Evaluating performance of individual plants with the combinations of genes in MN106 genetic background

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Abstract: Several necessary domestication traits were identified in Chopra et al. (2020) and effects of combinations of these genes on agronomic performance remains to be tested. During my internship with IPREFER, I surveyed MN106 individuals with three genes of interest (to be referred to as triple mutant) which carried alleles for high oleic acid, low erucic acid, and reduced shatter. To evaluate the performance of individual plants, I tagged 48 triple mutant plants and 48 wild-type (MN106) plants. These plants were genotyped using the KASP markers to verify they were homozygous mutants. These plants were phenotyped and data was collected for total plant height, reproductive stem height, per plant yield, 1,000 seed weight, and seed composition. We found that the triple mutants had a total plant height of 90.07±6.55cm, and reproductive stem height of 39.29±6.07cm. The wild-type had a higher total plant height of 97.15±12.26cm, and a shorter reproductive stem height of 23.46 ±5.44cm. We also found that the triple mutants had higher per plant yields compared to the wild-type (3.85±1.96g vs. 1.19±0.7g) and no significant differences were observed on 1,000 seed weight. We also measured combine-harvested yields for the wild-type and triple mutants on large 60'x5' plots and found that the triple mutant had 21.3% more seed yield than wild-type (1465 lbs/acre vs. 1207 lbs/acre). Furthermore, we also evaluated seed composition traits using the NIRS instrument and recorded erucic acid, oleic acid, total oil and total protein content among these two groups. We found statistically significant differences for erucic acid (29.53±1.9 vs. 2.72±2.46), oleic acid (24.32±3.4 vs. 59.54±2.94), total oil content (38.1±1.6 vs. 34.65±1.84) and total protein content (19.4±1.14 vs. 21.18±1.31) between the wild-type and triple mutant, respectively. Overall, the triple mutant performed better than the wild-type for plant yield, oil composition and protein content. These results provide important information on the benefits of incorporating these traits and will inform future pennycress improvement decisions.

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