The Evaluation of Comprehensive Traits of Sugarcanes Cultivated in and Introduced by Guizhou Province with Grey Relation Degree Analysis

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Abstract

This paper evaluates the 7 kinds of comprehensive trait of 19 varieties of sugarcanes cultivated in Guizhou Province and introduced from other areas with grey relation degree analysis. The results show that Qiantang 4, QY07-01 and ROC 21 are the best sugarcanes with excellent characters; Qiantang 3 and Qiantang 5 are better ones similar to CK F134; QY07-02, Guitang 11, Yunzhe 03-422 and QY07-03 are poor ones that are unfit to be used as sugarcane and fruit sugarcane, but might be reserved in species resources.

Keywords: Sugarcane, New varieties, Comprehensive evaluation, Grey relation degree

1. Introduction

The comprehensive evaluation of new varieties of sugarcane is an important part of research. Such an evaluation plays a decisive role in the promotion of the plantation of the sugarcanes. This paper evaluates the comprehensive traits of the sugarcanes cultivated in and introduced by Guizhou Province with gray relation degree analysis (Jia, Z. K., 1988; Wu, M.S & Dai, J.R., 1999) for the first time. The quantitative evaluation will objectively reflect their degree of excellence in terms of the comprehensive traits.

2. Samples and Methods

There are 19 species of sugarcanes selected in the sample for the test including: 3 strains of sugarcanes that are Qiantang 3, Qiantang 4 and Qiantang 5 cultivated by Guizhou Institute of Subtropical Crops, and Luohanzhe that is locally grown, and Xuan 50, ROC21, ROC22、ROC26, QY07-01, QY07-02, QY07-03, QY07-04, QY07-05, Yunzhe 03-422, Yunzhe 99-91, Baxi 45, Guitang 11 and Ganzhe that are introduced by Guizhou Institute of Subtropical Crops. The sampled species are compared with CK F134 during the one year experiment. The test land is of yellow soil and the irrigation is normal. The sugarcanes are randomly planted in the test land. Each species of sugarcane occupies 18 m^2 in total and is separately planted in 3 areas each of which measures 1.2 m by width and 5m by length. The test land is managed in a normal way. The sugar contents analysis is carried out in the middle of November and the harvest time is in December.

The plant disease classification is modified based on Yi (2007) as follows. Grade 5: perfectly healthy; Grade 4: healthy with less than 25% of the surface exhibiting disease spots, the number of which varies from 1 to 25 in each leaf; Grade 3: basically healthy with 26% to 50% of the surface exhibiting disease spots, the number of which varies from 26 to 50 in each leaf; Grade 2: unhealthy with 51% to 75% of the surface exhibiting disease spots, the number of which varies from 51 to 75 in each leaf; Grade 1: very unhealthy with more than 75% of the surface exhibiting disease spots, the number of which exceeds 75 in each leaf; Grade 0: extremely unhealthy or

totally diseased, in which condition, most of leaves are withered to death because of diseases. The analyzed traits of the study include the plant height, the stem diameter, the number of valid stalks, the sugar content, the disease resistance, the yields of the sugar and canes from the area of each 667m^2. The data are processed with Microsoft Excel.

3. Results and Analysis

The average values of the comprehensive traits of the first year crops are listed as follows in table 1. In the table a series of values that are a little bigger than each max value are composing the coreference (C_o), and C_i stands for species factor, in which i = (1,2,3….,19), and k stands for linear factors, in which k = (Plant height, stem diameter, number of valid stalks, the sugar content, the disease resistance, the yields of the sugar and canes). Suggested by experts and combined with the practical conditions in Guizhou Province, the researcher endows some powers on the influences of the various species of sugarcanes to their comprehensive traits.

First of all, the researcher processes the data in table 1 with the dimensionless method $C_i = \frac{C_i(K)}{\overline{C_i}}$, then calculate the absolute value of the difference between C_o and C_i, finally figures out correlation coefficients with the formula of

$$\delta_i(k) = \frac{\min_i \min_k |C_o(K) - C_i(K)| + \rho \max_i \max_k |C_o(K) - C_i(K)|}{|C_o(K) - C_i(K)| + \rho \max_i \max_k |C_o(K) - C_i(K)|}.$$

The result are $\min_i \min_k |C_o(K) - C_i(K)|$ =0.0000, and $\max_i \max_k |C_o(K) - C_i(K)|$ =1.3103 when ρ =0.5. The correlation coefficients are listed in table 2.

According to $r_i = \sum_{k=1}^{N} W_k \, \delta_i(k)$, the correlational degrees between the sample species and the reference are listed in table 3.

The table 3 shows the top 3 species of the sugarcanes in comprehensive traits are Qiantang 4, QY07-01 and ROC 21. They have stronger correlation to and quite agreement on the reference. Then Xuan 50, QY07-05 and Ganzhe are worse than the top 3 but are better than Qiantang 5, F134 and Luohanzhe. Also the table 1 shows similarly that the yields of the top 3 are Qiantang 4, QY07-01 and QY07-05. Then Ganzhe, Xuan 50 and ROC21 are worse than the top 3 but are better than Qiantang 5, F134 and Luohanzhe.

4. Conclusion

The above analyses show the 3 species of sugarcanes that are Qiantang 4, QY07-01 and ROC 21 have stronger correlation to and quite agreement on the reference in terms of their comprehensive traits. Being far better than F134 in their qualities, the 3 species of sugarcanes are suitable to be promoted in Guizhou Province. In particular, the Qiantang 4 cultivated and tested by Guizhou Institute of Subtropical Crops keeps stable in its comprehensive traits. The QY07-02, Guitang 11, Yunzhe 03-422, QY07-03 etc. are not so good in their comprehensive traits, and moreover their sugar contents are over high as fruit sugarcane, so they are not suitable to be promoted though they might be reserved in species resources. Qiantang 3 and Qiantang 5 drop down in the list of the comprehensive traits as sugar canes, but they are good as fruit sugarcanes, because Qiantang 5 is especially resistant to the diseases and Qiantang 3 tastes crispy and juicy. The locally grown Luohanzhe was of high quality as the fruit sugarcane 10 yeas ago, but damaged by disease and insect for years, it has degraded dramatically in its comprehensive traits.

In conclusion, the evaluation of comprehensive traits of sugarcanes with gray relation degree analysis is objective and feasible. It can boost up the degree of accuracy, validity and efficiency of the evaluation of the canes. The results of the evaluation with the gray relation degree analysis conform to the ones observed in the field.

References

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Table 1. The average values of 7 comprehensive traits of sampled species from the 1st year crops

Species	Plant Height (cm)	Stem Diameter (cm)	Valid stalk (stalk/667m²)	Cane yield (kg/667m²)	Sugar Content (%)	Disease resistance	Sugar yield (kg/667m²)
Qiantang 3	233.00	3.01	5894	8509.59	11.32	2	962.95
Qiantang 4	285.30	3.02	6894	12601.02	13.52	4	1704.16
Qiantang 5	201.40	3.35	4226	6381.16	11.11	5	708.88
Luohanzhe	206.80	3.45	3447	5694.18	10.07	1	573.63
Xuan 50	261.10	3.10	6450	11244.83	13.59	3	1528.51
ROC 21	249.90	3.15	6894	11808.30	12.77	3	1507.33
ROC 22	257.50	3.13	6116	10700.58	13.52	3	1447.15
ROC 26	235.70	3.18	4670	7625.62	15.18	3	1157.57
QY07-01	223.20	3.26	6783	10932.86	14.90	3	1629.43
QY07-02	244.90	3.15	4559	7631.27	14.84	3	1132.10
QY07-03	216.40	3.26	4559	7089.58	14.28	3	1012.60
QY07-04	207.00	3.36	5894	9245.53	13.46	3	1243.99
QY07-05	254.00	3.46	5338	11236.95	14.15	3	1589.47
Yunzhe 99-91	222.60	3.29	4670	7642.49	15.46	3	1181.22
Yunzhe 03-422	221.50	2.95	5115	6691.57	14.90	3	997.31
Baxi 45	273.40	2.94	5004	8264.23	14.42	4	1191.78
Guitang 11	236.30	3.27	5004	8665.26	13.39	3	1159.93
Ganzhe	259.60	3.32	5338	10604.65	14.49	3	1536.61
F134	233.10	3.28	4670	8010.21	11.32	3	906.44
Average	238.04	3.21	5343	8977.89	13.51	3.05	1219.53
Reference C_0	285.40	3.47	6895	12601.02	15.47	5	1704.20
Weight(W_k)	0.15	0.1	0.15	0.15	0.15	0.1	0.2

Table 2. The grey correlation coefficients of the sampled species of sugarcanes in terms of Comprehensive traits

Varieties	Plant height (cm)	Stem diameter (cm)	Valid stalk (stalk/667m²)	Cane yield (kg/667m²)	Sugar Content (%)	Disease resistance	Sugar yield (kg/667m²)
Qiantang 3	0.7485	0.8204	0.7776	0.5898	0.6806	0.4000	0.5187
Qiantang 4	0.9994	0.8236	0.9997	1.0000	0.8198	0.6667	1.0000
Qiantang 5	0.6499	0.9460	0.5674	0.4860	0.6699	1.0000	0.4453
Luohanzhe	0.6649	0.9906	0.5038	0.4599	0.6212	0.3333	0.4141
Xuan 50	0.8652	0.8503	0.8872	0.8126	0.8250	0.5000	0.8197
ROC 21	0.8146	0.8678	0.9997	0.8812	0.7659	0.5000	0.8023
ROC 22	0.8482	0.8607	0.8180	0.7558	0.8198	0.5000	0.7566
ROC 26	0.7583	0.8787	0.6114	0.5417	0.9683	0.5000	0.5938
QY07-01	0.7149	0.9091	0.9690	0.7791	0.9399	0.5000	0.9144
QY07-02	0.7938	0.8678	0.5998	0.5420	0.9331	0.5000	0.5827
QY07-03	0.6933	0.9091	0.5998	0.5163	0.8817	0.5000	0.5360
QY07-04	0.6655	0.9502	0.7776	0.6367	0.8146	0.5000	0.6345
QY07-05	0.8324	0.9953	0.6922	0.8117	0.8698	0.5000	0.8744
Yunzhe 99-91	0.7129	0.9211	0.6114	0.5426	0.9984	0.5000	0.6044
Yunzhe 03-422	0.7093	0.8016	0.6629	0.4988	0.9399	0.5000	0.5306
Baxi 45	0.9286	0.7986	0.6493	0.5756	0.8940	0.6667	0.6093
Guitang 11	0.7605	0.9131	0.6493	0.5991	0.8094	0.5000	0.5948
Ganzhe	0.8580	0.9334	0.6922	0.7466	0.9003	0.5000	0.8266
F134	0.7498	0.9171	0.6114	0.5616	0.6806	0.5000	0.5004

Table 3. The grey relation degrees between the sample species and the reference in order

variety	Qiantang 3	Qiantang4	Qiantang5	Luohanzhe	Xuan 50	ROC 21	ROC 22	ROC 26	QY07-01	QY07-02
grey relation degree	0.6453	0.9218	0.6396	0.6322	0.8075	0.8165	0.7737	0.6886	0.8342	0.6836
order	16	1	17	19	4	3	7	11	2	12
variety	QY07-03	QY07-04	QY07-05	Yunzhe99-91	Yunzhe03-422	Baxi 45	Guitang11	Ganzhe	F134	
grey relation degree	0.6518	0.7061	0.8053	0.6928	0.6579	0.7255	0.6830	0.7882	0.6322	
order	15	9	5	10	14	8	13	6	18	