IN VITRO TUBERIZATION AND TUBER PROTEINS AS INDICATORS OF HEAT STRESS TOLERANCE IN POTATO

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Abstract

In vitro tuberization as a potential screening method for heat stress tolerance in potato, was assessed on nodal explants of Desirée, LT-2, Kennebec and Russet Burbank. Two tuber inducing media protocols were evaluated at 20 C and 28 or 30 C. Independently of the media protocol, heat stress significantly reduced tuberization. A delay in the formation of tuber initials was also observed in Desirée, Kennebec and LT-2 at 28 and 30 C compared to 20 C. Russet Burbank failed to tuberize under heat stress on both media. At higher temperatures Desirée either did not tuberize, or tuberized poorly on high sucrose-agar medium and tuberized the best of all cultivars, on low sucrose—Gelrite medium. Kennebec and LT-2 tuberized on both media. Medium with Gelrite gave better tuberization and more reproducible results than with agar. A high sucrose-agar medium, on the other hand, separated the heat tolerant clone LT-2 from the other cultivars.

Higher temperature reduced accumulation of patatin and 22 kDa protein in all cultivars. The reduction was greater in Kennebec and least in LT-2. The results indicate that microtuber production under heat stress conditions, combined with SDS-PAGE protein electrophoresis, can be considered as a preliminary method in screening potato germplasm for subtropical and tropical climates.

Compendio

Se ha ensayado la tuberización in vitro como un método potencial de tamizado para tolerancia al estrés por calor en papa, sobre explantas nodales de Desirée, LT-2, Kennebec y Russet Burbank. Se evaluaron dos medios de inducción de tuberización a 20 C y 28 ó 30 C. Independientemente del medio, el estrés por calor redujo significativamente la tuberización. Se observó también un retardo en la formación de iniciales del tubérculo en Desirée, Kennebec y LT-2 a 28 y 30 C comparado con 20 C. Russet Burbank no llegó a tuberizar bajo estrés por calor en ambos medios. Desirée no tuberizó o tuberizó muy poco en medio de agar con alto contenido de sacarosa y tuberizó mejor que todos los cultivares en medio Gelrite con bajo...
contenido de sucrosa. Kennebec y LT-2 tuberizaron en ambos medios. Ed medio con Gerlita dió mejor tuberización y resultados más reproducibles que el con agar. Por otra parte, un medio de agar con alto contenido de sucrosa diferenció al clon tolerante LT-2 de los otros cultivares.

Las temperaturas más altas reducen la acumulación de patatina y proteína 22 kDa en todos los cultivos. La reducción fue mayor en Kennebec y mucho menor en LT-2. Los resultados indican que la producción de microtubérculos bajo condiciones de estrés al calor, combinada con electroforesis de proteína SDS-PAGE, pueden ser considerados como un método preliminar para el tamizado de germoplasma de papa en climas tropicales y subtropicales.

Introduction

One of the major constraints of potato production in the subtropical and tropical climatic zones is limited heat stress tolerance in existing cultivars (4, 6, 13). For this reason germplasm selection for heat stress tolerance has been one of the principal goals in potato breeding programs.

Cultivar evaluation and/or screening for tuber initiation and bulking under heat stress has been conducted in the field or greenhouse (5, 6, 8, 9, 12, 13, 18, 20). This involves considerable amounts of time and space. Sattelmacher (18) refers to a “field evaluation bottleneck” to describe problems in screening for heat tolerance. A simple and effective means of screening genotypes for heat stress tolerance is a prerequisite for the production of suitable cultivars for subtropical and tropical regions. It is possible that tissue culture could provide a quicker method of screening larger numbers of clones for their capacity to tuberize and bulk under stress conditions.

The objective of this study was to examine the potential use of in vitro tuberization as a screening method for heat stress tolerance. Heat tolerant Desirée (9) and the CIP clone LT-2 (8); and heat sensitive Kennebec (1) and Russet Burbank (20) were used in this study. Two media were evaluated; one containing 8% sucrose, benzylaminopurine (BAP) and agar (11) and the other 6% sucrose, kinetin and Gelrite (2) as tuberization inducing and gelling agents, respectively.

Materials and Methods

(i) Plantlet Source and Micropropagation

Virus-free stock plantlets of Desirée were obtained from Fox Island Seed Potato Farm, Prince Edward Island, Canada. Kennebec and Russet Burbank were from the Plant Propagation Center, Fredericton, New Brunswick, Canada, and the CIP clone LT-2 was from our collection of potato germplasm. Micropropagation was done on potato nodal cutting medium (PNCM), as described earlier (19). Approximately 8 nodal explants with one bud per node were taken from each plantlet discarding apical and basal nodes and all the leaves. The explants were cultured in 25 × 200 mm