

## **SOME BIOCHEMICAL AND PHYSIOLOGICAL ASPECTS OF RESPIRATION, DURING SENESCENT FABA BEAN SEEDS GERMINATION**

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### **Abstract**

*Four seed samples of different ages, belonging to one faba bean landrace, represented the biological material analysed as to respiration and peroxydase activity, during 168 hours of germination. In all studied samples, the respiration process evidenced the greatest values at 48 hours of germination, while the peroxydase activity registered a decreasing, mainly between 96 and 168 hours of germination, in older seed samples.*

**Keywords:** *faba bean, landrace, sample, peroxydase, respiration*

### **Introduction**

The seeds storage can lead, in time, to the loss of viability because of the action of some external and internal factors. Regarding the inner factors, the enzymatic activity and the respiration have a great importance. It seems that it is one direct relationship between loss of the seeds viability and reduction of the catalase, peroxydase (Davis, 1926) and decarboxylases activities (Grabe, 1964). The respiration proportionally increases to seed moisture content and temperature raising, leading to senescence (Harrington, 1963)..

Trying to find a relationship between enzymatic activity and respiration in some senescent seeds, this work analyses the peroxydase and respiration evolution during germination of four faba bean samples having different physiological ages.

### **Experimental**

Four seed samples, belonging to one faba bean landrace of Suceava Genebank seeds collection, were used as biological material. Some features of the samples, at the tests start date, are reproduced in the table 1.

**Table 1: Characteristics of the used biological material**

Samples	Storage period (years)	G (%)	WTG (g)	SMC (%)
MB	1	95	1040	12.434
B1	10	85	1044	12.032
B2	26	85	1032	11.266
B3	22	88	1053	13.243

G=germination percentage; WTG=weight thousand grain; SMC=seed moisture content

MB, having the greatest germination percentage (G) and stored in proper conditions (Suceava Genebank), was used as blank. Concerning germination, except the blank, it was 85-88% for seeds whose storage period varied between 10 and 26 years. Thousand grain weight and seed moisture content registered small differences between samples.

In order to estimate the germination percentage, 4 replicates of 50 seeds for each sample were achieved. Petri dishes, with special filter paper, have been used and medium of germination was the distilled water. The maximum term of the test evaluation was 10 days (Anghel et al., 1959; Ellis et al., 1985).

The peroxydase activity was investigated, according to a colorimetric method (Artenie and Tănase, 1981), at different times of germination, within 0-168 hours interval, and was expressed as IU/g DM.

The respiratory activity was assessed, according to Boysen-Jensen proceeding (Boldor, Raianu and Trifu, 1983), by measuring CO<sub>2</sub> released at different times of germination, within 0-168 hours interval, and was expressed as cm<sup>3</sup> CO<sub>2</sub>/g fresh material/h.

## Results and Discussions

Table 2 includes the peroxydase activity in faba bean samples during germination. Along the whole analysed interval, one can see an increasing of the enzymatic activity once with the germination time increasing, as well as significant differences between blank and the other samples. The lowest enzymatic values were found at 0 and 24 hours of germination, and the highest ones at 96 and 168 hours. Except 24 hours, at the other germination times the greatest peroxydase values were held by the blank (MP). Between samples with less viability (and older) there were differences too (B<sub>1</sub> versus B<sub>2</sub> and B<sub>3</sub>).

**Table 2:** The mean values of the peroxidase activity in faba bean seed samples, at different periods of germination

Peroxidase activity (IU/g DM)						
Time Samples	0 h	24 h	48 h	72 h	96 h	168 h
MB	7.41	6.97	23.67	18.54	31.04	30.60
B1	4.64	7.98	20.59	18.17	26.15	27.27
B2	5.43	4.67	17.07	15.53	28.02	22.03
B3	2.82	5.40	16.74	16.46	16.80	15.54

IU = international units; DM = dry matter

Working on caryopses of barley having different storage periods, MacLeod (1952) found an important reducing of the peroxidase activity mostly in caryopses older than 10 years.

The respiratory activity (table 3) has registered significant differences along the assessed interval - very low values at 0 and 24 hours and much higher ones, beginning with 48 hours of germination. For the four tested samples, 96 hours of germination represented the greatest respiratory mean value in the whole analysed cycle.

**Table 3:** Mean values of the respiration in the faba bean seed samples, at different periods of germination

Respiration activity (cm <sup>3</sup> CO <sub>2</sub> /g/h)						
Time Samples	0 h	24 h	48 h	72 h	96 h	168 h
MB	0.017	0.054	0.150	0.130	0.190	0.147
B1	0.019	0.066	0.144	0.130	0.190	0.160
B2	0.009	0.045	0.125	0.110	0.200	0.210
B3	0.016	0.049	0.126	0.090	0.200	0.192

During the first stages of germination, as a result of seeds imbibition and of the embryo cells hydration, the respiration, having as substratum the simple sugars in the reserve tissue (mainly cereals), increases very much. After 2-7 days, depending on species, the starch hydrolysis begins, and the respiration intensity, in this stage, depends on the rate of its hydrolysis (Peterfi and Sălăgeanu, 1972). It seems the differences between seeds, as to the water absorption or mitochondria activity (the latter one representing the respiratory enzymes centre) or the both, determine great differences between samples, regarding the respiration, because the ageing process does not reduce so much the respiration substratum (i. e. the sugars reserve), but especially its using efficiency (Heydecker, 1969).

Analysing and comparing the data of the both tables, one can better see the relationship between the peroxydase activity and respiration. Thus, at MB and B1, on the second part of the germination time (96-168 h), the peroxydase values increase, while the respiration values decrease. At B<sub>2</sub> and B<sub>3</sub> the same report is inverted.

### Conclusions

In four seed samples of different ages, belonging to one faba bean landrace, the respiration process, based on volume of CO<sub>2</sub> released, evidenced much greater value at 48 hours versus 0 and 24 hours of germination.

The peroxydase activity was more reduced in older seed samples than in blank, mainly between 96 and 168 hours of germination.

In some seeds, the rising of the respiration activity and the decrease of the peroxydase could cause the accumulation of a great amount of toxic produce.

### References

- Anghel, G., Raianu Maria, Matei, C., Bucurescu, N., Rădulescu, I., Anganu, I., Velea, C., (1959). *Determinarea calității semințelor*, Edit. Acad. R.P.R., București
- Artenie, V., Tănase Elvira, (1981). *Practicum de biochimie generală - Univ. " Al. I. Cuza " Iași*, 138-140
- Boldor, O., Raianu, O., Trifu, M., (1983). *Fiziologia plantelor. Lucrări practice*, Edit. Did. și Ped., București, 204-206
- Davis, W. E., (1926). The use of catalase as a means of determining the viability of seeds, Boyce Thompson Inst. Plant Res. Prof. Paper 1, 6-12
- Ellis, R.H., Hong, T.D., Roberts, E.H., (1985). *Handbook of Seed Technology for Genebanks*. International Board for Plant Genetic Resources, vol. II, Rome
- Grabe, D. F., (1964). Glutamic acid decarboxylase activity as a measure of seedling vigour, Assoc. Off. Seed Anal. Proc. 54, 100-108
- Harrington, J. F., (1963). The value of moisture resistant containers in vegetable seed packaging, Cal. Agr.Expt. Sta. Bul. 792, 15-18
- Heydecker, W., (1969). The "vigor" of seeds - a review, Proc. int. Seed Test. Ass., 34, 201-219
- Peterfi, St., Sălăgeanu, N., (1972). *Fiziologia plantelor*, Edit. did. și ped., București, 506-509