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Experimental Study on Glutinous Variety Improvement of Maize Population Yuzong 5

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Abstract The representative samples were selected from Yuzong 5, and the methods of field planting and indoor measuring were employed for investigation and data processing on 894 plants of Yuzong 5. The results showed that the coefficients of variation about some traits of 894 plants were as follows: ear height (19.9%); panicle weight (35.1%); ear length (18.1%); ear row number (19.7%); number of kernels per row (22.5%); grain weight per panicle (36.3%); ear diameter (11.1%). It was found that there was large variation in these traits for various plants which could represent Yuzong 5 for glutinous variety improvement.

Key words Yuzong 5, Improvement, Sampling, Test

1 Introduction

The maize population Yuzong 5 is the ordinary maize bred by Henan Agricultural University, with rich genetic basis, so it is the an ideal material for breeding inbred lines. At present, the glutinous maize germplasm resources are insufficient, and the breeding method is simple. If the trans-breeding is done from the common maize collective species with rich genetic basis, it will be of important significance to increasing the germplasm resources. There are a lot of genetic variations and different genotypes in collective species, and it is necessary to make a certain number of samples contain useful variation as much as possible, make the samples representative and statistically significant according to the purpose of the study, and require that the number of samples should be in the operable range, so it involves sampling problems. Li Yu *et al.* [1] believed that it was feasible to use the composite samples consisting of 30 plants for evaluation of maize populations. Wang Tiegu *et al.* [2], Liu Xue *et al.* [3], Li Mingshun *et al.* [4] and Chen Weiguo *et al.* [5] used 10 mixed samples to analyze 6 maize populations, 2 subtropical populations, 13 maize populations, and 27 maize populations. Due to the difference in test object, this paper studied the plants within population, and it was rarely reported before. Therefore, before glutinous variety improvement of Yuzong 5, this paper analyzed the sampling representativeness in order to provide a scientific basis for future research.

2 Materials and methods

The test material was Yuzong 5. The plants were arranged in order, spacing in the rows was 25 cm and spacing between rows was 65 cm. The single - grain sowing was carried out. 894 of Yuzong 5 were investigated. Some traits (ear height, panicle weight, ear length, ear diameter, ear row number, number of kernels per row, grain weight per panicle) about plants were recorded during the field investigation. Excel was used for data processing and statistical analysis.

3 Field management

The test was done in Hainan Cashew Research Center. The soil was sandy loam with medium fertility and the terrain was flat. Watering was done after sowing on November 5, 2014, and acetochlor herbicide was applied. The seedlings were earthed up when they grew to 8 - 10 true leaves, and 8 kg of K fertilizer and 10 kg of urea per 667 m^2 were applied. About 10 days before tasseling, 20 kg of K fertilizer and 20 kg of urea per 667 m^2 were applied. During the maize pollination period, 5 kg of K fertilizer and 3 kg of urea per 667 m^2 were applied.

4 Results and analysis

The data about 894 plants of Yuzong 5 were processed, and it was found that there was a big difference between different plants.

4.1 Ear height As shown from Table 1, ear height was 18 - 113 cm; the variation range was 95 cm; the average height was 74.8 cm; the standard deviation was 4.9 cm; the coefficient of variation was 19.9%. It indicated that the ear height variation range was wide for the plants of Yuzong 5. From Table 2, it was found that among 894 individuals, 819 of them had ear height of 50 - 100 cm, accounting for 91.6%; 2 individuals had ear height of 15.5 - 20.5 cm; 1 individual had ear height of 20.5 - 25.5 cm; 1 individual had ear height of 25.5 - 30.5 cm; 1 individual had ear height of 30.5 - 35.5 cm; 8 individuals had ear height of 35.5 - 40.5 cm; 14 individuals had ear height of 40.5 - 45.5 cm; 23 individuals had ear height of 45.5 - 50.5 cm; 15 individuals had ear height of 100.5 - 105.5 cm; 9 individuals had

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ear height of 105.5 – 110.5 cm; 1 individual had ear height of 110.5 – 115.5 cm.

Table 1 Various traits of Yuzong 5

Items \ Traits	Ear height//cm	Panicle weight//g	Ear length//cm	Ear row number	Number of kernels per row	Single spike grain weight//g	Ear diameter//cm
Mean	74.8	131.7	12.7	14.2	26.2	113.5	4.5
Maximum	113.0	267.4	19.0	22.0	41.0	226.2	5.8
Minimum	18.0	23.5	1.7	4.0	6.0	15.0	1.0
Variation range	95.0	243.9	17.3	18.0	35.0	211.2	4.8
Standard deviation	14.9	46.2	2.3	2.8	5.9	41.2	0.5
Coefficient of variation//%	19.9	35.1	18.1	19.7	22.5	36.3	11.1

Table 2 Frequency distribution of ear height

Class boundary//cm	Mid-range//cm	Frequency	Class boundary//cm	Mid-range//cm	Frequency
15.5 – 20.5	18	2	65.5 – 70.5	68	108
20.5 – 25.5	23	1	70.5 – 75.5	73	111
25.5 – 30.5	28	1	75.5 – 80.5	78	117
30.5 – 35.5	33	1	80.5 – 85.5	83	114
35.5 – 40.5	38	8	85.5 – 90.5	88	77
40.5 – 45.5	43	14	90.5 – 95.5	93	57
45.5 – 50.5	48	23	95.5 – 100.5	98	41
50.5 – 55.5	53	40	100.5 – 105.5	103	15
55.5 – 60.5	58	78	105.5 – 110.5	108	9
60.5 – 65.5	63	76	110.5 – 115.5	113	1

4.2 Panicle weight As shown from Table 1, panicle weight was 23.5 – 267.4 g; the variation range was 243.9 g; the average weight was 131.7 g; the standard deviation was 46.2 g; the coefficient of variation was 35.1%. It indicated that the panicle weight variation range was wide for the plants of Yuzong 5. From Table 3, it was found that among 894 individuals, 108 of them had panicle weight of 108.01 – 121.01 g, accounting for 12.1%; 6 individuals had panicle weight of 17.01 – 30.01 g; 16 individuals had panicle weight of 30.01 – 43.01 g; 1 individual had panicle weight of 238.01 – 251.01 g; 1 individual had panicle weight of 251.01 – 264.01 g; 1 individual had panicle weight of 264.01 – 277.01 g.

Table 3 Frequency distribution of panicle weight

Class boundary//g	Mid-range//g	Frequency	Class boundary//g	Mid-range//g	Frequency
17.01 – 30.01	23.5	6	147.01 – 160.01	153.5	88
30.01 – 43.01	36.5	16	160.01 – 173.01	166.5	83
43.01 – 56.01	49.5	23	173.01 – 186.01	179.5	67
56.01 – 69.01	62.5	47	186.01 – 199.01	192.5	45
69.01 – 82.01	75.5	46	199.01 – 212.01	205.5	28
82.01 – 95.01	88.5	61	212.01 – 225.01	218.5	16
95.01 – 108.01	101.5	76	225.01 – 238.01	231.5	19
108.01 – 121.01	114.5	108	238.01 – 251.01	244.5	1
121.01 – 134.01	127.5	85	251.01 – 264.01	257.5	1
134.01 – 147.01	140.5	77	264.01 – 277.01	270.5	1

4.3 Ear length As shown from Table 1, ear length was 1.7 – 19 cm; the variation range was 17.3 cm; the average length was 12.7 cm; the standard deviation was 2.3 cm; the coefficient of variation was 18.1%. It indicated that the ear length variation range was wide for the plants of Yuzong 5. From Table 4, it was found that among 894 individuals, 156 of them had ear length of 12.95 – 13.85 cm, accounting for 17.4%; 2 individuals had ear length of 1.25 – 2.15 cm; there was no individual having ear length of 2.15 – 3.05 cm; 1 individual had ear length of 3.05 – 3.95 cm; 3 individuals had ear length of 3.95 – 4.85 cm; 1 individual had ear length of 4.85 – 5.75 cm; 3 individuals had ear length of 5.75 – 6.65 cm; 9 individuals had ear length of 6.65 – 7.55 cm; 14 individuals had ear length of 15.65 – 16.55 cm; 15 individuals had ear length of 16.55 – 17.45 cm; 8 individuals had ear length of 17.45 – 18.35 cm; 3 individuals had ear length of 18.35 – 19.25 cm.

4.4 Ear row number As shown from Table 1, ear row number was 4 – 22; the variation range was 18; the average number was 14.2; the standard deviation was 2.8; the coefficient of variation was 19.7%. It indicated that the ear row number variation range was wide for the plants of Yuzong 5. From Table 5, it was found that among 894 individuals, 161 of them had 12 ear rows, 273 of

them had 14 ear rows, and 248 of them had 16 ear rows, accounting for 18%, 30.5%, 27.7%, respectively; the small ear row number included 4, 6, 8, 10, 18, 20, 22.

Table 4 Frequency distribution of ear length

Class boundary//cm	Mid-range//cm	Frequency	Class boundary//cm	Mid-range//cm	Frequency
1.25 – 2.15	1.7	2	10.25 – 11.15	10.7	68
2.15 – 3.05	2.6	0	11.15 – 12.05	11.6	116
3.05 – 3.95	3.5	1	12.05 – 12.95	12.5	131
3.95 – 4.85	4.4	3	12.95 – 13.85	13.4	156
4.85 – 5.75	5.3	1	13.85 – 14.75	14.3	120
5.75 – 6.65	6.2	3	14.75 – 15.65	15.2	126
6.65 – 7.55	7.1	9	15.65 – 16.55	16.1	14
7.55 – 8.45	8.0	25	16.55 – 17.45	17.0	15
8.45 – 9.35	8.9	35	17.45 – 18.35	17.9	8
9.35 – 10.25	9.8	58	18.35 – 19.25	18.8	3

Table 5 Frequency distribution of ear row number

Ear row number	Frequency	Ear row number	Frequency	Ear row number	Frequency
4	4	12	161	20	18
6	17	14	273	22	2
8	22	16	248		
10	54	18	95		

4.5 Number of kernels per row As shown from Table 1, number of kernels per row was 6 – 41; the variation range was 35; the average number was 26.2; the standard deviation was 5.9; the coefficient of variation was 22.5%. It indicated that the variation range of number of kernels per row was wide for the plants of Yuzong 5. From Table 6, it was found that among 894 individuals, 681 of them had 19.5 – 32.1 kernels per row, accounting for 76.2%; 2 of them had 5.1 – 6.9 kernels per row; 2 of them had 6.9 – 8.7 kernels per row; 8 of them had 8.7 – 10.5 kernels per row; 8 of them had 14.1 – 15.9 kernels per row; 4 of them had 39.3 – 41.1 kernels per row.

Table 6 Frequency distribution of number of kernels per row

Class boundary	Mid-range	Frequency	Class boundary	Mid-range	Frequency
5.1 – 6.9	6.0	2	23.1 – 24.9	24.0	69
6.9 – 8.7	7.8	2	24.9 – 26.7	25.8	119
8.7 – 10.5	9.6	8	26.7 – 28.5	27.6	135
10.5 – 12.3	11.4	12	28.5 – 30.3	29.4	110
12.3 – 14.1	13.2	14	30.3 – 32.1	31.2	105
14.1 – 15.9	15.0	8	32.1 – 33.9	33.0	20
15.9 – 17.7	16.8	22	33.9 – 35.7	34.8	45
17.7 – 19.5	18.6	41	35.7 – 37.5	36.6	20
19.5 – 21.3	20.4	51	37.5 – 39.3	38.4	15
21.3 – 23.1	22.2	92	39.3 – 41.1	40.2	4

4.6 Grain weight per panicle As shown from Table 1, grain weight per panicle was 15 – 226.2 g; the variation range was 211.2 g; the average weight was 113.5 g; the standard deviation was 41.2 g; the coefficient of variation was 36.3%. It indicated that the variation range of grain weight per panicle was wide for the plants of Yuzong 5. From Table 7, it was found that among 894 individuals, 96 of them had grain weight of 95.25 – 105.95 g per panicle, accounting for 10.7%; 3 individuals had grain weight of 9.65 – 20.35 g per panicle; 4 individuals had grain weight of 202.25 – 212.95 g per panicle; there was no individual having grain weight of 212.95 – 223.65 g per panicle; 2 individuals had grain weight of 223.65 – 234.35 g per panicle.

4.7 Ear diameter As shown from Table 1, ear diameter was 1 – 5.8 cm; the variation range was 4.8 cm; the average diameter was 4.5 cm; the standard deviation was 0.5 cm; the coefficient of variation was 11.1%. It indicated that the ear diameter variation range was wide for the plants of Yuzong 5. From Table 8, it was found that among 894 individuals, 220 of them had ear diameter of 4.77 – 5.03 cm, accounting for 24.6%; 1 individual had ear diameter of 0.87 – 1.13 cm; there was no individual having ear diameter of 1.13 – 1.91 cm; 1 individual had ear diameter of 1.91 – 2.17 cm; 2 individuals had ear diameter of 2.17 – 2.43 cm; 2 individuals had ear diameter of 2.43 – 2.69 cm.

Table 7 Frequency distribution of grain weight per panicle

Class boundary//g	Mid-range//g	Frequency	Class boundary//g	Mid-range//g	Frequency
9.65 – 20.35	15.0	3	127.35 – 138.05	132.7	83
20.35 – 31.05	25.7	21	138.05 – 148.75	143.4	78
31.05 – 41.75	36.4	19	148.75 – 159.45	154.1	71
41.75 – 52.45	47.1	28	159.45 – 170.15	164.8	47
52.45 – 63.15	57.8	39	170.15 – 180.85	175.5	24
63.15 – 73.85	68.5	54	180.85 – 191.55	186.2	28
73.85 – 84.55	79.2	59	191.55 – 202.25	196.9	13
84.55 – 95.25	89.9	72	202.25 – 212.95	207.6	4
95.25 – 105.95	100.6	96	212.95 – 223.65	218.3	0
105.95 – 116.65	111.3	76	223.65 – 234.35	229.0	2
116.65 – 127.35	122.0	77			

Table 8 Frequency distribution of ear diameter

Class boundary//cm	Mid-range//cm	Frequency	Class boundary//cm	Mid-range//cm	Frequency
0.87 – 1.13	1.00	1	3.47 – 3.73	3.60	24
1.13 – 1.39	1.26	0	3.73 – 3.99	3.86	34
1.39 – 1.65	1.52	0	3.99 – 4.25	4.12	106
1.65 – 1.91	1.78	0	4.25 – 4.51	4.38	207
1.91 – 2.17	2.04	1	4.51 – 4.77	4.64	173
2.17 – 2.43	2.30	2	4.77 – 5.03	4.90	220
2.43 – 2.69	2.56	2	5.03 – 5.29	5.16	70
2.69 – 2.95	2.82	4	5.29 – 5.55	5.42	27
2.95 – 3.21	3.08	13	5.55 – 5.81	5.68	5
3.21 – 3.47	3.34	5			

5 Conclusions and discussions

Yuzong 5 had rich genetic basis and high combining ability. The research results of Zhao Ruifang[6], Wu Liancheng *et al.* [7] showed that Yuzong 5 had a long genetic distance from other populations, and the descendants bred from Yuzong 5 were easy to produce excellent hybrids. The research results of Wu Liancheng[8], Duan Yunping[9] and Wang Tiegu *et al.* [10] showed that Yuzong 5 had great genetic variation. The findings of Chen Yanhui *et al.* [11-13] showed that there were significant differences in some traits (such as yield) between individuals in the populations, and the genetic variation was large; the population had high general combining ability and large specific combining ability variance. The findings of Tan Hua *et al.* [14] showed that the grain yield additive effect of Yuzong 5 populations was great, and it could be directly used in breeding. In this experiment, there was great variation in ear height, panicle weight, ear row number, number of kernels per row, grain weight per panicle, ear length, and ear diameter, indicating that the 894 samples of Yuzong 5 had rich variation and could represent Yuzong 5 for glutinous variety improvement.

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