⁻¹) as well as fenugreek and ajwain grown in 2:1 ratio (1811kg ha⁻¹), whereas, highest total gross realization had recorded in the fenugreek and ajwain grown in 1:1 ratio (164,298 ha⁻¹). Ajwain (sole) gave maximum benefit (BCR = 1:3.70) followed by fenugreek and ajwain grown in 1:1 ratio (BCR= 2.59), whereas, fenugreek (sole) gave the lowest benefit (BCR= 1:1.11).

It can be concluded from the present investigation that fenugreek growers are advised to grow ajwain as an inter crop in fenugreek in 1:1 ratio for effective management of termite.

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