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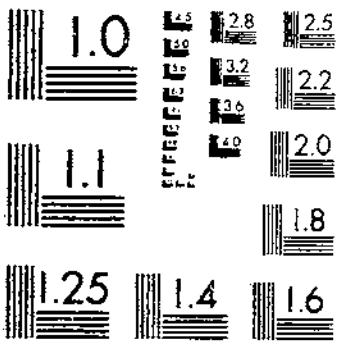

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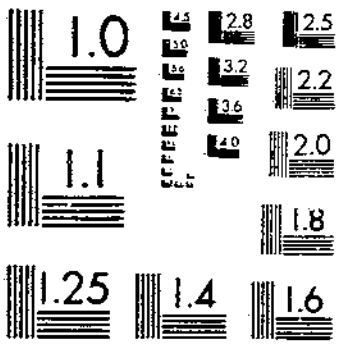

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History and Status of the GREEN PEACH APHID

as a Pest of Tobacco in the United States

by F. S. Chamberlin

Technical Bulletin No. 1175
UNITED STATES DEPARTMENT OF AGRICULTURE

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This paper is a compilation of information from many sources including unpublished notes, correspondence, and manuscripts. The author gratefully acknowledges contributions from P. W. Oman, Louise M. Russell, Norman Allen, L. M. May, F. R. Lawson, and L. B. Scott of the Entomology Research Division; Kelvin Dorward of the Plant Pest Control Division; E. G. Beinhart of Ciudad Trujillo, Dominican Republic; G. Mallory Boush and W. D. Valleau of the Kentucky Agricultural Experiment Station; C. B. Dominick and J. O. Rowell of the Virginia Agricultural Experiment Station; L. W. Morgan of the Georgia Coastal Plain Experiment Station; L. D. Newsom of Louisiana State University; W. B. Ogden of the University of Wisconsin; C. F. Smith of North Carolina State College; W. W. Stanley of the Tennessee Agricultural Experiment Station; J. B. Kring of the Connecticut Agricultural Experiment Station; A. N. Tissot of the Florida Agricultural Experiment Station; and G. N. Wolcott of the University of Puerto Rico.

Washington, D. C. Issued January 1958

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. - Price 10 cents

History and Status of the GREEN PEACH APHID as a Pest of Tobacco in the United States

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The sudden and widespread aphid attacks on tobacco in the United States in 1946 remain unexplained. Aphids in noneconomic numbers had been known to occur on tobacco. The earliest available record is by Howard (*17*)[1] in 1898, who reported the potato aphid (*Macrosiphum solanifolii* (Ashm.)) infesting experimental tobacco in Maryland. Gillette and Taylor (*14*) reported the occurrence of the green peach aphid (*Myzus persicae* (Sulz.)) on tobacco in a greenhouse in Colorado in 1908. The identity of apterous specimens collected on tobacco in Connecticut in 1909 by A. I. Bourne has been verified as the green peach aphid.[2] H. A. Allard collected green peach aphids on tobacco in Washington, D. C., in 1915 and in Arlington Farms, Virginia, in 1917.[3] The species was taken on tobacco in Quincy, Fla., in 1924 by F. S. Chamberlin. Chamberlin and Madden (*4*) recorded the feeding of potato aphids and green peach aphids on tobacco in Florida in 1925, and Tissot (Wilson *et al. 34*) reported breeding of the latter species on tobacco in the same area in 1943. Several species of aphids, including the green peach aphid, the potato aphid, and the bean aphid (*Aphis fabae* Scop.), were observed occasionally on tobacco in Connecticut by Lacroix (*22*, p. 127), but never in sufficient numbers to cause any injury. The bean root aphid (*Trifidaphis phaseoli* Pass.) was found in a tobacco field in Windsor, Conn., by Morrill and Lacroix (*36*) in 1937.

Tobacco growers in Connecticut, Florida, North Carolina, Kentucky, Tennessee, and Wisconsin had observed occasional aphids on their crops long before 1946. In 1934, J. G. Gaines noted an infestation in two small experimental tobacco plant beds at Tifton, Ga., which were being heated by kerosene burners. These observations make it apparent that minor, widespread infestations on tobacco had occurred over a long period. The species concerned in these early infestations is largely unknown.

Outbreak of 1946–1948

The first damage of economic importance by aphids on tobacco in the United States occurred during the 1946 growing season. Severe infestations were reported in Florida, Georgia, South Carolina, North Carolina, and Virginia. A moderate infestation developed in Con-

[1] Italic numbers in parentheses refer to Literature Cited, p. 10.
[2] Unpublished manuscript by James B. Kring.
[3] Records furnished by Louise M. Russell, Insect Identification and Parasite Introduction Laboratories.

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necticut (Turner *30*). Most of these infestations were confined to a few fields. In South Carolina the first reported outbreak was confined to a single tobacco field. In Virginia the infestations were confined to three fields in one county. The Florida infestations occurred in a few fields in two separate northwestern counties. The North Carolina outbreak was apparently more widespread, but was confined to eastern sections of the State (Kulash *21*). The aphid populations in these first outbreaks were generally high, but in many instances were confined to small areas within tobacco fields. In other instances, entire fields were involved before the end of the growing season.

The 1947 tobacco crop was subjected to a general aphid outbreak extending from the Gulf States to Canada. In the Florida-Georgia shade-grown tobacco area it reached epidemic proportions, with all shade fields infested by the end of the harvesting season. The infestation was less disastrous in the Georgia flue-cured tobacco section, but caused damage on about half of the field acreage. In South Carolina the infestation was widely distributed and caused serious losses in Darlington, Dillon, Florence, Horry, and Marion Counties. Heavy and widespread infestations were experienced in North Carolina and Virginia. The first damaging infestations in Tennessee occurred on dark, fire-cured tobacco in July 1947, but no economic injury was observed in plantings of burley tobacco in the State. The aphid first became an abundant pest of tobacco in Pennsylvania in 1947 (Coon *6*). Serious damage occurred in Connecticut during the season. In 1947, infestations appear to have been general throughout all of the northern tobacco-growing States, with the exception of Wisconsin where epidemic infestations on tobacco were not reported until 1950.

The aphid epidemic in 1948 was generally more severe than the one experienced the previous year. It extended into some tobacco-growing sections not previously attacked. All of the many types of tobacco were affected. The aphid was by far the worst pest of shade-grown tobacco in Connecticut in 1948 (Turner *31*, pp. 6–8). Isolated commercial plantings, such as those in the Louisiana Perique section, did not escape attack. Small patches of home-grown smoking tobacco, far removed from commercial tobacco fields, were frequently invaded by the aphids. Strenuous efforts to control the 1948 infestations by means of insecticides were attended with varying degrees of success in the many affected areas.

Species of Aphid Involved

Taxonomists seem to be in agreement that the destructive aphid on tobacco in the United States is the green peach aphid, which has been recognized for many years as an important pest on a great variety of plants and crops. The physiological differences demonstrated by this aphid on tobacco have been noted by several investigators. Studies of the different colored individuals of the species have led deJong (*8*) to conclude that "we are justified to speak of different races." Definite host-plant relationships are lacking, but studies in the Southern States have shown that the insect can alternate between tobacco and some cultivated crucifers, and between tobacco and certain weed hosts.

The potato aphid is frequently found on tobacco in most producing areas. Kring [2] records collections of this species from Massachusetts

[2] Unpublished manuscript by James B. Kring.

as early as 1904, and from Connecticut in 1909. However, all the records indicate that the species has caused only slight or no injury to tobacco and is not considered an economic pest of this crop. Occasionally it has been reported in large numbers on broadleaf tobacco in Connecticut; and it has caused limited injury on burley tobacco in Kentucky, and on cigar-wrapper tobacco in Florida. Recent observations in Florida indicate that it is more prevalent on tobacco in that area than in previous years.

The bean root aphid is reported by Kring [2] to be found occasionally feeding and reproducing on the roots of tobacco in Connecticut, but at present it is not considered a pest of economic importance.

Other aphid species found occasionally in moderate numbers on tobacco in this country, but apparently causing no economic damage, include the spirea aphid (*Aphis spiraecola* Patch), the foxglove aphid (*Myzus solani* (Kltb.)), the buckthorn aphid (*Aphis abbreviata* Patch), *Aphis oestlundi* Gill., *Capitophorus hippophaes* (Wlkr.), and *Macrosiphum ambrosiae* (Thomas).

Aphids as Pests of Tobacco in Other Countries

In the Pacific Islands of Java and Sumatra aphids were known as serious pests of tobacco for many years prior to the 1946 outbreak in the United States. The green peach aphid was recognized as the predominant form. Present information indicates that this species now occurs on tobacco in nearly all countries throughout the world where tobacco is grown. In certain countries, including China, Formosa, Japan, Malaya, Thailand, Rhodesia, Cuba, Puerto Rico, the Dominican Republic, and Canada, the insect is generally considered an important economic enemy of tobacco owing to its feeding activities or to its transmission of diseases. In Europe, South America, and Australia the aphid is considered of little importance as a tobacco pest.

It is noteworthy that the first outbreaks in Puerto Rico, Cuba, the Dominican Republic, and Canada all occurred following the 1946 outbreaks in the United States. In the winter of 1950–51 the first infestations on tobacco in Puerto Rico were reported by Wolcott (*35*), who stated, "The question arises as to whether the outbreaks developed from adults migrating from infested tobacco plants in the continental United States, or whether a physiologically distinct strain evolved independentently in Puerto Rico from the aphids of this species, which are there in abundance but normally infest tomato, Irish potato, eggplant, pepper, and, exceptionally, the green fruit of papaya." The aphid was definitely reported on tobacco in Cuba for the first time in 1948 (Valdes *32*). Its discovery on tobacco in the Dominican Republic in 1951 was reported by Beinhart (*2*), who refuted the frequently advanced explanation that the development of infestations bore some correlation to the introduction of new synthetic insecticides, especially DDT. The first Canadian outbreak occurred in 1947 (Fox *12*), apparently as a geographical extension of similar infestations in the United States. In these four countries the aphid has been subjected to a considerable range of elevation and climatic conditions, but this has not prevented attacks on subsequent crops of tobacco.

[2] Unpublished manuscript by James B. Kring.

Present information indicates that the insect has not yet infested tobacco in the nearby countries of Haiti, Jamaica, Panama, and Costa Rica.

Variability of Infestations

In the years following the first outbreaks, green peach aphid infestations on tobacco have shown marked seasonal fluctuations. The infestations have also varied in the several tobacco-producing areas. Variations between and within fields in the same locality have been a part of the usual pattern.

In some areas peak infestations were reached in 1948; in others, not until 1950. The aphid has caused little damage over considerable tobacco-growing areas during certain years, while in nearby counties it has proved to be an annual, or nearly annual, problem.

Each season infestations have been generally heavier and more continuous in the southern tobacco sections than in the northern sections. The most favorable conditions for large-scale aphid reproduction occur in Florida-Georgia shade-grown tobacco. The humid and shaded environment in the tobacco shade tents evidently approaches optimum conditions for development. Experimental shade-grown-tobacco plots at Quincy, Fla., during the 1948–57 seasons, have shown no diminution in the aphid potential, and have furnished ample evidence that aphids can quickly ruin a crop in the absence of controls. The aphid, when present in the tobacco shade tents of the Connecticut River Valley area, can likewise reproduce in numbers sufficient to cause serious damage. While these insects attack both shade-grown and sun-grown tobacco in this area, the infestations occur earlier, and are more severe under shade tents than in open-field plantings (Waggoner and Kring *33*).

The history of the green peach aphid on tobacco in Wisconsin indicates that it has been very sporadic. Occasional infestations have occurred but these have usually disappeared within a short period. Rather extensive infestations occurred in the State during the 1950, 1951, and 1952 growing seasons.

Types of Injury

Aphid infestations on tobacco plant beds have seldom caused much injury to the seedlings. However, the insects are easily carried to the field on the transplants, and this has been the major source of serious field infestations in most tobacco-producing areas.

Heavy infestations of aphids can severely stunt the growth of young tobacco plants in the field. As the initial distribution of aphids in a field is likely to be irregular, an uneven crop can result from early attacks. Stunting of older plants and withering of leaves may be caused by large populations of aphids. Their feeding on the foliage produces tobacco leaves of an inferior or worthless quality, this condition being accentuated in the relatively thin cigar-wrapper types. On such types of tobacco, which are harvested by cutting the whole plant, the yield and quality may be reduced by premature ripening of the lower leaves. Feinstein and Hannan (*10*) have shown that aphid-damaged tobacco contains less nicotine than comparable undamaged tobacco. Injury is believed to be due mainly to the removal of plant juices, but may be caused in part by injected salivary secretions absorbed and translocated by the plant (Lawson *et al.*, *23*). The deposi-

tion of honeydew prevents normal curing and causes disfiguration due to the presence of adhering cast skins and sooty molds. Severe infestations cause variable losses in both yield and quality. Infestations of lesser intensity are believed to produce injuries that frequently escape attention or are wrongly ascribed to other causes.

Other types of injury in tobacco are produced by certain diseases transmitted by the aphid. These are usually evidenced as leaf injuries, the symptoms of which vary with the different diseases. Some of these diseases affect the entire plant, causing it to wilt and deteriorate.

Losses Caused by Aphids

The greeen peach aphid injures all types of tobacco grown in the United States. Shaded types are especially susceptible, and burley tobacco is perhaps least subject to harmful attack. Conditions within tobacco shade tents are especially favorable for aphid development, and the thin cigar-wrapper leaves grown in these enclosures depreciate quickly when attacked. Aphid reproduction is markedly greater, and subsequent injury more severe on sun-grown tobacco plants that are partially shaded by trees or buildings. Dark, fire-cured tobacco is relatively more susceptible to injury than burley when grown under similar conditions, apparently owing to the greater amount of shade afforded by the plants. The spacing of plants, density of foliage, and other factors seem to influence the size of aphid populations and the resulting damage.

Few data on losses caused by aphids to tobacco are available. The aggregate seasonal losses to many plantings are probably underestimated. In the Florida-Georgia shade-grown tobacco section losses caused by aphids reached a peak during the 1947 season, at which time there was little available information on control. The damage to individual crops ranged from slight to almost complete destruction, with an aggregate estimated loss of 20 percent sustained by the industry. Since that time aphid losses in this shade-grown area have been held to almost negligible amounts through the consistent use of insecticides.

Aphid damage sustained on the flue-cured tobacco crop in Florida and Georgia during the 1947 epidemic was estimated at about 7 percent of its value. The damage exceeded 30 percent in some fields; other fields escaped injury. Approximately one-half of the fields in Georgia sustained some damage. Two reports of aphid damage on flue-cured tobacco in South Carolina in 1947 indicate the losses in heavily infested fields. One estimate in a 13.5-acre field in Horry County, which made excellent growth but was severely infested with aphids, was 38 percent loss in weight and 56 percent loss in income. This estimate was based on the yield from a similar but uninfested crop raised on the same piece of ground in 1946. Another available estimate of aphid damage in 1947 is from a farm in Marion County. The infestation in this 4.5-acre field of tobacco was much less than in the field in Horry County, and also received one insecticide treatment for aphids. Under these conditions the grower sustained an estimated loss in yield of 28 percent and a loss in income of 46 percent. In 1949 and subsequent years the aphid has been prevalent in Georgia and South Carolina tobacco fields, but in general the timely use of effective insecticides has prevented it from causing as severe losses as

were experienced in the first few years of its appearance. While estimates in Georgia indicate that aphid damage on tobacco has not exceeded 2 percent of the crop value during the last several years, the insect was considered the most important pest of tobacco in 1955, and required control measures more frequently than other insect enemies of the crop.

Aphid losses on the most severely infested dark, fire-cured tobacco plantings in Tennessee amounted to about 25 percent in 1947, and such losses were common in the 1948 crop. In some plantings the loss reached 35 percent. The infestations caused only moderate injury to burley tobacco in the same area. The 1949 tobacco crop was heavily attacked by aphids, and the 1950 infestation was by far the heaviest recorded in north-central Tennessee. Damage was considerably reduced during both seasons by the general use of aphidicides. The period 1951–54 was characterized by extremely high temperatures and severe drought. So far as it known, the green peach aphid caused no more than a trace of damage during this period. Aphids became very abundant on tobacco in the State during June and early July of 1955, but daily temperatures reached 95° F., and the infestation practically disappeared.

In Kentucky the green peach aphid has caused considerable damage to tobacco in the southern tier of counties bordering Tennessee. Crops in the western tip of the State are also troubled with this pest, but to a lesser degree. The aphid occurs on tobacco throughout central and northern Kentucky, and is a sporadic pest of the crop in certain of these areas.

In Virginia aphid losses on tobacco have been extremely variable since the first outbreak. Losses ranged from slight to severe during the 1947 and 1948 growing seasons. Considerable damage resulted from the 1950 outbreak. The 1949 infestation was considered light, and the insect was not a problem on tobacco during the period 1951–53.

In North Carolina aphids caused severe damage to tobacco in 1947 and 1948, and an outbreak of some severity was experienced in 1950, but they normally cause rather minor losses in tobacco crops in the State. Frequently the damage is confined to small areas, and occurs only during the cooler growing weather. Infestations are generally heaviest on the southern border of the State, perhaps because there is much wild mustard in grain, pasture, and fallow fields in this section. The use of insecticides on the crop for the control of other insect pests, and the application of materials specifically for aphids, evidently play a considerable part in reducing aphid losses.

The green peach aphid was responsible for an estimated million dollar loss to Connecticut shade-tobacco growers in 1947 (Friend *13*). Kring [2] states that aphids could have been a serious problem on shade-grown tobacco in the area in all of the years following the initial outbreak if effective insecticides had not been available. He reports that open-field-grown cigar tobaccos apparently had their highest infestations in 1947, 1948, 1951, 1954, and 1956, but that these tobaccos were generally not damaged, with the possible exception of the 1947 crop. Infestations in the open fields were generally extensive only on suckers. These infestations developed later and at a slower pace than infesta-

[2] Unpublished manuscript by James B. Kring.

tions under shade tents. This lag enabled growers to harvest their plants before the peak infestations occurred.

Natural Controls

While the abundance of the green peach aphid is greatly influenced by natural controls, a knowledge of the factors involved is generally lacking. No means are available for determining when or where these natural agencies may exert sufficient control on infested tobacco crops.

Predators are numerous in most areas and effect varying degrees of aphid control. Often they are too few in numbers or arrive too late to be of much benefit. Parasitic enemies appear to be of less value than predators at the present time. In an effort to improve this situation, foreign parasites of the green peach aphid have been released in several tobacco-growing areas.

The beneficial effects of predators and parasites are reduced by the potent insecticides now applied to tobacco crops. The integration of chemical controls with these natural enemies remains an unsolved problem. Under certain weather conditions, fungus diseases exert a restraining influence on aphid infestations. They seem to be of main importance during the winter season when the aphids are living on host plants other than tobacco.

The frequent restriction of infestations to low, damp spots in tobacco fields indicates the importance of moisture in aphid development. This is little understood and has no practical control application at the present time. Under favorable temperatures the aphid has demonstrated a high reproductive capacity on tobacco under both wet and dry conditions. Low winter temperatures, which eliminate or limit the cultivated crucifers and certain weed hosts that serve as winter reservoirs, are believed to be an important factor in determining the abundance of the aphids over large tobacco-producing areas.

The profound influence of high temperatures on green peach aphid populations is becoming well recognized. This influence was observed in Virginia by Dominick (*9*). Studies by F. R. Lawson[4] in North Carolina have advanced the knowledge of this control complex. Records made in Tennessee from 1947 through 1955 indicate that the green peach aphid cannot become abundant on tobacco in north-central sections of the State when the maximum temperature exceeds 95° F. on several consecutive days. While it is apparent that conditions frequently concurrent with high temperatures are a limiting factor in aphid abundance on tobacco, these are less operative, or their effects are masked by a higher biotic potential, under a shaded environment. There is also evidence that the high-temperature complex exerts a lesser control of the aphid on sun-grown tobacco in southern sections of the country than in the central and northern areas.

Artificial Control

In the artificial control of aphids on tobacco, dependence has been placed mainly on insecticides. Certain cultural practices that give appreciable control have been largely ignored (Lawson and Chamberlain *24*).

[4] Unpublished manuscript.

The first attempts to control the insects with nicotine and other common aphidicides resulted in failure. Parathion became available for experiments in 1947 (Creighton *et al.*, *7*) and proved to be very effective. This material and TEPP have both been used successfully against aphid infestations. These materials have since been partially replaced by malathion, which is less toxic to warm-blooded animals. DDT has proved to be of value in preventing or reducing aphid infestations in some areas. Certain other insecticides, such as endrin, which are used primarily for the control of budworms and hornworms, exert a depressing effect on aphid populations in tobacco crops. New chemicals under study show some promise of effective aphid control with fewer accompanying hazards than the chemicals now in use (Boush *et al.*, *3*; Guthrie *et al.*, *15*).

The problem of economical aphid control on tobacco by means of insecticides is made more difficult by the uncertainties attending infestations and the need for treatments. In shade-grown tobacco the possibilities of heavy monetary losses are so great as to warrant a preventive system of control (Chamberlin *5*, p. 12; Kring *20*, pp. 10–12). This control system includes plant bed and early field treatments to prevent aphid development during the first half of the growing season. Treatments are made the latter part of the season as the situation demands. In practice, the aphidicides are frequently combined with materials needed to control other insects and certain diseases that attack the crop.

In sun-grown types of tobacco, insecticidal treatments are seldom applied until the need becomes apparent. The treatment of infested plant beds is advocated in most areas, and is a strategic method of eliminating many field infestations. Field infestations originating from infested seedlings are likely to be especially dangerous, as aphid populations obtain an early start and may be able to reach harmful proportions before high temperatures and epidemic disease appear. In practice, the difficulty in recognizing light to moderate infestations in the thick, plant-bed growth is a serious limitation.

The practicability of protective field treatments on sun-grown tobacco in advance of damaging populations has not been determined. Such treatments may have possibilities in some areas where injurious infestations occur most frequently. At the present time there is little definite information to indicate when or where insecticide applications are needed, or justified. Some general progress has been made in gaging the need for treatments, but the problem has been left mainly to the judgment of the individual grower. Fortunately, very effective insecticides are available. Aphid damage in tobacco fields may be completely eliminated by the proper and timely use of these materials. However, additional information is needed to improve the efficiency and economy of aphid control on sun-grown tobacco.

Disease Transmission

The proclivity of the green peach aphid in transmitting plant diseases is well known. It is an important vector of many diseases on various plants and crops throughout the United States. In several foreign countries, where the species occurs as a pest of tobacco, it is dreaded mainly as a vector of serious virus diseases. Those of foreign

importance include tobacco etch, rosette, cucumber and certain other mosaics. Other viruses transmitted by green peach aphids include severe etch virus (Kassanis *18*) and aspermy virus (Hollings *16*).

In Canada, Stover (*29*) reports that etch virus disease has been epidemic, and has caused considerable injury in the Ontario burley tobacco belt following the first appearance there of the green peach aphid on tobacco in 1947. As the disease symptoms appear in the absence of any mechanical operations, and are coincident with the appearance of the aphid, this insect is indicated to be the main cause of its rapid spread. McKeen (*25*) reports that etch was found on peppers in Ontario for the first time in 1950, and caused extensive damage to the crop. The appearance of these epidemics only in sweet pepper fields infested with green peach aphids indicated that the virus is largely dependent upon this insect for its spread.

As far as can be determined, the green peach aphid has not been associated with tobacco diseases in the United States except in occasional instances. Etch virus disease has been known to occur on tobacco grown in an experimental greenhouse in Kentucky, under which conditions it appeared to be freely transmitted by the aphid. In this same area, potato Y veinbanding disease, which is known to be aphid-transmitted, was found on tobacco growing near potatoes. In Virginia, etch has become much more common on field tobacco with the widespread prevalence of aphids (Fenne *11*). Two virus diseases, etch and potato Y veinbanding, which had not been recognized in shade-grown tobacco previous to 1948, appeared on plantings at the North Florida Experiment Station (Kincaid *19*). Appearance and spread of these diseases apparently were associated with the infestation of green peach aphids carried over for experimental purposes. Etch did not appear in 1949, but veinbanding attacked the 1949, and several following crops. The disease was largely confined to experimental tobacco plantings where green peach aphids were allowed to survive for limited periods. Leaves from infested plants were valueless. Transmission studies by Rhoades and Kincaid (*27*) gave further proof that the aphids are vectors of the disease. Simons and coworkers (*28*) report that potato Y veinbanding virus disease is prevalent on peppers and tomatoes in widely scattered Florida trucking areas. They fear that its establishment in new areas is a logical development.

From the available evidence it is apparent that the aphid-control problem on tobacco includes the definite possibilities of new disease hazards.

Conclusions and Future Outlook

There is every indication that the green peach aphid has become a permanent pest of tobacco in the United States. The 10-year period of infestations has shown it to be sporadic in character. Under favorable conditions, and in the absence of controls, it is capable of causing serious losses.

The complex of climatic factors, host plants, and natural enemies determines the intensity of infestations. Undetermined disease organisms or nutritional conditions coincident with high summer temperatures exert a strong, depressing effect upon infestations. These have been a limiting factor in the general latitude of North Carolina and further north. In the areas to the south this natural control appears

to be somewhat less effective, thereby placing greater dependency upon artificial control.

The insect's status as a pest of tobacco can be expected to change in the course of time. Biological and weather data should afford better means of predicting outbreaks. Benefits from predators and parasites may increase as their activities become better understood and appreciated. The aphid is an important transmitter of diseases on tobacco. It is a vector of serious tobacco diseases in several foreign countries. The recent widespread occurrence of etch on burley tobacco in Ontario, Canada, is attributed to the prevalence of this aphid. If this disease becomes prevalent on tobacco in the United States, the aphid's status as a pest of this crop will be considerably increased. In several peach orchard areas the green peach aphid has become difficult to control with the same organophosphorus insecticides used against the insect on tobacco (Anthon *1*); therefore, an increased tolerance to these materials on tobacco will not be surprising. Breeding experiments underway indicate some possibility of developing aphid-resistant varieties of tobacco. This possibility offers some hope of reducing the present dependency on chemical control.

The present knowledge of the green peach aphid as a pest of tobacco in most areas is superficial and fragmentary. Studies have been limited mainly to the immediate effects of insecticides. Only slight attention has been given to the biological phases of the problem. There is need for a better understanding of these factors. This is requisite for the efficient and economical control of this insect pest at the present time. Reserve defense knowledge should be available to meet new problems that are likely to develop.

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U. S. GOVERNMENT PRINTING OFFICE: 1958

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