RESEARCH ARTICLE | JANUARY 10 2019

Karyotype analysis of Brassica juncea cv. bianhachi big flesh sweet mustard FREE

Bo Sun; Zhen Jin; Xue Xia; Zejing Liu; Ping Zhou; Chunyan Chen; Fen Zhang

AIP Conf. Proc. 2058, 020051 (2019)
https://doi.org/10.1063/1.5085564

Karyotype Analysis of Brassica Juncea CV. Bianhachi Big Flesh Sweet Mustard

Bo Sun[1)], Zhen Jin[1)], Xue Xia[1)], Zejing Liu[1)], Ping Zhou[2)], Chunyan Chen[2)], and Fen Zhang[1, a)]

[1]*College of Horticulture, Sichuan Agricultural University, Chengdu 611130, China.*
[2]*Bijie Institute of Agricultural Science, Bijie 551700, China.*

[a)]Corresponding author email: zhangf_12@163.com.

Abstract. Brassica juncea cv. bianhachi big flesh sweet mustard had the flat bone and thick flesh, the flesh was sweet, mouth fragrance, the less fiber, and with high quality characteristic. Moreover, the market demand for this variety is large and popular with gourmets and restaurants. In this research, we try to obtain cytological parameters on 'bianhachi big flesh sweet mustard'. The experiment results showed that the maximum chromosome length was measured 4.72 μm and max arm ratio was determined 2.25, relative length ranged between 3.08% to 8.29%. There are four types of relative length, including short (S), medium short (M1), medium long (M2) and long (L) chromosomes. In addition, the maximum centromeric index was measured in 44.60%, centromere type were submetacentric chromosomes (sm) and metacentric chromosomes (m). Karyotype asymmetry index was 61.561%, and the karyotype formula was 2n=2x=36=24m+12sm. The karyotype characteristics was type 2B according to Stebbins's classification criteria. According to the above information, we can drawn a conclusion that 'bianhachi big flesh sweet mustard' is a relatively primitive mustard variety. The findings revealed its karyotypic characteristics of 'bianhachi big flesh sweet mustard' from the cytogenetic aspects. The results also provided the basis and reference for the inheritance and breeding, identification and development of mustard germplasm resources.

Key words: Brassica juncea cv. Bianhachi Big Flesh Sweet Mustard, Chromosome, Karyotype.

INTRODUCTION

Brassica juncea is a kind of cruciferae brassica annual herbaceous plant, which originated from spontaneous hybridization of the ancestors of B. rapa (AA, n=10) and B.nigra (BB, n=8)[1]. Brassica juncea, first found in Asia, is now widely grown throughout China and is nutritious. The mustard variety 'bianhachi big flesh sweet mustard' is a leaf mustard variety produced by Yangchun Agricultural Means of Production Co., Ltd.. The variety was purified and improved from the local variety, and matured at the middle and late stage. It has the characteristics of strong cold tolerance, easy cultivation, thick flesh and sweet taste. The mustard has high edible and market value and popular with gourmets and restaurants.

Karyotype analysis is a basic method to study chromosomes, it is a basic work in cytogenetics research. In this experiment, the karyotype analysis was carried out on the variety 'bianhachi big flesh sweet mustard' to reveal its chromosome composition, and to provide the basis for determining the genetic composition of Brassica juncea cv. bianhachi big flesh sweet mustard.

International Conference on Frontiers of Biological Sciences and Engineering (FBSE 2018)
AIP Conf. Proc. 2058, 020051-1–020051-4; https://doi.org/10.1063/1.5085564
Published by AIP Publishing. 978-0-7354-1786-1/$30.00

MATERIALS AND METHODS

Plant Materials

The representative Brassica juncea cv. bianhachi big flesh sweet mustard from Guangdong Province was used as experimental material.

Chromosome Preparation

The seeds were soaked for 2 h, then cultured in dark in petri dishes with moist filter paper at 25 °C incubator to the root length of 1-1.5 cm and cut root tips of about 1 cm. Pretreated in 0.002 mol·L-1 8-hydroxyquinoline at 4 °C for 4h, and fixed in Carnoy's solution (acetic acid: absolute ethanol, 1:3, v/v) at 4 °Cfor 24 h, subsequently, the root tips were macerated in 1 mol·L-1 hydrochloric acid at 60 °C for 8 min, stained with Carbol Fuchsin, and observed under microscope[2].

Karyotype Analysis

Chromosome counts were performed on 30 well-spread metaphase chromosomes from five different root tips. Karyotype analysis referred to the standard of Li et al.[3]. Following parameters were calculated: chromosome relative length, arm ratio, type of chromosomes, index of chromosomes relative length and centromere index. karyotypic formula referred to the standard of Levan et al.[4], and the asymmetry coefficient of karyotypes was calculated by the method of Arano[5], the karyotypes were calculated according to Stebbins's standard[6].

RESULTS

Chromosome Number of Brassica Juncea Cv. Bianhachi Big Flesh Sweet Mustard

Metaphase chromosomes and karyotype of Brassica juncea cv. bianhachi big flesh sweet mustard root tips were shown in Fig. 1, detailed karyotype parameters of chromosome were listed in Table 1. The chromosome number of 'bianhachi big flesh sweet mustard' was 2n=36.

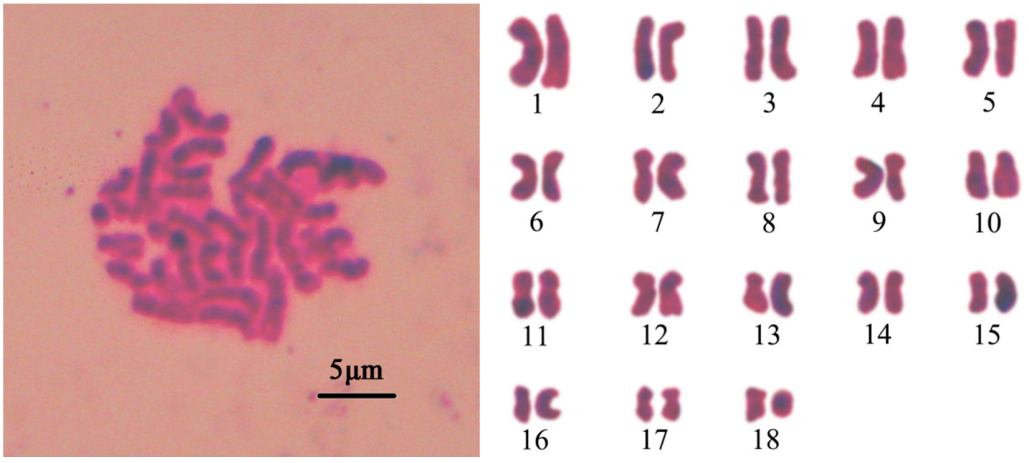

FIG 1. Metaphase chromosomes and karyotype of Brassica juncea cv. bianhachi big flesh sweet mustard root tips

Note: The number 1-18 represent chromosome no.

Karyotype Analysis

Chromosome relative length ranged from 3.08% to 8.29%, and chromosome length ratio (longest chromosome / shortest chromosome) was 2.25. The chromosome types included long chromosomes (L), medium long chromosomes2 (M2), medium short chromosomes1 (M1) and short chromosome (S), the constitution of the relative length was 6L+12M2+12M1+6S. The centromeric index ranged from 30.76% to 44.60%, and arm ratio ranked from 1.24 to 2.25. There were six pairs (the first, second, tenth, twelfth, thirteenth and sixteenth chromosome) of submetacentric chromosomes (sm) and twelve pairs (number three, four, five, six, seven, eight, nine, eleven fourteen, fifteen, seventeen and eighteen chromosome) of metacentric chromosomes (m). The karyotype formula was 2n=2x=36=24m+12sm. Karyotype asymmetry index was 61.561%, and karyotype characteristics fell into type 2B according to Stebbins's classification criteria. The chromosome idiogram of Brassica juncea cv. bianhachi big flesh sweet mustard were shown in Fig. 2.

TABLE 1. Karyotype parameters of chromosome of Brassica juncea cv. bianhachi big flesh sweet mustard

Chromosome No.	Relative length / %			Index of relative length	Type of relative length	Arm ratio	Centromere index / %	Centromere type
	Short arm	Long arm	Total length					
1	1.70	3.03	4.72	1.49	L	1.78	35.93	sm
2	1.25	2.82	4.07	1.29	L	2.25	30.76	sm
3	1.69	2.36	4.05	1.28	L	1.39	41.78	m
4	1.62	2.27	3.90	1.23	M2	1.40	41.67	m
5	1.41	2.32	3.73	1.18	M2	1.65	37.78	m
6	1.42	1.97	3.39	1.07	M2	1.39	41.91	m
7	1.29	2.06	3.35	1.06	M2	1.59	38.56	m
8	1.24	2.09	3.32	1.05	M2	1.69	37.19	m
9	1.27	1.97	3.24	1.02	M2	1.55	39.25	m
10	0.99	1.98	2.97	0.94	M1	2.00	33.31	sm
11	1.30	1.67	2.96	0.94	M1	1.29	43.75	m
12	1.07	1.88	2.95	0.93	M1	1.76	36.26	sm
13	1.00	1.76	2.77	0.87	M1	1.76	36.28	sm
14	1.05	1.67	2.73	0.86	M1	1.59	38.66	m
15	1.17	1.46	2.63	0.83	M1	1.24	44.60	m
16	0.83	1.52	2.35	0.74	S	1.82	35.43	sm
17	0.86	1.20	2.05	0.65	S	1.40	41.65	m
18	0.72	1.04	1.75	0.55	S	1.44	40.93	m

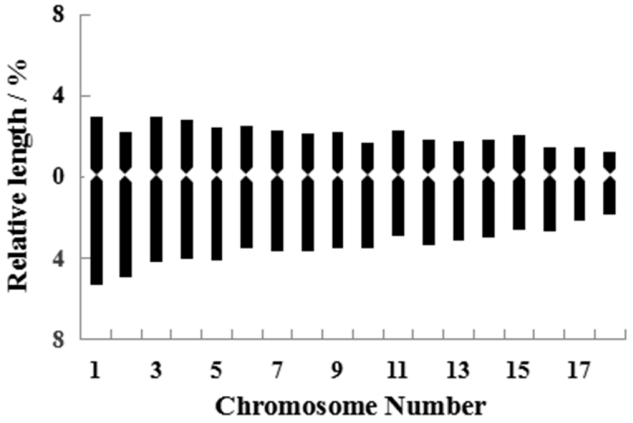

FIG 2. Chromosome idiogram of Brassica juncea cv. bianhachi big flesh sweet mustard

SUMMARY

The results of karyotype analysis of Brassica juncea cv. bianhachi big flesh sweet mustard were significantly different among different varieties of mustard. For example, in this experiment, the karyotype formula of 'bianhachi big flesh sweet mustard' was 2n=2x=36=24m+12sm, chromosome types contained m-type and sm-type chromosomes, no M-type and st-type chromosomes were observed, but Tong observed that its karyotype formula was 2n=2x=36=12m+16sm+8st or 2n=2x=36=2M+28m+6st[7]. The number of chromosomes varies among different mustard varieties, such as the chromosome karyotype formula of some varieties in Song et al. were 2n=20=14m+4sm+2st or 2n=20=14m+2sm+4st [8]. The number of chromosomes with satellites also varies, in this experiment, mustard does not have satellite, but some studies have shown two pairs or one pair of satellites [9]. In terms of chromosome karyotype asymmetry index, the results of this experiment was more similar to Brassica juncea var. Leucanthas (61.61%), and was far from the result of Brassica juncea var. Rugosa (66.33%) and Brassica juncea var. Cmssicauels (58.0%). The basic evolutionary trend of plant karyotypes is from symmetry to asymmetry. Thus, primitive plants have symmetrical karyotypes. And the more asymmetric the plant karyotype is, the higher its degree of evolution [6]. Therefore, 'bianhachi big flesh sweet mustard' should be a relatively primitive mustard variety in all mustard varieties.

ACKNOWLEDGEMENTS

This work was supported by key project of Department of Education of Sichuan Province (14ZA0016), Agricultural Support Project of Guizhou Province (QianKeHeZhiCheng [2018] 2372- 1; QianKeHeZhiCheng [2018] 2372-), and Science and Technology Special Fund Project of Central Subsidized Place (QianKeHeTiaoZhongBuDi [2015] 4003).

REFERENCES

1. Wang J.L., He Y., and Zhang Y.Q., et al. A study on origin, evolution and spread of Brassica in china. Zhongguo Nongxue Tongbao. Vol. 22 (2006) No. 8, p. 489-494
2. Wang X.R., Tang H.R., Duan J., et al. A comparative study on karyotypes of 28 taxa in Rubus sect. Idaeobatus and sect. Malachobatus (Rosaceae) from China. Journal of Systematics and Evolution, Vol. 46 (2008) No.4, p. 505-515.
3. Li M.X., and Chen R.Y. A suggestion on the standardization of karyotype analysis in plants. Journal of Wuhan Botanical Research. Vol. 3 (1985) No. 4, p. 297-302.
4. Levan A., Fradga K., and Sandberg A.A. Nomenclature for centromeric position on chromosomes. Hereditas. Vol. 52 (1964) No. 2, p. 201-220.
5. Arano H. The karyotypes and the speciations in subfamily Carduoideae (Compositae) of Japan. Japanese Journal of Botany. Vol. 19 (1965) No. 3, p. 31-67.
6. Stebbins G.L. Chromosomal evolution in higher plants. Edward Arnold Ltd. Press, London, 1971, p. 87-123.
7. Tong N.K. Observation on karyotype and chromosome behavior of different varieties of mustard. Journal of Southwest Agricultural University. Vol. 13 (1991) No. 3, p. 321-324
8. Song J.J, Zhang D.H. and Shao S.M. Karyotype of several Brassica vegetables cultivated in Chaoshan area. Journal of Shantou University (Natural Science). Vol. 16 (2001) No. 1, p. 1001-4217.
9. Du W., Chen Q.X., and Mo H., et al. Study on somatic chromosome karyotypes of Xinjiang wild rape, B.Campestris, B.Nigra, and B.Juncea. Journal of August 1st Agricultural College. Vol. 16 (1993) No. 4, p. 26-31.