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HERITABILITY OF THE CHARACTER "SECONDARY BLOOMING" ON PEAR (*Pyrus communis*).

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Abstract

The progenies of 12 parents were registred in june, july and august for the character "secondary blooming", responsable of the great susceptibility of the cultivar PASSE CRASSANE to fire blight in the south west of France.

The mean values of these progenies allowed to build up four groups. PRESIDENT DROUARD, DUCHESSE DE MOUCHY and DOYENNE DU COMICE belong to the first group where the progenies show few secondary blossoms whereas the progenies of PASSE CRASSANE and BEURRE D'AVRIL have many seedlings with this characteristic. For some parents the observed values are extremely variable according to the combinations.

Analysis with the Griffing method of a partial diallel with 7 parents and 21 progenies allowed to estimate the general and specific combining abilities for this character.

Introduction

Secondary blossoms are the main entry of the bacteria responsible of Fire blight on the pear variety PASSE CRASSANE in the South West of France.

In 1979 and 1980 we observed the importance of that phenomenon in some pear progenies. These progenies belonged to a half diallel (excluding the reciprocals and the parental lines) bred at Angers since 1962. In 1980 some progenies were already discarded either completely either partially. Thus the effectives by progeny were irregular.

Two models of analysis were choosen :

1 - analysis of the value of parents for transmitting this character. This analysis concerns 12 parents used in the initial diallel.

2 - analysis by the GRIFFING's model concerning a sub-set of the initial diallel. This new half diallel was made up from 7 parents and included 21 progenies of 38 hybrids planted with no replications. This analysis allowed us to estimate the General Combining Ability (G.C.A.) and the Specific Combining Ability (S.C.A.) for this character.

First analysis

We had at our disposal a partial incomplete diallel between 12 parents: PASSE-CRASSANE, PRESIDENT DROUARD, DUCHESSE DE MOUCHY, CONFERENCE, DOYENNE DU COMICE, DOYENNE D'HIVER, NOTAIRE LEPIN, REMY CHATENAY, DOYENNE PERRAULT, BEURRE D'AVRIL, MADAME BALLET, JEANNE D'ARC.

Theoretically we should obtain 66 progenies but we could observe only 58. The effectives varied from 27 to 207 hybrids by progeny and a total of 5 136 trees were observed (Table 1).

Three observations were recorded : 10th June - 3d July - 23d August
Each tree is noted from 0 to 6 according to the following code :

Note	0	1	2	3	4	5	6
Number of se- cond. flow./tree	0	1-5	6-10	11-15	16-20	21-25	25

A) Observation of the families

The progeny of each parent make a family of half sibs. The effectives of these families varied from 587 to 1119. Table 2 shows the adjusted means for the twelve families and their variance for the three observations. The analysis of variance indicates highly significant differences between the values for the three dates.

We observed that :

- DUCHESSE DE MOUCHY and PRESIDENT DROUARD transmit to their seedlings a low intensity of secondary blossoms.
- Whatever the parents this intensity decrease in July and August.
- Progenies of PASSE CRASSANE and particularly of BEURRE D'AVRIL show, even in August a rather high intensity of secondary blossoms.
- Progenies of some parents (as PASSE CRASSANE and BEURRE d'AVRIL) have not an homogeneous behaviour (high variance).

The figure 1 illustrates this behaviour.

Using DUNCAN'S multiple range test at the 5 % level a classification was established for these twelve families. Table 3 shows, only for June, this classification and the phenotypic tendency of the parents. Figure 2 summarizes these values for the three dates and allows us to establish four groups of parents :

- DUCHESSE DE MOUCHY, PRESIDENT DROUARD, DOYENNE DU COMICE.
- DOYENNE DU COMICE, REMY CHATENAY, NOTAIRE LEPIN, CONFERENCE, DOYENNE D'HIVER, MADAME BALLET.
- DOYENNE D'HIVER, MADAME BALLET, JEANNE D'ARC, DOYENNE PERRAULT.
- BEURRE D'AVRIL, PASSE CRASSANE.

B) Observation of the progenies

It is interesting to note that some progenies showed no secondary blossoms neither in June nor in July or August :

- DUCHESSE DE MOUCHY x PRESIDENT DROUARD	57 trees
- DUCHESSE DE MOUCHY x CONFERENCE	22
- DUCHESSE DE MOUCHY x DOYENNE DU COMICE	51
- DUCHESSE DE MOUCHY x REMY CHATENAY	64
- DOYENNE DU COMICE x MADAME BALLET	91
- PRESIDENT DROUARD x MADAME BALLET	70

Some other progenies have high means specially with PASSE CRASSANE and BEURRE D'AVRIL.

These results are in agreement with those obtained the previous year (THIBAULT, 1979).

Second analysis

The progenies still alive in the field in 1980 allow us to establish a half diallel including 7 parents : PASSE CRASSANE, DUCHESSE DE MOUCHY, CONFERENCE, DOYENNE PERRAULT, BEURRE D'AVRIL, MADAME BALLET, JEANNE D'ARC.

Absence of reciprocals and self fertilization led us to follow the GRIFFING'S analysis, Method 4. As the parents are assumed to be a chosen set we use the Model I (GRIFFING, 1956)*.

We will limit this note to the results of the observations made in June:

- The differences between the 21 progenies are high significant.
- A DUNCAN'S multiple range test at the 5% level allowed us to make a classification (Table 4).
- Table 5 shows the means for each parental family.
- We have a highly significant effect for General Combining Ability (G.C.A.) and a significant effect for Specific Combining Ability (S.C.A.).

- The ratio between the mean squares of G.C.A. and S.C.A. (= 6,50) indicates that additivity is more concerned than the other genetic effects.

- As the effects due to the G.C.A. were all significant, their classification was made (Table 6) : DUCHESSE DE MOUCHY and CONFERENCE are different from all the others and have a high G.C.A. (negative). On the other hand BEURRE D'AVRIL shows the highest positive value.

- The variances of G.C.A. associated with each parent are low for JEANNE D'ARC, DOYENNE PERRAULT and MADAME BALLET and high for DUCHESSE DE MOUCHY.

- Estimates of S.C.A. constants are showed in the table 7 and in the figure 3.

- JEANNE D'ARC, PASSE CRASSANE and DOYENNE PERRAULT show the greatest variation depending to the other parent. The extreme values were obtained by DOYENNE PERRAULT X JEANNE D'ARC and PASSE CRASSANE X DUCHESSE DE MOUCHY on the one hand (negative values) and by PASSE CRASSANE X JEANNE D'ARC and DOYENNE PERRAULT X BEURRE D'AVRIL on the other hand (positive values). The values for MADAME BALLET are the most concentrated.

- Table 7 shows also the variances of S.C.A. associated with each parent: DUCHESSE DE MOUCHY, CONFERENCE and MADAME BALLET have the lowest estimates and JEANNE D'ARC and PASSE CRASSANE the highest.

A brief summary of results indicates that :

- DUCHESSE DE MOUCHY and CONFERENCE have the best G.C.A. and a low variation of their S.C.A. they will have progenies with few secondary blossoms whatever the second parent.

* The authors gratefully acknowledge the contribution of J.D. FLICK for preparing the computer program.

- JEANNE D'ARC shows a G.C.A. negative but close to zero. However this parent shows a high variation for the S.C.A. : some combinations with JEANNE D'ARC will have a high level of secondary blossoms. Others will have a low one.

- This variability of S.C.A. is high too for PASSE CRASSANE and moreover the G.C.A. is positive. Some but few combinations with this parent may be interesting.

Conclusion

These two types of analysis are in concordance. Analysis by the GRIF-FING'S method brings fuller information appreciable for building an accurate breeding program. The fixed model limits the use of these results only to parents involved in this analysis. All other combination should be entered in a new experimentation and a new analysis.

References

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- Griffing, B., 1956. Concept of General and Specific Combining Ability in relation to diallel crossing systems. Aust. J. Biol. Sci. 9 : 463-493.

Table 1 - Incomplete half diallel.

[illegible]

12 parents :

66 theoretical progenies

58 observed progenies

intersterile cross

uprooted progenies
(end of selection)

Table 2 - Adjusted mean and variance for the 12 parents and the three dates.

PARENTS		P. C.	P. D.	D. M.	C. F.	D. C.	D. H.	N. L.	R. C.	D. P.	B. A.	M. B.	J. A.
NUMBER BY FAMILY		979	587	673	593	976	780	773	720	1119	969	993	1110
JUNE 1980	MEAN	0,658	0,059	0,039	0,162	0,070	0,174	0,131	0,114	0,4325	0,652	0,340	0,389
	VARIANCE	2,004	0,125	0,115	0,332	0,172	0,468	0,357	0,268	1,326	1,961	1,045	1,274
JULY 1980	MEAN	0,346	0,012	0,013	0,051	0,028	0,145	0,088	0,0625	0,231	0,3725	0,152	0,190
	VARIANCE	0,844	0,011	0,013	0,072	0,0495	0,399	0,306	0,120	0,498	0,947	0,367	0,470
AUGUST 1980	MEAN	0,075	0	0	0,025	0,007	0,019	0,021	0,001	0,051	0,109	0,011	0,022
	VARIANCE	0,233	0	0	0,129	0,015	0,047	0,044	0,001	0,1235	0,321	0,048	0,108

BEHAVIOUR OF THE 12 PARENTS IN CROSSING

Figure 1 - JUNE 1980

Table 3 - Intensity of secondary blossoms by parental families.

PARENTS	PHENOTYPIC TENDENCY OF PARENTS	FAMILY MEAN	DUNCAN TEST (5 %)
DUCHESSE DE MOUCHY	No	0,039	a
PRESIDENT DROUARD	No	0,053	a
DOYENNE DU COMICE	No	0,070	a b
REMY CHATENAY	No	0,114	a b c
NOTAIRE LEPIN	No	0,131	a b c
CONFERENCE	No	0,162	b c
DOYENNE D'HIVER	Weak	0,174	c
MADAME BALLET	Strong	0,340	d
JEANNE D'ARC	No	0,389	d e
DOYENNE PERRAULT	Fairly strong	0,432	e
BEURRE D'AVRIL	Weak	0,652	f
PASSE CRASSANE	Fairly strong	0,658	f

figure 2 - VARIATION OF THE LEVEL OF SECONDARY BLOSSOMS
AT THREE DATES

□ DUCHESSE DE MOUCHY
◆ PRESIDENT DROUARD
◇ DOYENNE DU COMICE
▽ REMY CHATENAY
▼ NOTAIRE LEPIN
○ CONFERENCE

△ DOYENNE D'HIVER
✱ MADAME BALLET
▲ JEANNE D'ARC
⊙ DOYENNE PERRAULT
■ BEURRE D'AVRIL
● PASSE CRASSANE

Table 4 - Means, variances and classification of the progenies.

JUNE 1980

PROGENIES		VARIANCE	MEAN	DUNCAN'S TEST
7	D. M. X C. F.	0,000	0,000 *	a
1	P. C. X D. M.	0,000	0,000 *	a
8	D. M. X D. P.	0,051	0,053	a
10	D. M. X M. B.	0,051	0,053	a
11	D. M. X J. A.	0,051	0,053	a
15	C. F. X J. A.	0,051	0,053 *	a
18	D. P. X J. A.	0,074	0,079 *	a b
12	C. F. X D. P.	0,117	0,132 *	a b c
2	P. C. X C. F.	0,117	0,132 *	a b c
9	D. M. X B. A.	0,352	0,158	a b c d
13	C. F. X B. A.	0,185	0,237	a b c d e
21	M. B. X J. A.	0,293	0,237 *	a b c d e
14	C. F. X M. B.	0,427	0,289	a b c d e
17	D. P. X M. B.	0,293	0,368	b c d e f
4	P. C. X B. A.	0,520	0,421	c d e f
5	P. C. X M. B.	0,899	0,421	c d e f
20	B. A. X J. A.	0,953	0,421	c d e f
3	P. C. X D. P.	0,578	0,447	d e f
19	B. A. X M. B.	0,634	0,474	e f
6	P. C. X J. A.	0,785	0,605	f
16	D. P. X B. A.	0,779	0,632	f

* Progeny mean lower than the lower parent.

Table 5 - Means of the parents.

PASSE - CRASSANE	0 , 3 3 8
DUCHESS DE MOUCHY	0 , 0 5 3
CONFÉRENCE	0 , 1 4 0
DOYENNE PERRAULT	0 , 2 8 5
BEURRE D'AVRIL	0 , 3 9 0
MADAME BALLE	0 , 3 0 7
JEANNE D'ARC	0 , 2 4 1

Table 6 - Classification of the estimates of G.C.A. effects for each parent and estimates of variances associated with each parent.

PARENTS	A G C	CLASSIFICATION **	VARIANCE
D. M.	- 0 , 2 3 8	a	0 , 0 5 4 9
C. F.	- 0 , 1 3 2	a	0 , 0 1 6 0
J. A.	- 0 , 0 1 1	b	0 , 0 0 0 0
D. P.	0 , 0 4 0	b	0 , 0 0 0 2
M. B.	0 , 0 6 8	b c	0 , 0 0 3 0
P. C.	0 , 1 0 5	b c	0 , 0 0 9 4
B. A.	0 , 1 6 8	c	0 , 0 2 6 6

* L S D 5%

Table 7 - Estimates of S.C.A. constants and of variances of S.C.A. associated with each parent.

PARENTS	P. C.	D. M.	C. F.	D. P.	B. A.	M. B.	J. A.
N°	1	2	3	4	5	6	7
ESTIMATES OF S C A VARIANCES	0,0134	0,0000	0,0006	0,0075	0,0014	0,0000	0,0167
		- 0,118	- 0,091	0,051	- 0,102	- 0,002	0,261
			0,119	- 0,002	- 0,023	- 0,028	0,051
				- 0,028	- 0,049	0,104	- 0,054
					0,172	0,009	- 0,202
						- 0,012	0,014
							- 0,070
						S.E (S1j - S1k)	0,120
						S.E. (S1j - Sk1)	0,104

figure 3 - ESTIMATES OF S. C. A. CONSTANTS