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Ecological plasticity of maize hybrids, development by Ukrainian scientific institute of plant breeding, under the conditions of Ukraine

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Abstract. Changes the thermal regime during the period of active vegetation significantly affects the maize development and yield. The main purpose of the study was to identify new high-yielding maize hybrids adapted to cultivation in contrasting agro-climatic conditions of Ukrainian regions in the course of environmental trials.

The sites were of maize hybrid trials has been grouped by climatic conditions, and their suitability for maize cultivation has been characterized. Promising mid-early and mid-ripening maize hybrids with various environmental

plasticity, giving yields of > 9,0 t/ha (based on five-site studies) were selected. The response of hybrids of different plasticity groups to cultivation conditions differing in favorableness was determined. Based on results of studying their environmental plasticity and stability, the promising hybrids are recommended for cultivation in certain regions of Ukraine.

Keywords: maize, hybrid, yield, environmental plasticity, stability.

Introduction. Today maize is one of the major crops of the global agriculture and an essential component of the grain economy of Ukraine. Analysis of the air temperature variability during the maize growing period in Ukraine demonstrated its considerable changes all over the country, which significantly affects the crop yields.

Analysis of recent researches and publications. Not only the maturity group but also the suitability of a hybrid to regional production conditions ensure the complete fulfillment of the maize productivity potential. Therefore, the development of hybrids combining high potential performance and genetically determined adaptability to particular climatic conditions is one of the main objectives of the crop breeding.

Purpose. The study purpose was to distinguish new maize hybrids development by Ukrainian Scientific Institute of Plant Breeding (VNIS) in the experiments of large-scale environmental trials in Ukrainian regions differing in agro-climatic conditions.

Methods. The experimental plots were laid out in five regions of Ukraine in 2019. Maize hybrids were tested in the environmental trials: 131 mid-early hybrids (FAO 240–299) and 83 mid-ripening hybrids (FAO 300–399). The best-registered in Ukraine hybrids bred at the All-Ukrainian Research Institute of Breeding (Hran 6, Vn 63 and Hran1) were taken as standards in the experiments.

The laying out the experimental plots, phenological observations and measurements were conducted by conventional for maize techniques. The total plot area was 20 m^2; the record plot area was 10 m^2. The plant density at harvest was

70,000–80,000 plants per hectare.

Maize was harvested by the plot combine Haldrup CTS - 95 Twin Rotor. The environmental plasticity and stability parameters were calculated by S. A. Eberhart and W. A. Russell (1966) method presented by V. Z. Pakudin and L. M. Lopatina (1984). To assess differences in humidity between the regions, GT Selyaninov's hydrothermal coefficient was calculated. Cluster analysis was performed by complete link method using the Euclidean distances. The experimental data were processed by variation statistics as well as by analyses regression and variance in Microsoft Office Excel 2010 and Statistics 10.0.

Results. Cluster analysis grouped the trial sites by climatic conditions during the maize growing period. The Ternopil location was singled out as a separate cluster, which is the farthest in terms of climatic conditions from the other locations. The climatic conditions in the Cherkasy and Kyiv locations were highly similar. Due to the similar climatic conditions, the Chernihiv location was included in this cluster. The the Dnipro location in this cluster was the most distant according to Euclidean distances and climatic conditions.

The Ternopil location had the best conditions for high yields from of mid-early hybrids (I_i = 1,12). The Cherkasy location had the least favorable conditions by produced yield (I_i = -1,03).

The Ternopil region (I_i = 0,82) was also recognized as the most favorable by environmental indices for mid-ripening hybrids, while the conditions in the Chernihiv region (I_i = -0,67) were the least favorable.

On average across the trial sites, the maize yields ranged 5,86 to 9,48 t/ha in mid-early hybrids and 6,71 to 9,67 t/ha in mid-ripening ones.

Thus, judging from the environmental plasticity coefficients, in the high plasticity group the number of mid-early hybrids was almost twice as the number of mid-ripening hybrids (26 vs. 12).

Of the most high-yielding mid-early hybrids with high environmental plasticity coefficients (b_i = 1,73–2,12), 4 hybrids, with a yield of 8,52–9,25 t/ha, (UA-46, UA-52, UA-54, UA-55) were selected as the most susceptible to the

environmental conditions of cultivation. UA 2, UA 17, UA 67, UA 103, UA 104, and UA 126, with yields of 9,05–9,48 t/ha, were referred to medium plastic mid-early hybrids (b_i = 0,50–1,64).

Mid-ripening hybrids UA 178, UA 188, UA 189, UA 192, UA 193, and UA 196 gave high yields of 8,99–9,61 t/ha. The environmental plasticity coefficients of these hybrids ranged 0,03 to 0,72.

Of 8 lowly plastic mid-ripening maize hybrids (b_i = -0,20 – -1,13), hybrids UA 137, UA 159, UA 164, UA 172, UA 177, UA 179, UA 182, and UA 186 gave yields of 8,34–9,67 t/ha.

Discussion. Thus, the mid-early and mid-ripening maize genotypes adapted for cultivation in certain regions of Ukraine have been selected. Highly plastic hybrids will fully manifest their yield potential in more favorable agro-climatic conditions. Medium and lowly plastic hybrids will respond optimally in less favorable areas.