## Supplementary Materials for

# The role of wild rice awns in seed dispersal

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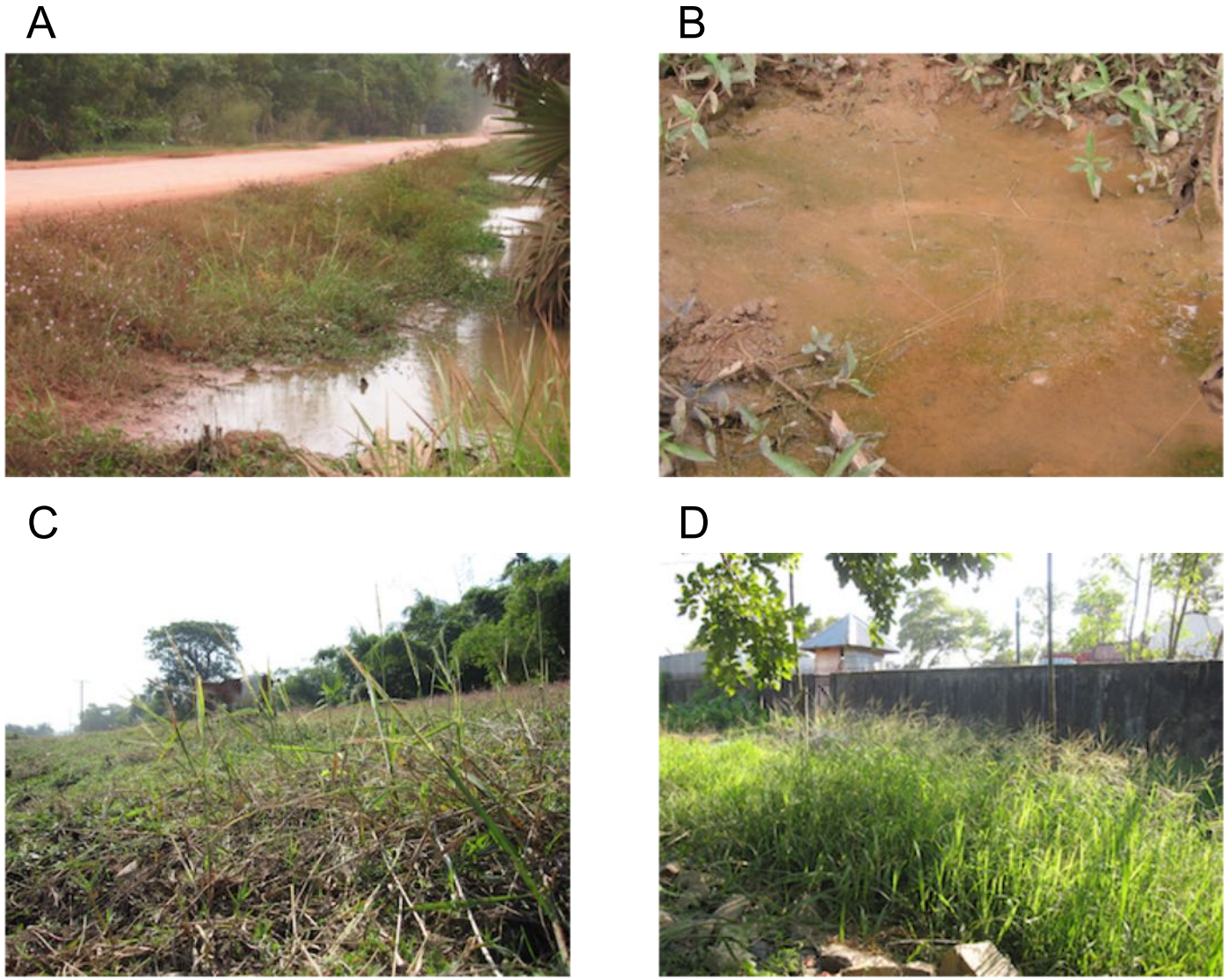



**Figure S1.** Natural habitats of Asian wild rice, *O. rufipogon*. (A, B) Plants beside a muddy ditch and shed seeds standing on the muddy ground in Siem Reap, Cambodia. (C, D) Wild rice grown on the ground covered with other plant leaves and stems in Sittwe, Myanmar.

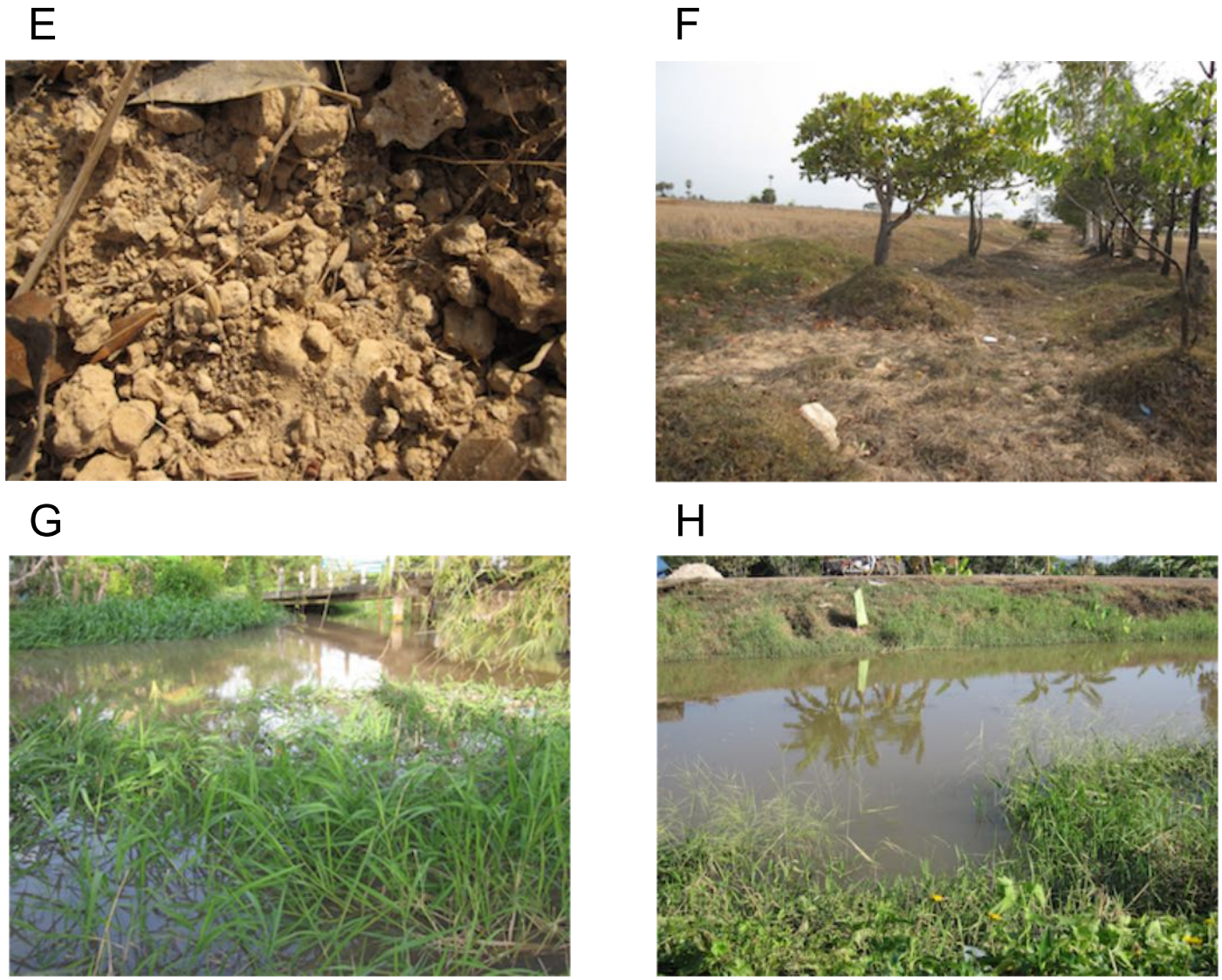
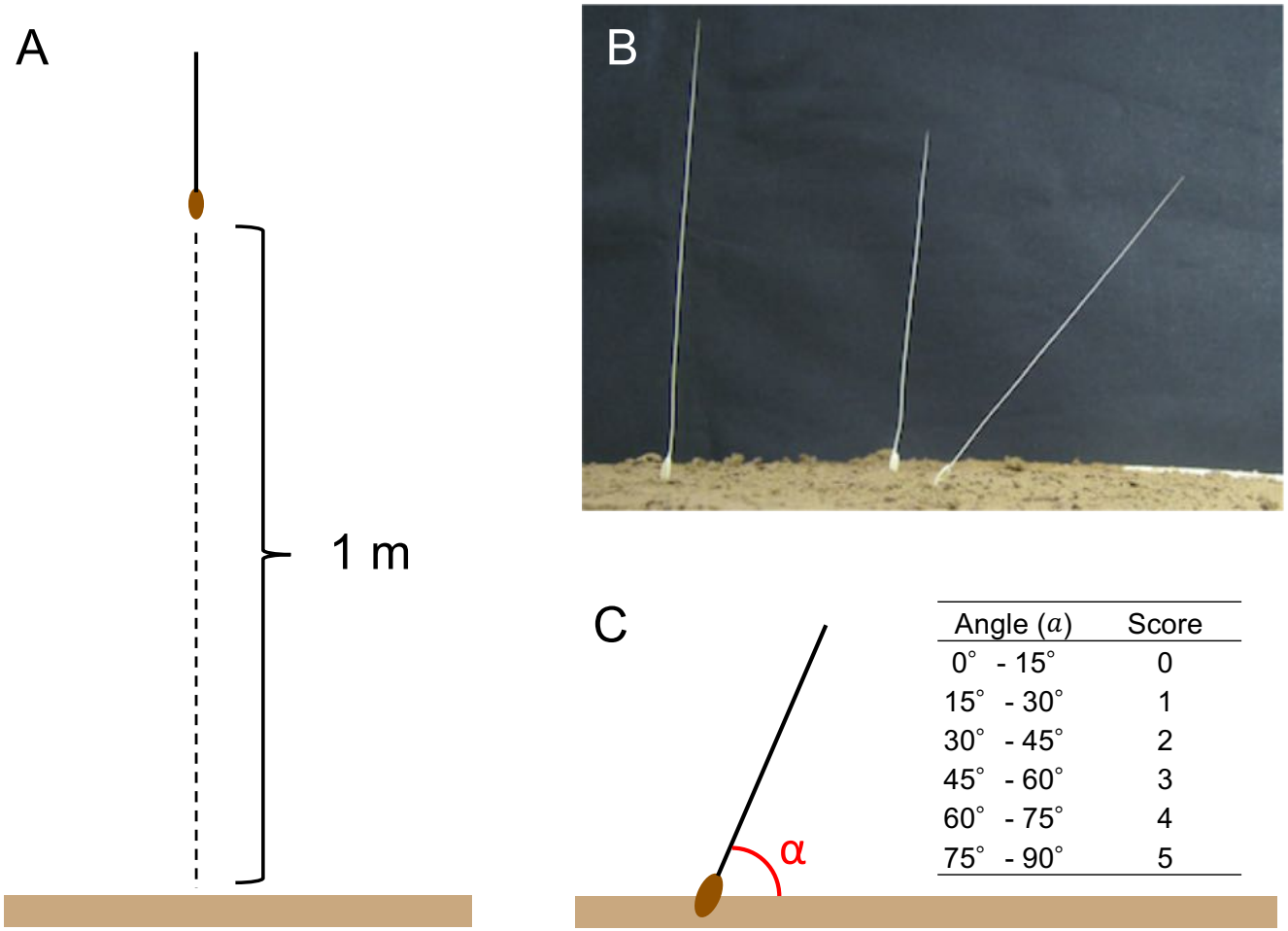



**Figure S1.** Natural habitats of Asian wild rice, *O. rufipogon*. (E, F) Wild rice seeds half-buried in the ground beside a paddy field in Kampong Thom, Cambodia. (G, H) Wild rice grown beside small canals in Cantho, Vietnam and in Chiang Mai, Thailand, respectively.




| Angle ($a$) | Score |
|---|---|
| 0° - 15° | 0 |
| 15° - 30° | 1 |
| 30° - 45° | 2 |
| 45° - 60° | 3 |
| 60° - 75° | 4 |
| 75° - 90° | 5 |

**Figure S2.** An experiment on falling angle of mature seeds. (A) Seed drop position. Seeds were dropped in a vertical position from 1 m above the muddy ground. (B) Seeds stuck in the muddy ground. (C) Measurement of the seed angle and scoring.

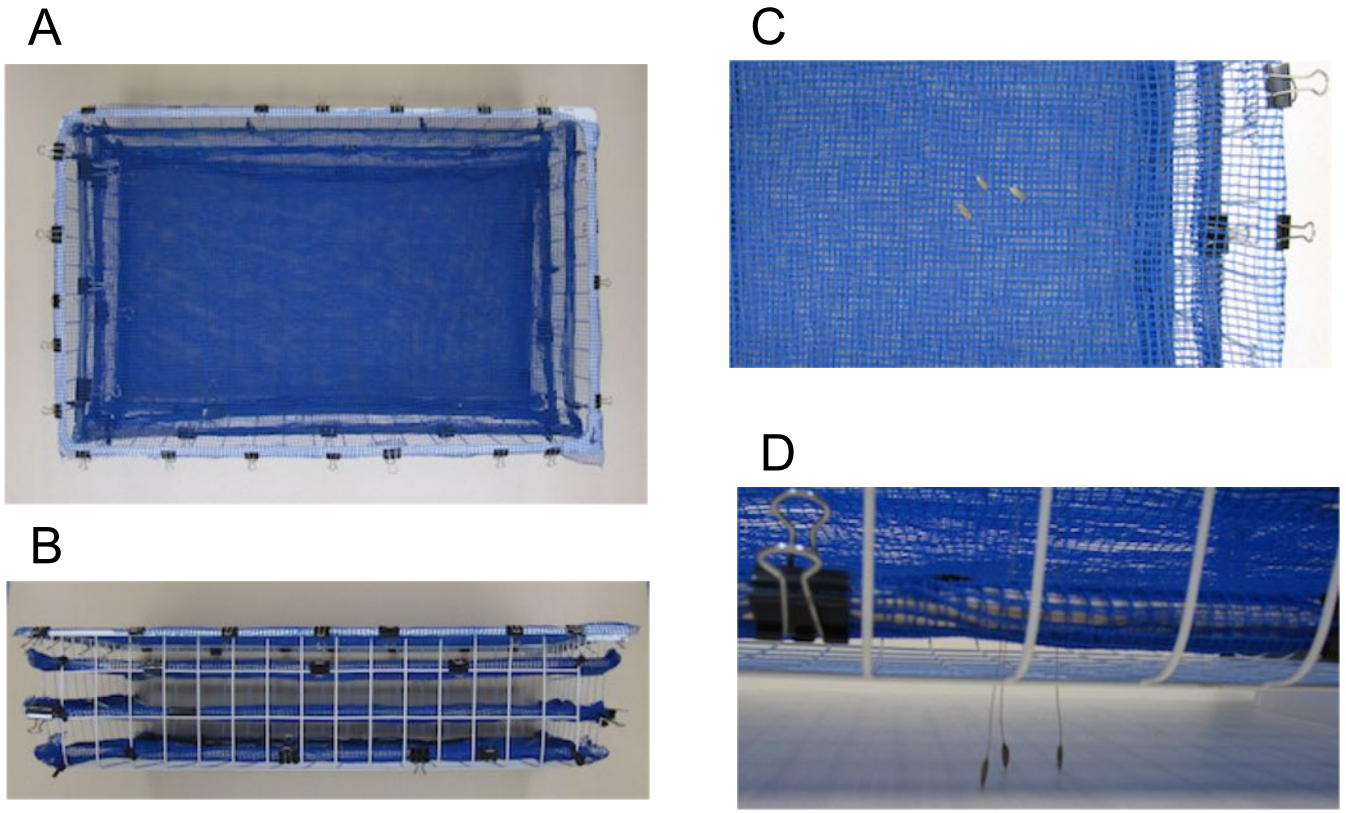



**Figure S3.** An apparatus for the seed slipping experiment. (A) Top view. Mesh sheet was set in 40 cm X 60 cm. (B) Side view. Four layers of plastic mesh sheets were set at 2- or 4-cm intervals. (C) Awnless seeds on the first mesh. Mesh size is 4 mm. (D) Awned seeds passed all four layers.


**Figure S4.** An apparatus for the experiment of horizontal movement on the ground. (A) Top view. A V-shaped plastic rod (80 cm) was set on a reciprocal shaker with a swing of 5 cm. (B) Side view of the rod. The filter paper was fixed on the rod (2 x 2 cm).

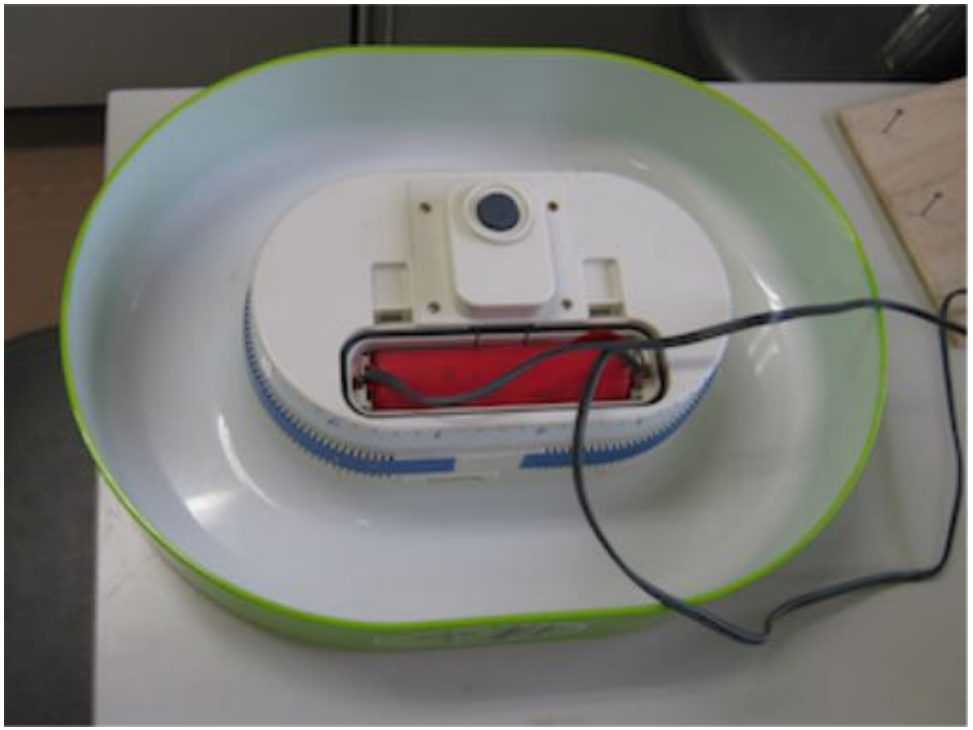


**Figure S5.** An apparatus for the experiment of horizontal movement in water. Water was circulated in the elliptic flow apparatus (31 x 41.5 cm).

**Supplementary Table S1.** Data on seed detachment from the parental plant. Awns were cut to give four awn lengths (full, 1/2, 1/4, and no awns). In each awn treatment, days to shedding were examined with eight panicles (two panicles each from four plants).

| Data | Full awn | | | 1/2 awn | | | 1/4 awn | | | No awn | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Panicle no. | | Ave. | Panicle no. | | Ave. | Panicle no. | | Ave. | Panicle no. | | Ave. |
| | 1 | 2 | | 1 | 2 | | 1 | 2 | | 1 | 2 | |
| Heading date | Aug. 22 | Aug. 22 | | Aug. 21 | Aug. 23 | | Aug. 22 | Aug. 25 | | Aug. 23 | Aug. 26 | |
| No. spikelets | 26 | 50 | 38 | 68 | 49 | 58.5 | 64 | 44 | 54 | 65 | 53 | 59 |
| Days to shedding | 14.68 | 14.24 | 14.46 | 14.56 | 13.92 | 14.24 | 14.84 | 14.45 | 14.65 | 15.34 | 15.17 | 15.26 |
| Heading date | Aug. 22 | Aug. 25 | | Aug. 23 | Aug. 22 | | Aug. 21 | Aug. 26 | | Aug. 22 | Aug. 23 | |
| No. spikelets | 93 | 55 | 74 | 70 | 79 | 74.5 | 78 | 52 | 65 | 43 | 48 | 45.5 |
| Days to shedding | 15.05 | 15.30 | 15.18 | 14.37 | 14.77 | 14.57 | 15.15 | 14.75 | 14.95 | 14.79 | 15.60 | 15.20 |
| Heading date | Aug. 25 | Aug. 26 | | Aug. 28 | Aug. 27 | | Aug. 23 | Aug. 24 | | Aug. 27 | Aug. 27 | |
| No. spikelets | 61 | 53 | 57 | 55 | 64 | 59.5 | 46 | 47 | 46.5 | 47 | 61 | 54 |
| Days to shedding | 14.36 | 13.72 | 14.04 | 14.24 | 14.58 | 14.41 | 14.43 | 15.47 | 14.95 | 15.77 | 15.39 | 15.58 |
| Heading date | Aug. 23 | Aug. 22 | | Aug. 27 | Aug. 27 | | Aug. 22 | Aug. 24 | | Aug. 24 | Aug. 26 | |
| No. spikelets | 46 | 61 | 53.5 | 56 | 56 | 56 | 61 | 38 | 49.5 | 66 | 44 | 55 |
| Days to shedding | 14.39 | 14.16 | 14.28 | 14.61 | 14.61 | 14.61 | 14.67 | 14.00 | 14.34 | 16.14 | 15.11 | 15.63 |
| Overall average | | | | | | | | | | | | |
| No. spikelets | | | 55.6 | | | 62.1 | | | 53.8 | | | 53.4 |
| Days to shedding | | | 14.49 | | | 14.46 | | | 14.72 | | | 15.41 |

**Supplementary Table S2.** Scores of the experiment on seed falling angle. Average scores of ten seeds were calculated for four groups of different awn lengths (full, 1/2, 1/4, and no awns) with ten replications.

| Replication | Score on seed falling angle | | | |
|---|---|---|---|---|
| | Full awn | 1/2 awn | 1/4 awn | No awn |
| 1 | 4.0 | 4.0 | 2.2 | 0.0 |
| 2 | 4.7 | 4.7 | 3.2 | 0.4 |
| 3 | 4.1 | 4.7 | 3.3 | 0.5 |
| 4 | 4.7 | 4.5 | 2.7 | 0.5 |
| 5 | 4.9 | 3.7 | 3.2 | 0.0 |
| 6 | 4.8 | 4.0 | 2.3 | 1.1 |
| 7 | 4.1 | 3.6 | 2.3 | 0.4 |
| 8 | 4.7 | 3.7 | 2.9 | 0.4 |
| 9 | 4.7 | 4.0 | 3.9 | 0.3 |
| 10 | 4.4 | 3.9 | 3.4 | 0.4 |
| Average | 4.51 | 4.08 | 2.94 | 0.40 |
| S.E. | 0.33 | 0.41 | 0.56 | 0.31 |

Scores were given based on the falling angles as shown in Fig. S2.

**Supplementary Table S3.** Scores of the seed slipping experiments with four layers of plastic mesh sheets at 2- and 4-cm intervals. Slipping ability was scored based on the number of mesh sheets passed through. (A) Average scores of ten seeds calculated for four groups with different awn lengths (full, 1/2, 1/4, and no awns) with ten replications. (B) Result of t-test between the average scores at two intervals in each awn group.

(A)

| Replication | 2-cm interval | | | | Replication | 4-cm interval | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Full awn | 1/2 awn | 1/4 awn | No awn | | Full awn | 1/2 awn | 1/4 awn | No awn |
| 1 | 3.7 | 3.4 | 3.1 | 0.4 | 1 | 4.0 | 2.6 | 2.2 | 0.3 |
| 2 | 3.6 | 3.6 | 2.8 | 0.6 | 2 | 3.7 | 2.8 | 1.8 | 0.2 |
| 3 | 3.6 | 3.4 | 2.7 | 0.6 | 3 | 4.0 | 3.7 | 2.4 | 0.3 |
| 4 | 3.3 | 3.4 | 2.8 | 0.4 | 4 | 4.0 | 2.7 | 2.3 | 0.5 |
| 5 | 3.8 | 3.4 | 3.3 | 0.1 | 5 | 3.2 | 3.0 | 1.5 | 0.7 |
| 6 | 4.0 | 4.0 | 2.1 | 0.2 | 6 | 2.8 | 3.8 | 2.1 | 0.2 |
| 7 | 3.9 | 3.6 | 2.3 | 0.3 | 7 | 3.2 | 3.0 | 2.0 | 0.0 |
| 8 | 3.0 | 2.8 | 3.2 | 0.2 | 8 | 3.5 | 3.3 | 1.8 | 0.6 |
| 9 | 3.6 | 3.4 | 2.6 | 0.9 | 9 | 2.7 | 4.0 | 2.2 | 0.5 |
| 10 | 3.9 | 3.2 | 2.4 | 0.3 | 10 | 3.7 | 2.7 | 2.6 | 0.2 |
| Average | 3.64 | 3.42 | 2.73 | 0.40 | Average | 3.48 | 3.16 | 2.09 | 0.35 |
| S.E. | 0.30 | 0.30 | 0.39 | 0.24 | S.E. | 0.49 | 0.51 | 0.32 | 0.22 |

(B)

| Awn group | Full awn | 1/2 awn | 1/4 awn | No awn |
|---|---|---|---|---|
| t-test | n.s. | n.s. | ** | n.s. |

n.s.: not significant. **: significant at 1%.

**Supplementary Table S4.** Data of the shaker experiments using four seed groups with different awn lengths (full, 1/2, 1/4, and no awns). (A) Percentage of moved seeds on the V-shaped rod at three shaking speeds (150, 175, and 200 rpm). (B) Velocity of seeds measured at at two shaking speeds (175 and 200 rpm). Average speeds of ten moving seeds were calculated with ten replications.

(A)

| Speed (rpm) | Percentage of moved seeds (%) | | | |
|---|---|---|---|---|
| | Full awn | 1/2 awn | 1/4 awn | No awn |
| 150 | 85 | 77 | 76 | 51 |
| 175 | 92 | 81 | 87 | 75 |
| 200 | 93 | 92 | 88 | 86 |

(B)

| Replication | Velocity of seed (cm/s) 175 rpm | | | | Replication | Velocity of seed (cm/s) 200 rpm | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Full awn | 1/2 awn | 1/4 awn | No awn | | Full awn | 1/2 awn | 1/4 awn | No awn |
| 1 | 14.7 | 13.2 | 12.4 | 11.0 | 1 | 21.5 | 20.0 | 17.4 | 18.5 |
| 2 | 13.4 | 13.1 | 11.1 | 10.9 | 2 | 20.6 | 19.6 | 19.3 | 16.7 |
| 3 | 12.8 | 13.7 | 11.0 | 10.5 | 3 | 20.8 | 21.5 | 16.8 | 18.2 |
| 4 | 13.3 | 14.4 | 12.2 | 8.8 | 4 | 21.8 | 21.0 | 18.3 | 17.8 |
| 5 | 14.0 | 13.5 | 12.0 | 9.2 | 5 | 20.2 | 19.6 | 17.1 | 18.0 |
| 6 | 12.9 | 14.0 | 13.6 | 10.2 | 6 | 20.7 | 20.0 | 16.1 | 18.6 |
| 7 | 14.7 | 13.6 | 13.5 | 9.5 | 7 | 19.6 | 18.7 | 18.7 | 18.9 |
| 8 | 14.0 | 13.8 | 12.0 | 10.0 | 8 | 21.2 | 17.2 | 15.8 | 17.9 |
| 9 | 14.0 | 14.5 | 12.3 | 9.9 | 9 | 20.6 | 18.9 | 19.4 | 19.1 |
| 10 | 14.0 | 14.3 | 11.7 | 9.0 | 10 | 19.3 | 19.2 | 17.0 | 20.4 |
| Average | 13.79 | 13.80 | 12.18 | 9.90 | Average | 20.62 | 19.57 | 17.58 | 18.41 |
| S.E. | 0.66 | 0.50 | 0.86 | 0.78 | S.E. | 0.79 | 1.20 | 1.28 | 0.97 |

**Supplementary Table S5.** Data of the water flow experiments using four seed groups with different awn lengths (full, 1/2, 1/4, and no awns). Velocity of seeds in the water were measured at two water speeds (5 and 15 cm/s). Average speeds of five moving seeds were calculated with four replications.

| Replication | Velocity of seed (cm/s) | | | | Replication | Velocity of seed (cm/s) | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 5 cm/s | | | | | 15 cm/s | | | |
| | Full awn | 1/2 awn | 1/4 awn | No awn | | Full awn | 1/2 awn | 1/4 awn | No awn |
| 1 | 2.15 | 0.05 | 0.02 | 0.03 | 1 | 11.70 | 12.88 | 7.73 | 8.24 |
| 2 | 2.03 | 0.12 | 0.00 | 0.03 | 2 | 11.40 | 12.54 | 8.92 | 7.64 |
| 3 | 1.93 | 0.12 | 0.02 | 0.05 | 3 | 10.73 | 12.10 | 8.97 | 8.13 |
| 4 | 2.64 | 0.31 | 0.02 | 0.06 | 4 | 10.93 | 11.70 | 8.95 | 8.59 |
| Average | 2.19 | 0.15 | 0.01 | 0.04 | Average | 11.19 | 12.31 | 8.64 | 8.15 |
| S.E. | 0.32 | 0.11 | 0.01 | 0.01 | S.E. | 0.44 | 0.51 | 0.61 | 0.39 |

**Supplementary Movie S1 (in the separate file)**

Horizontal movement of wild rice seed on the V-shaped plastic rod. An awned seed was set in the right side of the rod at a shaker speed of 175 rpm.

**Supplementary Movie S2 (in the separate file)**

Horizontal movement of wild rice seed in the water. Both awned and awnless seeds were set in the flow apparatus at a water speed of 5 cm/s.