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ENTOMOLOGICAL SECTION.

The Life History of Gelechia gossypiella

from the time of the cotton harvest to the time of cotton sowing

by

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THE LIFE HISTORY OF *GELECHIA GOSSYPIELLA* FROM THE TIME OF THE COTTON HARVEST TO THE TIME OF COTTON SOWING.

The whole problem of the control of *Gelechia gossypiella* Saund. is closely bound up with the solution of the question where and how *Gelechia* passes the late autumn and winter.

As is well known in the summer, from June onwards, *Gelechia gossypiella* passes through many generations, each of which lasts only a few weeks. Each successive generation is immensely more numerous and more important in the damage it does, than the preceding one. Towards late autumn, however, we find a change; with the advent of colder weather the larvæ no longer pupate, but hibernate unchanged when full fed, pupation taking place, on the advent of warm weather, next spring.

The object of this paper is to show what happens with the seed worm between the time of the first picking and the time of sowing, this being the period during which the pest can be controlled most effectively.

It is so well known to cultivators and ginners that it is not necessary to insist on the enormous increase of the pest between the first and second pickings. As a general rule the first picking is affected only to a slight degree, whilst the second is seriously damaged, and if the harvesting of a third picking were attempted, it would in most places be found to be worthless. Four or five years ago three pickings appear to have been the rule, but this year, owing to *Gelechia* attacks, few cultivators in Lower Egypt obtained a third picking.

The increase of the pest between the first and second pickings can be most easily gauged by examination of commercial cotton seed.

Thus it was found that in a first picking sample only eighty seeds per thousand had been damaged by the seed worm as against 377 seeds per thousand damaged by this insect in a second picking sample, showing an increase of 297 per thousand in damaged seed during the interval of approximately six weeks that separates the first and second pickings.

The extent of the increase in numbers at this period is, however, not so interesting from the point of view of pest control, as is the fact that during the harvest season (*i.e.* the period including the first and second pickings) the life-cycle of *Gelechia* becomes modified, and that it is soon after the first picking that the full fed seed worm intercalates a period of hibernation as larva before pupating.

Examining first picking seed in January a certain number of *Gelechia* larvæ are found hibernating, together with a number of dead worms. These hibernating larvæ were not necessarily full grown at the time of picking, or of ginning; safely hidden in the "double" seeds they can have finished feeding after both of these operations were completed. In the case of the dead worms there is of course nothing to show when or how they died. Taking the number of living hibernating worms, found in January in first picking seed and comparing them with the number of damaged seeds, six living and thirteen dead worms were found to eighty damaged seeds, or seventy-five living worms in one thousand damaged seeds.

For second picking seed the numbers of hibernating worms present in January are much greater. The sample we examined contained 377 damaged seeds in every thousand seeds. In this case 118 living and fifty-six dead worms were found in the 377 damaged seeds, or 313 living worms in every thousand damaged seeds.

The proportion of living worms found in January in one thousand seeds (uninjured and damaged) in the sample examined consequently works out at six per thousand in the case of the first picking and 118 per thousand in the case of the second picking.

The question immediately arises, what has happened to reduce the proportion of living worms to damaged seeds so considerably in the first picking seed as compared to the second picking seed.

A solution to this problem is offered by the observation that very large quantities of larvæ leave the seed and pupate on the sacks, especially in first picking seed. The moths from these pupæ emerge

during the winter, and apparently do not wander away from the sacks to any great extent. During December, January, and February, it is always possible to find immense quantities of dead moths in the accumulation of dust and dirt that collect on and between the sacks in a seed store. For example, scrapings off sacks containing first picking seed taken in February at Kafr el Zayat were found to contain large quantities of dead moths. Ten grammes were examined and found to include 248 dead moths, forty-four empty pupa cases, and two dead larvæ.

In second picking seed at the same time of the year, the worms are mostly still in the seeds, and have not emigrated to pupate.

This leads one inevitably to the conclusion that the worms in the seed at the time of the first picking do not to any great extent hibernate, but that they pupate and emerge during the course of the next few months. A further conclusion is that for want of suitable food plants, or on account of the cold weather, the majority of these moths do not propagate their species.

The main danger consequently lies in the worms which were not full fed at the time of the first picking. If it were possible at the time of the first picking to destroy all the cotton plants and immature bolls, the damage to be anticipated from *Gelechia* in the next season would be very slight. Such a procedure is, however, impossible on account of the great financial loss involved by rejecting the second picking.

A recommendation can, however, be made to reserve first picking for sowing, and either to crush or export all second picking seed as soon as possible. Alternatively the second picking seed could be treated by heat or poisonous gas to kill all the worms contained, should it for any reason be desired to keep it in Egypt. Similar treatment of first picking seed is not so necessary but would be useful.

Not all the worms that having left the seed wander about in a seed store, pupate on the sacks. A small minority is to be found in other places. Sweepings were taken in February in a seed store at Kafr el Zayat. 639 grammes were examined, which consisted of 113 grammes of cotton seed, 95 grammes of stones or straw, and 431 grammes of dust. In this material three larvæ were found, of which two dead. The living larva was discovered in the dust, the

two dead ones in the seed. Of one thousand of the seeds 154 had been damaged by seed worm.

A further recommendation is that, if possible, all seed cotton stored in Egypt after January 22 of each year should be kept in moth-proofed stores, and that cotton seed be permitted to remain unprotected until after planting is finished. Before this date it might be kept in open stores without much harm, provided they are sprayed and swept periodically, as the majority of larvæ emigrating from seed and seed cotton before then will belong to generations bred in the first picking cotton; these larvæ can be expected to pupate and the moths to emerge during winter and early spring; such moths not finding foodplants to oviposit on are lost for the propagation of the species, whilst the hibernating larvæ from the later seed are not yet leaving the seed. Of course it would be better if all cotton seed and seed cotton could be stored in moth-proofed stores, from the time of picking until ultimately disposed of, but it is not possible to interfere to so great an extent with ordinary practice.

Leaving the question of cotton seed and seed cotton in stores on one side, the much more important question arises as to the fate of the larvæ left in the fields after the last picking.

Under the old boll worm law, which was intended to restrict *Earias insulana* Boisd., all cotton sticks have to be pulled up by December 31 of each year. This is in order to reduce the quantity of *oqr* or ratoon cotton which in the spring could offer breeding grounds for *Earias* larvæ. The law further ordered all bolls to be removed from the sticks before December 15 in order to destroy the last generation of *Earias*.

At first it was hoped that vigorous enforcement of this law would also help to check *Gelechia gossypiella*. It has without doubt made *Earias insulana* much rarer this winter (1915-1916) than it used to be only four years ago, but in the case of *Gelechia* the result has not been appreciable.

At the time of pulling the sticks great attention has been given to the removal and burning of the bolls, and the Ministry of Agriculture has caused large quantities of badly cleaned sticks to be burnt. To affect *Gelechia gossypiella* this work ought to be carried out at a much earlier date than prescribed by the Boll Worm Law (*Earias* Law),

and much more attention would have to be paid to preventing bolls falling to the ground and being left there to rot. In combating *Earias*, bolls left on the ground did not have the same significance as they have in the control of *Gelechia*.

It can be considered as certain that all *Gelechia* larvæ arriving at maturity after the middle of October are going to hibernate before pupation. As we have seen above, it is the hibernating larvæ which are chiefly responsible for carrying on the pest from one season to the other. The later the bolls are left on the plants or in the field, the more certain they are to be infested by *Gelechia* larvæ. It is consequently urgently to be recommended that the final destruction of immature or worthless bolls should take place at the time of final picking.

It has been almost impossible this year to obtain bolls for examination in January from cotton sticks or from cotton plants left standing in the fields or stored as fuel. That such bolls are a favourite hibernating place for *Gelechia* larvæ is well known. We have, however, been able to examine a number of bolls collected at Gîza in October 1915. These bolls were stored in the insectarium of the Entomological Section, no special care being given to them. On February 21, 1916, seventy-six bolls were examined and were found to contain five small, eight half-grown, and thirty-nine full-grown living *Gelechia* larvæ, fourteen dead larvæ, and two empty pupa cases of *Gelechia*. In addition to these three empty pupa cases of *Pyroderces gossypiella* Wlsm., one *Earias insulana* pupa, and one dead *Pimpla roborator* F. were found. Seventy-five cotton bolls found on sticks, used as supports for peas, were collected in a garden near Cairo in February 1916; these contained two small, three half-grown, and one full-grown *Gelechia* larvæ.

The destruction of the bolls to be really effective must be complete. *Fellahîn* do not realise that bolls fallen to the ground are as great a menace to the next year's crop as bolls left on the cotton sticks, and very much more serious than the worms left in the seed.

In order to ascertain what happens to worms in bolls lying on the ground, two sets of examinations have been made. In one case bolls have been collected from the ground in the field amongst growing crops, in the other, seed and bolls containing worms have been buried at various depths under growing *bersîm* as well as in unwatered land.

The following monthly results have been obtained by the end of March (at the time of sowing the 1916 crop).

Bolls were collected in fields under beans, wheat, barley, and *bersîm*, in the neighbourhood of Shibîn el Qanâter, on December 26, 1915, January 23, February 16, and March 18, 1916 (*see* Table I).

About two hundred and thirteen bolls were examined in December. These contained twelve small, five half-grown, and twenty full-grown living larvæ, besides two living pupæ and ten empty pupa cases of *Gelechia*.

Three hundred and fifteen bolls were examined in January, containing sixteen small, twenty-one half-grown, and forty-three full-grown living larvæ and eighteen empty pupa cases of *Gelechia*.

Two hundred and forty-three bolls were examined in February, containing five small, forty-seven half-grown, and fifty-two full-grown living larvæ and nineteen empty pupa cases of *Gelechia*.

Two hundred and thirty-nine bolls were examined in March, containing one small, four half-grown, and forty-nine full-grown living larvæ, two living pupæ, and sixteen empty pupa cases of *Gelechia*.

It will be noted that no living pupæ were found in January or February and that they again occurred in March. The pupæ found in March doubtless belonged to the hibernating generation of worms, those found in December to the last maturing generation of the previous autumn.

Attention is also drawn to the steady increase in the proportion of the worms present in the bolls during December, January, and February, and the obvious decrease in March. This decrease is very probably to be considered in connection with the emigration of full fed larvæ previous to pupation.

It becomes very obvious from the study of Table III that during the winter months two generations of *Gelechia* larvæ are found in the bolls on the ground.

The older of the two generations, the hibernating generation, consists entirely of full-fed worms. These form about fifty per cent of the total of worms found in December, January, and February; and without doubt compose part at least of the eighty-eight per cent of full-grown larvæ found in March. There are, however, indications that many of the worms of the hibernating generation must have emigrated to pupate, or pupated by the end of March.

The younger of the two generations is the winter-feeding brood.

From the figures given in the table it is quite easy to trace the slow growth of the individuals composing it during December, January, and February. By March all but nine per cent of this generation were full fed. As the last picking in the fields from which these bolls were collected took place on October 26, and the cotton sticks were removed from the fields on or before November 3, 1915, there appears to the writer to be considerable probability that the eggs from which the larvæ forming the winter-feeding generation were derived must have been laid on bolls on the ground. Should this be actually what happens, bolls left on the ground after the last picking acquire a still greater economic importance than they already had.

Having found that *Gelechia* larvæ readily survive in bolls lying on the surface of the ground amongst cultivated crops, where the bolls are liable to rot and where they must be submerged every time the fields are irrigated, it is not surprising to find that many of the larvæ that are buried at the time of preparing the ground for the crops survive. As it was difficult or even perhaps impossible to find such bolls by digging in the fields, experiments in this direction were made in the grounds of the Ministry of Agriculture at Cairo.

Seed containing larvæ and "double" seeds were used, on account of the difficulty in procuring bolls at the time when the experiment was started (December 23, 1915). Two series of experiments were made; small flower pots were prepared by having the drainage hole being stopped by plaster of Paris. One set of these pots, Series I, was filled with apparently good cotton seed, fifteen full fed *Gelechia* larvæ placed in the seed, the pots were then closed by tying muslin over the opening. In the second set, Series II, the pots were filled with infested seed ("double" seed) instead of sound seed with isolated larvæ.

The further treatment of both these sets of pots was exactly the same. One half of them were buried in dry ground, in land left unwatered except by rain, the other half was buried in land on which a crop of *bersîm* was grown.

To test the influence of depth at which the seed was buried part of the pots were lowered until their tops were five, ten, fifteen, and twenty centimetres from the surface.

From these experiments the depth factor does not appear to be an important one, and *Gelechia* larvæ seem to support being buried

in moist or dry conditions very well (*see* Table II). On January 23, when the first examination was made in the infested seed (Series II), eighty-one living and seventeen dead were found in the pots which had been buried under growing *bersîm*, and 113 living and seventeen dead in the pots buried in unwatered land.

The "good" seed (Series I), gave similar results; here twenty-five living and eighteen dead larvæ were found in the pots buried under *bersîm*, and twenty-three living and five dead in the pots buried in dry soil. Forty-nine larvæ had disappeared. This disappearance is not to be wondered at, as the gauze covering the pots had rotted away entirely.

Two months were supported quite as well as four weeks interment had been. On February 23, further sets of pots were dug up and examined. The pots containing "infested" seed (Series II) buried under *bersîm* yielded 153 living *Gelechia* larvæ and eighteen dead ones, those buried in dry soil 132 living and six dead seed worms. No pupæ were found.

In the "good" seed (Series I) fifteen living and four dead larvæ were recevered from pots buried under *bersîm*, one dead and twenty-four living worms from the pots buried in dry land; seventy-six larvæ had disappeared.

Although there were no double seeds in the "good" seed pots at the time of burying (December 23, 1915) several were found when the pots were examined, showing that some of the larvæ had spun seeds together in the interval. The instinct to spin up seeds appears to have been stronger in the case of worms in moist surroundings. Attention is specially drawn to the fact that a very large majority of the worms were found inside seeds in Series I.

Three months' burial were also supported by a part of the worms. The numbers of worms found were, however, distinctly less than those recovered in the earlier examinations, possibly on account of emigration for pupation.

From these experiments it would appear that the hibernating or full-fed larvæ survive even if ploughed under or buried in seed, or in bolls, and that they can exist for long periods under these conditions.

Consideration of all the facts submitted in this paper makes it appear probable that hibernation of full-fed larvæ is induced by the temperature of their surroundings at the time of their reaching maturity.

Moisture or dryness does not under certain limits appear to affect their hibernation. The period of hibernation can also be very protracted given the right conditions. Thus hibernating larvæ were found in seeds taken from some Indian cotton imported by an Alexandria firm in January 1914, when the cotton was re-ginned and the seeds examined in December 1915. These larvæ must have belonged to the last generation before the cotton was picked in India in September 1913, and they must have been considerably over two years old. They were found in *Desi* cotton seed.

Similarly in cotton seed from the 1914 crop, one thousand damaged seeds were examined in February 1916, and three living *Gelechia* larvæ were found. These larvæ must consequently be at least sixteen months old.

CONCLUSIONS.

1. The larvæ of *Gelechia gossypiella* maturing after the first picking intercalate a period of suspended or lessened activity, or hibernation before pupating. This period normally extends to the next spring or summer, but can last at least two years.

2. The larvæ reaching maturity before or at the time of the first picking mostly pupate and emerge as moths during the next few months, but before the next crop season.

3. There are two broods of larvæ to be found during the winter, a hibernating and a winter-feeding brood; these are the most fertile source for re-establishing the pest in the next season.

4. The moths emerging in autumn and winter are to a great extent lost for the maintenance of the species, and will be still less important if destruction of bolls on cotton sticks stored for fuel or lying on the ground is properly carried out.

5. During the winter hibernating larvæ are to be found in cotton seed and seed cotton, and are very much more numerous in second picking than in first picking material. Still greater numbers remain in bolls left on cotton sticks, unless destroyed there, or in bolls left in the fields to rot. At the time of sowing, such bolls still contain enormous numbers of living *Gelechia* larvæ. Burial under growing irrigated crops does not affect the vitality of these larvæ.

6. Efficient control is only possible if the destruction of all bolls is systematically undertaken at the time of the last picking, the bolls on the ground, or even buried bolls, being as important as those left on the cotton sticks. Cotton seed (other than for sowing) and seed cotton stored after the middle of January ought to be kept in moth-proof stores, and all cotton seed intended for sowing (excepting perhaps first picking seed), ought to be treated by heat or poisonous gas before distribution. All other cotton seed ought to be exported or crushed before April 1, unless it has been treated in the same way.

7. The order of importance of the methods of control are :—

(*a*) Destruction of bolls as early as possible, earliness being an important factor; (*b*) moth-proofing of all stores intended for the storage after January of cotton seed and seed cotton (except seed kept for sowing); (*c*) treatment of all seed intended for sowing, and immediate exportation, crushing or treatment of all the remaining cotton seed.

8. None of these methods of treatment can be efficient alone, and unless all three are universally and thoroughly applied. Treatment of the seed alone cannot be expected to give any appreciable results.

TABLES.

TABLE I.—**Examination of Cotton Bolls found in the Field after the Crop has been removed, to Demonstrate the Presence of *Gelechia* Larvæ.**

Sample No.	Locality. Markaz Shibîn el Qanâter. Village.	Date of Last Picking of Cotton.	Date when Cotton Sticks were removed.	Present Crop.	Number of Bolls examined.	*Gelechia gossypiella* Larvæ. Living. Small.	Living. Half-grown.	Living. Full-grown.	Dead. Small.	Dead. Half-grown.	Dead. Full-grown.	*Gelechia gossypiella pupæ.* Living.	*Gelechia gossypiella pupæ.* Empty Pupa Cases.	Remarks.
1	Kafr Hamza ...	19.10.15	25.10.15	Barley ...	21	2	0	1	0	0	0	0	0	These samples were collected December 26, 1915. Samples 10, 11, 12 were examined December 28, 1915, the remainder on January 13, 1916.
2	„ ...	14.10.15	23.10.15	*Bersîm* ...	14	1	0	0	0	0	0	0	0	
3	„ ...	20.10.15	1.11.15	Wheat ...	21	0	0	3	0	0	0	0	0	
4	„ ...	17.10.15	27.10.15	Beans ...	13	2	0	2	0	0	0	0	0	
5	El Manayel ...	15.10.15	19.10.15	Barley ...	17	1	0	2	0	0	0	0	0	
6	„ ...	9.10.15	13.10.15	*Bersîm* ...	12	0	0	1	0	0	0	1	0	
7	„ ...	13.10.15	27.10.15	Wheat ...	18	1	0	2	0	0	0	1	4	*About.
8	„ ...	13.10.15	17.10.15	Beans ...	15	1	0	3	0	0	1	0	1	
9	Sindiwa ...	25.10.15	3.11.15	Wheat ...	22	2	0	4	0	0	3	0	0	
10	„ ...	20.10.15	24.10.15	Barley ...	19	0	3	0	0	0	0	0	3	
11	„ ...	19.10.15	25.10.15	Beans ...	21	1	1	2	0	0	1	0	2	
12	„ ...	17.10.15	20.10.15	*Bersîm* ...	20*	1	1	0	0	0	0	0	3	
	Totals for December				213*	12	5	20	0	0	5	2	13	
13	Kafr Hamza ...	17.10.15	27.10.15	Beans ...	31	3	1	8	0	0	2	0	0	These samples were collected January 23, 1916, and were examined January 26, 1916.
14	„ ...	19.10.15	25.10.15	Barley ...	24	0	4	7	1	0	3	0	3	
15	„ ...	20.10.15	1.11.15	Wheat ...	41	2	1	1	0	0	1	0	1	
16	„ ...	14.10.15	23.10.15	*Bersîm* ...	30	5	2	4	0	0	1	0	4	
17	El Manayel ...	15.10.15	19.10.15	Barley ...	18	2	1	0	0	0	0	0	0	
18	„ ...	9.10.15	13.10.15	*Bersîm* ...	20	0	0	3	2	1	1	0	0	
19	„ ...	13.10.15	27.10.15	Wheat ...	22	0	2	5	2	0	0	0	4	
20	„ ...	13.10.15	17.10.15	Beans ...	18	1	0	4	0	0	0	0	0	One *Earias* pupa.
21	Sindiwa ...	25.10.15	3.11.15	Wheat ...	15	0	4	3	0	0	0	0	0	
22	„ ...	20.10.15	24.10.15	Barley ...	20	1	5	1	0	1	0	0	3	
23	„ ...	19.10.15	25.10.15	Beans ...	45	2	0	6	0	0	2	0	3	
24	„ ...	17.10.15	20.10.15	*Bersîm* ...	31	0	1	1	0	0	0	0	0	
	Totals for January				315	16	21	43	5	2	10	0	18	

25	Kafr Hamza ...	17.10.15	27.10.15	Beans ...	19	2	1	5	0	2	1	0	1	One empty *Earias* pupa case.
26	,, ...	20.10.15	1.11.15	Wheat ...	25	2	6	7	0	0	1	0	2	
27	,, ...	19.10.15	25.10.15	Barley ...	26	0	7	4	1	1	1	0	6	
28	,, ...	14.10.15	23.10.15	*Bersim* ...	18	0	2	4	0	0	2	0	0	
29	El Manayel ...	13.10.15	17.10.15	Beans ...	19	0	8	8	1	2	0	0	1	
30	,, ...	13.10.15	27.10.15	Wheat ...	18	0	0	3	0	0	0	0	0	These samples were collected February 19, 1916, and were examined February 20 and 21, 1916.
31	,, ...	15.10.15	19.10.15	Barley ...	19	0	7	4	1	0	3	0	0	
32	,, ...	9.10.15	13.10.15	*Bersim* ...	24	0	3	2	0	0	1	0	7	
33	Sindiwa ...	19.10.15	25.10.15	Beans ...	23	0	5	2	0	0	1	0	0	
34	,, ...	25.10.15	3.11.15	Wheat ...	16	0	4	6	1	0	2	0	0	
35	,, ...	20.10.15	24.10.15	Barley ...	16	0	2	4	0	1	1	0	2	
36	,, ...	17.10.15	20.10.15	*Bersim* ...	20	1	2	3	1	2	1	0	1	
	Totals for February				243	5	47	52	5	8	14	0	19	
37	Kafr Hamza ...	17.10.15	27.10.15	Beans ...	17	0	0	2	0	1	1	0	0	
38	,, ...	20.10.15	1.11.15	Wheat ...	27	0	0	5	0	0	2	0	5	
39	,, ...	19.10.15	25.10.15	Barley ...	16	0	0	2	0	0	0	1	1	
40	,, ...	14.10.15	23.10.15	*Bersim* ...	25	0	0	1	1	0	2	0	2	
41	El Manayel ...	13.10.15	17.10.15	Beans ...	22	0	0	8	0	0	1	0	2	
42	,, ...	13.10.15	27.10.15	Wheat ...	17	0	2	4	0	0	0	0	0	
43	,, ...	15.10.15	19.10.15	Barley ...	29	0	0	5	0	0	1	0	3	
44	,, ...	9.10.15	13.10.15	*Bersim* ...	19	0	0	5	0	0	1	0	1	
45	Sindiwa ...	19.10.15	25.10.15	Beans ...	18	0	0	2	0	0	0	0	0	
46	,, ...	25.10.15	3.11.15	Wheat ...	18	1	1	6	0	0	1	1	1	
47	,, ...	20.10.15	24.10.15	Barley ...	15	0	0	4	0	0	0	0	0	
48	,, ...	17.10.15	20.10.15	*Bersim* ...	16	0	1	5	0	0	1	0	1	
	Totals for March				239	1	4	49	1	1	10	2	16	
	GRAND TOTAL				1,010	34	77	164	11	11	39	4	66	

TABLE II.—**Experiments to Demonstrate the Power of *Gelechia* Lar**

Experiments start

SERIES I.—POTS FILLED WITH "GOOD" SEED: FIFTEEN FULL-FED LARVÆ WERE PLACED IN EACH P

Serial No. of Pot.	Conditions to which the Pot was subjected.			*Gelechia* Larvæ.		Date of Examination.	Remarks.
	Buried.	Depth in Centimetres.	Time of Exposure.	Living.	Dead.		
65	Under *Bersîm* sown December 23, 1915.	5	One month.	4	9	January 23, 1916.	
66		10	„	4	2		
67		15	„	9	5		
68		20	„	8	2		
69	In unwatered land which, however, became wetted by rain.	5	„	8	2		
70		10	„	3	1		
71		15	„	5	1		
72		20	„	7	1		
49	Under *Bersîm* sown December 23, 1915.	5	Two months.	3	2	February 23, 1916.	
50		10	„	7	1		
51		15	„	3	0		
52		20	„	2	1		
53	In unwatered land which, however, became wetted by rain.	5	„	11	1		
54		10	„	1	0		
55		15	„	7	0		
56		20	„	5	0		
33	Under *Bersîm* sown December 23, 1915.	5	Three months	5	9	March 23, 1916.	1 pupa in 34.
34		10	„	5	0		
35		15	„	1	0		
36		20	„	1	1		
37	In unwatered land which, however, became wetted by rain.	5	„	7	1		1 pupa in 39.
38		10	„	2	0		
39		15	„	1	1		
40		20	„	1	0		
	Totals for the January Examination.						
65–68	Under *Bersîm*	—	One month.	25	18	—	
69–72	In dry ground	—	„	23	5	—	
	Totals for the February Examination.						
49–52	Under *Bersîm*	—	Two months.	15	4	—	
53–56	In dry ground	—	„	24	1	—	
	Totals for the March Examination.						
33–36	Under *Bersîm*	—	Three months	12	10	—	
37–40	In dry ground	—	„	11	2	—	
	Totals for three Months.						
—	Under *Bersîm*	—	—	52	32	—	
—	In dry ground	—	—	58	8	—	
—	Together	—	—	110	40	—	

to Survive when buried under a Growing Crop or in Dry Soil.

December 23, 1915.

SERIES 2.—POTS FILLED WITH INFESTED SEED CONTAINING A LARGE NUMBER OF DOUBLE SEEDS. THESE DOUBLE SEEDS WERE NOT OPENED IN ORDER TO AVOID DISTURBING THE LARVÆ UNNECESSARILY.

Serial No. of Pot.	Conditions to which the Pot was exposed.			*Gelechia* Larvæ.		Date of Examination.	Remarks.
	Buried.	Depth in Centimetres.	Time of Exposure.	Living.	Dead.		
57	Under *Bersim* sown December 23, 1915.	5	One month.	26	6	January 23, 1916.	
58		10	„	15	4		
59		15	„	15	5		Pots 1–24 will be examined in April.
60		20	„	25	2		
61	In unwatered land which, however, became wetted by rain.	5	„	19	4		
62		10	„	35	11		
63		15	„	19	1		
64		20	„	40	1		
41	Under *Bersim* sown December 23, 1915.	5	Two months.	31	1	February 23, 1916.	
42		10	„	63	8		
43		15	„	32	6		
44		20	„	27	3		
45	In unwatered land which, however, became wetted by rain.	5	„	37	2		
46		10	„	20	1		
47		15	„	42	2		
48		20	„	33	1		
25	Under *Bersim* sown December 23, 1915.	5	Three months	11	1	March 23, 1916.	
26		10	„	13	6		1 pupa in 15.
27		15	„	10	1		1 pupa in 26.
28		20	„	4	0		
29	In unwatered land which, however, became wetted by rain.	5	„	5	0		
30		10	„	8	0		1 pupa in 30.
31		15	„	8	4		1 pupa in 31.
32		20	„	9	0		
	Totals for the January Examination.						
57–60	Under *Bersim*	—	One month.	81	17	—	
61–64	In dry ground	—	„	113	17	—	
	Totals for the February Examination.						
41–44	Under *Bersim*	—	Two months.	153	18	—	
45–48	In dry ground	—	„	132	6	—	
	Total for the March Examination.						
25–28	Under *Bersim*	—	Three months	38	8	—	
29–32	In dry ground	—	—	30	4	—	
	Totals for three Months.						
—	Under *Bersim*	—	—	272	43	—	
—	In dry ground	—	—	275	27	—	
—	Together	—	—	547	70	—	

TABLE III.—**Proportion of Small, Half-grown and Full-grown Larvæ and of Pupæ of *Gelechia* found in Bolls left on the Ground after the Last Picking (October). The Last Pulling of the Cotton Sticks took place November 3.**

Months.	Number of Bolls examined.	Total Number of Living *Gelechia* Larvæ and Pupæ found.	Number of Bolls examined to Find One Living *Gelechia* Larva or Pupa.	Living *Gelechia*.							
				Larvæ.						Pupæ.	
				Small.		Half-Grown.		Full-grown.			
				Actual Number found.	Percentage	Actual Number found.	Percentage	Actual Number found.	Percentage	Actual Number found.	Percentage
December	213	39	5	12	31	5	13	20	51	2	5
January	315	80	4	16	20	21	26	43	54	0	0
February	243	104	2	5	5	47	45	52	50	0	0
March	239	56	4	1	2	4	7	49	87	2	4

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