https://doi.org/10.29321/MAJ.10.A04357

Cardamom Thrips

(*Taeniothrips cardamomi R.*)

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Cardamom, (*Elettaria cardomum* Maton,) is an indigenous spice crop of South India. It is found growing wild in portions of Western ghats from Coorg to Tirunelveli on elevations ranging from 2,500 to 5,000 feet above sea level. It is also cultivated in the above regions on a plantation scale. Only a few places possess the conditions conducive to the growth of cardamoms and as such the area under this spice crop is very much restricted. But the produce has a keen demand in continental markets and enjoys the position of a rare commodity.

Of late, the cultivation of this spice is very much handicapped by the incidence of cardamom thrips (*Taeniothrips cardamomi* 'R'). It was first observed in the Anamalais in the year 1932 and has now spread over all the cardamom-growing areas causing heavy damage to the crop, resulting in lower yields and poorer quality of the produce.

The insect belongs to the order *Thysanoptera*, family *Thripidae*, the members which are characterised by fringed wings. The insect is provided with lacerating and sucking mouth parts. The male insects are shorter and about 0·9 to 1·0 mm. in length and of a slightly lighter colour than the female.

Life history of the insect: The whole life of the insect is spent on the cardamom plant itself. Eggs are laid in all the feeding areas at random. The mother digs into the tissue of the plant with its well-developed ovipositor and thrusts the eggs singly with one end of the egg exposed. It was observed that a female laid on an average 19 to 27 eggs in the course of 16–24 days commencing from 2 or 3 days after emergence from the pupa. The egg-laying record of some of the insects kept under observation is presented below:

Date of emergence	Insect I July 1, 1949		Insect II July 1, '49		Insect III July 25, '49		Insect IV Aug. 27, '49		Insect V Aug. 29, '49	
	Date	No. of eggs.	Date	No. of eggs.	Date	No. of eggs.	Date	No. of eggs.	Date	No. of eggs.
	July 3	1	July 3	2	July 28	1	Sept. 2	1	Sept. 1	2
	4	1	5	1	29	2	3	2	2	2
	5	2	6	1	30	1	4	2	4	1
	7	2	7	2	2	1	6	2	5	2
	8	3	10	2	3	3	8	1	6	1
	10	1	12	2	4	1	9	1	7	2
	12	2	14	2	6	2	10	2	8	2
	13	2	15	2	7	1	12	1	10	1
	14	2	16	3	10	3	14	1	12	3
	15	2	18	2	12	2	15	3	13	1
	16	3	19	3	13	2	18	2	15	2
	18	2	20	1	14	3	19	2	16	1
	19	3	21	2					17	2
	20	1							19	2
									20	1
									11	2
Total No. of eggs laid		27		25		22		20		27
Died.....	July 22, '49		July 21, '49		Aug. 17, '49		Sept. 21, '49		Sept. 21'94	

Date of emergence	Insect VI Aug. 31, '49		Insect VII Nov. 4, '49		Insect VIII Nov. 4, '49		Insect IX Mar. 10, '50		Insect X Mar. 11, '50	
	Date	No. of eggs.	Date	No. of eggs.	Date	No. of eggs.	Date	No. of eggs.	Date	No. of eggs.
	Sept. 2	2	Nov. 5	1	Nov. 5	1	Mar. 12	1	Mar. 12	2
	3	1	6	2	6	1	13	1	13	3
	4	2	7	1	7	2	14	1	14	1
	6	3	8	1	10	3	15	1	15	2
	8	1	9	4	11	2	17	1	16	2
	9	2	10	2	13	2	19	1	17	1
	11	2	11	3	14	3	20	2	18	1
	13	3	12	2	18	1	21	1	20	2
	16	2	13	2	19	2	22	1	21	2
	17	1	14	3	20	1	23	2	23	1
	18	2	15	1	21	1	24	1	24	1
	19	1	16	1			25	2	26	1
	20	2					27	1	28	2
							29	2	29	2
							30	1	30	1
							31	1	April 1	1
							April 1	2	2	2
							2	1		
							3	1		
Total No. of eggs laid		24		23		19		24		27
Died.....	Sept. 22, '49		Nov. 17, '49		Nov. 23, '49		April 4, '50		Ap. 4, '50	

The eggs are minute, about 0·3 m. m. long, pale white in colour, smooth and kidney-shaped. They hatch out 9–12 days after they are laid. A few days before hatching a pair of dark red eye spots develop at the broader exposed end of the egg and it turns brownish in colour just before hatching. There are four nymphal stages viz. the first instar, second instar, pre-pupa and pupa. The first two stages only are active and feeding stages. The prepupal and the pupal stages are non-feeding and quiescent ones. During the prepupal stage the insect develops two pairs of wing pads. These wing pads get well developed in the pupal stage. The pupa differs from pre-pupa in that the wing pads are longer, the antennae are held folded back on the dorsal side of the head and three ocelli are present in between the eyes.

The duration of the above four stages of development was worked out and the data gathered are given in the following table :

S. No.	Date of egg laying	Date of hatching i.e., (I Instar)	Date of I moult (II Instar)	Date of II moult (i.e., Pre-pupa)	Date of III moult (i.e., Pre-pupa)	Date of final moult (adult)	Duration of developmental period
1.	1—3—49	10—7—49	14—7—49	23—7—49	25—7—49	29—7—49	29 days.
2.	10—7—49	19—7—49	24—7—49	1—8—49	3—8—49	7—8—49	29 days.
3.	6—9—49	16—9—49	20—9—49	28—9—49	30—9—49	5-10—49	30 days.
4.	7—9—49	17—9—49	21—9—49	29—9—49	1-10—49	4-10—49	28 days.
5.	17-11—49	29-11—49	3-12—49	11-12—49	13-12—49	16-12—49	30 days.
6.	21-12—49	11-12—49	15-12—49	24-12—49	26-12—49	31-12—49	30 days.
7.	4—3—50	15—3—50	20—3—50	26—3—50	28—3—50	31—3—50	28 days.
8.	5—3—50	14—3—50	17—3—50	25—3—50	27—3—50	31—3—50	27 days.

From the above table it is seen that the duration of various stages are as follows : the egg stage - 9 – 12 days ; first instar 3 – 5 days ; second instar 7 – 9 days ; pre-pupa 2 days only ; pupa 3 – 5 days. The complete developmental period from egg to adult ranges from 27 to 30 days. The nymph moults four times before developing into an adult. The adult insects continue to live upto 25 to 30 days after full development.

The phenomenon of parthenogenesis occurs in this insect. In other words the female insect is able to reproduce itself without mating with male insects. To study this phenomenon, the insects were isolated in their pupal stage itself. A few days after emergence from pupa the female adults were found to lay eggs on pieces of leaves placed inside the tubes as feeding materials. The egg-laying record of some of these isolated females are given below :

Date of emergence	Female I 24—12—50		Female II 25—12—50		Female III 26—2—51		Female IV 25—2—51	
	Date	No. of eggs.	Date	No. of eggs.	Date	No. of eggs.	Date	No. of eggs.
	Dec. 28	2	Dec. 29	1	Mar. 1	1	Mar. 1	2
	30	1	31	2	2	2	2	2
	31	2	Jan. 2	3	3	1	3	2
	Jan. 3	1	4	1	4	1	4	3
	4	1	5	1	5	2	5	3
	5	1	7	2	6	1	6	2
	8	2	8	2	7	1	7	1
	10–18	12	9	1	8	2	8	8
			10	6	9	2	9	1
					10	1	11	2
					15	6		
					16	1		
					17	1		
Total No. of eggs laid		22		19		22		26
Died	19—1—51		16—1—51		18—3—51		13—3—51	

Date of emergence	Female V 26—2—51		Female VI 21—3—51		Female VII 27—3—51		Female VIII 10—5—51	
	date	No. of eggs.	Date	No. of eggs.	Date	No. of eggs.	Date	No. of eggs.
	Mar. 3	2	Mar. 24	2	Mar. 3	2	May 13	2
	4	3	26	2	4	1	14	1
	5	3	27	1	5	1	15	1
	6	2	28-2-4-51	6	6	2	16	2
	7	2	April 4	1	7	2	17	1
	8	1	6	1	9	2	18–27	12
	9	2	7	3	10	1		
	10	2	8	1	12	3		
	11–16	5	10	2	13	2		
	17	1			14	2		
	19	2			16	1		
	20	1			17	1		
	21	1			18	1		
	22	1			19	1		
	23	1						
	25	2						
Total No. of eggs laid		31		20		22		19

Though parthenogenesis is the common method of reproduction, copulation was often found in *Taeniothrips cardamomi*, both in the field and in the laboratory.

Nature and extent of damage: The insects feed on the plant sap. Due to heavy drain on the plant sap the plant loses its vigour. Badly infested panicles dry up. The flowers that survive the attack are malformed with characteristic scabs on the surface. The seeds are also rendered chaffy and odourless. By the incidence of this pest the normal yield has been brought down from 100 lb. to about 25 lb. per acre in recent years.

Control measures: Since the inception of the scheme various insecticides, both foreign and indigenous, were tried against this pest. Of those, nicotine sulphate 0·05% spray at 20 gallons per acre and Gammexane D ·025 dust at 3 – 4 lb. per acre proved to be both efficient and economical. (Subbiah, 1949).

Further trials were made in 1948 to test the efficacy of the following foreign and indigenous insecticides as sprays or dusts.

Spray

1. Nicotox 0·05%.
2. Nicophytan 0·5%.
3. Derryphytan 1%.
4. Lobelia decoction 1 lb. in 5 gallons.
5. Acorus decoction 1 lb. 10 gallons of water.
6. Torch Brand DDT 1%.

Dust

7. Acorus.
8. Turmeric.
9. Sandotox.
10. Gammexane D·025.
11. DDT 5%.

Treatments with the above insecticides were given once a month during a period of 3 months. One hundred flowers from each treated plot were examined for thrips a week after each treatment. The data are presented below:

Treatments.	No. of thrips in 100 flowers examined at random				No. of flowers infested out of 100 flowers examined at random.			
	July '41	Aug. '48	Sept. '48	Average.	July '48	Aug. '48	Sept. '48	Average.
Spray:								
1. Nicotox	24	6	16	15	19	4	13	12
2. Nicophytan	44	19	35	33	19	12	28	23
3. Derryphytan	34	44	42	40	30	21	34	31
4. Lobelia decoction	75	89	79	81	51	54	46	50
5. Acorus decoction	60	79	45	61	32	39	29	33
6. Torch Brand DDT	11	1	33	15	9	1	17	9
Dust:								
7. Acorus	74	55	84	71	45	38	45	42
8. Turmeric	39	74	52	55	27	44	37	36
9. Sandotox	28	50	51	43	22	32	27	27
10. DDT 5%	55	71	47	58	38	38	30	35
11 Gammexane D.025	14	13	14	14	11	10	8	10
12. Control (Untreated)	54	94	75	74	31	54	42	45

Nicotox (a concentrated nicotine preparation), Tata's Torch Brand DDT sprays, and Gammexane dust were found to give good results in the preliminary trials. Spraying with decoctions from indigenous insecticides, Lobelia and Acorus, and with dusts of indigenous materials, Acorus and Turmeric were not at all effective as plots treated with them were as bad as the untreated plots in thrips infestation.

Sprays Derriphytan and Nicophytan and dusts Sandotox and DDT 5% were effective in controlling thrips to some extent but did not compare favourably with nicotine sulphate and Gammexane.

To confirm the efficacy of the Torch Brand DDT spray which was promising in the preliminary trials, a randomised replicated trial on a field scale was started in September 1950 and this experiment is now in progress. In this trial, DDT is used in two concentrations of 0·05% and 0·25% and compared with nicotine sulphate 0·05% spray. Nine monthly treatments have been given so far. Flowers in the treated plots were examined for thrips both before and after every treatment. The data gathered are presented below:

Month	No. of thrips in 100 flowers taken at random							
	N. Sulphate		D.D.T. 0·25%		D.D.T. 005%		Control	
	before treatment	after treatment	before treatment	after treatment	before treatment	after treatment	before treatment	after treatment
September '50	22	2	16	4	26	18	22	24
October	18	6	8	2	30	26	32	34
November	14	6	26	2	52	58	60	88
December	8	2	2	0	14	4	30	32
January '51	4	2	6	0	28	14	30	24
February	18	0	18	0	26	10	30	28
March	10	4	16	4	14	13	20	16
April	6	4	6	2	16	14	24	32
May	14	2	20	6	26	18	22	18
Total ...	114	28	118	20	232	175	270	296
Percentage of reduction	75		83		25		10	

Month	No. of infested flowers out of 100 taken at random							
	N. Sulphate		D.D.T. 0.25%		D.D.T 0.05%		Control	
	before treatment	after treatment	before treatment	after treatment	before treatment	after treatment	before treatment	after treatment
September '50	20	2	14	4	18	16	20	20
October	12	6	8	2	26	20	22	24
November	14	6	12	2	28	38	42	60
December	8	2	2	0	14	4	24	24
January '51	4	2	6	0	24	14	26	14
February	16	0	16	0	22	10	24	22
March	10	4	16	2	12	12	14	10
April	4	4	6	2	14	12	22	28
May	14	2	20	6	18	16	18	12
Total ...	102	28	100	18	176	142	212	214
Percentage of reduction	73		82		19		—1	

It is seen that the dilute form of DDT 0·05% is not very effective in controlling thrips. But DDT 0·25%, a more concentrated form appears to be as effective as nicotine sulphate in reducing the population of thrips. Final conclusions can be drawn only after continuing the trials for one more season. During the next season, in addition to gathering data on the reduction of thrips due to the above insecticides, the effect of the treatments on yield will also be studied. This aspect could not be studied in the last season because the treatments were started only in September 1950. The flowers that were treated in September would have developed into ripe fruits only in January, at the fag-end of the picking season. As the treatments are now being given throughout the year, once a month, yields of 1951—'52 season are expected to give indications as to how the various treatments affect the yield.

"Kitkari AP 315" and "Kitkari BP 505" dusts prepared by Messrs Tatas & Co., and Sandotox dust prepared by Messrs Sandoz Products Ltd., were tried against thrips in another experiment started in April 1950. Gammexane was also included in the experiment for comparison. Twelve treatments were given at intervals of one month. Flowers were examined for thrips both before and after every treatment. The results of the examinations conducted during the season are tabulated below :

Month	Number of thrips on 100 flowers, collected at random.									
	Gamexane		Sandotox		Kitkari AP 315		Kitkari BP 505		Control	
	before treatment	after treatment	before treatment	after treatment	before treatment	after treatment	before treatment	after treatment	before treatment	after treatment
April 1950	16	16	20	6	22	16	12	14	8	18
May	54	48	52	36	74	36	66	60	36	34
July	62	2	40	8	52	10	36	...	66	28
August	10	2	24	14	20	26	3	12	34	26
September	8	4	28	18	42	36	8	4	28	36
October	12	4	22	14	44	34	16	8	42	46
December	12	4	22	14	16	20	8	6	16	28
January 1951	4	2	4	4	18	10	14	8	14	6
February	6	0	30	24	14	10	12	4	22	20
March	10	4	18	14	18	14	16	6	22	20
April	4	0	30	4	14	6	20	6	14	26
Total ...	198	86	290	156	334	218	211	128	302	288
Percentage of reduction	57		46		32		39		5	

Month	Number of infested flowers out of 100 collected at random.									
	Gamexane		Sandotox		Kitkari AP 315		Kitkari BP 505		Control	
	before treatment	after treatment	before treatment	after treatment	before treatment	after treatment	before treatment	after treatment	before treatment	after treatment
April '50	14	2	16	6	10	8	8	10	8	12
May	30	24	24	24	36	20	28	32	20	18
July	46	2	30	8	28	6	28	0	40	18
August	8	2	18	12	18	22	2	12	32	22
September	8	4	32	14	28	24	8	4	20	22
October	6	4	16	10	28	22	14	8	26	28
December	10	4	20	10	16	16	8	6	14	22
January '51	2	2	4	4	12	6	6	6	8	8
February	6	0	22	18	4	6	10	4	20	12
March	8	4	12	8	12	8	16	4	14	12
April	4	0	14	4	14	6	18	6	14	24
Total ...	142	48	208	118	206	144	146	92	216	198
Percentage of reduction		66		43		30		37		

It was seen that while Gammexane reduced the thrips population by 57%, the other insecticides were poorer than Gammexane though they had some little effect as compared with the untreated control.

Seven pickings were done in the trial plots during the season. The extent of damage caused by thrips to cardamom capsules in plots treated with various insecticides was determined by analysing the produce of every picking. The percentage of scab-free pods in the experimental plots is given below:

Treatments	Percentage of scab-free pods					Total for each treatment	Average
	I	II	III	IV	V		
1. Gammexane	50	78	50	46	41	265	53·0
2, Sandox	23	25	35	51	56	190	38·0
3. Kitkari AP 315	11	29	20	23	31	114	22·8
4. Kitkari BP 505	36	60	48	27	33	104	40·8
5. Control	30	27	35	37	18	147	29·4

A statistical analysis of the above data showed that Gammexane gave significantly higher percentage of scab-free pods than the control. The other insecticides, namely Sandotox, Kitkari AP 315 and BP 505 did not give significantly higher percentage of scab-free pods than the control. Thus, none of the above insecticides was superior to Gammexane which is now popular.

Attempts were made to find out if it was necessary to repeat the operations once a month to control thrips effectively. Treatments once in two months with nicotine sulphate and Gammexane were tried and compared with treatments once a month. The object of the trial was to reduce the cost of operations without loss of efficacy. Such attempts proved unwise. The yield was reduced when the intervals between operations were prolonged beyond a month. The loss thus caused was more than the saving in the cost of treatments.

The experiments detailed so far go to show that Gammexane D·025 as a dust and nicotine sulphate 0·05% as a spray are quite effective in controlling thrips. Tata's Torch Brand DDT 0·25% is in the trial stage against cardamom thrips. This insecticide is promising, but final conclusions can be drawn only after completing the experiments now in progress.

The authors feel it a pleasure to acknowledge the valuable work done by their predecessors in the Cardamom Scheme in the campaign against this serious pest on cardamoms.

Testing Seed Viability by Chemical Means

(A biochemical method of testing seeds for germinability)

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Introduction: The standard method of testing the germination capacity of seeds is by germinating 100 seeds in either moist sand or blotting paper and counting the number that actually germinates. There are however two drawbacks in this method. One is that a period of 4 to 10 days is often needed to get the full count of seeds that germinate out of every 100 that are kept; the actual number of days required being different for different crops. The other is that in the case of certain crops and varieties, the seeds seem to have a period of "after-ripening" or dormant stage, during which the germination is poor and often nil. In such cases, the ordinary germination tests become inconclusive and valueless.