

	Rs.	As	Ps.
12 ploughings at 4 as. each	3	0	0
Cattle manure 12 cart loads at 10 as. each cart load	7	8	0
Spreading manure	0	4	0
Two ploughings for covering manure	0	8	0
Forming ridges and furrows	0	6	0
Cutting seed	0	4	0
Spreading seed and planting on the ridges	1	0	0
Earthing up furrows	0	12	0
First irrigation—3 men	1	0	0
Second irrigation	0	8	0
Subsequent irrigations—16 for 7 months (May to October)	11	4	0
Weeding 6 times and earthing up	6	0	0
Harvesting at 8 as. per cart load	3	0	0
	<hr/>	<hr/>	<hr/>
	35	6	0
Cost of seed material 1600 lb. at Rs. 38 per cart load of			
1200 lb.	51	0	0
Add assessment for 33 cents	3	15	0
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Total expenditure	90	5	0
Yield—6 cart loads or 7200 lb.			
Value—Rs. 38 per cartload (1200 lb.)	228	0	0
Net profit for 33 cents or $\frac{1}{4}$ kanni	137	11	0
Net profit for one acre	413	0	0

The yield taken is normal and it goes up to 10 cartloads depending upon manuring and field conditions

### Preliminary Trials with *Trichogramma* Parasites for the Control of the Cotton Boll Worms

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**Introduction** Species of *Trichogramma* are well known egg-parasites used extensively in biological control of some of the major pests of crops the world over. Their distribution is world-wide and their range of hosts varied, comprising several orders and families. Their life-cycle is short and they can be bred in very large numbers with comparatively little cost. The breeding technique is simple and manipulation of the parasites in the field easy.

These parasites have come into prominence since the time of their being used against the sugarcane borer *Diatraea saccharalis* (Fabr.), one of the most serious pests of sugarcane in many of the American States, West Indies, Hawaii etc. They are also used in the control of the codling moth *Cydia (Carpocapsa) pomonella* (L); the Oriental fruit moth *Cydia (Grapholitha) molesta* (Busck); and the European corn-borer, *Pyrausta nubilalis* Hbn. in America. In Russia they are used extensively against the American

boll worm of cotton *Heliothis armigera* Hbn., the oriental fruit moth *Cydia (Grapholitha) molesta* Busck and the cabbage pest *Barathra brassicae* L. In Africa they are used in the control of the American cotton boll worm *Heliothis armigera*. In India no attempt has so far been made in the liberation of these parasites for the control of crop pests except the sugarcane borer in Mysore (Subrahmanyam 1937).

The two commonly known species of *Trichogramma* are *T. minutum* (Riley) and *T. evanescens* Westw. The validity of their being styled as distinct species is doubted and the opinion seems to gain ground that these are two races of one and the same species. Till this is settled by systematists, the one referred to in this paper will be termed *T. minutum* (Riley). It has so far been obtained in nature from eggs of the sugar cane borers *Argyria sticticrasis*, and *Diatraea venosata* and the paddy stem-borer *Schoenobius incertellus*. Hussain and Mathur (1923) record it on *Earias* eggs. (This paper gives an account of the *Trichogramma* parasite liberation work done at Coimbatore during the season 1941—42 in the control of the two cotton boll worms *Earias* and *Platyedra*.)

**Laboratory Studies** 1. On *Earias fabia* eggs. Series of experiments were devised to obtain information on the life-cycle of *Trichogramma* parasites, effect of age of host on the degree of parasitism, number of parasites that emerge from a single host etc.

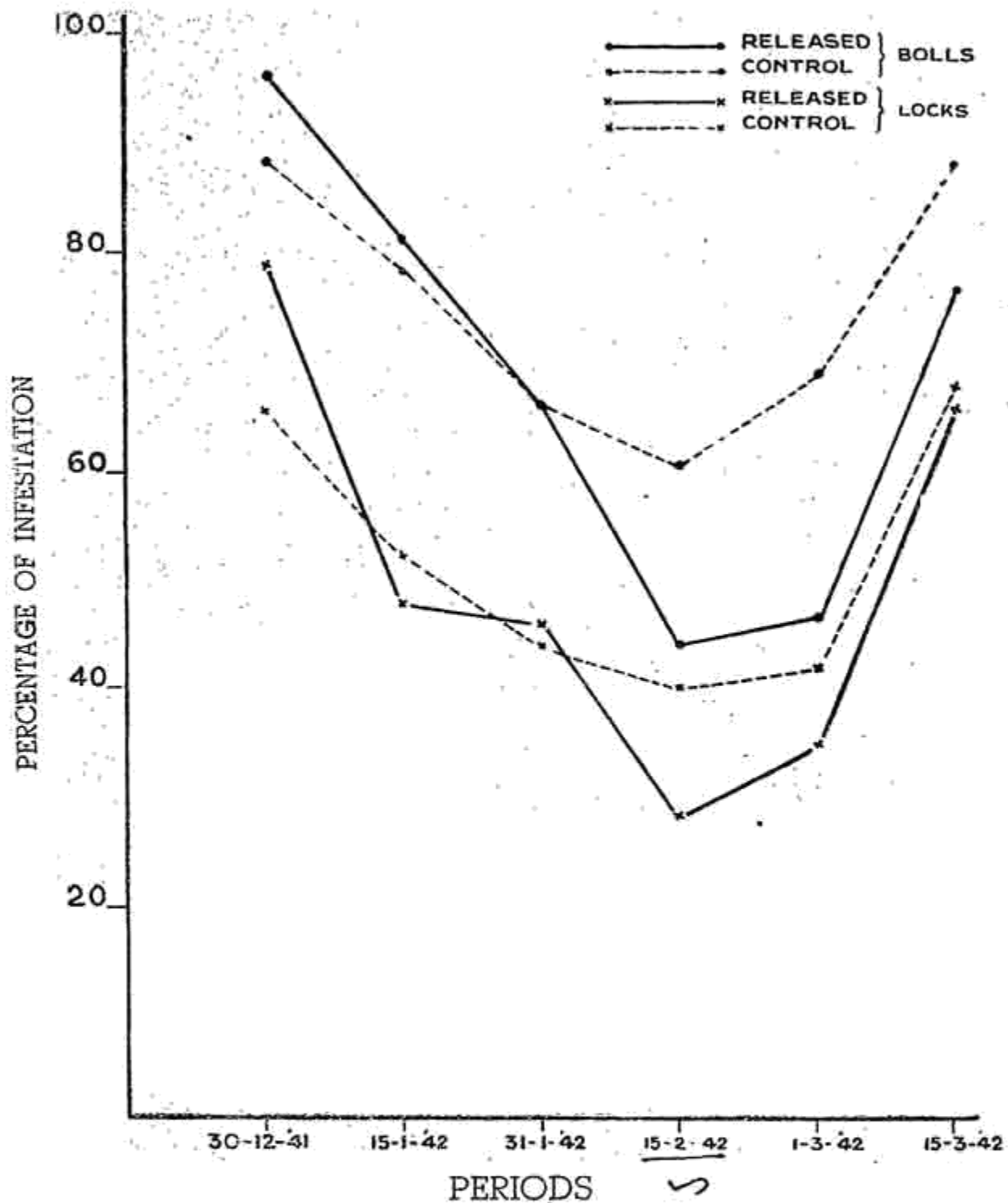
*Degree of parasitisation and age of host eggs* Out of 23 trials with one-day old eggs in 14 cases there was 100 % parasitisation and in 3 cases 75 %, 78 % and 98 %. In the case of two-day old eggs, for a total of 14 trials there was complete parasitisation in seven cases and in 3 cases 75 %, 87 % and 87 %. In 3 days old eggs out of 7 trials there was complete parasitisation in 3 cases and in 3 other cases 60 %, 95 % and 95 %.

*Preferential oviposition on host eggs of different ages* Host eggs— one, two and three days old—were given to one lot of parasites in one container and the degree of parasitism for one, two and three days old eggs in one trial was 100%, 59% and 71% respectively; and for the second trial it was 83%, 86% and 100% respectively. Thus it is possible to get high degree of parasitisation irrespective of the age of the host egg.

*Number of parasites that emerge from a single host egg* Individual parasitised eggs were put in tubes to see the number of parasites emerging out of a single egg. Out of the 13 cases under observation, in 7 there was one parasite per egg and in 6 two per egg.

*Duration of life-cycle of the parasite from egg to adult within the host egg* The duration of life-cycle has been found to vary from 6 to 9 days based on initial emergence, 6 being very rare. The average works out to 8 days for 55 trials.

*The period of maximum emergence from host eggs* In most cases the maximum occurs either on the first or the second day and the emergence itself is almost complete during these two days.



CURVES SHOWING THE INCIDENCE OF BOLL WORMS IN PICKED BOLLS AND LOCKS IN TRICHOGRAMMA LIBERATED AND CONTROL FIELDS, 1941-'42

*Egg-laying capacity of parasites* In one case the female lived for 11 days and laid 125 eggs, the average per day being 11 eggs. The maximum number of eggs laid in a day was 20 as judged by the number of parasites emerging from the host eggs. In another case where the female lived only for 8 days the maximum number of eggs laid in a day was 53.

2. *On Platyedra gossypiella eggs* The percentage of parasitism for 8 trials is as follows:— 20, 38, 60, 63, 67, 75, 85 and 96. The duration of life-cycle is nearly 7 days. Out of 51 parasitised eggs of *Platyedra* kept in individual tubes in all the cases only one parasite was got from each egg.

**Field studies** *Material and methods* Eight cotton fields sown during August—September on the Central Farm, Coimbatore, were selected for the experiments. In four fields half-acre blocks were marked centrally and parasites liberated at various points to uniformly cover the whole area. Four other fields served as control. The liberations were done once in four days at 5000 parasites per half acre per release. The liberations commenced from 17th December 1941 and were carried to the end of February 1942 till the completion of the first flush. There were 18 liberations in all. In order to note the effectiveness of the liberations, burst bolls were collected from treated and control plots and examined for boll worm infestation. In this way 80,947 burst bolls comprising 325,218 locks were examined. The parasites for release were bred in the laboratory from *Corcyra cephalonica* eggs.

*Results of trials* The incidence of attack in the treated (released) and control fields is given for fortnightly intervals in the statement and curves appended. It will be seen (i) that the incidence of attack is appreciably reduced during February, (ii) at one period the reduction in the percentage of attack of bolls by the release of parasite is as high as 22% (vide statement) and (iii) the effect of release is seen both in the bolls and locks.

Statement showing the fortnightly incidence of the boll worms in the picked bolls and locks in released and liberated fields.

		Total examined.*	Total affected.	Percentage of incidence.	
BOLLS	Released.	30-12-41.	1228	1179	96
		15-1-42	3326	2716	82
		31-1-42	5708	3769	66
		15-2-42	13271	5857	44 ✓
		1-3-42	10219	4749	47
		15-3-42	3943	3021	77
		Control.	30-12-41	1462	1297
	15-1-42		2540	1998	79
	31-1-42		12988	8506	66
	15-2-42		11933	7220	61
	1-3-42		10325	7076	69
	15-3-42		4010	3574	89



LOCKS	Released.	30-12-41	5154	4061	79
		15-1-42	13308	6441	48
		31-1-42	22778	10415	46
		15-2-42	54752	15179	28 ✓
		1-3-42	41080	14221	35
		15-3-42	15488	10282	66
	Control	30-12-41	6269	4151	66
		15-1-42	10765	5574	52
		31-1-42	53092	23157	44
		15-2-42	47428	18925	40
		1-3-42	49635	16617	42
		15-3-42	15469	10544	68

\* The figures represent the total of the 4 released and 4 control fields.

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#### References

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## SELECTED ARTICLES

### Some Biological Discoveries of Practical Importance\*

By Dr. C. H. WADDINGTON.

There are two main spheres in which biology is of practical importance to society. One is medicine in the widest sense, which it would perhaps be more accurate to call human biology, and the other is food production or agriculture, also in the widest sense.

I do not propose to discuss the first of these fields in any detail, although new discoveries and new applications of old discoveries are always being made. Among recent new discoveries one may perhaps mention the bacteriocidal and bacteriostatic substances which are now being obtained from lower organisms. Penicillin, extracted from a mould related to the ordinary bread mould, is being investigated at Oxford and elsewhere and seems likely to prove one of the most powerful aids in dealing with infected wounds, a matter of the greatest importance at the present time. It may, however, be rivalled by gramicidin, a substance prepared by American workers from certain types of bacteria which grow in soil; but perhaps the more optimistic view will prove justified and the two substances be found to attack rather different kinds of germs and thus to supplement each other. As an example of a new technique of utilizing old biological knowledge, one may mention the treatment of various diseases, chiefly cancer in some of its forms, by radio-active substances artificially prepared with the aid of new physical apparatus such as the cyclotron. Radio-phosphorus and radio-iodine are differentially absorbed by different tissues in the body; their radio-activity causes the destruction of the tissues in which they become located and the surgeon can in this way bring about a localized inhibition of particular tissues which are proliferating too rapidly.

But the great tasks of medicine in the immediate future are concerned with the application of knowledge which we already possess. These tasks can be

\* Substance of a lecture delivered at the Royal Institution on Feb. 12, 1942.