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Application of AMMI model for analysis of genotype-environment interactions of rapeseed thousand seed weight

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Background:

Genetic potential of rapeseed for reaching high seed and oil yield can be jeopardized by multiple environmental factors that shape rapeseed performance and stability at different growing sites. A combination of high temperatures and drought during sowing make the germination and initial plant growth critical phases for successful rapeseed production in Serbia. Thousand seed weight is related to seed size, which affects seeding rate as well as speed of germination and emergence and is important to achieve high yield potential.

Objective:

The goal of this study was to study changes in thousand seed weight of rapeseed in response to different environments. Furthermore, we sought to determine genotypes that had high and stable thousand seed weight values. Additional goal was to implement additive main effects and multiplicative interaction model (AMMI) to partition genotype × environment interactions.

Methods:

Field trials were set up in three replications as randomized complete block design during three consecutive years. Nineteen winter rapeseed lines resulting from breeding program of the Institute of field and vegetable crops, Novi Sad, Serbia were tested at one location per year at the province of Vojvodina, Serbia. Standard production technology for these agroclimatic conditions was applied regarding sowing date, fertilisers, and pesticides application. Air-dried seeds from plants from two middle rows of plot were collected to determine thousand seed weight. AMMI analysis was conducted to assess effects of genotype, environment, and their mutual interaction on thousand seed weight of tested lines.

Results:

ANOVA revealed significant effects of genotype, environment (year) and mutual interaction between genotype and environment. Thousand seed weight was largely affected by differences between years with 78.68% of the overall variance. Different genetic background of studied genotypes accounted for 24.73% of the variation, while the interaction between genotype and year explained 15.28% of the variation. Highest IPC1 score was detected in 2017. The most stable line in terms of 1,000 seeds weight was NS-L-46 whose IPC1 value was close to zero (0.01), indicating high adaptability to environmental conditions during period 2015-2017. Analysed lines had highest TSW in 2017, 4.77g, while lowest values were recorded in 2015, 3.84g. In all years, NS-L-44 stood out as best performing line with average TSW of 5.02g. This line also had favourable IPC1 (-0.14) value denoting its stability.

Conclusions:

Variance for thousand seed weight was most influenced by environmental conditions in analysed winter rapeseed lines. Usefulness of AMMI analysis was confirmed for the purpose of selection lines that have both high thousand seed weight and high stability in different environments. Line NS-L-44 was found to be the genotype of particular interest for further breeding and selection purposes. Using thousand seed weight to determine seeding rate and estimate emergence can lead to good plant stand establishment.