

# Management of termite in Isabgul through intercropping

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## Abstract

Field trial was conducted on termite management in Isabgul (*Plantago ovata* Forsk.) at Seed Spices Research Station, Jagudan for four consecutive seasons, Rabi 2013-14 to 2016-17 through intercropping with Ajwain (*Trachyspermum ammi* L.). Isabgul and Ajwain was grown in ration of 1:1, 2:1, 3:1, 4:2 and 5:1 ratio along with Isabgul and Ajwain as sole crop. The result showed that Isabgul and Ajwain grown in 1:1 ratio (3.95%) had recorded the least infestation of termite in Isabgul in 1 meter row length. Minimum per cent termite damage in net plot at harvest had also recorded in Isabgul and Ajwain grown in 1:1 ratio (2.42%). Highest Isabgul Equivalent Yield had recorded in Isabgul and Ajwain grown in 1:1 ratio (1085kg ha<sup>-1</sup>), whereas, highest total gross realisation had recorded in the Isabgul and Ajwain grown in 1:1 ratio (₹ 49101 ha<sup>-1</sup>). Ajwain (Sole) gave maximum benefit (BCR = 1:1.88) followed by Isabgul and Ajwain grown in 1:1 ratio (BCR= 1:1.84), whereas, Isabgul (Sole) gave the lowest benefit (BCR= 1:1.10).

**Key words :** Ajwain, intercropping, isabgul, isabgul equivalent yield, termite

## Introduction

India is endowed with a rich wealth of medicinal plant. Isabgul (*Plantago ovata* Forsk.) is one of the important medicinal crop cultivated traditionally in North Gujarat, Saurashtra and Kachchh regions of Gujarat state. The most important component of Isabgul is husk obtained from its seed. Isabgul husk is popularly known as Sat Isabgol in Indian market. It is an important medicine for intestinal and stomach disorders.

Insect pests as well as diseases are of major limiting factors in achieving the higher productivity of Isabgul crop. Among them, Isabgul aphid, *Aphis gossypii* Glover, seed beetle, *Lasioderma serricornis* Fabricius, termite, *Odontotermes obesus* Rambur and white grub, *Holotrichia consanguinea* Blanchard are major insect pests attacking in Isabgul crop (Reddy, 2009). In sandy and light textured soils of North Gujarat and Kachchh regions, termite, *Odontotermes obesus* Rambur (Isoptera: Termitidae) is a crucial one which feeds on roots of Isabgul plants and thereby, the yield of Isabgul is reduced drastically.

Among different components of IPM, cultural method is an effective and economical tool to manage the termite in Isabgul eco-system. It is cost effective and environment friendly alternative to manage an important soil arthropod i.e., termite. Among various cultural methods, crop barrier/intercrop plays a vital role to manage termite in Isabgul. Among them, 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). Among different Seed Spices, roots of Ajwain repel the termite. Hence, termite does not appear in Ajwain crop. Keeping this fact in mind, Ajwain crop has chosen as an inter crop/ crop barrier in Isabgul for the management of termite in Isabgul. The information on termite management is scanty in general and particularly from North Gujarat Agro-Climatic Zone (IV). Hence, the present experiment was conducted on intercropping to manage termite in Isabgul with Ajwain during four consecutive seasons i.e., Rabi 2013-14 to 2016-17 and the results are presented here under.

## Materials and methods

Field experiments were laid out at Seed Spices Research Station, Jagudan, Gujarat during Rabi 2013-14 to 2016-17 to find out an optimum row arrangement ratio of Ajwain with Isabgul for the management of termite in Isabgul. A total of seven treatments viz., Isabgul and Ajwain grown in 1:1 ratio, Isabgul and Ajwain grown in 2:1 ratios, Isabgul and Ajwain grown in 3:1 ratios, Isabgul and Ajwain grown in 4:2 ratios, Isabgul and Ajwain grown in 5:1 ratios, Isabgul (Sole) and Ajwain (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 Isabgul-3 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 Isabgul and Ajwain crops in 1 meter row length were recorded. Finally, per cent damaged plants of Isabgul and Ajwain by termites in net plot at harvest 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 Isabgul and Ajwain in kg hectare<sup>-1</sup> at the time of harvest were recorded and converted them into Isabgul Equivalent Yield and total gross realization were worked out for each treatment. Economical analysis of different treatments was also computed.

## Results and discussion

### Termite damage in Isabgul/ meter row length

Four individual years as well as pooled data on per cent termite damage in Isabgul plants meter<sup>-1</sup> row length are presented in table 1. Perusal of the pooled results revealed that the termite damage in Isabgul plants meter<sup>-1</sup> row length differed significantly during individual years as well as in pooled analysis. Isabgul and Ajwain grown in 1:1 ratio had registered the least attack of termite (3.95%) and remained at par with intercropping treatments viz., Isabgul and Ajwain grown in 2:1 ratios (6.46%) and Isabgul and Ajwain grown in 4:2 ratios (6.61%). Isabgul (Sole) had

exhibited the highest termite damage (24.12%) and remained significantly inferior over the rest of the treatments, whereas, Ajwain (Sole) remained free from the damage caused by termite. Meena *et al.*, 2015 from Ajmer, Rajasthan studied an influence of cultural practices on infestation of seed wasp, *Systole albipennis* Walker in fennel. Thus, the present findings more or less corroborate to the earlier findings.

### Termite damage in Isabgul / net plot at harvest

The four years as well as pooled data on per cent termite damage in Isabgul plants in net plot at harvest are presented in table 2. Pooled results showed that the termite damage in Isabgul 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 Isabgul and Ajwain grown in 1:1 ratio (2.42%) and remained significantly superior over rest of the intercropping treatments. Isabgul and Ajwain grown in 2:1 ratios (6.36%) ranked in second order but it was remained at par with Isabgul and Ajwain grown in 4:2 ratios (6.87%). Ajwain (Sole) had recorded free from the damage due to termite, whereas, Isabgul (Sole) had registered the highest termite damage (13.83%) and found significantly inferior over rest of the treatments. Aswathanarayananareddy *et al.*, 2006 who reported all the intercropped treatments were significantly superior in reducing the sucking pests infestation in chilli and had significantly higher yield as compared to sole crop of chilli.

**Table 1.** Termite damage in Isabgul in 1 meter row length in different intercropping treatments

Treat No.	Treatments	Termite damage in Isabgul (%)				
		2013-14	2014-15	2015-16	2016-17	Pooled
1.	Isabgul and Ajwain grown in 1:1 ratio	10.95* (3.61)	9.64* (2.81)	12.16* (4.46)	13.13* (5.14)	11.47* (3.95)
2.	Isabgul and Ajwain grown in 2:1 ratios	12.66 (4.80)	13.46 (5.46)	14.48 (6.26)	18.31 (9.87)	14.73 (6.46)
3.	Isabgul and Ajwain grown in 3:1 ratios	14.28 (6.08)	14.37 (6.17)	18.02 (9.57)	20.86 (12.68)	16.88 (8.43)
4.	Isabgul and Ajwain grown in 4:2 ratios	12.62 (4.76)	12.88 (4.98)	15.64 (7.26)	18.48 (10.04)	14.90 (6.61)
5.	Isabgul and Ajwain grown in 5:1 ratios	14.97 (6.67)	15.03 (6.73)	18.46 (10.02)	20.45 (12.21)	17.23 (8.77)
6.	Isabgul (Sole)	28.45 (22.70)	28.58 (22.89)	26.21 (19.50)	34.43 (31.98)	29.42 (24.12)
7.	Ajwain(Sole)	0.00 (0.0)	0.00 (0.0)	0.00 (0.0)	0.0 (0.0)	0.00 (0.0)
	S.Em.±	0.61	1.37	1.56	0.47	0.76
	C.D.at 5%	1.83	4.06	4.66	1.41	2.26
	C.V.%	9.18	20.41	20.93	5.29	14.87
	YXT					3.14

\* Arcsin transformed values

Figures in parenthesis are retransformed values

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.

**Isabgul Equivalent Yield (kg ha<sup>-1</sup>)**

The four years data individually as well as the pooled data on Isabgul Equivalent Yield in kg hectare<sup>-1</sup> presented in table 3 revealed that Isabgul Equivalent Yield of differed significantly due to different treatments. Among them, Ajwain (Sole) had recorded significantly the highest Isabgul

Equivalent Yield (1283kg ha<sup>-1</sup>). However, all the intercropping treatments found equally effective as far as equivalent yield of Isabgul is concerned. Among the different row arrangement, Isabgul and Ajwain grown in 1:1 ratio recorded numerically higher Isabgul Equivalent Yield (1085kg ha<sup>-1</sup>) than rest of the intercropping systems. Isabgul (Sole) recorded the lowest Isabgul Equivalent Yield (644kg ha<sup>-1</sup>).

**Total gross realisation (₹ ha<sup>-1</sup>)**

Four years data individually as well as the pooled data on total gross realisation presented in table 4 differed significantly. Among them, Ajwain (Sole) and Isabgul (Sole) were recorded maximum (₹ 49734 ha<sup>-1</sup>) and

**Table 2.** Termite damage in Isabgul plants in net plot at harvest in different intercropping treatments

Treat No.	Treatments	Termite damage in Isabgul (%)				
		2013-14	2014-15	2015-16	2016-17	Pooled
1.	Isabgul and Ajwain grown in 1:1 ratio	8.25* (2.07)	9.47* (2.71)	8.43* (2.15)	9.95* (2.97)	9.02* (2.42)
2.	Isabgul and Ajwain grown in 2:1 ratio	12.24 (4.49)	13.17 (5.19)	15.85 (7.45)	17.18 (8.72)	14.61 (6.36)
3.	Isabgul and Ajwain grown in 3:1 ratio	14.79 (6.52)	15.54 (7.18)	18.55 (10.12)	19.73 (11.40)	17.15 (8.69)
4.	Isabgul and Ajwain grown in 4:2 ratio	12.41 (4.62)	12.93 (5.01)	16.87 (8.42)	18.64 (10.21)	15.21 (6.87)
5.	Isabgul and Ajwain grown in 5:1 ratio	16.77 (8.33)	17.41 (8.94)	17.89 (9.44)	19.17 (10.78)	17.81 (9.36)
6.	Isabgul (Sole)	19.89 (11.59)	20.46 (12.22)	22.29 (14.39)	24.72 (17.49)	21.84 (13.83)
7.	Ajwain(Sole)	0.00 (0.0)	0.00 (0.0)	0.00 (0.0)	0.0 (0.0)	0.00 (0.0)
	S.Em.±	0.39	0.45	0.26	0.26	0.59
	C.D.at 5%	1.16	1.33	0.80	0.78	1.76
	C.V.%	6.47	7.08	3.78	3.38	5.15
	YXT					0.99

\* Arcsin transformed values

Figures in parenthesis are retransformed values

**Table 3.** Isabgul Equivalent Yield (kg ha<sup>-1</sup>) in different intercropping treatments

Treat No.	Treatments	Isabgul Equivalent Yield (kg ha <sup>-1</sup> )				
		2013-14	2014-15	2015-16	2016-17	Pooled
1.	Isabgul and Ajwain grown in 1:1 ratio	1212	1176	1118	835	1085
2.	Isabgul and Ajwain grown in 2:1 ratio	1079	1057	968	713	954
3.	Isabgul and Ajwain grown in 3:1 ratio	1190	1169	909	689	989
4.	Isabgul and Ajwain grown in 4:2 ratio	1202	1181	732	726	960
5.	Isabgul and Ajwain grown in 5:1 ratio	1160	1139	784	631	928
6.	Isabgul (Sole)	688	683	794	410	644
7.	Ajwain(Sole)	1790	1773	845	724	1283
	S.Em.±	38	39	73	27	89
	C.D.at 5%	114	118	216	79	264
	C.V.%	6.47	6.81	16.52	7.91	9.73
	YXT					134

minimum (₹ 29630 ha<sup>-1</sup>) total gross realisation, respectively. Different row arrangement of Isabgul and ajwain intercropping systems were remained at par with each other. However, Isabgul and Ajwain grown in 1:1 ratio (₹ 49101 ha<sup>-1</sup>) recorded numerically higher total gross realisation than rest of the intercropping systems.

**Economics**

Economics of different treatments of Isabgul was worked out considering total cost of cultivation of different intercropping systems (Table 5). The gross realisation, net realisation and Benefit Cost Ratio (BCR) were also worked out for different treatments.

Looking to the economic analysis of different treatments, Ajwain (Sole) gave maximum benefit (BCR = 1:1.88) among all the treatments under experimentation followed by Isabgul and Ajwain grown in 1:1 ratio (BCR=1.84) followed by Isabgul and Ajwain grown in 2:1 ratios

(BCR=1:1.59) followed by Isabgul and Ajwain grown in 3:1 ratios (BCR=1:1.59), whereas, Isabgul (Sole) gave the lowest benefit (BCR=1: 1.10).

Overall, Isabgul and Ajwain grown in 1:1 ratio (3.95%) had recorded the least infestation of termite in Isabgul in 1 meter row length. Minimum per cent termite damage in net plot at harvest had also recorded in Isabgul and Ajwain grown in 1:1 ratio (2.42%). Highest equivalent seed yield of Isabgul had recorded in Isabgul and Ajwain grown in 1:1 ratio (1085kg ha<sup>-1</sup>), Isabgul and Ajwain grown in 3:1 ratios (989kg ha<sup>-1</sup>) as well as Isabgul and Ajwain grown in 4:2 ratios (960kg ha<sup>-1</sup>), whereas, highest total gross realisation had recorded in the Isabgul and Ajwain grown in 1:1 ratio (₹ 49101 ha<sup>-1</sup>), Isabgul and Ajwain grown in 2:1 ratios (₹ 42760 ha<sup>-1</sup>) as well as Isabgul and Ajwain grown in 3:1 ratios (₹ 42703 ha<sup>-1</sup>). Ajwain (Sole) gave maximum benefit (BCR = 1:1.88) followed by Isabgul and Ajwain

**Table 4.** Total gross realisation (₹ ha<sup>-1</sup>) in different intercropping treatments

Treat No.	Treatments	Total gross realisation (₹ ha <sup>-1</sup> )				
		2013-14	2014-15	2015-16	2016-17	Pooled
1.	Isabgul and Ajwain grown in 1:1 ratio	30312	29397	78246	58448	49101
2.	Isabgul and Ajwain grown in 2:1 ratio	26966	26419	67769	49887	42760
3.	Isabgul and Ajwain grown in 3:1 ratio	29739	29214	63611	48248	42703
4.	Isabgul and Ajwain grown in 4:2 ratio	30035	29509	51241	50826	40403
5.	Isabgul and Ajwain grown in 5:1 ratio	29006	28481	54861	44149	39124
6.	Isabgul (Sole)	17187	17079	55538	28717	29630
7.	Ajwain(Sole)	44739	44323	59166	50708	49734
	S.Em.±	960	994	5,079	1,869	3119
	C.D.at 5%	2854	2654	15091	5554	9268
	C.V.%	6.47	6.81	16.52	7.91	13.32
	YXT					7884

**Table 5.** Economical analysis of different intercropping treatments

Treatments	Isabgul Equivalent Yield (kg ha <sup>-1</sup> )	Total gross realisation (₹ ha <sup>-1</sup> )	Total cost of cultivation of intercropping system (₹ ha <sup>-1</sup> )	Net realisation (₹ ha <sup>-1</sup> )	BCR
Isabgul and Ajwain grown in 1:1 ratio	1085	49101	26708	22394	1:1.84
Isabgul and Ajwain grown in 2:1 ratio	954	42760	26810	15950	1:1.59
Isabgul and Ajwain grown in 3:1 ratio	989	42703	26861	15842	1:1.59
Isabgul and Ajwain grown in 4:2 ratio	960	40403	26810	13593	1:1.51
Isabgul and Ajwain grown in 5:1 ratio	928	39124	26913	12212	1:1.45
Isabgul (Sole)	644	29630	27015	2615	1:1.10
Ajwain(Sole)	1283	49734	26400	23334	1:1.88

Price of Isabgul: ₹ 70 kg<sup>-1</sup>; Price of Ajwain: ₹ 120 kg<sup>-1</sup>

grown in 1:1 ratio (BCR= 1:1.84) followed by Isabgul and Ajwain grown in 2:1 ratios (BCR=1:1.59) followed by Isabgul and Ajwain grown in 3:1 ratios (BCR= 1:1.59) followed by Isabgul and Ajwain grown in 4:2 ratios (BCR= 1:1.51) followed by Isabgul and Ajwain grown in 5:1 ratios (BCR= 1:1.45), whereas, Isabgul (Sole) gave the lowest benefit (BCR=1: 1.10).

It can be inferred from the foregoing investigation that Isabgul growers of North Gujarat Agro-Climatic Zone (IV) are advised to grow Ajwain as an inter crop in Isabgul with 30cm spacing in (1:1 ratio) for effective management of termite.

## References

- Aswathanarayanareddy, N.C.T., Ashok Kumar and Gowdar, S.B. 2006. Effect of inter cropping on population dynamics effect of inter cropping on population dynamics of major pests of chilli (*Capsicum annum* L.) under irrigated conditions. *Indian J. Agric. Res.*, 40(4) : 294-297.
- Baumann, D.T., Krop, M.J. and Bastiaans, L. 2000. Intercropping leeks to suppress weeds, *Weed Res.*, 40, 359-374.
- Hatcher, P.E. and Melander, B. 2003. Combining physical, cultural and biological methods: prospects for integrated non-chemical weed management strategies, *Weed Res.*, 43: 303-322.
- Kenny, G.J. and Chapman R.B. 1988. Effects of an intercrop on the insect pests, yield and quality of cabbage, *New Zeal. J. Exp. Agr.*, 16: 67-72.
- Meena, S.R, Krishna Kant, Mishra, B.K., Mehta, R.S., Dubey, P.N., Meena, N.K. and Sinha, P. 2015. Influence of cultural practices on infestation of fennel seed wasp (*Systole albipennis* Walker). *International J. Seed Spices*, 5(2): 92-94.
- Poggio, S.L. 2005. Structure of weed communities occurring in monoculture and intercropping of eldpea and barley. *Agr. Ecosyst. Environ.*, 109: 48-58.
- Reddy, P. 2009. Advances in Integrated Pest Management in Horticultural Crops. Vol. 3: Ornamental, Medicinal, Aromatic and Tuber Crops. Studium Press (India) Pvt. Ltd. New Delhi: 124-128.
- Singh, D. and Kothari, S.K. 1997. Intercropping effects on mustard aphid, *Lipaphis erysimi* Kalténback populations. *Crop Science*, 37(4): 1263-1264.

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