Germplasm Evaluation and Selection of Lettuces (*Lactuca sativa* L.), Edible Chrysanthemums (*Chrysanthemum coronarium* L.) and Mallows (*Malva verticillata*) for Organic Farmers

Jang, S. W.[1], Hur, Y. Y.[1*], Choi, H. S.[1], Yang, E. Y.[1], Kim, K. D.[2] & Yeoung, Y. R.[3]

Abstract

We collected and examined germplasm resources of lettuces, edible chrysanthemums and mallows for organic farmers. We found that 3 genotypes (OL-51, OL-52, and OL-63) are suitable for organic cultivation. The main use of treatment for grey mold among eco-friendly pest control methods is helpful to increase efficiency of seed-gathering after collecting and evaluating a total of 64 kinds of lettuces- collected 43 South Korea local varieties, 8 kinds cultivated by the Highland Agriculture Research Center, 4 kinds of cultivated lettuces, and 9 kinds for sales- to choose appropriate kinds of lettuces for organic cultivation in South Korea. We chose those with more than 300 leaves (OC-18, OC-44, and OC-51) after evaluation of yield characteristics of a total of 62 edible chrysanthemums. We covered each genotype of seed of edible chrysanthemums when gathering the seeds by ourselves so as not to decrease the purity of each genotype. We chosed OM-38, OM-39, and OM-40 for their yield performance and germination rates among the total 41 genotypes of mallows. We selected 9 genotypes of lettuces, editable chrysanthemums and mallows with possibility of organic cultivation and found that they can be used permanently through self seed-gathering on organic farms.

Introduction

Demand for environmentally friendly agricultural products is on the rise as society is increasingly interested in health and food safety, and consumer awareness of the environment has increased. Research on cultivation has been undertaken on a large scale as shown in publication of Guidelines to Organic Cultivation (2006: National Institute of Agricultural Science and Technology, 2007: Jelloabuk-do Agricultural Research and Extension Services, 2010: Jeonnam Agricultural Research and Extension Service) but research on varieties suitable for organic cultivation and ways for seed-gathering is weak. 138,000 tons of lettuces were produced on 4,574ha, reaching KRW 115.9 billion in production volume as of 2008 in South Korea. 26,000 tons of edible chrysanthemums were produced on 1,079ha. Edible chrysanthemums are an important vegetable with its amount of production on bare ground reaching KRW 36 billion (2009: Ministry of Agriculture and Forestry). Mallow is not shown in statistics yet, but it is becoming a vegetable mainly used for soups in South Korea.

Use of native seeds is critical for organic cultivation which meets international standards but most farms use commercial seeds due to the lack of distribution of seed-gathering technology. Efforts to search varieties suitable for organic cultivation such as those for lettuces, edible chrysanthemums, and mallows are weak and organic farmers have gathered seeds by themselves or planted and harvested general genotypes consequently until now. Some genotypes suitable for organic cultivation, which had already been reported, were introduced in the Manual for Organic Cultivation of Lettuces (2006: National Institute of Agricultural Science and Technology), Manual for Eco-friendly Cultivation of Lettuces (2007: Jeollabuk-do

[1]National Institute of Horticultural & Herbal Science RDA, Suwon 440-706, Korea,
E-mail: swjang02@korea.kr
[2]Highland Agriculture Research Center, National Institute of Crop Science RDA, Pyeongchang 232-955, Korea
[3]Department of Plant Science, Gangnung-Wonju National University, Gangnung 210-702, Korea

Agricultural Research and Extension Services) and Technology Handbook for Organic Cultivation of Lettuces (2010: Jeonnam Agricultural Research and Extension Service) but such introduction is insufficient compared to that of general cultivation.
In addition, research on ways which help organic farms gather seeds by themselves and use them permanently has in fact not been done. This research intended to look for crops whose seeds farms can gather by themselves and use, especially promising resources in lettuces, edible chrysanthemums, and mallows, and other resources appropriate to organic cultivation.

Material and methods

As for lettuce, we gathered 43 traditional genotypes we collected in South Korea and abroad, 8 genotypes cultivated by the Highland Agriculture Research Center, 4 cultivated genotypes and 9 genotypes for sales and made them public. We separated organic and conventional management in lettuce by using an high altitude cool region organic field in Daegwanryeong and conducted characteristics research until late October after sowing on April 30, 2008 and planting on June 3. We publicized a total of 62 genotypes (57 traditional genotypes, which the agriculture gene bank and resource center of Rural Development Administration had distributed to us, and 5 genotypes for sales we gathered in the market) and made comparison in growth and yield in the case of organic cultivation to choose genotypes of edible chrysanthemums for organic cultivation. We made a total of 41 genotypes (37 traditional genotypes from the agriculture gene bank and resource center of Rural Development Administration, and 4 genotypes for sale that we gathered in the market) and compared their yield performance in the case of organic cultivation. We evaluated their characteristics and yield performance as in the case of general edible chrysanthemums. We used SAS 9.12 for statistical evaluations.

Results and discussion

Lettuces

Germination rates of collected traditional genotypes varied ranging from 0 to 100%. Their number of leaves was similar or more when they were organically harvested than when they were generally harvested. Differences between leaves (leaf length, leaf width) were large but leaf shape (proportion of leaf width/leaf length) was consistent. We found that collecting OL-63 have higher yields than other genotypes when it comes to organic cultivation of Chima type lettuce (Tab. 1). However, genotypes of red leaf ('Geocgchugmyeon' type) lettuces were found to have noticeably low yield in organic cultivation compared to general cultivation and we found that differences in growth are attributable to organic cultivation of lettuces according to leaf shape. In addition, collecting OL-51 is the only genotype which saw a higher yield than other genotypes of red leaf lettuces when it comes to organic cultivation (Tab. 2).

Tab.1: Comparison of growth and yield in organic and general cultivation of 'Chima' type leaf lettuces (*Lactuca sativa*)

Collecting No.	Organic cultivation				Conventional management			
	No. of leaves (each/plant)	Leaf length (cm)	Leaf width (cm)	Yield (ton/ha)	No. of leaves (each)	Leaf length (cm)	Leaf width (cm)	Yield (ton/ha)
OL-47[x]	40.9 c	13.5 b	9.0 bc	3.6 c	54.4 b	15.2 bc	10.5 a	9.7ab
OL-48[x]	39.1 c	11.3 cd	7.4 cd	3.0 c	35.9 c	16.8 abc	13.1 a	8.8 b
OL-53[x]	28.7 d	10.3 de	7.3 d	1.5 c	47.3 bc	16.0 abc	12.4 a	10.6 ab
OL-56[x]	40.3 c	13.2 bc	10.0 ab	6.4 b	44.7 bc	19.3 b	13.8 a	12.4 ab

OL-63[y]	65.7 a	16.7 a	11.3 a	11.8 a	71.1 a	17.8 ab	12.7 a	16.6 a
OL-64[z]	56.4 b	14.7 b	9.7 ab	7.1 b	51.7 bc	18.4 ab	12.0 a	9.6 ab
LSD (5%)	7.03	1.87	1.65	4.68	16.38	3.77	3.35	16.52
CV	2.14	2.14	2.14	2.14	2.14	2.14	2.14	2.14

[x]Jeogchima; [y]Cheongchima; [z]Heugchima

Tab.2: Comparison of growth and yield in organic and general cultivation of 'Geocgchugmyeon' type leaf lettuces (*Lactuca sativa*)

Collecting No.	Organic cultivation				Conventional management			
	No. of leaves (each/plant)	Leaf length (㎝)	Leaf width (㎝)	Yield (ton/ha)	No. of leaves (each)	Leaf length (㎝)	Leaf width (㎝)	Yield (ton/ha)
OL-45	26.6 b	10.7 a	11.2 a	3.5 bcd	30.9 ab	16.2 ab	15.9 abc	8.8 ab
OL-46	25.2 b	11.2 a	12.5 a	3.0 cd	26.4 abc	12.9 d	14.8 c	5.0 b
OL-49	28.6 b	11.1 a	11.8 a	22.7 d	29.9 ab	13.5 cd	14.6 c	7.3 ab
OL-50	22.7 b	11.5 a	13.6 a	4.4 b	28.8 abc	13.7 bcd	15.2 bc	5.8 b
OL-51	40.0 a	12.4 a	12.6 a	8.1 a	32.0 ab	15.0 bcd	15.7 bc	10.3 ab
OL-54	22.3 b	10.7 a	13.0 a	4.4	26.3 abc	14.6 bcd	17.7 abc	9.9 ab
OL-55	22.4 b	10.7 a	13.5 a	3.3 bcd	23.4 bc	13.9 bcd	18.1 ab	12.0 a
OL-59	15.0 c	11.1 a	12.6 a	3.8 bcd	33.2 a	16.0 abc	17.0 abc	12.4 a
OL-60	15.2 c	11.8 a	13.1 a	2.6 d	19.8 bc	18.1 a	19.0 a	8.9 ab
LSD (5%)	6.62	1.99	2.82	2.60	9.56	2.69	3.30	10.77
CV	2.10	2.10	2.10	2.10	2.10	2.10	2.10	2.10

Edible chrysanthemums

Most of the collected traditional genotypes germinated, except for two cases, but their germination rate tended to be generally low. 40 genotypes have less than 40% germination, 16 genotypes showed 41-70%, and only 4 genotypes had more than 70% germination rate. Growth characteristics showed that 4 genotypes (OC-17, 42, and 44) have more than 70 % of initial germination rate after being planted, 10 genotypes (OC-9, 13, 16, 18, 31, 37, 51, and 60) have more than 200g of yield performance, and OC-44 was the only one genotypes which has more than 70% germination rate and more than 200g of weekly yield performance. We could choose 3 genotypes (OC-18, 44, 51) as promising varieties for organic cultivation among the collected germplasm resources based on comprehensive consideration of germination rate, growth, yield, and budding period (Tab. 3).

Tab. 3: Selected of good sprouting rate, late bolting and yield of edible chrysanthemum (*Chrysanthemum coronarium*)

Collecting No.	Sprouting rate (%)	Plant height (cm)	No. of leaves (each/plant)	Leaf length (㎝)	Leaf width (㎝)	Total weight (g/plant)	Yield (ton/ha)	Budding days after sowing
OC 18	14	24.3	380.0	11.6	4.7	242.9	13.5	89
OC 44	74	27.8	428.6	12.4	5.8	361.7	20.1	-[z]
OC 51	37	23.4	375.3	12.5	5.5	293.3	16.3	78
Control	61	25.3	375.9	11.7	5.3	250.2	13.9	-
LSD 5%	-	NS	218.9	-	-	146.2	8.11	
CV	-	2.0	2.0	-	-	2.0	2.0	

[z]Dead in field before budding.

Mallows

Six of the collected traditional varieties did not germinate and most of them germinated but germination rates tended to be low on the whole. 37 genotypes had less than a 40% germination rate. 8 genotypes saw germination rates of 41-70%. Only 6 genotypes had more than 70% germination. Growth characteristics after being planted showed that 5 genotypes (OM-36, 37, 38, 39 and 40) have more than 70% of initial germination rate, 11 genotypes (OM-13, 17, 34, 36, 37, 38, 39 and 40) have more than 100g of yield performance, and 4 genotypes (OM-36, 38, 39, and 40) have more than 70% of germination rate and 100g of weekly yield performance. We could choose 3 genotypes (OM-38, 39 and 40) as promising germplasm resources for organic cultivation among those collected germplasm resources based on comprehensive consideration of germination rate, growth and yield performance (Tab. 4).

Tab. 4: Selected of hood sprouting rate, late bolting and yield of mallow (*Malva verticillata*)

Collecting No.	Sprouting rate (%)	No. of leaves (each/plant)	Leaf length (cm)	Leaf width (cm)	Petiole length(cm)	Total weight (g/plant)	Yield (ton/ha)
OM 38	89	65.4	15.9	17.3	2.0	120.1	6.8
OM 39	100	67.3	15.9	17.7	3.6	115.0	6.4
OM 40	74	67.5	16.5	18.6	2.2	118.7	6.6
Control	100	58.8	15.9	18.7	2.7	109.4	6.1
LSD 5%	-	23.8	4.0	4.3	2.4	62.6	3.48
CV	-	2.0	2.0	2.0	2.0	2.0	2.0

Conclusions

Based on our research, we chose 9 promising genotypes for organic cultivation including lettuces, edible chrysanthemums and mallows and found that organic farmers can gather their seeds by themselves and use them permanently.

References

Technology Handbook for Organic Cultivation of Lettuces (2010): Jeonnam Agricultural Research and Extension Service, Environmental-friendly Agriculture Research Center of Chonnam National University.

Manual for Eco-friendly Cultivation of Lettuces (2007): Jeollabuk-do Agricultural Research and Extension Services.

Manual for Organic Cultivation of Lettuces (2006): National Institute of Agricultural Science and Technology of Rural Development Administration.

2009 Statistics of greenhouses for vegetables grown in facilities and performance of production of vegetables (2010): Dept. of Special Production of Vegetables, the Ministry of Agriculture and Forestry.