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ADVANCES IN CORN PRODUCTION IN THE SOUTH

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The geographical region, the South, I suppose means to most people that region south of the Mason-Dixon line and east from Oklahoma and Texas. Corn production in this large region varies, and some subdivision of the region is necessary. I shall refer to the upper South to include Virginia, Kentucky, Arkansas, Oklahoma, and parts of Texas. Corn growing in this belt is often quite similar to that in the Corn Belt. The middle South includes most of North Carolina, Tennessee, the northern half of South Carolina, Georgia, Alabama, Mississippi, and Louisiana. The lower South would include a belt running along the Gulf of Mexico from Texas to Florida and a similar area up the Atlantic coast to Virginia.

In order to give you a general picture of corn production in this vast area, I have called on the aid of several co-workers in the states mentioned and wish to express my appreciation for their generous help. I am also indebted to Dr. B. A. Krantz, Dr. E. R. Collins, and many others who have helped with the corn program in North Carolina.

Corn Has Played Second Fiddle

Most of you think automatically of corn as the number one crop. Think if you can for a moment what it would mean to corn production in the Corn Belt if there should be some other crop whose cash value per acre was several times that of corn. Under such conditions corn becomes a second rate crop and receives second rate care. 1 cotton For generations corn has occupied such a minor position in most of the South where cotton, tobacco, and peanuts have been the main cash crops. These cash crops demand 2 peanuts large amounts of hand labor at critical seasons. It has been quite natural that secondary crops, such as corn, should be neglected during those critical seasons for the cash crops. Naturally the tenant system of farming, along with a relatively small livestock industry, placed emphasis on cash crops rather than feed crops. I should

like to point out that in most areas corn had no dependable cash market should the farmer desire to convert surplus corn into cash.

3
Table 1

You have all heard of the low acre production of corn in the South. In Table 1 we see the ten-year average acreage and yield per acre given by states. A yearly average of 30,887,000 acres of corn harvested produced only 17.3 bushels per acre. Low as this production was it represents a 12 percent increase over the preceding ten-year period. The increase can be based largely on the influence of the war and a small acreage of hybrid corn. Such average yields do not create much interest in corn production. Southern farmers should not be blamed for their lack of interest in the corn crop. Most corn was planted to make feed for the work stock which were needed for the growing of the more profitable cash crops. Although from one-third to one-half of the crop land was planted to corn annually, it was at best only a filler or clean-up crop following cotton, etc.

A Changing Picture in Corn Production

The real subject which has been assigned to me is to tell you how this dark picture of corn production has changed in recent years. Many factors are influencing corn production, causing an increase in production per unit of land in all 13 states. During 1949 the total production was 613,959,000 bushels or 12 percent greater than for the ten-year average 1936-45, but on only 76.5 percent as much acreage planted. The per acre yield was 26.0 bushels for the region, or a 50 percent increase over the ten-year average. Figure 1 shows graphically the story of corn yield per acre in North Carolina over the past 80 years. We are interested mainly in what has happened during the past five years or the period covered by the new corn production program. In these five years the yield per acre has increased steadily from 23 bushels in 1944 to 34 bushels in 1949. The trend is roughly the same in the other Southern states as that shown here for North Carolina.

4
Fig. 1

Factors Influencing the Change in Corn Production

No single factor can be pointed out as the major cause of this rapid improvement in the corn picture. The shortages of labor, machines, feed, etc. which World War II brought on placed a new value on feed crops in the South. The increase in livestock in the region also increased the need for feed at a time when feed stuffs were not available elsewhere. Under these conditions the southern farmer has become more interested in seeing what feed he can grow at home. Hybrid corn has played an important role in capturing the interest of the farm people in their corn crop. Farmers are far more aware of their corn crop today than before the days of hybrid corn. This same fact is true in all corn growing areas as they shift from open pollinated corn to hybrid corn.

Fortunately, along with the new interest in corn growing has gone new methods of growing corn which were based on research programs in soil fertility, cultural practices, chemical weed control, and disease and insect control. We shall discuss these newer methods, but first let us review how corn was formerly grown. Throughout most of the area corn received little or no fertilizer directly but instead was used as a clean-up crop following the cash crops. Generally the plant spacing was very wide - 4000 to 6000 plants per acre being common. Cultivation was often too late and too deep, which frequently caused much damage in dry weather.

The first hybrid corn to be grown in the region was that adapted to the Corn Belt. During the latter part of the 1930s and in the first part of this decade, many farmers planted Corn Belt hybrids only to be greatly disappointed. Except for limited uses all Corn Belt hybrids are poorly adapted to the middle and lower South. I should like to emphasize this point because we still find individuals who think they have hybrids that are universally good regardless of where grown. I would like to urge you to restrict your hybrid strains to the regions in which you know them to be adapted. No other single factor has retarded the use of hybrid seed in

our region as much as the harm caused by the use of unadapted or Corn Belt hybrids. In all of the southern states it is taking a great deal of educational work to re-sell hybrid corn to those who associated "hybrid corn" with "unadapted corn". ~~We would appreciate your cooperation in helping us in this effort.~~

Cooperative Research Points the Way

If corn production in the South was to be raised to a profitable level, much had to be learned through research in several phases of production. Breeding of superior hybrids adapted to the soil and climatic conditions was only one step. Obviously, hybrid corn could not be expected to increase production much over 25 to 30 percent. Such an increase is not an impressive amount when figured on land averaging only 10 to 20 bushels per acre.

The region was known to be deficient in soil nutrients, and fertilizer programs in several states have shown how to increase corn production by new methods of fertilization. Most of the states report nitrogen as the number one fertilizer need. In many cases corn production could be increased several fold by the use of nitrogen alone. This is especially true where a well fertilized crop is included in the rotation. Krantz[1] has shown in Figure 2 ~~illustrates~~ a case where yield was increased from 19 to 121 bushels per acre by the addition of 180 pounds of nitrogen.

Along with increased fertilization have gone studies on ~~the size of the~~ plant population. Figure 3 shows the results of six tests grown under favorable fertilizer and moisture conditions. You can easily see that a population of 4000 plants was not enough for maximum yield, while there was little difference in the yield of 7000, 10,000, and 13,000 plants per acre. Jordan has reported very similar results for 4000 and 12,000 plants per acre, as a three-year average in Mississippi. The relationship between fertilization rates and plant population is shown in Table 2. All southern states are now using from 30 to 80 percent greater plant populations on well fertilized land than formerly. This increased plant population also greatly reduces the need for cultivation especially in the later stages of growth when most damage to the corn roots occurs.

1. Krantz, B.A. 1949. Fertilize corn for higher yields. N.C. Agr. Exp. Sta. Bul. 366

10 corn fert.

The Changing to high ~~rates of~~ fertilization, mainly high nitrogen levels, and heavy stands was quite a revolutionary step. Many agricultural workers and farmers shook their heads and said just wait until it turns hot and dry and those plots will burn up. Experience has shown that such is not the case. Figure 4 compares the results of tests grown under good moisture conditions and dry conditions. You will notice that in either case the high nitrogen plots produced well above the check plots. True, the total yield was less under dry conditions but in no case was it as low as the check plots. Observation of such plots has repeatedly shown that the well fertilized plants stand the dry, hot periods longer and better than do the plots only partly or poorly fertilized. The average of 55 bushels per acre under dry conditions for plots receiving 120 pounds of nitrogen is very encouraging in comparison with the former state average of less than 20 bushels.

11 Fig. 4

Extension Teaches Five-Point Corn Program to Farmers

You are all aware that research is of little value unless the findings can be put into use. Those of us working in the experiment stations cooperated to find how to produce good corn yields. The various agricultural agencies have given us their full support in carrying the results of our work out to the farmers. The county agents, vocational agricultural teachers and many others have done an excellent job in teaching better corn production. The five-point program generally followed in our state is namely:

12 5 steps

1. Use an adapted hybrid or variety
2. Adapt fertilizer to your soil
3. Provide adequate stands
4. Control weeds early
5. Apply adequate sidedressing

The 100-bushel corn clubs which were organized in several states have greatly aided the program by popularizing the corn production demonstrations. A summary of corn progress made in seven southeastern states is given in Table 3. Notice the steady increase in per acre yield which has occurred during the past five years. At the end of 1948 there were 8,168 members of 100-bushel corn clubs. A total of 56,532 corn production demonstrations had been grown by farmers with an average of 70 bushels per acre.

The "Kentucky Corn Derby" is another program planned to arouse general interest in high corn production. The results of the 1946 demonstrations are summarized in the University of Kentucky Circular 433. Cost of production per bushel (not including charge for use of land or cost of cover crops) was 39.5 cents for 65 farm demonstrations which averaged 85 bushels per acre as compared with 48 cents for 44 farms which averaged 47 bushels per acre. Bushels of corn produced per hour of man labor was 5.1 compared with 2.3 bushels for the two groups of farms, respectively.

Demonstrations Converted into Farm Practices

After a farmer has demonstrated to himself the benefits of a well rounded corn production program, the next step is to make such methods a part of his farm plan. Many farmers are doing just that and are aiding in the steadily rising state and regional yields per acre as shown in Table 3.

In every state a reduction in acreage planted to corn has taken place during the past five to ten years. This is in contrast to most Corn Belt states where acreage has reamined the same or increased. Agricultural leaders feel this trend in acreage planted to corn is a very good indication of an improved farming system since most of the acreage reduction has come in submarginal crop land which is now being put into some form of soil improvement such as pastures or forest. This reduction in acreage alone accounts for some of the per acre average increase, but by no means can it account for increased state or regional total production. True,

the better crop land is being put in corn, but the use of better seed, better fertilization methods, and better cultural practices must account for the greater corn crops now being grown.

16 corn field

Many examples could be pointed out as to where farmers are carrying out the five steps to better corn production on their whole corn acreage. Farm per acre averages of 90 to 100 bushels per acre are now being made, and the farmers are sold on the value of such corn production. The increase in corn yields is making it easier for the farmers to practice better farming methods with other crops. Small grain and soybeans are showing equally as much promise in demonstrations as did corn. Pasture improvement has increased very rapidly in recent years. I should not have given you a clear picture of corn production if I did not mention how the success already gained with corn is helping to improve the whole farm balance. The South needs more livestock for its own use, i.e. to improve the nutritional standards of its people. We believe that this coordinated agricultural program is doing just that, improving the living standards of our people.

17 small grain

Breeding Corn for Southern Conditions

I have already pointed out that corn strains which are excellent in the north central states are very poorly adapted under most southern conditions. In the middle and deep South from 70 to 90 percent of the hybrid seed planted in 1949 was of southern breeding. These percentages include all hybrids released by southern state experiment stations, the U. S. Department of Agriculture, and a few by commercial companies who have breeding work in the region. Some limited uses of early maturing corns can be filled by Corn Belt hybrids, but I repeat that there is danger of such hybrids causing more harm than good unless they are restricted very closely to those limited uses.

The brief survey which I made with other Southern corn breeders showed a very close agreement of opinions with respect to the general methods and problems involved. The methods of breeding corn are in general the same as those used in the Corn Belt. Likewise, the problems include most of those important in the north central states, with the exception of frost damage, but in addition several extra problems are added. The long growing season increases the hazards in any crop production and greatly increases the insect populations and disease growth. The relatively heavy rainfall in the region with the accompanying high relative humidity adds to the difficulties of insect and disease control.

Such factors as yield and lodging resistance are of importance everywhere. The methods of growing the crop may change the requirements for even these characters. Corn planted in eastern North Carolina in April normally ripens in late August yet most of it will remain in the field until November or until cotton, tobacco, and peanuts are harvested or sold. Under such conditions a hybrid which is rated strong as a living plant may lodge badly as a dead plant. In other words, for a plant to remain erect it must not only have a strong root and stalk while growing but must resist rot organisms after the plant has matured.

The prolific tendency is found in most southern corn varieties. Natural or man made selection would favor the multiple eared plants in a region of heavy insect and weather damage to grain. The small to medium sized ears of the prolific strains are generally covered better by husks than are large ears, which in turn means less insect and weather damage. There is some difference of opinion as to whether prolific or single-eared types will be most popular in the future. It has been easier to date to breed a high yielding prolific hybrid for southern conditions. This does not necessarily mean that single-eared types may not be bred in the future which will partially or wholly replace the prolifics.

Insect Problems Serious

To the corn breeder insect problems are the most difficult. Insects are generally not too specific in their host relationships ~~which~~ and this makes breeding for resistance discouraging. It is more difficult to artificially culture most insect pests than disease organisms, which often makes the breeder dependent upon natural infestations which are at best unpredicatable.

Which insect species are the most serious is difficult to say. The occurrence of these pests varies from one location to another and from season to season. If any generalization can be made, the stored grain insects, acting as both field and storage pests, would rate first in the lower and much of the middle South. Two other general groups of insect pests are often serious - earworms and stand destroying insects.

21 weevil damage

In the lower South the rice weevil (Sitophilus oryza) is most prevalent, while in areas with more severe winters the Angoumois grainmoth (Sitatroga crealella) is very abundant. Freeman has summarized three years data showing the relationship between earworm infested ears and weevil infestation given in Table 4. While 92 percent of the ears examined showed earworms had been present, the percentage of weevil free ears was 46.3 percent in this class as compared with 91.3 percent among the eight percent ears free of earworms. In Table 5 is shown the relationship between husk extension and earworm and weevil infested ears. Freeman's data show the advantage of long husks in reducing weevil and earworm damage. North Carolina data indicate these same general relationships with somewhat less emphasis on husk extension for weevil control. Long, tight husks help protect the grain from earworm and weevil attack and in many cases good husks are of equal importance in weather protection during wet fall seasons. We now know that good husks alone are not enough to make corn strains resistant to weevil under heavy infestation. What the other factors are in resistance have not yet been determined.

22 table 4

23 table 5

24 long husks

The insects which cause seedling damage are serious in low wet land and following sod crops. Southern corn rootworm, bud worm, sugar cane beetle, bill bug and the lesser and greater corn stalk borer all are important. This group of insects are so seasonal and local in their occurrence that it is very difficult to breed for specific resistance. In general those corn strains which germinate quickly and grow rapidly in the seedling stage tend to escape serious damage.

So far, the South has been relatively free of the European corn borer. The upper South has had fairly heavy infestations. We have one area in the northeastern part of North Carolina which has had this pest for the past 12 years. We are watching it closely, but have some reason to hope that it may not establish itself in the South due to the mild winters.

Corn Diseases Grow in Importance

All of the major corn disease organisms are found in the region. Their relative importance has greatly increased in recent years as a result of better cultural and fertilizer practices. The very fact that more corn plants are grown on an acre favors the spread of disease organisms on susceptible strains. The increased use of nitrogen which makes the plants more succulent also tends to increase the susceptibility to some diseases.

The various state workers are about equally divided as to the relative importance of leaf spot organisms and stalk and ear rot organisms. In areas where brown spot (Physoderma zeae maydis) occurs regularly, very serious damage is caused by the stalk seedling effect which greatly reduces the yield and increases the stalk breakage. We know that some inbred lines are highly susceptible, while others carry some resistance. Hybrids in test this past season showed from 13 to 55 percent of the plants infected (Table 6). In the same test stalk breakage varied from 3 to 41 percent. There was a definite relationship between the amount of brown spot present

in a strain and the amount of stalk breakage. The correlation value r = .4135 indicates this relationship, although some hybrids do not stalk break even with high occurrence of brown spot. In another location where brown spot was less severe and lodging was greater there was no relationship shown.

Leaf spot organisms are widespread and cause heavy losses under conditions of heavy fertilization, large plant populations, and high humidity. We have found by the use of artificial inoculation with Helminthosporium maydis that inbreds do not differ much in their susceptibility to heavy doseages. Figure 5 shows NC18 resistant and NC52 susceptible to secondary spread or natural infection of the organism. Hybrid strains differ as do the inbreds, but in general the extra vigor tends to make all hybrids more resistant than the susceptible inbreds. H. turcicum is widespread but in general has not been as important as H. maydis. Jenkins and Robert[1] have shown wide differences in reaction of inbreds to this organism. Further, they have been able to transfer resistance from the high resistant lines into susceptible lines. This work on transfer of resistances indicates a rather complex genetic mechanism is influencing resistance.

The ear rots are universally present but in varying amounts. Diplodia zea is estimated to destroy oneto three percent of the crop in Mississippi annually. While present in small quantities most years selection has been fairly successful in keeping Diplodia at a low level in North Carolina. Gibberella or fusarium is often more abundant and may affect a higher percentage of plants and ears than Diplodia. While we have not been inoculating for either of these stalk and ear rot organisms, we do know that they are important and select heavily against susceptibility to the natural infection.

Other diseases such as smut, Pythium, H. carbonum, Stewart, etc. occur and must be taken into account in the selection of breeding stock.

1. Robert, A. L. and M. T. Jenkins. 1948 Helminthosporium Turcicum leaf blight ratings on corn at Plant Industry Station, Beltsville, Md. 1944. Mimeographed.

Summary

During this talk I have tried to give you a picture of the change in corn production in the South. This large region is not likely to become a competitor as the "corn belt" of the nation, at least not in the near future. Throughout the region agricultural programs are designed to aid the area in becoming more diversified. The fact that southern farmers have of their own accord reduced their corn acreage nearly 25 percent in the past ten years is good evidence of a balancing of the agriculture rather than a specialization. ~~Even with all of the gains made in corn production in recent years, these 13 states have a total corn production of slightly less than Iowa's 1946 crop.~~

The corn production activities of southern states can increase the living standards among rural people and thereby bring them more in line with such standards in other sections of the nation. Producing more corn on fewer acres means our farmers can better manage their soils for conservation, raise more pasture and forage which will increase livestock in the area.

Insert

Forty pounds of nitrogen per acre or 945,000,000 lbs. of nitrogen would be required to raise the corn yield from 20 bus. to 40 bus. per acre in the southern states. A total of only 822,950,000 pounds of nitrogen was used on all Southern crops combined in 1946. If all the available fertilizer should be used on corn in these 13 states the region would only produce approximately 83% as much corn as Iowa and Illinois combined did in 1946.