POSSIBILITIES FOR SELECTION OF GARDEN BEAN (*PHASEOLUS VULGARIS* L.) GENOTYPES TOLERANT TO HIGH TEMPERATURE. I. CHANGES IN CHLOROPHYLL FLUORESCENCE PARAMETERS.

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Introduction

Breeding of new varieties with higher temperature tolerance is one of the most promising ways for an increase of the bean productivity and make it cultivation more sustainable (Palomares et al., 1992; Genchev, 1995; Kleiner and Frett, 1996).

Under stress conditions, the photosynthetic apparatus (PSA) is one of the most sensitive components. The high temperature (HT) strongly influences parameters of the PS2 fluorescence emissions, therefore they may successfully used as criteria of assessment to stress tolerance (Goltsev et al., 1994; Briantais et al., 1996).

In the Institute of Horticulture and Canned Foods, Plovdiv is under way a breeding program in garden bean for searching of initial material tolerant to high temperature. Our preliminary investigations indicated that the changes in chlorophyll fluorescence parameters could be used as reliable criteria for temperature stress (Petkova et al., 2002).

Within the frames of this program the objective of our investigation was to establish the effect of high temperature on the PSA temperature stability of two garden bean accessions by changes in chlorophyll fluorescence parameters.

Materials and methods

During 2000 - 2001 two pot experiments took place. Two accessions of garden bean - cv. *Oreol* (bred in the Maritsa Vegetable Crops Research Institute, Plovdiv) and line *87201231* (from the gene pool of the Institute of Plant Genetic Resources, Sadovo), preliminary characterized as tolerant to high temperature were used. The plants were grown in a 5 l pots on soil-peat substrate in glasshouse at 25/18°C day/night±1°C.

The PSA temperature stability of investigated accessions were evaluated by changes in the chlorophyll fluorescence parameters F_o, F_m and F_v and their ratios at high temperature (35 and 40°C) compared with controls (22°C) measured by Plant Efficiency Analyzer MK2 (PEA) (Hansatech, UK). Whole plants were treated during the anthesis in thermostate, with duration of 90 min. Fluorescence parameters were registered in 30 replications, on intact, dark-adapted (for 30 min) fully developed leaves, illuminated with actinic light (>650 nm) with photon flux 1500 $\mu mol.m^{-2}.sec^{-1}$ for 15 s.The data were statistically processed by the common MS Excel software.

Results

The measured values of F_0, F_v and F_m and their ratios were compared in the control and HT experienced plants (Table 1). It is established that initial fluorescence level (F_0) increases under temperature stress (Schreiber and Berry, 1987; Briantais et al., 1996) and describe a loss of the excitation energy during its transfer from the pigment bed to RC of PS2 (Yordanov et al., 1997). Investigated accessions differed significantly by F_0 only in 40°C treatment.

Under mild stress the F_v/F_0 ratio, which is considered as an indicator for the electron transport chain state and effectiveness, remained practically unchanged in cv. *Oreol,* while in line *87201231* it decreased by 2,39% compared to the control. However, under a 40°C temperature stress, the ratio F_v/F_0 decreased by 13,15% and 8.1% in cv.*Oreol* and line *87201231,*

respectively to the controls.The ratio F_v/F_m, characterizing the potential effectiveness of PS2 have not been influenced under applied HT and its values maintained in normal limits (Bolhar-Nordenkampf et al., 1989).The core complex stability, expressed by the ratio F_0(control)/F_0(HT), showed the similar tendency.

Table 1. Chlorophyll fluorescence parameters in bean plants treated with high temperature (35°C and 40°C for 90 min). Values represent the means of two experiments ± SD, n = 30.

Variants	Fo	Fv/Fo	Fv/Fm
cv. *OREOL*			
Control	0.0420 ± 0.004	5.788 ± 0.654	0.850 ± 0.013
35° C	0.0410 ± 0.001	5.842 ± 0.119	0.854 ± 0.025
Control	0.0407 ± 0.002	6.052 ± 0.200	0.852 ± 0.013
40° C	0.0458 ± 0.003	5.256 ± 0.267	0.840 ± 0.020
Line *87201231*			
Control	0.0405 ± 0.002	6.068 ± 0.314	0.858 ± 0.006
35° C	0.0415 ± 0.002	5.923 ± 0.140	0.854 ± 0.004
Control	0.0402 ± 0.001	6.151 ± 0.177	0.859 ± 0.003
40° C	0.0412 ± 0.001	5.653 ± 0.158	0.848 ± 0.009

Conclusions

The results obtained showed that:

- The tested bean accessions cv.*Oreo*l and line *87201231* showed a tolerance to 35°C (for 90 min) temperature.
- HT affected the chlorophyll fluorescence parameters only just at 40°C for 90 min which could be used as screen-temperature in breeding for heat-tolerance of garden bean.
- In both bean accessions the HT effect was best expressed by the ratio F_v/F_0 (which supported the results of Yordanov et al.,1997 obtained for maize and sunflower plants).

Abbreviations: HT-high temperature; Fo-initial, Fv-variable, Fm-maximal chlorophyll fluorescence; PS - photosystem; PSA - photosynthetic apparatus; RC - reaction center(s).

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