

Changes in the Relationship Between Top and Average Yields of Selected Commodities in New York

By

K. L. Robinson

J. E. Hope

Department of Agricultural Economics
Cornell University Agricultural Experiment Station
New York State College of Agriculture
A Contract College of the State University
Cornell University, Ithaca, New York

TABLE OF CONTENTS

Introduction	1
Sources of Data	3
Trends in the Relationship Between Top and Average Yields	6
Milk	6
Eggs	9
Wheat	11
Oats	15
Corn	18
Summary and Conclusions	21

CHANGES IN THE RELATIONSHIP BETWEEN
TOP AND AVERAGE YIELDS OF
SELECTED COMMODITIES IN NEW YORK

K. L. Robinson
J. E. Hope

Introduction

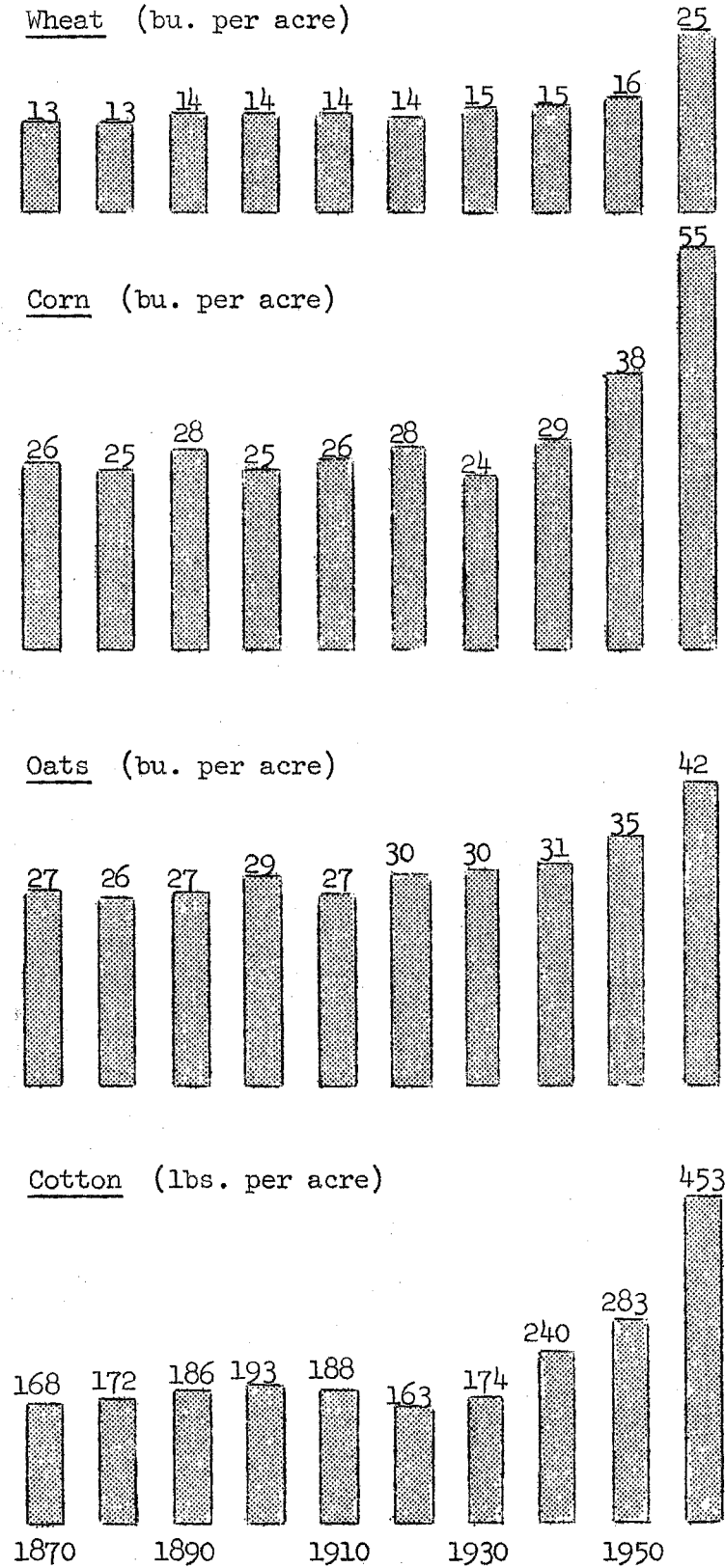
For a number of farm commodities, yields have increased more during the past decade than in the preceding 100 years! Average yields of major crops, both in the United States and in New York, generally rose relatively little between the Civil War and the beginning of World War II. During this period, average yields of wheat in the United States, for example, increased only about two bushels per acre and corn about three bushels (Figure 1). Yields began rising more rapidly in the late 1930's and early 1940's. During the past decade, especially since the mid 1950's, the rate of increase has been even greater.

The exceptionally high rates of increase in yields which have prevailed in recent years are largely responsible for the persistence of the farm surplus problem. If the rate of increase in yields continues in the future as in the recent past, still further reductions in the area of land in farms will be required and unfavorable agricultural price relationships can be expected to persist in the absence of substantial government intervention. On the other hand, if the rate of increase in yields slows down or reverts to the rate which prevailed prior to 1940, the surplus problem will gradually disappear, adjustment problems in agriculture will be less severe, and demands for government programs, particularly those designed to control production, will be reduced. Thus, the future course of farm policy as well as the general level of farm commodity prices will be strongly influenced by future trends in yields.

Because of the critical importance of future yields, a study was initiated to determine the rate at which state average yields of several important commodities (including milk, eggs, corn, wheat and oats) might be expected to increase in New York during the next few years. Are yields likely to continue to rise at the high rates of the recent past or is the average rate of gain likely to slow down or level out?

One way of attempting to answer this question is to examine the trend of top yields, that is the yields obtained by outstanding farmers in the past. A study of top yields should indicate whether or not a practical ceiling exists, and if so, whether or not present average yields are close enough to be influenced by such a ceiling. If yields obtained by outstanding farmers appear to be leveling out, this would suggest that the rate of increase in state average yields ultimately would decline. In addition, a study of top yields in relation to average yields should help to

Figure 1. AVERAGE YIELDS OF MAJOR CROPS, UNITED STATES,
FOUR YEAR AVERAGES AT TEN YEAR INTERVALS,
1868-71 to 1958-61



determine whether the backlog of unused technology in agricultural production is being maintained. A decreasing gap between average and top yields, for example, would suggest that farmers are drawing on existing technology at a faster rate than new yield-increasing techniques are being developed. Finally, top yield data may be used directly in making forecasts of future average yields provided there is a consistent time lag or ratio between the two series. For these reasons, data reflecting top yields as well as state average yields were reviewed to ascertain whether or not the trends of such yields differ significantly and to note any changes that may have occurred in the relationship between top and average yields over the past three decades.

The report which follows is divided into three parts. Sources of data used in the study are outlined in the first part. In the second, historical trends of selected measures of top and average yields and changes in the relationship between such series are described. The final section deals with future yield prospects, based on the analysis of trends reviewed in the preceding section.

Sources of Data

State average yield data for each commodity are readily available. These figures are computed annually by dividing estimates of total production by estimates of the number of acres planted or harvested in the case of crops or the number of animals in the case of livestock products. Revised state average yield data for the period 1931-1961 were used in this study.

Top yield information is much more difficult to obtain. Ideally, one would like to have a complete array (or at least a frequency distribution) of actual yields obtained by all farmers each year covering a period of three decades or more. Unfortunately, this type of information is obtainable only for selected commodities and non-random samples of farms. Only two sources of data that would make it possible to construct a continuous array of yields obtained by farmers in New York, covering a twenty to thirty year period, could be found. These included the Farm Cost Account records obtained by the Department of Agricultural Economics of the New York State College of Agriculture and the milk production records assembled by the Dairy Herd Improvement Association.

Farm Cost Account Records

Complete data relating to yields as well as financial transactions have been obtained from a changing sample of farmers in New York for more than forty years. Since the disposition of all commodities is checked carefully, yield information obtained from these records probably is more accurate than that obtained from farm surveys. Cost Account farmers are representative of better than average full-time commercial farms in New York.

The sample of farms included within the Cost Account group does not remain constant over time. For a variety of reasons, approximately ten per cent of the farms are replaced each year; however, the turnover of farms does not seriously affect the top yield series. A significant change would occur only in cases where a very high yielding farm was dropped or added. In most cases differences in yields among the top group of farms were not so great that dropping or adding a farm from this group would substantially alter the trend.

For each of the commodities studied, Cost Account yields were arrayed for each year beginning with 1931 and ending with 1960. The single highest yield, an average of the three highest yields, or in some cases, an average of the second and third highest yields in the array was used to construct the top yield series. A constant number of farms was used for each series. Thus, the Cost Account top yield series is based on the highest single farm or group of farms regardless of where or how these yields were obtained and not the yields obtained over a period of years on a single farm.

Dairy Herd Improvement Association Records

Figures on herd averages obtained by farmers participating in the Dairy Herd Improvement Association program are available in some counties for more than thirty years. Since 1951, an annual report has been prepared each year listing herd averages of all members by counties. From these figures, a series representing top yields was constructed for each of three counties and for the state.^{1/}

Poultry Husbandry Trial Data

Data obtained from the Department of Poultry Husbandry were used as an additional source of information on top egg yields. This information is based on so-called "Random Sample" tests which have been conducted each year since 1951 to determine differences in genetic potential of chickens obtained from hatcheries that supply replacements to New York poultrymen. In these tests, production records have been obtained annually on 22 or more flocks of pullets. The flocks are penned and fed an all-mash ration without additional grain supplements. General flock management and feeding practices closely approximate those of commercial farm operators.

^{1/} Top yield series were constructed for Cortland, Dutchess and Oneida Counties. These counties were selected on the basis of completeness of records and their importance in milk production. Individual county yield information pertaining to these counties is not reported in this study. For more detailed information concerning trends of top yields in these counties, see J. E. Hope, Changes in Yields of Major Farm Commodities in New York State, Unpublished M.S. Thesis, Cornell University, 1963.

Average annual yield data from all the flocks were used in constructing the top yield series from this source. The data were not reported in such a way as to permit forming an array. Thus, the series should be considered as representative, not of the highest yields attainable, but average yields which might be obtained by an outstanding group of producers.

Plant Breeding Trial Data

To supplement the top yield series obtained from Farm Cost Account records for corn, oats and wheat, an additional series for each of these commodities was constructed using information made available by the Department of Plant Breeding. The corn and oat yield series are based on field trials which have been conducted on commercial farms throughout the state for a number of years. Information on wheat yields was obtained from non-farm trials conducted at experimental nurseries maintained by the New York State Agricultural Experiment Station; however, the trial plots are managed in such a way as to duplicate, as nearly as possible, commercial growing conditions. The yield trials for corn and oats are described as "Regional Tests" while those for wheat are described as "Advanced Tests."

Each year four or five farmers in different parts of New York State permit personnel associated with the Plant Breeding Department to use sections of their farm to test from twenty-five to thirty varieties of hybrid corn. The majority of these are commercial hybrids. Six replicate plots are placed on each farm. Planting is done by personnel of the Department at the same time that the remainder of the field is planted. Fertilization, weed control and other cultivation techniques are carried out by the farm operator in identical fashion with techniques applied to the remainder of the field. The grain from the replicated plots is harvested by hand and the yield recorded.

The figure chosen to represent top corn yields, based on this information, was the median yield obtained each year. The highest yield figure was not used since this frequently was recorded for a variety not then widely used by commercial farmers. Each median yield was obtained with a variety in common use at the time, but the median-yield variety changed over time as new hybrids were developed and old ones were dropped.

Hybrid corn yield data based on the regional trials are available for each year beginning with 1944; however, data for the first two years were omitted because of the small number of varieties tested.

Data from regional oat trials are available for a longer period of time. In constructing the top oat yield series based on Plant Breeding data, the average yield obtained for the variety most commonly used by outstanding farmers during each year was selected. For the period 1931-41, the variety selected was "Cornellian"; from 1942-45, it was "Vicland"; from 1946-52, it was "Mohawk"; and from 1953-61, it was "Garry."

Conditions under which wheat trials are conducted are similar to those for corn and oats except that all the plots are on land belonging to the Experiment Station and located in the vicinity of Ithaca, New York. As in the case of oats, the yield used in constructing the top yield series for wheat was based on the average obtained for all plots planted to the variety then most commonly used by farmers. "Forward" was the predominant variety from 1931 to 1936, "Yorkwin" from 1937 to 1945, "CU 595" from 1946 to 1949 and "Genesee" from 1950 to 1961. The decision to change varieties in a particular year was somewhat arbitrary; however, the yields of the old and new varieties selected to represent the trend of top yields on commercial farms were generally so close at the time the change was made that dropping one variety and replacing it with another had little effect on the trend.

Trends in the Relationship Between Top and Average Yields

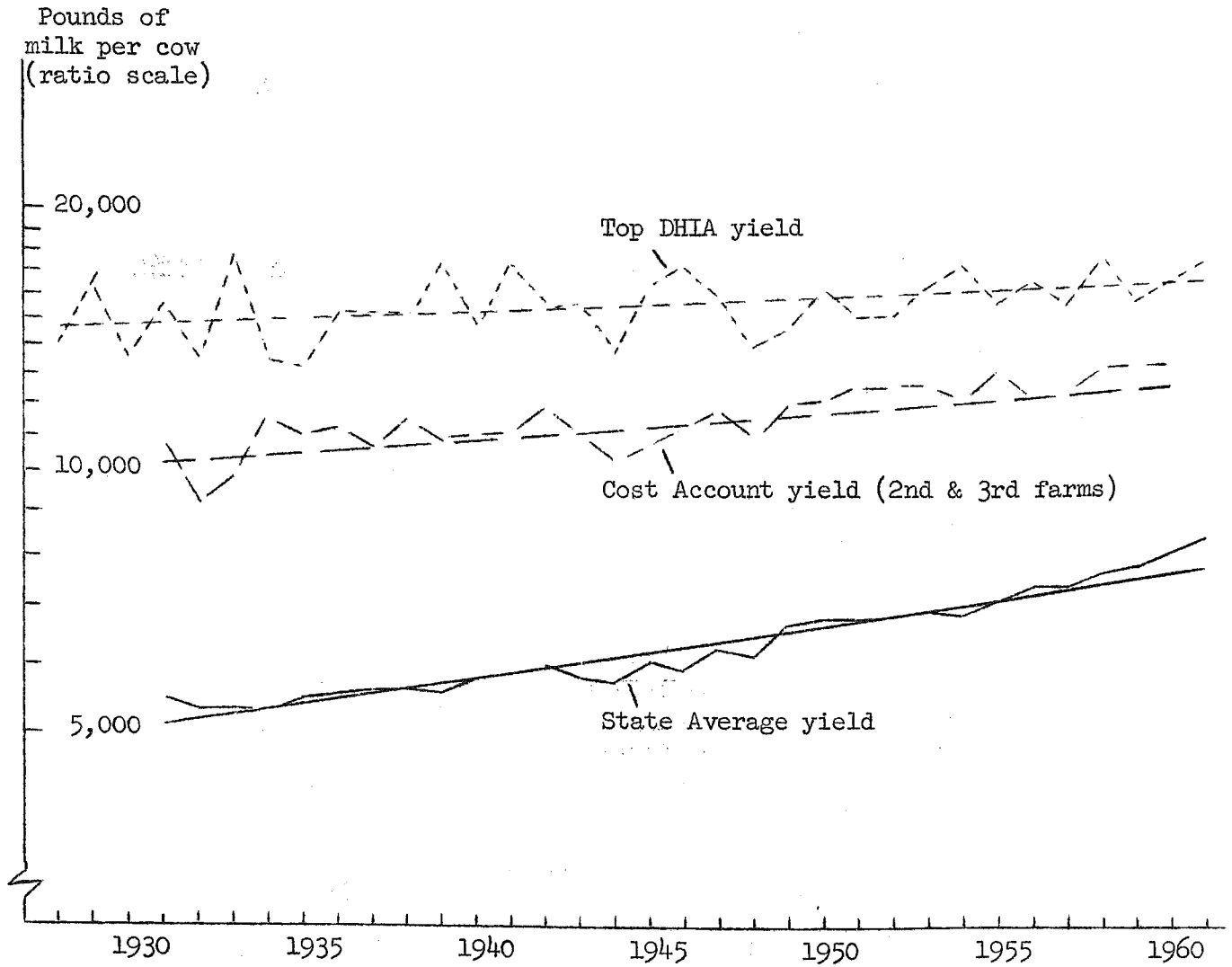
Linear trend lines were fitted to each of the selected top and state average yield series described in the preceding section. Average annual rates of increase in yields were calculated for each series based on both the long-run trend (in most cases the thirty year period beginning about 1930 and ending about 1960), and the more recent trend which has prevailed since the end of World War II (beginning in the late 1940's and ending in 1960 or 1961). In addition, the state average yield was calculated as a percentage of each top yield series included in the study for each of three four-year periods: 1937-40, 1947-50 and 1957-60. The results of this analysis are presented on a commodity basis, beginning with milk and continuing with eggs, wheat, oats and corn in that order.

Milk

Several of the milk yield series were originally plotted using arithmetic scales, but the trends when plotted in this manner were found to be curvilinear rather than linear. For this reason, the data were replotted using logarithmic or ratio scales (Figure 2). Thus, the milk yield trend values were obtained using the logarithmic form of a linear equation; this yields annual increments that are constant in percentage terms. Constant percentage increments result in larger absolute increases in yields each succeeding year since the yield base from which the constant percentage change is computed increases through time.

The long-run trend line fitted to each of the top milk production series proved to be less steeply inclined than that fitted to state average yields. For all series, however, the postwar average rate of increase exceeded the long-run rate. For example, the average rate of increase covering the thirty year period, 1930-1961 for the top DHIA series was about .40 per cent per year, while the rate of increase for the postwar years was .62 per cent (Table 1). The corresponding rates for the highest

Figure 2.

MILK PRODUCTION PER COW--TREND IN
NEW YORK STATE AVERAGE AND TOP YIELDS

Cost Account series were .59 for the entire thirty year period, and 1.16 for the postwar period. The state average yield increased at an annual rate of 1.41 per cent for the longer period and 2.05 per cent for the postwar years.

Table 1. AVERAGE ANNUAL RATES OF INCREASE IN SELECTED SERIES
OF TOP MILK YIELDS PER COW AND STATE AVERAGE YIELDS
New York, 1930 or 1931 to 1960 or 1961

Source of data	Average annual increase in milk yields based on:	
	Long-run ^a trend	Postwar ^b trend
(per cent)		
Top yield series:		
Dairy Herd Improvement Association (highest herd)	.40	.62
Cost Account (highest herd)	.59	1.16
Cost Account (2nd and 3rd highest herds)	.73	1.08
State average	1.41	2.05

a/ Based on linear trend lines fitted to logarithms of annual yield data beginning about 1930 and ending in 1960 or 1961.

b/ Based on linear trend lines fitted to logarithms of annual yield data beginning about 1946 and ending in 1960 or 1961.

The gap between top and average milk yields appears to have narrowed slightly during the past thirty years. In the late 1930's, for example, state average yields were only 36 to 51 per cent of the figures chosen to represent top yields; by the late 1940's the ratio of average to top yields had increased to between 42 and 55 per cent; and by the late 1950's the ratio had risen to between 47 and 59 per cent (Table 2). Despite the somewhat more rapid rate of increase in average yields than in top yields, a very substantial margin between top and average yields remains. Herd averages on good dairy farms are still nearly double the state average milk yield.

Table 2. STATE AVERAGE MILK YIELDS PER COW AS A PER CENT
OF SELECTED MEASURES OF TOP YIELDS
New York, 1937-40, 1947-50 and 1957-60

Top yield series	State average yields as a per cent of top yields:		
	1937-40	1947-50	1957-60
Dairy Herd Improvement Association (highest)	36	42	47
Cost Account (highest)	48	54	56
Cost Account (2nd and 3rd highest)	51	55	59

Eggs

The analysis of egg yields is based on only one long-term series of top yields, i.e. those obtained from Farm Cost Accounts. The Cost Account series proved to be quite unstable particularly during the late 1940's and early 1950's (Figure 3). For this reason, caution must be exercised in drawing inferences from computed trends based on this series. Additional information concerning recent trends in top yields was obtained from the Random Sample Test series described earlier.

Linear trend lines were fitted to the two top egg yield series and to the state average series. From these fitted trend lines, the average annual increase in egg yields per hen was computed for each series. The long-term computed rates of increase are based on data covering the period from 1931 through 1960 or 1961, while the more recent values are based on data covering the decade of the 1950's.

The long-run annual rate of increase in state average egg yields slightly exceeded the increase in top yields based on the highest three Cost Account farms; however, the recent trend values for both of the top egg yield series were higher than for the state average series (Table 3). In all cases the average annual rate of increase exceeded two eggs per hen.

Figure 3.

EGG PRODUCTION PER HEN--NEW YORK STATE:
STATE AVERAGE (1931-1961),
TOP 3 COST ACCOUNT FARMS (1931-1960),
AND RANDOM SAMPLE TEST AVERAGE (1952-1962)

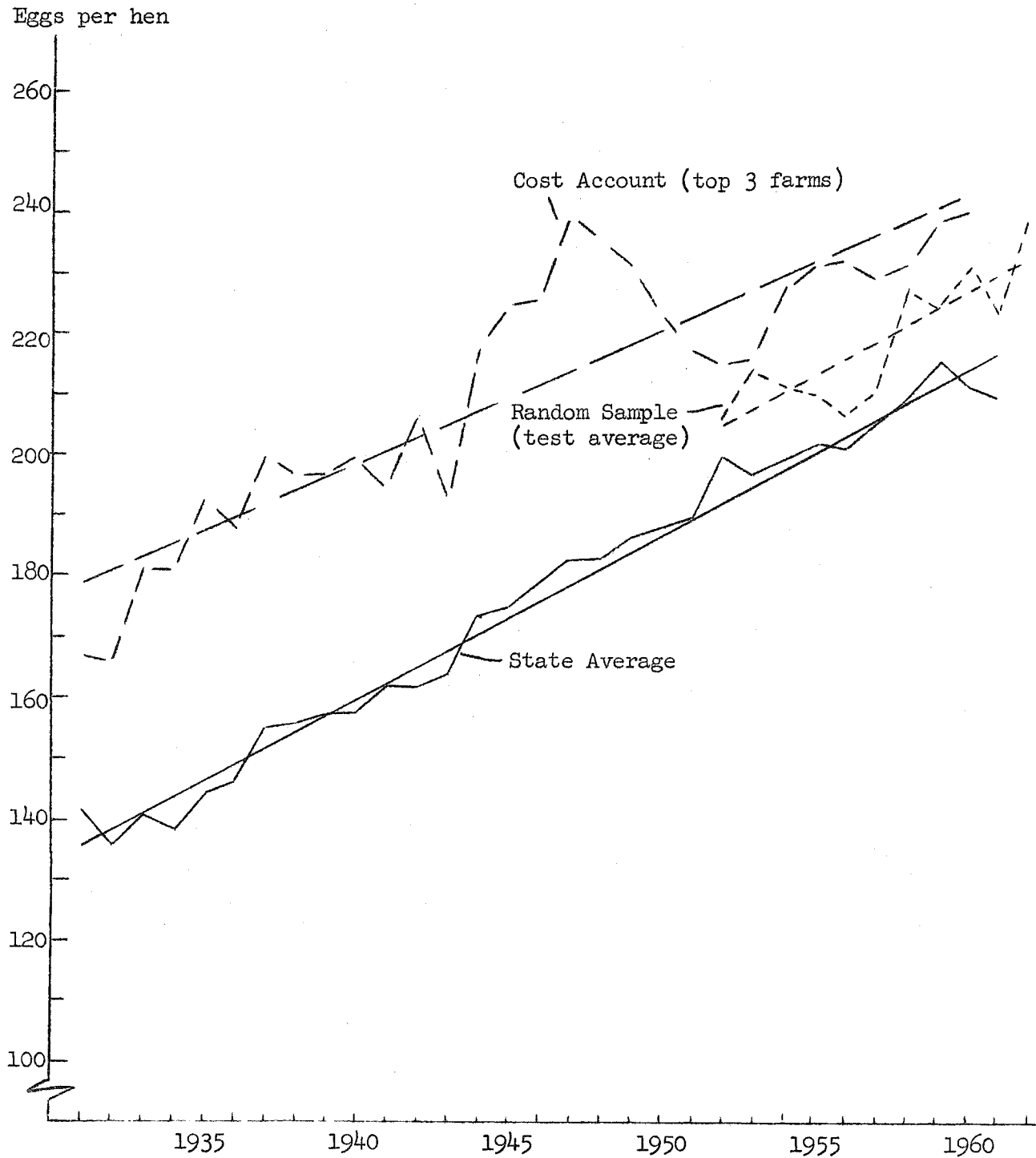


Table 3. AVERAGE ANNUAL RATES OF INCREASE IN SELECTED MEASURES
OF TOP EGG YIELDS AND STATE AVERAGE YIELDS
New York, 1931 to 1960 or 1961

Source of data	Average annual increase in rate of lay per hen based on:	
	Long-run ^a / trend	Postwar ^b / trend
(eggs per hen)		
Top series:		
Cost Account (highest 3 farms)	2.19	2.35
Random Sample Tests (mean)	n.a.	2.77
State average	2.71	2.11

a/ Based on linear trend lines fitted to annual yield data for the period 1931 to 1960 for the Cost Account series and 1931 to 1961 for the state average yield series.

b/ Based on linear trend lines fitted to postwar years as follows: Cost Account series, 1950-60; Random Sample Test series, 1952-62; and state average series, 1950-61.

While recent trends for both the top and average series appear to be approximately parallel, with no increase in the average relative to the top, there is now only a relatively small gap between top and state average egg yields. The contrast between the egg and milk series is striking in this respect. Average egg yields during recent years have ranged between 90 and 95 per cent of the two top series, whereas average milk yields during the same period have been only about 50 to 60 per cent of top yields. Over the thirty year period for which data were obtained, there has been a gradual rise in the average series relative to the top series, but the gap between the two egg series has never been as wide as with milk yields. In the late 1930's, average egg yields were about 80 per cent of the top Cost Account series; more recently they have been about 90 per cent.

Wheat

The analysis of wheat yields is based on two series of top yields: the Cost Account series which was constructed using the average of the three highest yields obtained by Cost Account farmers each year; and the Plant Breeding Trial series which was constructed from the average yield of all plots planted to the variety then commonly used by farmers in New York. The Plant Breeding series fluctuated much more than either the

Cost Account or the state average series, perhaps due in part to the small sample of yields obtained each year. Average yields of the Cost Account series dipped substantially below the long-run trend line in the late 1940's.

The long-run trends of both top yield series were slightly less steeply inclined than the state average (Figure 4). With wheat as with milk, however, there is still a substantial gap between top and state average yields. Furthermore, the difference between the top and average yield series appears to have been reduced very little over the past 30 years. The gap between top Cost Account and state average yields declined from about 18 bushels per acre in the early 1930's to about 15 bushels in the late 1950's.

Average annual rates of increase in wheat yields, based on the linear trend lines fitted to each of the series, are slightly higher for the postwar years than for the entire thirty year period (Table 4). Both the top yield series had slightly lower long-run rates of increase than the state average series; however, the postwar rate of increase in the Plant Breeding series exceeded that of the state average series. The postwar trend of the Cost Account series is strongly influenced by the beginning year. The annual rate of increase in the Cost Account series for the period beginning in 1946 was .66 bushels, but the rate fell to .42 bushels when the two low-yielding years of 1947 and 1948 were excluded and the trend values were calculated using only the years 1949-60. This illustrates the critical importance of yields obtained at the beginning and the end of the period selected in fitting the trend line, particularly if only a few years are included.

Figure 4.

WHEAT YIELDS--TREND IN
NEW YORK STATE AVERAGE AND TOP YIELDS

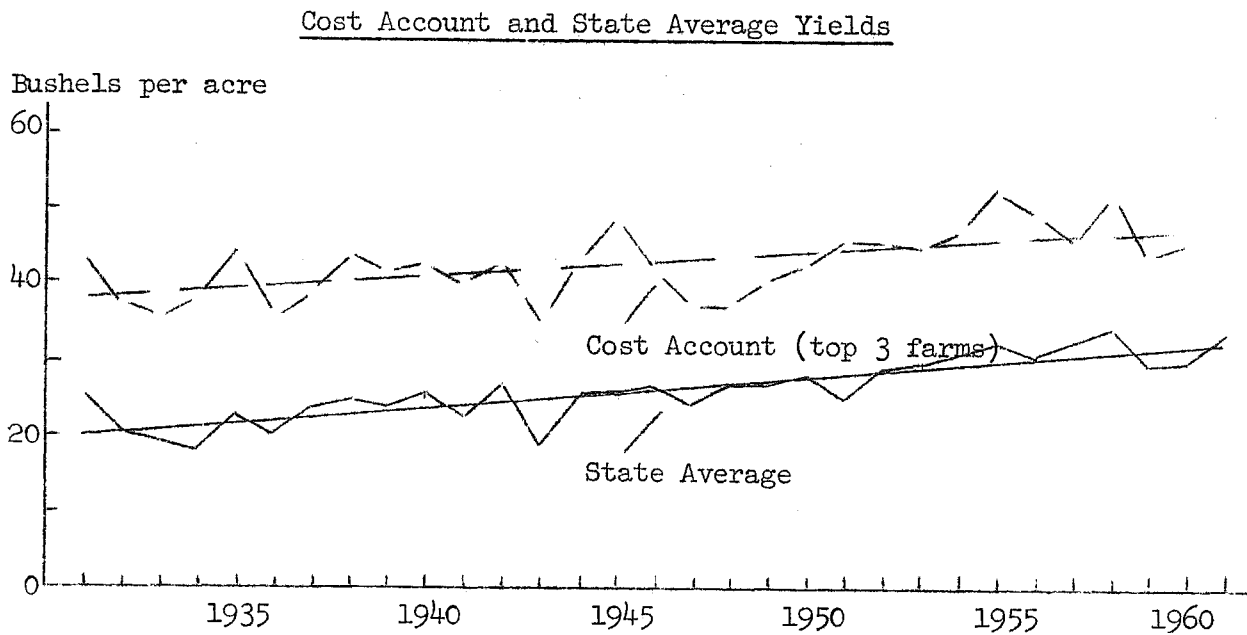
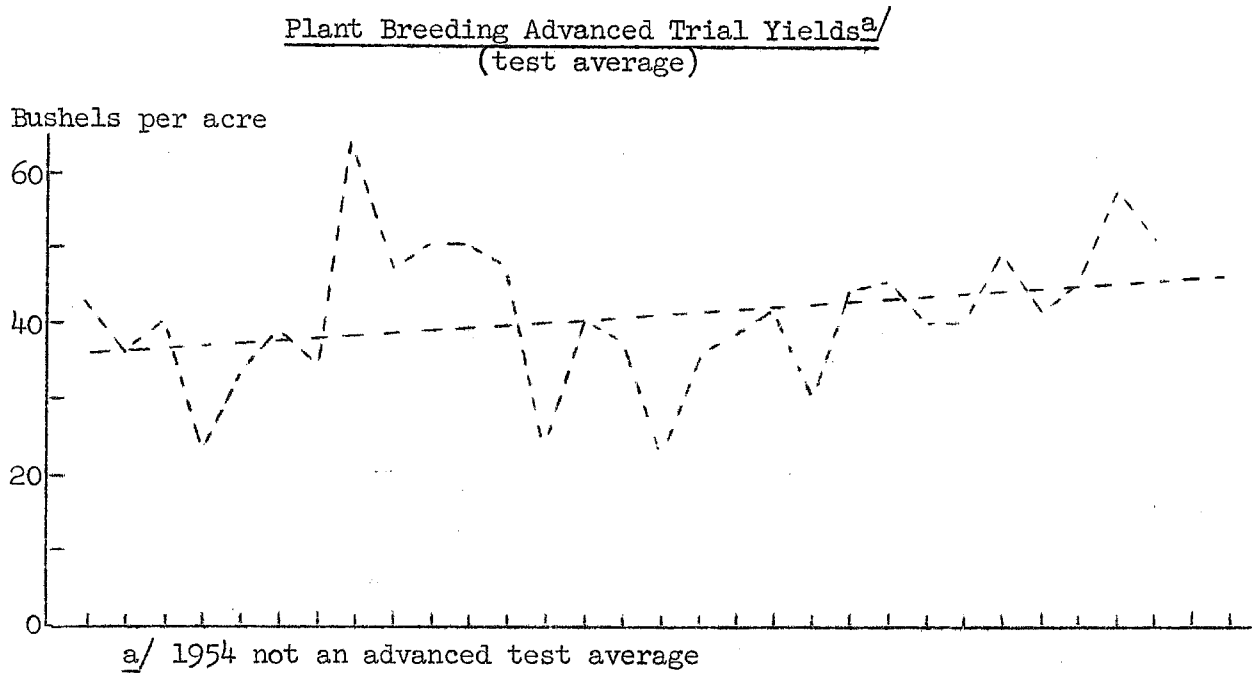


Table 4. AVERAGE ANNUAL RATES OF INCREASE IN SELECTED MEASURES
OF TOP WHEAT YIELDS AND STATE AVERAGE YIELDS
New York, 1931 to 1960 or 1961

Source of data	Average annual increase in wheat yields based on:	
	<u>Long-run^a</u> trend	<u>Postwar^b</u> trend
(bu. per acre)		
Top yield series:		
Cost Account (average of three highest)	.31	.42
Plant Breeding Trials (average of plots seeded to commonly used variety)	.32	1.18
State average	.41	.52

- a/ Based on linear trend lines fitted to each of the series beginning in 1931 and ending in 1960 or 1961.
- b/ Based on linear trend lines fitted to each of the series beginning in the late 1940's and ending in 1960 or 1961. The beginning year for the state average series was 1946, for the Plant Breeding series, 1948 and for the Cost Account series, 1949.

State average wheat yields rose relative to top yields between the late 1930's and the late 1940's, but since then the relationship has not changed significantly (Table 5). In 1937-40, state average yields were about 50 per cent of those obtained in the Plant Breeding Trials and 59 per cent of those obtained by the top three Cost Account farmers; in 1957-60, state average wheat yields were about 68 per cent of each of the two selected measures of top yields. Thus, state average wheat yields at present are somewhat higher in relation to top yields than is the case with milk. As the subsequent analysis will show, state average wheat yields also are slightly higher in relation to top yields than is the case with oats and corn.

Table 5. STATE AVERAGE YIELDS AS A PER CENT OF
SELECTED MEASURES OF TOP YIELDS
New York, 1937-40, 1947-50 and 1957-60

Top yield series	State average yields as a per cent of top yields:		
	1937-40	1947-50	1957-60
Cost Account (average of three highest)	59	67	68
Plant Breeding Trials (average of plots seeded to commonly used variety)	50	72	68

Oats

The sources of data used to construct the top oat yield series are the same as those for wheat except that the highest single Cost Account farm yield was used rather than the average of the three highest. The average yield of the three highest Cost Account farms differed very little from the highest single yield; thus trends based on either series would have been quite similar. Year-to-year variations in the two top oat yield series were greater than for wheat. Wide year-to-year variations make it particularly difficult to determine short-run trends in oat yields.

The slopes of the long-run trend lines fitted to both top yield series and to the state average series appear to be similar although the slope of the average series is slightly steeper than for either of the top series (Figure 5). There appears to have been only a very modest narrowing of the gap between top and average oat yields during the past thirty years.

Annual rates of increase in oat yields based on the fitted trend lines covering the thirty year period since 1931 are double those of wheat, thereby indicating a more rapid rate of technological improvement in oat production than in wheat. As with other major commodities, postwar rates of increase in both the top and average oat yield series exceeded the long-run rates of increase (Table 6). The upward trend in oat yields has averaged 1.35 bushels per acre per year during the past 15 years; this exceeds the average gain in each of the top yield series by about 30 per cent. Thus, the gap between state average and top oat yields appears to have narrowed at a more rapid rate in recent years than in the prewar period.

Figure 5.

OAT YIELDS--TREND IN
NEW YORK STATE AVERAGE AND TOP YIELDS

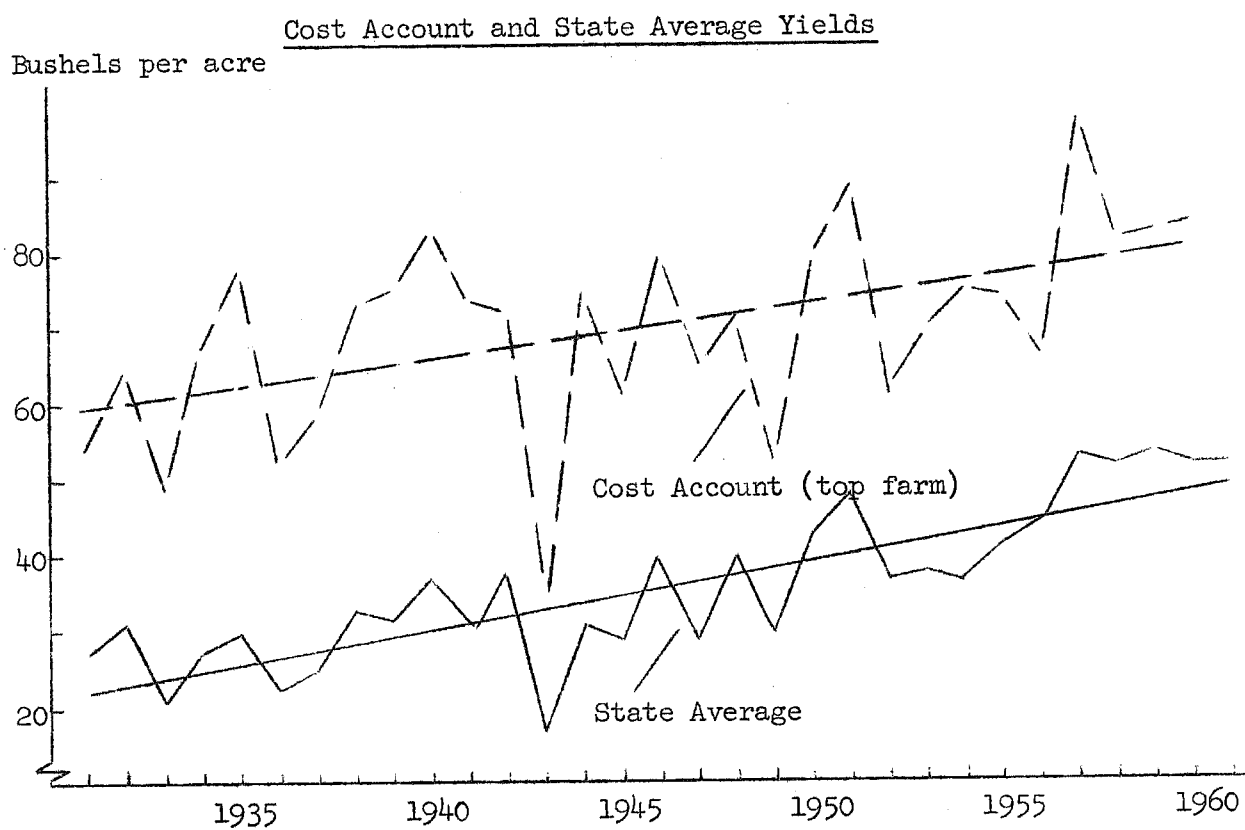
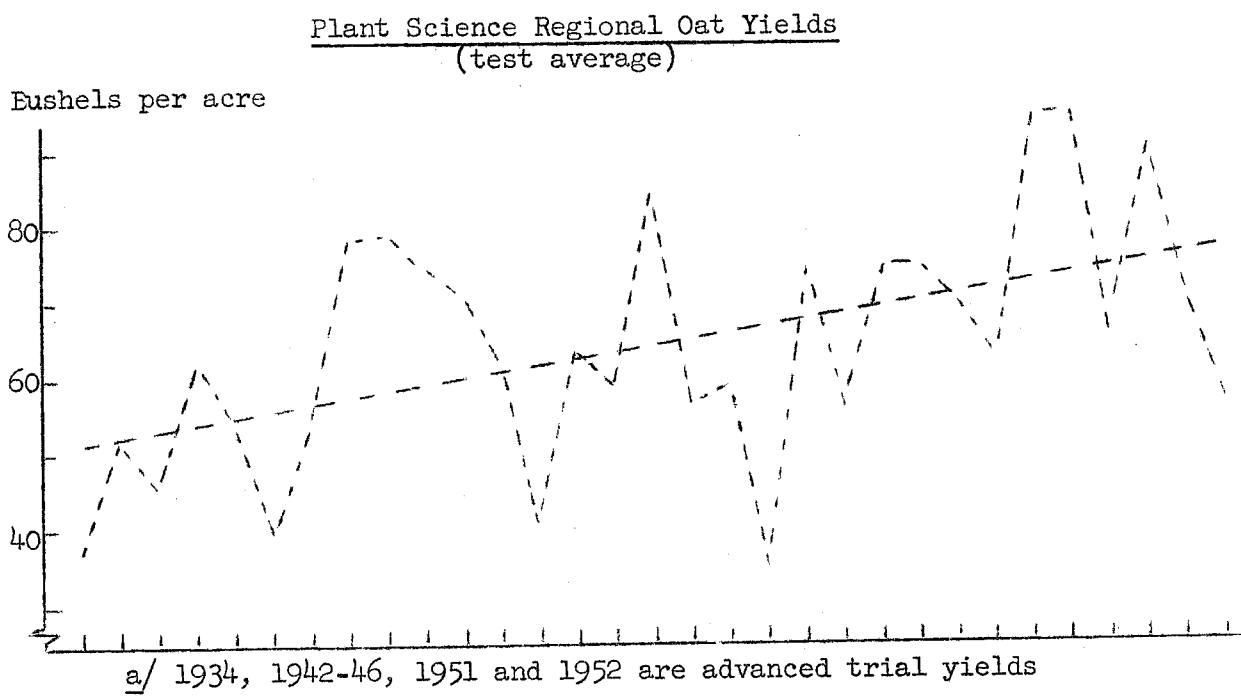


Table 6. AVERAGE ANNUAL RATES OF INCREASE IN SELECTED MEASURES
OF TOP OAT YIELDS AND STATE AVERAGE YIELDS
New York, 1931 to 1960 or 1961

Source of data	Average annual increase in oat yields based on:	
	Long-run ^a / trend	Postwar ^b / trend
(bu. per acre)		
Top yield series:		
Cost Account (highest)	.72	1.05
Plant Breeding Trials (average of plots seeded to commonly used variety)	.87	1.06
State average	.91	1.35

a/ Based on linear trend lines fitted to each of the series beginning in 1931 and ending in 1960 or 1961.

b/ Based on linear trend lines fitted to each of the series beginning in 1945 or 1946 and ending in 1960 or 1961.

The gain in average yields relative to top yields has been greater for oats than for wheat; nevertheless both the absolute and percentage gap between top and average yields remains slightly greater for oats than for wheat. In the late 1930's, state average oat yields were less than half of each of the selected measures of top yields (Table 7). By the late 1950's, the gap had narrowed appreciably. At that time average oat yields were between 60 and 65 per cent of top yields.

Table 7. STATE AVERAGE OAT YIELDS AS A PER CENT OF
SELECTED MEASURES OF TOP YIELDS
New York, 1937-40, 1947-50 and 1957-60

Top yield series	State average yields as a per cent of top yields:		
	1937-40	1947-50	1957-60
Cost Account (highest)	43	52	61
Plant Breeding Trials (average of plots seeded to commonly used variety)	44	62	65

Corn

The top corn yield series are based on the same sources as for wheat and oats. Yields obtained by the three highest Cost Account farms were used in constructing the top Cost Account series. The Plant Breeding series was constructed using the median yield of all plots. Unlike the wheat and oat series obtained from the same source, no attempt was made to trace corn yields using specific varieties. The Plant Breeding corn yield series is available only for postwar years. Both top yield series exhibit wide fluctuations; thus, the selection of beginning and ending years in fitting short-run trend lines is of critical importance (Figure 6).

Postwar rates of increase in both the Cost Account and the state average corn yield series exceeded the corresponding long-run values. For the thirty year period, 1931-60, the average increase was slightly less than one bushel per acre per year (Table 8). The postwar rate of increase in the state average yield was 1.27 bushels per year. This rate of increase exceeded the average annual gain in the Cost Account series for the period 1949-60 but not for the period 1946-60.^{1/} The top yield series constructed from the Plant Breeding trials shows a higher rate of gain for the postwar period than either the state average or the Cost Account series. It would appear from these data that the gap between top and average corn yields is not decreasing significantly, and may even be widening. Graphs showing the Plant Breeding and state average yield series confirm this impression (Figure 6).

^{1/} The higher rate of gain for the period 1946-60 (1.75 bushels per year) than for the shorter period 1949-60 (.96 bushels per year) is attributable to the relatively low yields recorded by top Cost Account farms between 1946 and 1949. The 1949-60 rate of increase of .96 bushels per year appears to be more representative of recent trends in yields obtained by the top Cost Account group than the higher rate of increase achieved in the period between 1946 and 1955.

Figure 6.

CORN YIELDS--TREND IN
NEW YORK STATE AVERAGE AND TOP YIELDS

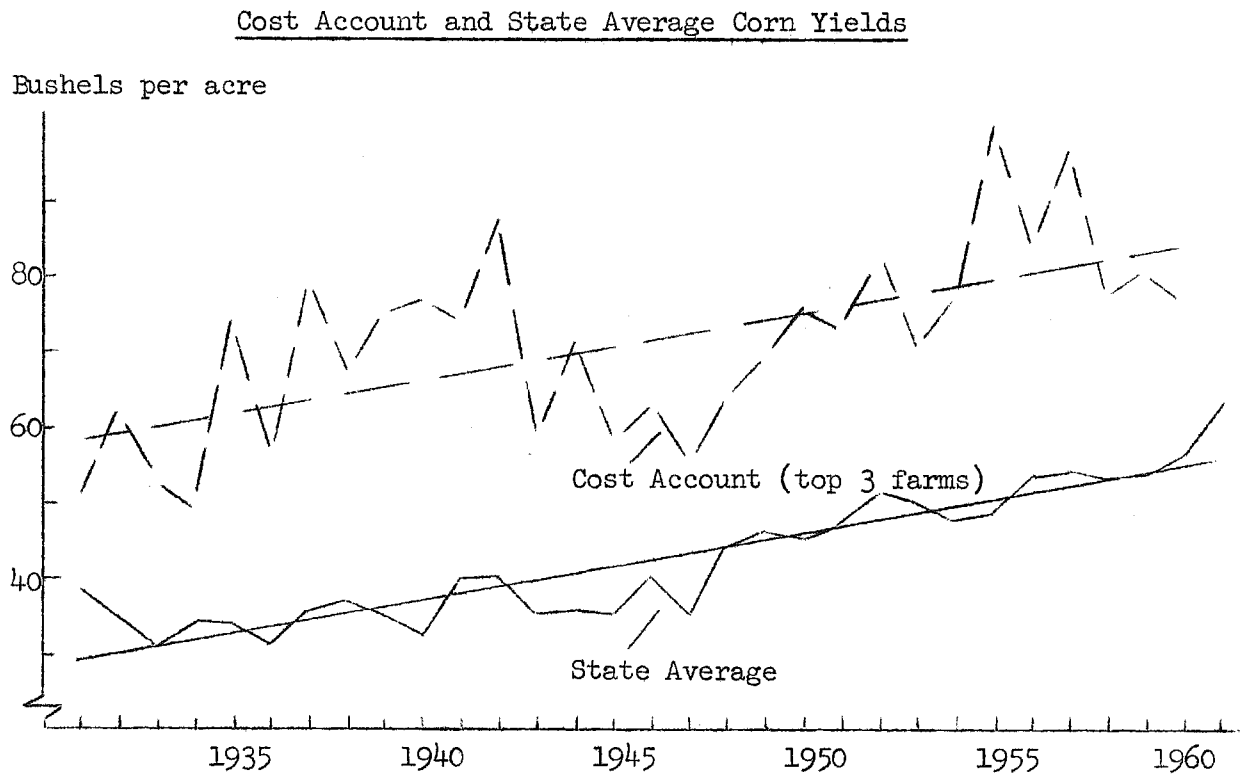
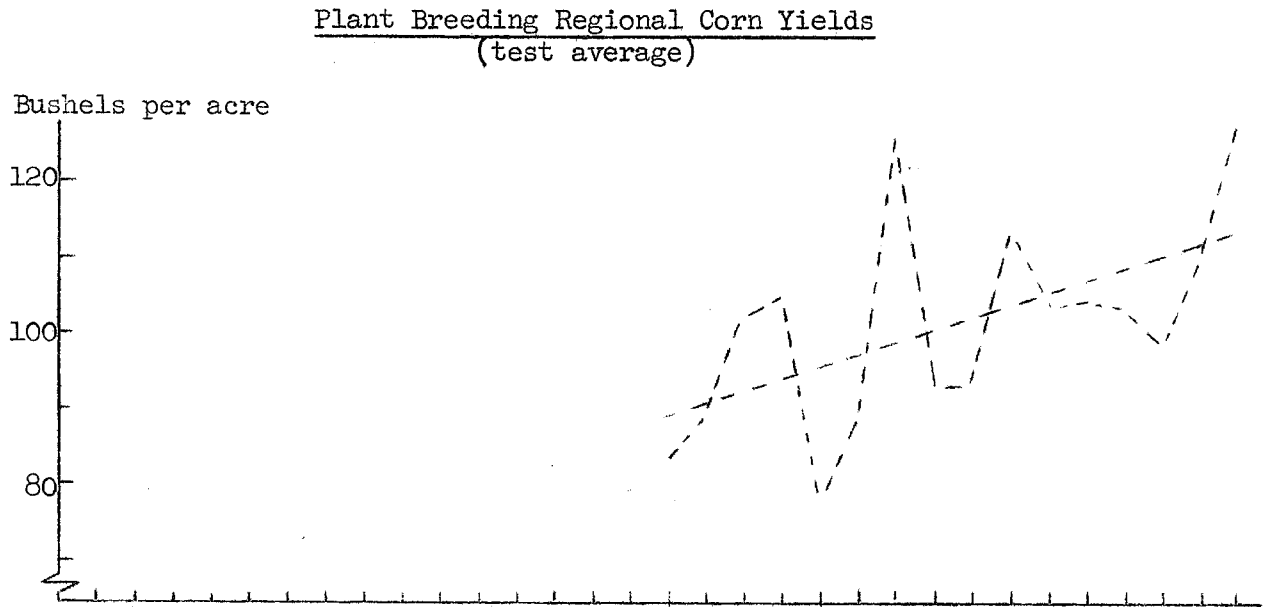


Table 8. AVERAGE ANNUAL RATES OF INCREASE IN SELECTED MEASURES
OF TOP CORN YIELDS AND STATE AVERAGE YIELDS
New York, 1931 to 1960 or 1961

Source of data	Average annual increase in corn yields based on:	
	Long-run ^a / trend	Postwar ^b / trend
(bu. per acre)		
Top yield series:		
Cost Account (average of three highest)	.91	.96
Plant Breeding Regional Trials (median of all plots)	n.a.	1.56
State average	.86	1.27

a/ Based on linear trend lines fitted to each series beginning in 1931 and ending in 1960 or 1961.

b/ Based on linear trend lines fitted to each series beginning in the late 1940's and ending in 1960 or 1961. The Cost Account figure is based on the years 1949-60; the Plant Breeding and state average figures are based on the years 1946-61.

State average yields have increased relative to those obtained by top Cost Account farmers during the past thirty years. In 1937-40, state average yields were slightly less than one-half those obtained by top Cost Account farmers, whereas in the late 1940's and again in the late 1950's, state average yields were nearly two-thirds of top Cost Account yields (Table 9). The changing ratio is due in part to wide fluctuations in the top Cost Account yield series. Yields in this series rose relative to the state average in the late 1930's and early forties and again in the mid fifties, but the gap narrowed substantially in the mid 1940's and again in the late 1950's. State average yields also have increased slightly relative to Plant Breeding trial yields during the past decade, although the state average is still only slightly more than one-half the median yield of the trial plots. The absolute difference between these two series has changed very little during the past decade. In 1947-50, the difference was 50 bushels, while in 1957-60 it was 48 bushels.

Table 9. STATE AVERAGE CORN YIELDS AS A PER CENT OF
SELECTED MEASURES OF TOP YIELDS
New York, 1937-40, 1947-50 and 1957-60

Top yield series	State average yields as a per cent of top yields:		
	1937-40	1947-50	1957-60
Cost Account (average of three highest)	47	65	66
Plant Breeding Regional Trials	n.a.	46	53

Summary and Conclusions

The preceding analysis of trends in top and state average yields of milk, eggs, wheat, oats and corn in New York indicates that the gap between state average yields and top yields has narrowed during the past thirty years, but only moderately. Trend lines fitted to the top yield series generally were slightly less steeply inclined than those fitted to state average yields. But there is no clear evidence to suggest that the upward trend in either the top or average series has been slowing down or leveling out in recent years. Postwar rates of increase in both top and average yield series for all the commodities studied except eggs were higher than the thirty year average rate of increase covering the period from 1931 to 1960 or 1961.

The gap between state average yields and top yields varies considerably among commodities and has changed over time at differing rates. Average egg yields, for example, were nearly 80 per cent of those obtained by the top Cost Account group just prior to World War II, while state average yields of milk, oats and corn during the same period were less than one-half those obtained by top Cost Account farmers (Figure 7). By 1957-60, state average egg yields were 90 per cent of those obtained by outstanding farmers. State average yields of major grain crops have been about two-thirds of top Cost Account yields during recent years.

Because of the substantial margin which now exists between state average and top yields of milk and major grain crops in New York and the absence of any apparent ceiling or upper limit to top yields, recent rates of increase in state average yields are likely to continue in the immediate future. Based on recent trends, it would take several decades for state average yields of most commodities to equal present top yields. Moreover, most of the top yield series are still increasing. At some future time, the rates of increase in both series may begin to level out, but the data presently available give no indication as to when this might occur.

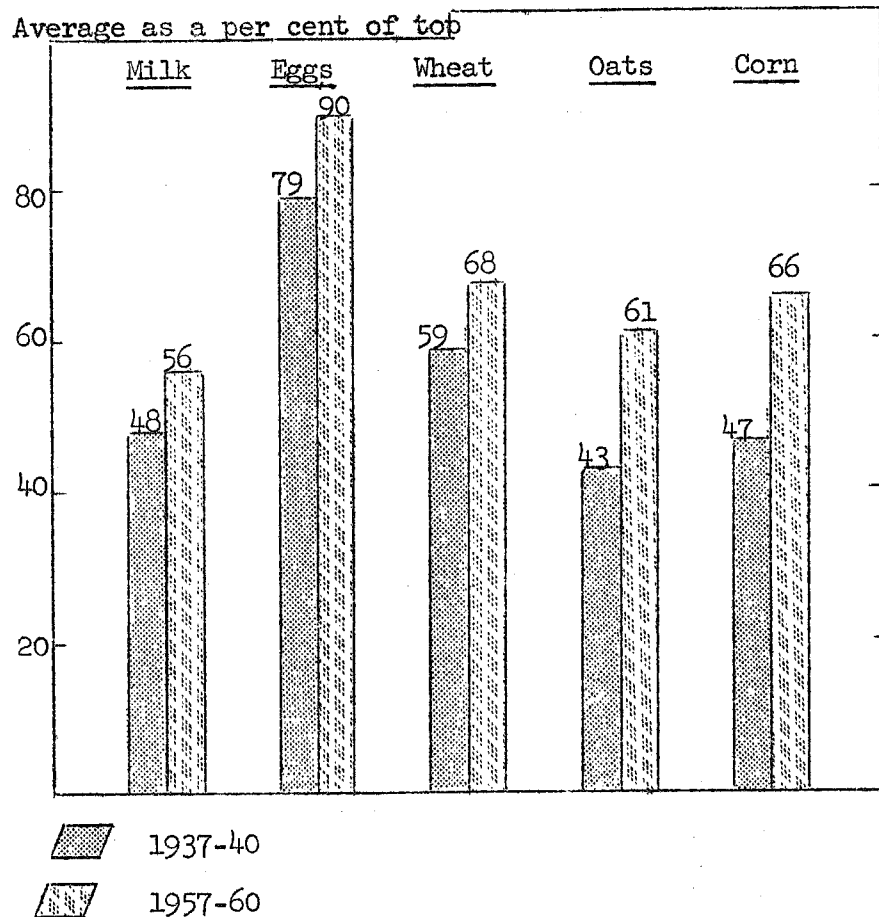


Figure 7. STATE AVERAGE YIELDS OF MILK, EGGS, WHEAT, OATS AND CORN
 AS A PER CENT OF TOP COST ACCOUNT FARM YIELDS,
 NEW YORK, 1937-40 and 1957-60

Since there is little or no evidence to suggest a reversal or slowing down of recent upward trends in yields, one may be justified in using the data which have been presented to make projections of yields that might be expected during the remainder of the present decade. Several estimating techniques, mainly based on relationships which have prevailed since World War II, were used in making projections of state average yields in 1967-70 for each of the commodities included in this study. The results obtained using three alternative estimating procedures are presented in Table 10.^{1/} Similar yield estimates for 1967-70 were obtained for milk, wheat and corn. The projected yields of eggs and oats for 1967-70, based on the rate of increase in average yields which

^{1/} For a more detailed description of the techniques used and the results obtained when these techniques were applied to estimates in the past, see Jack E. Hope, Op. Cit., pp. 60-77.

prevailed from 1947-50 to 1957-60, probably are too high. State average yields of 225 eggs per hen and 65 bushels of oats may be more realistic estimates for the late 1960's. Milk yields undoubtedly will exceed 9,000 pounds per cow and may approach 10,000 pounds towards the end of the present decade. Corn yields in the late 1960's probably will average between 65 and 70 bushels per acre.

Table 10. AVERAGE YIELDS OF MILK, EGGS, WHEAT
OATS AND CORN IN NEW YORK
1947-50 and 1957-60 and estimated yields for 1967-70

Commodity	Unit	Actual yields 1957-60	Estimated average yields in 1967-70, based on:			Average of 1967-70 projec- tions
			Same percentage increase as in the past decade ^{a/}	Postwar trend of average yields ^{b/}	Relation- ship of average to top yields ^{c/}	
Milk	lbs./cow	7,780	9,345	9,575	8,974	9,299
Eggs	eggs/hen	210	238	238	212	229
Wheat	bu./acre	32	38	37	37	38
Oats	bu./acre	53	80	63	67	70
Corn	bu./acre	54	69	68	68	68

a/ Percentage increase in state average yield of each commodity from 1947-50 to 1957-60 added to 1957-60 average yields.

b/ Calculated from postwar trend lines fitted to average yield data for each commodity.

c/ The ratio of the state average yield in 1957-60 to the corresponding Cost Account top series ten years earlier multiplied by the 1957-60 Cost Account top yield average for each commodity. This implies that the lagged relationship between average yields and top Cost Account yields ten years earlier will be the same during the decade of the 1960's as during the preceding decade.

The preceding estimates imply annual rates of gain in average yields of two per cent or more for milk, oats and corn; about 1.5 per cent per year for wheat; and somewhat less than one per cent for eggs. If these estimates prove to be correct and yields of major commodities increase at an average rate of about two per cent per year, while the population continues to grow at a somewhat slower rate, averaging between 1.5 and 1.8 per cent per year, less rather than more cropland will be needed in 1970 than was farmed in 1960.

Average rates of increase in yields have changed in the past and probably will change in the future. For this reason, one cannot be certain what future yields will be, particularly those prevailing twenty or thirty years hence. Neither the recent rates of change or the long-run average gains in yields may be appropriate if a significant change in the rate of increase occurs in the future such as took place in the 1940's and 1950's. But clearly the margin for improving yields of most commodities in New York remains substantial. For this reason, one may expect recent upward trends in yields to continue, at least during the present decade.