A NEW HIGH YIELDING WHEAT VARIETY DEVELOPED BY BOTH SOMACLONAL VARIATION AND CALLUS–IRRADIATION MUTATION

Gao Mingwei (高明尉), Cheng Xiongying (成雄鹰), Liang Zhuqing (梁竹青) and Hu Tianci (胡天赐)

(Institute of Nuclear Agricultural Science, Zhejiang Agricultural University, Hangzhou 310029, China)

(Received June 1992)

ABSTRACT

Immature embryo- derived calli from the wheat accession 1908 were irradiated with gamma rays at 2.58×10^{-1}C/kg. The frequency of somaclonal variation in the second generation (C_2R_2) went up to 25 %, being about four times as high as that of the non- irradiated counterpart (R_2). From the calli- irradiated regenerant's progeny, one elite line with high yield potential, early maturity, resistance to both scab disease and lodging was isolated and officially registered as a new variety named Hezu 8.

Keywords: Common wheat Immature embryo culture Callus- irradiation

1 INTRODUCTION

A new winter wheat variety Hezu 8 with high yield, early- maturity and resistance to scab and lodging was officially approved to release in 1992. This might be the first case that a wheat variety was developed by both somaclonal variation and callus- irradiation mutation, being isolated from a young- embryo- calli derived C_2R_2 population. In 1987/88 and 1988/89 regional yield trials, it outyielded the local leading variety Zhemai No.1 by over 11 % and 13 %, respectively, ranking first among all the lines tested. In the late spring of 1991, wheat crop was seriously suffered from the adverse weather conditions with extremely high moisture and exceptional low temperature during meiosis, which led the local cultivars and most of breeding lines tested to a heavy yield loss due mainly to the scab disease and reduced seed- setting rate, but the grain production of Hezu 8 was much less affected and still had 27 % increase over Zhemai No.1. Hezu 8 adapts to the vast double cropping rice area as a winter crop in the lower reaches of the Yangtse River.

2 PROCESS FOR THE VARIETY BREEDING

In 1984, immature embryos were taken for *in vitro* culture from an advanced and

stable breeding line named 1908,[1] one of the progenies from the cross between Henong No.1 and Zhemai No.1. Zhemai No.1 is a leading cultivar in local region and is characterized by wide adaptability and early maturity. The other parent Henong No.1 is a mutant cultivar developed by our laboratory in the early 1980's with a high yield potential. The advanced line 1908 also showed a high yield potential with improved tillering capacity and greater grain weight, and was, however, susceptible to wheat scab and lodging, and matured five days later than Zhemai No.1.

Callus culture has been established from the immature embryos following a protocol reported by Liang[2], and were irradiated after two month culture with 2.58×10^{-1} C/kg cobalt- 60 gamma- rays at a dose rate of 7.74×10^{-3} C/(kg · min). In the autumn of 1984, a total of 10 plants (C_1R_1) were regenerated from the irradiated calli coded Ar1, Ar2, Ar11, Ar12, Ar15, Ar18 and Ar23. Among them, Ar23 gave rise to 4 survival plants Ar23- 0, Ar23- 2, Ar23- 5 and Ar23- 6, while the others produced one plant each. From 22 non- irradiated calli, a total of 38 plants (R_1) were regenerated.

Plants from the above two treatments were grown in the field in the same year. Agronomic characters were observed and scored as shown in Table 1.

Table 1

Agronomic comparison of traits between somaclonal wheat plants regenerated from irradiated (C_1R_1) and non—irradiated (R_1) callus cultures with the donor line 1908 as control

Generation	No. of regenerative calli	No. of regenerated plants	No. of plants per callus	No. of tillers per plant	No. of spikelets per spike	Plant height/ cm	Spike length/ cm	Rate of sterile plants/ %	Seed setting rate/ %
C_1R_1	7	10	1.4	4.2	9.5	50.2	5.5	30.0	64.4
R_1	22	38	1.7	2.7	10.4	52.1	5.6	15.8	70.2
CK (donor plant)				8.5	16.0	89.0	8.4	0.0	96.0

Reduction of number of plants per callus and seed fertility and increment of sterility rate in C_1R_1 as compared with those in R_1 could be attributed to radiation effect. As a whole, both the C_1R_1 and R_1 plants exhibited lower values than the non- cultured original donor (line 1908) in agronomic characters such as plant height, tillering capacity, seed fertility and number of spikelets per spike. Considering that most of the changes appeared in the regenerated plants were physiologically caused by *in vitro* culture stress, no selection was intentionally made in the first regeneration, and all the regenerants were selfed to raise C_2R_2 and R_2 populations.

Sixteen C_2R_2 spike- derived lines were raised from 7 fertile C_1R_1 plants with each providing 1 to 5 lines depending on the number of effective tillers of each regenerant. Among the 16 spike lines, 4 lines were found variant, belonging to two C_1R_1 plants, the

variant frequency being as high as 25 %. Meanwhile, 58 R_2 spike lines were grown from 32 fertile R_1 plants, of which 4 lines from two R_1 plants were variant, accounting for 9.4 % of the total lines observed. It is obvious that variants appeared at significantly higher rate in the C_2R_2 population than in the R_2 group. Variations in the C_2R_2 and R_2 populations and their inheritances are summarized in Table 2.

Table 2

Phenotypic variation of the wheat somaclonal variants isolated from C_2R_2 and R_2 generation and the inheritance of variations

Treatment	Code of variant line	No. of lines	Phenotypic variations in C_2R_2 or R_2	Phenotypic variations in C_3R_3 or R_3
Irradiation of calli at 2.58×10^{1}C/kg	#21 from callus Ar 13	1	10 cm shorter than 1908	10 cm shorter with larger spike but seperated
	#72–74 from callus Ar23–2	3	Heading 7 days earlier than parental line 1908, better performance	Bred true
Non-irradiated	#31	1	15 cm shorter	15 cm shorter but seperated
	#46	1	Heavy waxiness	Bred true
	#55–56	2	4 days earlier and 5 cm shorter	Earliness bred true

The above-mentioned eight variant lines isolated in C_2R_2 and R_2 population were planted in C_3R_3 and R_3 generation in 1986/87 for further observation and evaluation. The superior C_3R_3 progeny of line #72—74 originated from callus Ar23–2 featured by early-maturity, disease and lodging resistance and higher yield potential was finally selected for field trial and named Hezu 8.

REFERENCES

[1] Gao Mingwei, Cheng Xiongying, Liang Zhuqing. Cereal Research Communications (in Chinese), 1991, 19(1-2):77.

[2] Liang Zhuqing, Gao Mingwei, Cheng Xiongying. Acta Agronomica Sinica, 1988, 14(2):137.