

Breeding for improved responsiveness to arbuscular mycorrhizal fungi in onion

G.A. Galvan^{1,2}, K. Burger-Meijer¹, Th.W. Kuiper³, C. Kik⁴ & O.E. Scholten¹

Introduction

Onion (*Allium cepa* L.) is one of the leading vegetable crops worldwide. Due to its superficial root system that is rarely branched and lacks root hairs, onion is very inefficient in the uptake of water and nutrients. As a result, large amounts of fertilizer are used in onion cultivation. In low-input systems crops need to be nutrient scavengers. To improve nutrient uptake in onions it is possible to breed for larger root systems using *A. fistulosum*. A complementary approach is to use arbuscular mycorrhizal fungi (AMF), which associate with onion and improve plant growth and the uptake of nutrients and water from soils. Previous research showed high responsiveness of *A. fistulosum* with AMF. The aim of the present research was to study possibilities to improve onions for mycorrhizal responsiveness by breeding.

Materials and Methods

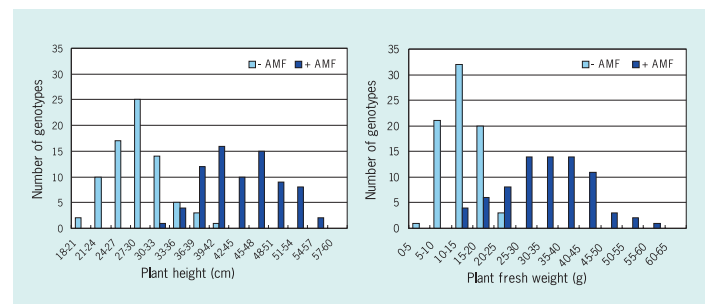
A tri-hybrid population of *A. cepa* x (*A. roylei* x *A. fistulosum*) called CCxRF was obtained (Khrustaleva and Kik, 2000). Seventy-seven genotypes, vegetatively multiplied, were tested for responsiveness in a greenhouse (day/night 22/17 °C). AMF species *G. intraradices* was kindly provided by Dr. Kapulnik, Volcani Centre, Israel. Responsiveness was calculated as the increase in plant height/weight compared to the non-mycorrhiza treatment: $(W_{AMF} - W_{NM})/W_{NM} * 100\%$. Responsiveness was considered significant when the AMF and control treatment were statistically different ($p < 0.05$).



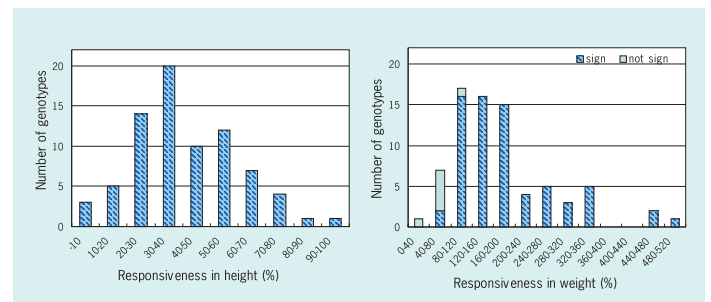
Figure 1. AMF added to *Allium* genotypes positively influenced plant growth (left: without AMF, right: with AMF, one genotype).

Results and Discussion

AMF had a significant effect on plant height and fresh weight of genotypes of the population (Figures 2 and 3). The frequency distribution for height responsiveness clearly demonstrated genetic variation between genotypes that varied from hardly or no response to genotypes with up to 100% increase in plant height (Figure 4). For weight variation in responsiveness up to 500% was found (Figure 5).



Figures 2 and 3. Frequency distribution of individual genotypes of the CCxRF population in plant height (2) and fresh weight (3) for the *Glomus intraradices* treatment (+AMF) and the control.



Figures 4 and 5. Frequency distribution of individual genotypes of the CCxRF population in responsiveness to *Glomus intraradices* (see text for calculation) for plant height (4) and weight (5).

The next step will be the analysis of the genetic basis of mycorrhizal responsiveness in this population via QTL mapping. We expect not only to find traits to improve the rooting system but also to improve the mycorrhizal responsiveness. The results support the hypothesis that exploitation of *A. fistulosum* is an interesting option to improve onions by breeding to obtain cultivars better adapted to low input farming because of their improved rooting system and mycorrhizal responsiveness.

Khrustaleva, L. and Kik, C. (2000). *Theor Appl Genet* 100: 17-26.

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¹ Plant Research International b.v.

P.O. Box 16, 6700 AA Wageningen, The Netherlands
Tel: +31 317 47 70 22 - Fax: +31 317 41 80 94
E-mail: olga.scholten@wur.nl

² University of the Republic, Montevideo, Uruguay

³ Soil Quality Group, WUR, Wageningen, The Netherlands

⁴ Centre for Genetic Resources, the Netherlands (CGN), WUR, Wageningen, The Netherlands