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Bulletin No. 11.

(ENTOMOLOGICAL SECTION.)

SIMON'S HOT-AIR MACHINE

FOR THE

TREATMENT OF COTTON SEED AGAINST PINK BOLL WORM,

BY

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(Submitted for printing on June 25, 1916.)

CAIRO.

GOVERNMENT PRESS.

To be obtained, either directly or through any Bookseller,
from the GOVERNMENT PUBLICATIONS OFFICE, Old Ismailia Palace, Sharia Qasr el 'Aini.

1921

PRICE: P.T. 1.

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SIMON'S HOT-AIR MACHINE
FOR THE TREATMENT OF COTTON SEED
AGAINST PINK BOLL WORM.

A machine of the type used in England for drying malt, manufactured by Messrs. Richard Simon & Sons of Nottingham, was, during the course of last year, brought to this country by Messrs. Mosseri, Curiel & Co., and erected at the factory of Messrs. Choremi, Benaehi & Co. at Kafr el Zaiyât, the Ministry of Agriculture being invited to carry out experiments with it with a view to testing its suitability for the treatment of cotton seed against the pink boll worm.

The machine consists of a horizontal cylinder in which revolves a skeleton comprising five longitudinal steam pipes and an equal number of bars carrying flanges which serve to mix up the seed. The seed is fed in at the top at one end of the cylinder and makes its way out through a hole in the side near the other end.

Experiments have now been carried out which sufficiently demonstrate the possibilities of the machine. The earlier experiments were largely spoilt by the lack of accessories such as an elevator for the seed and a governor for the engine, the absence of which made it almost impossible to keep the machine working regularly. However, by April 27, most of these defects had been remedied, and on that date an extended trial was carried out, the results of which are shown in Table I. In Table II the treated samples are divided into three approximately equal series according as the temperature of the treated seed lay (i) between 51°·5 and 54°·5 C., (ii) between 55° and 56° C., or (iii) between 56°·5 and 60°·5 C. Table III shows the summarized results of the last eighty minutes' running when an attempt was

made to maintain the temperature of the treated seed continuously at about 55° C., the actual range of temperature during this time being from 53°·5 to 58° C. a difference of 4°·5 C. only.

From Table II it would seem that the optimum temperature for this machine lies between 55° and 56° C., but that at all the temperatures tried there seems to be a small percentage of worms that succeed in surviving the treatment, together with a small percentage of seed that is damaged. As a matter of fact the figures probably make the case look considerably worse than it actually is. As far as the worms are concerned, the number that would survive in practice is probably less than one in a thousand. The samples examined were taken as they came from the machine and placed in small bags in which they cooled rapidly. In practice, however, the seed is sacked as it comes from the machine and in the sacks remains hot for a long time, during which the seeds which have come through the machine quickly, and which have in consequence not attained the average temperature, absorb heat from their neighbours and eventually reach a temperature sufficient to kill the pink boll worms they contain. It follows, then, that those worms which survive the passage through the machine are almost certainly doomed to die after leaving the machine unless chance brings them to the outside of the sacks. That this is so is confirmed by the fact that six samples taken at random from the treated sacks a week or two after the experiments did not contain a single living worm between them.

With regard to the loss in germination of the seed, the actual existence of this in practice is somewhat doubtful. The seed treated was very poor and very variable in quality and the differences in germination recorded are within the range of experimental error. Certainly the fact that the average of the controls is higher than the average of any of the three series of treated seed shown in Table II makes it appear probable that the damage is actual and not merely apparent. Against this, however, one may put the fact that of the three series of treated seed the one which shows the lowest germination is the one which underwent the least severe treatment. The previous experiments carried out with the machine also fail to confirm the supposition that the seed is damaged, the seed treated on February 14 giving an average germination of 86 against a control of 88, while that treated on March 23 gave an average of 67 against a control

of only 60. The seed treated on February 14 was of course of better quality than any used since.

However, allowing that a small percentage of worms come through the machine alive and supposing that a small percentage of the seeds are damaged, we have then to consider, firstly, to what extent these deficiencies affect the value of the machine, and, secondly, how they can be remedied. With regard to the worms it is fairly certain that at present it cannot be hoped to destroy as much as 98 per cent of those of the worms left in the bolls in the fields. If, therefore, 98 per cent of those in the seed are destroyed, it should be sufficient for practical purposes, except when the seed is to be exported to a cotton-growing country where the pink boll worm does not yet occur, in which case a hundred per cent mortality should be insisted on. Further, with regard to the seed a loss in germination of five per cent is of little importance in *taqâvî* seed so long as the *jellâh* continues his present methods of sowing, and in commercial seed is of no importance whatever.

The machine in its present state therefore seems to fulfil all practical requirements. It may, however, be possible to improve it by a comparatively simple alteration. From a large variety of experiments it can be said fairly certainly that a temperature that does not kill the worms does not harm the seed. If, therefore, living worms come through at the same time as damaged seed the heating of the seed must be uneven. In the machine in question this may be due to one or more of the following three causes.

Firstly, the seeds that come in direct contact with the steam pipes may be overheated and consequently damaged. Were this the correct explanation, however, one would expect to find a much larger proportion of the seeds damaged, as the majority of them must come in direct contact with the steam pipes at one time or another during their passage through the machine.

In the second place, the presence of underheated seeds, and therefore of living worms, may be due to the insulating action of pieces of lint surrounding the seeds. This, however, does not seem very likely, from the fact that with the hot air machine erected by the Ministry it is possible to get a regular mortality of a hundred per cent. In this machine the seed is heated by a blast of hot air while spread out on iron trays, so that one would expect the insulating action

of the lint to be much greater than in Simon's machine, in which the seeds are kept in continuous motion and are subjected to the pressure of the other seeds from above. In any case, if this is the correct explanation of the safe passage of living worms through the machine, it is fairly certain that the lint does not suffice to preserve the worms in the heated mass in the sacks after leaving the machine.

The third and most likely theory is that the presence of both underheated and overheated seeds simultaneously may be due to the fact that some seeds come through the machine much more rapidly than others, as was shown by passing a handful of torn-up paper through the machine, odd pieces of which were still arriving at the end of a quarter of an hour, although the first pieces arrived at the end of seven minutes only. This irregularity is probably caused by the arrangement of the oblique flanges on the revolving framework. Of the five ribs which alternate with the steam pipes three bear flanges which push the seed forward while the flanges on the remaining two push the seed backward. The object of this arrangement is, of course, to mix the seed up well. The revolving ribs, however, which lift the seed up from the bottom and pour it over the steam pipes do all the mixing that is necessary, and the actual effect of the flanges seems to be to cause some seeds to go through much faster than others, according to which set of flanges they happen to hit the more often.

If this conclusion is correct the defect can very easily be remedied by making all the flanges face the same direction. They should also be made with a much larger surface and a smaller obliquity, in such a way that they form an almost complete Archimedean screw, in which case the passage of the seed will be much more regular and consequently the effect on the worms and the seed more uniform.

The only other alteration required in the machine is the fixing of an automatic regulator for the steam pressure. A simple form of this might consist of a reducing valve which could be regulated by hand so as to give a pressure sufficient to raise the temperature of the seed at the exit to about 50°C ., combined with a by-pass which when open would raise the pressure enough to bring the temperature up to about 60°C . The valve on the by-pass would be connected with a Hearson's capsule situated in the seed exit in such a way that it would open when the temperature of the seed fell below 55°C . and shut again when it rose above that temperature.

Automatic regulators could also be constructed on the basis of a cooling blast of air through the machine, or of the speed at which the machine revolves, but the regulation of the steam pressure would probably be found the most satisfactory.

With the alterations outlined above, the machine should prove thoroughly satisfactory. The initial cost in this country of the machine itself, exclusive of the donkey engine and other accessories, is between L.E. 200 and L.E. 250. In running the only requirement is the necessary steam power. No extra labour is involved, the seed being sacked as it comes from the machine instead of as it comes from the gins in the usual way. The machine is therefore cheap as regards both initial cost and running expenses; it is very compact, simple of construction, easy of management, continuous in action, and entirely devoid of danger; it is therefore a practical proposition from every point of view. During the last eighty-one minutes of the above experiments it dealt with nineteen *ardebs*, its output thus being fourteen *ardebs* per hour.

TABLE I.

Time.	Steam Pressure.	Adjustments made, etc.	Sample No.	Temperature of Seed.	Mortality of Pink Boll Worm.	Germination of Seed.
a.m.	lbs. per sq. in.			°C.	Per Cent.	Per Cent.
11:35	8	Adjustments not recorded	1	53.5	90	55
11:40	6		2	53.5	100	46
11:45	6		3	58.5	100	46
11:50	5.5		4	58	100	47
11:55	5.5		5	57.5	98	46
12:—	7.5		6	57.5	98	55
p.m.						
2:—	—		7	Control	60	46
2:25	5		8	54.5	100	38
2:30	5		9	55	100	47
2:35	3.5		10	53.5	98	55
2:39	5.5		11	52.5	98	54
2:40	—		12	Control	64	59
2:43	8	Stoppage owing to broken belt	13	52.5	98	56
3:20	9	Steam turned off partly...	14	51.5	90	53
3:23	2	Steam turned off altogether	15	56	100	61
3:27	0	One lid removed	16	60	100	51
3:32	0	Steam turned on slightly, lid replaced	17	60.5	98	53
3:33	—	—	18	Control	45	58
3:37	6	—	19	56.5	98	56
3:41	6	—	20	54.5	98	50
3:46	6	Steam turned off slightly	21	55.5	100	54
3:50	5	—	22	57	100	55
3:55	3	One lid removed	23	57.5	100	59
3:58	—	—	24	Control	50	64
4:—	2	Lid replaced	25	57	100	63
4:4	1	—	26	55	96	57
4:9	1	Steam turned on slightly	27	53.5	94	54
4:13	2	—	28	55	100	65
4:18	3	—	29	55	98	59
4:20	—	—	30	Control	54	71
4:23	3	—	31	54	96	61
4:28	2.5	Steam turned on slightly	32	54	84	59
4:33	3.5	Steam turned off slightly, lid removed	33	55	100	54
4:37	3	—	34	58	100	62
4:41	2.5	Lid replaced	35	55	100	54
4:43	—	—	36	Control	56	61
4:45	2.5	Steam turned on slightly	37	55	100	56
4:50	2.5	—	38	56	100	54
4:54	2	—	39	54.5	100	52
4:58	1.5	—	40	55.5	98	61

TABLE II.

Number of Tests.	Temperature.			Mortality of Pink Boll Worm.			Germination of Seed.		
	Max.	Min.	Average.	Max.	Min.	Average.	Max.	Min.	Average.
	°C.	°C.	°C.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
12	54.5	51.5	53.5	100	84	95.5	61	38	53
11	56	55	55.2	100	96	99.3	65	47	56.5
11	60.5	56.5	58	100	98	99.3	63	46	54
	Control		—	64	45	55	71	46	60

TABLE III.

	Temperature.			Mortality of Pink Boll Worm.			Germination of Seed.		
	Max.	Min.	Average.	Max.	Min.	Average.	Max.	Min.	Average.
	°C.	°C.	°C.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.	Per Cent.
Experiments 19-40 (Exclusive of controls).	58	35.5	55.4	100	84	98	65	50	57
Controls	—	—	—	64	45	55	71	46	60

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