Scientific Papers. Series A. Agronomy, Vol. LXIII, No. 1, 2020
ISSN 2285-5785; ISSN CD-ROM 2285-5793; ISSN Online 2285-5807; ISSN-L 2285-5785

THE INFLUENCE OF CLASSICAL AND FOLIARE FERTILIZATION WITH HUMIC ACIDS ON THE PRODUCTIVITY ELEMENTS OF GROUNDNUTS

Marin SOARE, Paula IANCU, Ovidiu PĂNIȚĂ

University of Craiova, Faculty of Agronomy, 19 Libertatii Street, 200583, Craiova, Romania

Corresponding author email: paula.iancu76@gmail.com

Abstract

The purpose of this study was the analysis of the organic foliar fertilization influence on the groundnut yield. The experience was located at SD Banu Mărăcine, Târgurești farm, on sandy soil, in 2015-2017. The experiment included two factors. The graduations of A factor (A_1 and A_2) were consider fertilization type. First graduation A_1 - normal fertilization of soil with NPK complex fertilizers (20:20:0), 200 kg/ha and the second graduation A_2 - same fertilization of soil and three extra leaf fertilization with Humusoil, 2 l/ha. B factor (genotype) had 6 graduations (genotypes). The analyzed characters were: pods yield, efficiency, total number of pods/plant, percent of total mature pods/plant, weight of 1000 pods/plant and weight of 1000 seeds/plant. Fertilization and genotype and their interaction statistically influenced all characters, except percent of total mature pods/plant. In the case of analysis of the interaction of the two factors, concerning the pods yield, the best results are obtained from the genotypes Solar and Venus at the A_2 graduation (2884.24 kg/ha pods yield respective 2895.45 kg/ha pods yield), by additional foliar fertilization the genotypes registering superior results compared with the basic fertilization.

Key words*: pods yield, yields elements, PCA, characters correlations, genotype, fertilization type.*

INTRODUCTION

Groundnuts (*Arachys hypogaea*) are considered one of the most important tropical plants. They are mainly cultivated for their grains rich in fat and protein as well as for their high quality oil. The demand for groundnut is increasing due to its many uses and high nutritional value. Also, different parts of the groundnut can be utilized for different purposes, such as, groundnuts leaves, which provide good-quality roughage after the crops was harvested. Groundnut haulms constitute approximately 45% of the total plant biomass and provide excellent forage for livestock (Özyiĝit and Bilgen, 2013).
Higher quantities of chemical fertilizers have been used in our country since the 1970s and the rapid growth of agricultural fertilizer has played an irreplaceable role in promoting the development of agricultural production, but there are many problems. With the transition to the intensive agriculture and the use of higher doses of fertilizers it became necessary to create new varieties able to use superior quantities of nutrients (Iancu et al., 2019b). Excessive introduction of chemical fertilizer not only results in a great waste of resources, but also increases the risk of environmental pollution. It is therefore necessary to limit the use of fertilizers and synthetic chemical pesticides because of the harmful effect on the environment (Soare et al., 2018).
The intensive application of the synthetic fertilizing substances determines the decrease of the organic matter content in the soil, the base of its fertility. The application of humic acids and fulvic acids at optimum concentrations can be an alternative to chemical fertilization, with an effect on plant growth and development, as well as changing the bioavailability of nutrients in the soil. These products and methods of fertilization are modern technologies with a positive impact both economically and on the environment.
Organic fertilizers take the place of the chemical. Dinu et al. (2017) showed that the tomatoes cultivated in ecological system and fertilized in vegetation with the Folicist organic product had a good quantitative and qualitative yield.
The intensification of agriculture has conducted a critical point where the negative impact derived from this activity are now resulting in

irreversible global climate change and loss in many ecosystems, and one alternative solution maybe the use of plant biostimulants based on humic substances (Canellas et al., 2015).

The application of humic and fulvic acids at optimal concentrations can be an alternative to chemical fertilization, with an effect on plant growth and development, as well as changing the bioavailability of nutrients in the soil. These products and methods of fertilization are modern technologies with a positive impact both economically and on the environment.

Many studies conducted both in the open field and in the laboratory have provided experimental evidence on the beneficial action of humic substances (HS) on plant growth. In recent years, research has focused on the use of humic acids as foliar fertilizers in various crops: tomatoes (Dinu et al., 2015; Dinu et al., 2013), melon (Soare et al., 2018), cabbage (Soare et al., 2017), vines and sunflower (Pârvan et al., 2013), sugar beet, maize and sunflower (Sîrbu et al., 2016). Yield components as well as quality parameters of sweet potato tubers grown into biocyclic humus soil were determined in comparison with tubers grown conventionally and shoed significant increases (Eisenbach et al., 2018).

The purpose of this study was to compare the influence of classical complex fertilizers and extra foliar fertilization with the Humusoil product on the morphological and productivity characteristics of groundnuts cultivated in the conditions of southern Romania.

MATERIALS AND METHODS

Yield potential and some yield elements evaluation of groundnuts was conducted at Tâmburești Research Station of University of Craiova, Romania, located at latitude of 44°1'40" N, longitude 23°56'9" E, and 52 meters above sea level, on sandy soil. The quantity of humus is low (0.3-0.5%). The sands are very poor in nitrogen and phosphor and mediocre supplied with potassium (0.03-0.05% total nitrogen; 2-5 mg/100 g soil phosphor assimilable and approximately 12 mg/100 g soil assimilable potassium).

The experiment was carried out during 2015-2017 and has the aim to study the influence of foliar fertilization with Humusoil upon groundnut crop. Humusoil is a natural organic growth stimulator produced from Leonardite of plant origin 100% and contain 12.5% humic acid and 2.5% fulvic acid. The sow was made at the beginning of May, at a distance of 50 cm between rows and 20 cm between plants/row. Biological material was sowed after randomized block design with three replicates.

In this experience, the technological sequences specific to groundnut crop were applied. Humusoil was applied in 3 stages: at the vegetative growth, at flowering and at pods formation.

The analyzed characters were: pods yield, efficiency, total number of pods/plant, percent of total mature pods/plant, average weight of 1000 pods and average weight of 1000 seeds.

The experiment included two factors. The graduations of A factor (A_1 and A_2) were considered: fertilization type. First graduation A_1-normal fertilization of soil with NPK complex fertilizers (20:20:0), 200 kg/ha and the second graduation A_2 - same fertilization of soil and three extra leaf fertilization with Humusoil, 2 l/ha. B factor (genotype) had 6 graduations (6 genotypes): Tâmbureşti, Virginia B, Argentine, Jelud, Solar and Venus.

From the combination of the two factors resulted the next variants:

A factor	B factor	A x B
A_1 200 kg/ha NPK fertilizers	Tâmbureşti	a_1b_1
	Virginia B	a_1b_2
	Argentine	a_1b_3
	Jelud	a_1b_4
	Solar	a_1b_5
	Venus	a_1b_6
A_2 200 kg/ha NPK fertilizers and extra Humusoil leaf fertilization	Tâmbureşti	a_2b_1
	Virginia B	a_2b_2
	Argentine	a_2b_3
	Jelud	a_2b_4
	Solar	a_2b_5
	Venus	a_2b_6

Statistical methods

Data were statistically analyzed and means were compared by least significant differences (LSD), $p \leq 0.05$ (Ciulcă, 2006).

Correlation analysis and coefficients were compare after Pearson significance values and Principal component analysis (PCA) was performed based on the analyzed indices. Both correlation and PCA were performed by IBM SPSS Version 2011 and MS Office Excel 2016.

RESULTS AND DISCUSSIONS

The number of pods that are formed by a plant is an important element of yield and of these the mature pods have an important role.

As concern the influence of A factor (fertilization), except for the character percent of total mature pods/plant, in all other characters the average values registered at graduation A_2 have significant differences compared with the average values registered at graduation A_1.

Regarding the number of pods character, it showed small amplitude of variation for both the fertilized variants and for the additional fertilized variants with the Humusoil product.

It is noted also that the variants fertilized in addition to the product Humusoil showed an increase in the percent of mature pods, so it can be seen that the product Humusoil had a positive effect on the processes of fruiting and maturing of groundnuts. In the case of percent of total mature pods/plant, no statistically significant difference was identified between the two average values recorded for the two factors graduations (Table 1). In a similar experiment analysis of yield indicate that the mean of the irrigated variants recorded significant differences compared to the average of non-irrigated variants and drought can lead to a substantial decline in yield, but this reduction depends on genotype (Iancu et al., 2019a).

Table 1. The influence of factor A on the studied characters

Value / A / Graduation	Pods yield (kg/ha)	Efficiency (%)	Total number of pods/plant	Total mature pods/plant (%)	Weight of 1000 pods (g)	Weight of 1000 seeds (g)
A_1	2237.278^{b}	63.38^{b}	16.63^{b}	72.09^{ns}	568.17^{b}	403.94^{b}
A_2	2580.909^{a}	67.20^{a}	18.88^{a}	75.81^{ns}	599.52^{a}	426.04^{a}
LSD 5%	122.89	1.53	0.44	8.99	14.95	10.93

Values represent the mean in the same column followed by different superscript letters are significantly different at $p \leq 0.05$

Regarding the influence of factor B (genotype), in the case of pods yield kg/ha, the highest results are obtained by the genotypes Solar and Venus, which have significant differences compared to all other genotypes analyzed. The last classified genotype is Argentine, which shows significant negative differences compared to 4 of the 6 analyzed genotypes (Table 2).

Concerning efficiency character, the best results are obtained by the Argentine, Jelud and Tâmburești genotypes, which record positive differences compared to the other three genotypes, between them there are no statistically significant differences.

In case of total number of pods/plant character, the best results are recorded by the genotypes Argentine and Venus, which record positive differences compared to the other four genotypes, between them there are no statistically significant differences.

Regarding the analysis of the percent of total mature pods/plant character, no statistically appreciated differences were recorded.

Regarding the average weight of 1000 pods/plant character, the best results are obtained by the genotypes Virginia B, Solar and Venus, which register significant differences compared to the other three genotypes, between them there are no statistically appreciated differences. The accumulation of biomass is intense in groundnut plants, especially in July and August, which is corresponding to the formation and maturation of pods (Iancu et al., 2014b).

Concerning average weight of 1000 pods character, the average values recorded by the first two genotypes, respectively Solar and Venus, obtain significant differences compared to all the other average values recorded. Also, they differ significantly in value, the last one being the Tâmburești genotype.

Fertilizers and variety represents adequate agricultural practices to increase yield to groundnut crop (Iancu et al., 2019b).

In the case of analysis of the interaction of the two factors, concerning the pods yield, the best results are obtained from the genotypes Solar and Venus at the A_2 graduation (2884.24 kg/ha pods yield respective 2895.45 kg/ha pods yield), the values recorded by them differing significantly from all the other values, in general, at the foliar fertilization the genotypes registering superior results compared with the basic fertilization (Table 3).

Table 2. The influence of factor B on the studied characters

Value / B Graduation (genotype)	Pods yield (kg/ha)	Efficiency (%)	Total number of pods/plant	Total mature pods/plant (%)	Weight of 1000 pods (g)	Weight of 1000 seeds (g)
Tâmburești	2354.39^{bc}	67.64^{a}	17.10^{b}	74.43^{ns}	484.10^{c}	300.52e
Virginia B	2499.06^{b}	61.64^{c}	15.69^{c}	68.50^{ns}	672.17^{a}	334.66^{d}
Argentine	2036.12^{d}	67.22^{a}	19.69^{a}	76.15^{ns}	444.53^{d}	353.28^{c}
Jelud	2103.80^{cd}	67.93^{a}	17.70^{b}	76.01^{ns}	527.62^{b}	439.06^{b}
Solar	2734.39^{a}	62.75^{bc}	17.17^{b}	73.73^{ns}	684.87^{a}	525.00^{a}
Venus	2726.79^{a}	64.56^{b}	19.20^{a}	74.62^{ns}	689.77^{a}	537.41^{a}
LSD 5%	212.86	2.64	0.76	15.57	25.89	18.93

Values represent the mean in the same column followed by different superscript letters are significantly different at $p \leq 0.05$

Some authors in there researches with groundnuts cultivated on sands reported 2359 ka/ha pods yield, applying nitrogen fertilizer in dose of N90 on two occasions, the first at sowing, the second in vegetation (Dima et al., 2013).

Other studies indicate that yield is also influenced by the type of fertilization and irrigation and non-irrigation, being until 2020.95 kg/ha pods yield (Iancu et al., 2019b). Humidity is a key factor of the groundnuts crop technology, the presence or absence of this factor influencing other factors such as nitrogen fertilization (Iancu et al., 2015).

The increase of yield and its components according to adding organic fertilizer may provides nutrient rich in organic carbon for the microbial biomass which converts unavailable nutrient in plant residues to one's available (Zaki et al., 2017).

It can say that groundnut yield is influenced by many factors: genotype, fertilization, irrigation or non-irrigation and also by drought. Pod yield in some genotypes decrease in drought conditions, reduced number of pods and height of plants (Soare et al., 2016).

Regarding the efficiency, the best result is recorded by the genotypes Tâmburești, Jelud, Argentine and Venus on the A_2 graduation.

In the case percentage of total pods/plant, the best results are obtained by the most productive genotypes at the A_2 graduation, while the last classified variants are found in the A_1 graduation at the genotypes with the lowest biological potential.

Regarding the percent of total mature pods/plant, there was no statistical difference, that is, not only that the single action of the two factors does not influence this index, but also the interaction of the two does not influence this character.

The average weight of 1000 pods reaches the highest values by the variants of the Solar and Venus genotypes at A_2 graduation, while the lowest values are registered at the A_1 graduation by the least productive genotypes. In others studies, moderate doses of nitrogen increases the number of pods/plant and phosphorus, potassium and especially irrigation, have contributed in making a larger number of seed/plant (Iancu et al., 2014a).

In the case of average weight of 1000 seeds, the highest values are recorded in the genotypes with the highest productive potential at graduation A_2, while the lowest values are also found in the genotypes weakly productive at graduation A_1.

Table 3. The influence of A and B factors interaction on the studied characters

Value / a_ib_i	Pods yield (kg/ha)	Efficiency (%)	Total number of pods/plant	Total mature pods/plant (%)	Weight of 1000 pods (g)	Weight of 1000 seeds (g)
a_1b_1	2186.67^{fgh}	65.75^{bcdf}	15.98^{f}	72.89^{ns}	469.29^{gh}	325.11^{fg}
a_1b_2	2302.67^{de}	59.80^{g}	14.01^{g}	66.43^{ns}	654.77^{d}	427.50^{d}
a_1b_3	1868.00^{h}	65.58^{cdf}	18.90^{b}	74.05^{ns}	434.11^{h}	292.75^{h}
a_1b_4	1923.67^{gh}	66.22^{abcd}	16.69^{def}	74.66^{ns}	514.51^{ef}	344.10^{ef}
a_1b_5	2573.33^{bcd}	60.73^{g}	16.30^{ef}	72.08^{ns}	666.19^{cd}	510.83^{c}
a_1b_6	2569.33^{cd}	62.22^{fg}	17.91^{bc}	72.39^{ns}	670.17^{bcd}	523.34^{b}
a_2b_1	2522.12^{cd}	69.53^{ab}	18.21^{bc}	76.75^{ns}	498.92^{fg}	344.20^{ef}
a_2b_2	2695.46^{ab}	63.48^{dfg}	17.38^{cd}	70.57^{ns}	689.57^{abcd}	450.63^{d}
a_2b_3	2204.24^{efgh}	68.85^{abc}	20.49^{a}	78.25^{ns}	454.95^{h}	308.29^{gh}
a_2b_4	2283.94^{def}	69.65^{a}	18.70^{b}	77.37	540.74^{e}	362.46^{e}
a_2b_5	2895.45^{a}	64.77^{df}	18.03^{bc}	75.38^{ns}	703.55^{ab}	539.16^{ab}
a_2b_6	2884.24^{a}	66.91^{abcd}	20.48^{a}	76.85^{ns}	709.37^{a}	551.48^{a}
LSD 5%	301.03	3.73	1.07	22.02	36.63	26.76

Values represent the mean in the same column followed by different superscript letters are significantly different at $p \leq 0.05$

Regarding the influence of Humusoil treatment on average weight of 1000 seeds/plant, it is observed that the additional fertilized variants with two doses, achieved higher values for this character in all experienced genotypes.
Chemical fertilizers along irrigation ensure high yield increases (Iancu et al., 2014b). Nitrogen fertilizer is an important factor in achieving better growth and development of vegetative and reproductive organs of groundnut and sequently the yield components (Awadalla and Abbas, 2017).
Regarding the analysis of the variation of the correlation coefficients for the studied characters in the variants resulting from the AxB interaction, in the case of pods yield, very significant values of the coefficients were identified in the case of average weight of 1000 pods and respectively in the case of average weight of 1000 seeds (Table 4).
The efficiency character, records very significant values in the case of correlations with total number of pods/plant, percent of total mature pods/plant and average weight of 1000 pods.
Related to total number of pods/plant, this records a very significant value in the case of correlation with the percentage of total mature pods/plant.
Also, the average weight of 1000 pods is in very close correlation with the character average weight of 1000 seeds, a fact proved by the very significant value of the correlation coefficient.

Table 4. Correlation coefficients variation for the studied characters on the analyzed variants in the case of A x B interaction

Specification	Pods yield (kg/ha)	Efficiency (%)	Total number of pods/plant	Percentage of total mature pods (g)	Weight of 1000 pods (g)
efficiency	-0.130				
total number of pods/plant	0.220	0.725***			
percent of total mature pods/plant	0.068	0.902***	0.873***		
average weight of 1000 pods	0.798***	-0.589***	-0.160	-0.389*	
average weight of 1000 seeds	0.851***	-0.480**	0.011	-0.189	0.949***

P 5%=0.325, P1%=0.418, P 0.1%=519

Regarding PCA analysis, the first two components account for 93.708% of the total version, of which the first component registers 55.797 and the second component 37.910% (Table 5).

Table 5. Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	3.348	55.797	55.797	3.348	55.797	55.797	2.846	47.438	47.438
2	2.275	37.910	93.708	2.275	37.910	93.708	2.776	46.270	93.708
3	0.218	3.641	97.349						
4	0.091	1.512	98.860						
5	0.060	1.001	99.861						
6	0.008	0.139	100.000						

Extraction Method: Principal Component Analysis

Regarding the analysis of the first component, positive values record for pods yield and efficiency, this component can be considered as high biological yield potential of producing pods and peanuts with high weight (Table 6).
For the second component, positive values are recorded for efficiency, total number of pods/plant and percent of total mature pods/plant so this component can be considered as high biological potential of producing a high number of mature pods/plant and with high efficiency.

Table 6. Character Component score Method: Principal Component Analysis - 2 components extracted

Character	Component	
	1	2
pods yield (kg/ha)	0.938	0.168
efficiency (%)	-0.348	0.898
total number of pods/plant	0.130	0.934
total mature pods/plant (%)	-0.086	0.977
weight of 1000 pods (g)	0.934	-0.309
weight of 1000 seeds (g)	0.974	-0.132
Extraction Method: Principal Component Analysis		

The first group consists of 2 variants that have both positive components, these variants being: a_2b_6 and a_2b_5. This group is characterized by the fact that there are the genotypes with highest yield potential on A_2 graduation and has the highest values for pods yield, average weight of 1000 pods and average weight of 1000 seeds (Figure 1) and high value for the other characters.

The second group consists of 4 variants respectively a_1b_2, a_1b_5, a_1b_6, and a_2b_2, variants having the first component positive and the second negative. Characteristic for this group is that it is the group with the highest yield potential after the first group. Also, this group has high value for average weight of 1000 pods and average weight of 1000 seeds.

The third group consists of 2 variants respectively a_1b_1 and a_1b_4, variants that have both negative components. Characteristic for this group is that it has the lowest values for pods yield and total number of pods/plant and low value for average weight of 1000 pods and average weight of 1000 seeds.

The fourth group consists of 4 respective variants a_1b_3, a_2b_1 a_3b_3, a_2b_3 and a_2b_4, variants having the first negative component and the second positive. Characteristic for these groups is the fact that it has high value for efficiency, total number of pods/plant and percent of total mature pods/plant and low value for pods yield, weight of 1000 pods and weight of 1000 seeds. Results obtained previously indicate the possibility of using peanut cultivars with medium but stable yields for cultivation and those with higher but fluctuating yields as sources of breeding genes (Soare et al., 2011).

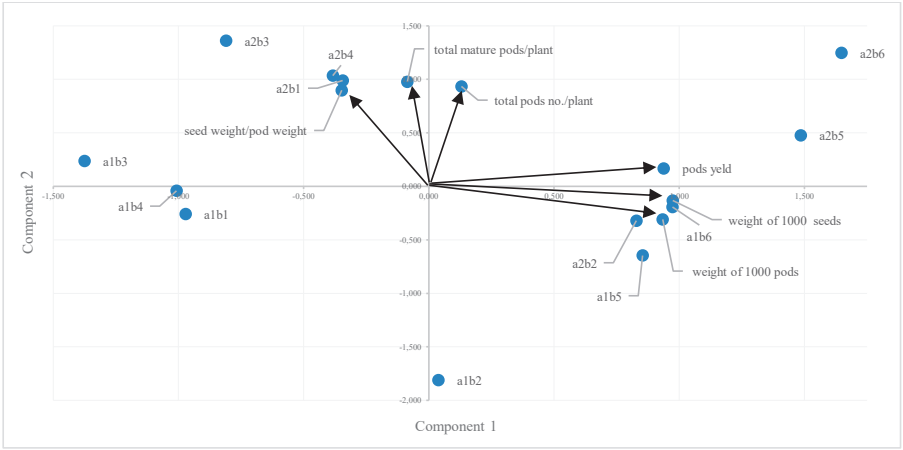

Figure 1. Distribution of the analyzed variants by groups according to PCA analysis

CONCLUSIONS

Concerning the influence of A factor (fertilization), except for the character of percentage of total mature pods/plant, in all other characters the average values registered at graduation A_2 have significant differences compared with the average values registered at graduation A_1.

Regarding the influence of factor B (genotype), in the case of pods yield, the highest results are obtained by the genotypes Solar and Venus, which have significant differences compared to all other genotypes analyzed. The last classified genotype is Argentine which shows significant negative differences compared to 4 of the 6 analyzed genotypes.

In the case of analyzing the interaction of the two factors on the most studied characters, the best results are obtained on the A_2 graduation. The percent of total mature pods/plant character is the only character that wasn't influenced by the two analyzed factors or by the interaction of those ones.

Regarding the analysis of the variation of the correlation coefficients for the studied characters in the variants resulting from the A x B interaction there were calculated statistical values coefficient for the next cases:

- between efficiency and total number of pods/plant, percent of total mature pods/plant, average weight of 1000 pods and average weight of 1000 seeds;
- between total number of pods/plant and percent of total mature pods/plant;
- between percent of total mature pods/plant and average weight of 1000 pods;
- between average weight of 1000 pods and average weight of 1000 seeds.

Regarding the PCA analysis, the first component had positive values record for pods yield, average weight of 1000 pods and average weight of 1000 seeds, so this component can be considered as high biological yield potential of producing pods and groundnuts with high weight. For the second component, positive values are recorded for efficiency, total number of pods/plant and percent of total mature pods/plant, so this component can be considered as high biological potential of producing a high number of mature pods/plant and with high efficiency. The four groups that resulted from the PCA analysis were the next: the group with both positive components has 2 variants (a_2b_6 and a_2b_5), the second group with first component positive and the second one negative consists of 4 variants respectively a_1b_2, a_1b_5, a_1b_6, and a_2b_2, the third group with both negative components consists of 2 variants respectively a_1b_1 and a_1b_4 and the fourth group with first component negative and the second one positive consists of 4 respective variants a_1b_3, a_2b_1 a_3b_3, a_2b_3 and a_2b_4. Based on all these characteristics and traits studied, it can be noted that the extra application of Humusoil product had favorable effects on the genotypes of groundnuts cultivated on sandy soil from South of Romania.

REFERENCES

Awadalla, A.O., Abbas, M.T. (2017). Peanut (*Arachis hypogaea* L.) yield and its components as affected by N-fertilization and diazotroph inoculation in Toshka desert soil-South Valley-Egypt. *Environ Risk Assess Remediat., 1*(3), 40–46.

Canellas, L.P., Olivares, F.L., Aguiar, N.O., Jones, D.L., Nebbioso, A., Mazzei, P. et al. (2015). Humic and fulvic acids as biostimulants in horticulture. *Scientia Horticulture, 30*(196), 15–27.

Ciulcă, S. (2006). *Experimental methodologies in agriculture and biology*. Agroprint Publishing House, Timişoara.

Dima, M., Croitoru, M., Drăghici, R. (2013). Research on application of NPK fertilizers in peanuts grown on sandy soils. *Scientific Papers. Series A. Agronomy*, *LVI*, 223–225.

Dinu, M., Soare, R., Dumitru, M.G. (2017). The effect of organic fertilization on fruit production and quality of tomatoes grown in the solar. *Annals of the University of Craiova, Agriculture, Montanology, Cadastre Series*, *47*(2), 112–118.

Dinu, M., Dumitru, M.G., Soare, R. (2015). The effect of some biofertilizers on the biochemical components of the tomato plants and fruits. *Bulgarian Journal of Agricultural Science*, *21*(5), 998–1004.

Dinu, M., Soare, R., Dumitru, M.G. (2013). Effect of the humic acids and their combination with boron and polyphenols extracted from the seeds of *Vitis vinifera* to culture of tomatoes in solar. *Annals of the University of Craiova, Series Biology*, *XVIII*(LIV), 157–163.

Iancu, P., Păniţă, O., Soare, M. (2019a). Response of some new wheat genotypes to nitrogen fertilization and prospects of yield breeding based on yield elements. *Romanian Agricultural Research, 36*(1), 1–9.

Iancu, P., Păniță, O., Soare, M. (2019b). Evaluation of Drought Tolerance Indices and Nitrogen Fertilization for Some Groundnut (*Arachis hypogaea* L.) Genotypes. *Agricultural Science, 1*(1), 18–29.

Iancu, P., Păniţă, O., Soare, M., Bonciu, E., Soare, R. (2015). Humidity and Nitrogen Dose Influence on Yield Capacity of Some Groundnut Genotypes in Southern Oltenia. *International Multidisciplinary Scientific GeoConference Surveying Geology and Mining Ecology Management*, SGEM I, 443-450.

Iancu, P., Soare, M., Matei, G. (2014a). Experimental results concerning the influence of fertilizers and x rays upon quantity and quality of groundnuts yield, in

irigated conditions, on sands. *Annals of the University of Craiova-Agriculture, Montanology, Cadastre Series, 43*(1), 161–165.

Iancu, P., Soare, M., Matei, G. (2014b). The influence of chemical fertilisers and soil upon the crop formation to groundnuts and the correlation with the phenomenon of withering. *Annals of the University of Craiova-Agriculture, Montanology, Cadastre Series*, *44*(1), 107–112.

Özyiĝit, Y., Bilgen, M. (2013). Forage potential of some groundnut (*Arachis hypogaea* L.) cultivars. *Romanian Agricultural Research*, *30*, 57–63.

Pârvan, M.D., Sîrbu, C., Cioroianu, T. (2013). Fertilizer with humic substances. *Romanian Agricultural Research*, *30*, 205–211.

Sîrbu, C., Cioroianu, T., Bireescu, G., Grigore, A., Stănescu, A., Rujoi, B., Burtan, L., Mărin, N., Mihalache, D., Iancu, M., Dumitrașcu, M., Nicu, E. (2016). Fertilizers with Humic Substances - Development and Characterization of New Products. *Lucrări Ştiinţifice, Seria Agronomie*, *59*(2), 257–260.

Soare, M., Iancu, P. (2011). Selection indices used to groundnut for choosing the initial material of breeding by irradiation. *Annals of the University of Craiova, Agriculture, Montanology, Cadastre Series, XLI*(2), 231–236.

Soare, M., Iancu, P., Matei, Gh. (2016). Drought and its influence upon groundnut crop. *SGEM 16th International Multidisciplinary Scientific Geoconference. Advances in Biotechnology*, *6*(1), 517–524.

Soare, R., Dinu, M., Băbeanu, C. (2017). The influence of foliar fertilization with humic acids on the production of White Cabbage. *Annals of the University of Craiova, Agriculture, Montanology, Cadastre Series, 47*(2), 246–252.

Soare, R., Dinu, M., Băbeanu, C., Soare, M. (2018). The influence of alternative technological sequences on the quality of melon production. *Scientific Papers. Series B. Horticulture*, *LXII*, 477–483.

Zaki, N.M., Hassanein, A.M.S., Mohamed, M.H. (2017). Effect of organic and bio-fertilizer on yield and some chemical composition of two peanut cultivars under newly reclaimed sandy soil condition. *Middle East Journal of Applied Sciences*, *7*(4), 937–943.