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PRELIMINARY OBSERVATIONS ON THE INHERITANCE OF SEVERAL FACTORS IN THE PASSION FRUIT (*PASSIFLORA EDULIS* L. AND FORMA *FLAVICARPA*)

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PRELIMINARY OBSERVATIONS ON THE INHERITANCE OF SEVERAL FACTORS IN THE PASSION FRUIT (*PASSIFLORA EDULIS* L. AND FORMA *FLAVICARPA*)

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In most areas of the tropical and subtropical world where passion fruit is grown, the species *Passiflora edulis* (purple passion fruit) and its botanical form, *P. edulis*, f. *flavicarpa* (yellow passion fruit) predominate. *P. edulis*, hereafter referred to as edulis, is by far the more popular in Australia, New Zealand, Brazil, and South Africa, while *P. edulis* f. *flavicarpa*, hereafter referred to as flavicarpa, dominates commercial plantings in Hawaii.

Although the passion fruit has been in cultivation for about 50 years in Hawaii and longer in other areas, reports of genetic studies are meager. Several reports (2, 3, 5, 6) from Australia and New Zealand indicate that edulis is susceptible and flavicarpa is resistant to a passion fruit wilt disease caused by a *Fusarium* sp. Kajewski (4) reported that *P. incarnata*, a yellow-fruited species, is also resistant to this wilt disease. Grozzmann and Purss (3) have grown F_3 and backcross (to *P. edulis*) progenies to select resistant types with edulis characteristics but have not reported its mode of inheritance. Reports on inheritance of other factors are rare.

A preliminary investigation on the inheritance of a few characters was made on a small planting composed of edulis, flavicarpa, F_1, F_2 and a backcross (to flavicarpa) population on the Manoa campus and at the Waimanalo Experimental Farm. A deterrent to genetic studies of passion fruit is the high cost of establishing a large number of individual "tree" trellises. Each vine must be restricted to its own trellis in order to be identified easily. The studies reported here used such an individual "tree" trellis to maintain the identity of each vine.

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RESULTS AND DISCUSSION

Crown Rot and Wilt of Passion Fruit*

The absence of edulis in commercial passion fruit plantings in Hawaii may be the primary reason why a disease condition which results in crown rot and wilting of the vines has never been reported. The appearance of this unidentified disease in an experimental planting provided the opportunity to study the inheritance of the factors associated with this disease.

Approximately a year and a half after field transplanting, edulis vines began to wilt, and within six months 30 out of 32 vines were dead. The two remaining vines were partially affected. Entire branches of healthy green leaves began to wilt suddenly and were completely dead within a week. Leaf drop occurred after the leaves had completely dried. The two vines that were still alive after the 30 vines had died showed symptoms of crown rot.

Figure 1 illustrates a row of healthy flavicarpa vines. Figure 2 shows an edulis vine showing the first symptoms of wilt while Figure 3 shows an entire row of edulis which died earlier. Figure 4 shows a close-up of a dead vine.

A close examination of the affected vines showed that the base of the vine near the soil level (frequently referred to as the collar or the crown) had partially or completely rotted away. Figure 5 shows all of the primary branch trunks severely but not completely rotted, while Figure 6 shows the primary branch trunks completely rotted. Whether the crown rot is the primary cause of wilt or a secondary symptom caused by root rot has not been clearly established in Hawaii.

Data on the mode of inheritance of the factors for this disease are given in Table 1. Segregation in the F_2 population indicates a simple 3:1 ratio with edulis possessing a homozygous pair of recessive genes for susceptibility. Flavicarpa is resistant to this disease and its dominance is reflected in the F_1 and other ratios.

From the commercial standpoint, this disease is not of great importance in Hawaii because plantings are mainly of flavicarpa. However, it is important in a breeding program directed towards developing varieties that incorporate the desirable traits of flavicarpa and edulis.

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*The terms "crown rot" and "wilt" are used here in a descriptive sense and do not identify a specific disease.

Table 1. Classification of observed and expected ratios for the wilting disease

Progeny	Number of plants	Classification: Observed alive	Observed dead	Expected (3:1) alive	Expected (3:1) dead	Adjusted X^2	P
P_1 = *P. edulis*	32	2	30	0	32		
P_2 = f. *flavicarpa*	23	23	0	23	0		
F_1 hybrid	6	6	0	6	0		
F_2 segregants	35	28	7	26.25	8.75	0.24	.65
Backcross to P_2	24	24	0	24	0		

Tendril Color

Tendril color is not a particularly significant trait but because of its possible correlation with fruit color, data were taken and the results are presented in Table 2.

Table 2. Inheritance data for tendril color

Progeny	Number of plants	Classification: Observed Green	Observed Purple	Expected (3:1) Green	Expected (3:1) Purple	Adjusted X^2	Approx. P. value
P_1 flavicarpa	23	0	23	0	23		
P_2 edulis	25	25	0	25	0		
F_1 hybrid	6	0	6	0	6		
F_2 segregants	32	9	23	8	24	.042	.86
Backcross to P_1	24	0	24	0	24		

Figure 1. Row of flavicarpa vines on individual "tree" trellises. None showed crown rot or wilting.

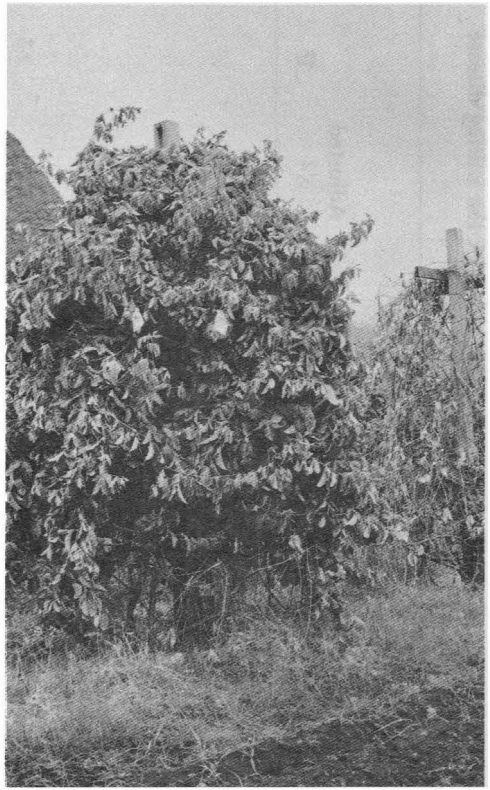

Figure 2. Edulis vine showing first symptoms of wilt. Branches with healthy leaves are just beginning to wilt.

Figure 3. Row of "tree" trellises with dead vines of edulis. The two live vines are beginning to show some crown rot and wilt.

Figure 4. A close-up of a dead edulis vine. Leaves do not completely shed for a long time.

Figures 5 and 6. Crown rot which precedes wilt is shown in Figure 5 where four primary branch trunks are not completely rotted. Vascular connection still exists since much of the top is living. Figure 6 shows five branch trunks completely rotted and severed.

The purple tendril color of flavicarpa is found to be dominant over the green tendril color of edulis. The tendrils of all F_1 plants are purple, and the purple and green tendrils of the F_2 segregants show an observed ratio closely approximating the expected 3:1 ratio with purple being dominant. This dominance is also reflected in the backcross progeny, all the plants of which were purple-stemmed, as expected.

Fruit Shell Color

The fruit shell color of flavicarpa is a distinct yellow, while that of edulis is a dark purple. The fruit shell color of F_1 is reddish-purple and occasionally, a yellow tinge is noticeable in the background. The F_1 shell also has a white speckling, more prominent in the F_1 than in the parental flavicarpa fruits. The white speckling on flavicarpa fruits is subdued by the yellow base color. The reddish-purple shell color of the F_1 appears to be an intermediate color.

In the F_2 population three color types are recovered but some difficulty arises in distinguishing the intermediate from the parental edulis color type. The intensity of the purple color is often affected by differing exposure of the fruits to sunlight. Segregation data for shell color are summarized in Table 3.

Table 3. Segregation of fruit shell color factor disregarding the speckling factor in the F_2 and backcross progenies

		Classification							
		Observed			Expected				
Progeny	Number of plants	Purple	Inter.	Yellow	Purple	Inter.	Yellow	Adj. X^2	Approx. P. value
P_1 flavicarpa	23	0	0	23	0	0	23		
P_2 edulis	25	25	0	0	25	0	0		
F_1 hybrid	6	0	6	0	0	6	0		
F_2 segregants	23	4	12	7	5.75	11.5	5.75	.37	.84
Backcross to P_1	24	0	13	11	0	12	12	.04	.89

Observed data on the fruit shell color of the F_2 segregants do not reveal a ratio deviating significantly from the expected 1:2:1 ratio. The low chi-square value supports this interpretation. The observed backcross ratio and its low chi-square value also conform to the expected 1:1 ratio.

Another interpretation of the three colors observed in the F_2 segregants may be based on the presence of two pairs of alleles with interaction to produce a 9:3:4 ratio. The chi-square value calculated for this ratio is 0.21. However, without a larger number of plants in the F_2 population, further critical analysis of this hypothesis seems unwarranted.

SUMMARY AND CONCLUSIONS

A passion fruit disease that becomes apparent first in crown rot and later in wilting of green healthy leaves and stems has been noted. The causal agent is not known. Edulis vines showed susceptibility and flavicarpa vines showed resistance to the disease, with inheritance data from limited populations indicating a simple dominant gene for resistance.

Purple tendril color is dominant over green.

Fruit shell color appears to be controlled by a single pair of genes with no dominance. Three color types are recovered in the F_2.

Correlation of tendril and fruit shell color has not been made apparent, but a re-examination of these factors in larger populations seems desirable.

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