A STUDY OF FRUIT AND SEED SETTING ABILITY AND FEMALE STERILITY IN THE SWEET POTATO (*IPOMEA BATATS* (L.) LAM)[1]

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Once methods of inducing the sweet potato plant to blossom were discovered, sweet potato improvement programs changed almost entirely from the selection of spontaneous mutant types to the selection of new seedlings resulting from cross-and open-pollinations (Boswell, *et al.*, 1937; Chung, 1927; Edmond, 1946; Fujise, *et al.*, 1955; Menezes, 1952; Miller, 1937, 1939; Stout, 1924, 1926; Thompson, 1925: Warmke and Cruzado, 1947, 1949). With this new ability to produce true seed, it was found that new factors limiting seed production were introduced. Most self-and many cross-pollinations produced no seed at all, and in successful pollinations the percentage of fruit set was low. A system of self-and cross-incompatibility has been identified as the main factor affecting fruit set (Hernandez, *et al.*, 1962, 1964; Martin, 1965, 1966; Shigemura, 1943; Shinjo, 1962; Terao, 1934; Togari, *et al.*, 1942; Van Schreven, 1954; Wang, 1964 a, b) with environmental, genetical, morphological, pathological, and physiological factors contributing their influences (Burnham, 1967; Jones, 1964; Montelaro, *et al.*, 1951; Qubedeaux, 1963; Ting, *et al.*, 1953; Wang, 1964 b.).

The identification of incompatibility of groups and assignation of sweet potato clones to them has not eliminated the problems of low percentage of fruit set and low number of seeds per developing fruit. Within compatible matings, some clones consistently set more fruit and develop more seed than others. The variety, Goldrush, sets almost no fruit at all under any conditions (Hernandez, *et al.*, 1962).

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The purposes of this study are to investigate the fruit set and seed forming ability following compatible matings in L9-39, L0-240, and the female sterility of the Goldrush variety.

Materials and Methods

All sweet potato clones used in the present study were grown during the summer and fall of 1966 in the sweet potato breeding nursery of the Louisiana Agricultural Experiment Station at Baton Rouge. The crosses which were utilized in the study of clonal differences in capacity to set seed were listed in the Table 1 and Table 6.

Pollination Techniques: All pollinations, both self-and cross—, were made the day of anthesis from mid-August through the end of September, 1966, between 6 and 9 A. M. Blossoms to be cross-pollinated were emasculated the afternoon prior to anthesis by slitting the unopened corolla and removing the undehisced anthers. Emasculated buds were protected from insect visitation by covering with glassine envelopes secured with paper clips. Blossoms to be self-pollinated and those serving as pollen sources were also coverd with glassine envelopes the day before anthesis. Pollinations were accomplished by removing the protective glassine envelopes, tearing away sufficient corolla to expose the stigma, and applying the appropriate pollen. Pollinated blossoms were tagged indicating parents and date of pollination, and then recovered till late in the afternoon. The glassine envelopes were made of Lilly-glassine Powder paper (4-3/8″×5-3/4″) glued with wheat starch paste.

Records were kept of the number of each cross made on a particular date, the number of fruit set, and the number of seed per fruit. Fruit were harvested 30-50 days after pollination. The number of seed per fruit was also recorded for open-pollinated fruits of the selected seed parents collected during the pollination season. Ovaries of 25 flowers of the three seed parents, Goldrush, L0-240, and L9-39 were observed every 10 days from September 1 to October 28. The ovaries of the collected pistils were cut transversely and the exposed ovules squeezed out and counted.

Cytological Techiques—Styles and stigmas (referred to as style only hereafter) of pollinated flowers were collected at 1, 1½, 2, and 3½, hours after pollination to examine pollen germination on the stigmas and pollen tube growth in the styles.

Carnoy's fluid (Purvis, 1964)-(6: 3: 1, absolute alcohol; chloroform; glacial acetic acid) was used as killing-fixing solution. The fixed styles were softened in 1 N HCl at 60°C for 30 minutes. Following softening, the styles were washed in distilled water. Style was placed on a slide with several drops of safranin 0 and aniline blue (Dionne, 1958) and squashed under a cover glass.

Additional stain was added from time to time. The stain was prepared by dissolving 150 mg of safranin 0 and 20 mg of aniline blue in 25 ml of hot 45% acetic acid.

Records were made of:

1. The number of germinated pollen grains on the stigma.
2. The number of pollen tubes at various levels of the styles at certain intervals after pollination.
3. The condition of each pollen tube (normal or abnormal)

Embryo sac development was studied in L9–39 and the 'Goldrush' variety. Flowers and buds were collected 3 hours after bloom and one day before bloom. They were fixed in carnoy's fixative and dehydrated in a standard TBA series (Johansen, 1940). Serial longitudinal sections, 12–20 microns thick, were stained with safranin 0 and fast green according to the schedule of Conn, *et al.* (1960).

Results and Discussion

(1) *Fruit Setting Ability*

In relation to controlled self-and cross-pollinations—The results of a comparative study of fruit and seed setting ability of the two sweet potato clones L0–240 and L9–39 when self-pollinated and cross-pollinated with the three clones L1–80, L131, and L3–80, representing incompatibility groups III, V, and VI, respectively, are listed in Table 1. It was determined that L0–240 is self-sterile while L9–39 is highly self-fertile giving slightly more than 80 percent fruit set and an average of 2.11 seeds per fruit. Following controlled cross-pollinations the average percent fruit setting ability of L9–39 was twice that of L0–240, 57.45 percent compared to 27.42 percent. L9–39 and L0–240 responded differently to each of three pollen parents. L131 was a more compatible pollen parent for L0–240, as determined by percent fruit set, than either L1–80 or L3–80. L1–80 was the most compatible pollen parent for crosses with L9–39. Because of the variation in performance of each pollen parent on the two seed parents, it is not likely that differences in pollen viability were involved in the response obtained within each seed parent.

L9–39, which had the higher percentage fruit set, also had the higher average number of seeds per fruit, 1.70 seeds as compared to 1.18 seeds. Within each seed parent, there were almost no differences in average number of seeds per fruit among the different crosses. Although certain crosses within each seed parent were more compatible than others as reflected by a higher percentage of fruit set and a higher total number of seed produced, no important differences in compatibility were reflected in the number of seed contained in the fruit of each seed-parent, Table 1 and 2.

Tale 1. *Percentage of fruit set and number of seeds per fruit of clones L0–240 and L9–39 following self-pollination and cross-pollination with these three individual pollen parents and their combined pollen*

Cross	Number of Flowers Pollinated	Number of Fruit Set	Percent Fruit Set	Average No. of Seeds Per Fruit
L0-240 × Self	66	0	0.00	0.00
L9-39 × Self	102	83	81.37	2.11
L0-240 × L1-80	225	61	27.11	1.16
L0-240 × L131	236	94	39.83	1.19
L0-240 × L3-80	312	57	18.27	1.18
Average			27.42	1.18
L9-39 × L1-80	257	173	67.32	1.73
L9-39 × L131	186	102	54.84	1.74
L9-39 × L3-80	255	126	49.41	1.63
Average			57.45	1.70
L0-240 × L1-80 L131 L3-80	40	16	40.00	1.31
L9-39 × L1-80 L131 L3-80	42	33	78.57	1.97

Table 2. *Percentage of control-pollinated fruit of L0–240 and L9–39 containing 1, 2, 3, and 4 seeds*

Cross	Number of Seeds per Fruit				Total Number of fruit set
	1	2	3	4	
L0-240 × L1-80	83.61	16.39	0	0	61
L0-240 × L131	82.98	15.96	0	1.06	94
L0-240 × L3-80	84.21	14.03	1.75	0	57
Average	83.49	15.57	0.47	0.47	212
L9-39 × L1-80	43.93	41.04	11.56	3.47	173
L9-39 × L131	49.02	33.33	11.76	5.88	102
L9-39 × L3-80	53.97	32.56	11.11	2.38	126
Average	48.38	36.41	11.47	3.74	401

Triple pollination (the act of placing pollen from each of the three pollen parent clones on the same stigmatic surface) resulted in an increase in average number of seed per fruit but not an increase in fruit set.

The clones L0–240 and L9–39 are suspected of belonging to different incompatibility groups. since there is no group in the system of Hernandez and

Miller (1964), which contains both self-fertile and self-sterile members. The differences observed in fruit setting ability under conditions of controlled pollination are assumed to be varietal characteristics similar to those pointed out by other workers (Miller, 1939; Montelaro, *et al.*, 1951; Warmke and Cruzado, 1949). These differences and the differences in number of seed per fruit are probably due to a factor or factors other than the major compatibility-incompatibility system in operation in sweet potatoes. The reason for the increase in number of seed per fruit under conditions of multiple pollination is not known at this time. It may have resulted from extra pollen or from a pollen stimulatory effect.

The results of observations on the number of seeds per open-pollinated fruit of clones L0–240 and L9–39 are listed in Table 3. Averages of number of seeds per fruit over the season for the two clones are similar to those obtained under conditions of controlled pollination, Table 1. This indicates that the technique of hand emasculation and pollination was not responsible for any influence on the number of seeds per fruit. In open-pollinated combinations of L0–240, for the season, The percentage of fruit containing one seed was nearly five times larger than that of fruit containing two seeds. In L9–39, the percentage of open-pollinated fruit containing one and two seeds were about equal. This relationship is also approximated in the fruit of the controlled crosses, Table 2. The fact that on the average there were approximately 50 percent fewer in both open- and cross-pollinated fruit containing one seed in L9–39 than in L0–240 is of more importance.

Table 3. *Percentage of open-pollinated fruit of L0–240 and L9–39 containing 1, 2, 3, and 4 seeds and average number of seeds per fruit*

Clone	Collection Date 1966	Seed Distribution of Number per Fruit				Total Fruit Number	Average number of Seeds per Fruit
		1	2	3	4		
L0-240	September 1	80.00	20.00	0	0	30	1.20
	October 8	95.00	5.00	0	0	60	1.05
	October 17	82.14	17.86	0	0	140	1.18
	October 28	72.73	23.97	3.30	0	121	1.30
Average		80.91	17.95	1.14	0		1.20
L9-39	September 2	44.61	43.08	10.77	1.54	65	1.69
	September 16	42.86	45.24	11.90	0	42	1.69
	October 8	41.67	40.28	16.66	1.39	72	1.78
	October 17	34.23	36.94	24.32	4.50	111	1.99
	October 28	32.50	38.75	22.50	6.25	80	2.02
Average		38.11	40.00	18.65	3.24		1.87

In relation to the number of ovules in the ovaries—Observations on the percent age of ovaries containing two, three, and four ovules for the clones L0–240 and L9–39 are listed in Table 4. No irregularities were found in clone L9–39. All ovaries examined contained the normal complement of four ovules. The irregularities detected in L0–240 are not considered of sufficient magnitude to result in the difference in number of seed per fruit existing between L0–240 and L9–39.

Table 4. *Percentage of ovaries containing 2, 3 and 4 matured ovules in clones L9–39 and L0–240 collected at five 10–day intervals**

Date	L9-38			L0-240		
	2	3	4	2	3	4
September 1	0	0	100	4	4	92
September 11	0	0	100	8	12	80
September 21	0	0	100	12	0	88
October 1	0	0	100	4	0	96
October 11	0	0	100	4	4	92
Average	0	0	100	6.40	4.00	89.60

* Based on 25 ovaries observed each day

In relation to pollen germination and pollen tube growth—Staining with safranin 0 and aniline blue gave the best results for observing pollen germination on the stigma and pollen tube growth in the style. This staining method was used in all cytological examinations. Pollen grains, germinated and ungerminated, and pollen tubes stained deep blue. The stigmatic and stylar tissues stained red. Pollen tubes were stained deepest at their growing tips. The stigmatic ends of long pollen tubes stained very poorly, and in many cases the pollen tubes could not be easily detected in the upper stylar regions, while their growing ends near the base of the style were deeply stained.

The results of observations on pollen germination and pollen tube growth in the two clones L0–240 and L9–39 are shown in Table 5. Pollen grains were considered germinated if they remained on the stigma through the whole staining procedure. It was observed that in incompatible crosses all pollen grains are washed off the stigma prior to staining and squashing. Many instances were observed where pollen tubes grew over the stigmatic surface and never penetrated the stylar tissue (Figure 1). In all instances, more than a sufficient number of pollen grains germinated to pollinate the four ovules present in an ovary. An average of 26.88 germinated pollen grains were on each L0–240 stigma, and an average of 24.92 on each L9–39 stigma.

Two morphologically different types of pollen tubes were found in the styles, (Figures 2 and 3). One was normal and characterized by a slender growing tip while the second was abnormal as indicated by a swollen tip. The swollen tip is interpreted as a cessation of pollen tube growth. Both normal and abnormal pollen tubes occurred in each of the six crosses studied. Usually two or three normal pollen tubes developed further down the style than the abnormal pollen tubes. These observations are in agreement with those of Shigemura (1943). There was a tendency for an incerase in number of abnormal pollen tubes with increasing time after pollination, Table 5. Normal type pollen tubes could not be counted at 3.5 hours after pollination because the tips had already grown into the ovaries, and the portions of the pollen tubes in the styles were too lightly stained to be counted. This same problem confronted Shigemura (1943).

Table 5. *Pollen germination and pollen tube growth in the style at 1, 1.5, 2, and 3.5 hours after pollination of clones L0–240 and L9–39 with clones L1–80, L131, and L3–80*

Cross	Average Number of Germinated Pollen Per Stigma#				Average Number of Abnormal Pollen Tubes per Style##				Average Total Number of Pollen Tubes per Style##			Average Percent Length of Style Traveled##		
	1	1.5	2	3.5	1	1.5	2	3.5	1	1.5	2	1	1.5	2
L9-39 × L1-80	14.2	20.2	17.0	36.6	1.6	3.0	4.2	2.8	5.0	6.4	7.0	53.82	90.38	94.34
L9-39 × L131	14.8	27.4	16.0	46.4	3.0	2.4	1.2	2.8	5.8	7.2	3.6	47.06	64.15	96.55
L9-39 × L3-80	8.8	22.6	19.8	55.2	0.2	2.2	2.8	4.2	4.6	7.2	6.8	33.33	70.91	92.59
L0-240 × L1-80	33.6	23 8	25.8	52.3	1.6	4.2	3.8	4.8	4.8	5.4	5.0	52.83	81.13	94.54
L0-240 × L131	18.0	14.2	26.6	16.4	1.0	0.8	0.8	1.8	3.4	3.2	5.4	23.91	47.27	71.43
L0-340 × L3-80	22.8	21.6	25.6	42.0	0.2	0.8	1.6	2.2	3.4	5.0	6.0	37.50	68.52	87.27

Average of 5 Stigmas
Average of 5 Styles

Pollen tubes in L9–39 were faster growing than those in L0–240, Table 5. Rate of growth was determined by recording the level in the style reached by the most advanced, normal pollen tube. For the three crosses with L9–39 the pollen tubes had grown through an average of 45.67, 75.00 and 94.54 percent of the stylar length at 1, 1.5, and 2 hours, respectively, afther pollination. In L0–240, an average of 38.71, 65.43, and 84.34 percent of stylar length were traveled in the same time intervals.

The abnormal of swollen pollen tubes were interpreted by Quebedeaux (1963) and Togari, *et al.* (1942) as an expression of the major incompatibility system operating in sweet potatoes. Since Martin (1965) classified the incompatibility system in sweet potatoes as sporophytic (incompatible pollen

does not germinate) and since abnormal pollen tubes are found in association with the normal type, abnormal pollen tubes must be reinterpreted.

(2) *Female Sterility in The 'Goldrush' Variety*

Female sterility in relation to controlled cross-pollination—Although the 'Goldrush' variety set an occasional fruit following cross-polination, Hernandez and Miller (1962) considered it to be female sterile. On the basis of fruit set when used as pollen parent 'Goldrush' was identified by Hernandez and Miller (1964) as belonging to incompatibility group II, a group whose members are self-sterile and intra-group sterile.

The results of cross pollination of 'Goldrush' with clones L1–80, L131, and L3–80, members of incompatibility groups III, V, and VI, respectively, are listed in Table 6. 'Goldrush' exhibited very low female fertility, averaging less than 10 percent fruit see in the crosses studied. Most of the fruit that matured contained only one seed, though occasionally one containing two seeds matured. There seemed to be little or no differential influence of the pollen sources on the percent fruit set or number or seeds per fruit. Pollination with the combined pollen of L1–80, L131, and L3–80 resulted in no increase in percent fruit set but a little increase in number of seed per fruit as occurred in L0–240 and L9–39. The reason for the increase in number of seed per fruit under conditions of multiple pollination is still not known at this time.

Table 6. *Percentage of fruit set and number of seeds per fruit of 'Goldrush' following cross-pollination with three individual pollen parents and their combined pollen*

Cross	Number of Flowers Pollinated	Number of Fruit Set	Percent Fruit Set	Average Number of seeds per Fruit
Goldrush × L1-80	224	15	6.69	1.06
Goldrush × L131	292	26	8.90	1.08
Goldrush × L3-80	163	12	7.36	1.17
Average			7.81	1.09
Goldrush × L1-80 L131 L3-80	41	3	7.31	1.33

Female sterility in relation to pollen germination and pollen tube growth—The results of studies of pollen germination and pollen tube growth in the styles of 'Goldrush' are listed in Table 7. A sufficient number of germinating pollen grains to accomplish fertilization of four ovules were observed on the stigmas. Both normal and abnormal pollen tubes were observed in the styles as in the case of cross combination involving L0–240 and L9–39 as female

parents, (Figures 2 and 4). Normal pollen tubes could not be counted at 3.5 hours after pollination because of light staining of the portions of the pollen tubes in the styles. For the 1, 1.5, and 2 hour periods after pollination, there were an average of 3.09 normal pollen tubes per style, a sufficient number to result in fruit set, but insufficient to pollinate four ovules if they were present. The average number of abnormal pollen tubes at 1, 1.5, and 2 hours after pollination were 1.20, 1.86, and 2.00, respectively. It appears, from the observation, that the extremely low female fertility of 'Goldrush' is not caused by stigmatic and stylar inhibition of pollen germination and pollen tube growth.

Table 7. *Pollen germination and pollen tube growth in the style at 1. 1,5, 2. and 3.5 hours after pollination of 'Goldrush' with clones L1–80, L131, and L3–80*

Cross	Average Number of Germinated Pollen per Stigma#				Average Number of Abnormal Pollen Tubes per Style##				Average Total Number of Pollen Tubes per Style##			Average Percent Length of Style Traveled##		
	1	1.5	2	3.5	1	1.5	2	3.5	1	1.5	2	1	1.5	2
Goldrush × L1-80	15.0	12.0*	12.8	76.0	1.4	1.5*	2.6	2.6	4.2	4.0*	4.2	53.70	86.05*	96.55
Goldrush × L131	7.8	9.8	6.8	14.2	0.8	2.4	1.0	0.6	3.4	3.0	4.6	59.26	88.24	100.00
Goldrush × L3-80	33.0	16.6	30.0	66.4	1.4	1.6	3.0	2.2	6.4	5.8	7.2	70.69	93.22	98.56

Average of 5 Stigmas
Average of 5 Styles
* Average of 4

Female sterility in relation to the ovary—Twenty-five ovaries of 'Goldrush' were examined for ovule number on each of five dates at 10 day intervales beginning September 1, 1966. Of the 125 ovaries examines, 68.80, 9.79, and 21.60 percent contained two, three, and four matured or fertilized ovules, respectively. The percent abnormal ovaries was higher than that observed by Burnham (1967). No varies were found that contained only one ovule. Since only one developing seed is necessary for fruit set to occur (Martin, 1965), the reduction in ovule number may contribute to low fruit set only by reducing the chances for fertilization to occur. If, however, the factor or factors responsible for reduction in ovule number also contribute to abnormal development of the ovules present, here in lies the explanation of the female sterility of 'Goldrush'.

Female sterility in relation to ovule and embryo sac morphology—Ovule and embryo sac morphology was studied on a comparative basis of the clone L9–39 and the variety, Goldrush. Ovule and embryo sac morphology of L9–39

was found to be as described by Peterson (1945) and assumed as normal. All ovaries examined cytologically contained four normally arranged ovules. Embryo sacs were long, slender, slightly curved structures, (Figure 5). The egg apparatus (egg cell plus two synergid cells) could be clearly identified at the micropylar end of the embryo sac, but the individual nuclei were not discernable because of dense cytoplasmic staining with safranin 0, (Figur 6). Two polar nuclei were easily found, but the three antipodal cells were never detected and had most likely disintegrated prior to the time of bud and flower collection. The micropyle was easily detected as shown in (Figure 5).

The arrangement of the ovules in ovaries of 'Goldrush' was irregular, as expected, since 78.40 percent of the ovaries contained less than four ovules. Ovule morphology was abnormal in many cases, but normal appearing ovules were found, (Figure 7 and 8). No. embryo sacs comparable in structure to those of L9–39 were observed in 'Goldrush' though they must occur as evidenced by the occasional seed matured. Embryo sacs of two morphologically different types were detected in 'Goldrush'. One approached that of L9–39 in shape, but was shortened at the micropylar end, (Figure 7), Nuclei within these embryo sace were difficult to detect and no regular arrangement of nuclei was observed. The second type of 'Goldrush' embryo sac observed was limited to a small circular cavity at the chalazal end of the ovule, (Figure 8).

The factor or factors responsible for the abnormalities detected in embryo sac and ovule development are not known at this study. If meiotic abnormalities are responsible they should be detectable in microgametogenesis and result in pollen of low viability. Sufficient germinating pollen and pollen tubes in the styles were observed to accomplish fertilization of normal ovules if they were present, but the presence of ovules alone was not found to be sufficient evidence of their normality.

Summary

A differences in fruit set and seed forming ability of the two sweet potato clones of L9–39 and L0–240 and the female sterility of the 'Goldrush' variety were investigated.

Self pollination studies indicated that L9–39 was highly self-fertile with more than 80 percent fruit set and an average of 2.11 seeds per fruit while L0–240 was self-sterile. Under conditions of controlled cross-pollination, the percentage fruit set of L9–39 was twice that of L0–240. L9–39 had an average of 1.70 seeds per fruit as a seed parent compared to an average of 1.18 seeds per fruit for L0–240 as seed parent. Approximately 50 percent fewer in both open-and cross-pollinated fruit contained one seed in L9–39 crosses than in L0–240 crosses. L9–39 and L0–240 showed differently in fruit setting but not

in seed forming ability when cross-pollinated with each of the three different pollen parents.

Ovary irregularities were not detected in L9–39, but were evident in L0–240 showing reduction in ovule number. However, the percentage of irregular ovaries was not considered to be of a sufficient magnitude to explain the differences in percent fruit set and average number of seed per fruit which existed between L0–240 and L9–39.

An average of more than 20 germinated pollen grains were observed on each stigma of the six crosses studied, and were considered to be of sufficient number to fertilize the four ovules contained in each ovary.

Two morphologically distinct types of pollen tubes were found in the styles of each of the six crosses studied. Two or three pollen tubes classified as normal developed further down the styles than those with swollen tips which were classified as abnormal. The swelling of the pollen tube end was interpreted as cessation of its growth. Three and one half hours after pollination, normal pollen tubes had already grown into the ovaries. An average of 3.69 and 2.98 normal pollen tubes per style were found in L9–39 and L0–240, respectively. Pollen tubes grew faster in L9–39 styles than in L0–240 styles.

Definite differences in fruit set and seed forming ability existing between the two clones L9–30 and L0–240 were found in the controlled cross-pollination studies. The cause of these diffierences, however, was not identified. L0–240 showed some abnormal ovaries which might be an indication of some irregularity in ovule ontogeny which caused the ovules incapable of being fertilized and ultimately reduced fruit set and seed formation. Ovule and embryo sac ontogeny should be examined in the L0–240 clone. Because of the lack of identification of the specific nature of the causative factor or factors the differences in fruit set and seed formation must for the present be considered unexplained clonal defferences. No explanation was found either why L9–39, the 'fertile' clone set only an average of 1.63 to 1.97 seeds per fruit rather than four. The abnormal, swollen pollen tube, heretofore considered an indication of the major incompatibility system in sweet potatoes must be reinterpreted.

Studies on pollen germination and pollen tube growth in the styles of the 'Goldrush' variety shown that its female sterility did not seem to be due to inhibition of pollen germination and tube growth.

Sixty eight percent of the ovaries examined contained only two ovules and this no doubt contributes to 'Goldrush's' female sterility by reducing chances for fertilization and fruit set. The arrangement of the ovules, when less than four, was very irregular, and the embryo sacs were irregular compared to those of L9–39. Embryo sace were shortened, thereby increasing

micropyle length and decreasing chances for fertilization. Some embryo sacs were restricted to small circular cavities at the chalazal end of the ovule. Some ovules were observed which did not show a clearly defined micropyle. None of the Goldrush' embryo sacs examined contained a normal appearing egg appartus, though the production of occasional seeds is evidence that normal ovules and embryo sacs exist.

甘藷結果及結子力及雌性不稔之研究

王 俠

本文旨在探討路州兩甘藷品系，L9-39 及 L0-240 之結果與結子能力及影響此兩性狀之因子以及 Goldrush 之雌不稔性。

由自交人工雜交以及調查天然雜交結果之種子數，得知L9-39自交可稔性極高，L0-240則爲自交不稔。人工雜交結果率，L9-39 較 L0-240高達一倍，天然雜交結子率與人工雜交結子率相似，均以 L9-39較 L0-240 爲高。雖經調查花粉在柱頭上發芽，花粉管在花柱內伸長數量及子房內胚珠數等性狀，但未獲得影響其不同結果結子率之正確因素。

Goldrush 品種之雌不稔性，並非由於花粉發芽或花粉管伸長受到抑制所致。調查子房內之胚珠數，得知百分之六十八的子房僅含二個胚珠（正常者爲四胚珠）。Goldrush 之胚囊形狀及核發育不正常。影響胚囊不正常及胚珠數減少之因子，對於 Goldrush 之雌不稔性頗有關係。

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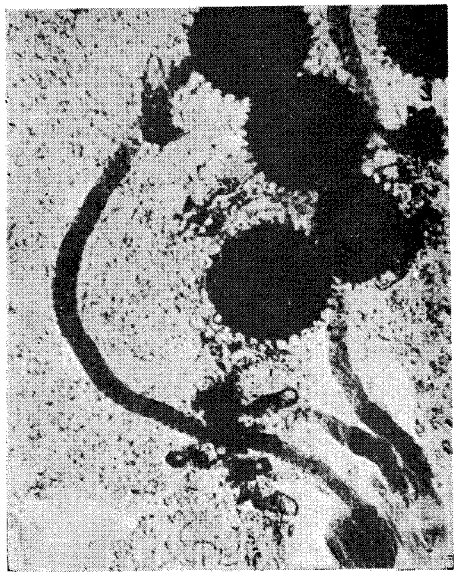

Figure 1. Pollen tubes of L1-80 growing over the stigmatic surface of L0-240. (120×)

Figure 2. Abnormal and normal pollen tubes of L1-80 in 'Goldrush' (80×)

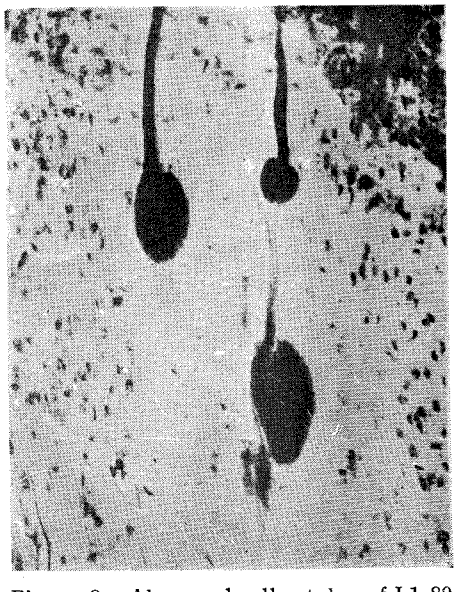

Figure 3. Abnormal pollen tubes of L1-80 in L9-39 (80×)

Figure 4. Pollen tubes of L1-80 in 'Goldrush' (80×)

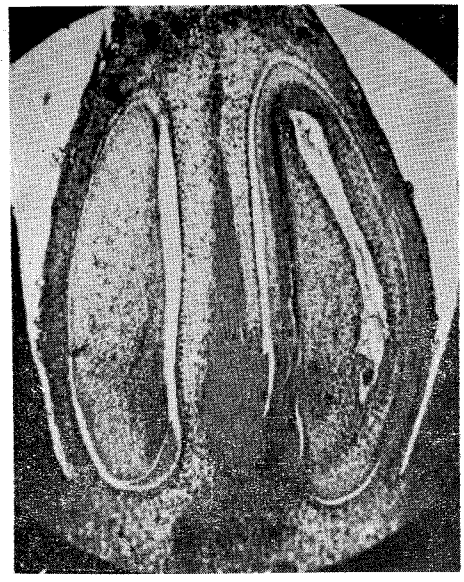

Figure 5. Longitudinal section of an L9-39 ovary one day before anthesis. The ovules are normal. The right ovule contains a normal embryo sac with the deeply stained egg apparatus at the micropylar end (40×)

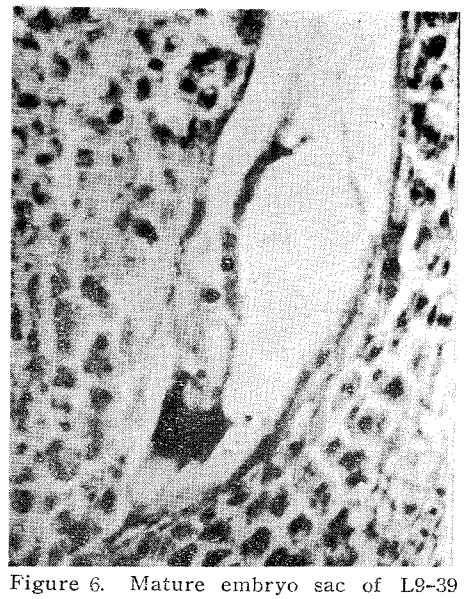

Figure 6. Mature embryo sac of L9-39 showing the two polar nuclei and one synergid cell (240×)

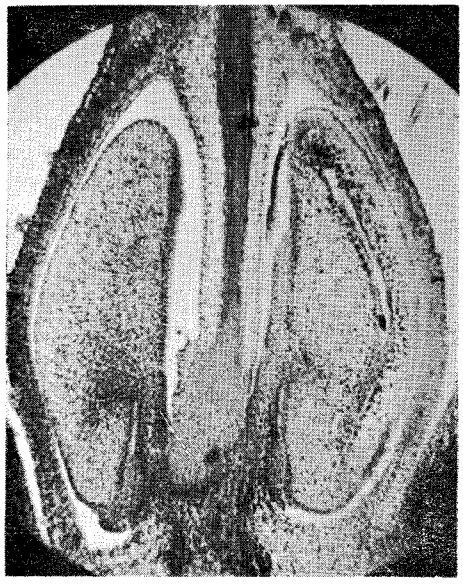

Figure 7. Longitudinal section of 'Gold-rush' ovary on the day of anthesis. The two ovules appear normal but the embryo sac of the right ovule is shortened placing deeply stained embryo sac nuclei near the center of the ovule (40×)

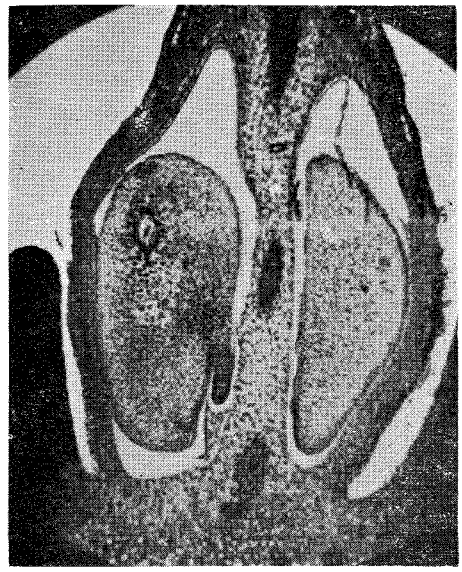

Figure 8. Longitudial section of a 'Gold-rush' ovule. The embryo sac in the left ovule is reduced to a circular hole in the Chalazal end of the ovule (40×)

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