

The Loss of Water from 3 Species of Insect

II. Evaporation from the pupae of *Dictyoploca japonica* BUTLER

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INTRODUCTION

In the previous paper (Ouchi, 1962), the rate of decrease in pupal body weight of *Dictyoploca japonica* BUTLER, measured through the pupal stage at weekly intervals, was reported. According to this report, it has been suggested to be possible to forecast the death of pupae before emergence, so far as the death is caused by desiccation resulted from lower relative humidity. The experiments were intended to reveal the decreasing tendency in pupal body weight when pupae are kept under various lower relative humidities.

MATERIALS AND METHODS

The mature larvae were collected from a walnut tree at the end of June in 1962 and were reared inside the room until pupation. One week after pupation individual body weight was weighed and 6 pupae (4 males and 2 females) were placed in each of 3 corked desiccators (diameter of inner plate measured 12 cm). Then each desiccator was kept at 30°C and regulated by sulphuric acid solution so as to maintain respectively 29, 45 and 70% relative humidity.

After the initial measurements, the body weight of each pupa was measured at weekly intervals until emergence. At the time of emergence, the pupae which had not emerged were dissected to investigate the advanced state in metamorphosis.

RESULTS

The numbers of emerged and dead pupae at each relative humidity are shown in Table 1. At 45 and 70% relative humidity, emerged adults were all moribund and survived for several days. And dissected pupae were divided into the following two groups:

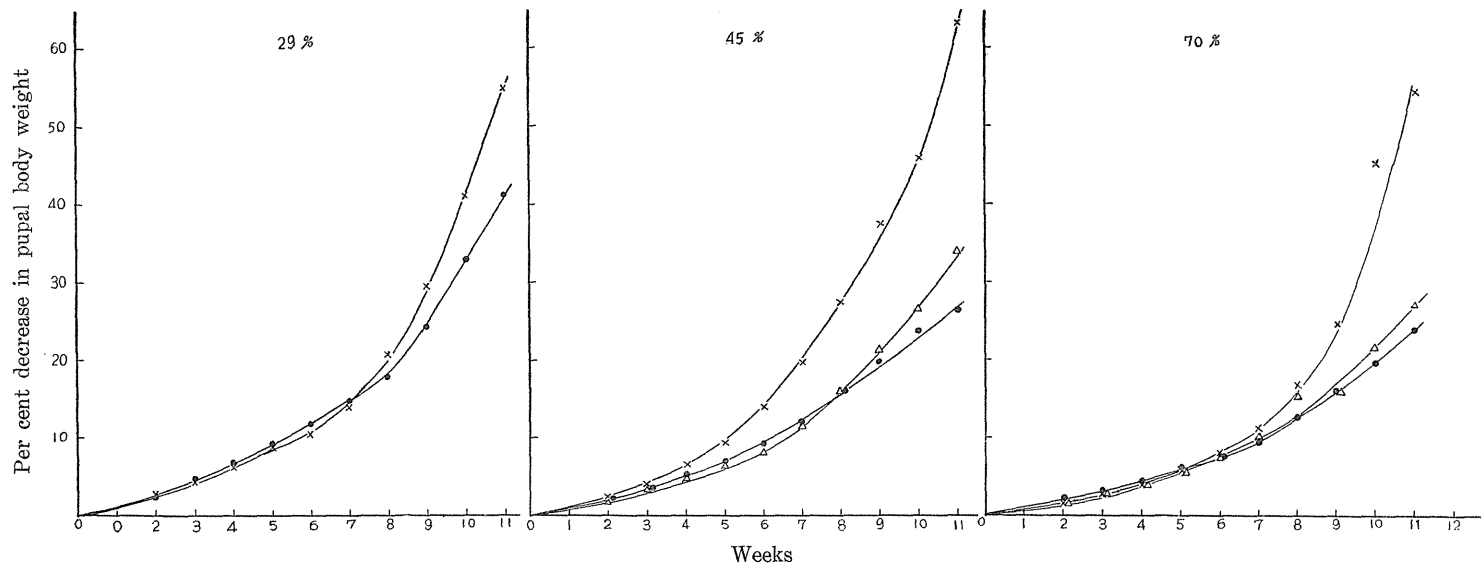
- (a) The imaginal organs of each pupa were completed and desiccated.
- (b) The same organs of many individuals were corrupted by various diseases.

The rate of decrease in body weight at each interval was expressed by percent decrease of initial body weight. And it will be described in the following irrespective of sex. Hereafter the live pupa means the emerged one and the desiccated or corrupted pupa means respectively the one which belongs to the group (a) or (b).

- 1) The tendencies of the rates of decrease in pupal body weight.

The curves for the average rates of decrease in pupal body weight at three relative humidities are shown in Figure 1.

Figure 1. Per cent decrease in pupal body weight at three relative humidities.



△—△: live pupae, ×—×: desiccated pupae, ●—●: corrupted pupae.

At three relative humidities, each curve was drawn according to averages of the rate of decrease at weekly intervals.

Table 1. Per cent decrease in pupal body weight shortly before emergence.

Relative humidity (%)	Total no. of pupae used	Pupae emerged			Pupae died					
					By desiccation			By disease		
		No. of pupae	Per cent decrease	Mean	No. of pupae	Per cent decrease	Mean	No. of pupae	Per cent decrease	Mean
70	6	2	20.6-26.8	23.7	2	38.2-70.5	54.3	2	20.7-27.0	23.8
45	6	2	32.6-35.7	34.1	3	52.9-73.5	63.6	1	26.5	
29	6				5	40.0-59.3	54.7	1	41.0	

At three relative humidities, the average rates of desiccated pupae became higher than that of live pupae with the time from the beginning of pupal stage at 45% and from the middle at 29 and 70% (at 29%, the above rate was compared with that of the live pupa at 45%). The rates of corrupted pupae were a little higher than live pupae in the former half of pupal stage and vice versa in the latter one.

2) The rates of decrease in pupal body weight shortly before emergence.

The rates of decrease shortly before emergence are shown in Table 1. The rates ranged from 20.6 to 35.7% in live pupae, from 38.2 to 73.5% in desiccated pupae and from 20.7 to 41.0% in corrupted pupae. The average rate of desiccated pupae at 45% was higher than that at 29 or 70%.

DISCUSSION

As shown in Figure 1, the slope of curves of desiccated pupae was steeper than that of live pupae after a certain time in the pupal stage at three relative humidities. And this time became earlier with the decrease of relative humidity. Consequently, if the death, as described before, occurs under natural conditions, it will be able to distinguish desiccated and live pupae by weighing them before emergence. Nevertheless, it will need a large number of curves for the rate of decrease of live pupae as the standard curves under natural conditions. In this experiment, the colours of some corrupted pupae had changed sooner or later in the pupal stage and not in others. So the former can be easily distinguished from that of the live pupa.

On the other hand, the difference between the lowest rate of desiccated pupae (38.2%) and the highest rate of live pupae (35.7%) was very slight. So in desiccated pupae, the rate of decrease at turning point from life to death was considered to be near the above both rates.

The lower average rate of desiccated pupae at 29% relative humidity as compared with that at 45%, may be explained by the regulation against the excessive evaporation in insect. Koizumi (1934) had reported on the regulative capacity in several species, when they were placed under extremely lower relative humidities.

SUMMARY

The evaporation from the pupae of *Dictyoploca japonica* BUTLER was measured through the pupal stage at weekly intervals at 30°C and 29, 45 and 70% relative

humidities.

The results showed that some pupae had emerged and others died at 45 and 70% relative humidities, but all had died at 29%. And live adults were all weak and survived for several days. Dead pupae were divided into two groups as a) those metamorphosed to adults but desiccated, b) those dead by diseases.

The slopes of curves for the rate of decrease in body weight of desiccated pupae were steeper than that of live pupae after a certain time in the pupal stage. And this time became earlier with the decrease of relative humidity. From these results, it was suggested to be possible to forecast the death of pupae, if the death, caused by excessive loss of water resulted from lower relative humidity, occurs in natural conditions.

REFERENCES

- 1) Ouchi, M.: Sci. Rep. Agric. Ibaraki Univ. 10, 21 (1962)
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摘 要

3 種昆虫の体水分喪失について

第2報 クスサン蛹の体水分喪失

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前報(大内, 1962)において, クスサンの病死した蛹の初体重に対する体重減少率一時間(週)曲線は, ある時期に生蛹の曲線よりも傾斜が急になることを述べた。そこで体水分の過剰喪失によって死亡する個体は, どのような体重減少率曲線を示すかを知るため, 蛹を 30°C の恒温, 29, 45, 70% の湿度下に置いて, 蛹期間を通じ各個体の体重減少率を7日ごとに秤量した。湿度の調節は, 各湿度区に1個あてのデシケーター(中板直径12cm)を用い, それらの中に硫酸溶液を入れて行ない, 供試蛹は各デシケーターに6頭(雄4頭, 雌2頭)あて入れた。

実験の結果, 羽化成虫は45, 70%区のみに見られ, すべて弱っており数日間生存した。死蛹は各湿度区に見られ, これらは成虫体をなして乾固した個体と病死した個体に分けられた。乾燥蛹の体重減少率一時間(週)曲

線の傾斜は, ある時期から生蛹のそれよりも急になり, 体重減少率の生蛹との差は時日の経過に伴って大になった。またこの時期は低湿になるほど早くなった。したがって自然環境下において体水分の過剰喪失によって死亡する個体があるとすれば, 蛹重の側定によってこれらを羽化期以前に生蛹と区別することができるように思われる。

羽化期においては, 乾燥蛹の最低体重減少率(38.2%)と生蛹の最高体重減少率(35.7%)の差が著しく小さい点より, 乾燥蛹の生より死への転機における体重減少率は上記の率に近い値であると思われる。

なお, 湿度29%区の羽化期における平均体重減少率は, 45%区のそれより低い値を示した。これはある種の昆虫に見られるように, 体水分の過剰喪失に対する調節作用の結果によるものと思われる。