Depression and stress are associated with the loss of hippocampal dendritic spines of principal cells, contributing to hippocampal dysfunction. Hippocampal neuroplasticity mechanisms have the potential to mediate rapid mood change. Because pyramidal cell spine synapse remodelling vitally influences hippocampal activity, we hypothesize that major depression are associated with loss of hippocampal spine synapses. Recently, we have confirmed the validity of the new "synaptogenic hypothesis" of depression by demonstrating an inverse correlation between the number of synapses in limbic brain areas and the severity of depressive symptoms, both in animal models and in human beings. It is hypothesized that loss of synapses in depression is, at least partly, caused by prolonged stress and the resultant glutamate excitotoxicity, which could be prevented by antagonizing glutamate release in response to stress. In addition to their anxiolytic, anticonvulsant, muscle-relaxant, and sedative/hypnotic effects, benzodiazepines, such as diazepam, strongly inhibit glutamate release at high, pharmacological doses.

Postpartum depression is a serious clinical problem that affects approximately 10-15% of postpartum women during the six-month period following childbirth. Symptoms of postpartum depression are similar to those of a major depressive episode, exerting a severe impact on family functioning and mother-infant relations in this critical period of life.

To test our theory that remodeling of hippocampal spine synapses also occurs in postpartum depression, we utilized a rat pseudopregnancy model. Ovariectomized CD(SD) rats were subcutaneously implanted with continuous release pellets, providing pregnancy levels of estradiol and progesterone. After 21 days, the hormones were withdrawn and the ensuing week was considered as the postpartum period. "Pregnant" and "postpartum" rats were tested in the learned helplessness paradigm and the number of their hippocampal spine synapses estimated using electron microscopic stereology. Inescapable stress caused a severe loss of spine synapses in "postpartum" animals, while there were no synaptic changes in "pregnant" females. In line with synaptic alterations, performance of "pregnant" rats was significantly better in the active escape test compared to "postpartum" animals.

We can conclude that maintaining pregnancy levels of estradiol and progesterone prevents the synaptic and behavioral effects of inescapable stress, suggesting that the sudden decrease in ovarian hormone levels after childbirth plays a major role in predisposing to postpartum depression.

Our result presents a series of experiments, investigating whether diazepam is able to prevent helplessness and to protect synapses in the learned helplessness (LH) model of depression. Diazepam, when administered intraperitoneally to ovariectomized female CD(SD) rats dose-dependently decreased depressive symptoms in LH and demonstrated synaptoprotective effects in electrophysiological and morphological measurements.

These findings further support the synaptogenic hypothesis of depression and suggest that synaptoprotective treatment is able to antagonize the negative effect of stress on mood, which may be useful in the clinical management of patients with recurrent and/or treatment-resistant depression.

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Occurrence and importance of Aspergilli in agricultural products and clinical sources

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Aspergillus species are filamentous fungi which are widespread on agricultural products in subtropical and tropical areas of the world. Aspergilli are able to produce a range of mycotoxins, which can be harmful to animals or humans, including aflatoxins, ochratoxins, fumonisins and patulin. *Aspergillus flavus* is also an important pathogen of various cultivated plants including maize, cotton and peanut, and cause serious yield losses throughout the world. Since aflatoxin production is favoured by moisture and high temperature, *A. flavus* is able to produce aflatoxins in warmer, tropical and subtropical climates. According to recent studies, climate change accompanied by global warming affects the occurrence of fungi and their mycotoxins in our foods and feeds. A shift has recently been observed in the occurrence of aflatoxin producers in Europe, with consequent aflatoxin contamination in agricultural commodities in several European countries not facing with this problem before (Italy, Serbia, Slovenia, Croatia, Romania, Ukraine). Although aflatoxin contamination of agricultural products is not treated as a serious threat to Hungarian agriculture due to climatic conditions, these observations led us to examine the mycobiota and mycotoxin content of different agricultural products (wheat, maize, chili pepper, nut, etc.) collected from different locations in Hungary and Vojvodina. The surface-sterilized products were placed on selective media, and the isolated fungal strains were identified using morphological and sequence-based methods.

Aspergillus strains are among the most common organisms causing fungal keratitis in tropical and subtropical areas. The main risk factor for the infection is trauma by vegetable matter during agricultural activities. Among *Aspergillus* species, mainly *A. flavus*, *A. terreus*, *A. fumigatus* and *A. niger* have been isolated from fungal keratitis cases. During our study, 52 *Aspergillus* strains isolated from keratitis cases in South India were examined. Based on morphological studies, all isolates were classified to the *A. flavus* species. For the molecular identification, part of the calmodulin gene was amplified and sequenced. As a result, 46 isolates were identified as *A. flavus*, while four as *A. tamarii*, one as *A. terreus* and one was found to belong to the *A. pseudotamarii* species. That was the first case that *A. pseudotamarii*

was identified from a human infection. Antifungal susceptibility tests of clinical isolates were carried out using disc diffusion and E-test methods. The detected antifungal susceptibility values were mostly within the value ranges determined previously for *A. flavus* isolates, although the *A. pseudotamarii* isolate proved to be more susceptible to amphotericin B than either *A. flavus* or *A. tamarii*. Aflatoxin producing abilities of the isolates were tested in YES culture media, and determined by HPLC analysis. Most of the examined *A. flavus* isolates carry the MAT1 mating-type gene.

Further investigations of the genetic variability of the *A. flavus* isolates by UP-PCR, microsatellite analysis and mating-type locus gene (MAT) analysis, and aflatoxin producing ability testing using an ELISA method are in progress.

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The role of glutathione transferases in the stress tolerance of different plant species

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Physiological processes involved in detoxification have important role in agriculture (and so in plant biology), because plants are exposed to disadvantageous environmental conditions. Abiotic stressors, e.g. xenobiotics, heavy metals presented in the soil, and drought are able to launch the production of toxic by-products of metabolic processes (such as lipid peroxides) and harmful amount of reactive oxygen species in stress-exposed plants, which can cause reduced growth and decreased yields.

Glutathione transferases (GSTs) are a divergent enzyme family with two major *in vivo* detoxification functions in plants: conjugating toxic compounds with a glutathione molecule, thereby making them less harmful and promoting their compartmentalisation to the vacuole, and the glutathione-dependent peroxidase activity, which plays a role in maintaining membrane integrity under stress conditions. To examine the role of GSTs in the abiotic stress tolerance of different plant species, we used two experimental set-up.

First, two inbred lines of the cereal model organism *Brachypodium distachyon,* Bd21 and Bd21-3 were grown hydroponically, and were exposed to osmotic stress treatment for modelling drought stress. We observed the effects of osmotic stress to growth parameters, water status, enzymatic responses, and gene expression pattern of the plants. As results, we concluded that root growth of the *Brachypodium* lines differed (Bd21 had increased root growth, while it was reduced in Bd21-3). The water homeostasis of the two line were similar: both showed isohydric strategy during our experiments. We observed higher guaiacol peroxidase and glutathione transferase activities in line Bd21, and all examined enzymes showed induced activities during the osmotic treatment. For quantitative real-time PCR, six GST genes were selected based on our previous studies on wheat cultivars, expression data published in literature, and promoter sequence analysis. In line Bd21 we observed the induction of a wider range of genes under the osmotic stress, which indicates the importance of the selected genes in the detoxification process, and also suggests (according to the other parameters) that line Bd21 may be more tolerant to the applied osmotic treatment. In addition, we may conclude that both lines are highly resistant, compared to cereals previously studied in our research, so using *Brachypodium* lines for experimental purposes may give important results for cereal breeding.

Our other experimental system was equipped to examine the detoxification processes of bred poplar clones. Poplars (*Populus spp.*) are widely cultivated plants for their rapid growth and high biomass, and are increasingly used in scientific research as model organism of trees, and for phytoremediation purposes. Stress adaptation processes against heavy metals and osmotic stress were examined on three outstanding biomass producer poplar lines. Cuttings were grown hydroponically, and treated by copper, zinc, and polyethylene-glycol. We described the water potential of plants, the malondialdehyde content of shoots and roots, enzyme activities (guaiacol peroxidase, glutathione peroxidase, and glutathione transferase activities), amount of reactive oxygen (total intracellular ROS, superoxid radical) and nitrogen species (nitrogen oxide, peroxynitrite). Furthermore, we quantified the induction of ten transcripts, which probable are fundamental parts of the poplars stress adaptation processes. Among these were four glutathione transferases, two ABC transporters, three metallothioneins, and a phytochelatine synthase. Our results shows, that all three poplar clones are efficient in stress adaptation, but this properties have different molecular backgrounds. *P. deltoides* clones B-229 and PE 19/66 showed slightly lower water potential during zinc and hyperosmotic treatment, and in all treatments, they have significantly lower glutathione transferase activities, than *P. x canadensis* clone M-1. By contrast, B-229 and PE 19/66 clones are more effective to induce the gene expression of various components of the detoxification process, such as the GSTs. Based on our research, *P. deltoides* clones may be well utilized for phytoremediation purposes on heavy metal contaminated sites with good water supply, but under osmotically inappropriate circumstances further research needed to understand acclimatization processes.

During our work, evidence was found for the important role of GSTs in the stress responses of *Brachypodium* and *Populus*.

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