CHLOROPHYL MUTATION-LIKE CHIMERIC CASES INDUCED BY FAST-NEUTRONS IN M1 GENERATION OF A DURUM WHEAT

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ABSTRACT

In this study, 3 visible chimeric cases observed in the M1 generation of fast-neutron irradiated durum wheat cultivar, Kunduru-1149, were introduced and possible explanations to their occurence were made in relation to the initial cell numbers, "slicing" effect of fast neutrons and dominant mutations. Considering the chimerism phenomena in M1, dominant mutations should be screened in sectors, i.e. in tillers in cereals, not in the whole M1 plants.

INTRODUCTION

There are several durum wheat varieties acceptable for industry and growers in the drylands of Turkey. One of them is 'Kunduru-1149', selected from a land race and released by the Agricultural Research Institute located at Eskisehir. Despite its quality attributes (large kernels with amber colour) it is susceptible to lodging in favourable years and fertile soil conditions. To solve this problem, a mutation project was launched at the Akdeniz University, Antalya, Turkey in order to select short-height mutants to stabilize or even increase yielding capacity without losing desirable quality characteristics of the cultivar.

Studies in the M1, M2 and M3 generations did not yield any mutant targeted. However, threes visible chimeric cases were observed in the M1 of fast-neutron irradiated material, which are unique and useful to show chimerical pattern of monocotyledonous species with specific reference to durum wheat. Therefore the aim of this paper was to demonstrate the role of initial cells regarding chimera phenomena and haplontic- and diplontic selection in mutant selection as well as suggesting a strategy on how to screen for dominant mutations.

MATERIALS AND METHODS

Air-dried seeds of Kunduru-1149 were irradiated in 1993 with 2 different doses of gamma rays and fast-neutrons at the International Atomic Energy Agency Laboratories and Austrian Research Center located at Seibersdorf, Austria. M1 generation was grown in the experimental field of Akdeniz Agricultural Research Institute, at Aksu (near Antalya), Turkey. Single spikes were harvested from each plants to raise the M1 plant progenies to screen short height mutants in the M2. Beside, all spikes of three M1 plants of which one tiller showed chlorophyl mutation-like modifications in fast neutron irradiated populations were harvested and these differentiated tillers' spikes were marked with the premise that they carried induced genetic changes. The M2 generation was grown in 1994 in the field at Akdeniz University Campus. The M2 populations were harvested in two bulks based on mutagens used in the study in order to rescreen for mutants considering polyploid nature of durum wheat. The M3 populations were grown at Urkutlu, (in Burdur province of Turkey).

RESULTS AND DISCUSSION

In the M_1 generation of fast-neutron irradiated material, three plants had only one tiller carrying chlorophyl 'mutation' (Fig. 1). Every spikes produced seeds from these 'mutated' tillers although the third case with the least chlorophyl production only in the central weins of leaves (Fig.1c) had relatively small seeds. There was no any other events observed like these in the gamma rays irradiated material, neither in this study nor previous ones undertaken by the author in monocotyledonous but in dicotyledonous species (e.g. *kabuli* chickpea and sesame). The M_1 plant progeny tests in the following generation revealed that these changes were not transferable into the progenies.

In M1, only dominant mutations with very low frequencies ($<1x10^{-6}$) are observable (IAEA,1977). These cases might be considered as single dominant mutations in chlorophyl production pathways. Apart from a possible dominant mutation hypothesis, these events may also be attributable to the 'slicing effect' of fast neutrons mutating both alleles to recessive direction simultaneously considering no any such events observed in the gamma-rays treated material. Chlorophyl mutations are also recessive in nature supporting this explanation. Dominant or recessive, the reason for observing them only in one tillers of M1 plants instead of in whole plants is that a mutation is induced in an initial cell which initiates differentiation of tissues in a meristem (embryo), and is carried only in the progeny from that cell. Number of initial cells in the embryos of cereals is known to be around 5 and as a consequence of this principle, mutated and non-mutated cells occur in the same M1 plants, which are chimeric. Also, more than one mutation can be carried in the same M_1 plant and one mutated cell may give rise to a tissue with mutant cells only (*solid mutant*) depending on the sector size. A mutation may be induced, but the progeny of that mutated cell may not participate in the plant or tiller development because of haplontic or diplontic selection, explaining why the cases were not transferable in to the next generation. Apart from an induced genetic change approach, the occurrence of sectors of chlorophyl deficient or morphological deviations in the appearance of M1 plants caused by the physical damage of the mutagen may be useful to estimate the effectiveness of the treatments and to insight on chimerical pattern of the species in question. Last but not least, dominant mutants should be screened on single tillers or in sectors -not in whole M_1 plants-considering chimerism phenomena.

a b c

Figure 1. Visible chimeric cases in one tiller of M1 plants of 'Kunduru-1149' durum wheat irradiated with fast neutrons. Thick white (a) and yellow (b) stripes on the leaf edges; yellow leaf blades and sheats but green only in the central weins (c).

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