# ABSTRACT

Soil water deficiency is the important reason of yield loss, its impact is increasing because of the changes in global climate. The probability of the onset of short ground frost and drought caused by insufficient rainfall in Poland is bigger during the spring. Also, temperature fluctuations and irregularity in the distribution of rainfall are increased during the spring. This is why the research focused on improvement of drought tolerance of the spring crops, including the legumes.

The aim of this work was to find a way to stabilize the yield of the legumes subjected to environmental stresses by the determination of the physiological and biochemical markers of plant tolerance to drought, minimalization of yield loss by changes in the structure of fruiting zone and use of biostimulators.

- The aim was accomplished by verification of the following hypetheses:
- Legumes have a yielding reserve; its mobilisation will increase the yield of plants subjected to stresses.
- Different fruiting zones are characterized by varied yielding effectivity.
- Removing of the apical part of stem (decapitation) causes increase of yield.
- Preconditioning of seed affects position of generative organs on plant and yield.
- Some physiological and biochemical parameters can be markers of plant drought tolerance.
- Active compounds applied during the flowering phase can mitigate drought effects and improve yield and, applied on seedlings, affect the position of the fruiting zone.
- Drought subjected to plants during seed filling phase is able to increase the tolerance to this stress of the progeny plants.

The research was performed on cultivars of pea, yellow, white and blue lupine, and soybean.

Yield was determined by measurements of number of flowers and pods, and yield components analysis (number and weight of seeds per plant, number of seeds per pod and weight of one thousand seeds).

The following were analysed: polyamines and phytohormones by HPLC, sugars, photosynthetic pigments and phenolics by spectrophotometry, permeability of membranes by conductometry, photosystem II activity by measurements of chlorophyll fluorescence parameters, and proteomic analyses by two-dimensional electrophoresis.

The research showed that seed humidification is a good method for improvement of yield of the pea cultivar Wenus and the yellow lupine cultivars Talar and Taper sown in cold soil.

The drought caused a strong increase in the content of cadaverine, putrescine, 1,6-diaminohexane and spermidine, while the content of spermine was decreased. The reaction of yellow lupine cultivars to drought was strong, as was the increase of polyamines content. Conversely, the reaction of pea cultivars to drought and the changes in polyamines content were weak. The link between changes in the polyamines content and decrease of yield of plants subjected to drought was shown.

The most effective stimulators of yielding of lupine and pea subjected to environmental stresses were ASAHI and ZEN, which act by increasing the number of seeds and their weight per plant as well as the number of seeds per pod. Three years average results for ASAHI were increased by 70% for lupine yield and by 5% for pea yield, whereas for ZEN they were 45% and 8% respectively. It means that both the stimulators are similar in their efficiency, whereas the strong differences were observed in reactions of different cultivars and species. The combinations of the both compounds were unfavorable, which means that their cooperation does not occur.

The biostimulators applied (by spray) before flowering were less efficient in comparison to the spray performed during the advanced phase of flowering.

The results show that valuable markers of drought stress tolerance are the concentration of polyamines and abscisic acid, and ratio of $^{13}C/^{12}C$ isotopes.

Drought subjected to maternal plants of blue lupine during seed formation and filling increases the tolerance to this stress of the next generation. This fact could be practically used by collecting the seeds formed during drought stress as they are more tolerant to this particular stress.