Original Article (Full Paper)

Efficient nursery production and multiple-shoot clumps formation from shoot tiller-derived shoot apices of dwarf napiergrass (Pennisetum purpureum Schumach.)

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(Received: 5 March 2012 / Accepted: 16 April 2012)

ABSTRACT The objective of this study was to improve an in vitro tissue culture system for the dwarf napiergrass (Pennisetum purpureum Schumach.). Additionally, it was needed special treatments for acclimatization, and carried the risks of somaclonal variation and physiological aberrations. Shoot apices as initial explants were isolated aseptically from shoot-tillers, and cultured on in vitro MS (Murashige and Skoog, 1962) medium containing 3.0% sucrose and 0.3% phytagel. The most effective phytohormone treatment for multiple-shoot clumps (MSCs) induction was 0.1 mg L⁻¹ 2,4-D plus 2.0 mg L⁻¹ BAP. The addition of 50 μM CuSO₄ could increase the percentage of MSCs proliferation. Plant regeneration frequency was achieved up to 84% by culturing the MSCs on solid MS medium containing 0.1 mg L⁻¹ NAA and 2.0 mg L⁻¹ BAP. All regenerants were successfully grown up in the soil. Compared to control plants, in vitro regenerated plants did not reveal any significant difference (P > 0.05) on morphological characteristics and DNA content. The results of this study suggest that improved protocols for in vitro propagation would provide high quality nursery plant production of dwarf napiergrass in grassland field.


Key words: dwarf napiergrass; flow cytometry; multiple-shoot clumps formation; plant regeneration.

Introduction

In tropical and sub-tropical areas of the world including Asian and south-Asian countries, napiergrass (Pennisetum purpureum Schumach.) has been widely adopted as cut-and-carry grass by smallholder farmers for feeding dairy cattle (Valk 1990). It is a tall, predominantly clonally propagated, rapidly regenerates, high yielding perennial grass that is very palatable to cattle in the leafy stage (Lowe et al. 2003). Recently, Timbo et al. (2010) reported that it has also great energetic potential for bio-ethanol, bio-oil and biogas production as well as for electricity in thermoelectric power plants and rural properties.

Napiergrass has two different plant types in the genetic resources: one type is normal type including cultivars like "Merkeron", "Wrun wona" and "Rhodesia" (Davies 1963, Burton 1989, Mukhtar et al. 2003, Orodho 2006), and the another type is dwarf type (Thianna and Monson 1988). The both plant types are same chromosome number (2n=4x=28). Normal type ‘Rhodesia’ was introduced to southern part of USA in 1913 (Burton 1944, 1989; Pongtongkam et al. 2006). On the other hand, dwarf type is considered a cross-pollinated plant, which was originally found in Florida, USA. There are several negative properties of dwarf type, which prevents this grass to be developed as planned (Pongtongkam et al. 2006).

The dwarf type is leafier and can be grown in a wide variety of soil types. The biomass of dwarf type is lower than normal type, but it contains higher nutrients than normal type to feed the livestock. Their flowers are very small, while the pollens are short-lived which results in low level of seed formation. The flowering period of each type of napiergrass is different, which makes it more difficult and time consuming to have them cross-pollinated. Therefore, tissue culture has been used as the tool for production of high quality nursery and improvement of napiergrass cultivars (Pongtongkam et al. 2006).

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