RESEARCH ON RELATIONSHIPS BETWEEN VIABILITY, MEMBRANE BIOCHEMICAL INDICES AND MITOSIS ACTIVITY IN WHEAT SEEDS

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Abstract

The purpose of this work was to evidence the role of the cell exudate and of the mitosis în studying of cell membrane modifications. There were analysed the seed exudate and mitosis activity values, as well as the correlations between these indices and seed viability in six different wheat seed samples. The results have indicated negative correlations significant for viability-conductivity (sugars efflux) and for viability-aberrant cells. Between viability and dividing cells were found positive correlations.

Key words: exudate, viability, mitosis.

Résumé

Le but de ce travail a été de mettre en évidence le rôle d'exudate cellulaire et de la mitose en l'étude des modificationes de la membrane cellulaire. Pour cela, on a été analysés les valeures des indices de l'exudate de la semence et de l'activité mitotique, ainsi que l'étude des corrélationes entre ces indices et la viabilité de semences au six échantillones différentes du blé. Les résultats obtenu ont indiqué les corrélationes negatives, significatives, pour viabilité-conductivité, viabilité-sucres et pour viabilité-pourcent de cellule aberrante. Entre la viabilité et le nombre de cellules en division on a trouvé corrélationes positives.

Mots clef: exudate, viabilité, mythose

Rezumat

Scopul lucrării de faţă a fost de a evidenţia rolul exudatului celular şi al mitozei în studiul modificărilor membranei celulare. Pentru aceasta, s-au analizat valorile indicilor exudatului seminal şi ale activităţii mitotice, precum şi studiul corelaţiilor dintre aceşti indici şi viabilitatea cariopselor la şase eşantioane diferite de grâu. Rezultatele obţinute au indicat corelaţii negative, semnificative, pentru viabilitate-conductivitate (respectiv eflux de zaharuri) şi pentru viabilitate-procent de celule aberante. Între viabilitate şi numărul de celule în diviziune s-au găsit corelaţii pozitive.

Cuvinte cheie: exudat, viabilitate, mitoza.

Introduction

Last decades, plant physiological and biochemical field researchers tried to find a relatioship between seed cells membrane modifications and the values of some biochemical indices. Thus, since 1969, Heydecker showed that accurate information concerning cell membrane modifications would obtain by means of seed exudate exploration.

The aim of this paper was to find a relationship between viability (germination power), exudate indices (conductivity, sugars and aminoacids efflux) and mitosis activity in root meristem tips from wheat seeds.

Materials and methods

The biological material was represented by wheat seed samples belonging to six local cultivars, whose viability is reproduced within parenthesis: W1 (91%); W2 (81%) W3 (56%); W4 (68%); W5 (34%); and W6 (87%).

For viability assessment there were used 50 seeds in 4 replicates for each sample (Anghel et al., 1959; Ellis et al., 1985). The distilled water, which imbibed a special filter paper put into Petri boxes, represented the germination medium. The germination temperature was 25°C, and the maximum test assessment duration was 7 days. There were considered germinated the seeds whose rootlets were at least 1 mm length.

The seed exudate electrical conductivity was evaluated by measuring this index on a Radelkis type conductmeter (Hosnedl et al., 1993). Thus the samples, containing each one 20 seeds (in 2 replicates), have been introduced into Berzelius tumblers with 30 ml distilled water and incubated at

25^{0}C (at darkness). After 5 hours, the distilled water, containing the seed exudate, was collected for measuring its conductivity. The results have been reported as μ S/g (μ mho/g), seeds being previously weighed.

The total sugars dosing in exsudate has been accomplished in 2 replicates of each 3 g, which were incubated in 7 ml distilled water at 25^{0}C (darkness conditions). After 5 hours there were dosed the total sugars, using a method based on reducing of picric to picramic acid by monoglucides (Schell, 1980). The results were expressed as μg sugars at 1g of seed.

For aminoacids exsudate dosing there was worked in 2 replicates, each one of 3,5 g seed and 5 ml distilled water, which were introduced în thermostat at 25^{0}C (darkness conditions). After 5 hours, it has dosed the free aminoacids in extract, using a micromethod relied on colour reaction between the aminoacids from exudate and ninhidrine reagent (Villegas and Mertz, 1975). The results were expressed as μg aminoacids at 1g of seed.

The mitosis activity was evaluated by means of Feulgen method (Raicu et al., 1983), allowing the cytological examination of the first meristem divisions in the root tips. There were investigated 1000 cells in 2 replicates (for each sample), and the result was expressed at 1000 examined cells, for the number of dividing cells, number of aberrant cells (percentage).

Results and discussion

The table 1 reproduces the mean values of viability and exudate indices in wheat seeds.

Table 1. Mean values of viability and exudate indices in wheat seed samples

Index Smple	Viability (G%)	Conductivity (μS/g)	Sugars efflux (μg/g)	Aminoacids efflux (μg/g)
W1	97	26,25	160,30	20,15
W2	90	20,07	215, 40	48,50
W3	86	19,87	248,55	78,45
W4	75	26,10	277,84	59,75
W5	65	25,14	286,20	59,62
W6	42	37,50	425,08	81,35

The greatest values of sugars and aminoacids efflux were registered in the sample with lowest viability (W6), whereas the least values of the same indices were found in the highest viability sample (W1). As to electrical conductivity, the lowest value was registered in a sample with a high viability (W3), and the greatest conductivity registered the same wheat sample with lowest viability (W6).

Figures 1-3 reproduces the correlations between viability, on one hand, and electrical conductivity (C), sugars (S), and aminoacids (A) efflux, on the other hand, in the six studied samples.

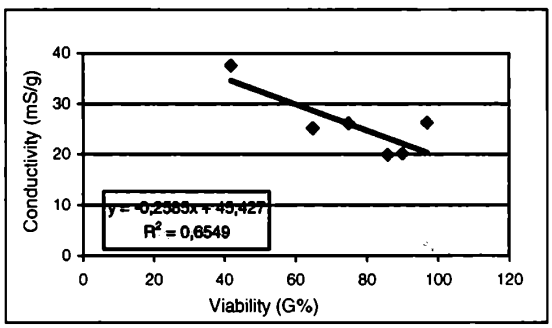

Fig. 1 Linear regression for the correlation between viability and conductivity

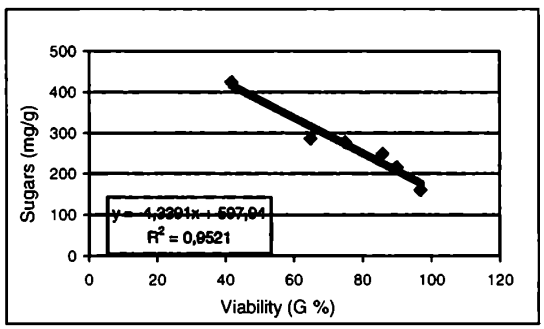

Fig. 2 Linear regression for the correlation between viability and sugars efflux

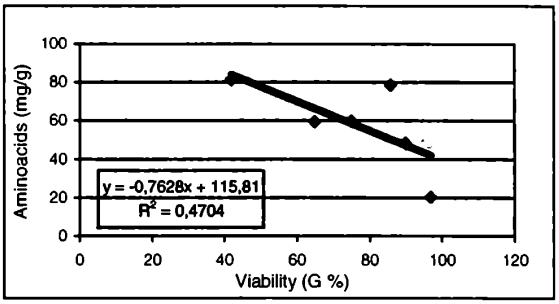

Fig. 3 Linear regression for the correlation between viability and aminoacids efflux

As seen, between viability (G) and electrical conductivity (C), sugars (S), and aminoacids (A) were found negative correlations, significant as to relationship G-C and G-S.

Beside sugars efflux and electrical conductivity, where one could establish an indirect and significant relationship between viability and these indices, in the case of aminoacids efflux was more difficult to find such a relationship, as seen in the fig. 3 (R^2=0,4704).

In the table 2 is rendered the number of dividing cells as well as the aberrant cell percentage, in the six wheat samples.

Table 2. The cell division dynamics in wheat samples

Indices Samples	Dividing cells (number)	Aberrant cells (%)
W1	120	0,5
W2	102	1,2
W3	110	0,9
W4	94	2,3
W5	96	3,0
W6	65	5,7

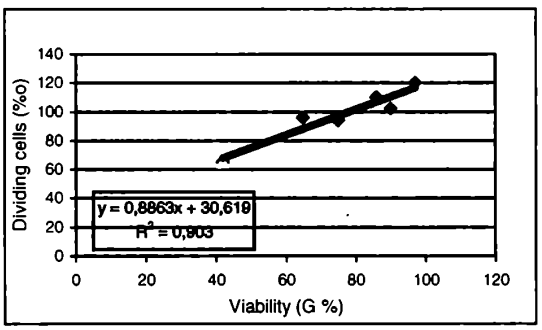

Fig. 4 Linear regression for the correlation between viability and dividing cells

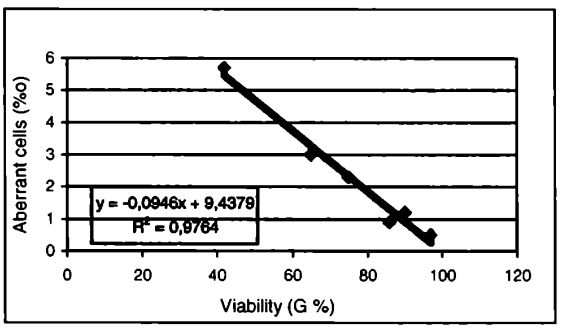

Fig. 5 Linear regression for the correlation between viability and aberrant cells

In the analysed samples, the most intense mitosis activities have been registered in W1, W2 and W3, where the viabilities have been higher too. The aberrant cells percentage ranged between 0,5% (W1) and 5,7% (W6).

Linear regressions for correlations between viability - dividing cells (fig. 4), and viabiliy - aberrant cells (fig.5) have evidenced a positive significant corerelation in the first case, and a negative significant correlation in the second one.

Conclusions

1. Analysing six wheat seed samples, with various viabilities, as to relationships between viability, on one hand, and conductivity, sugars, aminoacids efflux, and mitosis activity (in root meristem tips), on the other hand, were found negative correlations, significant for relationships viability-conductivity and viability-sugars efflux.

2. Between viability and mitosis activity were also found significant correlations, positive for relationship viability-dividing cells and negative for relationship viability-aberrant cells.

3. As other research on cereal seeds (Avramiuc et al., 1988; Avramiuc, 2003), this work evidences the role of cell exudate and mitosis activity indices in studying cell membrane modifications. An increase of sugars and aminoacids efflux values, as well as of electrical conductivity and aberrant cells number can indicate a certain degree of membrane deterioration and even a damage at genetical level.

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