Selection for Seed Size and its Impact on Kabuli Chickpea Production

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INTRODUCTION

Seed costs for kabuli chickpea production are the second major input expense behind fungicides. If small-sized seeds could be used without adversely affecting seedling vigour or seed yield, then seed costs could be reduced substantially because fewer kg of seed would be needed per unit area. However, we hypothesized that if small seeds of kabuli chickpea were selectively used for planting, year after year, the proportion of small seeds in the harvested seed lot may increase, which would ultimately affect plant vigour and market value of the harvested seed. The objectives of this study were to determine (i) the effects of seed size, and selective use of small seeds, year after year, on plant establishment, growth and development, and seed yield of kabuli chickpea, and (ii) the effect of seed size on the proportion of ≥9-mm diameter seeds in the harvested seed lot.

MATERIALS AND METHODS

Seed of 'CDC Xena' was separated into large (9.1-11.0 mm, 493 mg seed^{-1}) and small (8.1-9.0 mm, 366 mg seed^{-1}) diameter seed fractions. These separated seeds along with the original, unseparated seeds were designated as 1st generation seeds and were tested in a replicated field trial in 2000. After harvest, large seeds were obtained from the large-seeded 2000 crop, small seeds were separated from the small-seeded 2000 crop, and unseparated seeds were also obtained from the 2000 crop grown from the unseparated seeds; these represented the 2nd generation of seeds. In the following year, the 3rd generation of seeds were obtained using the same methods as used in the 2nd generation. During the 4-yr period, the 1st generation seeds were tested from 2000 to 2003, the 2nd generation seeds tested from 2001 to 2003, and the 3rd generation seeds tested in 2002 and 2003. In each year, the tests were arranged in randomized complete blocks designs with four replicates.

RESULTS AND DISCUSSION

Seed size did not affect plant biomass, seed yield, or the proportion of ≥9 mm diameter seed in the harvested seedlots (9DSeeds) when the 1st year of the separated large- and small-seeds was tested (Table 1). The crops performed similarly regardless of the size of the seeds.

When the 2nd generation of separated seeds were compared under the same conditions, differences in performances began to emerge (Table 1). The crops grown from large seeds,

during different test years (2001-2003), produced greater biomass, higher seed yields, and more 9DSeeds than crops grown from small seeds, although the effects were not always statistically significant.

However, when the 3rd generation of separated seeds were compared, the differences in performances became consistent and statistically significant (Table 1). Small seeded plants significantly lowered seed yields and decreased 9DSeeds in all test years when compared to plants grown from large and unseparated seeds.

The magnitude of differences in seed yield and 9DSeeds between small and unseparated seeds (also between large and unseparated seed) was described quantitatively by calculating the percent changes between the two seed size categories for each of the three generations. As small seeds were selectively used year after year, the gaps in field performance between small and unseparated seeds became larger. Use of small seeds selectively for three consecutive years reduced the seed yield of chickpea by 23% and 9DSeeds by 10%. The decrease in seed yield was attributable to fewer pods $plant^{-1}$ (in 2003) and fewer seeds pod^{-1} (in 2002), in addition to a noticeable decline in the size of the harvested seed.

However, selective use of large seed, year after year, did not improve seed yields or 9DSeeds when compared to unseparated seeds. In some cases, selective use of large seeds improved biomass production, but this did not translate into higher seed yields.

CONCLUSIONS

Our results showed that there were no differences in biomass production or seed yield between large- and small-sized seeds of kabuli chickpea when the crop was grown from a certified cultivar. However, selective use of small seeds for more than two consecutive generations significantly reduced seed yields and decreased the proportion of ≥9-mm diameter seeds in the harvested seed lot. A reduction of ≥9-mm diameter seed proportions means a significant decrease in the market value of the product because the ≥9-mm diameter seed receives a large price premium. The shift to smaller seeds with the selective use of small-sized seeds was probably due to environmental and maternal factors affecting plant fitness, but this type of selection would not likely result in any evolutionary change or genetic shift. The economic consequences of using large or small seeds in commercial production are associated with the margin between the value of seeds produced and the cost of production. Producers should always conduct an economic analysis using current seed costs, expected seed yields, and product prices to evaluate the opportunity costs of using small-sized seeds.

ACKNOWLEDGEMENTS

We acknowledge the excellent technical assistance of Greg Ford, Ray Leshures, and Lee Poppy, and the financial support of this project from Saskatchewan Pulse Growers, and the Matching Investment Initiative of Agriculture and Agri-Food Canada.

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