

Analysis of Two Silkworms' Movement during the Construction of Double Cocoons

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Two or more silkworms sometimes jointly spin a cocoon called a double cocoon. Double cocoons have been dismissed as worthless materials in raw silk production because we cannot reel the tangled silk thread using a usual automatic reeling machine. They have been mostly used to produce floss silk or doupion silk. Recently, however, a new phenomenon that consumers are fond of fabrics woven with the doupion silk yarn is emerging. Some researchers have been pointing out that both environmental conditions and races are main factors to produce double cocoons. No research, however, has been conducted using measurements of the behaviour. It has not been shown how a silkworm shares cocoon construction with another. So, we tried to approach this problem through the statistical model of silkworm's spinning behaviour. Firstly we measured its behaviour to collect a series of three-dimensional data. Experiment was conducted using two races, Ryukyu Tasan and N-tama x C-tama, having a high percentage of spinning double cocoons. Marking 15 points on the silkworms immediately before spinning cocoons by a felt-tip pen, we put them in a 50mm x 50mm x 50mm acrylic box that section paper was pasted inside. The silkworm's behaviour was videoed from two different angles, and then three-dimensional data of the behaviour were reconstructed by computer. We've developed a computer software for the visualization and statistical analysis of a silkworm's behaviour. We analysed the data to examine the relationships between two silkworms concerning the sharing of cocoon construction, the relative positions of two silkworms, moving properties and spinning speed. The results showed that they fixed their bodies in the same or opposite direction with high frequency and there existed pseudo-periodicity in serial change of the angle between two silkworms' bodies. From the fact, two silkworms were deemed to shift their bodies paying attention each other in a small space. Although there was no definite difference between two silkworms' spinning speed, they moved the spinneret significantly faster when the hind parts of the body were being fixed than when they were moving.