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Ecological Stability, Plasticity and Adaptability of Sweet Pepper Lines

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Annotation: The success of breeding work depends on the accuracy of the assessment of traits characteristic of the parental forms. To do this, a preliminary individual assessment of each variety sample is carried out under specific growing conditions. It is necessary not only to study the breeding material, but also to identify ways to involve it in breeding work.

Keywords: ecological stability, plasticity, adaptability, line, sweet pepper, productivity, breeding value.

Introduction. The success of breeding work depends on the accuracy of the assessment of traits characteristic of the parental forms. To do this, a preliminary individual assessment of each variety sample is carried out under specific growing conditions. It is necessary not only to study the breeding material, but also to identify ways to involve it in breeding work.

A variety or hybrid is an environmentally and economically effective means of increasing the size and quality of the crop. The importance of the variety is especially important in areas with unfavorable soil, climatic and weather conditions. Today, varieties and hybrids with high environmental resistance are of particular value, capable of generating a high level of productivity even with significant deviations of environmental conditions from the optimum and having the ability to withstand the effects of abiotic and biotic stressors. Ecological plasticity is the response of the genotype to changes in environmental conditions, manifested in phenotypic variability. Stability characterizes the ability of a genotype to maintain a phenotype under different growing conditions.

Materials and methods. To assess environmental plasticity and stability, the methodology of O. I. Kilchevsky and L. V. Khotylev was used.

Calculation of parameters of adaptability, stability and selection value of the genotype was carried out according to the method of O.V. Kilchevsky, A.V. Khotyleva [1,2].

Data analysis was carried out using STATISTICA 6.0 and Ecxel XP software packages. The critical significance level was taken to be 5%.

Observation, evaluation and recording of preliminary variety testing in the nursery were carried out according to the methodology of the State Commission for Variety Testing of Agricultural Plants [65], as well as the international classifier UPOV [66].

Sweet pepper seeds were sown on February 20. They dived on April 1, and on April 28 they were planted in a film greenhouse. Planting pattern 35x70, 3m^2 plots, with 3x repetition.

Results. One of the most important criteria for the production value of varieties and hybrids is their environmental sustainability. The forest-steppe zone of Ukraine is characterized by unstable climatic conditions, therefore the varieties and hybrids introduced into production must combine high productivity with environmental plasticity, which will allow obtaining guaranteed yields regardless of growing conditions. Average long-term data in Table 1 reflect the productivity of sweet pepper breeding lines and their environmental stability and plasticity.

Over three years of research, high yields were obtained from the lines HPTT/Doverchivy - 7.2 kg/m^2, Bianka/Doverchivy and Nunhems 7224/Bossa Nova - 6.7 kg/m^2.

The adaptive ability of plants is divided into general (ZAZ - Vi) and specific (CAZ - G^2). General adaptability characterizes the ability to form a number of phenotypes that are adapted to different conditions, and specific adaptability provides the genotype with high productivity in limited (specific) environmental conditions. The response of the lines based on the yield trait was determined based on the general adaptive capacity (Vi).

It was most pronounced in the MKChDDT / Merigo samples – 7.2; HPTT / Trustful, KDS -16 – 6.3 and 5.2, respectively. Among the studied plants, the F8 lines Line 42 and Bianca/Trustful had a high effect of specific adaptive ability (G^2) – 3.3 and 4.4, respectively.

Table 1. Ecological variability of sweet pepper breeding lines in terms of yield (2020-2022)

Varieties	Xser±Sxser, days	Adaptive ability		S_{gi}, %	bi	STs_{gi}
		ZAZ, (Vi)	CAZ (G^2)			
Chameleon 5	4,2±2,0	3,2	1,7	17,3	1,0	7,8
Tenderness / HPTT	4,2±2,5	-0,2	2,0	9,0	1,7	4,3
MKCHDDT / Merigo	4,3±1,9	7,2	0,4	12,0	0,9	2,8
F_8 ($F_1$29P9 / Bossa Novaya)	4,3±2,0	1,7	1,7	7,7	0,2	6,8
F8Line 42	4,3±2,5	1,5	3,3	9,4	1,8	3,3
MKCHDDT / Tenderness	4,7±2,3	-0,8	1,1	14,8	1,0	1,9
HPTT / Saroksary	4,8±1,8	-0,5	1,5	6,6	1,1	2,1
KDS-16	4,9±2,1	5,2	0,9	14,0	0,8	14,7
Nika / Consent	5,0±2,5	-0,2	2,0	3,3	1,6	4,3
Martos/Saroksary	5,3±1,8	-0,3	1,5	6,6	1,3	9,1
Nunhams 7224 /Bossa Nova	6,7±2,3	3,6	3,0	11,9	0,2	16,8
Bianca/Gullible	6,7±3,5	4,3	4,4	2,0	0,5	18,5
HPTT / Trusting	7,2±1,1	6,3	1,9	5,8	1,9	19,7
NIR_{05}	2,0					

Among the parameters of environmental stability, the most objective characteristic of a genotype is relative stability (S_{gi}), which in the range of 0-25 is considered highly stable. Consequently, all studied varieties can be classified as a highly stable group. The most stable (S_{gi}) for this trait are the lines Bianca/Trusting – 2.0 and Nika/Consent – 3.3.

Varietal samples in which the regression coefficient (b_i), characterizing the degree of ecological plasticity, is significantly higher than one belong to the intensive type. That is, they respond most to favorable conditions. However, in unfavorable years, as well as in low agricultural conditions, their productivity sharply decreases. Thus, among the lines that we evaluated, the highest indicators were obtained in the line HPTT/Trustful - 1.9, in the lines F_8 Line 42 and Tenderness/HPTT - 1.8; 1.7, respectively.

For lines F_8 ($F_1$29P9/Bossa Nova) and Nunhemsa 7224/Bossa Nova, this indicator was 0.2, which corresponds to a neutral type, characterized by a slight response to changes in environmental factors.

The selection value of a genotype (SVG) characterizes the level of productivity and general adaptive ability. So, the highest SVG, simultaneously with a high level of yield and ZAZ, is set in the line HPTT/Doverchivy - 19.7%, Bianca/Doverchivy - 18.5% and Nunhems 7224/Bossa Nova - 16.8.

These options are significantly superior to all other samples in terms of productivity and environmental stability.

Conclusions. Thus, the breeding lines that were studied had highly stable values ($S_{gi} < 25$) for yield. The F8 Line 42 and Bianca/Trusting lines had a high effect of specific adaptive ability (G_2). The highest breeding value of the genotype (SVG) were the initial forms HPTT/Doverchivy, Bianka/Doverchivy.

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