**Electronic Supplementary Information (ESM)**

1. *Figures*

**Figure S1**. Response surface experimental design. The x- and y-axes show planting densities of female and male Texas bluegrass. Circle size is proportional to the replication of each density combination (min: 1, max: 15). Panels show the replication of experimental plots (a), and the replication of the samples used in the analyses of seed germination in terms of (b) experimental plots and (c) female panicles.



**Figure S2**. Seed viability rate according to tetrazolium and germination assays. Data were jittered on the x- and y-axis. This figure replicates the mean prediction lines in Figure 1 of the main text using both tetrazolium and germination assay data. Lines show the predictions of model averages computed including the models that comprise 95% of AIC model weights. Dotted, dashed, and solid lines represent model predictions for plots where 5%, 50%, and 95% of observed panicles were female, respectively. The color of circles represents the sex ratio of panicles observed in each plot.

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**Figure S3.** Growth rate of individuals in 2015 as a function of planting density. Data were jittered on the x-axis. Circles and triangles represent female and male individuals, respectively. The shading of these symbols represents the percentage of females planted in each plot. The solid grey line and dotted black line represent model predictions referring to plots including 95% and 5% females, respectively. Fitted lines are shared by both sexes (effect sizes of sex were very small).

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**Figure S4.** Production of new tillers through asexual recruitment at the plot level in 2015. The shading of circles represents planting sex ratio, and solid and dotted lines represent model predictions for plots planted with 95% and 5% female individuals.

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**Figure S5**. Contour plots of per-capita recruitment (*r*) as a function of sex ratio and density which assume different seedling survival rates. Panel (a) reports the same data as Fig. 4d in the main text. This panel assumes a seedling survival rate of 100%. The remaining surfaces represent estimates of per-capita regeneration calculated assuming seedling survival of 70% (b), 46% (c), and 31% (d). We based these estimates on two studies reporting seedling survival in *Poa pratensis* (Kentucky bluegrass), a closely related species that hybridizes with Texas Bluegrass (e.g. Goldman 2008). We used estimates from *Poa pratensis* because there are no literature studies that estimate the proportion of surviving seedlings in Texas Bluegrass. These two studies provide similar average estimates for Kentucky bluegrass average survival (0.684 versus 0.707, Edwards et al. 2001, Chai et al. 2006). Chai et al. (2006) also reported survival rates across 11 genotypes and three water levels which ranged from 1 to 0.31. We therefore compared our baseline estimates of *r*, which assume seedling survival 1, with estimations of *r* assuming that the proportion of surviving seedlings is 0.7, 0.46, or 0.31. A surviving proportion of 1 was the maximum as well as the 90th percentile of the values reported in Chai et al. (2006), 0.7 was the mean value, 0.46 was the 10th percentile, and 0.31 was the lowest survival observed.



*2. Tables*

**Table S1.** Candidate models and AIC model selection results for female seed viability (based on germination assays). Models include as predictor variables the sex ratio and density of panicles.

|  |  |  |
| --- | --- | --- |
| **Model** | Viability | |
| **ΔAIC** | **AIC weight** |
| ~ 1 | 27.512 | 0.000 |
| ~ Sex ratio | 2.628 | 0.152 |
| ~ Density | 21.724 | 0.000 |
| ~ Density + Sex ratio | 1.410 | 0.280 |
| ~ Density + Density:Sex ratio | 0.000 | 0.567 |

**Table S2**. Candidate models and AIC model selection results for demographic performance. Candidate models for growth and panicle production include individual sex, population density, and population sex ratio, as predictors. Models for female and male reproductive effort (number of seeds initiated and number of spikelets per panicle, respectively) exclude sex as a predictor.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Growth rate | | Panicle production | | Reproductive effort (Female) | | Reproductive effort (Male) | |
| **Model** | **ΔAIC** | **AIC weight** | **ΔAIC** | **AIC weight** | **ΔAIC** | **AIC weight** | **ΔAIC** | **AIC weight** |
| ~ 1 | 0.000 | 0.860 | 2.636 | 0.091 | 5.820 | 0.041 | 0.000 | 0.412 |
| ~ Sex | 3.670 | 0.137 | 4.392 | 0.038 |  |  |  |  |
| ~ Density | 11.708 | 0.002 | 0.000 | 0.339 | 2.640 | 0.202 | 0.728 | 0.286 |
| ~ Density + Sex:Density | 23.652 | 0.000 | 1.958 | 0.127 |  |  |  |  |
| ~ Sex + Density + Sex:Density | 26.870 | 0.000 | 3.478 | 0.060 |  |  |  |  |
| ~ Density + Sex Ratio:Density | 22.042 | 0.000 | 1.472 | 0.162 | 0.000 | 0.757 | 0.626 | 0.301 |
| ~ Sex + Density +  Sex Ratio:Density | 26.553 | 0.000 | 2.812 | 0.083 |  |  |  |  |
| ~ Density + Sex Ratio:Density + Sex:Density | 34.532 | 0.000 | 3.264 | 0.066 |  |  |  |  |
| ~ Sex + Density + Sex Ratio:Density + Sex:Density | 37.985 | 0.000 | 4.630 | 0.033 |  |  |  |  |

**Table S3**. Candidate models and AIC model selection results for the production of new tillers through asexual recruitment in 2014. *At+1* = tiller production in spring 2014. *Nt*: total planting density in fall 2013. *Ft* and *Mt* are total planting density of females and males in fall 2013.

|  |  |  |
| --- | --- | --- |
| **Model** | **ΔAIC** | **AIC weight** |
|  | 0 | 0.346 |
|  | 1.862838 | 0.136 |
|  | 1.449273 | 0.168 |
|  | 1.465852 | 0.166 |
|  | 3.163367 | 0.071 |
|  | 5.640859 | 0.021 |
|  | 3.315784 | 0.066 |
|  | 5.231601 | 0.025 |

**Table S4.** Model structures fit using the growth rate data collected in 2015. Candidate models use the sex of individuals, planting density, planting sex ratio, or their combination as predictors. Note: plot random effect is not shown.

|  |  |  |
| --- | --- | --- |
| **Model** | **ΔAIC** | **AIC weight** |
| ~ 1 (Null) | 0.000 | 0.391 |
| ~ Sex | 4.676 | 0.038 |
| ~ Sex ratio | 3.141 | 0.081 |
| ~ Density | 0.250 | 0.345 |
| ~ Sex + Sex Ratio | 6.958 | 0.012 |
| ~ Sex \* Sex Ratio | 9.491 | 0.003 |
| ~ Sex ratio + Density | 3.115 | 0.082 |
| ~ Sex ratio \* Density | 12.454 | 0.001 |
| ~ Sex + Density | 5.077 | 0.031 |
| ~ Sex \* Density | 15.272 | 0 |
| ~ Sex + Density + Sex Ratio | 7.020 | 0.012 |
| ~ Sex \* Density + Sex Ratio | 17.330 | 0 |
| ~ Sex + Density \* Sex Ratio | 16.208 | 0 |
| ~ Sex \* Sex Ratio + Density | 9.275 | 0.004 |
| ~ Sex \* Density \* Sex Ratio | 34.781 | 0 |

**Table S5.** Candidate models for the production of new tillers through asexual recruitment in 2015. *Nt+1* = tiller production in spring 2015. *Nt*: total planting density in fall 2013. *Ft* and *Mt* are total planting density of females and males, respectively, in fall 2013. Model coefficients refer to Eq. 1-4 in the main text.

|  |  |  |
| --- | --- | --- |
| Equation | 2015 | |
| **ΔAIC** | **AIC weight** |
|  | 0 | 0.45 |
|  | 2.8753 | 0.107 |
|  | 2.2471 | 0.146 |
|  | 1.9680 | 0.168 |
|  | 3.9659 | 0.062 |
|  | 6.8760 | 0.014 |
|  | 6.3823 | 0.018 |
|  | 5.1403 | 0.034 |

**References**

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Edwards, G. R., H. Clark, and P. C. D. Newton. 2001. The effects of elevated CO2 on seed production and seedling recruitment in a sheep-grazed pasture. Oecologia 127:383–394.

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