PR-863

Agricultural Experiment Station

Overview of Kentucky Wheat Yield Contests, 2015–2024

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The Kentucky Wheat Yield Contest is organized and administered by the University of Kentucky Cooperative Extension Service. It is heavily supported by the Kentucky Small Grain Growers Association and several agribusinesses. Farmers are required to harvest a minimum of three (3) acres, all in Kentucky, from a continuously planted area with four straight sides. Reasonable variations are acceptable on the shape of the area harvested. Yields are harvested, weighed on certified scales, and corrected to 13.5% grain moisture to convert to bushels per acre. The County Agricultural and Natural Resources (ANR) Extension Agent or designated representative is responsible for supervising and verifying the yield check and the agronomic data.

The contest includes tillage and no-tillage divisions in four geographic areas. The areas are:

1. Purchase and Pennyrile areas
2. Green River area
3. Mammoth Cave area
4. All other parts of the state

A goal of the Wheat Yield Contest is to identify management practices that improve wheat yields across Kentucky. This analysis includes ten years of Kentucky Wheat Yield Contest data from 2015 to 2024 (Figure 1) to examine the practices of contest winners and determine if specific practices are associated with higher wheat yields.

Participating Counties and Number of Entries

From the 2015 harvest year through 2024, a total of 183 yield contest entries across Kentucky were submitted in the Wheat Yield Contest (Table 1). Union County led in participation, with 50 entries (27.3% of all entries) competing for highest wheat yield, followed by Daviess, Todd, and Logan counties. Participation from other counties was limited to fewer than 10 entries. While the contest attracted participants from across Kentucky, most entries came primarily from these four counties, which suggests that the results may be skewed toward their specific environmental and soil conditions.

Table 1. The number of entries, highest yield in bushels per acre (bu/ac), and award-winning county for each contest year.

Contest Year	Award-Winning County	Highest Yield (bu/ac)	Total Entries
2015	Union	134.27	28
2016	Graves	123.01	29
2017	Hancock	126.46	22
2018	Hancock	99.94	8
2019	Logan	126.90	8
2020	Union	105.73	15
2021	Daviess	131.89	23
2022	Hancock	132.68	18
2023	McLean	143.43	23
2024	Daviess	123.14	9

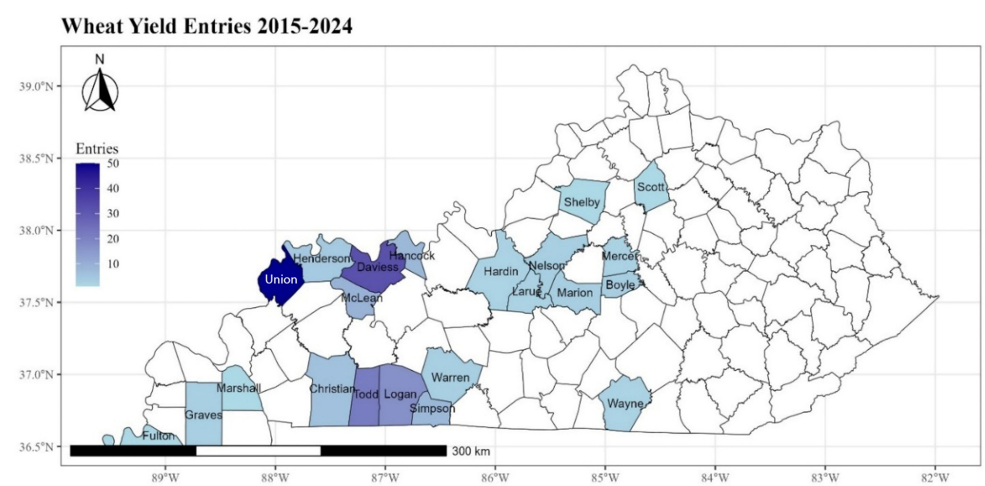

Figure 1. Number of entries received from participating counties from 2015 through 2024.

Average County Yield

In general, nearly all counties in Kentucky achieved good wheat yields (Figure 2). For instance, Scott County in the central Bluegrass and Marshall County in Western Kentucky reported yields well above 120 bushels per acre. However, this figure should be interpreted with caution. Union County, which had the highest number of yield contest entries, appears to have had a lower average yield than many other counties. This is due to the large number of entries, which naturally increases yield variation. In contrast, counties such as Marshall and Scott participated only once in the past ten years, meaning their data reflect a single entry rather than a broader trend.

Contest Winners

The highest yields in tilled wheat were concentrated in Western Kentucky, whereas top no-till wheat yields were more evenly distributed across the state (Figure 3).

Box and Whisker Plots

Many of the graphs in this overview include box and whisker plots, which summarize data distribution. The box represents the middle 50% of the data (the interquartile range, or IQR), with the solid line inside the box indicating the median—the value that separates the data into two equal halves. The whiskers extend from the box to the smallest and largest values within 1.5 times the IQR. Data points beyond this range are considered potential outliers.

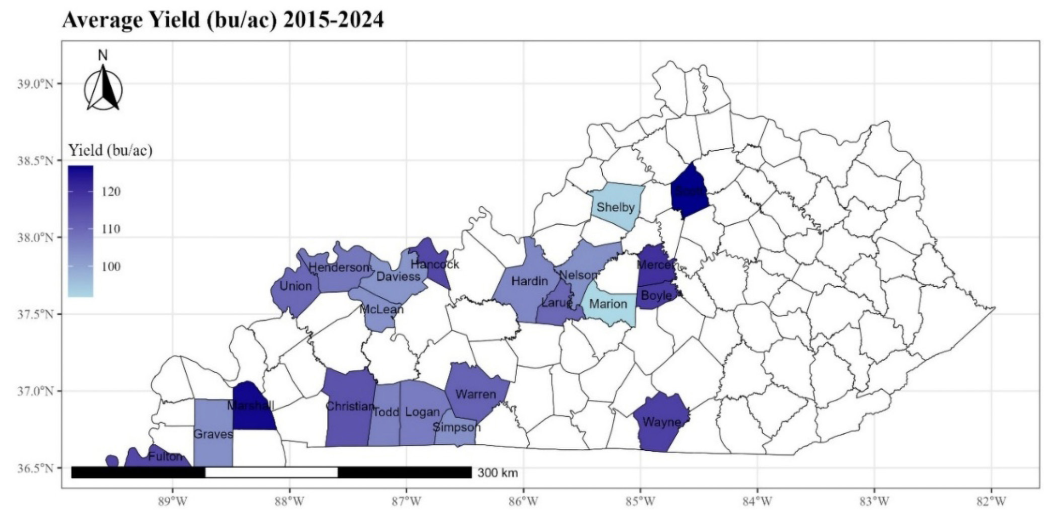

Figure 2. Average yield in participating counties from 2015 through 2024. Please note that some counties (Scott and Marshall counties, for example) had only one entry in the whole ten-year span.

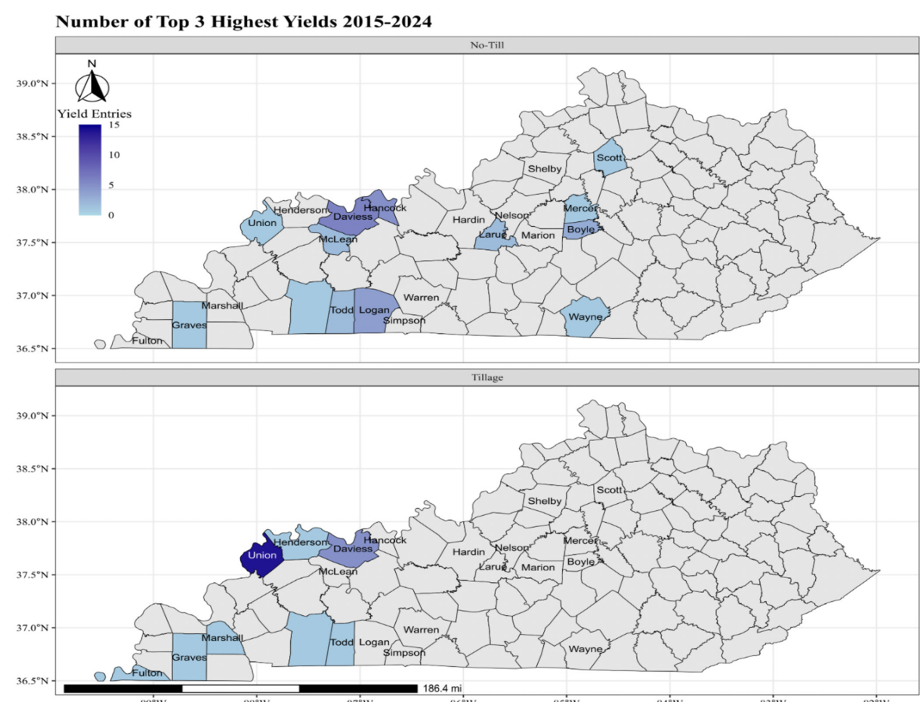

Figure 3. Number of top-three highest yield results from no-tillage (top map) and tillage (bottom map) wheat divisions.

Larger boxes indicate greater variability in the middle 50% of the data, while longer whiskers suggest a wider overall spread. For example, Figure 4 displays box and whisker plots for wheat yields reported each year from 2015 to 2024. The box for 2016 is smaller than that for 2017, indicating lower yield variability in 2016. Meanwhile, 2023 shows a wider spread and a higher overall yield than 2016 .

Annual Variation in Wheat Yield

Wheat yield varied significantly each year and across years (Figure 4). Wheat yields entered in the 2023 harvest season were the best yields overall for any season of the 10 seasons evaluated. Yields in the 2018 harvest season were the worst.

Total Nitrogen vs. Wheat Yield

Regardless of tillage practices, most farmers applied between 100 and 150 pounds (lb) of nitrogen (N) per acre. For both tillage and no-tillage, wheat yield generally increased as N rate increased (Figure 5). Even though these correlations are statistically significant, they remain relatively weak. In no-till fields, a unit increase in N fertilizer increased wheat yield by 0.1 bushels per acre in only 2% of cases. In contrast, in tilled fields, a unit increase in N rate led to a 0.08 bushel-per-acre yield increase in 8% of cases. These data suggest that N applications are important but perhaps not as impactful as other factors.

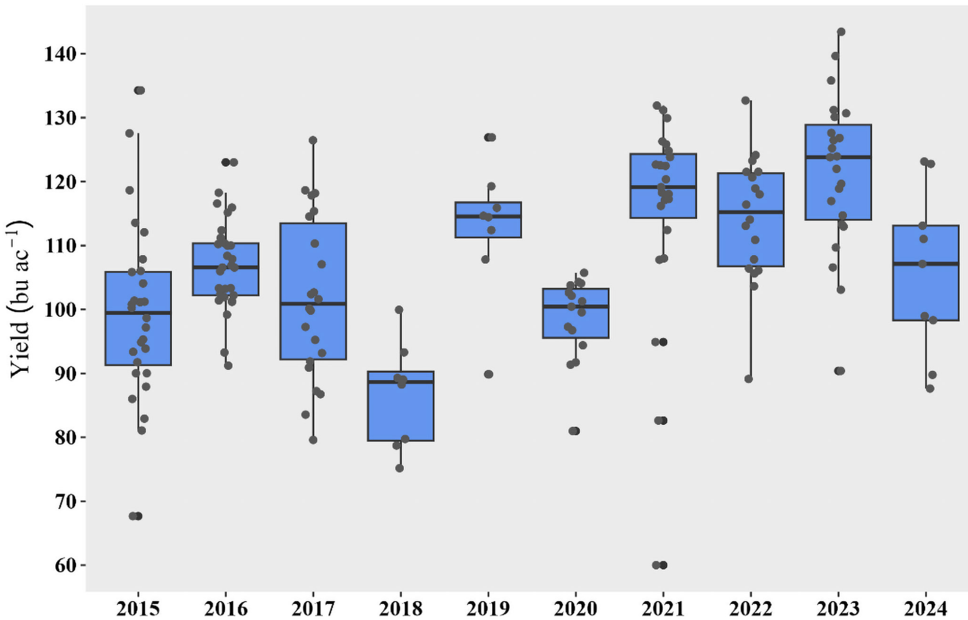

Figure 4. Variation of yield (boxplot) and number of participants in each year (dots). The blue box for each year represents middle 50% of all yields. The solid line in the box indicates the median of all yields for each year.

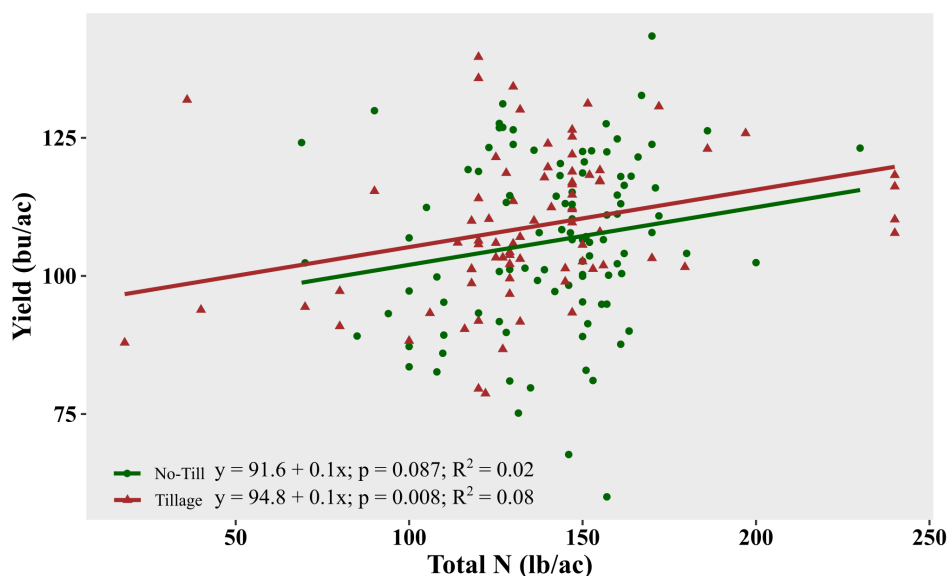

Figure 5. Correlation between N rate and wheat yield in both no-till and tillage wheat.

In general, most farmers applied around 30 lb N per acre in the fall, 50 lb N in February (winter), and the bulk of N in March (spring). Positive but insignificant correlations between N rate and yield were observed when N was applied in the fall and spring. Conversely, N application in winter showed no correlation with yield (Figure 6).

Tilled wheat had higher yields without N application in both fall and winter; however, no significant difference was observed between tilled and no-till wheat when N was applied in the spring. These findings suggest that a total of 130 lb N per acre, split-applied across fall, winter, and spring, may be the sweet spot for wheat production.

Tillage Practices

All entries received from the central Bluegrass and surrounding areas were no-till wheat, whereas the percentage of tillage operations increased moving westward (Figure 7). In Fulton and Marshall counties, 100% of the reported wheat was tilled, though this is based on a single entry from each location.

This trend suggests that no-till wheat is the preferred practice in the central Bluegrass and surrounding areas. Alternatively, it could indicate that tilled wheat in this region does not achieve yields comparable to those in Western Kentucky, leading producers to refrain from competing in yield contests.

Starting in 2016, the percentage of farmers competing in the no-till wheat yield contest increased linearly, reaching approximately 90% before dropping to around 30% in 2020 (Figure 8). It then rebounded to about 80% in 2022. Notably, 2023 had the lowest percentage of no-till contestants, yet the greatest percentage of no-till entries were received in 2024. Importantly, there is no clear trend indicating that changes in tillage practices have directly influenced fluctuations in average yield.

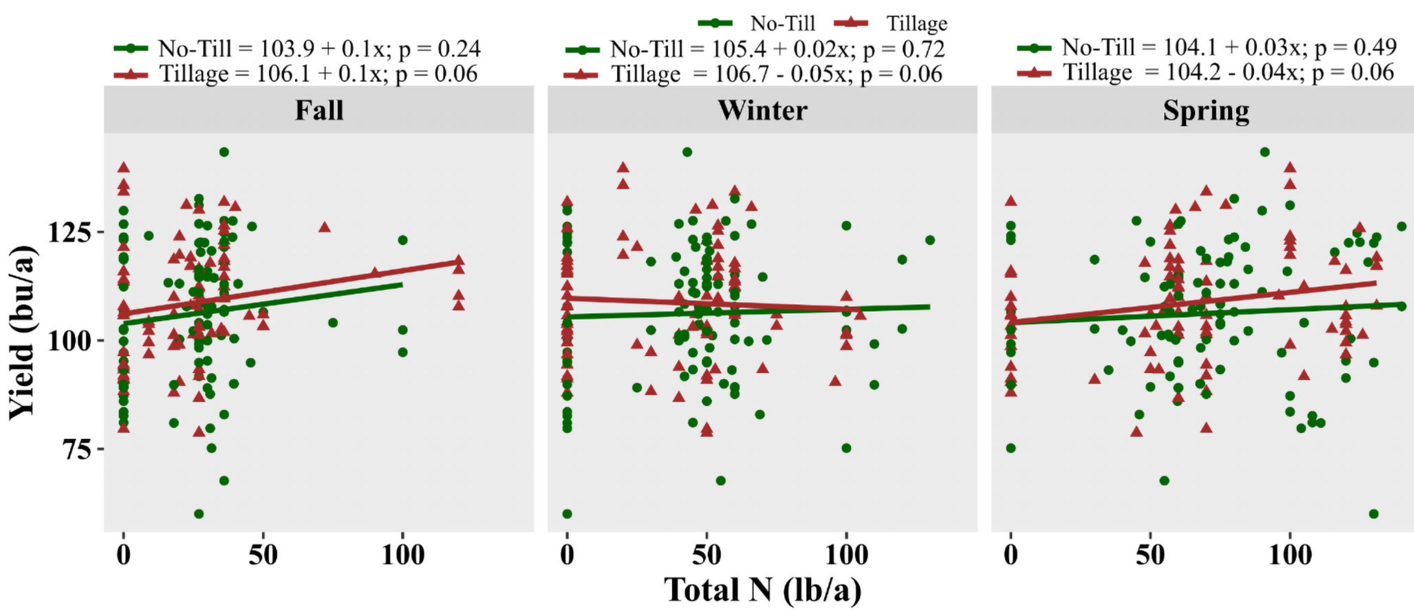

Figure 6. Correlation between N rate (in fall, winter, and spring applications) and wheat yield.

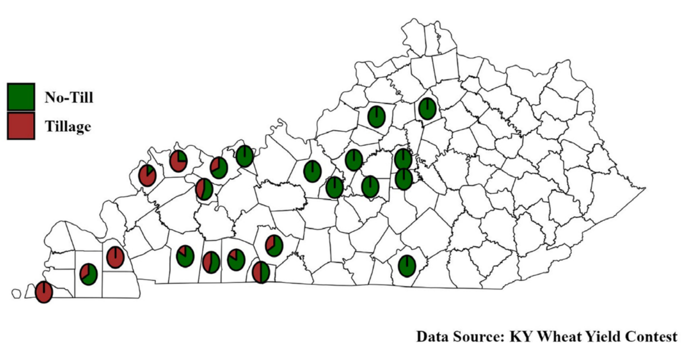

Figure 7. Spatial data of Kentucky, showing the percentage of entries for tillage and no-till operations in participating counties.

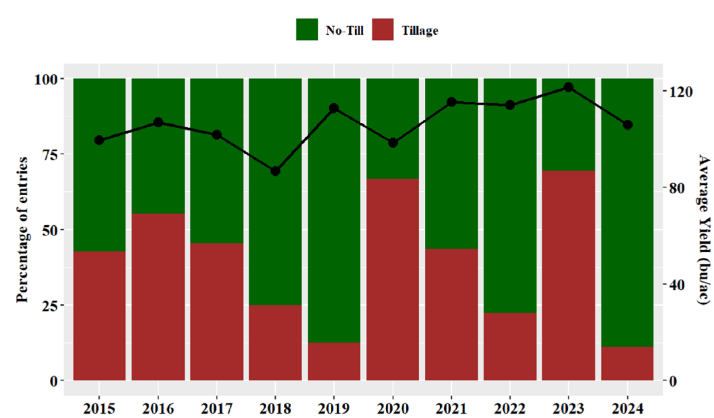

Figure 8. Percentage of yield entries in no-till (green bars) and tillage (red bars) wheat yield, shown with average yield (black line) for each year.

The Effects of Growth Regulators on Yield

The use of growth regulators increased significantly in later years. In 2015 and 2016, fewer than 20% and 10% of farmers, respectively, applied growth regulators (Figure 9). However, their adoption grew substantially, with over 70% of entries using them in 2023 and all entries incorporating them in 2024. Notably, in six out of the ten years, the median wheat yield was higher in entries where growth regulators were used compared to those without. However, in 2023, the median yield was lower in entries that applied growth regulators than in those that did not. Since all entries used growth regulators in 2024, no direct comparison can be made for that year.

The Effects of Number of Fungicide Active Ingredients on Wheat Yield

The number of fungicide active ingredients (a.i.), the chemicals in fungicides that prevent fungal diseases, increased in later years. In 2024, a farmer competing in the wheat yield contest used seven fungicide active ingredients. This suggests that the farmer applied at least four different fungicide products on their farm, assuming each fungicide product contained two active ingredients. Interestingly, the higher number of fungicide active ingredients appears to be accompanied by a slight increase in yield (Figure 10), which possibly indicates that disease prevention contributed to yield gains.

Farmers using a single fungicide active ingredient had slightly lower median and average yields compared to those who did not use fungicides at all (Figure 10). However, based on the size of the boxes, yield variability was higher among farmers who did not use fungicides (zero on the x-axis). Interestingly, yield increased with the number of fungicide active ingredients up to three, beyond which the response became unclear. This suggests that using three or four fungicide active ingredients (which may equal to two fungicide products, assuming each has two active ingredients) may be the optimal number for maximizing yield returns.

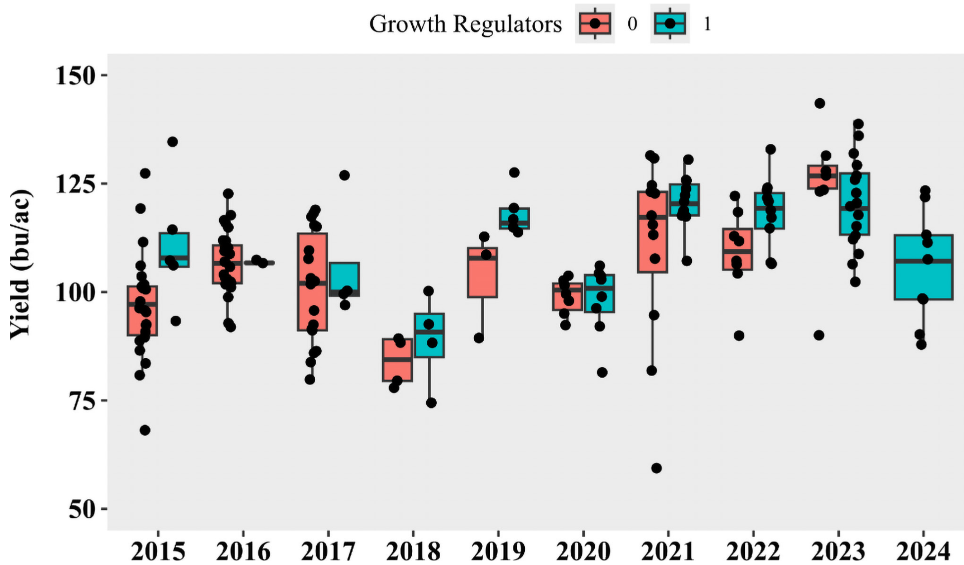

Figure 9. Variation in wheat yield (boxplot) across years with growth regulators applied (light green) and growth regulators not applied (light red).

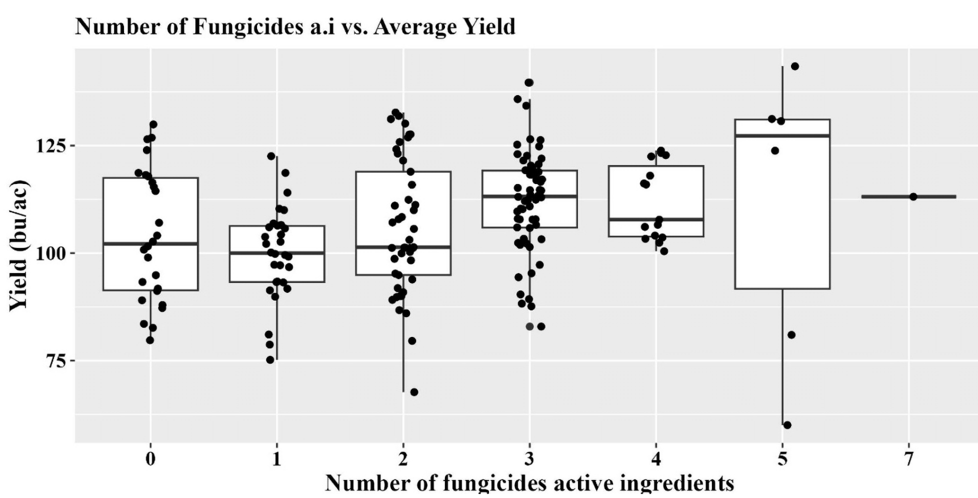

Figure 10. Variation in wheat yield (boxplot) across different numbers of fungicide active ingredients on the x-axis. The box represents 50% of the yields for each number of active ingredients applied.

Fungicides applied before anthesis (flowering) are targeting diseases that affect leaves. Fungicides applied at anthesis are targeting Fusarium Head Blight. Across all entries, a single fungicide active ingredient or three active ingredients before anthesis increased wheat yields (Figure 11a). Adding two or four active ingredients had marginal to no yield increase. Across all entries, a single fungicide active ingredient at anthesis did not increase yields (Figure 11b). Adding two or five fungicide active ingredients at anthesis increased yields.

Applying fungicides at anthesis was more impactful to yield than applying fungicides before anthesis. There was a positive but weak correlation between average yield and the average number of fungicide active ingredients when applied before anthesis. The regression analysis indicates that increasing fungicide active ingredients by one could increase yield by 7.1 bushels per acre. However, the larger error and low R^2 value suggest that this increase is not consistent, as only 5% of the variation in yield is explained by variations in fungicide active ingredients when applied before anthesis. On the other hand, a significant positive correlation was observed between average yield and fungicide active ingredients applied at anthesis. Increasing the number of fungicide active ingredients by one could result in a wheat yield increase of 15.5 (±7) bushels per acre. The smaller error and larger R^2 value indicate that the effect of fungicide active ingredients at anthesis is stronger, possibly suggesting that investing in fungicide applications at anthesis could lead to higher yield returns.

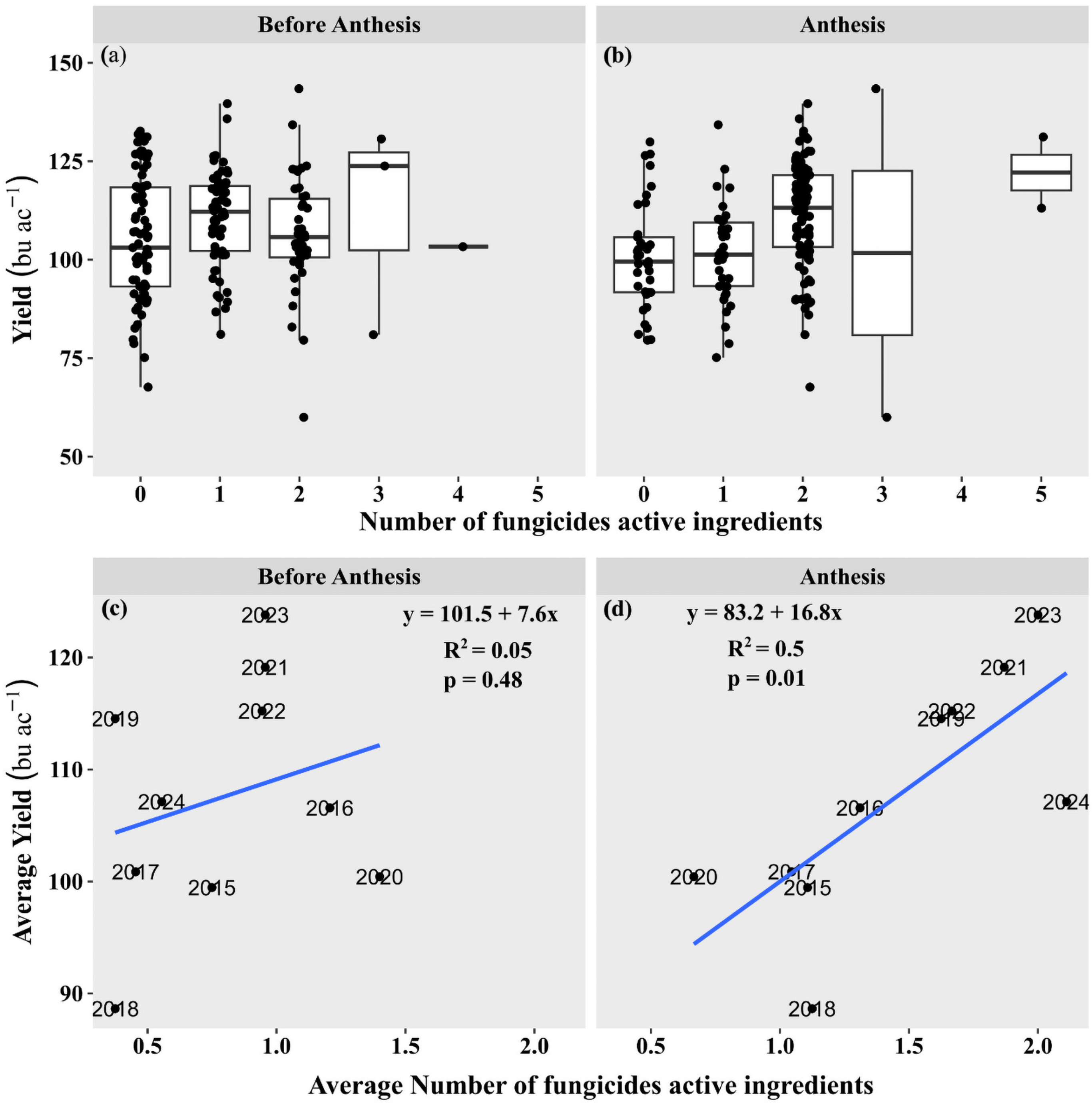

Figure 11. Variations in wheat yield associated with the number of fungicide active ingredients applied before anthesis (a) and at anthesis (b), as well as the correlations between average annual yield and the average number of fungicide active ingredients applied before anthesis (c) and at anthesis (d).

The Effects of Insecticides on Wheat Yield

While the use of insecticides varied greatly from one year to another, 85% of the entries used at least one insecticide treatment. In general, the median yield in entries where insecticides were not used was higher than those using one or two insecticide products and comparable to those using three insecticide products (Figure 12a). However, the story was different within each year. The use of insecticides tended to benefit wheat yield in six out of ten years (Figure 12b).

We conducted a conditional inference tree (CIT) analysis to assess the impact of certain management practices on wheat yield (Figure 13). A CIT analysis is a machine-learning approach that uses statistical tests to split the data and select the variable with the strongest relationship to the response (e.g., wheat yield) while avoiding bias. In this case, the variables tested included N fertilizer rate and timing, growth regulators, fungicide active ingredients used prior to anthesis and insecticide use. The analysis revealed that, among all the management practices evaluated, the number of fungicides active ingredients at the anthesis stage had the strongest influence on wheat yield ($p < 0.001$). The use of one fungicide active ingredient, or no fungicides at all, resulted in a median yield slightly above 100 bushels per acre, whereas using more than one fungicide active ingredient yielded a median of around 117 bushels per acre.

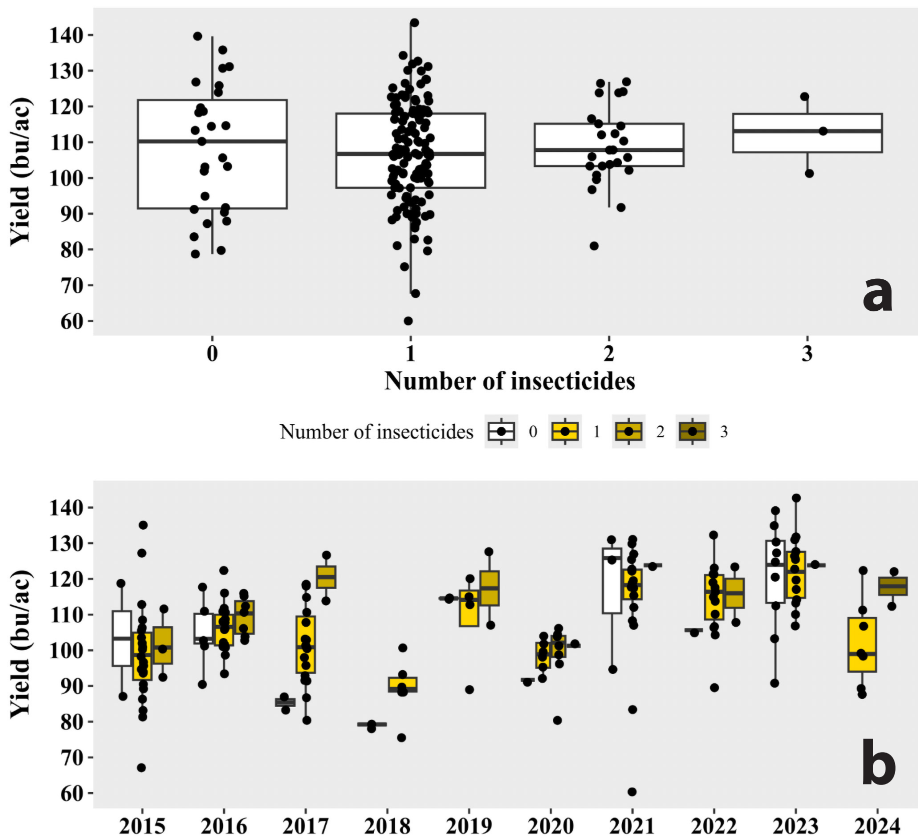

Figure 12. Variation of yield by number of insecticide products used (a) and variation of yield by number of insecticides used within and across years (b).

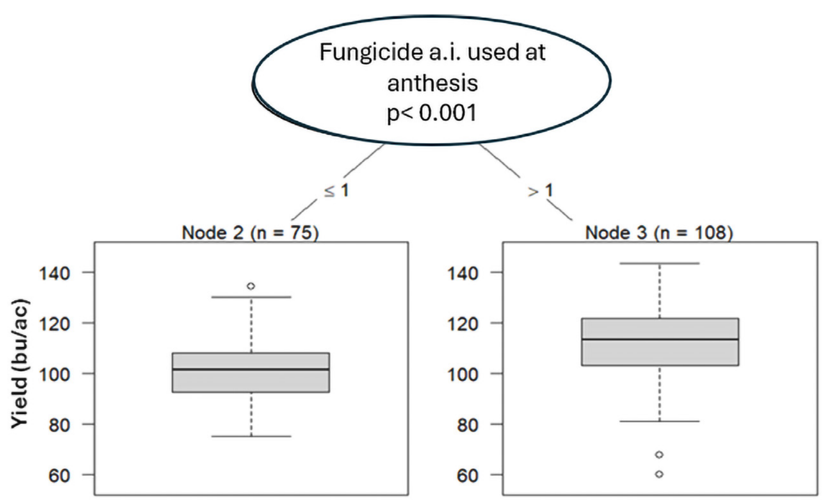

Figure 13. Conditional inference tree analysis indicates the effect of fungicide active ingredients (a.i.) applied at anthesis.

Disclaimer

The results presented in this document are based on entries submitted by farmers during the Wheat Yield Contest. These findings represent real-world examples of top-tier wheat. Therefore, conclusions should be drawn within the context of this dataset only.

The University of Kentucky Cooperative Extension Service provides comprehensive, research-based guidelines on all aspects of crop management practices. Readers are encouraged to conduct their due diligence and follow the University of Kentucky Cooperative Extension recommendations for their farm management decisions.

Acknowledgment

We extend our gratitude to the University of Kentucky ANR Extension Agents and other supervisors, whose efforts serve as the cornerstone of the Wheat Yield Contest. We also appreciate the growers, the Kentucky Small Grain Growers Association, and all agribusinesses for their continued support in facilitating this contest.

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