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Worker aggregation leads to collective chamber excavation in leaf-cutting ants

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Leaf-cutting ant nests consist of a complex system of tunnels and chambers that are excavated through a self-organized process. It is an open question, what the excavation rules are that underlie the emergence of either nest chambers, which are rounded and spacious, or tunnels, which are long and narrow. We examined whether worker aggregation at a digging site, i.e. the spatial distribution of workers, guides tunnel and chamber emergence in the leaf-cutting ant *Acromyrmex lundi*. In the laboratory, worker groups could excavate for 48 h in a clay arena. Differences in the extent of aggregation were achieved by presenting workers with either a small or a large available space as the starting point for excavation. The excavated chamber and tunnel volumes were measured, and aggregation was quantified during the excavation process using serial photography. When worker aggregation was dense because of the reduced available space, most of the digging activity was allocated to chamber enlargement, with less and delayed tunnel excavation. When aggregation was sparse because of the larger available space, ants only slightly enlarged the chamber, but excavated more tunnels, which were initiated earlier. The number of workers inside the nest structure was similar despite differences in initial available space, indicating that ant density, which is known to positively influence digging activity, was low when a large space was initially offered. It is suggested that available space determines the magnitude of worker aggregation at an excavation site, which in turn guides the excavation of chambers. These are enlarged until the actual worker density diminishes beyond a given threshold value, resulting in tunnel excavation.