

**SARE PROJECT FNE00-307
HARDY KIWI POLLENATION & PRODUCTION
FINAL REPORT**

By

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The purpose of this project was to address different pollination techniques in hardy kiwi, *actinidia arguta*,

Due to an early spring frost in the 2000 season, there was not ample spur material available, only secondary bud, to complete the research outlined in the grant proposal. We requested and received an extension until the 2001 season. Data was accumulated and submitted in an interim report for the 2000 season, which is included in this report.

This project entailed a three pronged approach conducting research trials which A) identified male cultivars that were best suited for use in the arbor based on their vigor and viability, and B) experimented with both biological and mechanical methods of pollen dispersion for female cultivars.

HARDY KIWI MALE CULTIVAR STUDY INFORMATION

The purpose of the male component of this study was to identify vigorous and viable male cultivars suitable for use in commercial production plantings.

Seven male cultivars were listed in the original grant for test trials. They were the Cornell, Fave, 74-32, 74-46, 127-40, Meader, and Ivan males.

As outlined in our interim report filed in 2000, two of the varieties listed in the original grant were assimilated. We found that two of the cultivars matched other male vines in the study, even though bearing a different name. Without the capability to test for individual genetic markers, these were omitted based on statistical data i.e.: leaf shape, petiole color, flower stem pattern, flower pollen nodule color, and wood characteristics. Those assimilated were the 127-40 that matched the Meader male, and Ivan which matched the 74-32 male.

The proposed statistics, pollen viability, flower density, and new growth characteristics, were collected for the five remaining male cultivars Cornell, Fave, 74-32, 74-46, and Meader.

Two vines in the study represented each male cultivar. One spur, twelve inches in length, was marked on each vine providing data from a total of 10 spurs.

One "terminating" and one "non-terminating" spur represent each cultivar in the trial.

A non-terminating spur is a single long green shoot with flower stems and flowers growing directly from it, in patterns of seven flowers, at the leaf nodules.

A terminating spur is a shoot with short multi-lateral shoots extending from it. Flowers grow at the leaf nodules, 1 patterns of seven, on the multi-lateral shoots.



A. Arguta male flowers

Terminating spurs will generally produce a heavier flower density; therefore, one spur of each type was chosen for each male cultivar to provide a good overall average for that cultivar's performance.



Non-Terminating Spur



Terminating Spurs

A male flower, once open, is viable for a period of one day. Flowers were collected from each vine at what we call the "popcorn stage", right before opening. This process was carried out from June 4th through June 8th collecting one variety of male flowers per day. The flowers were opened individually, by hand, and tweezers were used to remove the pollen nodules from the flowers. The pollen nodules were then dried, packaged, and placed in frozen storage for pollen viability testing.

MALE DATA FINDINGS:

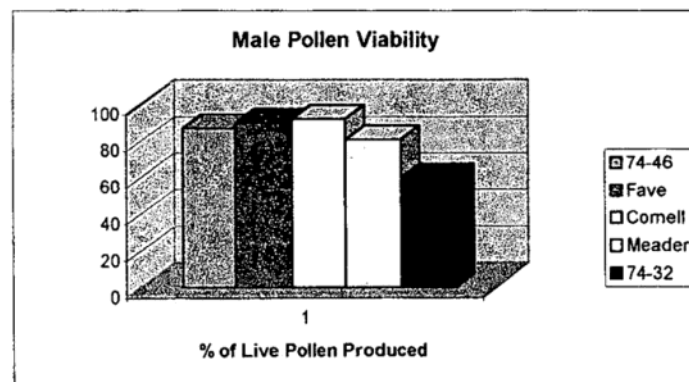
The goal was to identify the vigor of the *A. arguta* male vines in this study that would be suitable to achieve successful pollination in commercial production. The *A. arguta* male cultivars tested have revealed both strengths and weaknesses. The results are as follows:

POLLEN VIABILITY:

Dr. George Davis at Bloomsburg University, Bloomsburg, PA, tested pollen viability, the amount of live pollen produced by each male cultivar.

Dr. Davis tested for pollen viability by using stained flurscein, a diacetate, vital dye that does not glow. The dye is hydrophobic and penetrates the cell membranes of the pollen. The diacetate dye is then acted on by asterase, which liberates the pollen and converts it to flurscein, and allows the live pollen to glow a very bright green. Flurscein is measurable at 535 nanometers and by an actinic wavelength of 493 nanometers.

The results for the five male cultivars in our trial are as follows:



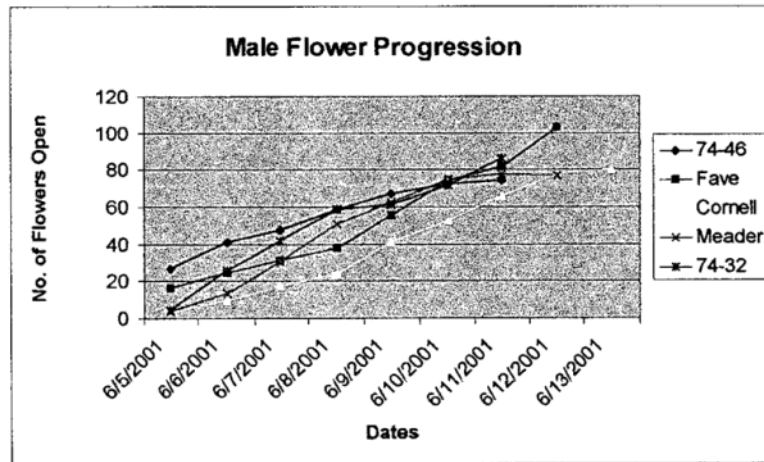
Graph No. 1

The pollen viability, shown in Graph No. 1, was very good for the *A. arguta* male varieties tested. Four cultivars, Cornell, Fave, 74-46, and Meader achieved 80% to 90% viability. These levels are acceptable for commercial production in that they meet and/or exceed the viability of *A. deliciosa* pollen that can be purchased on today's market. The exception was the 74-32 cultivar, which only displayed 60% viability.

FLOWER DENSITY & FLOWERING SCHEDULES:

The numerical information collected for the two vines of each cultivar was added together and averaged to provide the final data for those cultivars results.

Flower schedules were documented daily for each of the ten test spurs. The chart below shows the individual male cultivars, their respective flower densities, and opening progression schedules.



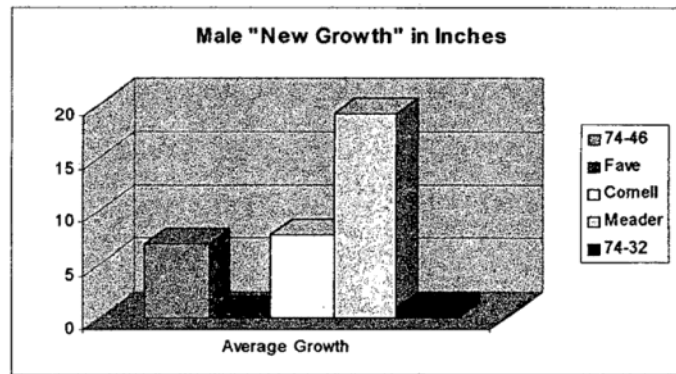
Graph No. 2

Flower density, shown in Graph No. 2, indicates that the 74-46, and 74-32 males displayed a high populous of flowers from the early to mid flowering period. These males would pair nicely with the early flowering female cultivars of Red Princess, Geneva, and Michigan. The Cornell, Fave, and Meader males began with a lower populous of flowers and achieved higher levels from the middle to end of the flowering period. These males would provide pollenation coverage for both the end of the early female cultivars and the entire cycle for the later flowering Ananasnaya cultivar.

NEW GROWTH:

Each of the trial spurs were cut back to one inch of the cordon or lateral cane that it had grown from, at the end of flower bloom. Annual replacement growth was documented, at the end of the growing season, for each spur in the test group by measuring any new growth that occurred.

One terminating and one non-terminating spur were chosen for each cultivar to allow a proper representation. Replacement growth is always more prominent on cane that supports a non-terminating spur. A terminating spur when cut back will at best produce a short, second year spur growth.



Graph No. 3

The 2001 growing season entailed an unseasonably long wet spring, warmed up during the middle of flower to excessive temperatures, and then remained hot and dry for the rest of the season. These conditions promoted a shorter, more condensed flowering schedule, a total of five days less than in the 2000 season. It also prompted an abundance of flower on the vines, which resulted in less annual replacement growth.

The results of replacement growth, shown in Graph No. 3, indicates the Meader male achieving the greatest amount of cane replacement, the Cornell and 74-46 with interim amounts, and the 74-32 and Fave males displaying the least growth.

In summary, each of the male cultivars studied here are vigorous, with perhaps the exception of the 74-32, and provide a viable pollenation source, flower density, annual growth, and would be of value for a commercial production planting. It would be worthwhile to conduct a replicate study on the 74-32 vines for another growing season before eliminating it from the category of a vigorous male vine.

Individual spur information providing the number of clusters, number of flowers per cluster, flower schedules, and new spur growth can be found on supplemental pages 12 through 16.

HARDY KIWI FEMALE CULTIVAR STUDY INFORMATION

The purpose of the female component of this study was to identify the effectiveness of methods of pollen dispersion achieved by bees introduced into the arbor or mechanical application.

This trial was separated into two test areas. Site #1: Pollen introduced into honeybee hives, and Site #2: Mechanical application of pollen. It is important to note that once a female flower has opened, it is able to receive pollen for a period of five to seven days.



A. Arguta female flowers

Female cultivars chosen for the trials in the original proposal were Ananasnaya (Anna), Geneva, Michigan, and Red Princess. Each female cultivar was to be represented by four vines interspersed throughout the arbor on each test site. Due to the damage sustained in the 2000 season spring frost, there were not ample Anna vines in each location on which to conduct studies. Therefore, one Anna vine was utilized in each location, and we included the female cultivar Fave that was represented by three vines in each location to maintain the original count of thirty-two vines in the study.

POLLEN TYPES (A. Deliciosa):

Pollen was purchased from Pollen Collection & Sales in Lodi, California, and The Pollen Bank in Bakersfield, CA., which are the only two sources for this type of pollen in the United States.

Deliciosa kiwi pollen must be stored in a frozen state until use. Pollen that is taken out of frozen containment is only viable for a period of up to three hours.

Three types of pollen were used for mechanical application. All had an 85% viability or better.

Type One - contained a mixture of pollen and anthers. This proved hard to distribute due to the anthers blocking the applicator. This pollen seemed to have the least effect.

Type Two - contained 100% pollen without anthers. This pollen, which provided very satisfactory results, was easily dispersed but would be costly to do large areas with proper coverage.

Type Three - contained 50% pollen, and 50% lycopodium. Lycopodium is a clay material that is used as an extender for pollen. This mixture produced good results, was easily dispersed, and would be the most cost effective to use in a commercial arbor.

WEATHER CONDITIONS DURING FLOWER:

Weather conditions were documented, in Fahrenheit degrees, on a daily basis during the flowering period and were as follows:

| | | | |
|----------------------|------------------------|-----------------------|-----------------------------|
| June 5 th | High 70's and overcast | June 10 th | High 70's and overcast |
| June 6 th | High 70's and overcast | June 11 th | High 70's and overcast |
| June 7 th | Low 80's and full sun | June 12 th | Mid 70's overcast and humid |
| June 8 th | High 70's and overcast | June 13 th | Mid 70's overcast and humid |
| June 9 th | Low 80's and full sun | | |

SITE #1: POLLEN INTRODUCED INTO HONEYBEE HIVES

The number of female cultivars represented were (1) Anna, (3) Fave, (4) Geneva, (4) Michigan, and (4) Red Princess equaling sixteen vines total.

Two spurs were marked on each vine providing data from a total of 32 spurs. Flowers were counted on each spur, and flower schedules were documented on a daily basis.

The aisle and buffer areas in this test location were mowed to reduce competitive flowering plants. Those noted were dandelion and clovers.

Honeybee hives were rented from Aucker's Apiary, Bloomsburg, PA. This firm is reputable for their honeybees that are contracted annually from Maine to Florida.

Twelve (12) honeybee hives were introduced into the arbor, at 20% flower bloom on June 5th. Five (5) grams of *A. deliciosa* pollen (Type Two - 100% pollen without anthers) was added to the hives and/or hive porches on four separate occasions so that the bees would be carrying male kiwi pollen before coming in contact with female flowers.

HONEYBEE ACTIVITY:

Firstly, it is of importance to note that *A. arguta*, hardy kiwi flowers contain pollen but do not contain nectar. According to apiary sources, honeybees will "work" flowers without nectar if placed in the arbor at a 20% or higher flower bloom.

Hives were observed on a daily basis to document the amount of kiwi pollen carried by the bees. Kiwi pollen can be distinguished from other types of pollen in that it is pure white. The pollen of multi-flora rose is orange for example.



Honeybees carrying kiwi pollen

The majority of honeybees lost interest in the kiwi flowers within 24 hours of their introduction into the arbor. A minimal number of bees, out of approximately twenty, were observed carrying pollen back to the hive the first day, and one to two bees, out of approximately fifty, the second day.

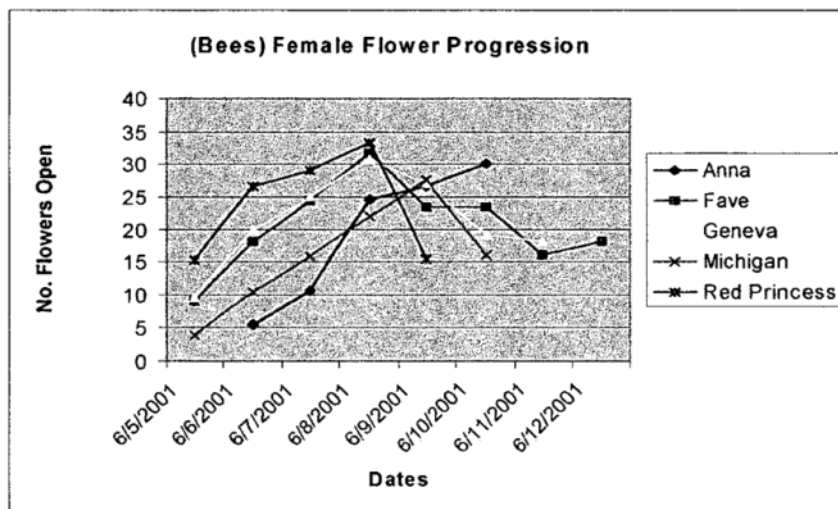
The *A. deliciosa* pollen, when added to hives or hive porches, seemed to irritate the honeybees and no bees were observed returning with kiwi pollen from the vines.

During flower, which lasted approximately eight days, no more than two honeybees were observed on a female cultivar at one time, yet pollination in the arbor did take place.

Weather conditions also play a major role in the activity of honeybees. The owners of the apiary confirmed that honeybees do not like, and generally will not work well in, overcast conditions.

FEMALE DATA FINDINGS – HONEYBEES WITH ADDED POLLEN

The numerical information, collected for the spurs of the four vines of each cultivar, were added together and averaged to provide the final data for that cultivar's results which are displayed in the following graphs.

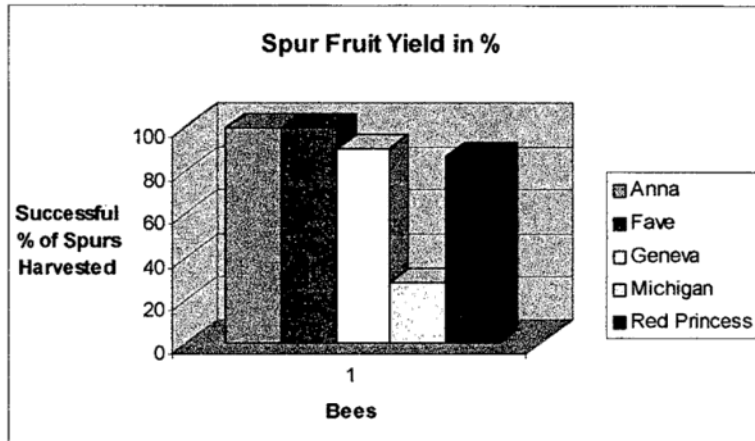


Graph No. 4

Graph No. 4 identifies June 8th, as the peak of female flower production. The weather conditions from June 5th, when the bees were introduced through June 12th, varied in temperature, were generally overcast, and not conducive to bee activity.

Male cultivars, however, in another location ¼ of a mile away, were beginning to reach their peak flower activity on June 11th.

Due to the documentation of minimal bee interaction with the kiwi vines and little or no pollen being returned to the hives, it is obvious that air born pollen from the male vines in another arbor was responsible for the pollination of the female vines in Test Location #1.



Graph No. 5

The successful percentage of pollination that occurred in the trial spurs is shown in Graph No. 5. All female cultivars, with the exception of the Michigan, displayed an eighty percent or better success rate in carrying the original number of flowers pollinated through to the fruit harvest stage.

Individual spur information providing the number of flowers per spur, flowers pollinated, fruit set, fruit drop, fruit yield, successful percentage of pollination, and flower schedules can be found on supplemental pages 17 through 22.

SITE #2: POLLEN INTRODUCED BY MECHANICAL APPARATUS

The number of female cultivars represented were (1) Anna, (3) Fave, (4) Geneva, (4) Michigan, and (4) Red Princess equaling sixteen vines total.

Two spurs were marked on each vine providing data from a total of 32 spurs. Flowers were counted on each spur prior to opening and were documented.

The spurs were covered on June 3rd, with white No. 7 bags, to prevent pollen contamination from any other source.

Due to the compressed flowering schedule, created by seasonal conditions, spurs were pollinated with 50 grams of *A.deliciosa* (Type One – pollen with anthers, and Type Three – 50% pollen/50%

lycopodium) on three separate occasions rather than the four occasions outlined in the original proposal. A pneumatic pollen dispenser was used to distribute the pollen. The flower progression was documented when the bags were removed to pollenate the spurs. Bags were removed, after a ten-day period, on June 13th and the number of flowers pollinated, fruit set, fruit drop, and fruit yield were documented.

NOTATION ON USE OF NO. 7 BAGS:

A large percentage of fruit drop occurred in this test trial.

The covered spurs had a delayed flower opening in comparison to the flower schedule for the rest of the vine.

Some mold was evident on flowers, and some previously pollinated flowers were aborted.

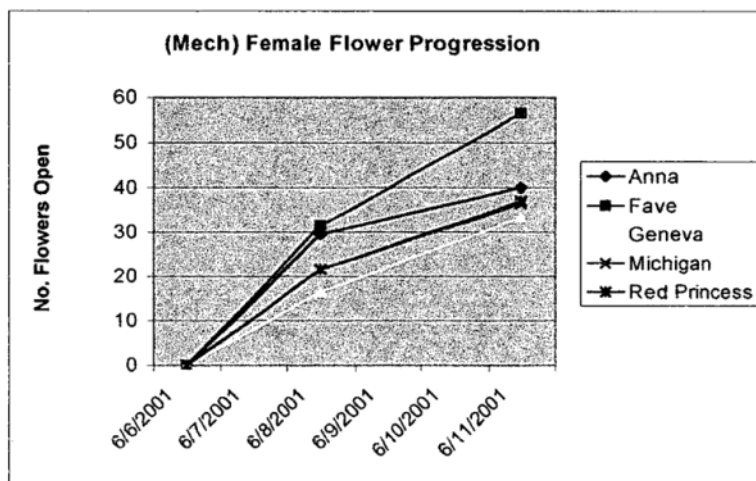
We attribute this to the spurs being bagged during high temperature, and high humidity weather conditions as well as the added suppression of light available to the spurs.



Female spurs covered with No. 7 bags

FEMALE DATA FINDINGS – POLLEN APPLIED BY MECHANICAL APPARATUS

The numerical information collected for the spurs of the four vines of each cultivar were added together and averaged to provide the final data for that cultivar's results.

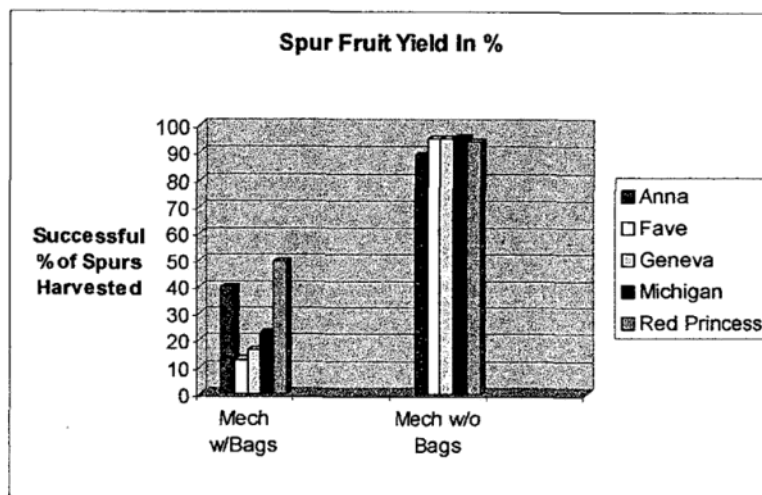


Graph No. 6

Graph No. 6 indicates the flower progression of the spurs that were covered with No. 7 bags. The evidence that the covered spurs experienced a delayed schedule, due to the lower volume of light, is evident when compared to the female flower progression for the honeybees, in Graph No.4 on page 7, that indicates that peak flower actually occurred on June 8th.

Due to the large percentage of flower/fruit drop that occurred with spurs covered by No. 7 bags, the

data for uncovered spurs, from the same test vines, was documented to show the actual performance of mechanical pollination.



Graph No. 7

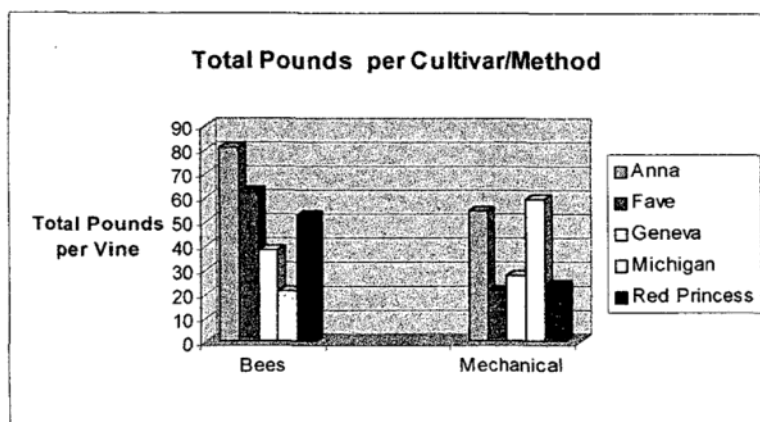
Graph No. 7 indicates the successful percentage of yield, for both bagged spurs and non-bagged spurs, which confirms that mechanical pollination does produce desirable results.

Individual spur information providing the number of flowers per spur, flowers pollinated, fruit set, fruit drop, fruit yield, successful percentage of pollination, and flower schedules can be found on supplemental pages 23 through 29.

POLLINATION METHOD COMPARRISON

The goal of this project was to test both biological (bees), and mechanical methods of pollen dispersion, to determine which of the supplemental methods would increase and/or achieve successful pollination of *A. arguta* female cultivars, and which method would be more cost effective for the grower.

FRUIT PRODUCTION PER METHOD



Graph No. 8

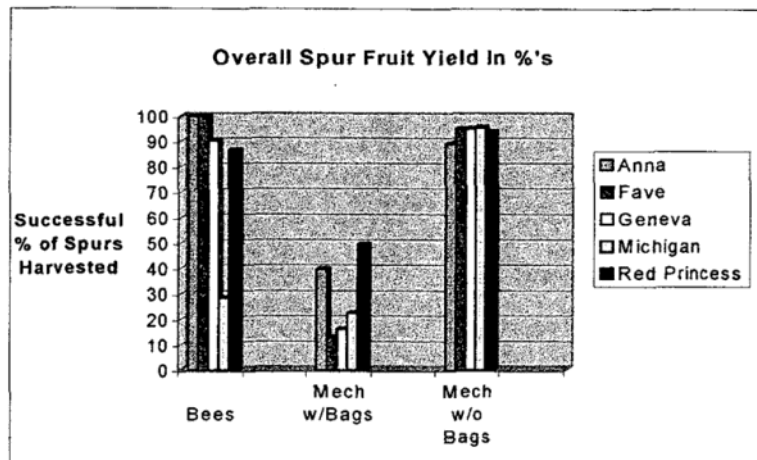
Graph No. 8 shows the results of one representative vine of each cultivar, from each study group that was harvested, to provide the total amount of poundage produced by each pollination method. Since the bees were not returning with kiwi pollen, or visible on location throughout the test trials, it is apparent pollination occurred from an outside source.

QUALITY & CHARACTERISTICS OF FRUIT

The quality and characteristics of the fruit harvested was to be evaluated on the uniformity of size, weight, and marketable quality.

There was no noticeable difference in the quality and characteristics of the fruit harvested from the two test locations.

SUCCESSFUL PERCENT - PER METHOD OF POLLENATION



Graph No. 9

Graph No. 9 indicates the successful percentage of fruit harvested from test spurs for the methods utilized in this study.

The results indicate that mechanical pollination provides more consistent results for a variety of female cultivars.

In summary, mechanical pollination also allows the grower "site specific" application to meet his individual pollination needs. Also, this method is more cost effective. It does not require the rental of honeybee hives and the purchase of pollen to be placed in the hives.

MALE CULTIVAR STATISTICS

CULTIVAR: 74-46 # 1 Location: B1-R6-S16#1

Pollen Viability:

12" Spur Data: No. of clusters: 3 spurs (terminating spurs)
No. Flowers per cluster: 35, 37, 40 = 112 flowers total

Flower Schedule: 6-05 44
6-06 65
6-07 73
6-08 91
6-09 106
6-10 110
6-11 112

Spurs Pruned: 6-23-01

New Growth: 10-14-01 6 new spurs = 11-1/4", 7", 8-1/2", 6", 2-1/8", 5-1/4"

CULTIVAR: 74-46 # 2 Location: B1-R4-S17#1

Pollen Viability:

12" Spur Data: No. of clusters: 1 spur total (non-terminating spur)
No. Flowers per cluster: 37 flowers total

Flower Schedule: 6-05 10
6-06 17
6-07 22
6-08 26
6-09 29
6-10 35
6-11 37

Spurs Pruned: 6-23-01

New Growth: 10-14-01 1 new spur = 8-1/2"

| | | | |
|-----------|---------------|------|-------------|
| CULTIVAR: | Fave Male # 1 | Loca | B1-R10-S2#1 |
|-----------|---------------|------|-------------|

Pollen Viability:

12" Spur Data:

No. of clusters: 1 spur total (non-terminating spur)

No. Flowers per cluster: 61 flowers total

Flower Schedule:

| | |
|------|----|
| 6-05 | 20 |
| 6-06 | 26 |
| 6-07 | 32 |
| 6-08 | 40 |
| 6-09 | 59 |
| 6-10 | 60 |
| 6-11 | 61 |

Spurs Pruned:

6-23-01

New Growth:

10-14-01

No new growth

| | | | |
|-----------|---------------|-----------|-------------|
| CULTIVAR: | Fave Male # 2 | Location: | B1-R4-S19#2 |
|-----------|---------------|-----------|-------------|

Pollen Viability:

12" Spur Data:

No. of clusters: 3 spurs total (terminating spurs)

No. Flowers per cluster: 16, 51, 46 = 103 flowers total

Flower Schedule:

| | |
|------|-----|
| 6-05 | 12 |
| 6-06 | 24 |
| 6-07 | 30 |
| 6-08 | 36 |
| 6-09 | 52 |
| 6-10 | 89 |
| 6-11 | 102 |
| 6-12 | 103 |

Spurs Pruned:

6-23-01

New Growth:

10-14-01

2 new spurs = 1/4", 1"

| | | | |
|-----------|------------------|------|-------------|
| CULTIVAR: | Cornell Male # 1 | Loca | B2-R10-S1#3 |
|-----------|------------------|------|-------------|

Pollen Viability:

12" Spur Data:

No. of clusters: 4 spurs total (terminating spurs)

No. Flowers per cluster: 3, 17, 39, 21 = 80 flowers total

Flower Schedule:

| | |
|------|----|
| 6-05 | 0 |
| 6-06 | 6 |
| 6-07 | 11 |
| 6-08 | 18 |
| 6-09 | 38 |
| 6-10 | 53 |
| 6-11 | 66 |
| 6-12 | 78 |
| 6-13 | 80 |

Spurs Pruned:

6-23-01

New Growth: 10-14-01

2 new spurs = 3/8", 7/8"

| | | | |
|-----------|------------------|-----------|-------------|
| CULTIVAR: | Cornell Male # 2 | Location: | B2-R10-S3#2 |
|-----------|------------------|-----------|-------------|

Pollen Viability:

12" Spur Data:

No. of clusters: 1 spur total (non-terminating spur)

No. Flowers per cluster: 52 flowers total

Flower Schedule:

| | |
|------|----|
| 6-05 | 6 |
| 6-06 | 13 |
| 6-07 | 24 |
| 6-08 | 30 |
| 6-09 | 44 |
| 6-10 | 53 |

Spurs Pruned:

6-23-01

New Growth: 10-14-01

2 new spurs = 12", 18"

| | | | |
|-----------|-----------------|------|------------|
| CULTIVAR: | Meader Male # 1 | Loca | B1-R7-S6#2 |
|-----------|-----------------|------|------------|

Pollen Viability:

12" Spur Data:

No. of clusters: 5 spurs total (terminating spurs)
 No. Flowers per cluster: 19, 12, 17, 21, 19 = 88 flowers total

Flower Schedule:

| | |
|------|----|
| 6-05 | 1 |
| 6-06 | 12 |
| 6-07 | 34 |
| 6-08 | 59 |
| 6-09 | 65 |
| 6-10 | 87 |
| | 88 |

Spurs Pruned:

6-23-01

New Growth:

10-14-01 1 new spur = 19-1/2"

| | | | |
|-----------|-----------------|-----------|------------|
| CULTIVAR: | Meader Male # 2 | Location: | B2-R3-S1#2 |
|-----------|-----------------|-----------|------------|

Pollen Viability:

12" Spur Data:

No. of clusters: 1 spur total (non-terminating spur)
 No. Flowers per cluster: 77 flowers total

Flower Schedule:

| | |
|------|----|
| 6-05 | 7 |
| 6-06 | 15 |
| 6-07 | 27 |
| 6-08 | 43 |
| 6-09 | 60 |
| 6-10 | 63 |
| 6-11 | 67 |
| 6-12 | 77 |

Spurs Pruned:

6-23-01

New Growth:

10-14-01 1 new spur = 19"

| | | |
|---------------------|------|-------------|
| CULTIVAR: 74-32 # 1 | Loca | B2-R10-S2#2 |
|---------------------|------|-------------|

Pollen Viability:

12" Spur Data:

No. of clusters: 4 spurs total (terminating spurs)

No. Flowers per cluster: 9, 22, 34, 24 = 89 flowers

Flower Schedule:

| | |
|------|----|
| 6-05 | 3 |
| 6-06 | 19 |
| 6-07 | 37 |
| 6-08 | 61 |
| 6-09 | 65 |
| 6-10 | 79 |
| 6-11 | 89 |

Spurs Pruned:

6-23-01

New Growth:

10-14-01

no new growth

| | |
|---------------------|-----------------------|
| CULTIVAR: 74-32 # 2 | Location: B2-R10-S3#1 |
|---------------------|-----------------------|

Pollen Viability:

12" Spur Data:

No. of clusters: 4 spurs total (terminating spurs)

No. Flowers per cluster: 12, 23, 14, 34 = 83 flowers

Flower Schedule:

| | |
|------|----|
| 6-05 | 6 |
| 6-06 | 33 |
| 6-07 | 47 |
| 6-08 | 56 |
| 6-09 | 58 |
| 6-10 | 64 |
| 6-11 | 83 |

Spurs Pruned:

6-23-01

New Growth:

10-14-01

4 new spurs = 1/4", 1", 1-1/4", 1-1/2"

SITE LOCATION: #1 TREATMENT: Bees

General Site Information: Honey bees were introduced on June 05, 01 and removed on June 20, 01, a total of 15 days on site.

CULTIVAR: Anna Flower Dates: 6-06-01 thru 6-10-01

| Anna Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|---------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 1 | B1-R7-S15#2 | 24 | 30 | 24 | 30 | 24 | 30 | 0 | 0 | 24 | 30 |
| Flower Schedule | | | | | | | | | | | |
| | 6-06 | 4 | 7 | | | | | | | | |
| | 6-07 | 9 | 12 | | | | | | | | |
| | 6-08 | 22 | 27 | | | | | | | | |
| | 6-09 | 24 | 29 | | | | | | | | |
| | 6-10 | | 30 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 100.00% | 100.00% |

CULTIVAR: Fave Flower Dates: 6-05-01 thru 6-12-01

| Fave Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 1 | B2-R11-S2#1 | 28 | 18 | 13 | 14 | 13 | 14 | 16 | 4 | 12 | 14 |
| Flower Schedule: | | | | | | | | | | | |
| | 6-06 | 16 | 0 | | | | | | | | |
| | 6-07 | 22 | 0 | | | | | | | | |
| | 6-08 | 28 | 0 | | | | | | | | |
| | 6-09 | | 4 | | | | | | | | |
| | 6-10 | | 6 | | | | | | | | |
| | 6-11 | | 16 | | | | | | | | |
| | 6-12 | | 18 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 42.86% | 77.78% |

| Fave Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 2 | B2-R11-S3#1 | 34 | 67 | 34 | 67 | 18 | 54 | 16 | 25 | 18 | 42 |
| Flower Schedule: | | | | | | | | | | | |
| | 6-05 | 1 | 17 | | | | | | | | |
| | 6-06 | 9 | 56 | | | | | | | | |
| | 6-07 | 18 | 61 | | | | | | | | |
| | 6-08 | 27 | 67 | | | | | | | | |
| | 6-09 | 31 | | | | | | | | | |
| | 6-10 | 34 | | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 52.94% | 62.69% |

| Fave Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 3 | B2-R11-S3#2 | 29 | 30 | 29 | 30 | 24 | 30 | 7 | 1 | 22 | 29 |
| Flower Schedule: | | | | | | | | | | | |
| | 6-06 | 4 | 5 | | | | | | | | |
| | 6-07 | 11 | 10 | | | | | | | | |
| | 6-08 | 19 | 17 | | | | | | | | |
| | 9-09 | 29 | 29 | | | | | | | | |
| | 6-10 | | 30 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 75.86% | 96.67% |

CULTIVAR: Geneva Flower Dates: 6-05-01 thru 6-11-01

| Geneva Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 1 | B1-R2-S16#2 | 70 | 30 | 70 | 30 | 70 | 28 | 7 | 2 | 63 | 28 |
| Flower Schedule: | | | | | | | | | | | |
| | 6-05 | 26 | 6 | | | | | | | | |
| | 6-06 | 54 | 18 | | | | | | | | |
| | 6-07 | 62 | 23 | | | | | | | | |
| | 6-08 | 70 | 29 | | | | | | | | |
| | 6-09 | | 30 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 90.00% | 93.33% |

| Geneva Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|--------------------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|---------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 2 | B1-R2-S16#3 | 64 | 15 | 64 | 15 | 49 | 15 | 16 | 0 | 48 | 15 |
| Flower Schedule: Spur A Spur B | | | | | | | | | | | |
| | 6-05 | 16 | 0 | | | | | | | | |
| | 6-06 | 38 | 4 | | | | | | | | |
| | 6-07 | 50 | 6 | | | | | | | | |
| | 6-08 | 62 | 8 | | | | | | | | |
| | 6-09 | 64 | 13 | | | | | | | | |
| | 6-10 | | 15 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 75.00% | 100.00% |

| Geneva Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|--------------------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|---------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 3 | B1-R2-S17#1 | 18 | 21 | 13 | 21 | 18 | 21 | 2 | 0 | 16 | 21 |
| Flower Schedule: Spur A Spur B | | | | | | | | | | | |
| | 6-05 | 1 | 0 | | | | | | | | |
| | 6-06 | 5 | 7 | | | | | | | | |
| | 6-07 | 9 | 13 | | | | | | | | |
| | 6-08 | 15 | 17 | | | | | | | | |
| | 6-09 | 15 | 19 | | | | | | | | |
| | 6-10 | 16 | 21 | | | | | | | | |
| | 6-11 | 18 | | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 88.89% | 100.00% |

| Geneva Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|--------------------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|---------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 4 | B1-R5-S19#2 | 24 | 26 | 24 | 26 | 21 | 26 | 9 | 0 | 18 | 26 |
| Flower Schedule: Spur A Spur B | | | | | | | | | | | |
| | 6-05 | 1 | 7 | | | | | | | | |
| | 6-06 | 17 | 15 | | | | | | | | |
| | 6-07 | 19 | 18 | | | | | | | | |
| | 6-08 | 21 | 23 | | | | | | | | |
| | 6-09 | 23 | 26 | | | | | | | | |
| | 6-10 | 24 | | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 75.00% | 100.00% |

CULTIVAR: Michigan Flower Dates: 6-05-01 thru 6-10-01

| Michigan Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | Fruit Yield | |
|--------------------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|-------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 1 | B1-R6-S14#1 | 21 | 24 | 21 | 24 | 14 | 11 | 15 | 13 | 6 | 11 |
| Flower Schedule: Spur A Spur B | | | | | | | | | | | |
| | 6-05 | 3 | 1 | | | | | | | | |
| | 6-06 | 7 | 6 | | | | | | | | |
| | 6-07 | 13 | 15 | | | | | | | | |
| | 6-08 | 20 | 21 | | | | | | | | |
| | 6-09 | 21 | 24 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 28.57% | 45.83% |

| Michigan Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | Fruit Yield | |
|--------------------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|-------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 2 | B1-R6-S15#1 | 24 | 17 | 24 | 17 | 11 | 13 | 24 | 17 | 0 | 0 |
| Flower Schedule: Spur A Spur B | | | | | | | | | | | |
| | 6-05 | 4 | 5 | | | | | | | | |
| | 6-06 | 8 | 12 | | | | | | | | |
| | 6-07 | 15 | 14 | | | | | | | | |
| | 6-08 | 23 | 17 | | | | | | | | |
| | 6-09 | 24 | | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 0.00% | 0.00% |

| Michigan Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | Fruit Yield | |
|--------------------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|-------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 3 | B1-R6-S17#2 | 14 | 13 | 14 | 13 | 11 | 12 | 3 | 13 | 11 | 0 |
| Flower Schedule: Spur A Spur B | | | | | | | | | | | |
| | 6-05 | 0 | 4 | | | | | | | | |
| | 6-06 | 6 | 11 | | | | | | | | |
| | 6-07 | 10 | 12 | | | | | | | | |
| | 6-08 | 14 | 13 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 78.57% | 0.00% |

| Michigan Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|----------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 4 | B1-R6-S18#1 | 16 | 54 | 16 | 54 | 12 | 41 | 4 | 54 | 12 | 0 |
| Flower Schedule: | | | | | | | | | | | |
| | 6-05 | 0 | 6 | | | | | | | | |
| | 6-06 | 7 | 26 | | | | | | | | |
| | 6-07 | 9 | 39 | | | | | | | | |
| | 6-08 | 15 | 52 | | | | | | | | |
| | 6-09 | 15 | 54 | | | | | | | | |
| | 6-10 | 16 | | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 75.00% | 0.00% |

CULTIVAR: Red Princess Flower Dates: 6-03-01 thru 6-09-01

| Red Princess Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|--------------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 1 | B1-R5-S16#2 | 15 | 33 | 15 | 33 | 15 | 29 | 0 | 6 | 15 | 27 |
| Flower Schedule: | | | | | | | | | | | |
| | 6-05 | 3 | 22 | | | | | | | | |
| | 6-06 | 7 | 27 | | | | | | | | |
| | 6-07 | 9 | 29 | | | | | | | | |
| | 6-08 | 14 | 33 | | | | | | | | |
| | 6-09 | 15 | | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 100.00% | 81.82% |

| Red Princess Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|--------------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|---------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 2 | B1-R5-S17#1 | 52 | 25 | 52 | 25 | 51 | 25 | 9 | 0 | 43 | 25 |
| Flower Schedule: | | | | | | | | | | | |
| | 6-05 | 33 | 12 | | | | | | | | |
| | 6-06 | 50 | 25 | | | | | | | | |
| | 6-07 | 50 | | | | | | | | | |
| | 6-08 | 52 | | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 82.69% | 100.00% |

| Red Princess Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|--------------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 3 | B1-R5-S17#2 | 16 | 61 | 16 | 61 | 16 | 59 | 0 | 12 | 16 | 49 |
| Flower Schedule: | | Spur A | Spur B | | | | | | | | |
| 6-05 | | 6 | 21 | | | | | | | | |
| 6-06 | | 11 | 54 | | | | | | | | |
| 6-07 | | 13 | 57 | | | | | | | | |
| 6-08 | | 15 | 61 | | | | | | | | |
| 6-09 | | 16 | | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 100.00% | 80.33% |

| Red Princess Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|--------------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 4 | B1-R5-S17#3 | 46 | 13 | 46 | 13 | 41 | 11 | 17 | 2 | 29 | 11 |
| Flower Schedule: | | Spur A | Spur B | | | | | | | | |
| 6-05 | | 24 | 1 | | | | | | | | |
| 6-06 | | 32 | 7 | | | | | | | | |
| 6-07 | | 37 | 9 | | | | | | | | |
| 6-08 | | 46 | 13 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 63.04% | 84.62% |

SIT LOCATION: #2 TREATMENT: Mechanical

General Site Information: Spurs were bagged on 6-03-01 and bags were removed 6-13-01, a total of ten days covered.

General Note: We feel the use of bags to cover the spurs promoted the large percentage of drop as this was not evidenced with those spurs not covered.

CULTIVAR: Anna Flower Dates: 6-06-01 thru 6-11-01

| Anna Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | Fruit Yield | |
|------------------|------------|---------------|--------|------------|--------|-----------|--------|------------|--------|-------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 1 | B3-R5-S2#3 | 31 | 49 | 31 | 49 | 14 | 28 | 19 | 29 | 12 | 20 |
| Flower Schedule: | | Spur A | Spur B | | | | | | | | |
| 6-06 | | 9 | 15 | | | | | | | | |
| 6-08 | | 27 | 32 | | | | | | | | |
| 6-11 | | 31 | 49 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 38.71% | 40.82% |

CULTIVAR: Fave Flower Dates: 6-06-01 thru 6-12-01

| Fave Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | Fruit Yield | |
|------------------|------------|---------------|--------|------------|--------|-----------|--------|------------|--------|-------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 1 | B3-R5-S1#1 | 60 | 64 | 60 | 64 | 0 | 28 | 60 | 40 | 0 | 24 |
| Flower Schedule: | | Spur A | Spur B | | | | | | | | |
| 6-06 | | 12 | 14 | | | | | | | | |
| 6-08 | | 31 | 42 | | | | | | | | |
| 6-11 | | 60 | 64 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 0.00% | 37.50% |

| Fave Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | Fruit Yield | |
|------------------|------------|---------------|--------|------------|--------|-----------|--------|------------|--------|-------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 2 | B3-R5-S1#2 | 60 | 47 | 60 | 47 | 2 | 18 | 58 | 34 | 2 | 13 |
| Flower Schedule: | | Spur A | Spur B | | | | | | | | |
| 6-06 | | 15 | 8 | | | | | | | | |
| 6-08 | | 34 | 30 | | | | | | | | |
| 6-11 | | 60 | 47 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 3.33% | 27.66% |

| Fav Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|------------------|------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 3 | B3-R5-S2#1 | 30 | 78 | 30 | 78 | 2 | 5 | 29 | 74 | 1 | 4 |
| Flower Schedule: | | Spur A | Spur B | | | | | | | | |
| 6-06 | | 7 | 16 | | | | | | | | |
| 6-08 | | 19 | 33 | | | | | | | | |
| 6-12 | | 30 | 78 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 3.33% | 5.13% |

CULTIVAR: Geneva Flower Dates: 6-06-01 thru 6-11-01

| Geneva Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|--------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 1 | B3-R7-S12#3 | 38 | 27 | 38 | 27 | 0 | 0 | 21 | 27 | 17 | 0 |
| Flower Schedule: | | Spur A | Spur B | | | | | | | | |
| 6-06 | | 12 | 8 | | | | | | | | |
| 6-08 | | 18 | 13 | | | | | | | | |
| 6-11 | | 38 | 27 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 44.74% | 0.00% |

| Geneva Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|--------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 2 | B3-R7-S13#1 | 55 | 29 | 55 | 29 | 5 | 6 | 50 | 24 | 5 | 5 |
| Flower Schedule: | | Spur A | Spur B | | | | | | | | |
| 6-06 | | 17 | 9 | | | | | | | | |
| 6-08 | | 30 | 16 | | | | | | | | |
| 6-11 | | 55 | 29 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 9.09% | 17.24% |

| Geneva Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|--------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 3 | B3-R7-S13#2 | 23 | 54 | 23 | 54 | 0 | 10 | 23 | 43 | 0 | 11 |
| Flower Schedule: | | Spur A | Spur B | | | | | | | | |
| 6-06 | | 7 | 16 | | | | | | | | |
| 6-08 | | 10 | 24 | | | | | | | | |
| 6-11 | | 23 | 54 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 0.00% | 20.37% |

| Ger Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|------------------|-------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 4 | B3-R7-S13#3 | 20 | 21 | 20 | 21 | 4 | 7 | 17 | 16 | 3 | 5 |
| Flower Schedule: | | Spur A | Spur B | | | | | | | | |
| 6-06 | | 6 | 7 | | | | | | | | |
| 6-08 | | 10 | 11 | | | | | | | | |
| 6-11 | | 20 | 21 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 15.00% | 23.81% |

CULTIVAR: Michigan Flower Dates: 6-06-01 thru 6-11-01

| Michigan Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|----------------------|------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 1 | B3-R6-S1#2 | 37 | 43 | 37 | 43 | 1 | 3 | 37 | 43 | 0 | 0 |
| Flower Schedule: | | Spur A | Spur B | | | | | | | | |
| 6-06 | | 11 | 13 | | | | | | | | |
| 6-08 | | 22 | 26 | | | | | | | | |
| 6-11 | | 37 | 43 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 0.00% | 0.00% |

| Michigan Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|----------------------|------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 2 | B3-R6-S1#3 | 43 | 11 | 43 | 11 | 5 | 10 | 41 | 10 | 2 | 1 |
| Flower Schedule: | | Spur A | Spur B | | | | | | | | |
| 6-06 | | 13 | 5 | | | | | | | | |
| 6-08 | | 24 | 7 | | | | | | | | |
| 6-11 | | 43 | 11 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 4.65% | 9.09% |

| Michigan Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|----------------------|------------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 3 | B3-R7-S1#1 | 39 | 41 | 39 | 41 | 3 | 17 | 39 | 25 | 0 | 16 |
| Flower Schedule: | | Spur A | Spur B | | | | | | | | |
| 6-06 | | 12 | 13 | | | | | | | | |
| 6-08 | | 23 | 25 | | | | | | | | |
| 6-11 | | 39 | 41 | | | | | | | | |
| Yield % | | | | | | | | | | A | B |
| | | | | | | | | | | 0.00% | 39.02% |

| Midi Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|---------------|-----------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |

4 B3-R7-S1#3 55 22 55 22 25 18 32 3 23 19

Flower Schedule: Spur A Spur B

| | | |
|---------|----|-------------------|
| 6-06 | 17 | 7 |
| 6-08 | 33 | 13 |
| 6-11 | 55 | 22 |
| Yield % | | A 41.82% B 86.36% |

CULTIVAR: Red Princess Flower Dates: 6-06-01 thru 6-11-01

| Red Princess Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|-----------------------|-----------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |

1 B3-R3-S1#1 73 41 73 41 29 0 59 41 14 0

Flower Schedule: Spur A Spur B

| | | |
|---------|----|------------------|
| 6-06 | 37 | 21 |
| 6-08 | 47 | 28 |
| 6-11 | 73 | 41 |
| Yield % | | A 19.18% B 0.00% |

| Red Princess Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|-----------------------|-----------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |

2 B3-R3-S1#2 30 30 30 30 14 25 16 7 14 23

Flower Schedule: Spur A Spur B

| | | |
|---------|----|-------------------|
| 6-06 | 11 | 10 |
| 6-08 | 17 | 16 |
| 6-11 | 30 | 30 |
| Yield % | | A 46.67% B 76.67% |

| Red Princess Vine No. | Location: | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | FruitYield | |
|-----------------------|-----------|---------------|--------|------------|--------|-----------|--------|------------|--------|------------|--------|
| | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |

3 B3-R3-S1#3 29 54 29 54 22 51 8 10 21 44

Flower Schedule: Spur A Spur B

| | | |
|---------|----|-------------------|
| 6-06 | 10 | 19 |
| 6-08 | 15 | 27 |
| 6-11 | 29 | 54 |
| Yield % | | A 72.41% B 81.48% |

| Rec Vine No. | Process | Location | Total Flowers | | Pollinated | | Fruit Set | | Fruit Drop | | Fruit Yield | |
|------------------|---------|------------|---------------|--------|------------|--------|-----------|--------|------------|--------|-------------|--------|
| | | | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B | Spur A | Spur B |
| 4 | | B3-R4-S1#2 | 15 | 24 | 15 | 24 | 12 | 11 | 5 | 16 | 10 | 8 |
| Flower Schedule: | | | Spur A | Spur B | | | | | | | | |
| 6-06 | | | 6 | 10 | | | | | | | | |
| 6-08 | | | 9 | 14 | | | | | | | | |
| 6-11 | | | 15 | 24 | | | | | | | | |
| Yield % | | | | | | | | | | | A | B |
| | | | | | | | | | | | 66.67% | 33.33% |

NOTE:

The test vines receiving mechanical treatment showed excessive fruit drop. We have determined that this was caused by the spurs being covered by bags.

To substantiate the actual capability of mechanical method of pollination, we documented statistics on additional spurs on the same test vines that were NOT covered with bags. The data from these additional spurs better represents the capability of mechanical pollination.

The following information was collected from additional spurs on the test vines.

| | Total Flowers | Fruit Drop | Fruit Yield | % Retained |
|------------------|---------------|------------|-------------|------------|
| Anna: Vine 1 | 21 | 0 | 21 | 100.00% |
| | 29 | 5 | 24 | 82.76% |
| | 13 | 2 | 11 | 84.62% |
| Fave: Vine 2 | 33 | 0 | 33 | 100.00% |
| | 29 | 4 | 25 | 86.21% |
| | 19 | 3 | 16 | 84.21% |
| Vine 3 | 12 | 0 | 12 | 100.00% |
| | 20 | 0 | 20 | 100.00% |
| | 29 | 0 | 29 | 100.00% |
| Geneva Vine 1 | 13 | 1 | 12 | 92.31% |
| | 15 | 0 | 15 | 100.00% |
| | 20 | 0 | 20 | 100.00% |
| Vine 2 | 12 | 2 | 10 | 83.33% |
| | 13 | 0 | 13 | 100.00% |
| | 18 | 0 | 18 | 100.00% |
| Vine 4 | 21 | 0 | 21 | 100.00% |
| | 17 | 1 | 16 | 94.12% |
| | 15 | 2 | 13 | 86.67% |

| | | | | | |
|--------------|--------|----|---|----|---------|
| Michigan | Vine 1 | 15 | 1 | 14 | 93.33% |
| | | 18 | 0 | 18 | 100.00% |
| | | 22 | 0 | 22 | 100.00% |
| | Vine 2 | 16 | 1 | 15 | 93.75% |
| | | 21 | 2 | 19 | 90.48% |
| | | 9 | 0 | 9 | 100.00% |
| | Vine 3 | 24 | 0 | 24 | 100.00% |
| | | 18 | 2 | 16 | 88.89% |
| | | 21 | 1 | 20 | 95.24% |
| Red Princess | Vine 1 | 18 | 2 | 16 | 88.89% |
| | | 13 | 2 | 13 | 100.00% |
| | | 15 | 1 | 14 | 93.33% |
| | Vine 3 | 7 | 0 | 7 | 100.00% |
| | | 11 | 2 | 9 | 81.82% |
| | | 23 | 1 | 22 | 95.65% |
| | Vine 4 | 8 | 0 | 8 | 100.00% |
| | | 18 | 0 | 18 | 100.00% |
| | | 13 | 2 | 11 | 84.62% |

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Reference: SARE Project FNE00-307
Hardy Kiwi Pollination and Production

INTERIM PROGRESS REPORT

In April 2000, inclement weather, an ice storm disaster, resulted in a significant primary bud loss, especially in the female cultivar selections.

Due to this circumstance, it was not possible to carry out all of the procedures outlined in the grant. We requested and received an extension, for the grant referenced above, until the 2001 growing season.

We did however collect significant data for the 2000 season, on the secondary bud, which you will find outlined below.

Soil and leaf analysis was conducted twice, and all vines were pruned three times during the growing season. Flower characteristics for, both male and female cultivars; were documented by digital photographs.

Item #1 - A. Arguta Male Cultivars suitable for commercial production. Data was collected for assessment on the following items for male cultivars Cornell, Fave, 74-32, 74-46, 127-40, Meader, & Ivan]

| | |
|---|--|
| <u>Male Flower Schedules</u> – Early, middle, or late bloom in reference to the flowering schedules of the female vines included in this study. | Flower schedules were documented on male cultivars. |
| <u>Pollen Viability</u> – The number and viable pollen grains produced by a flower. | Pollen viability studies were not completed due to equipment failure at Bloomsburg University. Appropriations to remedy this situation have been made for the 2001 season. |
| <u>Vigor</u> – Based on flower density, the number of flowers within a specific length of growth, and the measured amount of annual replacement growth. | Flower density, stem and flower characteristics, and measured replacement growth were documented. |

The data collected and observations made this year suggests that several of the male vines involved in this trial are, in actuality, the same cultivar but with different names. Many nursery distributors market unnamed plants they have acquired, and provide them with names and/or numbers for their catalogs.

Without the availability to test for different genetic markers, we don't feel that these multi-cultivars can definitely be separated as to their real origin and name. We are able however to group them by plant characteristics and assess their performance.

Item #2 – Methods of Deliciosa Pollen Dispersion. Data was collected for assessment on the following items for female cultivars [Ananasnaya, Geneva, Michigan, and Red Princess].

| | |
|---|---|
| <u>Flower Schedules</u> – To match with appropriate male cultivars. | Flower schedules were documented on female cultivars. |
|---|---|

(A) Utilizing Mechanical Application: Mechanical application had the largest impact throughout the arbor and the test vines which resulted in successful pollination of 98%.

| | |
|--|---|
| <u>Percentage of Successful Pollination</u> - per marked spur vs. the original number of flowers on each spur. | Spurs were not marked due to primary bud loss. General information was collected. |
| <u>Fruit Set</u> - those fruit that continue growing on each spur. | Two of the four cultivars tested had such damage that significant data could not be provided. Anna and Geneva were noted. |
| <u>Fruit Drop</u> - the number of empty flower stems on each spur. | Anna and Geneva were noted. |
| <u>Number of Fruit Yielded per Spur</u> - at harvest from each of the marked spurs. | Anna and Geneva were noted. |
| <u>Total Vine Fruit Yield</u> - One representative of each cultivar. | Anna and Geneva were noted. |
| <u>Quality & Characteristics of Fruit Harvested</u> - Uniformity of Size, Weight, & Marketable Quality. | Due to the excessive thinning, via ice damage, the uniformity of size and market quality of the fruit was very good in respect to the minimal number of fruit the vines produced. |

(B) Utilizing HoneyBees: Cultured honeybees produced the least effective mode of pollination. Honeybees returning to the hive were documented carrying little or no kiwi pollen. Varieties of bumblebees were observed visiting the vines on a 5 to 1 ratio and were collecting kiwi pollen. Due to the lack of bee activity, an additional eight (8) hives were added to the arbor and monitored.

| | |
|--|---|
| <u>Percentage of Successful Pollination</u> - per marked spur vs. the original number of flowers on each spur. | Spurs were not marked due to primary bud loss. General information was collected. |
| <u>Fruit Set</u> - those fruit that continue growing on each spur. | NA |
| <u>Fruit Drop</u> - the number of empty flower stems on each spur. | NA |
| <u>Number of Fruit Yielded per Spur</u> - at harvest from each of the marked spurs. | NA |
| <u>Total Vine Fruit Yield</u> - One representative of each cultivar. | NA |
| <u>Quality & Characteristics of Fruit Harvested</u> - Uniformity of Size, Weight, & Marketable Quality. | NA |

Competitive flowering plants amounted to sumac, and white clover, which was kept to a minimum by mowing.

The results for year 2000 provide performance of secondary bud, and that successful pollination can be achieved. The culmination of test data for two years will provide hardy kiwi growers with much needed information in many aspects of pollination and production.

David Jackson
Project Leader