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# Genetic Diversity for Breeding of Durable Barley Yellow Mosaic Virus Resistance

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## INTRODUCTION

Yellow mosaic disease of winter barley is caused by barley yellow mosaic virus (BaYMV), transmitted by Polymyxa graminis. Because of its soil-transmission, yield losses can only be prevented by growing resistant (immune) cultivars. Several immune cultivars are available, but they show unfavourable agronomic characters and their resistance is based on an identical recessive gene. Therefore, it is necessary to broaden the genetic basis of resistance in adapted European barley and to improve agronomic performance of resistant germplasm.

## MATERIALS AND METHODS

Commercial German cultivars, which are generally high-performing but non-resistant to BaYMV, were used to combine BaYMV-resistance with high yield. Anther-culture steps (1) were applied in the breeding programme in order to accelerate and facilitate the procedure. Furthermore, various barley stocks from different parts of the world were used to screen for resistance genes which are different from the "German gene" (2). Tests for resistance to BaYMV type M (BaYMV-M, 5) were carried out by mechanical inoculation and ELISA (3).

## RESULTS

Progeny of crosses of resistant genetic stocks to either cultivars which carry the "German resistance gene" or the Chinese landrace 'Mokusekko 3' (Ym1) lead to homogeneously resistant $F_2$-populations, i. e. without segregation (Table 1). On the contrary, in crosses of both resistances to the American variety 'Anson Barley' showed segregation in $F_2$ (Table 1).
Hybrid plants ($F_1$) from crosses of resistant to susceptible German cultivars were used for an anther-culture step. Regenerated doubled haploid (DH) lines were tested in field trials for agronomic performance. The results demonstrate that highly productive, BaYMV-resistant DH-lines can be obtained.

## DISCUSSION

The fact, that progeny of crosses of several resistant stocks

Table 1: Genetics of BaYMV-Resistance: Results in $F_2$ of crosses including "German resistance" and Ym1 as parents (4)

| Cultivar | Genetic relationship to "German resistance" (rezessive) | Ym1 (dominant) |
|---|---|---|
| Birgit | identical | allelic |
| Diana | identical | allelic |
| Franka | identical | allelic |
| Mokusekko 3 | allelic | identical |
| Hakei I-41 | allelic | allelic or identical |
| Iwate Mensury 2 | allelic | allelic or identical |
| Kagoshima Kobai 1 | allelic | allelic or identical |
| Kanto Nijo 19 | allelic | allelic or identical |
| Nirakei 31 | allelic | allelic or identical |
| S-1001 | allelic | allelic or identical |
| Turkey Naked 2 | allelic | allelic or identical |
| Anson barley | non-allelic/ epistatic | non-allelic/ epistatic |

to either Ym1 or German cultivars did not segregate, supports the conclusion that the "German gene" and Ym1 are allelic or very tightly linked. Segregation in $F_2$ of crosses of the "German gene" and Ym1, respectively, to 'Anson Barley' indicates that resistance of the latter variety is inherited independently from the former genes. Moreover, it confirms that these gene are not identical, although they have been shown to be allelic. Further crosses indicated that other different resistance genes are present in exotic barley germplasm. These genes should be incorporated in native breeding materials in order to broaden the genetic basis of BaYMV-resistance.
The results reported above demonstrate, that the anther-culture technique is applicable in a practical winter barley breeding programme for combining different characters like BaYMV-resistance (monogenic) and high grain yield (polygenic) in improved lines.

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