Title of invited lecture: Pains and Gains of Gametic Embryogenesis in Alliums

The genus *Allium* holds over 850 species including many economically important crop, medicinal and ornamental species. *Allium*s are highly heterozygous perennials with large genomes. Polyploidy, aneuploidy, and selfing depression are highly common among the species of this genus. Some *Allium* species such as onion, shallot, Japanese leek, Chinese chive, common chive, domestic and wild leeks, and several other uncultivated *Allium* species are responsive to gynogenesis-based haploidization technique with varying success. It is, now, possible to obtain plants with reduced ploidy levels from several diploid and tetraploid *Allium* species by culturing whole flower bud explants on gynogenesis induction media. However, obtaining doubled haploid (DH) fecund plants is still a quite cumbersome process. Success of gynogenic plant production is influenced by many factors including the genetic background of plant material under study. Emergence of gynogenic plantlets (gynogenic response) from cultured buds may take between two to 12 months depending on *Allium* species under study. About half of the plantlets are lost at this point since they seize to grow. Growing plants are analyzed to determine their ploidy level. In our studies, the highest frequencies haploid plants are obtained from onion and the highest frequencies of dihaploid plants are produced from leek. All haploid and the majority of dihaploid plants obtained are sterile and cannot produce seeds. These plants have to be converted to DH plants in order to re-establish fecundity and obtain seeds. Induced chromosome doubling treatments in hand require use of highly cytotoxic anti-mitotic agents and lead to generation of many mixoploid plants. Therefore, there is a need for an efficient method causing low plant mortality and providing high frequency of plants with doubled chromosome number. Fecund gynogenic onion lines are produced by several research groups. Utilization of DH lines as parents in the production of new F1 hybrids is underway and the future for DH onion looks very bright. Leek breeding programs can also benefit from the haploidization technology. Several gynogenic leek lines that were converted to tetraploid level were fecund and provided high numbers of selfed seeds. Leek plants produced from selfed gynogenic lines show very uniform morphological features. Utilization of gynogenic leek lines as pollen donors in the production of new F1 leek hybrids remains to be tested. In this presentation, I will explain difficulties and benefits of utilization of gynogenesis-based gametic embryogenesis technology in *Allium* improvement programs.