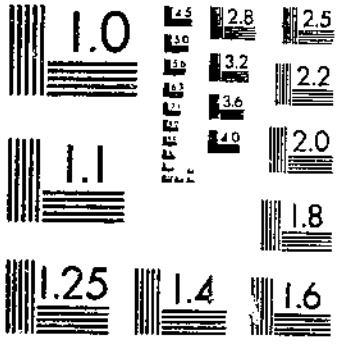
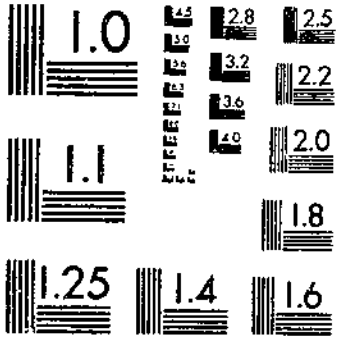

TB-775 (1941) USDA TECHNICAL BULLETINS UPDATE
THE YELLOW CHAPOTE: A NATIVE HOST OF THE MEXICAN FRUITFLY?
PLUMMER, C.C.; MCPHAIL, M.; MCMONK, J.M.
1 OF 1

START



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

Technical Bulletin No. 775 • July 1941

UNITED STATES
DEPARTMENT OF AGRICULTURE
WASHINGTON, D. C.

The Yellow Chapote, a Native Host of the Mexican Fruitfly [1]

By C. C. PLUMMER and M. MCPHAIL, *associate entomologists*, and J. W. MONK, [2] *assistant entomologist, Division of Fruitfly Investigations, Bureau of Entomology and Plant Quarantine*

CONTENTS

INTRODUCTION

The plant known in Texas as yellow chapote and identified by a Department botanist as *Sargentia greggii* S. Wats. is commonly called chapote amarillo, naranjillo, or limoncillo [3] in Spanish. As this tree produces one of the host fruits of the Mexican fruitfly (*Anastrepha ludens* (Loew)) and is found growing in Mexico south of the citrus plantings in the lower Rio Grande Valley, it seemed desirable to make a study of the tree in relation to its attractiveness for the fruitfly. The studies of fly movement were made in the vicinity of Santa Engracia, Tamaulipas, Mexico, in an area where citrus is grown in close proximity to chapote. No attempts have been made to extend the study beyond this area.

The yellow chapote, classified in the family Rutaceae along with *Citrus*, was described in 1890 by Watson [4] from specimens collected near Monterrey, Nuevo León, Mexico, by Gregg in February 1847. Zetek [5] mentioned having seen two trees of this species in Brownsville, Tex., in 1927 and stated at the time that it might prove to be favored as a host by the Mexican fruitfly. Mackie [6] mentions that Zetek

[1] Submitted for publication July 2, 1940. The study on which this manuscript is based was conducted in cooperation with the Secretaría de Agricultura y Fomento, Mexico.

[2] Transferred to Division of Pink Bollworm and Thurberia Weevil Control February 1, 1939.

[3] The native name "limoncillo" is also commonly used in reference to another, more recently described tree, *Esenbeckia runyoni* Morton, also of the rue family, and found growing under the same fertile conditions that are favorable for the growth of yellow chapote.

[4] WATSON, SERENO. CONTRIBUTIONS TO AMERICAN BOTANY. Amer. Acad. Arts and Sci. Proc. 25: 124–163 1890. See p. 144.

[5] ZETEK, JAMES. In correspondence with A. C. Baker.

[6] MACKIE, D. B. AN INVESTIGATION OF THE MEXICAN FRUITFLY, ANASTREPHA LUDENS (LOEW), IN THE LOWER RIO GRANDE VALLEY OF TEXAS. Calif. Dept. Agr. Monthly Bul. 17: 295–323, illus. 1928. See p. 316.

286604—41——1

called his attention to three trees of this species growing in one city block in Brownsville. On June 23, 1930, seeds infested with larvae of *Anastrepha ludens* found in the vicinity of Monterrey, Nuevo León, by U. R. Kuhn, of the Plant Quarantine and Control Administration of the United States Department of Agriculture, were determined as those of *Pistacia vera* L.[7] It was pointed out by Baker[8] that *P. vera* is a Mediterranean species and that Kuhn's description of the seeds indicates that they were probably seeds of *Sargentia*, not *Pistacia*. Fruit of *Sargentia* infested with larvae of the Mexican fruitfly was recorded in Matamoros, Mexico, in 1931[9] by workers of the present Division of Mexican Fruitfly Control. Several years later McPhail found the yellow chapote to be widely although not generally distributed in northeastern Mexico and heavily infested with larvae of the fruitfly. He was the first to show the important relationship between such infestations and those in citrus. This relationship has been mentioned by Baker.[10]

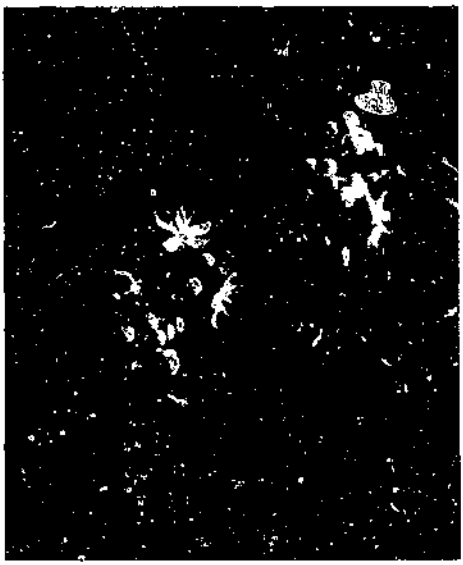


FIGURE 1.—Blossoms of *Sargentia greggii*, about natural size. (Photograph by A. C. Baker.)

DESCRIPTION OF THE TREE

Standley[11] gives the following description of *Sargentia greggii*:

> Tree, sometimes 13 meters high; bark smooth, gray, peeling off in thin plates; leaves alternate, persistent, digitately 2 or 3-foliate, 3 to 10 cm. long, obtuse or acutish, nearly glabrous, entire; flowers small, white; fruit fleshy, edible, 1.5 to 2 cm. long, yellow; seeds brown, 1.2 to 1.4 cm. long. 'Limoncillo' (Tamaulipas, San Luis Potosí); 'chapote amarillo' (Nuevo León); 'naranjillo' (Tamaulipas).

The flowers (fig. 1) seen in the vicinity of Santa Engracia, Tamaulipas, were light yellow never white.

Leaves and immature fruits of the yellow chapote are shown in figure 2. A typical full-grown fruit from Santa Engracia is approximately 2.6 to 2.8 cm. long and 1.4 to 1.6 cm. in maximum width (fig. 3, *A*, *B*). Not infrequently fruits 3.1 cm. long and 2.0 cm. in maximum width are found (fig. 3, *C*). Double fruits (fig. 3, *D*, *E*) are not uncommon, and triple fruits are found occasionally. The fruits are dark green while immature, becoming yellow upon maturity.

---

[7] SASSCER, E. R. Letter of October 1, 1930, to V. J. Shiner.

[8] BAKER, A. C. Letter of June 6, 1939, to L. A. Strong.

[9] U. S. DEPARTMENT OF AGRICULTURE, BUREAU OF ENTOMOLOGY. MEXICAN FRUITFLY (ANASTREPHA LUDENS LOEW). U. S. Dept. Agr. Insect Pest Survey 11: 491. 1931. [Mimeographed.]

[10] BAKER, A. C. THE BIOLOGY OF THE MEXICAN FRUITFLY. U. S. Bur. Ent. and Plant Quar., 6 pp. 1937. [Mimeographed.]

——— SPRAYING FOR THE MEXICAN FRUITFLY. U. S. Bur. Ent. and Plant Quar., 4 pp. 1937. [Mimeographed.]

[11] STANDLEY, PAUL C. TREES AND SHRUBS OF MEXICO. U. S. Natl. Mus. Contrib. U. S. Natl. Herbarium 23 (3): 517–848. 1923.

The seed of a typical full-grown fruit is about 2.1 cm. long and 1.1 cm. in maximum width (fig. 3, *B*); of large fruit, about 2.3 cm. long and 1.5 cm. in width (fig. 3, *C*). The seeds are light yellow, becoming brown on exposure to the weather.

FIGURE 2.—Foliage and young fruits of *Sargentia greggii*. About one-half natural size.

DISTRIBUTION

Standley [12] mentions that *Sargentia* is distributed in the States of Tamaulipas, Nuevo León, and San Luis Potosí. The second author, assisted by Gingrass and Hensley of the Division of Mexican Fruitfly Control, Bureau of Entomology and Plant Quarantine, made a pre-

[12] See footnote 11, p. 2.

liminary survey of southern Texas and northeastern Mexico to determine the northern limit of distribution and to learn whether chapotes grow in close proximity to citrus in the lower Rio Grande Valley of Texas. They found the chapote growing in the vicinity of Monterrey, Hacienda Guadalupe, Garza Gonzalez, and Cerralvo in Nuevo León, and of Cruillas and Burgos in Tamaulipas. These localities are approximately 130, 120, 80, 80, 100, and 95 miles, respectively, by air line from the nearest citrus in the Rio Grande Valley. The tree was particularly abundant in the vicinity of Cerralvo. Chapote grows abundantly in the vicinity of Montemorelos in Nuevo León and of Santa Engracia and Ciudad Victoria in Tamaulipas. It has been observed growing near the Pan American highway some 45 miles south of Ciudad Victoria, but the southernmost distribution has not been established. Thus far it has not been observed in the more tropical sections of Mexico. Residents of the vicinity of Tampico were not familiar with the plant. Baker,[13] in 1927, scouted the margins of the Rio Grande but failed to find *Sargentia*. A more extensive search along the river bottoms on the Texas side in 1937 by McPhail also gave negative results. The fruit of *Sargentia* is prohibited interstate shipment, and fruit and trees may be destroyed in accordance with quarantine regulations.[14]

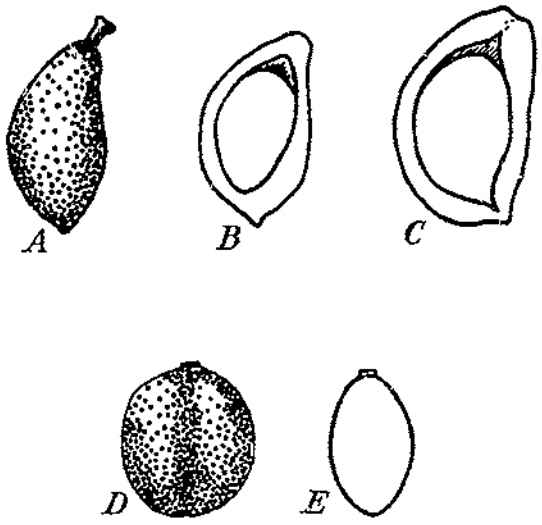


FIGURE 3.—Fruits of *Sargentia greggii*: *A*, Typical full-grown fruit; *B*, same in sagittal section; *C*, large fruit in sagittal section; *D*, double fruit; *E*, side view of double fruit. Natural size.

USES OF THE TREE AND ITS PRODUCTS

It has been learned from Hoidale[15] that the trees in Brownsville and Matamoros were planted for ornamental purposes. This seems to be true for other trees found growing in the Rio Grande Valley. The fruit is described by Standley as edible, but it is not known to be eaten by man or beast in the vicinity of Santa Engracia.

The wood of the chapote is close-grained and hard, and very similar in appearance to that of *Citrus*. In the vicinity of Santa Engracia the wood is sometimes used for wagon shafts, oxgoads, or other articles requiring considerable strength. Its use for larger articles is probably

[13] BAKER, A. C. Personal communication.
[14] U. S. Bureau of Entomology and Plant Quarantine. MEXICAN FRUITFLY QUARANTINE, U. S. Dept. Agr. B. E. P. Q.-Q. 64, 5 pp. 1937. [Revised.]
[15] HOIDALE, P. A. Letter of December 7, 1939, to A. C. Baker.

restricted by the limited size of the tree and the availability of other strong woods such as cerón (probably *Phyllostylon brasiliensis* Capanema) and mesquite (*Prosopis chilensis* (Molina) Stuntz).

FLOWERING AND FRUITING

The blossom period, in the vicinity of Santa Engracia in 1936, was more or less confined to the month of March. In 1937 blossoms were observed as early as January 11, and trees continued to bloom in February. In 1938 trees bloomed throughout February and March. In 1939 the blossom period came the latter part of February and continued throughout March.

Sometimes abundant blossoms are produced, but not infrequently most of them become desiccated and only occasional trees produce fruit. There is, as a rule, scant precipitation in northern Mexico in the winter months. Data collected for two seasons seemed to indicate that trees set little or no fruit when they bloom early. It was thought that this is due to lack of water available to the trees in the first months of some years. The accumulation of data over a longer period will be necessary to prove this point one way or the other.

Chapotes also produce off-season bloom, and this is apparently stimulated, in part, by water available to the tree. The summer months of 1938 were unusually dry and precipitation was scant until August 27, when 15.8 inches of rain fell in 2 days. Shortly after the storm some few trees—particularly, if not exclusively, trees growing on the banks of streams and trees that had all appearances of having been buffeted by flood water—bloomed and produced fruit. Even in December very few blossoms were found. In 1939 little rain fell in February and March, and most of the blossoms were desiccated. Later, 5.38 inches of rain were recorded from April 11 to 30 and 8.28 inches in May. Shaw [16] noted that blossoms were present but very scarce in May and stated that "Recent heavy rains, no doubt, are aiding the trees to produce a few blossoms this time of the year."

Small fruits were noted in the vicinity of Santa Engracia March 31, 1936, and the last mature fruits fell to the ground early in August. The first observation of fruit in 1937 was on March 22, when fruits about 19 mm. long were seen. No records were made later in the season. Fruits about 6.4 mm. long were noted March 21, 1938, and collections were begun on April 7 with fruit three-quarters grown. By the end of May most of the fruit had fallen to the ground. After the off-season bloom in September 1938, small fruits were observed in October, and fruits about three-quarters to full-grown were collected up to January 30, 1939. Single fruits were found as late as March 12 and April 6, 1939. The first fruits, about one-quarter grown, of the normal 1939 crop were observed April 6.

General observations extending over 3 years have shown that *Sargentia* is an erratic producer of blossoms and fruit. Occasional trees and groups of trees, a small fraction of the number present, blossom, and some produce fruit. Considering these habits, it is conceivable that only a small quantity of fruit might be produced in Santa Engracia in a year when the crop in some other place, Cerralvo for instance, might be relatively large.

[16] SHAW, J. G. Unpublished data.

INFESTATION WITH FRUITFLY LARVAE

McPhail closely followed the fruiting of chapote at Santa Engracia in 1936 and reported finding fruit infested with larvae of the Mexican fruitfly as early as May 2. At that time, when the fruit was less than half-grown, every fruit had from one to three larvae in it. No attempts have been made to determine the maximum number of larvae in a fruit.

Small larvae have been seen in the flesh of the chapote fruit, but as a general rule the larvae of *Anastrepha ludens* confine their feeding to the interior of the seed. They leave nothing but a mass of excrement enclosed by the shell of the seed. This type of injury can be readily distinguished from that caused later in the season by weevil larvae of an undetermined species, that tunnel through the seed but do not entirely destroy it.

Approximately 26,594 fruits of yellow chapote were collected between May 5 and July 25, 1936, and held in suitable rearing boxes until the larvae had left the fruit. Few larvae were recovered from this fruit (table 1). This can be ascribed (1) to the larvae having made their exit from fallen fruit previous to collection, (2) to the size and maturity of the fruit, and (3) to decomposition of fruit and mortality of larvae after the fruit was collected. The fact that larvae leave fallen fruit is well known. As mentioned before, half-grown fruits are often heavily infested, and collections of mature or full-grown fruit are often lightly infested (table 1). Mortality of larvae in rearing boxes in 1936 was often excessive, owing to the high temperatures that prevailed in the metal-roofed room where the boxes were kept.

TABLE 1.—*Infestation of fruit of Sargentia greggii collected in vicinity of Hacienda de Santa Engracia, Santa Engracia, Tamaulipas, 1936*

Collection				Fruit			Larvae			
Date	Locality	Quantity	Size	Source	Total	Per fruit	*Anastrepha ludens*	*Opius crawfordi*	*Opius cereus*	*Carpolonchaea pendula*
		No.			*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
May 5	El Carmen road, trap area	1,230	(1)	(2)	(4)	(4)	291	105	95	21
May 15	do	909	(1)	(2)	302	0.34	146	50	26	0
May 20	do	1,272	(1)	(2)	93	.07	41	0	5	0
May 20	Vicinity of El Roble	2,272	(3)	(2)	(4)					
June 5, 6, 7	Various	4,334	(3)	(2)	(4)					
June 11	do	4,532	(3)	(2)	142	.03	18	3	1	0
June 16	El Carmen road, trap area	1,274	(3)	(2)	59	.05	7	0	1	0
June 24	do	1,176	(3)	(2)	4	.003	0	0	0	0
July 1	do	1,344	(3)	(2)	8	.006	0	0	3	0
July 2	Vicinity of El Roble	1,344	(3)	Picked	23	.02	0	0	0	0
Do	Near dam	1,344	(3)	do	0	.00	0	0	0	0
July 3	Cañon Rosario	4,032	(5)	do	52	.01	0	0	0	0
July 15	El Carmen road, trap area	620	(6)	Fallen	(7)					
July 25	Vicinity of El Roble	1,120	(6)	(2)	(8)					

[1] Probably less than half-grown fruit.
[2] Unknown.
[3] Probably about half-grown fruit.
[4] Collection destroyed.
[5] Mostly full-grown and ripe fruit.
[6] Probably full-grown and ripe fruit.
[7] Three seeds infested with larvae.
[8] Two fruits infested with *Anastrepha* larvae.

Some 24,317 yellow chapotes were collected between April 7 and May 27, 1938. It is shown (table 2) that infestation, in terms of larva per fruit, ranged from 0.88 to 0.56 for picked fruit and from 0.66 to 0.10 for fallen fruit. These figures are slightly incorrect in some instances owing to the inadvertent inclusion of some larvae of *Carpolonchaea pendula* Bezzi.[17] Late in 1938 and early in 1939, 5,138 chapotes of the off-season crop were collected and held for larval and adult emergence. From 0.61 to 0 larva was found per picked fruit (table 2). Again, few larvae were recorded from mature or nearly mature fruit.

A total of 8,389 flies, all *Anastrepha ludens*, have been reared from all collections.

TABLE 2.—*Infestation of the normal 1938 crop and off-season 1938-39 crop of fruit of Sargentia greggii collected in the vicinity of Hacienda de Santa Engracia, Santa Engracia, Tamaulipas*

NORMAL CROP, 1938

Collection		Fruit			Larvae		Emergence				
Date	Locality	Quantity	Size relative to full-grown	Source	Total	Per fruit	*Anastrepha ludens*	*Opius crawfordi*	*Opius cerens*	*Opius* spp.	*Carpolonchaea pendula*
1938		*No.*			*No.*	*No.*	*No.*	*No.*	*No.*	*No.*	*No.*
Apr. 7	Near river, El Roble	489	¾	Fallen	67	0.10	10	4	3	0	6
Apr. 18	Near Salazar house	598	½	do	216	.36	61	26	8	0	0
Apr. 20	Kilometer 727, near Ciudad Victoria.	1,331	½ to ¾	Picked	740	.56	294	4	5	0	0
Apr. 22	Cañon Rosario	313	do	do	236	.75	76	0	4	16	0
Do	do	1,551	do	Fallen	253	.16	48	13	16	25	19
Apr. 25, 26	Santa Luisa	6,696	do	Picked	4,903	.74	3,037	0	0	74	0
Do	do	1,113	do	Fallen	377	.34	153	4	13	69	23
May 3	do	4,506	do	do	(1)		467	0	0	176	285
May 4	Near Rancho Las Guayabas.	4,471	½ to full	Picked	3,917	.88	1,461	0	0	1	14
Do	do	964	¼ to ½	Fallen	649	.61	232	0	0	105	37
May 5	Road to Hda. San Juan	624	¾ to full	Picked [2]	403	.65	272	0	0	0	25
May 6	El Carmen road, trap area	183	½ to ¾	do [2]	127	.69	100	0	0	1	4
Do	Cañon los Mimbres	719	do	(3)	473	.66	225	0	0	96	5
May 27	Cañon de la Corona	556	¾ to full	Fallen	71	.13	36	0	0	1	18

OFF-SEASON CROP, 1938-39

1938											
Nov. 21	Near Salazar house	736	½	Picked	390	0.53	260	0	0	0	0
Dec. 5	Near river, El Roble	2,052	½	do [4]	1,260	.61	670	0	0	0	0
Do	Santa Luisa	55	½ to ¾	(5)	16	.29	1	0	0	0	0
Dec. 12	Near Rancho Las Guayabas.	227	¾	Picked [2]	0	.00	0	0		0	0
Do	Cañon Rosario	19	½ to ¾	Fallen	9	.47	7	0	0	0	0
Dec. 16	Near river, below El Roble	898	½ to ¾	Picked [2]	516	.57	449	0	0	4	1
Dec. 20	Road to Hda. San Juan	484	Full	do	0	.00	0	0	0	0	0
Dec. 23	Santa Luisa	80	¾ to full	do	37	.46	35	0	0	0	2
1939											
Jan. 30	River, near El Olmo	584	do	do [2]	20	.05	25	0	0	0	0
Mar. 12	Cañon los Mimbres	1	Full	Picked	0	.00	0	0	0	0	0
Apr. 6	Cañon Rosario	1	do	do	0	.00	0	0	0	0	0

[1] Included many larvae of *Carpolonchaea pendula*.
[2] Included few that were fallen.
[3] Including 69 picked fruits and 650 fallen, the latter exposed to the sun, and many dead larvae in fruit.
[4] Both picked and fallen fruit.

[17] Determined by D. G. Hall.

PARASITES OF THE FRUITFLY

It is known that *Opius crawfordi* (Vier.), *O. cereus* Gahan, and *Opius* n. sp.[18] are parasites of *Anastrepha ludens* in its larval stage. It is shown (tables 1 and 2) that *Opius* parasites have been reared in considerable numbers, especially from collections made in the spring. The presence of several parasites in close association with *A. ludens* attacking chapote led Baker [19] to believe that yellow chapote, a native plant, is the original and primary host of this fruitfly. Only four specimens of *Opius* (probably *O. cereus*) were reared from collections of off-season fruit in the winter of 1938–39.

The status of *Carpolonchaea pendula* is not known. It is believed that it is neither parasite nor predator but probably a scavenger. This same little black fly has been reared from the fruit of white zapote (*Casimiroa edulis* Llave and Lex.), the fruit of "huilotillo," and other wild fruits collected in the vicinity of Santa Engracia.

No predators were observed.

MOVEMENT OF ADULT FRUITFLIES

Records of fruitfly populations were taken by means of glass traps filled with measured quantities of freshly prepared sugar solution and hung in yellow chapote and grapefruit trees at Hacienda de Santa Engracia, Tamaulipas. Data are available for most of 3 years and part of a fourth, during which time 30 traps were kept in chapote trees and 7 to 32 traps in grapefruit trees. The number of traps in grapefruit trees varied on account of differences in number of trees available after studies on insecticides were established. It was impossible to maintain trapping periods of the same length owing to the rapid rate of evaporation of the lure and to the filling of the traps with captured moths and other insects at certain seasons of the year. Most trap-exposure periods were 5 to 7 days long; some 4 and 8 days, respectively; occasionally 3 and 9 days, respectively, and one period was of 10 days' duration. The available records have been summarized to show the average number of flies taken in 1 trap in 15 days by weighting the data taken within the first 15 days of the month or the last 13 to 16 days of the month, depending on the month and year. Most of the averages for each 15 days were based on the number of flies taken in 3 or more trapping periods, although some were based on records from 2 trapping periods; and 3 averages, all from traps in grapefruit trees in 1939, were weighted from data taken in only 1 trapping period.

Traps were placed in grapefruit trees by Baker and a very high fly population was found to be present during the seven periods traps were exposed between October 15 and November 15, 1935. The high fly population measured at that time was probably due largely to flies coming into the groves from the surrounding brush. Trapping in grapefruit trees was resumed early in January 1936 and the population was shown (fig. 4) to be high at that time but not so high as it had been the previous October and November. A peak, also lower than that of the previous fall, is shown in the latter part of March, a time when trees were in bloom or had produced small fruits. It is

[18] Determined by C. F. W. Muesebeck.

[19] BAKER, A. C., STONE, W. E., PLUMMER, C. C., and MCPHAIL, M. A REVIEW OF STUDIES ON THE MEXICAN FRUITFLY AND RELATED MEXICAN SPECIES. [In manuscript.]

not unlikely that the increased population at this late date resulted from flies breeding in nearby oranges and not in grapefruit, as practically all the grapefruit had fallen to the ground in October and November. Examination of puparia found in the soil under grapefruit trees in January revealed that most of the flies had emerged.

The fly population in grapefruit fell off rapidly in March and April and remained very low until early in September, when grape-

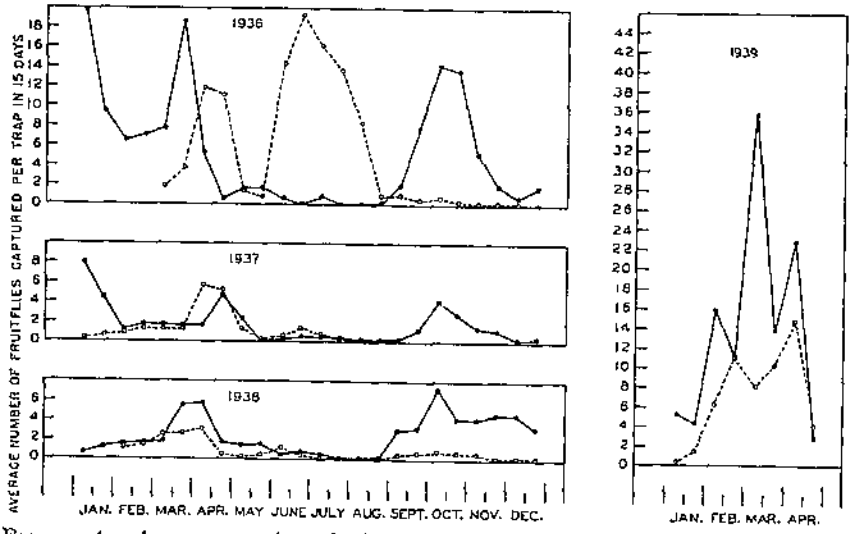


FIGURE 4.—Average number of adults of *Anastrepha ludens* captured in chapote and grapefruit trees by one trap in 15 days, 1936 to 1939. Solid lines show captures in grapefruit trees and broken lines represent captures in chapote trees.

fruit was maturing. Then the number of flies increased steadily and a peak was reached when an average of 14.25 flies per trap was taken during the first 15 days of October. After that the population fell off, and comparatively few flies were captured during the latter half of November and throughout December.

The data of subsequent years are, in many respects, similar to those of 1936. Manifestly, there will be differences in populations from year to year depending on such things as abundance and infestation of chapotes, grapefruit, and other citrus. In January 1937 the fly population in grapefruit was high, owing no doubt to the presence of flies produced by the fall infestation of grapefruit; but by February the population was lower and continued relatively low until the last half of April (fig. 4). After the middle of May it stayed close to zero until fall, when it increased as it did in 1936. There were few chapote fruits the previous summer, so it is not surprising that the fall fly population in grapefruit was low. Nor is it surprising that only a few flies were taken in January 1938. This was because most of the fruit had been picked the previous October and there was no infested fruit to build up populations similar to those of previous years. There was, however, some increase the latter half of March with a spring peak in the first half of April, but shortly thereafter the population became low again and the data for the balance of the year were similar to those of previous years.

The captures in January 1939 (fig. 4) probably comprised flies from infested citrus. It will be noted that there were fewer flies in grapefruit than in either January 1936 or 1937 and more than in 1938. In February, March, and April, 1939 enormous numbers of flies were taken in traps in grapefruit and orange trees. It is definitely known through observation that Santa Engracia fruit was lightly infested and could not have been responsible for this great increase in fly population. There is no doubt that these flies came from the off-season crop of chapote fruit.

The grapefruit data (fig. 4) are such that the following generalizations can be made: (1) There was a very definite increase in population in the fall of the year as shown by data for 4 consecutive years, including 1935; (2) there was a high fly population in January in 2 of the 4 years; (3) there were increases in fly captures in the spring with peaks in March and April in all 4 years; and (4) there was a very low fly population in the summer months of 3 years. Records taken by Shaw show this to be true also for a fourth year.

On March 4, 1936, traps were placed for the first time in yellow chapote trees in a locality about 1 mile distant from the nearest citrus tree of bearing age. It is shown (fig. 4) that the population in the chapote trees increased steadily until a peak in the number of flies captured in the spring was reached in the first half of April. Trees were in bloom and small fruits were produced coincident with the increase in population. A similar peak was also evident in the first half of April in 1937, and again, although less sharply defined, in the first half of April 1938 (fig. 4). It is believed that the emergence of flies from off-season chapote fruits was responsible for the peak shown the last half of February, and that the peak shown in the first half of April of the same year can be considered normal. In all years the fly population declined rapidly after attaining spring peaks, remained low in May, and continued relatively low the rest of the summer if few or no flies emerged from infested chapote fruit. In 1936, however, there was a heavily infested crop of chapotes on the trees where the traps were located, which is reflected in the large number of flies taken in traps during June, July, and August (fig. 4). The data for 1937 and 1938 show few flies captured in the summer months. This would be expected in view of the small quantity of fruit produced in those years.

Traps were not kept in chapote trees between September 18, 1937, and February 8, 1938. The data for other years show the fly population in chapote trees to remain low in the fall months of the year with slight increases in the number of flies taken in September and October 1936 and September, October, and November 1938 (fig. 4).

There are three essential features regarding the trapping in chapotes. (1) A peak in fly captures took place the first half of April for 4 consecutive years, with, in one instance, an early additional peak. (2) Except in the spring months, the population was relatively low throughout the year unless flies emerged from infested chapote fruits in the summer months (1936) or at other times from off-season fruit (February 1939). (3) There were slight increases in population in the fall months of the year as shown for the only 2 years for which such data are available.

In interpreting the movement of flies from one host to another it must be assumed that flies are constantly moving from tree to tree

and from place to place. They probably remain in one place, tree, or area only so long as certain conditions, such as those connected with food and reproduction, are favorable. It is easy to conceive that flies wander to chapote, like it at certain seasons, and remain for indefinite periods of time. Under favorable conditions the daily influx of flies into a given area soon results in definite increases in population. A similar wanderlust of flies has been shown in McPhail's studies [20] on the movement of Mexican fruitflies from mango to other trees in Cuernavaca, Morelos, where *Sargentia* is not present.

Sargentia and the Mexican fruitfly are indigenous to northeastern Mexico, but there are no data to indicate that this is true for southeastern Texas. No other native host plant of wide distribution or importance has been found in these areas. It can be premised that the introduction of another host, citrus, would not modify the habits of the fly in relation to *Sargentia*. There is some evidence to show that both hosts are sometimes favorable to the fruitfly at the same time. In such cases some flies might have congregated in citrus that otherwise would have gone to chapote. It appears that the spring peaks in the number of flies captured, although not very high, took place concurrently in chapote and grapefruit in 1938 (fig. 4). The peaks in the spring of 1939 were not superimposed and the peak in grapefruit preceded that in chapote by a month. In 1936 the peak in grapefruit preceded the peak in chapote by about 15 days. In 1937, however, the peak in chapote took place about 15 days before the one in grapefruit. These data indicate that both chapote and grapefruit may have been attractive to the fly in the spring when trees were blooming and setting fruit. Under such circumstances flies may or may not go from grapefruit to chapote in the spring of the year.

Intermittent trapping in trees other than chapote and citrus has shown that flies, usually few in number, can be captured at all seasons of the year. When the fly population in chapote and citrus reached a low point in May and stayed very low throughout the summer, there can be little doubt but that flies were dispersed in all kinds of trees in the brush. The population in chapote continued low until the following spring, but when grapefruit became favorable to the fly in the fall, a high population resulted in the manner already described. The number of flies coming into grapefruit in the fall seemed to depend on the abundance and infestation of chapotes the previous summer. It is shown that many more flies were present in grapefruit in the fall of 1936 following the emergence of large numbers of flies from chapote the previous summer (fig. 4) than were present in the fall of 1937 or 1938, when the summer crops and infestations of nearby chapotes were extremely low.

SUMMARY

The fruit of the tree *Sargentia greggii*, known in Spanish as chapote amarillo, naranjillo, or limoncillo, and in English as yellow chapote, was found infested with larvae of the Mexican fruitfly (*Anastrepha ludens* (Loew)) as early as 1931, or possibly 1930.

A description of the plant is given. The tree is known to be widely distributed in the States of Tamaulipas and Nuevo León and has also

[20] BAKER, A. C., and others. See footnote 19, p. 8.

been recorded in Mexico from San Luis Potosí, and in Texas from Brownsville. Notes on the flowering and fruiting of the tree show it to be an erratic producer of flowers and that oftentimes little or no fruit is produced. Trees sometimes produce off-season fruit.

Larvae feed mostly within the seeds. Field collections show that average infestation in terms of larva per fruit ranged from 0 to 0.88. Source, size of fruit, season, and other factors had much to do with the degree of infestation.

Parasites, particularly species of the braconid wasp *Opius*, were recorded in considerable numbers from fruit of the infested normal summer crop of chapotes but were very scarce in collections of infested off-season fruit in the winter.

Trapping in grapefruit for most of 3 years and part of a fourth year showed that in each of all 4 years there was a definite increase in fly population in the fall months, increases in the spring with peaks in the number of flies captured occurring in March and April, and a very low fly population in the summer. There was a high population in January in 2 out of 4 years. Trapping in yellow chapote trees during the same years showed that a peak in the number of flies captured took place the first half of April for 4 consecutive years; that, except in the spring months, the population was relatively low throughout the year unless flies emerged as a result of infestation of summer fruit or off-season fruit; and that there were slight increases in population in the fall months of the 2 years for which data are available.

The flies probably remain in one place or tree only so long as food and conditions for reproduction are favorable. Both chapote and grapefruit appear to be attractive to the fruitfly in the spring when trees are blooming and setting fruit, and the flies may go to either tree. During the period when few flies are to be found in either grapefruit or chapote, it is possible that they are scattered about in other trees. The numbers coming into grapefruit trees in the fall seem to depend on the production and infestation of chapote during the previous summer.

U. S. GOVERNMENT PRINTING OFFICE : 1941

For sale by the Superintendent of Documents, Washington, D. C. - - - - - - - - Price 5 cents

END