



入菌和換飼料

Larval Retrieval and Substrate Change

除非是生命週期偏短的小型種類锹形蟲，否則一般锹形蟲的收成時機大約都是雌蟲進產卵箱的2個月後。此時幼蟲差不多二齡，一取出來後便可以立刻入菌瓶。不過有時候還是會收成到一齡幼蟲或甚至是卵。而之前也有提過，锹卵一旦取出之後孵化率遠遠比兜卵低。這個問題是有辦法克服的。也就是雌蟲入產卵箱1個月後便將雌蟲取出（當然了，如果母蟲躲在產卵木中不能硬把她挖出來，必須等到某天她自己爬出來吃果凍或其他食物時再將其取出）。雌蟲取出後再等1個月再收成。這個時候就絕對不會有卵（除非雌蟲取出後把產卵箱放在低於20度的環境中）。如果有遇到少數一齡幼蟲，可先將牠們各自養在150-200 cc的小容器內。飼料為原產卵木磨成的屑（別忘了飼養容器內的木屑要壓緊）。等到幼蟲轉二齡1個星期後就可以入菌瓶了。但是入瓶時別忘了在菌瓶的最上方鋪一層大約菌瓶容量10%的原幼蟲木屑。（針對這一點，有些菌瓶買來時內容物只裝九分滿，此時舊木屑可直裝到這個空間內。如果買來的菌瓶是十分滿，可用湯匙挖除多餘的菌絲）。收成幼蟲的時機也不宜等太久，否則採收的幼蟲都已三齡，到時再入菌瓶已經錯過了生長的黃金時期。而有些幼蟲也因為空間不足而開始自殘。

到底什麼時候是幼蟲入菌瓶的最佳時期？幼蟲越早入菌瓶越早開始吸收菌的精華。但是可以確定的是，一齡幼蟲比二齡

Unless the species cultured belongs to the “small” category, the best time to harvest larvae is two months after the female was placed in the breeding tank. At this time, most larvae are second instar and can be placed directly into kinshi bottles upon retrieval. However, the presence of first instar larvae and eggs is possible. It was mentioned that stag beetle eggs tend to have a poor hatching rate once removed from the original environment. This problem can be solved by removing the female from the breeding tank one month after she was placed in it (of course, if the female is hiding in decayed wood, she should not be dug out. Retrieve her the next time she comes out to feed). After the female is removed from the breeding container, wait one more month before harvesting larvae. At this time there will be no eggs (unless the breeding container is kept below 20°C). If some of the larvae are first instar, keep them individually in 150-200 cc containers with sawdust made from the log they are found in (make sure to compress the substrate before putting in the larva). After the larva has turned second instar for a week, it can be transferred to a kinshi bottle. When doing so, make sure the top 10% of the kinshi bottle is filled with old substrate. Do not wait too long before harvesting larvae. Otherwise, all the larvae would be L3. Third instar larvae have already missed a good portion of growing period. Furthermore, some larvae might have cannibalized due to lack of space.

幼蟲脆弱許多，入菌後的死亡率會比二齡幼蟲高。死亡原因主要是無法順利消化菌絲。我們的建議是，如果幼蟲很多又想要養出紀錄蟲，那幼蟲一齡就可以入菌瓶。如果手上幼蟲不多，那還是等轉二齡1個星期後（開始穩定進食）再入菌瓶。

常常困擾初學者的一個問題就是何時更換飼料。這個問題受到兩個因素左右。一是容器內的木屑還可不可以吃。二是是不是只剩下大便。針對第一個因素而言，含有水分並且和氧氣有接觸的腐植物4-6個月後便會腐化到不適合原來的幼蟲食用（如果把溫度控在20度以下則可以延長到8-10個月）。超過時效的木屑營養已經被微生物分解，不再適合飼養幼蟲。若強行使用幼蟲輕則養不大，重則拒食死亡。假設把幼蟲養在無限大的空間裡，並裝有無限量的木屑，每4-6個月還是要進行飼料更換。若把幼蟲養在太小的環境裡，則4-6個月還沒到，食物便已經完全吃光。也因此，飼養幼蟲的關鍵之一為如何將幼蟲養在大小適中的容器內；容器太大浪費食物，容器太小要增加換飼料的次數，對幼蟲造成干擾，飼者也辛苦。最理想的容器大小為幼蟲放入4個月左右時吃掉70%的飼料。這裡選擇70%而不是100%是因為隨著容器內的糞便量增加，幼蟲會越來越難找到食物。如果70%還不換飼料時，幼蟲將會花太多體力在糞便堆中尋找食物，導致無法發揮其基因的最大體型潛能。

鍬形蟲的體型可以粗略分為三類：小 (20-40 mm)、中 (50-80 mm)、大 (90-

When is the best time to transfer a larva into a kinshi bottle? The earlier a larva is transferred to a kinshi bottle, the sooner it begins to absorb nutrients provided by kinshi. However, one thing is for sure. First instar larvae are more delicate than second instar larvae. As a result, they are more likely to die in a kinshi bottle. Primary cause of death is inability to digest kinshi. Our advice is, if you have many larvae, and you want to produce record beetles, then put first instar larvae in kinshi bottles. Otherwise, better to wait for them to first turn L2.

One of the most frequently-asked questions by beginners is “When to do a substrate change?” The answer to this question is dependent on two factors. One is whether or not the substrate is still edible. The other is whether there is only excrement left. In regard to the first factor, as previously mentioned, substrate exposed to moisture and oxygen will become too decayed for the intended species after 4 to 6 months (8 to 10 months if the substrate is kept below 20°C). If expired substrate is used, larvae do not gain weight and may even die. In other words, even if a larva is kept in an infinitely large container, with infinite amount of substrate, a substrate change is still necessary after 4 to 6 months. On the other hand, if a container is too small, all the substrate would be consumed before 4 to 6 months. As a result, one of the key issues is keeping a larva in a container of right size. If a container is too big, substrate is wasted. If a container is too small, substrate-change frequency is increased, resulting in excessive disturbance to the larva and inconvenience for the hobbyist. The most ideal container being one in which the larva finishes 70% of



120 mm)。小型的種類用500 cc的容器就綽綽有餘，而且通常還不到4個月幼蟲便開始製作蛹室。中型的種類一齡時可使用800 cc的容器。4個月後公的換到2000 cc的容器，母的換到1000 cc的容器。接著每4個月換一次飼料直到製作蛹室。大型的種類一開始時可使用800 cc的容器。4個月後公的換到2500-3000 cc的容器，母的換到1500 cc的容器。接著每4個月換一次飼料直到製作蛹室為止。當然了，如果覺得家中空間或是飼料有限可使用較小的容器，不過換飼料的頻率就要拉高。如果以1400 cc的標準菌絲包飼養，大型種類每兩個月要換一條。但畢竟我們養的是生物，隨時都會有變數。有些幼蟲就是吃得特別快，有些幼蟲就是吃得特別慢。沒有任何公式能夠取代您細心的觀察。

要用外觀判斷養有銹形蟲幼蟲的木屑是否還能吃並不容易，因為幼蟲有用大顎把糞便塗抹在隧道壁上的獨特習性，導致容器內不容易看到糞便顆粒（這個行為能夠讓糞便裡的消化菌先對木屑進行初步消化，將來幼蟲把木屑吃下肚時可以更迅速地吸收營養。這也是為什麼換飼料時最好也能夠在新飼料的最上方鋪上大約10%的舊飼料）。儘管如此，含有大量幼蟲糞便的飼料會由原來的木質纖維轉為粉末狀。菌絲瓶方面，幼蟲的排泄物不會長菌絲，所以當菌絲瓶70%都是咖啡色時就是該換瓶的時候了。當飼養容器內有許多糞便時，如果想要養出大型成蟲就一定要換上新的食物。如果不，令人驚訝地，幼蟲並不會餓死，只會就地化蛹成小型個體。不過

substrate four months after being placed in it. The number here is 70% and not 100% because as fecal pellets accumulate, it becomes increasingly harder for larvae to find food. If the substrate is still not changed by 70%, the larva will be spending too much energy trying to find flakes that are few and far in between among a mountain of fecal pellets, disallowing it to become the giant beetle it could have become.

Stag beetles can be divided into three size categories. Small (20-40 mm), medium (50-80 mm), large (90-120 mm). 500 cc containers are plenty big for small species. In fact, most species make pupal cells within 4 months. For species in the medium category, 800 cc containers can be used for first instar larvae. Transfer male larvae to 2000 cc containers after four months. Transfer female larvae to 1000 cc containers. Then perform a substrate change every four months until pupal cell construction. For species in the large category, 800 cc containers can be used for first instar larvae. Transfer male larvae to 2500-3000 cc containers after four months. Transfer female larvae to 1500 cc containers. Then perform a substrate change every four months until pupal cell construction. Of course, if the rearing room does not allow large containers, or there is not enough substrate to fill large containers at once, smaller containers can be used even for large species. However, substrate-change frequency has to increase. If rearing male larvae of large species in standard 1400 cc containers, a substrate change has to be performed every two months.

這種現象我只在鍬形蟲中看過，而且幼蟲是已經三齡的個體。

大兜蟲方面，如果是把1隻三齡雄性幼蟲飼養在 $25 \times 19 \times 14$ cm的容器內，並且每次換飼料時都把腐植物以稍微施壓的方式裝到滿，換飼料的間隔大約是1.5-3個月。如果是三齡雌性幼蟲，則可以2隻養在一個容器內。

幼蟲製造蛹室後就千萬不要再換飼料了。這個時候要給幼蟲最安靜的環境，否則幼蟲會放棄蛹室另外再造一個。如果這種情況發生，幼蟲會因為燃燒能量製作新蛹室而變輕，羽化成較小型的個體。如果幼蟲的蛹室和容器壁有接觸，最簡單的辨識方式就是看幼蟲周圍貼著容器壁的飼料顏色是否變得特別深。這是因為幼蟲製作蛹室時會把身邊的飼料壓得特別地緊。由於密度提高了，因此顏色也加深了。

知道幼蟲是否已經化蛹有時候是必要的。如果使用的是菌絲包，但是沒有注意到幼蟲是否已經化蛹，新成蟲過蟄伏後則有可能咬破塑膠膜爬走。問題是兜蟲和鍬形蟲不會每次都在飼養容器邊緣或是底部做蛹室。換句話說，不是每次都會看得到幼蟲的蛹室。其實要知道幼蟲是否已經化蛹並不難，只要輕敲飼養容器3下，然後把耳朵貼到容器上。如果聽到「刷刷刷」的聲響，表示幼蟲已經化蛹。這是因為蛹對震動很敏感，當飼育者輕敲飼養容器時，蛹就會不停地扭動。

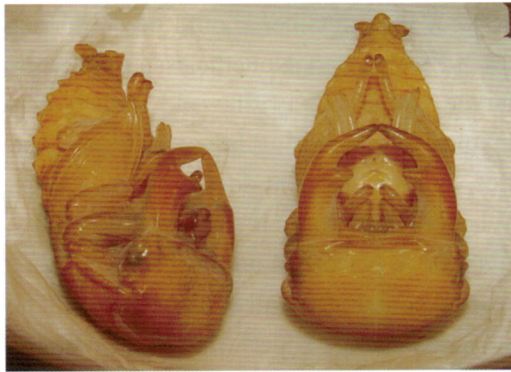
It's not easy to determine if decayed wood flakes containing a stag beetle larva are still edible by its appearance. Stag beetle larvae have a unique tendency to smear their fecal pellets on their tunnels. As a result, almost no fecal pellets can be seen. (This behavior is to allow preliminary digestion of decayed wood by digestive bacteria in the larva's excrement so that nutrients can be more quickly absorbed when the wood is eaten by the larva. This is why when performing a substrate change, the very top 10% of the container should be comprised of old substrate.) Nonetheless, stag beetle larvae excrement is fine and mud-like in texture. When rearing larvae in kinshi bottles, larval excrement does not grow kinshi. When a kinshi bottle is roughly 70% brown, it's time to perform a bottle change. When a rearing container is full of excrement, but no substrate change is performed, surprisingly, the larva does not die. It simply pupates early and becomes a minor adult. But this phenomenon is only observed in stag beetles, and the larvae must be third instar.

For giant rhinoceros beetle species, if a third instar larva is kept in a $25 \times 19 \times 14$ cm container, and substrate is packed with slight pressure and filled all the way to the top, substrate-change frequency is once every 1.5-3 months. Third instar female larvae can be kept two per container.

Once a larva has made a pupal cell, substrate change must be stopped. The larva needs the quietest environment at this time. Otherwise, it may abandon the pupal cell and make another one. It takes a tremendous



做在飼養容器底部的蛹室通常只會有一個小開口。幼蟲化蛹後，舊表皮通常會把這個小窗口遮住，導致飼育者無法觀察蛹室內部的情形。不過還是有辦法得知兜蟲的蛹是否已經羽化。兜蟲的蛹在羽化的第一時間，也就是新成蟲把蛹皮推破的那一剎那，會有大量的液體流出。如果發現蛹室的周圍整片濕掉(顏色加深)，表示蛹已經羽化了。



↗細心的照料換來大蟲的喜悅。圖為羽化後超過80 mm的尼泊爾DA雄蛹。2008
Your dedication will be rewarded with big beetles. Pictured are major *Dorcus antaeus* pupae that became over 80 mm. Nepal origin

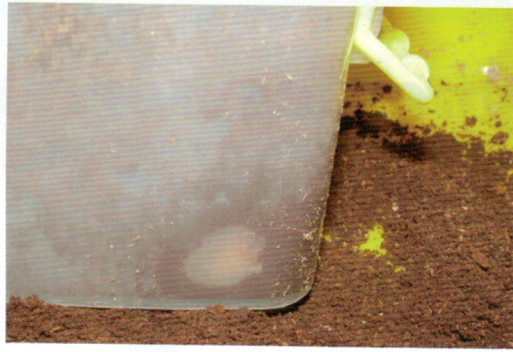


↗幼蟲消化過的木屑不會長菌絲。2006
Substrate digested by larva does not grow kinshi.

amount of energy to make a pupal cell. If a larva makes another one, it will certainly become a smaller beetle. If a pupal cell is made against the container wall, the easiest way to identify it is to see if the substrate around the larva is of a deeper color than the rest of the substrate. When a larva constructs a pupal cell, it compresses the substrate around it, which increases the substrate's density, thereby deepening its color.

Sometimes it is necessary to know if a larva has pupated. If rearing larvae in kinshi bags, new adults could chew through the plastic and disappear. However, rhinoceros and stag beetles don't always make their pupal cell against the container wall or bottom. In other words, pupal cells aren't always visible. But there is a way to tell if a larva has pupated. Simply tap lightly on the rearing container three times and put your ear to the container. If you hear scraping sounds, the larva has pupated. The sounds come from the wiggling pupa.

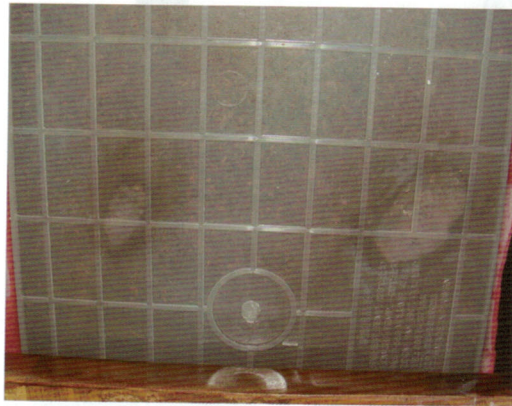
Pupal cells made against the bottom of the rearing container usually only have a small opening. After pupation, the opening is usually blocked by the old skin. But there is still a way to tell if the pupa has eclosed. When the new adult first pushes through the pupal skin, large quantities of liquid is released. When the area surrounding the pupal cell becomes soaked (color darkens), the pupa has eclosed.



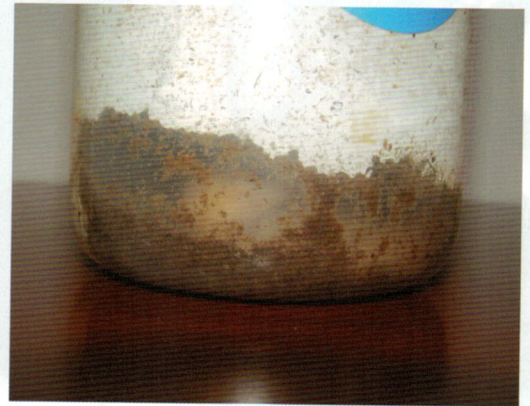
↗建造在容器角落的蛹室。可看見蛹室周圍的腐植物顏色特別深。圖為高砂深山锹形蟲的蛹室。2006
Pupal cell built in corner of container. The substrate around the cell is darker. Pictured is pupal cell of *Lucanus maculifemoratus taiwanus*.



↗做在飼養容器側面的雄性長戟大兜蟲蛹室。2007
Male *D. hercules* pupal cell against side of rearing container.



↗做在飼養容器底部的兩個雌性長戟大兜蟲蛹室。拍攝角度由下往上。2008
Two female *D. hercules* pupal cells against bottom of rearing container, as seen from bottom.



↗做在菌絲瓶底部的雄性中國大锹形蟲蛹室。2008
Male *D. c. hopei* pupal cell at bottom of kinshi bottle.



↗做在菌絲瓶中上部位的雄性中國大锹形蟲蛹室。2008
Male *D. c. hopei* pupal cell at upper center of kinshi bottle.



↗菌絲中的雌性扁锹形蟲蛹室。2008
Female *Dorcus titanus* pupal cell in kinshi.