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MODELS OF GRAIN PRODUCTION VARIATION IN THE WHEAT EAR

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Abstract: The weight of grains in the wheat ear (GWE), Alex variety, was analyzed in relation to morphological parameters of the plants. The regression analysis facilitated obtaining four models in the form of equations. The variation of GWE in relation to plant height (PH), spike length (EL), spike weight (EW), number of spikelets (SpkNo), and number of grains in spike (GNE) was described by models in the form of equations and graphs models (3D, and isoquants). The variation of GWE in relation to PH and EW was described with higher precision compared to the other morphological parameters, under conditions of $R^2 = 0.982$, $p < 0.001$, $F = 151.9273$. The RMSEP parameter was calculated for each model, and confirmed the level of accuracy in the case of the model based on PH and EW. Divergent action was recorded in the case of models based on PH and EL parameters, respectively in PH and SpkNo parameters. The results showed characters that can be optimized together (convergent), and morphological characters that require a differentiated approach through breeding programs and crop technology.

• Introduction

Wheat is the agricultural crop with a major importance in human nutrition. Some morphological traits of wheat plants were considered important in the formation of wheat crop yield. The underground and aerial biomass represent important features for the differentiation of grass cereals genotypes and the formation of yield in the wheat crop. The height of wheat plants is an important feature both for plant breeding programs and for agricultural practice, with influences on yield. Morphological parameters of wheat plants, the elements of productivity at the level of the ear, the yield and the quality of the production, are the result of the interaction "genotype x environment x technology", so that variations of these parameters are frequently recorded. The yield of wheat was analyzed in relation to soil properties, the degree of weeding, different tillage systems and technology. The yield increase in the wheat crop was analyzed in relation to technological factors, such as organic and mineral fertilization, irrigation, plant nutrition, in order to optimize these inputs. The variation of some morphological and physiological parameters of the plants was recorded in relation to fertilization and irrigation, parameters that contributed to the increase in production. The evolution of wheat crop yields was studied in a collection of 1322 genotypes. The authors have recorded changes in the morphological features ensured by the researchers through the breeding programs, in order to ensure the current yields. The progress recorded in the morphological traits of wheat plants has been communicated in other studies, as a result of conscious selection, programmed for certain objectives, within breeding programs. The study used regression analysis to describe the variation of grain weight in the wheat ear, Alex variety, in relation to different morphological parameters of the plants and the ear.

• Material and method

The study analyzed the variation of grain weight at the level of the wheat ear in relation to plant biometric parameters. The wheat crop, Alex variety, was placed in the specific climate and soil conditions within ARDS Lovrin. The wheat crop was in a non-irrigated system. Adequate technology, specific to the wheat crop, was applied.

At harvest maturity, Code BBCH 99, plant samples were collected for biometric determinations. For the safety of the determinations, 20 plant samples were taken at random.

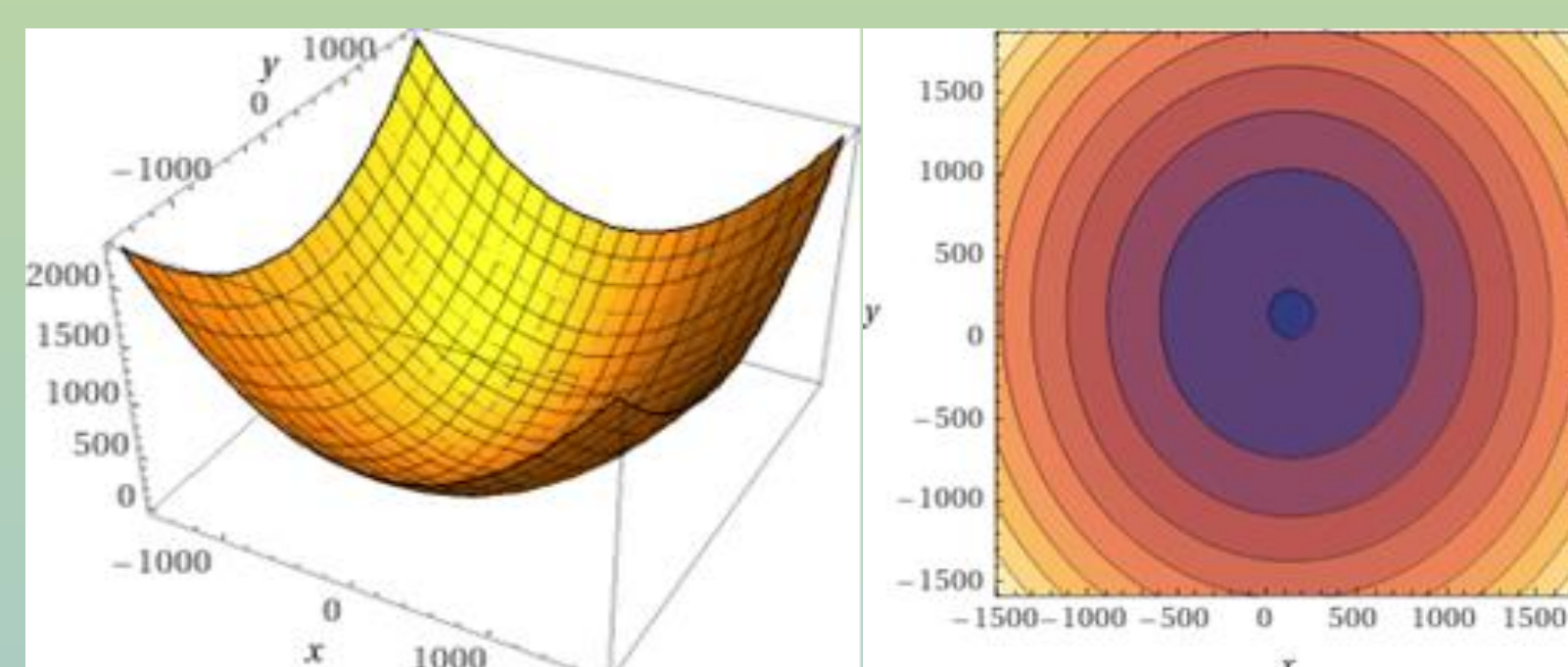
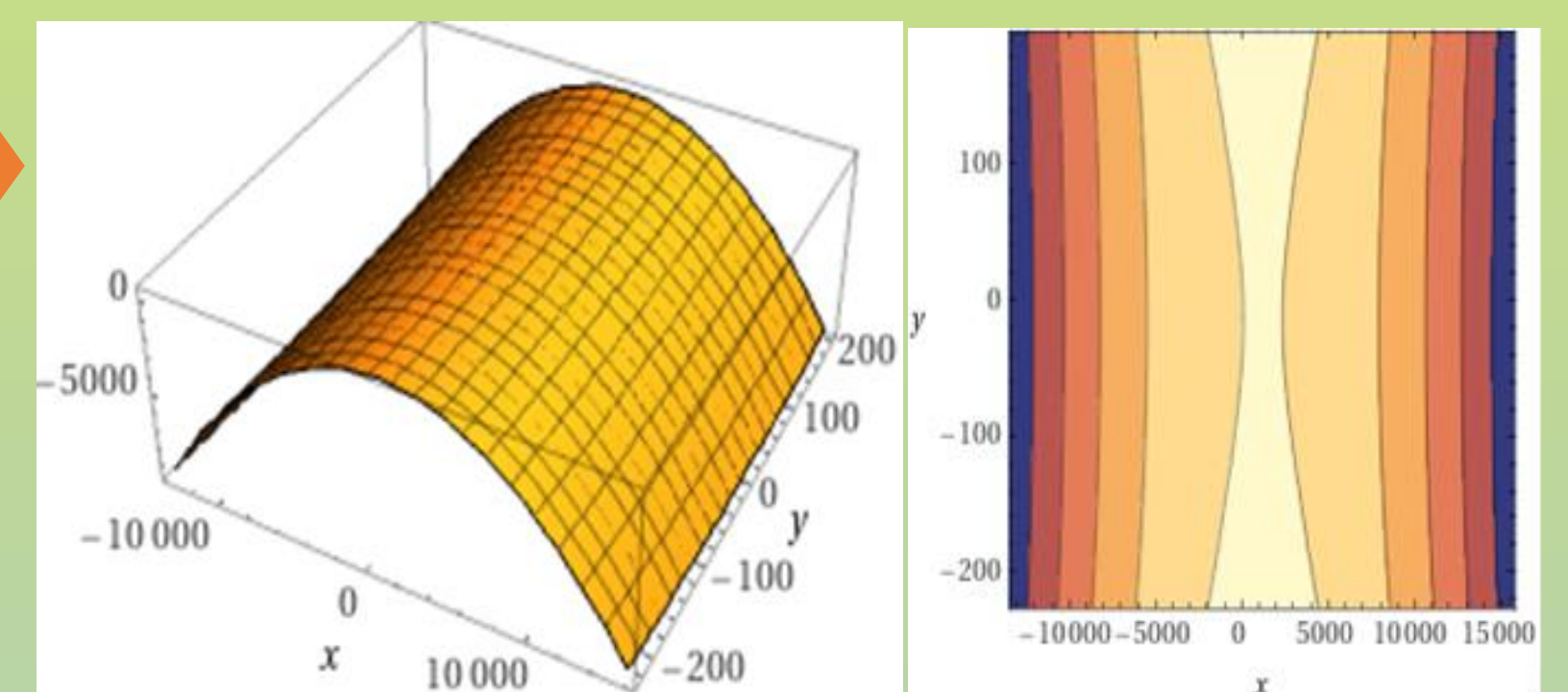
In relation to the purpose of the study, the height of the plants (PH, cm) was measured. As biometric parameters at the ear level were determined: the length of the ear (EL, cm), the weight of the ear (EW, g), the number of spikelets (SpkNo), the number of grains at the level of the ear (GNE), and respectively the weight of the grains at the ear level (GWE, g).

The series of experimental data, for each parameter, were recorded and analyzed to evaluate the safety and the presence of variance in the data set (Anova Test). The regression analysis was applied to evaluate the variation of the GWE parameter in relation to the plant height and morphological parameters at the ear level. The statistical calculation mode in EXCEL, the software Past, and Statistica were used.



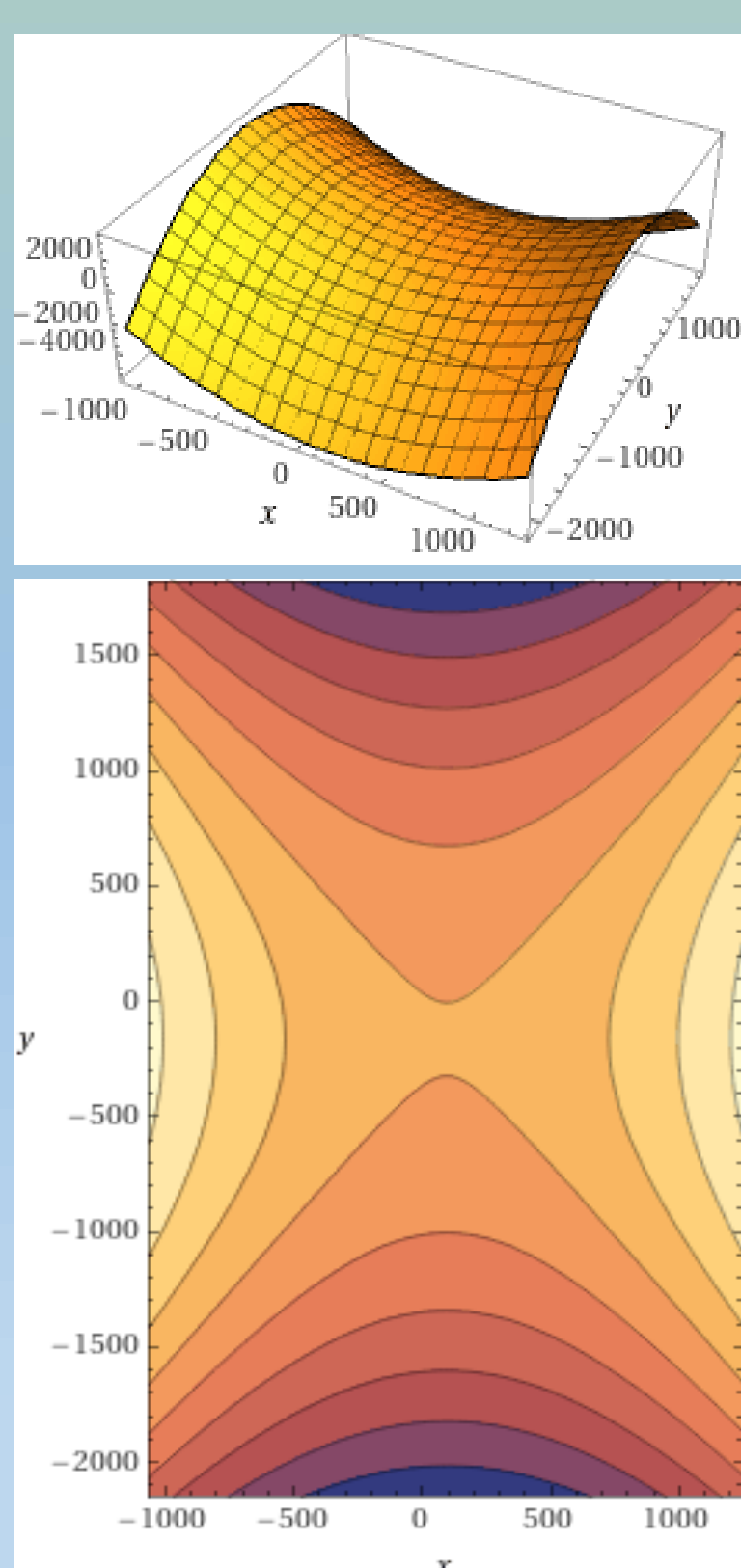
The variation of the GWE parameter in relation to the PH and SpkNo parameters was described by equation (2),

(3) $GWE_{(PH,SpkNo)} = ax^2 + by^2 + cx + dy + exy + f$ with $R^2 = 0.826$, $p < 0.01$, $F = 13.3031$. The graphic distribution of the GWE variation in relation to PH, and SpkNo.



The variation of the GWE parameter in relation to the PH and GNE parameters was described by equation (3),

(4) $GWE_{(PH,GNE)} = ax^2 + by^2 + cx + dy + exy + f$ with $R^2 = 0.929$, $p < 0.01$, $F = 36.8499$. The graphic distribution of the variation of GWE in relation to PH, and GNE.



• Results and discussions

Biometric determinations of wheat plant samples led to series of values for each parameter considered in the study. The data were analyzed for statistical characterization, with the values of the statistical parameters presented in table. The statistical reliability of the results and the presence of variance in the data set were verified by the Anova Test. Low variability was recorded in the case of the PH, SpkNo, and EL parameters, and moderate variability was recorded in the case of the EW, GNE and GWE parameters, according to the values. The variation of the weight of the wheat grains at the level of the ear was analyzed in relation to the height of the plants in combination with each of the other considered parameters. The height of the plants expresses the degree of vegetative growth and development of the biomass of the plants, in the environmental and technological conditions.

Regression analysis was used to obtain the equations that described the variation of the GWE parameter, the coefficient values of the equations and statistical safety parameters. The variation of the GWE parameter in relation to the PH and EL parameters was described by equation (1),

$$(1) \quad GWE_{(PH,EL)} = ax^2 + by^2 + cx + dy + exy + f$$

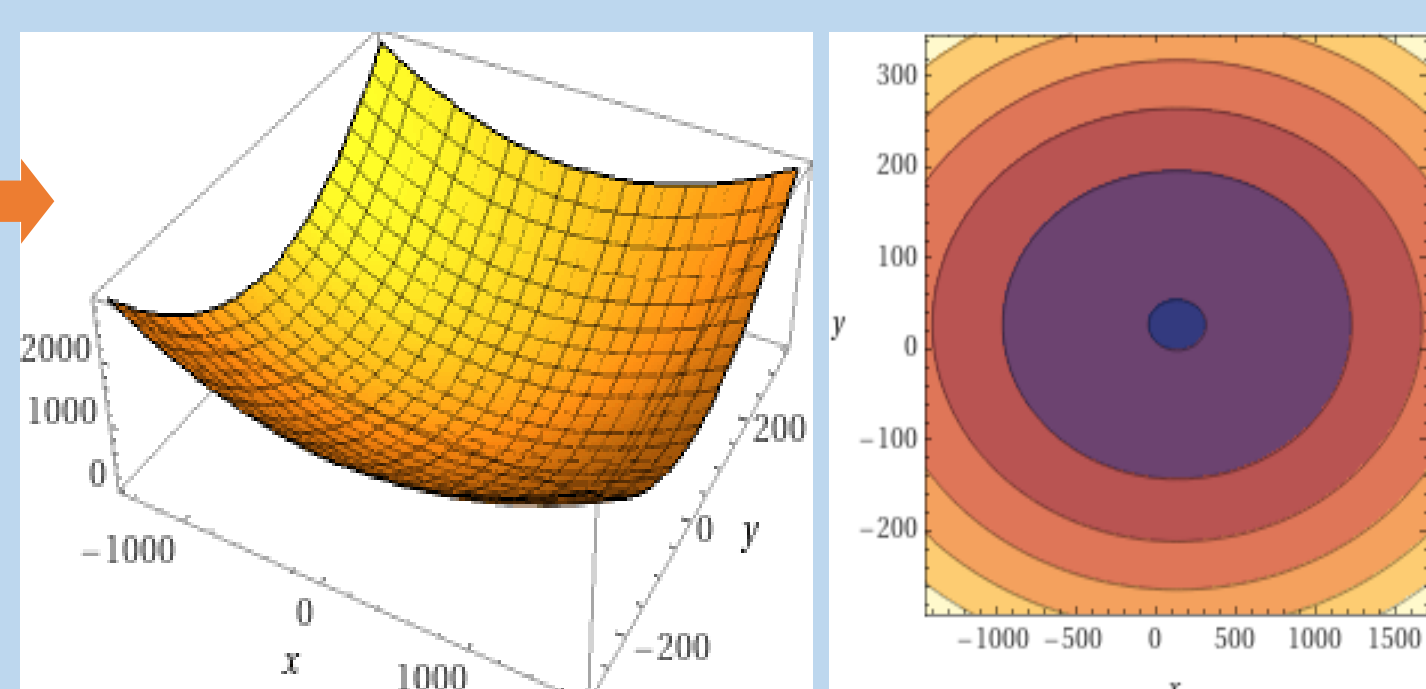
with $R^2 = 0.868$, $p < 0.01$, and $F = 18.5012$.

The variation of the GWE parameter in relation to the PH and EW parameters was described by equation (1),

$$(2) \quad GWE_{(PH,EW)} = ax^2 + by^2 + cx + dy + exy + f$$

with $R^2 = 0.982$, $p < 0.01$, $F = 151.9273$.

The graphic distribution of the GWE variation in relation to PH (x-axis), and EW (y-axis).



To verify the results, the RMSEP parameter was calculated for each model found. The results were RMSEP = 0.1521, related to equation (1), RMSEP = 0.0564, related to equation (2), RMSEP = 0.1749, related to equation (3), and respectively RMSEP = 0.1115, related to equation (4). From the analysis of the RMSEP values, it was found that the GWE parameter estimation model based on PH and EW ensured the highest accuracy.

From the analysis of the values of the coefficients of equations (1) – (4), as well as of the graphic models, figures 1 – 4, it was found that in the case of the models given by equations (1) and (3), divergent influences of the analyzed parameters were recorded, for the formation of the GWE parameter.

In the case of the model given by equation (1), PH and EL had a divergent relationship in the formation of the GWE parameter. The result showed that the two morphological characters (PH, and EL) cannot be optimized simultaneously in relation to the production of grains in the ear (GWE). A similar phenomenon was recorded in the case of the model given by the equation (3), when PH and SpkNo parameters were considered.

Plant height (PH) requires control through fertilization but also through growth bioregulatory substances. The morphological characters at the level of the ear require a separate approach, in order to increase the production of grains at the level of the ear, with a determining role in forming the yield of the wheat crop. Agricultural technologies require permanent adaptations and optimizations to ensure the yields and quality of the wheat crop.

From the analysis of the RMSEP parameter values, the model given by equation (2) ensured high accuracy in GWE estimation, RMSEP = 0.0564. The result agrees with the values of the regression coefficient ($R^2 = 0.982$) and the value of the F test, $F = 151.9273$.

• **Conclusions:** The morphological characters and the productivity elements studied in the Alex wheat variety registered different values, as a response of the variety to environmental and technological conditions. PH, SpkNo, and EL parameters showed low variability, and EW, GNE and GWE parameters showed moderate variability. The variation of the GWE parameter in relation to the plant height (PH) and the other biometric parameters at the spike level was described by models in the form of equations and graphic models. According to the equations obtained from the regression analysis, it turned out that based on the PH and EW parameters it was possible to estimate the GWE under conditions of high precision and statistical safety ($R^2 = 0.982$, $F = 151.9273$, $p < 0.001$). The recorded results showed that in the case of the GWE parameter estimation models based on PH and EL, respectively PH and SpkNo, there were divergent influences of the parameters analyzed for the formation of the GWE parameter, in study conditions. The results showed that these elements cannot be optimized simultaneously in relation to the production of grains in the ear but require different technological sequences.

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