

not so significant, that a very great discrepancy in the multiplications may be expected.

9. However it can be shown that the influence of the quantity of rain on the cacao plant causes a much greater difference in the mortality percentage than the influence of the r.h. directly on the bugs themselves. Most probably this feature can be explained by the alterations in the food sucked by the bugs.

Literatuur

- BETREM, J. G., Onderzoekingen over de biologie van de *Helopeltis*. Invloed van de luchtvochtigheid.; Verslag over het jaar 1939 van het Proefstation Midden en Oost Java : 100; idem over het jaar 1940 : 129; Malang 1940 en 1941 (gecyclostyleerd).
- FISHER, R. H., Statistical Methods for Research Workers, 4th ed; 1932.
- JONG, J. K. DE, Het verband tussen klimaat, schaduw en *Helopeltis* in theetuin; *De Bergcultures* 5: 1434—1444, Batavia, 19 Dec. 1931.
- JONG, J. K. DE, *Helopeltis* in de cacao; *De Bergcultures* 6: 523—529, 21 Mei 1932, idem: 725—729, 9 Juli 1932, Batavia.
- LEEFMANS, S., Bijdrage tot het *Helopeltis*-vraagstuk voor de thee; *Meded. v.b. Instituut (Laborat.) v. Plantenziekten* 26, 210 p.; Buitenzorg, 1916.
- ROEPKE, W., Het *Helopeltis*-vraagstuk, in het bijzonder met betrekking tot de cacao; *Meded. v. b. Proefstation Midden Java* 21, Salatiga, 1916.
- ZEHNTNER, L., *Helopeltis antonii* Sign.; *Bull. v. b. Proefstation voor cacao* no. 1 : 5—6, Salatiga, 1901.
- ZEHNTNER, L., De *Helopeltis*-plaag bij de cacaocultuur en hare bestrijding.; *Bull. v. b. Proefstation voor cacao* no. 7, 22 p., Salatiga, 1903.

Dermestids in Indonesia

by

L. G. E. KALSHOVEN

Blaricum

4. On the development of *Dermestes* species on dried fish and meat in Java¹).

Introductory. LEEFMANS published a paper on 'the insects injurious to colonial produce and their control' in the then Netherlands Indies as early as 1917²), few years after he began his successful career in that country. The stored product pests had become of preeminent importance in those years of World War I, when freight traffic was hindered, many ships were destroyed and export products were piling up in the oriental harbours. In order to investigate to what extent the insect pests were manifesting themselves, he visited the godowns (a word apparently derived from Malay 'gedong') of trading firms in his residence Padang, West Coast of Sumatra. Some 16 species were collected, amongst them

¹)Earlier contributions have appeared under the titles: Dermestiden in Nederlandsch Indië. 1. Aanteekeningen over hier voorkomende tapijtkevertjes, *Anthrenus* en *Attagen* spp. (with summary in English: Notes on local furniture beetles) *Entom. Meded. N. Indië* 1 (4): 72-76, 1935; 2. Het geslacht *Dermestes* (Genus *Dermestes*), 3. *Aethriostoma undulata* Mots. (with summary in English). *Ibidem* 3 (2): 29-33, 1937.

²) LEEFMANS, S., 1917, Insecten, schadelijk voor koloniale producten, en hunne bestrijding. *Teijsmannia*: 235.

two species of *Dermestes*, a black one and one with the ventral side white, which *cadaverinus* Fabr. (nowadays *D. ater* Deg.) and *D. vulpinus* Fabr. (= *D. maculatus* Deg.), both of which have been recorded from Sumatra since long (VETH 1897, HAGEN 1890).

were found to damage stored skins. Probably they may be identified with *D.*

After his transfer to headquarters in Bogor (Buitenzorg) LEEFMANS undertook to deal with the inquiries regarding pests in stored products, other than those in rice, which were submitted to the 'Instituut voor Plantenziekten' (Institute for Plant Protection) from time to time. When he repatriated in 1934 the task of dealing with stored product pests was handed over to the assistant entomologist RADEN AWIBOWO, who had been initiated by LEEFMANS in several problems of applied entomology, and besides had the advantage of being in close contact with the economic life of his countrymen. It was one year before the present writer began to take a special interest in this group of noxious insects, which became of particular importance again in 1939/1941, the prewar years of mobilisation when stocks of foodstuffs were stored up, while export products again accumulated in the warehouses in Indonesia, as a result of trade obstacles.

RADEN AWIBOWO was promoted acting chief of the Institute in the first year of the Japanese occupation, and in this capacity kept the investigations into the pests in stored products on the working program, as new problems arose under the prevailing circumstances. A number of data compiled at that time have not yet been worked out, however, as Mr. AWIBOWO soon left the staff. It is a pleasure for the author to be in a position to work out and publish part of these valuable data, fruits of the work which to a large extent we owe to LEEFMANS' initiative.

Observations on *Dermestes*. One of the new problems just mentioned was the severe damage done by *Dermestes* species to dried fish. Large quantities of the product had been brought to Java soon after the Japanese invasion when things began to get into some sort of shape again under the temporary government. Stocks of the perishable commodity were stored in godowns and shops and soon showed signs of being assailed by these insects. Field observations showed that several kinds of dried fish were badly infested. In some samples taken from the stocks kept in the shops for 3 to 8 weeks some 30% of the fish showed traces of having been gnawed at by *Dermestes*. In a sample from a 4 month old stock more than 70% of the fish were more or less eaten to the bone. The unsalted brands (ikan kering tawar) were more severely infested than the slightly salted ones (ikan setengah asin). Strongly salted fish (ikan asin) was left untouched in most cases. Dried shrimps (udang kering) and sugared seasoned meat (dendeng manis asin) appeared to be infested to the same moderate degree as slightly salted fish. Besides, it was found that goat and sheep skins, stored in houses and sheds in the villages, showed an increased degree of damage by *Dermestes*, as a consequence of the lack of preserving material, due to wartime conditions.

Laboratory experiments were started to investigate the rate of development of the two common species: *D. maculatus* and *D. ater*¹). The breeding substances

¹) The identifications have been verified by the author with the help of accurate drawings made by an Indonesian artist and accompanying the reports.



Dried fish badly eaten by *Dermestes* in Bogor, Indonesia (about natural size; photo of colour drawing by Indonesian artist).

used were unsalted and moderately salted fish and unsalted and slightly salted dried meat, wellknown ingredients in the native cooking and valued highly for their protein content, especially in wartime. The duration of the various stages was found by rearing the individuals separately in glass dishes. The work was carried out by the mantri ARSALI between September 1942 and March 1943.

An additional experiment was carried out in April/May 1943 to find what quantity of food *D. maculatus* consumes for its larval development. To this end batches of 10 newly hatched larvae were confined with 10 grams of dried fish (ikan tembang tawar) or dried meat (dendeng tawar). After pupation of the larvae the remaining quantities of food were weighed. The observations were repeated 10 times with both foodstuffs. There was no mortality at all in these experiments, all larvae forming pupae in due time. The amount of food consumed was found to be the same in both cases, ranging from 5 to 9 grams per batch of 10 larvae, and averaging 7 grams according to the report.

The data on egg production, duration of development, and longevity of the adults given in the following tables were condensed by the author from the detailed reports written in the Indonesian language by the mantri ARSALI. The egg stage was found to last invariably 3 days for both species in all the experiments.

Table 1. Egg production and longevity of *Dermestes* couples fed on dried meat (dendeng tawar)

Species	number of couples observed	number of eggs produced		longevity in days of			
				♀		♂	
		aver.	max.	aver.	max.	aver.	max.
<i>D. maculatus</i>	24	414	841	97	146	103	142
<i>D. ater</i>	20	226	551	55	84	152	88

Discussion. Of the foodstuffs investigated unsalted dried meat appears to favour the most rapid development for *D. maculatus* (larval period 21—26 days), and unsalted dried fish the same for *D. ater* (larval period 28—56 (36) days). Goat skin with the hair still on it was found a rather good food for the former species too, less so for the latter to judge from the mortality observed. A moderate salt content of the food substance hindered the development, as was shown by low egg production, a pronounced mortality rate in the larval stage, a slower rate of development with greater variations in duration, an increase in the number of moults, and a shortening of the life of the adults.

It seems that *D. maculatus* tends to develop slightly more rapidly than *D. ater*; this latter species, however, shows a somewhat longer duration of life in the adult stage except when reared on goat skin.

From the small quantities of food consumed by the larvae the conclusion may be drawn that 0.7 g of the nutrient substances are sufficient for the development of one individual from egg to beetle.

Dried fish has often been observed to be a favoured breeding place for *Dermestes* beetles. ILLINGWORTH recorded *D. ater* as a troublesome pest of dried cod in Hawaii in 1918; bales were found in the fish market so badly infested that the whole consignment had to be destroyed. He observed that the larval period, including 6 moults, was completed in 50 days, the life cycle from egg to adult in 64 days. The same author reared 6 newly hatched larvae of *D. maculatus* to the pupal stage on dry specimens of a large roach in 37-57 days (46 on the average), and considered this to be a rapid development under subtropical conditions. The pupal stage lasted 9 days constantly¹⁾.

The figures found in Bogor indicate how rapid the development of *Dermestes* can be under really warm and humid tropical conditions as the whole cycle from egg to egg may be completed in 35 days. (Mating can take place the same day the beetles emerge from the pupae; the first eggs may be laid on the 5th day). Considering that Bogor is situated in the hills at 250 m altitude the development of *Dermestes* may be still more rapid in the hot coastal plains.

An equally short larval development of 22—28 (24.5) days was observed for

¹⁾ ILLINGWORTH, I. F., Notes on the life history of *Dermestes cadaverinus* Fab. — *Proc. Haw. ent. Soc.* 3 (3): 255-257, 1916; —, The leather beetle (*Dermestes vulpinus* Fab.), a troublesome pest of dried fish in Hawaii. *Ibid.* 3 (5): 375—378, 1918.

Table 2. Mode of development of *Dermestes* spp. on various diets.

diet (food)	sex of individuals reared	number of observations	average duration of larval stage	number of moult	average duration of pupal stage	duration of development from egg to adult in days			lengths of adults bred	longevity of adults in days		mortality
			days	x	days	min.	max.	aver.	mm	max.	aver.	
<i>Dermestes maculatus</i>												
unsalted dried fish (ikan tembang tawar)	♀	9	34	6—8	7	42	47	44	7—8	69	57	0
	♂	11	34	6—8	7	42	48	43	7—8	69	54	
unsalted dried meat (dendeng tawar)	♀	10	24	6	7	30	35	34	8—10	160	82	0
	♂	10	24	6	7	33	35	34	8—10	165	84	
goat skin (kulit kambing)	♀	12	54	8—10	8	55	75	65	8—10	152	65	0
	♂	8	50	8—10	8	50	70	61	9—10	79	64	
slightly salted dried meat (dendeng manis asin)	♂	7	69	10—12	8	65	95	80	7½—9	55	42	430/3
	♂	10	64	8—10	8	52	83	75	7—9	61	43	
<i>Dermestes ater</i>												
unsalted dried fish (ikan tembang tawar)	♀	11	36	6—7	8	39	68	47	6—8	71	49	0
	♂	9	35	6—7	8	41	64	46	7—8	63	53	
unsalted dried meat (dendeng tawar)	♀	12	44	6	8	44	58	53	8—10	207	137	0
	♂	8	43	6	8	43	61	54	8—9	199	153	
goat skin (kulit kambing)	♀	18	54	7—14	9	50	94	66	7—10	71	38	27%
	♂	11	49	6—12	8	47	80	60	7—10	133	41	
slightly salted dried meat (dendeng manis asin)	♀	7	87	10—14	8	61	131	98	8—10	84	42	37%
	♂	12	78	10—14	8	66	113	97	7—10	81	33	

D. maculatus by GAY (1938, as quoted by HINTON, 1945)¹⁾ when larvae were reared on fish meal of 46% moisture content, at 27° C, 70% relative humidity. He found an even shorter duration of the larval period, viz. 18 days when the larvae were fed on yeast and salts, and 19-34 (23) days when they were fed on yeast, salts and cholesterol.

Enige belangrijke Macrolepidoptera-vangsten te Apeldoorn in 1953. 1. *Eupithesia iriquata* Hb. 30.IV tot 2.V. vijf exemplaren tegen beukenstammen in de omgeving van de Dassenberg. 2. *Harpyia bicuspis* Bkh. 19.VI op licht. 3. *Apamea furva* Schiff. 25.VII op smeer in de omgeving van de Harskamp. 4. *Atetbmia xerampelina* Esp. 1.IX op licht. 5. *Oporinia christyi* Prout. 30.X op licht. Dit exemplaar had ik eerst voor *Oporinia dilutata* Schiff. aangezien, maar het bleek bij nadere determinatie door de Heer LEMPKE *O. christyi* te zijn. 6. Evenals verleden jaar was *Cryphia raptricula* Schiff. in Juli en Augustus gewoon op licht, evenwel nog niet waargenomen te Vaassen (9 km ten Noorden van Apeldoorn). W. H. SOUTENDIJK, Tutein Noltheniuslaan 41, Apeldoorn.

¹⁾ HINTON, H. E., A Monograph of the Beetles associated with stored Products, Vol. I. 1945.