APPLICATION OF MUTATION BREEDING IN CREATION OF CLIMATE RESILIENT CEREAL CROPS

Ankica Kondić-Špika[1], Milan Mirosavljević[1], Bojan Jocković[1], Ljiljana Brbaklić[1], Dragana Trkulja[1], Sanja Mikić[1], Svetlana Glogovac[1], Dragana Miladinović[1]**Nevena Nagl** [1]

[1] *Institute of Field and Vegetable Crops, Maksima Gorkog 30, Novi Sad 21000, Serbia*

INTRODUCTION:

Since the 1930s plant mutation breeding was used to develop new crop varieties by speeding up the natural process of genetic change. Seeds and other plant material are treated by physical or chemical agents to generate random genetic variations similar to spontaneous mutations, resulting in improved varieties with higher yield, better quality or adaptation to environmental stresses.

In a global climate change scenario crop varieties with increased tolerance to drought, heat and other abiotic stresses are needed. So far, at the Institute of Field and Vegetable Crops many different studies for testing the existing varieties to these stresses were performed, but there was no breeding program for active development of tolerant varieties. Using mutation breeding we will try to develop wheat and barley varieties with incorporated drought and heat tolerance in order to be more adaptive to the changing climate.

OBJECTIVES:

The objectives of this study were to determine the optimal doses of gamma irradiation for mutation induction in two wheat and one barley variety, and to apply the identified doses in order to produce mutant populations

METHOD / DESIGN:

Radio-sensitivity test for determination of optimal irradiation doses was carried out according to the FAO/IAEA Manual on Mutation Breeding. Dried seeds of two winter wheat (NS40S and Simonida) and one barley variety (Rudnik) were exposed to 75, 150, 300, 450 and 600 Gy gamma irradiation. The treated seeds and non-treated control were sown at equal depths in a tray filled with soil in rows (20 seeds each). Per assay three replicates were performed, one tray per replicate. After fourteen days of growing in a greenhouse, the germination and seedling height was measured to determine the Growth Reduction Value 50 or GR50.

RESULTS:

The results have shown that treated wheat and barley varieties had different reactions to applied doses of gamma irradiation. Germination of both wheat varieties was very good at all applied doses (over 90%), and there was no significant difference in the germination rate among doses or varieties. However, barley seeds were more susceptible to gamma irradiation, where doses of 300, 450 and 600 Gy reduced germination rate for 14.2, 33.2 and 42.1%, respectively. The seedlings' growth was more affected by irradiation treatment then germination process in both wheat and barley varieties. The dose of 300 Gy was lethal for Rudnik and NS-40S, while Simonida expressed higher tolerance regarding this dose. Accordingly, the dose of 210 Gy was identified as GR50 for varieties Rudnik and NS-40S, while 310 Gy was determined for Simonida. These doses were used for the treatment of 2000 seeds of each variety and mutation populations were produced. Further, mutation populations of these cereal crops will be used in a breeding programs for creating the varieties with increase resilience to climate change.

CONCLUSIONS:

Gamma irradiation had negative effect on seed germination and growth in wheat and barley varieties, but the varieties had different reactions to applied doses. The GR50 values were identified for each variety and used for production of mutation populations. The obtained populations will be used in wheat and barley breeding programs for improved tolerance to climate change.

Figure 1. Seedling height and emergency at different gamma irradiation doses: a) barley cultivar Rudnik; b) wheat cultivar NS 40S; c) wheat cultivar Simonida

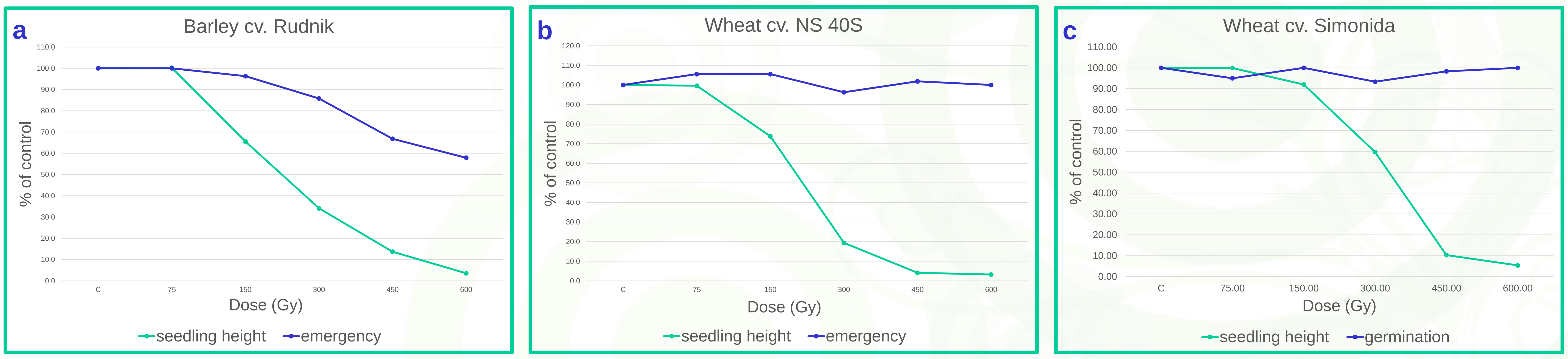
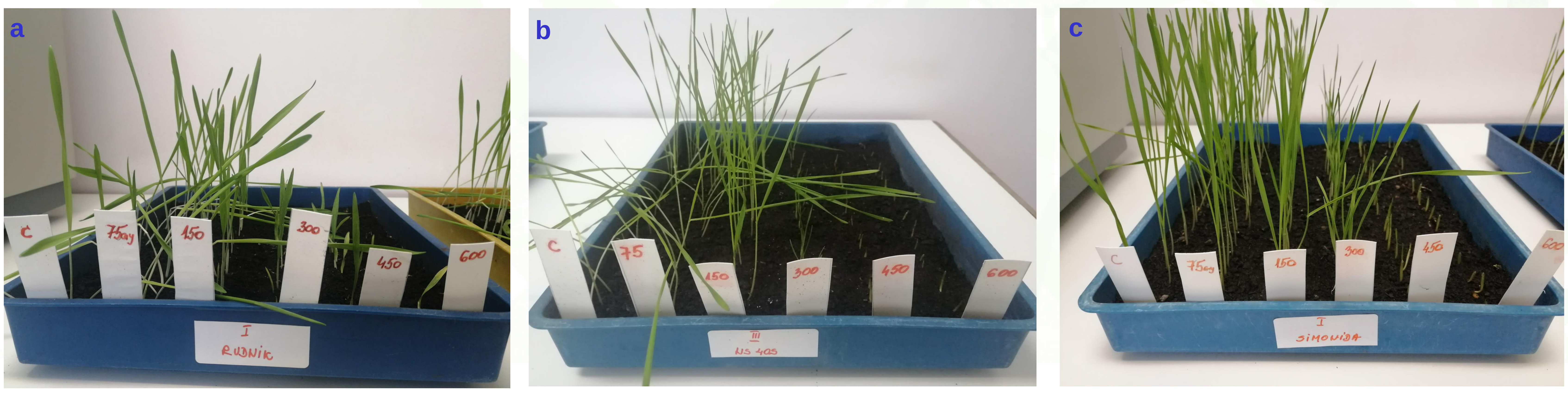


Figure 2. Seedling growth at different gamma irradiation doses: a) barley cultivar Rudnik; b) wheat cultivar NS 40S; c) wheat cultivar Simonida



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