STUDIES REGARDING THE BEHAVIOR OF SOME CHINESE PEANUT VARIETIES GROWN ON SANDY SOILS FROM SOUTHERN OLTENIA

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Abstract. Peanut culture can be considered as one of the most advantageous and cost-effective crops, taking into account the production results that can be obtained and the many fields of use of the obtained harvest. In our country, given the importance of peanuts in human nutrition and in some compartments of the industry, cultivated areas with peanuts should be on the increase. The growing demands on the variety of products that can be obtained from this plant and their quality will in the near future contribute to the expansion of the areas to be cultivated with this plant within the limits of a profitable economic efficiency. From the assortment of Chinese varieties, the highest yields of pods were recorded in the Origin China 2 (3690 kg / ha) with a yield of 657 kg / ha compared to the control variety, in the Ning variety with 3571 kg / ha, in the variety Origin China 1, with 3238 kg / ha.

Keywords: genotype, sandy soils, production, peanut.

Rezumat. Studiul privind comportarea unor genotipuri de arahide chinezești cultivate pe solurile nisipoase din sudul Olteniei. Cultura de arahide poate fi considerată ca una dintre cele mai avantajoase şi mai rentabile culturi, ţinând seama de rezultatele de producţie ce se pot obţine şi de multiplele domenii de folosinţă ale recoltei obţinute. În ţara noastră, având în vedere importanţa pe care o prezintă arahidele în alimentaţia oamenilor şi în unele compartimente ale industriei, suprafeţele cultivate şi producţiile de arahide ar trebui să se regăsească în continuă creştere. Cerinţele tot mai mari faţă de diversitatea de produse ce se pot obţine de la această plantă şi faţă de calitatea acestora vor contribui în viitorul apropiat la extinderea suprafeţelor ce se vor cultiva cu această plantă, în limitele unei eficienţe economice profitabile. Din sortimentul de soiuri chinezeşti cele mai ridicate producţii de păstăi s-au înregistrat la soiurile Provenienţă China 2 (3690 kg/ha) cu un spor de 657 kg/ha faţă de soiul martor, la soiul Ning cu 3571 kg/ha, la soiul Provenienţă China 1 cu 3238 kg/ha.

Cuvinte cheie: genotip, soluri nisipoase, producție, arahide.

INTRODUCTION

The groundnuts (*Arachis hypogaea* L.) are annual vegetables which are also known as peanuts, earthnuts, monkeynuts and goobers. It is the 13th most important food crop and 4th most important oilseed crop of the world. Groundnut seeds contain 40-50% fat, 20-50% protein and 10-20% carbohydrate. Groundnut seeds are a nutritional source of vitamin E, niacin, folacin, calcium, phosphorus, magnesium, zinc, iron, riboflavin, thiamine and potassium. Groundnut kernels are consumed directly as raw, roasted or boiled kernels or the oil extracted from the kernel is used as culinary oil. They are also used as animal feed (oil pressings, seeds, green material and straw) and industrial raw material (oil cakes and fertilizer). These multiple uses of the groundnut plant make it an excellent crop for domestic markets as well as for foreign trade in several developing and developed countries. Cultivated groundnuts originate from South America (WIESS, 2000). It is one of the most popular and universal crops cultivated in more than 100 countries in six continents (NWOKOLO, 1996). It is grown on 25.2 million hectares with a total production of 35.9 million metric tons (FAO, 2006). Major groundnut growing countries are India (26%), China (19%) and Nigeria (11%). Major groundnut producing countries are: China (40.1%), India (16.4%), Nigeria (8.2%), U.S.A (5.9%) and Indonesia (4.1%). In our country, given the importance of peanuts in human nutrition and some compartments of the industry, areas cultivated with peanuts should be on the increase (NEDELCU, 1995).

Peanut culture can be considered one of the most advantageous and most profitable crops, taking into account the production results that can be obtained from the many fields of use of the obtained harvest (DIMA, 2014; DIMA et al., 2014).

Peanuts contribute to the superior utilization of sandy soils in our country, due to reduced requirements for soil fertility, low fertilizer and water consumption, soil enrichment in nitrogen fixed symbiotic (POP et al., 1986). In the area of sandy soils in southern Oltenia, peanuts find favorable ecopedological conditions for growth and fructification, conditions that allow for the good cultivation of this species, occupying, in the framework of agricultural crops specific to sandy soils, the place of the leguminous improvement (MITREA, 1993).

MOZINGO (1987) emphasized both the role of both variety and technology in groundnut yield, concluding that, in order to obtain high yield, productive varieties have to be used and the adequate cultivation technology must be applied.

In order to know the behaviour of some foreign peanuts varieties and for the most valuable ones to be promoted in production and as initial breeding material, these Chinese varieties were introduced at the Dăbuleni Research- Development Station for Field Crops on Sandy Soils.

MATERIAL AND METHODS

The research carried out in 2014-2016 at the Research- Development Station for Field Crops on Sandy Soils of Dăbuleni followed the behaviour of some Chinese peanut varieties from a productive and qualitative point of view so that the most valuable ones could be recommended for culture on sandy soils.

The experiment used the randomized block method.

The studied biological material was represented by 8 genotypes of Chinese peanuts that differ from each other in different characters alongside the Romanian Dăbuleni variety used as a witness: Early China, HYY 1, HYY 2, HYY 3, Origin China 1, Origin China 2, Ning, Henan Province.

During the vegetation period and harvest, observations and determinations were made regarding:

- the percentage of plants growing up;
- the percentage of plants matured;
- plant height;
- number of shoots/plant;
- type of growth;
- pigmentation of the strain;
- the number of root nodules;
- the number of pods matured;
- the production of pods.

Also, physiological aspects such as dry matter content, vacuolar juice concentration, photosynthesis rate, sweating rate were determined in the genotypes studied. The realization of the peanut culture in the experiment was done using the peanut cultivation technology on the sandy soil elaborated by the Research-Development Station for Plant Growing on Sands of Dăbuleni. The results obtained from the researches performed were statistically processed by the variance analysis method (SĂULESCU N. A. & SĂULESCU N. N., 1967).

RESULTS AND DISCUSSIONS

Groundnut is essentially a tropical plant and requires a long and warm growing season. The favourable climate for groundnut is a well-distributed rainfall of at least 500 mm during the crop-growing season, and with abundance of sunshine and relatively warm temperature. A temperature in the range of 25 to 30º C is optimum for plant development (WEISS, 2000).

Temperature was identified as a dominant factor for controlling the rate of development of groundnut (COX, 1979). Every crop has its cardinal temperatures base, optimum and maximum temperatures.

The climatic elements during the period 2014-2016 recorded at the meteorological station of Research-Development Station for Plant Culture on Sands of Dăbuleni, which had a particular influence on peanut culture during their vegetation period are presented in tables 1 and 2.

Table 1. Air temperatures recorded at the meteorological station of Dăbuleni.

Temperature (°C)/period		April	May	June	July	August	September
Decade I	Minimum	1.7	8.4	10.9	13.0	16.5	11.8
	Maximum	24.1	26.0	32.3	35.2	36.1	33.6
	Average	12.2	15.8	20.6	24.0	25.4	22.1
Decade II	Minimum	2.8	7.8	13.8	13.8	12.6	11.0
	Maximum	28.0	27.6	35.5	36.2	36.7	33.1
	Average	13.7	17.0	22.5	24.0	24.0	20.3
Decade III	Minimum	3.0	9.4	12.4	15.7	12.4	6.9
	Maximum	24.5	30.8	33.6	36.9	36.1	25.2
	Average	14.2	19.8	21.7	24.7	22.1	16.4
Monthly average		13.4	17.5	21.6	24.2	23.8	19.6

From the thermal point of view, during the sowing-sunrise period, average temperatures between 14.2 – 17 °C were recorded, favourable for seed germination (Table 1).

Groundnut is drought tolerant, and to some extent it also tolerates flooding. A rainfall of 500 to 1000 mm will allow commercial production, although crop can be produced on as little as 300 to 400 mm of rainfall. Groundnut thrives best in well-drained sandy loam soils, as light soil helps in easy penetration of pegs and their development and their harvesting.

DULVENBOODEN et al. (2002) reported that groundnut production in Niger is significantly determined by rainfall during July to September.

The importance of rainfall distribution to groundnut yield is well appreciated, but experimental evidence is poorly documented (ONG, 1986). SIVAKUMAR & SHARMA (1986) analysed drought stress or soil moisture deficit

in all the growth phases of groundnut during three growing seasons and observed that stress from emergence to pegging gave increased yields over control in all the three years while stress in other stages decreased the yield.

The amount of rainfall during the vegetation period was 434.7 mm, unevenly distributed over the vegetation period. The highest average rainfall was recorded in September (96.1 mm) (Table 2). During the maximum consumption, the amount of precipitation was completed by irigation.

Table 2. Rainfall during the growing of groundnuts.

Month/Decade	April	May	June	July	August	September
Decade I	15.3	35.6	22.3	15.8	11.3	37.9
Decade II	27.0	31.2	46.3	27.7	12.3	29.6
Decade III	41.5	24.5	24.5	12.6	3.4	28.6
Monthly amount	83.8	91.3	93.1	56.1	14.3	96.1

The emergence of plants was almost uniform and staggered over short periods of time. The water balance in the soil during the vegetation period of the bedding was completed by irrigation.

In most situations, peanuts should rise in 7-14 days after planting, depending on soil temperature. (NAVARRO, et al., 1989).

The percentage ranges from 85% emerged plants (variety Dăbuleni) and 95% (Chinese varieties). There is an increase in the percentage of emerged plants of varieties grown in Chinese variants with large grains (Origin China 1, Origin China 2).

Not many plants were lost during the vegetation period, the percentage of the dead plants ranging between 0 and 7%.

The plant strains showed differences in the varieties, being different according to the genotype, with values ranging from 22 cm to the Origin of China 1 variety and 42 cm to the Ning variety. The lowest plant height of 21.6 cm was recorded in the Dăbuleni witness variety.

The number of shoots per plant is variable, oscillating between 4.6 for Origin China 1 and 5.3 for Henan Province variety. A large number of shoots on the plant also showed the genotypes HYY 2 (5.2), Origin China 2 (5.0), compared to the Dăbuleni witness variety, which recorded 4.8 shoots / plant.

About 30 days after emergence, peanut plants begin to produce flowers. Flower numbers will continue to increase until the plant reaches peak bloom at about 60 to 70 days after emergence, and then flower development will begin to decline. High temperature, moisture stress and low humidity can have a severe impact on the flowering response, limiting the number of flowers produced and reducing flower pollination (BEASLEY, 1990).

As for biological properties, the first flowers appear depending on the sowing date and on the climatic conditions of the sowing period. Blossoming started 30-35 days after emergence and continued throughout the summer until mid-August.

Table 3. Observations and determinations of Chinese peanut genotypes.

Variety	Type of growth	Pigmentation of the stem	Plant height		Number of shoots/ plant	
			(cm)	The difference from the witness	No.	The difference from the witness
Dabuleni (witness variety)	Erect	Absent	21.6	(witness)	4.8	(witness)
Early China	Erect	Absent	27.5	+5,9 *	4.8	-
HYY 1	Erect	Absent	25.5	+3,9	4.8	-
HYY 2	Erect	Absent	24.5	+2,9	5.2	+0,4
HYY 3	Erect	Absent	31.0	+9,4 **	4.8	-
Origin China 1	Decumbent	Absent	22.0	+0,4	4.6	-0.2
Origin China2	Decumbent	Absent	24.0	+2,4	5.0	+0,2
Ning	Erect	Absent	42.0	+20,4***	4.8	-
Henan Province	Decumbent	Absent	23.0	+1,4	5.3	+0,5
LSD 5% =			5,7		0,74	
LSD 1% =			7,8		1,02	
LSD 0,1% =			10,8		1,4	

Being a leguminous plant, peanuts form nodules in their roots where bacteria grow from the Rhizobium genius to fix atmospheric nitrogen. (SCHIFTMAN, & ALPER, 1968).

The biometric determinations of the number of root nodules shows, for all the studied peanut genotypes, a maximum level of symbiotic activity in the flowering-fruiting phase.

Analysing the results obtained and presented in table 4, we can estimate the maximum number of nodosities that are formed in the flowering-fruiting phase, highlighting the genotypes HYY 3, Shulamith (68.2 nodosities), HYY 2 (65.8 nodosities), Early China (62 nodosities).

In the maturation phase, bacterial activity in the soil is reduced and most of the nodosities are resorbed. It is observed in this phase that the HYY 3 variety has the highest number of nodosities (10.0) compared to the other varieties, followed by Dabuleni (witness variety) with 9.5 nodosities (Tables 3, 4).

Table 4. Characteristics of the root system of peanut varieties and lines studied.

Variety	Number of nodules / root					
	Before flowering		Flowering-fruiting		Maturity	
	Value	The difference from the witness	Value	The difference from the witness	Value	The difference from the witness
Dabuleni	24.0	(witness)	53.3	(witness)	9.5	(witness)
Early China	26.4	+2.4	62.0	+8.7 ***	5.8	-3,7 oo
HYY-1	25.0	+1	56.0	+2.7	6.8	-2.7 o
HYY-2	22.5	+1.5	65.8	+12.5 ***	5.3	-4.2 ooo
HYY-3	24.0	-	68.2	+14.9 ***	10.0	+0.5
Origin China 1	27.2	+3.2 *	58.6	+5.3 *	6.0	-3.5 oo
Origin China 2	24.3	+0.3	51.2	-2.1	7.5	-2.0
Ning	31.3	+7.3 ***	50.7	-2.6	5.4	-4.1 oo
Henan Province	25.8	+1.8	60.3	+7 **	4.4	-5.1 ooo
LSD 5% =		5.86		5.02		0.95
LSD 1% =		4.26		6.92		1.31
LSD 0,1% =		5.86		9.52		1.8

Analysing the resistance to drought, the physiological aspects of the studied varieties were determined, such as: dry matter content, vacuolar juice concentration, photosynthesis rate, transpiration rate.

Moisture stress also affects physiological characters like photosynthesis, stomatal conductance, leaf water potential, radiation and water use efficiencies, partitioning of dry matter (BOOTE & KETRING, 1990).

BHAGSARI et al. (1976) observed large reductions in photosynthesis and stomatal conductance as the relative water content of groundnut leaves decreased from 80 to 75% (due to moisture stress). SUBRAMANIAN & MAHESWARI (1990) reported that leaf water potential, transpiration rate and photosynthesis rate decreased progressively with increasing duration of water stress.

BLACK et al. (1985) recorded lower water potential and stomatal conductance when moisture stress was imposed. CLAVEL et al. (2004) reported that water deficit decreased leaf area index, relative water content and transpiration at about 3 weeks after the occurrence of water deficit at the soil level.

The accumulation of biomass is intense in peanut plants, especially in June-August, corresponding to the flowering-fructification phases.

The highest value of dry matter (31%) determined during the flowering was recorded at Origin China 1 variety, followed by HYY 1 variety (30%), Ning variety (24%). The concentration of the vacuolar juice is a reaction to adapt to stress conditions by increasing the osmotic pressure at the cellular level which diminishes the loss of water through transpiration. In this respect the following varieties stand out: Dăbuleni (witness) by 9%, HYY 1 (8.6%), China 1 (8.5%). Physiological processes have been influenced by climatic factors, the vegetation phase and the studied genotypes (Table 5).

Table 5. Physiological aspects of studied peanut genotypes.

Variety	Dry matter (%)		Vacuolar juice concentration (%)	
	Value	The difference from the witness	Value	The difference from the witness
Dabuleni	23	(witness)	9	(witness)
Early China	22	-1.0	8.2	-0.8
HYY1	30	+7.0 **	8.6	-0.9
HYY 2	25	+2.0	8.0	-1.0
HYY 3	22	-1.0	7.9	-1.1
Origin China 1	31	+8.0 ***	8.5	-0.5
Origin China 2	22.8	-0.2	8	-1.0
Ning	24	+1	8	-1.0
LSD 5% =		3.65		0.66
LSD 1% =		5.06		0.92
LSD 0,1% =		7.03		1.28

The photosynthesis rate (Table 6) was recorded, at 9 o'clock, between 12.3 micromoles $CO_2/m^2/s$ (at Dăbuleni variety) and 29.04 micromoles $CO_2/m^2/s$ (at HYY 1 variety); at 12 o'clock, between 13.04 micromoles $CO_2/m^2/s$ (at HYY2 variety) and 28.93 micromoles $CO_2/m^2/s$ (at Henan Province variety) and at 15 o'clock, between 13.6 micromoles $CO_2/m^2/s$ (at Dabubleni variety) and 28.21 micromoles $CO_2/m^2/s$ (at variety HYY1).

Peanuts love light and heat and have high values of the photosynthesis rate at midday. The maximum photosynthesis was recorded in the HYY 1 variety as compared to the Dabuleni variety with the lowest photosynthesis value. The varieties have responded differently to climatic conditions depending on the degree of adaptation to drought.

Table 6. Diurnal variation of photosynthesis (micromoles $CO_2/m^2/s$).

Variety	Rate of photosynthesis (micromoles $CO_2/m^2/s$)			Active radiation in photosynthesis (micromole/m^2/s)		
	9 o'clock	12 o'clock	15 o'clock	9 o'clock	12 o'clock	15 o'clock
Dabuleni	12.30	16.33	13.60	1183	1833	1833
Early China	13.07	28.51	16.34	1340	1846	1723
HYY1	29.40	21.45	28.21	961	1681	1782
HYY2	26.64	13.04	15.87	1480	1694	1844
HYY3	24.19	12.31	13.92	995	1653	1947
Origin China 1	14.58	18.70	21.40	1384	1790	1733
Origin China 2	14.57	28.29	16.32	1086	1748	1911
Ning	13.28	24.14	15.23	1338	1784	1921
Henan Province	24.45	28.93	19.60	1570	1880	1364

The foliar transpiration rate (Table 7) recorded the following values:

- at 9 o'clock values between 1.17 mmol $H_2O/m^2/s$ (Origin China 2) and 3.54 mmol $H_2O/m^2/s$ (Henan Province);
- at 12 o'clock values between 1.48 mmol $H_2O/m^2/s$ (Dăbuleni variety) and 7.92 mmol $H_2O/m^2/s$ (Ning);
- at 15 o'clock values between 1.34 mmol $H_2O/m^2/s$ (Dăbuleni variety) and 9.11 mmol $H_2O/m^2/s$ (Ning).

The varieties that reduce the rate of transpiration under the action of stressors better withstand the drought and consume less irrigation water. That is why we will choose to expand in the culture on sands, those varieties having productive photosynthetic potentials and reduced foliar transpiration. Sometimes, although the photosynthesis rate is high, assimilates are used for lush vegetation growths.

Table 7. Diurnal variation of foliar transpiration.

Variety	The foliar transpiration rate (mmol $H_2O/m^2/s$)		
	9 o'clock	12 o'clock	15 o'clock
Dabuleni	2.36	1.48	1.34
Early China	2.19	7.43	3.98
HYY1	1.90	7.26	5.72
HYY2	1.98	5.21	6.52
HYY3	2.78	4.63	7.24
Origin China 1	1.65	6.64	6.52
Origin China 2	1.17	6.82	8.10
Ning	2.49	7.92	9.11
Henan Province	3.54	7.36	4.36

Following the average production obtained during the period 2014-2016, the experience of Chinese peanut varieties highlights that the biological material had good behaviour and possibilities for the use of Chinese origins in the culture on the sandy soils of southern Oltenia, production achieved being over 2000 kg / ha. Table 8. Production results for studied peanut varieties (Table 8).

Variety	Number of mature pods / plant		Average production (kg/ha)	Relativ production (%)	The difference from the witness (kg/ha)
	Value	The difference from the witness			
Dabuleni	61.3	(witness)	3033	100	(witness)
Early China	32.6	-28.7	2709	89.3	-324
HYY1	27.3	-34	2504	82.5	-529
HYY2	55.6	-5.7	2658	87.6	-375
HYY3	46.0	-15.3	3041	100.2	+8
Origin China 1	63.6	+2.3	3238	106.7	+205
Origin China 2	38.0	-23.3 o	3690	121.6	+657 *
Ning	33.0	-28.3 oo	3571	117.7	+538 *
Henan Province	38.0	-23.3 o	2737	90.2	-296
LSD 5%=		20.2			530 kg/ha
LSD 1%=		27.8			730 kg/ha
LSD 0,1%=		38.3			1000 kg/ha

The variant of cultivation of Origin China 2 stands out with a yield of 3690 kg / ha, with an increase of 657 kg / ha, significantly compared to the Dăbuleni witness variety, followed by the Ning varieties with a significant increase of 538 kg / ha compared to the Dăbuleni witness variety, Provenance China 1 (3238kg / ha).

The results show the possibilities they have peanut growers to obtain favourable production results using varieties from large areas of improvement and cultivation of groundnuts.

The quality of peanuts. The chemical composition of peanuts is characterized by a content of 20-30% protein and 45-60% fat (REHM & ESPIG, 1976). Peanuts are among the most valuable plants in terms of chemical composition of grains and especially of the main components. Peanuts have a high content of oleic acid and a lower linoleic acid content. They also contain arachidic acid, which, like linoleic acid, cannot be synthesized by the human body (MINCHEVICI & BORCOVSCHI, 1953). From the research by HAMMOUS (1973), the protein content in several varieties from different areas of culture showed that there is a wide variation in terms of protein content depending on the variety, namely between 22.75 and 29.3 %.

The results regarding the quality of peanut crop production reveal a protein content of 29% for the Origin China 2 variety and 35,1% for the Dăbuleni variety. A high protein content was also recorded in Origin China 1, HYY 2 variety, which recorded 34.4% and 32.6% respectively. Chinese varieties tested had a high fat content between 43.8% at Ning variety and 48% at Origin China 2 variety (Table 9).

Table 9. The main biochemical components of the grain in the investigated peanut varieties.

Variety	Protein (%)	Fats (%)
Dăbuleni	35.1	45.1
Early China	30.8	44.9
HYY 1	31.9	47.6
HYY 2	29.9	47.0
HYY 3	32.6	45.1
Origin China 1	34.4	44.2
Origin China2	29.0	48.0
Ning	31.6	43.8
Henan Province	30.7	45.5

CONCLUSIONS

In the sandy soils of southern Oltenia, all studied peanut genotypes find enough thermal resources necessary for growth, fructification and maturation.

Peanut crops can be considered as one of the most advantageous and cost-effective crops, taking into account the yields of production that can be obtained and the many utilized fields of harvest obtained.

From the Chinese assortment, the highest yields of pods were recorded in the Origin China 2 (3690 kg / ha) with an increase of 657 kg / ha compared to the witness variety, Ning variety with 3571 kg / ha, Origin China 1 variety with 3238 kg / ha.

The results on the quality of peanut production reveal a protein content of 35.1% for the Dăbuleni witness variety, followed by Origin China 1, HYY 2 with 34.4% and 32.6% respectively. Genotypes also experienced a high fat content of 48% for Origin China 2, 47.6% for HYY 1, 47% for HYY 2.

For cultivation on sandy soils the varieties with productive photosynthetic potential and reduced foliar transpiration will be chosen. At noon, the maximum of photosynthesis was recorded in HYY 1 (28.21 micromoles $CO_2/m^2/s$) and the lowest transpiration rate of 9.11 mmol $H_2O/m^2/s$ was recorded in the Ning variety.

REFERENCES

BEASLEY J. P. 1990. Peanut growth and development. *The Cooperative Extension Service*. The University of Georgia. SB: 23-33.

BHAGSARI A. S., BROWN R. H., SCHEPERS J. S. 1976. Effect of moisture stress on photosynthesis and some related physiological characteristics in peanut. *Crop Science*. Wiley Press. London. **16**(5): 712-715.

BLACK C. R., TANG D. Y., ONG C. K., SOLON A., SIMMONDS L. P. 1985. Effects of soil moisture on water relations and water use of groundnut stands. *The New Phytologist*. Wiley Press. London. **100**(3): 313-328.

BOOTE K. J. & KETRING D. L. 1990. Peanut. In Stewart, B. A. and Nielson, D. R. (eds.). Irrigation of Agricultural Crops. *Asa- Groundnut - A Global Perspective*. International Crops Research CSSA-SSSA, Madison: 12-28.

CLAVEL D., SARR B., MARONE E., ORTIZ R. 2004. Potential agronomic and physiological traits of Spanish groundnut varieties (*Arachis hypogaea* L.) selection criteria under end-of-cycle drought conditions. *Agronomy*. EDP sciences publishing. New York. **24**: 101-111.

COX F.R. 1979. Effect of temperature treatment on peanut vegetative and fruit growth. *Peanut Science*. American Peanut Research Press. New York. **6**(1): 14-17.

DIMA MILICA. 2014. *Peanut culture in the sandy soil area*. Sitech Publishing House. Craiova. 203 pp. ISBN 978-606-11-4706-9.

DIMA MILICA, DRĂGHICI I., DRĂGHICI RETA. 2014. Technology of peanut cultivation on sandy soils. *Technologies for cultivation of cereals, technical plants, forage plants and medicinal plants on sandy soils*. Sitech Publishing House. Craiova: 23-34.

DULVENBOODEN N. V., ABDOUSSALAM S., MOHAMED A. B. 2002. Impact of climate change on agricultural production in the Sahel-Part 2.case study for groundnut and Cowpea in Niger. *Climatic Change*. Kluwer Academic Publishers. Netherlands. **54**(3): 349-368.

HAMMOUS R. O. 1973. Origin and early history of the peanut, in Patte H. L. and Young G. T. *Peanut Science and Tehnology*. American Peanut Research and Education Society Inc. Yoakum Tex: 15-35.

MINCHEVICI A. I. & BORCOVSKI E. V. 1953. *Cultivation of oil plants*. Agrosilvica State Publishing House. Bucharest. 153 pp.

MITREA I. 1993. The use of ecological resources and the establishment of the main technological links for the increase of peanut production on the sands of southern Oltenia. *Thesis University of Agronomic Sciences and Veterinary Medicine*. Bucharest: 24-32.

MOZING R. W., COFFELT T. A., WYNNE J. C. 1987. Characteristics of Virginia-type Peanut Varieties Released from 1944-1985. *Southern Cooperative Series Bulletin*. Virginia. **326**: 18.

NAVARRO S. E., DONAHAYE R., KLEINERMAN I, HAHAM H. 1989. The influence of temperature and moisture content on the germination of peanut seeds. *Peanut Science*. American Peanut Research Press. New York. **16**(1): 6-9.

NEDELCU N. 1995. *Higher utilization of land through agricultural crops (peanuts)*. Agricultural Technical Publishing House. Bucharest. 85 pp.

NWOKOLO E. 1996. Peanut (*Arachis hypogaea* L.). *Food and Fee from Legumes and Oilseeds*. Springer Publisher. Boston: 49-63.

ONG C. K. 1986. Agroclimatological factors affecting phenology of groundnut. *Agrometeorology of Groundnut*. Publisher International Crops Research Institute For The Semi-arid Tropics. Niger: 115-125.

POP L., CHICHEA I., MARGHITU VALERIA. 1986. *Culture of Groundnuts (Peanuts*). Ceres Publishing House. Bucharest. 125 pp.

REHM S. & ESPIG G. 1976. Die Kulturpflanzen der Tropen und Subtropen. *Journal of Botanical Taxonomy and Geobotany*. Verlag Eugen Ulmer. Sttutgart. **88**: 138.

SĂULESCU N. A. & SĂULESCU N. N. 1967. *Câmpul de experienţă*. Edit. Agro-Silvică. Bucureşti. 155 pp.

SCHIFTMAN J. & ALPER Y. 1968. Effects of Rhizobium-inoculum placement on peanut inoculation. *Experimental Agriculture*. Cambridge Core Press. Cambridge. **4**(3): 203-208.

SIVAKUMAR M. & SHARMA P. S. 1986. Studies on Water Relations of Groundnut. *Agrometeorology of Groundnut*. Publisher International Crops Research Institute For The Semi-arid Tropics. Niger: 83-98.

SUBRAMANIAN V. B. & MAHESWARI M. 1990. Physiological responses of groundnut to water stress. *Indian Journal of Plant Physiology*. Crop Sciences. India. **33**(2): 130-135.

WEISS E. A. 2000. Oilseed Crops. *Blackwell Science*. London: 45-72.

***. FAO. 2006. *FAO Production Yearbook*. Rome. Italy. **60**.

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