The Arrangement of Florets in Anthodia Optimizes Production of Germinable Seed in the Sunflower

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Some natural phenomena can be described by mathematical principles. The spiral arrangement of the florets in a sunflower (Helianthus annuus) inflorescence has a divergence angle of 137.5°, which is the “golden angle”. This study attempted to explain the physiological reasons for this arrangement of sunflower florets. After performing mathematical simulations which revealed the advantages of this floret arrangement in sunflowers, a refined mathematical model was developed by varying the divergence angle and examining its effect on floret areas. The findings showed that the golden angle is suitable for ensuring the optimal spacing of florets, and therefore seeds, on the sunflower inflorescence. We then examined the relationship among the germination capacity, weight, and position in the anthodium of the individual seeds. We found that the germination capacity of each seed was highly dependent upon weight and position of the seed. The germination rates of seeds lighter and heavier than 40 mg were very low (2.5%) and extremely high (84%), respectively. Seeds heavier than 40 mg were located relatively close to the periphery of the anthodia, forming a toroidal-shaped band of seeds with a high germination potential. This variation in germinable seed number may be closely related to the reproductive strategy employed by sunflowers. Our findings could be used to understand the maturation patterns of anthodia in other economically important species of the Asteraceae.

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