already been tried out and is being recommended for planting. Many other introduced plants show considerable promise.

Experimental figures during a period of 10 years show that the native forest grasses (fig. 171) grazed at the rate of one head to 10 acres do not afford sufficient grazing to support a cow with calf at side after July 1. On the other hand, carpet-grass and Lespedeza pastures will carry one mature animal per acre with continuous gains for a period of nine months and will afford some grazing throughout the winter months. Widespread tests on a considerable acreage confirm the high carrying capacity possible to attain on pastures suitably planted.

The adaptation of forest grasses to intensive grazing appears to be contrary to a fundamental law of nature which supplied sun-loving, turf-forming grasses to support grazing animals on the treeless plains. For the South, which was originally a forested country, this means that pastures must be built from plants brought in from other parts of the world.

S. W. GREENE.

PEACH Orchards in Georgia Menaced by Phony Disease

About 50 years ago Samuel H. Rumph, the originator of the Elberta and several other important commercial peach varieties, observed a few dwarfed peach trees in his orchard at Marshallville, Ga. These trees he called "ponies" because of their small size. The number of trees showing the dwarfing tendency continued to increase in Doctor Rumph's orchard and in the neighboring orchards, and the trouble was known as "pony peach." Various causes were assigned to this behavior, and finally it came to be regarded as a disease. The name "phony disease" has also been applied, and this term is in general use at the present time.

In 1900 an occasional phony tree was seen in the peach districts near Marshallville and Fort Valley, Ga. In 1915 in these localities the trouble had increased to the extent that orchardists became alarmed and the United States Department of Agriculture was called upon for assistance. In 1921 special investigations were begun by the Bureau of Plant Industry to determine the cause of the disease and methods of control.

The present known occurrence of the phony disease is limited to Georgia, where it has invaded nearly all of the commercial peach-growing districts of the State. Occurrence is recent and slight in the northern sections. During the last three years it has become serious in the north-central and west-central counties, and it has been for several years a great menace in the extensively planted central region, where practically every bearing orchard has diseased trees and it is not uncommon to find 50 per cent or more of the trees diseased in orchards that have reached 8 years old.

Increasing in Southern Area

In the southern part of the peach belt it is only moderately serious, but is increasing. In one of the southernmost orchards, consisting of 2,000 trees, situated on land entirely new to peaches and in a totally new peach district, the particular orchard being 15 miles

from any other planting of peaches, 3 per cent of the trees, now 6 years old, are typically phony. Taking into consideration trees of all ages for the entire State, it is probable that about 5 per cent are in various stages of the phony disease. The highest individual occurrence records show 60 per cent of diseased trees in an orchard 4 years old and 99 per cent in an orchard 12 years old.

Initial characters of the phony disease do not appear in commercial plantings before the latter part of the second growing season in the orchard, or three seasons from the bud. Thereafter, trees may come down with the disease at any age, and the first symptoms may become evident at any time between May 1 and September 15 of the year that the disease develops.

With the onset of the disease a phony tree develops shortened internodes, a large number of lateral twigs, and large, flattened,

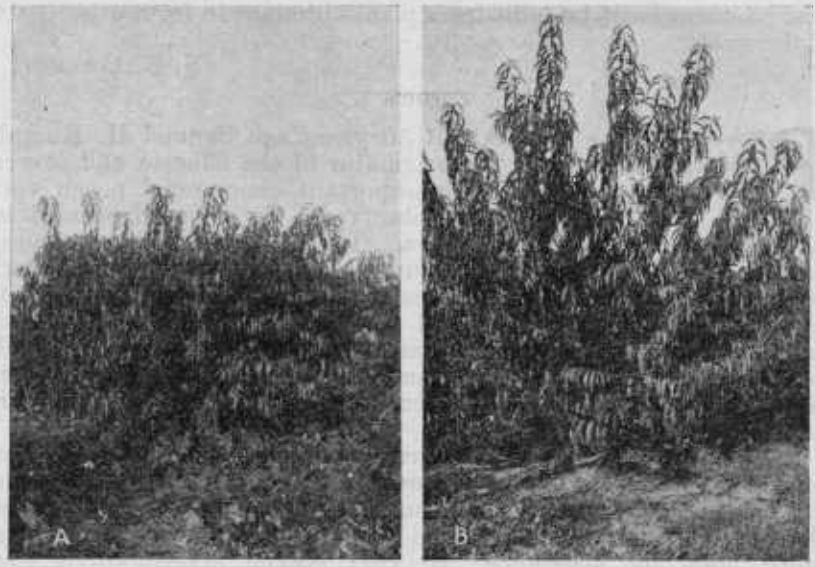

FIG. 172.—Phony disease of the peach. Trees of the Hiley variety completing third year's growth in the orchard. A, tree in the first year of the phony disease; B, normal tree. Fort Valley, Ga.

dark-green leaves, giving the appearance of compact, dense growth with very healthy foliage. (Fig. 172.) Especially in young trees, decided dwarfing results, and normal trees quickly exceed phony trees in circumference and height. The annual terminal twig growth of a phony tree may be only from 1 to 6 inches, as compared with a terminal growth of 1 to 3 feet or more in normal trees. The phony condition may advance the blooming, leafing, and fruit-ripening dates a few days, and it may retard the time of autumn leaf fall. In advanced cases, phony trees may be identified in the dormant condition by the short terminal and the profuse, short, lateral twig growth. In such trees, because of the condensed appearance of the growth, the disease is usually evident at blossoming time and with the first mature leaves in the spring.

Phony trees do not seem to be more subject to winter injuries than are normal trees, and they may live many years after showing the symptoms of the disease. However, since the terminal growth

is short, it is difficult to shape the phony trees by pruning to stimulate new growth, and as large limbs die they are not replaced by the tree. After four or five years of the disease the trees are generally ragged and there is apt to be a marked dying back of terminal twigs and branches. Trees are on record that have had the disease seven years and are still living.

Effect on the Fruit

With each additional year after the symptoms of the disease appear there is a notable decrease in the average size of fruit and in the number of fruits to the tree. At Fort Valley, Ga., for the Hiley variety, a normal tree 8 years old may bear 1,000 marketable fruits, while a phony tree of the same age that has had the disease five years may bear 50 fruits, mostly too small to be marketed. It is not unusual for the size of normal fruit to be about two and one-half times that of diseased fruit.

Fruit from phony trees is apt to be distinctly poorer in flavor than normal fruit, though slightly better in color. The seeds of phony peaches are small, but the kernels are well formed and they give a high percentage of germination. In an experiment, seedlings from phony seeds have not developed the disease after three seasons of growth.

The disease is not believed to be limited by ecological factors in its distribution in Georgia. It occurs on old and on new land, on all soil types within its range, and is apparently independent of cultivation, drainage, cover crops, and chemical fertilizers. Orchards that show numerous cases of this disease in young trees may be found on land not previously planted to peaches. Diseased trees do not recover when transplanted. Replants do not seem to contract the disease more easily when planted in holes from which phony trees have just been removed.

By detailed and extensive mapping of orchards over a period of several years, it has been shown that this disease does not spread in colonies in the manner that such contagious diseases as peach yellows are known to do. The new cases for any given year are scattered and seem to have no relation to previously existing cases in the same orchard. There is a popular belief that this disease is more prevalent near buildings or when stable manure and other highly nitrogenous fertilizers are applied to the land. Extensive observations, however, tend to show that in well-fertilized trees the characters of the disease are so pronounced as forcibly to attract attention, and that the casual observer overlooks definitely positive but less conspicuous cases scattered over the portions of a planting that are less favorably situated for luxuriant growth.

Cause Remains Unknown

The phony disease has been found occurring naturally only in the peach, and its cause remains unknown. It attacks alike seedling trees and trees of all commercial varieties grown in the State. Though wild plums (*Prunus angustifolia, P. umbellata,* and others) are abundant near commercial peach orchards, the phony condition has never been observed in them. Attempts to transmit the disease by injection of juice expressed from various parts of phony trees have failed.

When buds or scions from phony trees are budded on nursery trees or on normal peach trees, the resulting growth is invariably normal and the disease is not transmitted. When similar experiments are performed, using normal buds or scions on phony trees, the resulting growth is always typical of the disease.

Furthermore, in experiments where Peento and Honey peach types, *Amygdalus davidiana*, and commercial varieties of almond, apricot, and nectarine were top-worked on phony trees, the resulting growth was much dwarfed and developed leaf and twig characters typical of the phony disease. The dwarfing effect was particularly striking in the case of *A. davidiana*. Growth of this species when

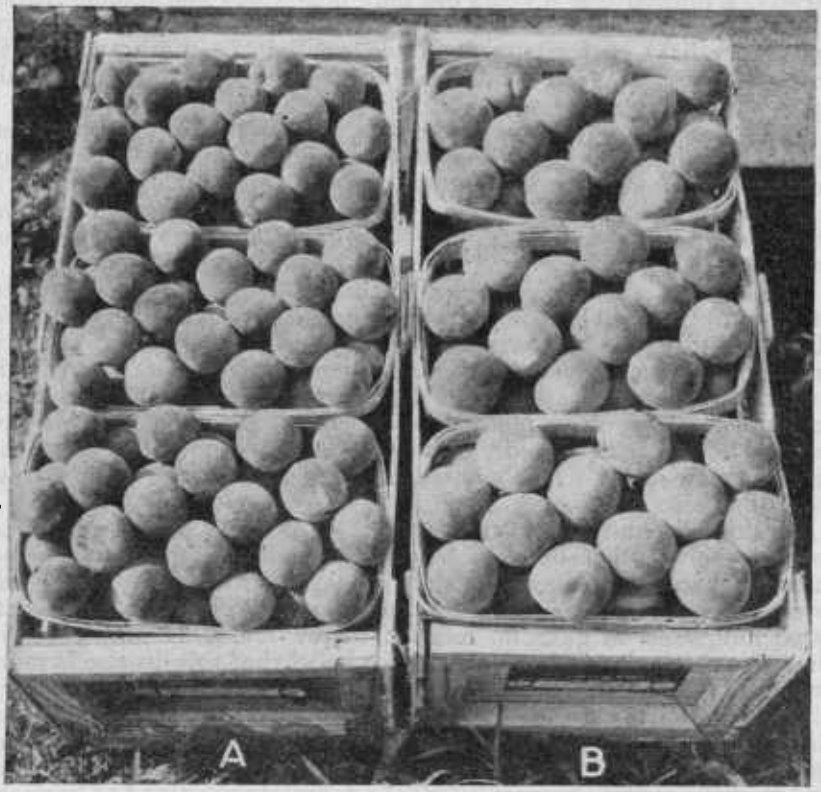

FIG. 173.—Phony disease of the peach, showing effect on the fruit. A, Early Rose peaches from a tree in the first year of the phony disease; B, Early Rose peaches from a normal tree. Fort Valley, Ga.

grafted on normal peach trees was in some cases 10 feet in one season, as compared with a bushy, profusely branched growth of 18 inches when grafted on a phony tree. Not only does it seem possible that the phony disease may invade peach-growing districts beyond the borders of Georgia, but the experiments just described suggest that the disease might also attack fruits closely related to the peach if introduced into the districts where they are grown.

The fact has been repeatedly established by experimentation that the dwarfing effect in the top growth is only a symptom and secondary, and that it is produced by diseased roots. Whether it may be due to an infective principle or to a purely physiological disturbance is not

yet certain, but the evidence of recent experiments indicates strongly that it may be due to an infective principle residing in the roots. In each of the leading commercial varieties observed, a very small percentage of trees in badly diseased orchards appear to be resistant to the phony disease, and year after year they continue to grow normally, even though surrounded by old phony trees. This behavior has suggested the possibility of selecting resistant stocks as a control for the phony disease, and extensive investigations are being carried on at the United States peach-disease field laboratory, Fort Valley, Ga., with this in view.

There is every reason for thorough and intensive effort to control the phony disease. Although its communicability has not been definitely established by experimentations, it has already traveled 200 miles from its point of earliest recorded observation, at Marshallville, Ga., and has increased from commercially unimportant numbers 30 years ago to such proportions that at the present time it threatens a great industry.

LEE M. HUTCHINS.

PEANUTS a Valuable Food for Man and Feed for Livestock

Peanuts are commonly associated in our minds with circuses, fairs, and gala days. That they constitute excellent feed for livestock, as well as food for man, is generally far too little appreciated. Peanuts are not nuts as the name might suggest, but with peas and beans belong to the legume family. They have, however, a nutritive value far superior to beans, with the possible exception of the soy bean. As a feedstuff, every part of the peanut plant can be used to advantage. The vines, properly cured, constitute a hay with a feeding value equal to or better than clover or alfalfa. Shelled peanuts contain from 40 to 50 per cent of a highly digestible oil that compares favorably with olive oil for culinary purposes. The press cake which remains after expelling the oil from whole peanuts, and which is generally ground and marketed as peanut meal, contains from 34 to 38 per cent protein; and when it is obtained from choice shelled peanuts, may contain as high as 58 per cent. Peanuts are also a good source of vitamin B.

The nutritive value of a protein is dependent on two factors, its digestibility and quality. Scientific experiments have shown that peanut proteins are not only highly digestible but that they rank among the highest in quality. The so-called nutritional quality of a protein depends on its chemical composition. Most proteins when digested yield 18 or 20 substances called amino acids, several of which are essential for the normal growth and nutrition of animals. Proteins of poor quality are those that are lacking or deficient in one or more of these essential amino acids.

Work recently done in the Bureau of Chemistry and Soils has shown that peanuts contain two proteins—arachin and conarachin. Both of these proteins contain all of the known essential amino acids. Arachin is conspicuously high in lysine (5 per cent), and conarachin, in cystine (3 per cent), two of the essential amino acids. The chief proteins of the cereal grains are deficient in lysine and cystine. Peanut meal or peanut press cake therefore serves as an excellent concentrate for mixing with corn or cereal feeds to supplement their deficiencies.