Vorträge für Pflanzenzüchtung

Heft 15-I 1989

Science for Plant Breeding

Book of Poster Abstracts

Part I

Poster Groups 1-15

XII. EUCARPIA Congress

February 27 – March 4, 1989

Göttingen, Germany F. R.

XII. Eucarpia Congress 1989

3-13

Vorträge für Pflanzenzüchtg. 15, 1989

Chromosomal Location of Resistance to Barley Yellow Mosaic Virus in German Winter-Barley

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INTRODUCTION

Resistance (immunity) of German winter barley cultivars to BaYMV is probably due to one identical recessive gene, because their crosses are resistant in F_1 and do not segregate in F_2, where all plants are resistant, too.
Another important source of resistance is the Chinese spring barley 'Mokusekko 3', which has one dominant resistance gene, called Ym1, that was reported to be linked to the gene K for hooded lemma on chromosome 4 (6). Hybrid plants (F_1) from crosses of German cultivars to 'Mokusekko 3' are all resistant and the respective F_2's do not segregate susceptible individuals. Therefore, it can be concluded, that the respective resistance genes are either allelic or very tightly linked.
Marker- and trisomic-analyses were carried out in order to localize the gene for resistance of German resistant cultivars.

MATERIALS AND METHODS

For marker-analyses the multiple genetic markers 'Nigrinudum' and 'Colsess orange lemma' were used. Trisomic-analysis was started with a complete trisomic set of the cultivated spring barley variety 'Shin Ebisu 16'.
Tests for resistance to BaYMV type M (BaYMV-M, 3) were carried out in the greenhouse by mechanical inoculation (1, 2). One month after inoculation all plants were examinated by ELISA.

RESULTS AND DISCUSSION

For marker-analyses, segregation in F_2 indicates, that the "German resistance gene" is inherited independently of genes n (naked kernels) on chromosome 1, V (two-rowed spike) on chromosome 2, B (black lemma and pericarp) on chromosome 5 and o (orange lemma base and nodes) on chromosome 6. Results indicate also, that the "German resistance gene" is inherited independently of gene K for hooded lemma on chromosome 4.
Still, the definite genetic location of the "German resistance gene" remained to be determined. Therefore, trisomic-analyses were carried out. Among F_2 disomics of crosses with cv. 'Ogra' the theoretically expected segregations have been observed (Table 1). In all F_2-populations, except the one including 'Pale' (trisomic 3) as a parent, a good fit to the uncritical segregation (3:1) was found, whereas the F_2 with 'Pale' showed a good fit to the critical segregation of 8:1 for disomics.

Table 1: Segregation for reaction to BaYMV-M in F_2 disomics of crosses of 'Shin Ebisu 16' trisomics to the resistant cv. 'Ogra' (4)

Trisomic type	Extra chrom.	Infect. rate (%)	susc.	resis.	Total	X^2 for 3:1 ratio	P
Bush	1	92	113	55	168	0.237	0.70-0.50
Slender	2	89	126	60	186	0.083	0.80-0.70
Pale	3	89	69	17	86	7.044	<0.01 *
Robust	4	96	109	39	148	0.199	0.70-0.50
Pseudo-normal	5	100	125	46	171	0.329	0.70-0.50
Purple	6	100	65	20	85	0.098	0.80-0.70
Semierect	7	96	113	39	152	0.414	0.70-0.50

Test of 8:1 ratio for 'Pale': $X^2 = 0.0649$; P = 0.90-0.80

CONCLUSIONS

It can be concluded from the data presented above, that the gene for resistance to BaYMV-M of German cultivars is located on barley chromosome 3. This conclusion is supported by recent results of KONISHI and MATSUURA (5), who found, that a resistance gene of 'Mokusekko 3' is linked to an esterase isozyme gene block on chromosome 3.
Our own results, together with the findings of TAKAHASHI et al. (6) and KONISHI and MATSUURA (5), can therefore be interpreted as follows; either the "German gene" for resistance is allelic to a minor gene of 'Mokusekko 3' on chromosome 3, or the "German gene" is allelic to the dominant gene Ym1 of 'Mokusekko 3', which then must also be located on chromosome 3.

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