

THE EXPRESSION OF THE Y-BRANCHED CHARACTER IN SUNFLOWER(H. annuus L.)

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SUMMARY

Not only is Y-branched character (Caractère isomature) study very important for dissociation bifurcation research, but also for sunflower genetics and breeding practice. Author's studies showed that (1). Y-branched variations were reported at Y-branched position, the number of branches by plant and incomplete penetrance in a population. These variations suggested the complex on which Y-branched genes expressed its phenotype in time and space; (2). the temperature(17-24℃) could condition the incomplete penetrance of Y-branched character by means of influencing the developemental process of embryon. Lower temperature(0-5℃), however, modified the Y-branched expression during the seed germination; (3). the Y-branch through plant seed setting number increased yield and shortened the time of maturity by way of lower weight of per 1000 seeds.

RESUME

EXPRESSION DU CARACTERE ISOMATURE CHEZ LE TOURNESOL(H.annuus L.)

L'étude du caractère isomature(Y-branched character) a une très grandes importance non seulement pour la recherche fondamentale de la bifurcation, mais aussi pour l'amélioration du tournesol. Les résultats presents montrent les points suivants:
— La variation du caractère isomature se manifeste sur le niveau de la bifurcation, le nombre de bifurcation par plante et la pénétrance incomplète, cela suggère que l'expression du gène isomature est complexe;
— La température(17-24℃) joue un rôle important sur le taux d'isomature par l'influence du développement de l'embryon, ainsi le taux d'isomature peut être modifié par le traitement du froid (0-5℃);
— La plante d'isomature produit plus et mature plus vite par un fort nombre de grains et par un petit poids de 1000 grains respectivment.

INTRODUCTION

Sunflower(H.annuus L.) with Y-branched character may be seen everywhere in nature, but a few of them is able to transmit the Y-branched character to filial generation. The results have shown that the genetic Y-branched character possess high-yield and early maturing potentiality(Liu et Leclercq, 1987). Therefore, sunflower specialists are paying a good deal of attention to this subject in the world.

MATERIALS AND METHODS

The inbred line WJR1629 with Y-branched character primariely originated in U.R.S.S.. The inbred line has been propagated for seven generations by self-pollination in France, and penetrance of the Y-branched character in WJR1629 is variable with different years(Leclercq, 1984). L'INRA provided the WJR1629. Partial experiment was carried out in phytotron of CNRS. Y-branched character was investigated during the flowering. The data were dealt with biostatistic method.

RESULTS

1. Factors determining yield

Pairing comparision(31 pairs) showedthat the simple plant yield component was significant difference between two phenotypes of the same genotype(I—stand for Y-branched phenotype, NI—stand for non-Y-branched phenotype) (Tab.1). Although the weight of per 1000 seeds of Y-branched plant only was as weight as normal plant of 83%, the simple plant seed setting number was 1.44 as many as that of normal plant, so that the simple plant yield with Y-branch was increased by 21% than that of normal plant.

Table 1. An analysis on factors determining yield of Y-branched plant

Factor of yield	I	NI	I/NI	t-test
Weight of per 1000 seeds(g)	64.83	78.30	0.83	**
Seed setting number	689	477	1.44	**
Yield of simple plant	44.41	36.81	1.21	*

* — Significance level 0.05; ** — Significance level 0.01.

2. Incomplete penetrance

Fifteen lines were selection filial generations of WJR1629. The phenotypes of Y-branched character were investigated in the same plot. The results indicated that the penetrance of Y-branched character had a great variance among lines(Tab. 2), and the variant range was 25% to 80%.

Table 2. Variance of penetrance of Y-branched character among lines

Code name of line	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Total plants	75	88	72	21	62	46	39	68	63	22	95	25	84	111	40
The number of Y-branched plant	19	26	27	9	27	21	18	36	34	12	55	15	54	81	32
Percentage of Y-branched plant	25	30	38	43	44	46	46	53	54	55	58	60	64	73	80

3. Y-branched position

Y-branched position was expressed by means of the percentage of which the length of the cotyledon to branch (a) ocurpied the length of cotyledon to heads of sunflower (b) (Fig. 1, right). As the percentage was lower, meaned the branches approached to ground;

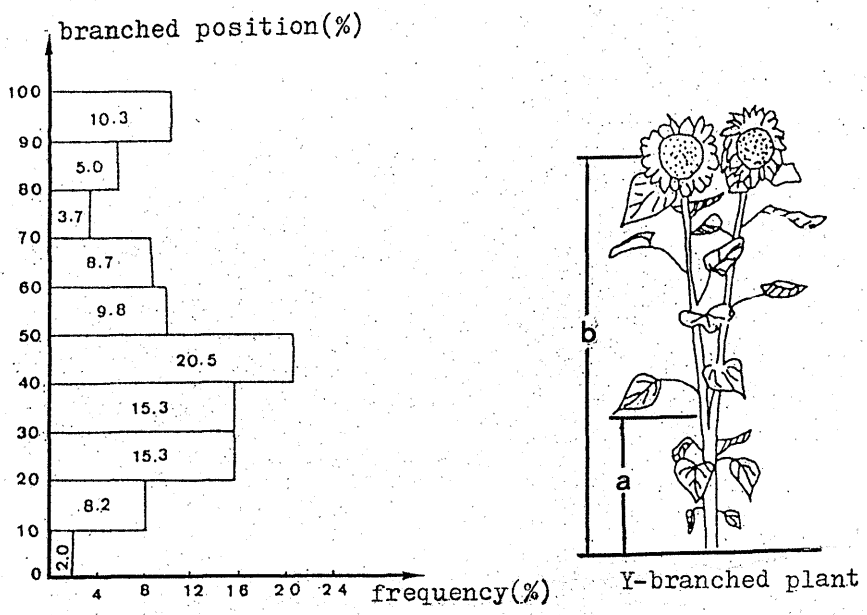

Fig. 1. The expression of Y-branched position(a/b × 100) and frequency of Y-branched position.

conversely, the branched position was higher. When the Y-branched position reached by 100%, appeared the situation of two heads cohesion. All kinds of Y-branches ocurred different frequencies in a population(Fig. 1, left). Early stage of Y-branches had a lower frequency(e.g. when Y-branch occurred at the second pair true leves). Commonly, the Y-branch was formed in the middle of plant. There were significant correlation(r=-0.73) between Y-branched position and its incomplete penetrance. Consequently, the more mean Y-branched position was low, the more penetrance was high in the same population.

4. The number of branches by simple plant

The branches of inbred line WJR1629 originated at the special division of apical meristem, and did not originated at lateral bud of main stem. When the Y-branched plant occurred 70% in a population, the plant with 3 - 4 stems occurred 25% and the rest were monstrous plants. The branches which were formed repeately showed difference in hight and thick, so that different diameter of head could be found in the same plant.

5. Influence of temperature for expression on Y-branched character

The morphological form of Y-branch have not been found within ripen seed. The seeds were dealt with different temperature(17°C, 22°C, 17 to 22°C, 22°C to 17°C) after the germination, but the penetrance of Y-branched character were not be influenced by the temperature. The plant was treated in different temperatue from fertilization to maturity(embryonic developement stage), then ripen seeds were planted in the field (Tab. 3). The result showed that the penetrance of Y-branched character was significant difference between two treats. When the seeds were harvested at 17°C in phytotron, the expresive ability of Y-branched character

was reduced (only 12%). However, to compare the seeds harvested at 24°C in phytotron with the seeds harvested in the field, the expresive ability of Y-branched character was indifferent. Worthy of attention, the weight of per 1000 seeds which were treated by different temperature(17 C, 24 C) were significant difference (60g. and 81g., respectively). Therefore, temperature could influence expresive ability of Y-branch by way of conditioning the process of embryonic developement.

Table 3. The influence of temperature for the penetrance of Y-branched character in embryonic developement stage

Temperature of embryonic developement	Replication 1	2	3	Total	I(%)	t-test
17°C	(1) 10/39	1/32	2/40	13/111	12	**(2)
24°C	8/12	21/32	19/28	48/72	67	

(1)Branched plant/Observed plant; (2)**—Significant level 0.01.

Table 4. Influence of low teperature for penetrance of Y-branched character

The temperature of seed germination	Replication 1	2	3	4	Total	I(%)	t-test
18 - 20°C	1/28	9/29	3/34	0/20	13/111	11.7	**
0 - 5°C	7/23	14/39	3/32	25/29	49/123	39.8	

Just like low temperature could break seed domancy, during the seed germination, properly low temperature treat(0 - 5°C, 10 days, dark) was favourable to promote expression of Y-branched character, too (Table 4).

DISCUSSION

The genetic studies of Y-branched character were partly reported by Skaloud et kovacik(1976), Brigham et Young(1980). The material with penetrance of 100% Y-branched plant was difficultly obtained by normal selection(Leclercq, 1984). The result of this trial agree with above-mentioned idea. The penetrance of Y - branched character among different lines had great variance. The use of higher penetrance lines to study the factors determining yield of Y-branched plant indicated that the seed setting number of simple Y-branched plant was higher, so that seed yield was increased(12%). The results shown that the seeds from such a plant were smaller than that of normal plant, and the seed lost water quickly in the mature stage, so this kind of material could be utilized in premature breeding.

The Y-branched position and the number of branches might report that there were some inherent gradient variance in time and space for expression of Y-branched character. In the period of embryonic developement, the expresive ability of Y-branch could be influenced by environmental conditions. The more expresive ability was strong thus, , the more Y-branched position was low and the number of Y - branches much better, and the reverse was also true. Environmental treatment(stress) on the seeds modified the physiological character of seed. Therefore, the penetrance of Y-branched character, which

the seeds were obtained from field, could be increased from 75% to 80% and 90%. And the penetrance of Y-branched character, which the seeds were obtained from phytotron, could be improved from 0 to 17% and 80%. The seeds which were obtained from phytotron at 17°C had lighter weight of per 1000 seeds and the penetrance of Y - branched character was reduced(12%). Thus it can be infered, seed size may be one of influence factors for Y-branched developement. Meanwhile, between weight of per 1000 seeds and penetrance of Y-branched character had a significant positive correlation(r=0.86), which the seeds were harvested from phytotron. The result also agreed with above-mentioned inference. However, physiological and biochemical mechanism of which temperature conditioned embryonic developement to influence the expression of Y-branched character remained to be studied.

Histocytological study indicated the process of Y-branched developement: apical meristem action become active after seed germination, meantime, the leaf primordia were increased, and within meristem occurred partial necrosis, the rest of meristem renewly formed two submeristems, so that it caused the Y-branched form and complex phyllotaxy(Liu, 1986). However, in the mature stage, the Y-branched plant may be easily broken by stormer and caused loss. Therefore, to study the optimum Y-branch has an importantly practical value.

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