A New Dwarf Mutant dw-4 in Watermelon

Hua YANG, Yong-gang LI, Ding-xin YANG & Jie YANG
Private Research, A8-1Xilaiyuan, Jinyu Road, Haikou, Hainan 570203, P. R. China

Abstract: A spontaneous dwarf mutant was discovered from inbred watermelon line '5-6y'. Genetic study showed that the dwarf mutant is genetically stable and the dwarf trait is inherited as a single recessive gene. Allelism test showed that the new dwarf gene is not allelic to the two known dwarf genes dw-1 and dw-2. The allelism test of this new mutant with dw-3 was not possible because the genetic stock of dw-3 is no longer available. The phenotype of this mutant appears different from dw-3 and we suggest that the new mutant gene is named as dw-4.

Key word: Watermelon; Dwarf, Gene

Introduction

A short internode plant was observed in a watermelon line '5-6y' grown in a watermelon winter nursery in Hainan Island in the winter of 2004. The short internode was stable in the self-pollinated progeny of the mutant plant. The line with short internode was then named as 'd5-6y'. The wild type line '5-6y' has a main stem length of 240 cm, and internode length of 8 – 12 cm. There is potential of branching at every node of the vine in the wild type. However, the mutant line 'd5-6y' has main stem length of 80 – 90 cm, internode length of 4 – 5 cm, and the plant has fewer branches, with 4 – 6 branches per plant. Leaf and fruit of the mutant plant are smaller than those of the wild type. The mutant plants produce normal flowers. Both the mutant and wild type have delayed green cotyledon and growing points (Figure 1 and 2).

Materials and Methods

Experiment 1: Crosses were made to determine the genetics of the dwarf mutant in 'd5-6y'. The F_1's are P1 x P2, P1 x P3, and P1 x P4. BC1's: (P1 x P2) x P1, (P1 x P3) x P1, and (P1 x P4) x P1 where P1 = 'd5-6' (short vine mutant), P2 = PL (normal vine wild type), P3 = Sugarlee (normal vine wild type), and P4 = Allsweet (normal vine wild type). A χ^2 test was used to test the goodness of fit.

Experiment 2: Crosses were made to test the allelism between the new dwarf mutant and reported dwarf mutant dw-1 and dw-2 (Guner, N. and T. C. Wehner. 2004). The reciprocal F_1's were P1 x P2, P2 x P1, P1 x P3 and P3 x P1, where P1 = 'd5-6y' (short vine mutant), P2 = Bush Sugarbaby (dw-1/dw-1, Figure 3), and P3 = BR15d (dw-2/dw-2, Figure 4). A χ^2 test was used to test the goodness of fit.

All the populations were phenotyped on plants grown in the open field.

Results and Discussion

As shown in Table 1, the F_2 progenies segregated in a 3:1 ratio (normal to dwarf), and the BC_1 progenies segregated 1:1. These genetic test results show that the dwarf trait in mutant line 'd5-6y' is conferred by a single recessive gene.

All the reciprocal F_1's made between the new mutant and the genetic stocks of dw-1 and dw-2 had the normal plant type (data not show). This means that the new dwarf mutant gene is neither allelic to dw-1 nor dw-2.

A dw-3 mutant was reported in watermelon (Huan, 1995). However, our effort to get the genetic stock of dw-3 mutant was not successful. The genetic stock of dw-3 is no longer available according to Huan. Therefore the allelism test between the new dwarf mutant and dw-3 is impossible.

The dw-3 mutant (Figure 5) was derived from watermelon line DMSW. The dw-3 mutant plant also shows male-sterility and non-lobe leaf. The male-sterility in dw-3 is conferred by the gene ms^{dw}.

Due the dramatic phenotypic different between the dw-3 mutant and the new dwarf mutant 'd5-6y' and the inability of testing allelism between dw-3 and the new mutant, we propose a new gene dw-4 for the new mutant.

References

Guner, N. and T. C. Wehner. 2004. The genes of watermelon. HortScience 39: 1175-1182

Huan, H. X., 1995. Study of Dwarf Male-sterile Watermelon. China Watermelon & Melon 3: 6-9 (in Chinese)

Table 1. Segregation of F_2 and BC_1 Progenies Derived from the Mutant Line 'd5-6y' and the Wild Type Lines

Cross	Generation	Total Plants	Dwarf Plants	Normal Plants	Dwarf/Normal	X^2-value
d5-6y X PL-1	F_2	516	137	379	1:2.77	0.6615
d5-6y X PL-2	F_2	509	127	382	1:3.01	0.0007
d5-6y X PL-3	F_2	610	155	455	1:2.94	0.0546
d5-6y X PL-4	F_2	172	41	131	1:3.20	0.1240
d5-6y X PL-5	F_2	277	77	200	1:2.60	1.1564
PL X d5-6y-1	F_2	233	54	179	1:3.31	0.4134
PL X d5-6y-2	F_2	253	62	191	1:3.08	0.0329
d5-6y X Sugarlee-1	F_2	276	67	209	1:3.12	0.0773
d5-6y X Sugarlee-2	F_2	366	83	283	1:3.41	1.0528
d5-6y X Sugarlee-3	F_2	490	111	379	1:3.41	1.4395
Sugarlee X 5-6y-1	F_2	425	89	336	1:3.78	3.7341
d5-6y X Allsweet	F_2	346	93	253	1:2.72	0.6513
Allsweet X d5-6y	F_2	539	146	393	1:2.69	1.2523
(d5-6y X PL) X d5-6y	BC_1	322	177	155	1:0.88	1.8137
(d5-6y X PL) X d5-6y	BC_1	250	121	129	1:1.07	0.2560
(d5-6y X PL) X d5-6y	BC_1	300	157	143	1:0.91	0.6533
(d5-6y X PL) X d5-6y	BC_1	162	73	89	1:1.22	1.5802

$X^2_{0.01(df=1)}$=6.635 $X^2_{0.05(df=1)}$=3.841

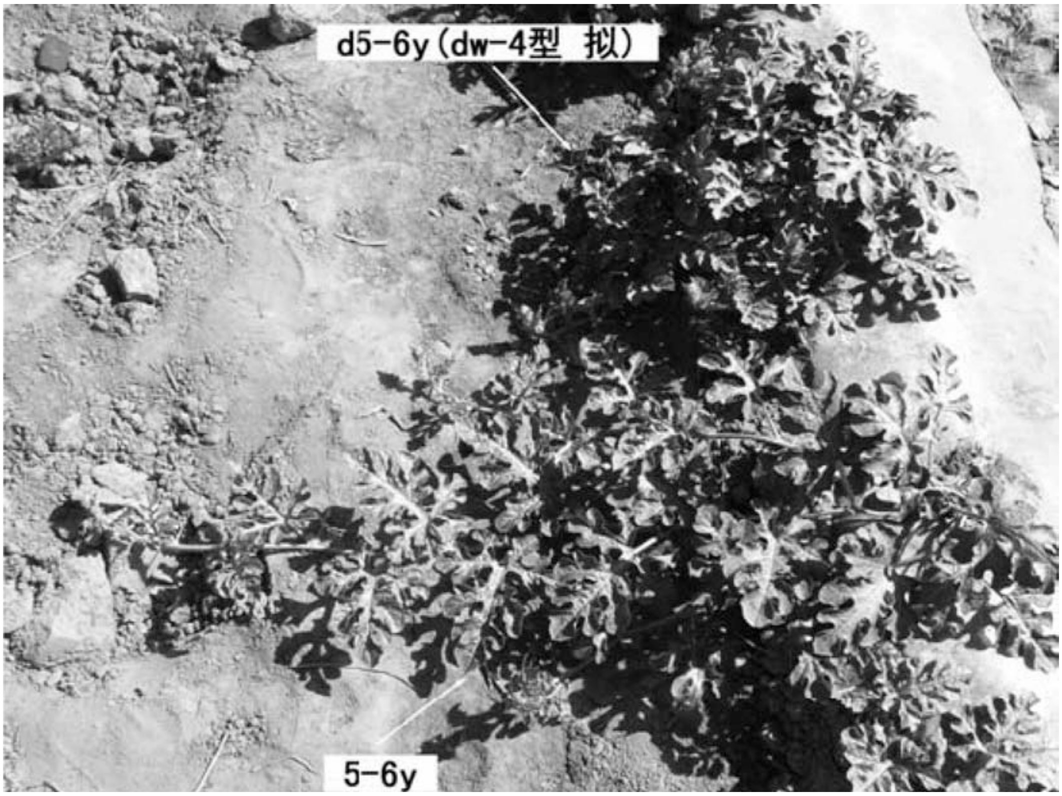

Figure 1. Plant phenotype of the new mutant (dw-4, top plant) and the wild type (bottom plant).

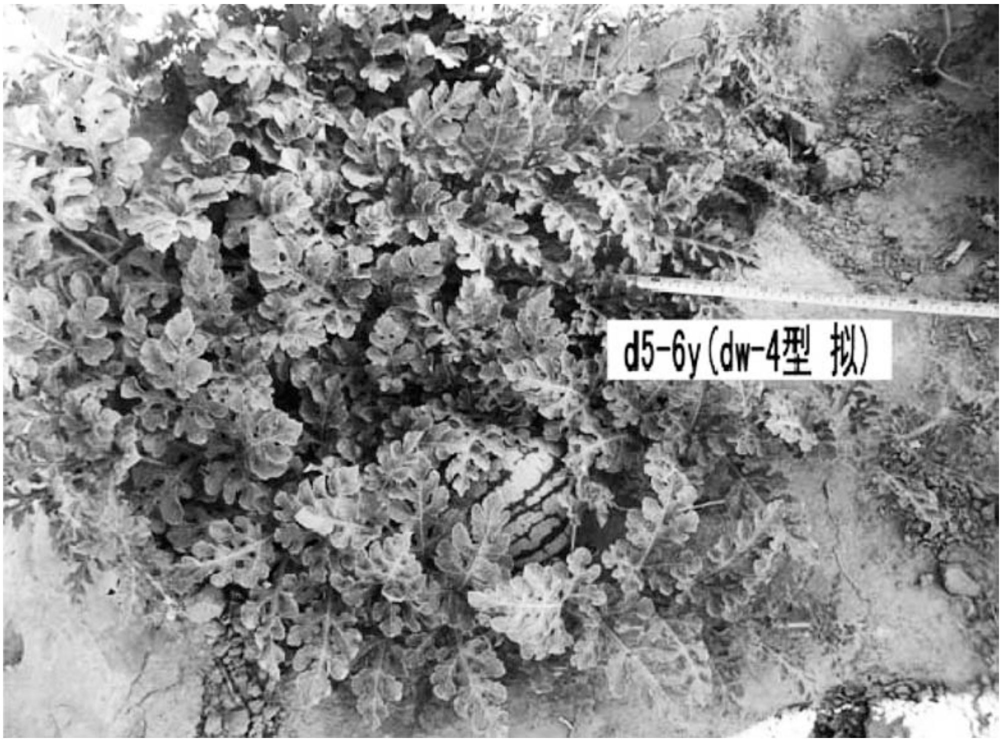

Figure 2. Plant morphology of the new dwarf (dw-4) mutant plant grown in open field.

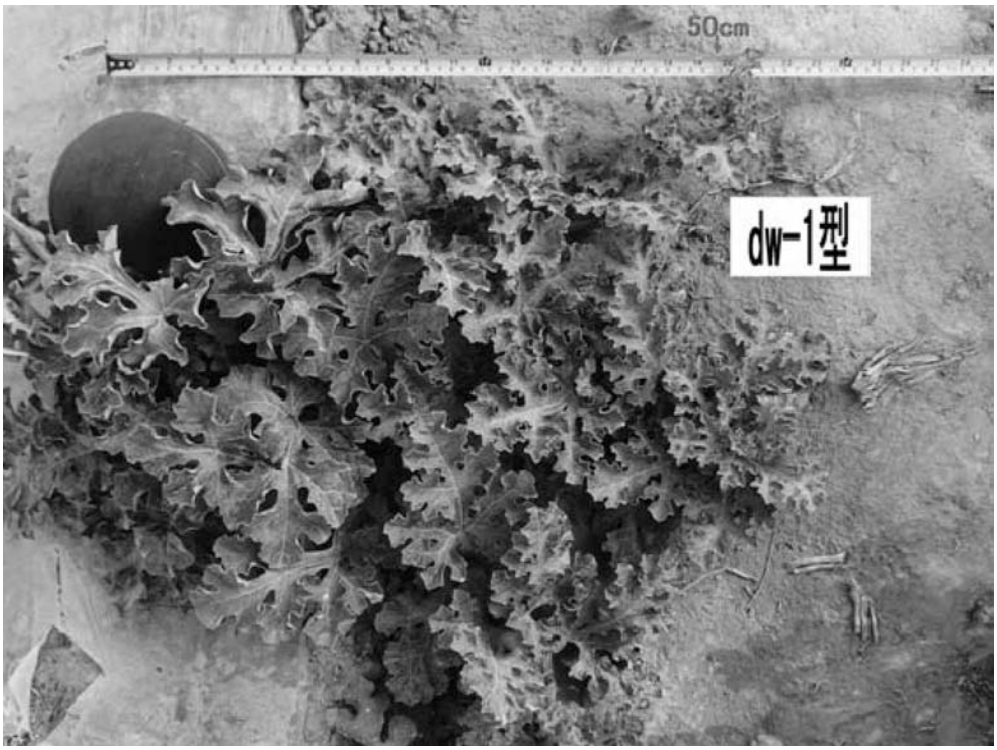

Figure 3. Plant morphology of dw-1 mutant, CV Bush Sugarbaby

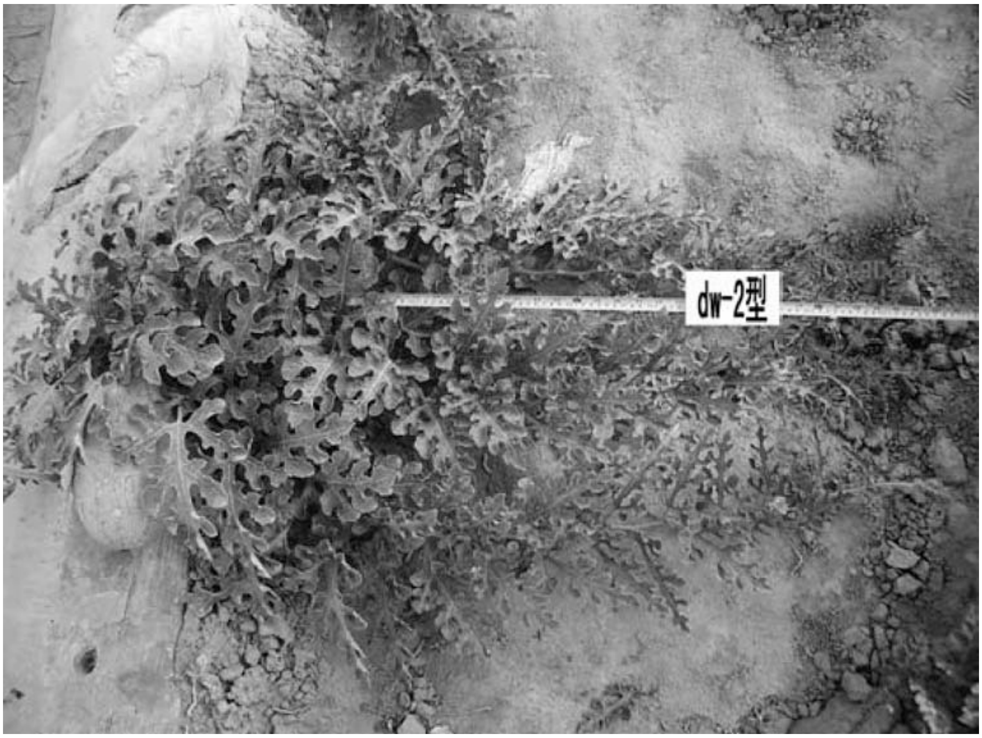

Figure 4. Plant morphology of dw-2 mutant plant, CV BR15d.

Figure 5. Plant morphology of dw-3 mutant, provided by H.X. Huan.