



# Design of Statistical Model for Difference of Leaf Color of Ornamental Begonia Based on Big Data Analysis

Hui Liu<sup>(✉)</sup>

Heze University, Heze, China  
ysh201701@163.com

**Abstract.** Based on big data's analysis, the statistical model of the difference between different leaf colors of ornamental begonia was designed in order to solve the problem of low statistical accuracy of the difference between different leaf colors of traditional ornamental begonia. Combined with quantitative classification, the variety of ornamental begonia was investigated and analyzed, and the characters of ornamental begonia were analyzed and the coding design was carried out. On this basis, the varieties of ornamental begonia were labeled with different leaf colors. The statistical model design of the difference between different leaf colors of ornamental begonia is realized. The experimental results show that the model design has good accuracy.

**Keywords:** Big data analysis · Ornamental begonia · Leaf color variety

## 1 Introduction

The cultivation and application of ornamental begonia in China has been recorded for nearly 2000 years. During the long-term cultivation process, many varieties have been formed through natural selection and human participation. Recently, some new species with high ornamental value have been introduced in China, which greatly enriches the resources of ornamental begonia. In order to make better use of these resources, it is urgent to make a scientific and systematic statistical study on the differences between different leaf colors. At present, there are many problems in the statistical research on the difference of leaf color among ornamental begonia. The resources of ornamental begonia are unclear [1]. The investigation of ornamental begonia resources was carried out as apple rootstock and breeding resource in the early stage. The taxonomy was also rarely carried out under the species line, and some of the varieties investigated at that time had been lost, while the new variety resources had not been systematically investigated [2]. The other is regulation of genes, regulation of anthocyanin biosynthesis structure gene expression intensity and process, and pigment accumulation in space and time.

The varieties of the modern ornamental begonia are becoming more and more diverse and the ornamental characters are more abundant. The varieties are different from the original species or their parents in such characters as branch type, flower color, flower type and fruit, etc. Generally speaking, the variety of ornamental begonia,

white flowers account for the majority. For example, the leaves of red jade begonia are light green, strawberry jelly begonia is dark green, the leaves of red begonia are yellow green ornamental begonia are rich in natural anthocyanin glycoside, flavonol, proanthocyanidins, etc. It can be used as ornamental tree species to beautify the urban and rural environment, as well as the construction tree species around the city forest belt, at the same time, it can be used to develop related ornamental begonia health products. It is of great significance for the development of new ornamental begonia varieties with both ornamental and medicinal value to deeply study the difference statistics among different leaf colors of ornamental begonia.

## 2 Design of Statistical Model for Difference of Leaf Color of Ornamental Begonia

### 2.1 Investigation and Analysis of Begonia Varieties

Combined with quantitative classification, a variety classification system for ornamental begonia varieties with different leaf colors was established, which laid a solid foundation for the classification of ornamental begonia varieties. In order to do a good job in classification of ornamental begonia [3], the first and urgent task is to carry out extensive investigation and research, find out the resources of ornamental begonia varieties, and analyze the leaf size, shape and color of ornamental begonia. The leaf characteristics of ornamental begonia varied in varieties, especially in leaf size, shape and color of leaves under inflorescences and new shoots during anthesis. Therefore, when the varieties were recorded, they were recorded separately. The leaves which have been fully expanded under the inflorescence at the time of anthesis are called young leaves, and the leaves on the new shoots which will be sprouted from leaf buds are called mature leaves or old leaves when they are fully expanded and reach their proper size [3]. The young leaf characters were recorded at flowering stage, with the records of flowers and inflorescences, while the records of old leaves were recorded in autumn, and the records of fruit characters were carried out at the same time. Leaf blade shape is round, ellipsoid, ovate, Obovate, in which the most oval and ellipsoid. The classification and coding of the characters of the varieties of *Malus* were carried out as shown in the table.

**Table 1.** Trait characteristics and coding.

	Character	Detailed coding
1	Flower color	Flowers red, pink, white
2	Flower pattern	Double cultivar single petal
3	Footpath among flowers	Flower diameter reaches 5 cm
		Flower diameter less than 4 cm
4	Florescence duration	Long viewing period
5	Flower quantity	Flower diameter covering leaf
6	Fruit size	Fruit diameter greater than 2 cm
7	Leaf color	Larger result
8	Tree form	Leaf purple red

Table 1 is the classification and coding of the characters of the begonia cultivars. The maximum width axis of a rectangular leaf and two nearly parallel leaf edges cover the middle of the long axis of the leaf, and the maximum width axis of the elliptic leaf is perpendicular to the midpoint of the leaf axis in a region composed of the maximum width axis of a rectangular leaf and two almost parallel leaf edges. The axis base of the axis of the oval leaf blade is at the midpoint of the former, and the axis of the Obovate leaf blade is the maximum width of the axis of the intersecting leaf at the midpoint of the former. At the same time, whether or not the leaves split, leaf color, young leaf color in addition to green, there are purple red, bright red and yellow. The old leaves have dark red in addition to green. Some old leaves become dark red or golden yellow, orange and other colors in autumn, as autumn leaves recorded in the specificity evaluation column. Green is divided into light green, dark green three levels [4]. Some young leaves are green, the leaves are respectively recorded by the surface and back of the hairy leaves, respectively, divided into dense, micro, only midvein, not four grades; The most important indexes for classification of ornamental begonia are leaf length, leaf width, middle width, broadest position and tip distance, so the measurement of leaf size mainly records these items. Leaf length refers to the length of leaf base to leaf tip, and leaf width refers to the distance between the two leaf edges at the broadest part of the leaf. The middle width of the leaf is the distance between the two leaf edges in the middle of the leaf, and the distance between the broadest part and the tip is to measure the length of the straight line from the leaf width to the tip, and the shape of the leaf tip is the area surrounding the edge of the leaf, which is slightly more than 25% at the upper end of the leaf. Apiculate, attenuate, mucronate, obtuse, and rounded [5]; leaf base shaped; leaf base refers to area surrounded by leaf margin slightly less than 25% of leaf base. Sharp, obtuse, narrowly cuneate, broadly cuneate, rounded, cordate, decurrent. The leaf margin is arc-shaped, with angle less than  $90^\circ$  as sharp tip and more than  $90^\circ$  as sharp point and more than  $90^\circ$  as obtuse; if the leaf margin is almost straight called wedge, the angle less than  $90^\circ$  is narrow cuneate and greater than  $90^\circ$  is broadly cuneate; the leaf edge is circular in arc shape at the base. The leaf margin of the ornamental begonia is mostly serrated, the whole leaf is very few, and the serrate is mostly single-serrated and the double-serrated is very few, so the records of the leaf margin are mainly recorded by the obtuse, sharp, neat and irregular of the serrated teeth. Petiole, mainly recorded petiole length, petiole coarseness, petiole color and coat, leaf blade texture subleathery and papery [6]. Nearly leathery leaf blade thick, hard, paper leaf thin, soft, leaf surface characteristics, mainly recorded smooth or not smooth, glossy or lustrous. Most of the leaves were spreading, some of them would appear leaf tip or leaf edge bending to the back. In the specific evaluation, inflorescence, ornamental malus inflorescence characters, mainly recorded the inflorescence type, the number of flowers per inflorescence, the number of leaves per inflorescence, and the number of leaves per inflorescence. Branches under inflorescences long, entire trees flowering and flowering. There are two types of inflorescences: umbels and umbels; the number of flowers per inflorescence, the number of leaves per inflorescence, the length of young branches under inflorescence, and the number of flowers per inflorescence, the number of leaves per inflorescence and the length of young branches in inflorescences are measured. The flower and fruit characters of flowering begonia are not only more stable than leaf characters, but also play an important role in classification, and

they are also the main ornamental parts. The buds of begonia are always darker in color than the Corolla, and thus have higher ornamental value. Mainly record bud color and bud shape, bud color has purple, crimson, bright red, pink four kinds. Bud-shaped apical and round, Corolla, including Corolla diameter, color, there are no veins, flowers, and other recorded items. Corolla diameter: Measure the natural corolla diameter when the flowers are in full bloom. It is impossible to flatten the flowers artificially or measure the flowers that are not in full bloom [7], in cm. The flower color of the begonia was gradually dimmed from the first flower to the last flower. Therefore, the full flowering stage was taken as the standard in the record, and the flower color of the first and last flowering stage was recorded as a reference. If the flower color changes significantly during the flowering process, it should be recorded separately. Because the bud color of the begonia is darker than the petals, there will be dark veins appearing in the petals color, and whether or not the veins are recorded at the same time when the flower color is recorded; flower incense: recorded in the blooming stage, there are no two grades. Through the investigation and analysis of the varieties of Begonia, we can provide help to mark the varieties of different leaf colors, so as to realize the statistical work of difference.

## 2.2 Marking of Different Leaf Color Varieties of Begonia

Under the analysis of big data, the different leaf color varieties of ornamental begonia were labeled. In order to prepare for the statistical analysis of the difference between different leaf colors of ornamental begonia, isozyme and molecular marker methods were used to mark [8]. On the premise of defining the “species line” to which the variety belongs (or if it is the origin of the intraspecific or intergeneric hybrid, and the name of the hybrid or hybrid genus), three taxonomic units, namely, variety group, variety and grafted chimera, are adopted, On the basis of the origin of natural taxonomic species (or hybrids and varieties), the varieties of ornamental begonia with different leaf colors were classified on the basis of source. The petals of most varieties of ornamental begonia are nearly rounded, ovoid or Obovate, apex obtuse, base with short claws. But the petals of ‘lotus-like’ begonia and ‘double petal’ Hubei begonia ‘are ellipsoid, petal apex apical, petal-shaped like lotus flower; petals of’ rolling calyx ‘Liriodendron are not spreading, middle base has raised ridges, and petals above petals are tomentose; The inner buckle of the petals. Some double petals with large number of petals, double petal varieties due to spatial position of petal smaller, irregular shape or surface shrink phenomenon.

Different leaf colors of ornamental crabapple have the same or similar substrates, which catalyze the same reaction. Isozymes are the direct products of gene expression [9], in which the number of bands and mobility changes are largely determined by structural genes. Therefore, according to the phenotypes of isozymes, we can directly judge the different leaf color varieties of Begonia hypoglauca. The zymogram of isozymes in the progeny of the same vegetative line was always unchanged, and the zymogram characteristics of the same species or variety after asexual reproduction remained basically unchanged. In the same variety, most isozymes were relatively stable at different tree ages and at different stages of development, the basic zymogram of the original variety was still maintained in the tissue culture seedlings of the same

variety, and some main enzyme bands of the same variety remained stable under different soil fertility conditions. Among them, molecular markers are a kind of genetic markers developed with the development of molecular cloning and recombinant DNA technology of ornamental begonia [10]. Molecular markers are expressed in the form of DNA directly in the tissues of plant, they can be detected in all developmental stages, not limited by season or environment, and the number is high, and the whole genome has polymorphism. The marker formula of analysis marker for different leaf color varieties of *Begonia hypoglauca* was as follows:

$$e = \frac{c(B_1, k)^{-1}}{v - rt_n} \tag{1}$$

In the formula,  $e$  represents the detected ornamental crabapple factor;  $t_n$  represents all third-party data;  $B_1$  represents the plant tissue of crabapple;  $k$  represents the set of non-stop leaves of crabapple; This calculation is only for introducing coefficients, not for directional analysis. On this basis, a formal definition will be given. If and only if item  $r$  is to be marked item  $t_n$ , the form of *Begonia* mark can be recorded as  $n(k) \Rightarrow x_i$ .

According to the requirement of molecular marker [11], the marker function of different leaf color cultivars of *Begonia* crabapple was obtained by using  $n(k) \Rightarrow x_i$  as the minimum support rule coefficient of marker without considering environmental limitation and quantity value.

$$M = \frac{B_n/f(t)}{K(cn)^2 \Rightarrow x_i} \tag{2}$$

In the formula,  $M$  represents the rule of molecular marking;  $B_n$  represents the parameter of marked crabapple;  $f(t)$  represents the total number of marked crabapples in  $t$  time. This calculation does not do directional analysis.

By marking different leaf colors of ornamental begonia, it can provide a basis for statistical analysis of the differences among different leaf colors, so as to realize the difference statistics of different leaf colors.

### 2.3 Statistical Analysis on the Difference of Leaf Color of Ornamental Begonia (*Tripterygium indica* L.)

The statistical model design of the difference between different leaf colors of ornamental begonia was realized through the investigation and analysis of the variety resources and the marking of different leaf colors. Considering the difference of leaf color among begonia varieties [12], the difference of begonia varieties is calculated first, and the formula is as follows:

$$K_n = \sum_v^N d_q / F_c N_u \tag{3}$$

In the formula,  $K_n$  represents the quantity parameter of crabapple and  $F_c$  represents the quantity of different leaf colours. Formal definition of  $N$ , when  $d_q$  and only if the transaction item  $v$  are included, the results of different varieties of Begonia with different leaf colors are obtained. On this basis, the statistical model of the difference between different leaf colors of ornamental begonia was established, and the process map was shown as shown in the diagram (Fig. 1).

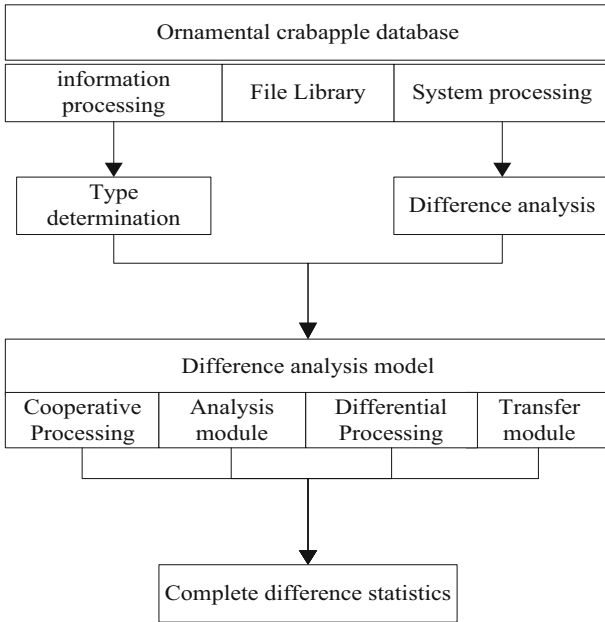


Fig. 1. Statistical process chart of differences

As shown in the chart, the statistical process map of the difference between different leaf colors is shown. According to the above-mentioned process, the difference statistics among different leaf color varieties are carried out, and on the basis of the results of the difference of different leaf colors, the results of the difference statistics between different leaf color varieties are obtained according to the above-mentioned process. To achieve the difference statistics among different leaf color varieties, the formula is as follows:

$$T_{\eta} = \sum_j^m c_j / m \times v_{\sigma} \times d \times g' \tag{4}$$

In the formula,  $T_{\eta}$  represents the number parameter of crabapple varieties,  $c_j$  represents the difference parameter in difference statistics,  $m$  represents the Initial Value of Different Leaf Colour Difference Data of Orange Begonia,  $v_{\sigma}$  represents the difference quantity of crabapple varieties,  $d$  represents the statistics of different leaf color

differences.  $g'$  represents the introduced statistics. This calculation only introduces parameters, not directional analysis.

Through statistical calculation of difference, the statistical model design of the difference between different leaf colors of ornamental begonia was completed. In order to ensure the validity of the design, the following comparative experiments were carried out.

### 3 Results

The experimental materials were taken from a certain area, and more than 100 species of begonia were planted in the experimental area, and more than one hundred varieties of begonia were planted at home and abroad. The petal samples of Begonia begonia were collected at the bud stage, the full flowering stage and the last flowering stage respectively. According to the different growth position of the leaves, the young leaves at the top and the functional leaves at the middle part were collected respectively. The following is the design of color parameters of begonia varieties (Table 2):

**Table 2.** Design of color parameters of begonia varieties.

Color series and subseries	Cultivar number	L	a	b
Green	28	46.80 ± 3.52	-6.60 ± 3.81	28.92 ± 4.77
Dark green	15	46.20 ± 3.13 b	-7.03 ± 2.83 b	27.35 ± 2.31 b
Brownish green	3	42.72 ± 2.28 a 49.90 ± 2.10 a	-1.98 ± 1.98	22.13 ± 1.61
Bright green	7	32.50 ± 2.70 b	1.18 ± 1.98 a	9.46 ± 3.40 b
Reddish brown	20	38.20 ± 2.87 a	7.60 ± 2.42 b	21.80 ± 3.34 a

#### 3.1 Processing Method

Analytic hierarchy process (AHP) is a multi-objective decision-making and evaluation method which combines qualitative analysis and quantitative analysis. The structural feature is that each element of the upper level is completely related to each factor of the next level, that is, each element of the upper level plays a role as the decision criterion of the next level. The whole operation process is completed by the analytic hierarchy process software Yaahp0.3.2 software package. The advantage of this software is: using the drawing method similar to Visio to complete the hierarchical structure model. The selection of fine ornamental begonia varieties is regarded as the target layer of difference statistics, that is, the difference analysis value obtained by comparison among the varieties, and the result as the evaluation layer of difference analysis.

### 3.2 Contrast Result

In the above environment, the experimental comparison is carried out, and the results are as follows (Fig. 2):

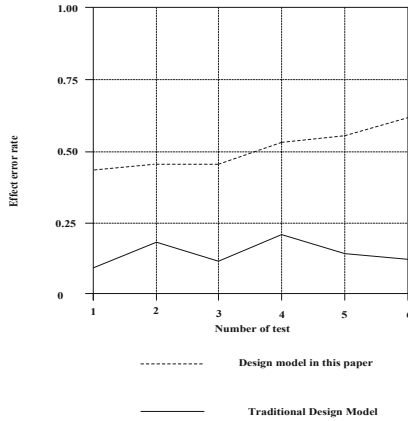


Fig. 2. Contrast chart of statistical accuracy of difference

Through the comparison chart, we can see that the precision of the difference statistical model design in this paper is high, and the error is small and the floating is low in the statistical time.

## 4 Conclusion

This paper puts forward the statistical model design of the difference between different leaf colors of ornamental begonia based on big data's analysis, and it is proved by experiments. The statistical model designed in this paper can improve the accuracy of difference statistics and help the further development of ornamental begonia. Therefore, it can be concluded that the statistical model designed in this paper is effective and can be applied to the statistical analysis of the difference between different leaf colors of ornamental begonia, and has a good prospect of application. However, the traditional statistical model is less accurate and more floating, so it is not very good for different leaf color varieties.

## References

1. Li, H.: A Study on the Impact of Personalized Service on Customer Loyalty Based on O2 O Clothing Brand. Zhejiang University of Technology (2016)
2. Wang, R.M.: Patent Status Analysis and Development Strategy Research on Processing Technology of Traditional Chinese Medicine Pieces. Guangzhou University of Traditional Chinese Medicine (2017)

3. Liao, H.T.: Preliminary study on differential proteomics of nitrogen use in different maize inbred lines. Sichuan Agricultural University (2008)
4. Xie, Y.: Modern Agricultural Internet of Things Monitoring System Based on Cloud Computing. Southwest Jiaotong University (2015)
5. Wang, M.L., Yu, S.L., Chen, H.D., et al.: Based on large data analysis, the difference of adverse drug reactions between the Chinese Pharmacopoeia and other quality standards. *Chin. J. New Drugs Clin.* **12**, 752–756 (2017)
6. Jiang, W.L., Fan, J.J., Zhang, D.D., et al.: Colour characteristics of different leaf positions and exotic germplasm excavation of ornamental crabapple. *J. Hortic.* **44**(6), 1135–1144 (2017)
7. Zhang, J., Pu, J., Zhao, C., et al.: Dynamic analysis and primary selection of leaf color of offspring from three half-sib families of ornamental crabapple. *J. Nanjing For. Univ. (Nat. Sci. Ed.)* **42**(3), 37–44 (2018)
8. Zhang, R., Mao, M.M., Liu, Z.L., et al.: Pollen morphology of different cultivars of ornamental crabapple observed by scanning electron microscopy. *Mol. Plant breed.* **16**(16), 257–264 (2018)
9. Tian, Y., Shen, H.X., Zhang, J., et al.: Cloning of McANS gene from Malus ornamental crabapple and analysis of expression differences among different leaf color varieties. *J. Hortic.* **37**(6), 939–948 (2010)
10. Qin, X.X., Song, T.T., Zhang, J., et al.: Cloning and expression difference analysis of McF3'H among different cultivars of Begonia crabapple. *J. Beijing Agric. Coll.* **28**(2), 11–14 (2013)
11. Du, W.W., Duan, Q., Ma, L.L., et al.: Analysis of foliar variegation structure and genetic characteristics of seven Begonia species. *Acta Botanica Boreali-Occidentalia Sinica* **38**(11), 28–32 (2018)
12. Wang, Z., Wang, W.H., Zhang, J., et al.: Analysis of genetic diversity and genetic relationship of main ornamental crabapple cultivars. *J. Fruit Tree* **31**(6), 1005–1016 (2014)