Study on the full sterile line and F_1 seed production technique of Huyouza No. 1(*Brassica napus* L.) with good quality and high yield

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Abstract

The production and purity of full sterile line Hu118A in the different isolation environments and the yield of commercial F_1 hybrid seed in different ratios of parental lines were studied. It showed that the production and purity of full sterile line Hu118A was 770.4kg/ha and 98% in greenhouse with honeybee as the pollination medium, and that planting ratios 1:3 and 1:4 were found to give similar results and produced significantly higher seed yields than the ratio of 1:2, 1:5 and 1:6. So the high yield of F_1 seeds Huyouza No.1 could be obtained in high purity of full sterile line and planting ratio 1:4 or1:3.

Key words: Huyouza No.1, hybrid seed, production technology, ratio of parental lines, isolation environment

Huyouza No.1, which was developed from a recessive genic male sterility (RGMS) system controlled by two pairs of recessive duplicate sterile genes (*ms*$_1$ and *ms*$_2$) interacting with one pair of a recessive epistatic fertile gene (*rf*), was commercial F_1 hybrid seed with high yield, high quality, broad adaptability and resistance to diseases (Sun et al., 2004). Since Huyouza No.1 was registered in 2003 by Shanghai Crop Registration Committee, and in 2005 by National Crop Registration Committee, it was broadly cultivated in Shanghai, Zhejiang, Jiangshu, Anhui, Hubei and Hunan.

In the present paper, we described the progenitive technique of full sterile line (Hu118A) and commercial F_1 hybrid seed production (Huyouza No.1).

Materials and methods

Plant Matetials

The RGMS line 20118AB of *Brassica napus*, which was developed by Sun et al. (2002), was used as female parent, with characteristics of 50% male sterile plants (20118A) with the genotype of $ms_1ms_1ms_2ms_2RfRf$, and 50% fertile plants (20118B) with the genotype of $Ms_1ms_1ms_2ms_2RfRf$. The temporary maintainer line M-6029 with the genotype of $ms_1ms_1ms_2ms_2rfrf$ could maintain the sterility of male sterile plants (20118A), and consequently, product the full sterile line Hu118A. Huyou 15 as restorer line was used to product commercial F_1 hybrid seeds.

The full sterile line production in different isolation environment

To obtain the good-quality full sterile line Hu118A by use of the male sterile plants (20118A) and the temporary manitainer line (M-6029), three different isolation environments were arranged with three replications: (i) Hu118A was producted in the nature isolation envirionment (the recommended space isolation of 1,000m). (ii) Hu118A was producted by use of covering stalker in the florescence. (iii) Hu118A was producted by use of covering stalker and setting honeybee free as the pollination medium in the florescence. Each treatment was arranged in 180m^2 area including 430 temporary maintainer plants and 1720 male sterile plants accoding to planting ratio1: 4. The purity of full sterile seed were identified in the next year.

The effect of planting ratio on the yield of commercial F_1 hybrid seed

To product commercial F_1 hybrid seed with high yield and good quality, 5 different planting ratios (1:2, 1:3, 1:4, 1:5 and 1:6) were arranged in a randomized complete block design with three replications. Each treatment was planted in 20m^2 area by the density of 120000 /hm^2.

Results

The purity and yield of Hu118A in different isolation environments

When covering stalker to isolate the outside pollen in the florescence: (i) The total yield of Hu118A could get up to 770.40kg/hm^2 by use of setting honeybee free as the pollination medium. (ii) the total yield was only 337.05kg/hm^2 without honeybee, there was significant difference between the two methods (Table 1). When Hu118A was producted in the natural isolation envirionment (the recommended space isolation of 1,000m), the total yield 603.75kg/hm^2 was significantly higher than the second method mentioned above, but significantly lower the first methods, it showed that the pollination mediums had important effect on the yield. The purity of seed, respectively 97.99% and 97.76%, was similar between with and without honeybee. Nevertheless, the purity, only 90.60% was little worse in the open air of the natural isolation than the former two methods, but also got to national standard.

Table 1 The yield of Hu118A in different isolation environments

Treatments	Block Yield(kg)			Mean Yield (kg)	Yield/hektare(kg/ha,)	Significance	
	I	II	III			5%	1%
Stalker and honerbee	14.2	13.5	13.9	13.89	770.40	a	A
Open Air	11.5	11.0	10.1	10.87	603.75	b	B
Stalker	6.3	5.8	6.1	6.07	337.05	c	C

Table 2 The purity of Hu118A in different isolation environments

Treatments		No.of plants (plant)	No. of fertility (plant)	No. of sterility (plant)	Purity(%)	Average of purity(%)
Stalker and honeybee	I	249	6	243	97.59	97.99
	II	253	4	249	98.42	
	III	245	5	240	97.96	
Stalker	I	257	7	250	97.27	97.76
	II	250	4	246	98.40	
	III	261	6	255	97.70	
Open air	I	235	25	210	89.36	90.60
	II	248	26	222	89.51	
	III	255	18	237	92.94	

The producation yield of commercial F_1 hybrid seed

On the understanding that the purity of commercial F_1 hybrid seed could be coincident with national standard, we hoped to enhance the yield in order to reduce the cost. To decide the appropriate row ratio of parental lines, 5 different planting ratios (1:2, 1:3, 1:4, 1:5 and 1:6) were studied. Whereas the five planting ratios had significant differences for seed yield and number of seeds per ear. Planting ratios 1:3 and 1:4 were investigated to obtain similar results and produced significantly higher seed yields compared to the other ratios(Table 3).

Table 3 The effect of planting ratio on the yield of F_1 hybrid seed

Row ratio	Block yield(kg)			Mean yield (kg)	Yield /hektare (kg/ha)	Enhancing percentage(%)	Significance	
	I	II	III				5%	1%
1:4	3.52	3.45	3.6	3.52	1762.35		a	A
1:3	3.45	3.45	3.48	3.46	1729.95	1.87	a	A
1:5	3.15	3.0	2.92	3.02	1512.45	16.52	b	B
1:6	3.0	2.85	2.83	2.89	1447.50	21.75	b	B
1:2	2.82	2.77	2.70	2.76	1382.40	27.48	c	C

Discussion

The purity of the full sterile line Hu118A played an important role in the quality of hybrid seed production, on the other hand, because 50% fertile plants (20118B) with the genotype of $Ms_1ms_1ms_2ms_2RfRf$ must be removed for producting the full sterile line, the area could be not big in order to shorten labor consuming and costs. Based on the two reasons, we need both the appropriate isolation environment and high-efficiency pollination system. In the present study, 3 different isolation environments were investigated, the result showed that Hu118A was producted by use of covering stalker and setting honeybee free as the pollination medium in the florescence.

There was significant difference in the yield of hybrid seeds because of planting ratio of parental lines resulting in the significant difference of yield components. The present study showed that the number of seeds per ear did not differ significantly between planting ratios 1:2 and1:3, but little higher than 1:4. Whereas the number of female plants showed significant differences among 3 planting ratios (1:2, 1:3 and 1:4), so seed yields of planting ratios 1:2 was much lower than that of both 1: 3 and1:4, the result was similar to the reports by Pu et al. (1999), Xiao et al.(2004) and Zhou et al. (2004). The planting ratios 1:5 and 1:6 produced significantly poor seed yields with fewer seeds per ear because of not enough pollens. In a word, the planting ratio 1:3 and 1:4 is more appropriate compared to the other ratios .

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