Genotype x Environment interaction on seed yield of Indian mustard (*Brassica juncea* L.) and canola (*Brassica napus* L.) in a Mediterranean type environment of South Western Australia

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Abstract

The effect of genotype and environment interaction on the seed yield of mustard and canola were studied in low rainfall, Mediterranean type environments of South Western Australia. Mustard genotypes 887.1.6.1, 82 No 22-98 and Muscon and canola genotype Monty have shown average phenotypic stability across the environments studied. Mustard genotypes 887.1.6.1, 82 No 22-98 has shown general adaptability as they produced the highest mean seed yields across all environments tested. Mustard genotypes JM 25 and JM 33 showed specific adaptation to drought and high temperature conditions. Canola genotype Oscar produced the lowest mean seed yield across environments and showed high sensitivity to environments.

Key Words

Indian mustard, canola, genotype x environment interaction, adaptation, phenotypic stability

Introduction

Adaptation of genotypes to a range of environments can best be explained by their phenotypic stability. In the cropping regions of South Western Australia general adaptability of crop species has proved to be particularly important, as edaphic variation between localities and the seasonal variation within localities are great. Recently Indian mustard (*Brassica juncea*) has been identified as a potential new crop for these cropping areas, however limited research has been carried out on its adaptation to specific environments. In this study, the effect of genotype and environment interaction on seed yield of mustard and canola was analysed to investigate their responsiveness, stability and adaptation to different environmental conditions experience in low rainfall, Mediterranean type environments of South Western Australia. It was hypothesized that mustard would perform better than canola under water and high temperature stress conditions experienced in these environments.

Methods

Six identical field experiments were conducted at three sites at Merredin (31?29'S, 118?18' E, average annual rainfall 315 mm), Mullewa (28?33'S, 115?25'E, average annual rainfall 337 mm) and Newdegate (36?51'S, 119?1'E, average annual rainfall 363 mm) during 2000 and 2001 growing seasons. Five mustard breeding lines/variety (887.1.6.1, JM25, JM33, Muscon, 82 No 22-98) varying in plant height, maturity and oil quality and two commercial canola varieties (Monty and Oscar) were sown at three times after the break of the season in a split plot design with three replicates. Plots were machine harvested and seed yield was determined. The genotype x environment interaction was examined by conducting a Finlay Wilkinson analysis (Finlay and Wilkinson 1963). Regression coefficient of the linear regression of individual genotype yield on the mean yield of all genotypes for each environment illustrates responsiveness of the genotype to the environments studied. Environments were denoted as follows:

M–Merredin, MU–Mullewa, N–Newdegate, 00–2000 growing season, 01-2001 growing season, S1- early sowing, S2- mid sowing, S3- late sowing. i.e.; first sowing at Merredin in 2000 - M00S1.

Results

Regression of individual seed yield of genotype on the mean seed yield for each environment was significant and accounted for 92 % variation in the data (Figure 1). Mean seed yield of environments was in the following decreasing order; M01S1, MU00S1, M00S1, N01S1, M00S2, M00S3, N01S2, N00S1, MU00S3, M01S2, MU00S2, N00S2, N01S3, M01S3 and N00S3. Seed yield increased by 2 % for each 1 mm rise in rainfall and by 12 % for each 1?C fall in average daily temperature. Responsiveness of genotypes to increasing seed yield potential at these environments ranged from 0.82 to 1.14 and was in the following increasing order: JM 33, JM 25, 82 No 22-98, Muscon, Monty, 887.1.6.1, and Oscar (Figure 2). Mean seed yield of genotypes across environments was in the following decreasing order: 887.1.6.1, 82 No 22-98, Monty, Muscon, JM 33, JM 25, and Oscar. Genotypes 82 No 22-98, Muscon, Monty, and 887.1.6.1 have shown average phenotypic stability and there was no significant difference between their responsiveness. Oscar was very sensitive to changes in the environmental conditions and has shown below average phenotypic stability (Figure 2). Mustard genotypes JM 25 and JM 33 on the other hand exhibited above average phenotypic stability (Figure 2).

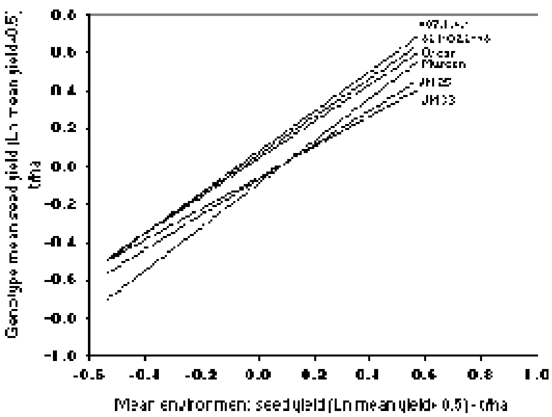

Figure 1. Regressions between individual seed yields of seven genotypes of mustard and canola and mean environment seed yield .

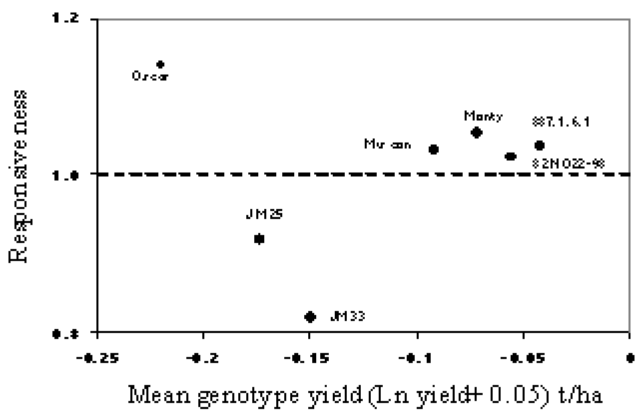

Figure 2. Plot of responsiveness of seven genotypes of mustard and canola to different environments.

Conclusion

Mustard genotypes 887.1.6.1 and 82 No 22-98 produced the highest mean seed yields across all environments than higher yielding canola variety Monty suggesting general adaptation to the environments tested. Mustard genotype Muscon also has shown general phenotypic stability similar to Monty, though produced slightly lower yields. Oscar showed specific adaptation to high yielding environments hence produced very little yield in poor environments, particularly in mid and late sowings. Although JM 25 and JM 33 produced lower yields they showed greater adaptation to low yielding environments with low soil moisture and high temperature conditions. These two genotypes were less sensitive to environmental changes and variation in yield was small. This study demonstrates that Indian mustard as an oil seed crop had good adaptation and seed yield potential in the low rainfall cropping regions of South Western Australia.

Reference

(1) Finlay, K.W. and Wilkinson, G. N. (1963) Aust. J. Agric. Res., 14: 742-754