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# INFLUENCE OF SOME AGROTECHNICAL FACTORS ON PHYSIOLOGICAL INDICES OF POTATO GROWN ON SANDY SOILS

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**ABSTRACT.** Less favorable conditions on sandy soils in southern Oltenia (Romania) limited number of species and varieties grown in the area. Drought and high temperatures in recent years have acted as forces dehydrated plants, disturbing their metabolism.Very high air temperature, relative humidity decreased to 25%, high surface temperature and lack of rainfall during the growing season, producing an imbalance of fluid balance in plante. Excessive foliar transpiration level can dehydrate plants, close osteoles and diminuted gas exchange in the process of photosynthesis. Irrigation plants can remove the stress factor action in the area, maintaining a positive fluid balance, that evaporated water is replaced by water traspiration administered by irrigation. On the sandy soils plant photosynthesis shows a depression at noon when the action is the maximum stress factors. Research early require selection of species with short growing season, to avoid atmospheric and soil drought in July and August. Potatoes meet these requirements, and research in the present study we aimed directing agrotechnical factors (variety, irrigation, fertilization) in order to obtain high yields and efficient, in economic terms.

**Key words**: Sandy soils; Fertilization; Potato; Photosynthesis.

**REZUMAT. Influența unor factori agrotehnici asupra unor indici fiziologici la cartoful cultivat pe soluri nisipoase.** Condițiile mai puțin favorabile de pe solurile nisipoase din sudul Olteniei limitează numărul speciilor şi soiurilor cultivate in zonă. Seceta şi temperaturile ridicate din ultimii ani au acționat ca forțe deshidratante asupra plantelor, perturbând metabolismul acestora.Temperatura aerului foarte ridicată, umiditatea relativă a aerului scăzută la 25%, temperatura la suprafața solului ridicată şi lipsa precipitațiilor în perioada de vegetație produc un dezechilibru al bilanțului hidric în plante. Transpirația excesivă la nivel foliar poate

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deshidrata plantele, închide osteolele şi diminua schimbul de gaze în procesul de fotosinteză. Irigarea plantelor poate înlătura acțiunea factorilor stresanți din zonă, menținând un bilanț hidric pozitiv, încât apa evaporată prin traspirație să fie înlocuită de apa administrată prin irigare. Pe solurile nisipoase, fotosinteza plantelor înregistrează o depresiune la amiază, când acțiunea factorilor stresanți este maximă. Cercetările impun selectarea unor specii extratimpurii, cu perioadă de vegetație scurtă, pentru a evita seceta atmosferică şi pedologică din lunile iulie-august. Cartoful îndeplineşte aceste cerințe şi, prin cercetările din lucrarea de față, s-a urmarit dirijarea factorilor agrotehnici (soi, irigare, fertilizare) în scopul obținerii unor producții ridicate şi eficiente, din punct de vedere economic.

**Cuvinte cheie**: soluri nisipoase; fertilizare; cartof; fotosinteză.

## INTRODUCTION

Research on the behavior of potato varieties and the influence of agrotechnical factors (irrigation and fertilization) were performed in potato growing areas (Chichea *et al.,* 1994; Berindei and Chichea, 1997; Draica, 1995; Chichea, 2000). Photosynthesis rate varies depending on the values of physiological parameters, and other characteristics of plants (Acatrinei, 1991).

Physiological parameters are determinants of plant physiological processes and are determined by internal and external factors. The intensity of photosynthesis is limited by the concentration of $CO_2$, temperature and light, lower early morning, evening and during cloudy days or in excess summer, the midday hours. Internal factors acting on photosynthesis, depending on the particular plant. Transpiration rate also varies depending on the values of physiological parameters and plant characteristics. Among the external factors that influence the process of photosynthesis and transpiration, photosynthetic active radiation action are important, incident on the leaf surface and air temperature. Photosynthetic active radiation induce their role in photosynthesis, and transpiration, by making photoactive opening stomata movements and increasing leaf temperature (Burzo *et al.,* 2004). Temperature, solar radiation with intensity, is the main external factor that influences the processes of photosynthesis and transpiration. Atmospheric and soil drought limited plant development metabolism, which fall in stress termohidric (Petcu, 2008).

## MATERIAL AND METHOD

In the present study sought to influence of diurnal variation agrotechnical on physiological indices in terms of climatic factors in the sandy soil. Agrotechnical factors studied were: variety, irrigation and fertilization doses of $N_{100}P_{50}K_{50}$, $N_{150}P_{75}K_{75}$, $N_{200}P_{100}K_{100.}$

Determinations made were made as follows: photosynthesis, the PRO LC device, sweat, with your PRO LC, RAF (photosynthetic radiation active), the LC PRO device, the amount of water and dry the leaves, by the gravimetric method, juice concentration cell by refractometry. Production of tubers was determined by weighing and reporting for each plot t/ha.

## RESULTS AND DISCUSSION

Research on the dynamics of air temperature showed an increase, beginning with the morning (8 clock), when values were recorded 24°C, then a slight increase in temperature at noon (12 clock), when they values of 34.5°C and a further increase in temperature at night (16 clock), when there were 37.5°C values.

Varieties studied from different ecological regions of Romania (Braşov, Târgul Secuiesc) or abroad. These varieties have reacted differently to the influence of climatic and agrotechnical factors apply. Diurnal variation of photosynthesis rate showed a maximum clock 10 registered with the value of 20.5 micromoles $CO_2$ in plants irrigated at 80% of the AWC (available water content) compared with those irrigated at 50% of the AWC, where values were lower photosynthesis rate, respectively 16.32 micromoles $CO_2$ (*Fig. 1*).

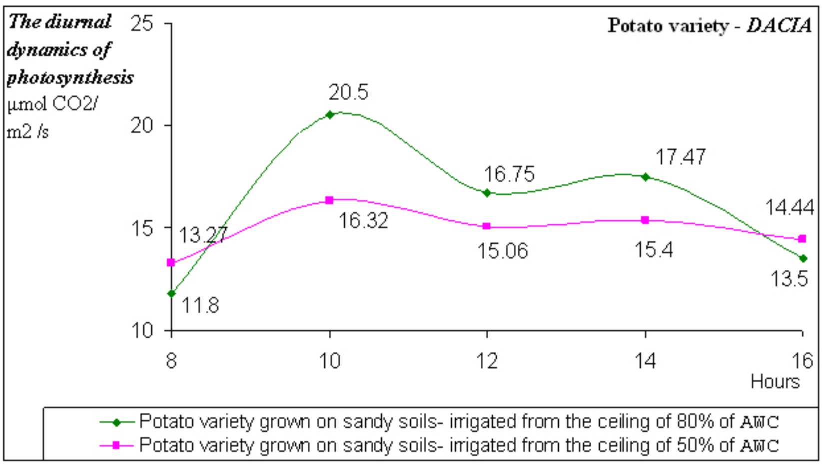


**Figure 1 - Changes in daytime photosynthesis of potatoes grown on sandy, irrigated from the ceiling of 80% and 50% of AWC**

At noon, the action of atmospheric and soil drought with air temperature and relative humidity decreased to 20% dehydration plant product and closing stomata, reducing photosynthesis rate.

Sweat maximum diurnal leaf recorded at 12, with 6.53 mmol $H_2O$ value in plants irrigated at 80% of the AWC, and 5.63 mmol $H_2O$ in plants irrigated at 50% of the AWC follows that irrigation of plants positively influence their metabolism.

Dacia variety reacted differently to the variety of soil moisture threshold, provided the irrigation plant. Irrigation of plants to 80% of the AWC has provided a good water supply plant, effectively exploiting the sweat evaporated water foliar

(*Fig. 2*). He established a positive correlation between transpiration rate and photosynthesis active radiation, where R2 0.77 and ranged between 0.81 (*Fig. 3*).

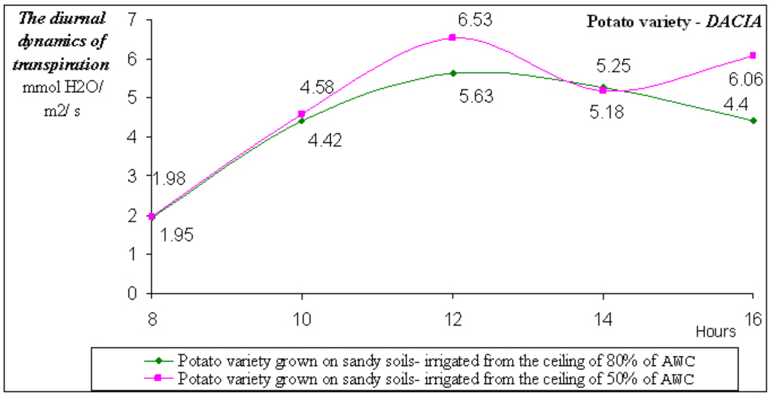


**Figure 2 - Diurnal variation of transpiration in potato grown on sandy, irrigated from the ceiling of 80% and 50% of AWC**

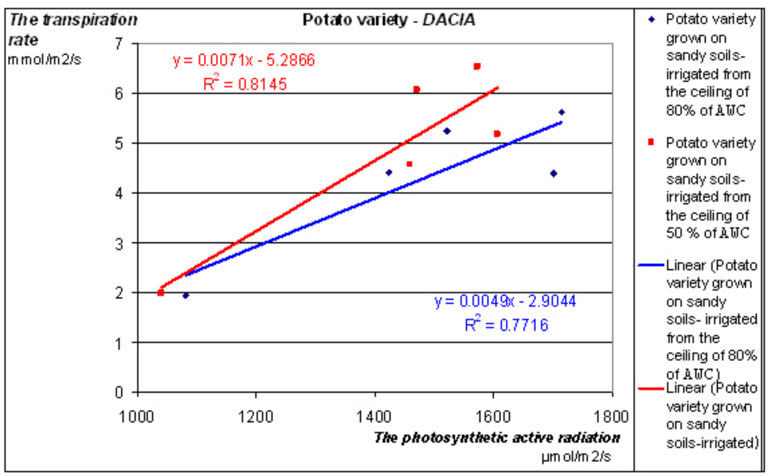


**Figure 3 - Correlation between transpiration rate and photosynthetic active radiation potatoes grown on sandy, irrigated from the ceiling of 80% and 50% of AWC**

Luiza variety showed maximum photosynthesis rate at 12, the value of 25.5 micromoles $CO_2$, the plants irrigated at 80% of AWC compared with those irrigated at 50% of the AWC, which recorded a value of 17.16 micromoles $CO_2$ (*Fig. 4*). It is noted that the variety. Luiza photosynthetic potential was higher than the Dacia variety grown under the same environmental conditions.

Sweat leaf diurnal variation had a maximum value at 12, 6.15 and 6.54 mmol range (*Fig. 5*). Water was evaporated by sweating more efficiently exploited in plants irrigated at 80% of the AWC, which was the maximum rate of photosynthesis.

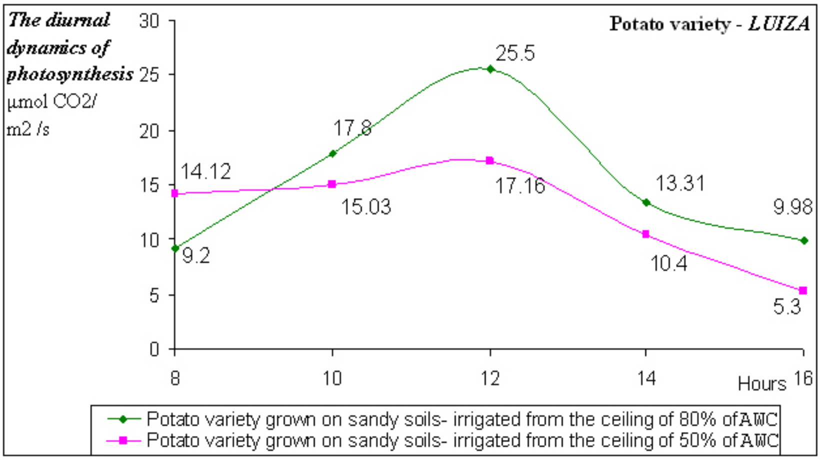


**Figure 4 - Diurnal variation of photosynthesis in potatoes grown on sandy, irrigated from the ceiling of 80% and 50% of AWC**

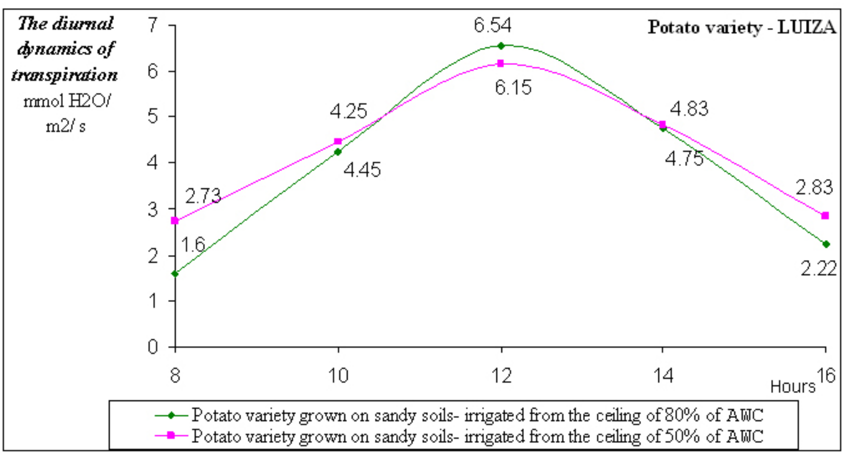


**Figure 5 - Change in daytime sweat potatoes grown on sandy, irrigated from the ceiling of 80% and 50% of AWC**

Table 1 - Influence of fertilization on photosynthesis (micromoles $CO_2$) for potatoes grown on sandy soils

| Variety | Photosyntesis, clock 8 | | | Photosyntesis, clock 12 | | | Photosyntesis, clock 16 | | |
|---|---|---|---|---|---|---|---|---|---|
| | A1 | A2 | A3 | A1 | A2 | A3 | A1 | A2 | A3 |
| Impala | 13,17 | **8,69** | 17,23 | **6,13** | 6,49 | **4,28** | 14,16 | 5,14 | 9,08 |
| Magic | 16,53 | 12,09 | 13,46 | **17,55** | 6,34 | 7,87 | **17,03** | **9,21** | 9,47 |
| Astral | 16,15 | 12,00 | **17,48** | 14,09 | 8,64 | 13,12 | 14,68 | **3,20** | 7,76 |
| Virgo | 16,63 | 14,41 | 9,49 | 15,84 | **21,09** | **13,82** | **5,94** | 3,71 | **12,53** |
| Tresor | **18,85** | 14,62 | 11,74 | 8,87 | 11,82 | 4,98 | 11,60 | 6,36 | 6,06 |
| Almera | **11,2** | 17,82 | **5,79** | 11,80 | **5,92** | 4,63 | 16,82 | 7,21 | **3,14** |
| Redsec | 17,49 | **22,58** | 14,7 | 10,32 | 9,33 | 4,66 | 14,01 | 5,05 | 24,11 |

A1- $N_{100}$ $P_{50}$ $K_{50}$; A2-$N_{150}$ $P_{75}$ $K_{75}$; A3-$N_{200}$ $P_{100}$ $K_{100}$

Table 2- Influence of fertilization on transpiration (mmol H2O/m2/s) for potatoes grown on sandy soils

| Variety | Transpiration, clock 8 | | | Transpiration, clock 12 | | | Transpiration, clock 16 | | |
|---|---|---|---|---|---|---|---|---|---|
| | A1 | A2 | A3 | A1 | A2 | A3 | A1 | A2 | A3 |
| Impala | 2,06 | 2,42 | 2,52 | 3,35 | 2,10 | 3,20 | 5,99 | **1,21** | 3,98 |
| Magic | 2,31 | 2,05 | 2,06 | **4,64** | 1,91 | 2,88 | **6,32** | **3,90** | 4,09 |
| Astral | 2,07 | 1,72 | 2,45 | **3,17** | **1,70** | **3,66** | 3,85 | 3,14 | 4,43 |
| Virgo | 2,17 | 2,18 | 2,12 | 4,12 | **4,76** | 3,55 | 3,91 | 1,72 | **5,78** |
| Tresor | **2,32** | 2,21 | **2,64** | 3,84 | 2,72 | **1,55** | 3,80 | 3,55 | **2,15** |
| Almera | 2,20 | **2,48** | 2,38 | 3,22 | 2,08 | 2,59 | **3,20** | 1,62 | 3,27 |
| Redsec | **1,74** | **1,46** | **1,87** | 3,67 | 2,14 | 2,05 | 3,23 | 2,51 | 5,33 |

A1- $N_{100}$ $P_{50}$ $K_{50}$; A2-$N_{150}$ $P_{75}$ $K_{75}$; A3-$N_{200}$ $P_{100}$ $K_{100}$

Table 3 - Influence of variety on production recorded at physiological maturity

| No. | Variety | Producțion of tubers Com.>35 mm | | Producțion of tubers <35 mm | | Total producțion of tubers | |
|---|---|---|---|---|---|---|---|
| | | t/ha | Ranking | t/ha | Ranking | t/ha | Ranking |
| 1 | Impala | 31.17 | BCD | 7.34 | CDEF | 38.52 | BCD |
| 2 | Magic | 30.22 | BCD | 6.75 | DEF | 36.98 | CD |
| 3 | Astral | 34.90 | AB | 7.34 | CDEF | 42.25 | ABC |
| 4 | Virgo | **42.49** | A | 4.62 | FG | **46.11** | A |
| 5 | Tresor | 29.39 | BCD | **3.08** | G | **32.47** | D |
| 6 | Almera | 35.73 | AB | 6.81 | DEF | 42.55 | ABC |
| 7 | Redsec | 34.78 | AB | 9.65 | BCD | 44.44 | AB |
| 8 | Ruxandra | 26.96 | CD | **15.41** | A | 42.36 | ABC |
| 9 | Cosmos | 35.91 | AB | 6.63 | EF | 42.55 | ABC |
| 10 | Tampa | 32.95 | BC | 11.44 | B | 44.38 | AB |
| 11 | Dumbrava | 26.71 | D | 8.05 | CDE | 32.77 | D |
| 12 | Dacia | **24.18** | D | 9.83 | BC | 34.01 | D |
| 13 | Mikel | 33.48 | BC | 11.61 | B | 45.09 | AB |
| 14 | Luiza | 29.51 | BCD | 12.62 | AB | 42.13 | ABC |
| **LSD 005** | | **7.738** | | **2.993** | | **7.312** | |

Potato plants fertilization is obligatory sandy soils that are very poor in humus. Doses of fertilizer used different metabolism influenced varieties studied.

Tubers accumulation phase (May), at 8, the rate of photosynthesis showed the following maximum values: 18.85 micromoles $CO_2$ Tresor variety, fertilized with a dose of $N_{100}P_{50}K_{50}$, 22.5 Redsec variety, fertilized with dose $N_{150}P_{75}K_{75}$, and 17.48 micromoles $CO_2$ Astral variety, fertilized with $N_{200}P_{100}K_{100}$ (*Table 1*).

It is noted that different varieties are metabolized doses of fertilizer used, depending on their physiological requirements. Magic variety consumed large amounts of NPK at this stage of vegetation.

During the day, at noon, has changed its level of use of chemical fertilizers, due to increased soil solution concentrations were absorbed more difficult in plants. At 12, the maximum photosynthesis rate were recorded Magic and Virgo varieties. The time between12-16 hours, photosynthesis rate decreased in all varieties, owing to increased atmospheric and soil drought.

Magic variety had a high rate of photosynthesis, $CO_2$ value of 17.3 micromoles and this time with a greater capacity to adapt to drought and reduced consumption of chemical fertilizers. Astral and Virgo varieties prefer high doses of chemical fertilizers, but also recorded higher production. *Figures 6 and 7* presents the influence of fertilizer doses on the rate of photosynthesis at Impala varieties, Magic, Almera and Astral.

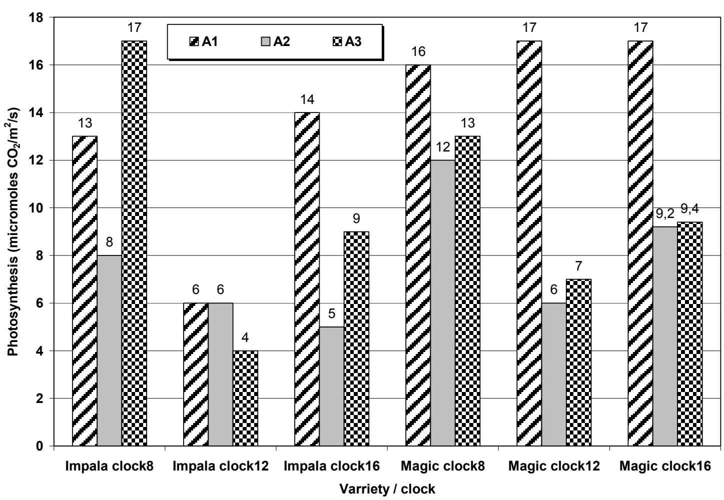


**Figure 6 - Influence of fertilization doses on the rate of photosynthesis in potato varieties Impala and Magic**

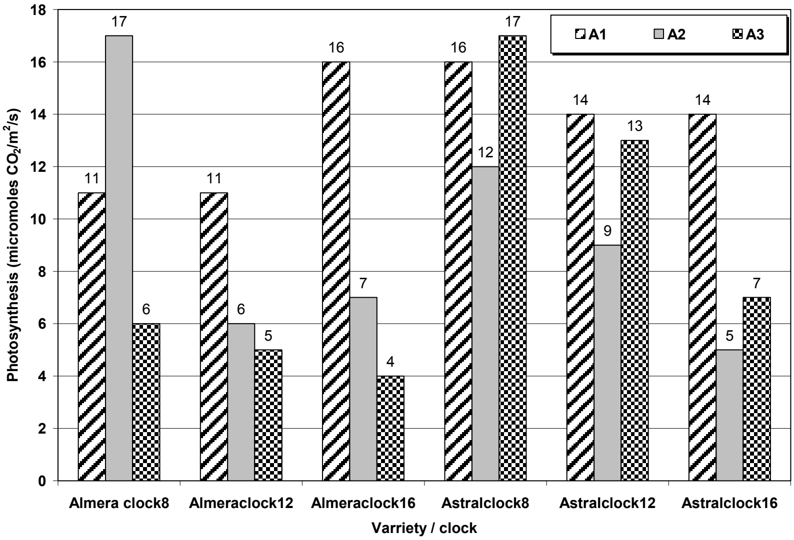


**Figure 7 - Influence of fertilization doses on the rate of photosynthesis in potato varieties Almera and Astral**

Foliar fertilization influenced and perspiration, which registered a morning low values, ranging between 1.46 mmol $H_2O$ to 2.64 mmol $H_2O$ variety Redsec and the variety Tresor, fertilized with $N_{200}P_{100}K_{100}$. At 12, leaf transpiration values increased in all varieties, ranging between 1.7 mmol $H_2O$ to 4.76 mmol $H_2O$ variety Astral and the variety Virgo, which recorded maximum at 16 with 5.78 mmol $H_2O$ value. Reduce their sweat leaf varieties for drought are more easily rise to stress termohidric. Increasing doses of NPK decreased absorption of water at the plant and reduced leaf transpiration intensity at 16 *(Table 2).*

Tubers production was influenced by agrotechnical factors apply. The main role in the production had variety. It shows, so that by cultivation under identical conditions, they are detached by their photosynthetic capacity and degree of adaptation to atmospheric and soil drought. Separating the production of tubers under state standards, is observed a high yield varieties and economic efficiency *(Table 3).*

Production of commercial tubers fluctuated between 24 t / ha in variety Dacia and 42 t/ha in variety Virgo. High yields were recorded and Impala varieties, Magic, Astral, Almera and Redsec. In some varieties, although there were higher total production (40 t/ ha), substandard tubers had high values (11-15 t/ha), for example Ruxandra, Tâmpa and Luiza varieties, reducing thus economic efficiency.

## CONCLUSIONS

Diurnal and meteorological factors influencing the metabolism agrotechnical potato plants grown on sandy soils.

Irrigation of plants to 80 % of AWC increased sweating rate and leaf photosynthesis in all varieties.

Sweat leaf presented a significant diurnal variation, being influenced by meteorological factors, the dose of fertilizer and moisture threshold. Some varieties have been diurnal maximum at 12, others at 16.

Photosynthesis rate showed maximum values in plants irrigated at 80% of AWC and fertilized with $N_{150}P_{75}K_{75.}$

Varieties Magic, Astral, Virgo, Almera production recorded between 29 and 42 t / ha.

Following the results of recommended varieties with high photosynthetic potential, tolerance to drought and high commercial production for their expansion in culture on sandy soil.

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