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A STUDY ON THE STOMATA MUTATION OF PEANUT LEAVES AND ITS RELATIONSHIP WITH DROUGHT RESISTANCE

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摘　要

利用 ^{60}Co γ射线照射白沙 1016 产生的 4 个突变体，研究了花生叶片气孔突变及其与抗旱性的关系。结果说明，辐射可以诱发花生叶片气孔发生突变，和原品种白沙 1016 比较，气孔数，有的突变体变多，有的变少，气孔大小，有的变大，有的变小；花生气孔数目的多少和抗旱性存在较紧密的负相关，而气孔的大小与抗旱性的相关不明显。研究证明，通过辐射诱变途径选育抗旱花生品种是一种较为有效的方法。

A Study on the Stomata Mutation of Peanut Leaves and its Relationship with Drought Resistance

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ABSTRACT

Stomata mutation of leaves and its relationship with drought resistance were studied with four peanut mutants as well as original variety Baisha 1016. Results showed that irradiation was able to cause peanut leaf stoma to mutate. By comparing with original variety Baisha 1016, some of the mutants have more stomas, and some have less ones; some mutants have bigger stomas, some have smaller ones. The stomata numbers of peanut leaf have close relation to the drought resistance, while the stomata size seems to have no relation to it. It's possible that more drought-resistant variety or line could be elected among peanut mutants.

INTRODUCTION

There were lots of reports, in the world, on the mutation of various characters of peanut plants, which was caused by irradiation of γ ray[1, 5, 6]. However, there were few reports about studies on stomata mutation of inducing peanut leaves and its relationship with drought resistance. Therefore, we have observed the stomata mutation of leaves of several mutants of Baisha 1016 and studied its relationship with drought resistance so as to offer an evidence for bringing out, picking and choosing and making use of the mutants.

1 MATERIAL & METHOD

Materials The test was conducted with the materials of Little Leaf Mutant [LM], Polyleaflet Mutant [PM] (Both irradiated from Baisha 1016 by fifteen thousands roentgen ray), Obviously Leaf Vein Mutant [OM], and Ambiguous Leaf Vein Mutant [AM] (Both irradiated from Baisha 1016 by thirty thousands roentgen ray). The original Baisha 1016 was used as CK [CK].

Method and Design The pot experiment was conducted in a greenhouse. A pot was cylindrical, which was 33 cm high and 30.5 cm in diameter. All windows and doors were open. Here the temperature was near to that of summer-sowing peanut in the fields. Each variety or line was planted in ten pots. There must be four plants in each of pots. The soil with the same texture and the same moisture was fed into each pot. Then the equal quantity of water was put into the pots. Peanuts were sown on April 27th. The young plants emerged on the ninth day after sowing and flowers on the twenty-sixth day after sowing. Except for the controlling moisture according to the requirement of the test, the water was added into pots to keep the plants developing. The test was divided into two groups and each group consisted of five pots. The test was completely randomly arranged with five replication.

The first group of pots was used to observe the stomata characters of the plants after flowering. It was conducted on May 27th, June 3rd and 10th respectively. The leaves for observation that were unfolded, feathered and compound were sampled from the same place of the third node below the top leaf of main stem of plants. Each line was, at a time, observed with five leaves. The thin pieces made by painting pyzoxylin glue on leaves were observed for the size, number and distribution of stomas of both epicuticle and hypodermis of the leaf under a microscope. The stimulate number of epidermis of each leaf was randomly observed with ten lenses of vision field, and the stimulate size of those with ten stomas, getting an average

respectively. The statistical analysis was made with completely random method and couple data test. The 44×10 lens of the microscope was applied and the vision field of the lens was 313 microns in diameter and 0.0769449 square millimeters in area.

The second group of pots did not add any water after sowing. The soil moisture content of each line was measured when the plants turned into permanent wilting.

2 RESULTS

2.1 Variation of leaf stomas

Table 1 Variation of stomata number of each mutant

Variety or line	Stoma number per square millimeter	Width of variation	Significant test
Epicuticle			
PM	291.7	266.2	
		315.9	
AM	286.3	260.0	
		310.8	5.4
CK	244.6	255.7	
		286.1	47.1[2)] 41.7[2)]
LM	238.1	204.0	
		272.4	53.6[2)] 48.2[2)] 6.5
OM	206.5	180.3	
		243.8	85.2[2)] 79.8[2)] 38.1[2)] 31.6[2)]
Hypodermis			
AM	203.5	180.0	
		236.9	
PM	202.9	169.1	
		247.1	0.6
CK	175.8	140.5	
		212.7	27.7[2)] 27.1[2)]
LM	153.7	125.6	
		191.5	49.8[2)] 49.2[2)] 22.1[2)]
OM	134.5	110.1	
		174.1	69.0[2)] 68.4[2)] 41.3[2)] 18.5[2)]

Notes: 1) $p<0.05$; 2) $p<0.01$.

The result of observation showed that irradiation was able to cause mutation of stomata characters of peanut leaves, but the variations were not exactly the same.

Variation of stomata number: Table 1 showed that the stomata numbers of epicuticle and hypodermis of the leaf of mutants had mutation in different degree. Some got more and some did less in comparison with original Baisha 1016. With respect to the stomata number of the epicuticle per square millimeter, PM, AM, CK, LM and OM were 2971.7, 286.3, 244.6, 231.8 and 206.5 respectively. In comparison with CK, PM and AM increase 47.1 and 41.7 respectively, while LM and OM reduce 6.5 and 38.1 respectively. The variation of stomata number of the hypodermis was almost the same as that of the epicuticle. The stomata number of AM and PM

was more than that of CK, but LM and OM was less than that of CK. The results of significant test illustrated that variations of stomata number between mutants, except for the epicuticle of LM, and CK, were significant ($p<0.05$) or highly significant ($p<0.01$). Variations among mutants except PM and AM were significant or highly significant. This indicated that irradiation could cause mutation of controlling-stomata genes of original variety.

In addition, Table 1 showed that the epicuticle had more stomas than the hypodermis. The difference between epicuticle and hypodermis was highly significant by test of couple data (see Table 2). This was almost accordant with the observational result[2]. It indicated that irradiation-inducing effects on the stomata number of epicuticle and hypodermis seemed the same.

Table 2 Stomas of epicuticle in comparison with ones of hypodermis by couple data test

Lines	CK	LM	PM	OM	AM
t-Test					
t-value	8.757[2)]	9.302[2)]	0.689[2)]	22.135[2)]	23.947[2)]
t 0.05	2.776	2.776	2.576	2.776	2.576
t 0.01	4.604	4.604	4.032	4.604	4.032

Notes: 2) $p<0.01$.

Variation of the stomata size: The size of stomas of mutants except epicuticle of LM was less than that of original Baisha 1016 (see Table 3).

Table 3 Variation of the stomata size of each mutant μm

Lines	AM	PM	CK	LM	OM
Epicuticle	18.57×9.76[1)]	18.21×11.11	16.83×13.46	18.75×13.02	16.92×9.78
Hypodermis	23.06×14.50	26.68×15.13	27.12×15.57	23.39×16.32	21.75×15.12

1) Length×width

Table 3 illustrated that irradiation effects on the length and width of the stoma varied among various lines and even between epidermis (namely, epicuticle and hypodermis), too. The stomata length of the epicuticle of each mutant was evidently longer than that of CK, while the stomata width of each mutant was evidently shorter than that of CK. Each mutant's hypodermis-stoma length was shorter than CK's, but it's stomata width seemed to be as wide as CK's. Having tested by couple data method, the epicuticle had smaller stoma than the hypodermis whether it was mutants or CK. The difference between epicuticle and hypodermis was significant or highly significant (see Table 4).

Table 4 The stomata size of epicuticle in comparison with one of hypodermis by couple data test μm

Lines	CK	LM	PM	OM	AM
Stoma length					
t-value	28.390[2)]	16.691[2)]	21.122[2)]	30.479[2)]	7.313[2)]
t 0.05	3.182	2.776	4.303	4.303	4.303
t 0.01	5.841	4.609	9.925	9.925	9.925
Stoma width					
t-value	4.764	12.306[2)]	5.877[1)]	18.520[2)]	8.919[1)]
t 0.05	3.812	2.776	4.303	4.303	4.303
t 0.01	5.841	4.684	9.925	9.925	9.925

Notes: 1) $p<0.05$; 2) $p<0.01$.

2.2 Relationship between stomata characters and drought resistance

Relationship between stomata number and drought resistance: As for per square millimeter the average stomata number of the leaf epidermis, PM and AM were 247.3 and 244.9, 37.1 and 34.7 more than CK (210.2) respectively. Both mutants had less drought resistance than CK under the same conditions. As to the plants becoming permanent wilting, PM, AM and CK were 29, 32 and 45 days respectively; PM and AM were earlier 16 and 13 days than CK respectively. The soil moisture content of PM and AM was 18.6% and 18.21% while their plants got permanent wilting, but that of CK was 15.36% at permanent wilting. The stomata number of LM and OM was 195.9 and 170.5 and less 14.3 and 39.7 respectively in comparison with CK. Both mutants had much greater drought resistance than CK. In respect of the plants getting permanent wilting, LM and OM were 76 and 59 days and later 31 and 14 days than CK respectively. When plants got permanent wilting, the soil moisture content of LM and OM was 13.61% and 14.06% and less 1.75% and 1.30% than that of CK respectively. It indicated that the more the stomas were, the weaker the drought resistance was, and the less, the stronger.

Stomata size relating to drought resistance: the study results showed that the stomata size seemed no relationship with drought resistance whether it was in epiculticle or hypodermis. Some drought-resistant varieties had either larger stoma or smaller one, while some non- drought-resistant varieties had either larger stoma or smaller one.

3 DISCUSSION

The study results illustrated that irradiation was able to cause mutations in the number and size of stomas of peanut leaves, and the variation was heritable, but the inducing effects were not the same. Some mutants got more stomas and others less ones. Some mutants became larger stoma and others did smaller stoma. It was possible that useful mutants were selected to serve as breeding materials.

The stomata number and size of the epicuticle of peanut leaves was not the same as that of the hypodermis, that was to say, the epicuticle has more stomas than the hypodermis. This was nearly the same as the result observed by Ilyina, A. I.[2~4]. The stomata size of epicuticle was smaller than that of hypodermis. Although all mutants were not evidently the same as original Baisha 1016 in the number and size, they were nearly similar to CK in the sidtributive law of stomata number and size of epicuticle or hypodermis.

Drought resistance of crops was affected by a great number of factors, and so was peanut. One of them was stomata character of leaves. The stomata number among them has greater effect on drought resistance of crops. Results of the study and our previous observation showed that peanut lines with more leaf stomas had the less drought resistance, on the contrary, the less ones, the greater one. This was probably because the more the leaf stomas per unit area were, the stronger the transpiration was, and the less the former, the weaker the later. Hence, it suggested that the number of leaf stomas is one of important targets used as breeding drought-resistant variety of peanuts. The observational results also illustrated that the stomata size had little relationship with drought resistance. In short, the irradiation inducing is a more effective technique to breed drought-resistance variety of peanuts.

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