# Intensive Wheat Management in the Corn Belt[1/]

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Intensive wheat management (ICM) is based on European cropping systems including narrow row spacing, precise seeding rates, multiple nitrogen (N) fertilizer application, fungicide application for disease control, and plant growth regulator (PGR) application for lodging control. Components of this cropping system were compared to current recommended management (CRM) practices with 12 varieties during 1986-87. The purpose for the experiment was to determine the responsiveness of soft winter wheat varieties to intensive management practices including increased seeding rate, increased N fertilization in multiple applications, fungicide application and PGR application.

## Materials and Methods:

Eleven soft red and one soft white winter wheat varieties were planted in Parr silt loam, Kokomo silty clay loam and Plano silt loam soils in Indiana, Ohio, and Wisconsin. The experiments were set out in a randomized complete block experimental design with a split plot arrangement of eight management levels as main plots and varieties as sub-plots. Management levels are shown in Table 1.

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Table 1. Current (CRM) and intensive (ICM) management levels for wheat in this experiment.[1/]

| Management level | Fungicide application | | Plant growth regulator application | |
|---|---|---|---|---|
| | Product | Rate | Product | Rate |
| | | lb ai/a | | lb ai/a |
| CRM | -- | -- | -- | -- |
| CRM | Tilt® | 0.12 | -- | -- |
| ICM | -- | -- | -- | -- |
| ICM | Tilt® | 0.12 | -- | -- |
| ICM | Corbel®+ Dithane M-22® | 0.5 1.4 | -- | -- |
| ICM | Tilt® | 0.12 | Cerone® | 0.25 |
| ICM | Corbel®+ Dithane M-22® | 0.5 1.4 | Cycocel | 0.9 |
| ICM | Corbel®+ Dithane M-22® | 0.5 1.4 | Terpal C | 0.75 |

1/ Corbel®, Dithane M-22®, Cycocel, and Terpal C are not registered for use on wheat in the United States.

Management factors varied by location because soil test levels varied and estimates of available N release from the preceding crop and from soil sources were different. Phosphorus and potassium fertilizer applications were based on soil test values and individual state extension service recommendations. Rates were 35 lb/a P and 65 lb/a K in Indiana, 0 P and K in Ohio, and 150 lb/a K in Wisconsin. Wheat was seeded at 23 seeds/ft$^2$ for CRM and 37 seeds/ft$^2$ for ICM from October 9 through October 11 at all three sites. The CRM system used 7-inch row spacings and the ICM system used 7-inch row spacings in Indiana and Ohio and 3.5-inch row spacings in Wisconsin.

The N fertilization program varied by management system and location. For the CRM system, 20 lb N/a was applied at planting and urea was topdressed at 60, 30, and 50 lb N/a shortly after wheat green-up in Indiana, Ohio, and Wisconsin, respectively. For the ICM system 20 lb N/a was applied at planting and urea was topdressed at 30 lb N/a in mid-March and at 70 lb N/a in Indiana and 50 lb N/a in Ohio and Wisconsin during the jointing growth stage. Fungicides and PGRs were applied to selected management areas in 30 gal/a water at 40 psi. during the flag-leaf emergence growth stage. The fungicides and PGR's were applied in separate application trips when both were applied to the same management area.

Yields were obtained by harvesting the center 4 by 20 foot area with plot combines and correcting the weights to a constant grain moisture of 13.5%. Disease ratings were made by visual estimation of the percentage of flag leaf with disease symptoms, and lodging ratings were made using the Belgium rating system.

Results and Discussion:

The ICM systems were evaluated by comparing them with the CRM system since it had lower input costs for seed, fertilizer, fungicide, and PGR than the ICM systems. The CRM system was significantly higher yielding than the ICM system, which did not include fungicides or fungicides and PGR applications, in 13 of 36 comparisons (Fig. 1). This illustrates that increased seeding rates and increased N fertilization rates in multiple applications do not ensure higher grain yields. In comparisons of individual varieties and locations, however, 9 of the 12 varieties had significantly increased grain yields from an ICM system which included fungicides or fungicides and PGR. Disease and lodging

control for wheat become much more important factors in the ICM system when plant populations and N fertilization rates are increased.

Two varieties, Adder and Titan, had higher grain yields when the ICM practice included either a fungicide or fungicide and PGR at the 3 locations as compared to CRM. The yield increases for Adder could primarily be attributed to inclusion of fungicides in the ICM system. Tilt fungicide in Ohio and Wisconsin and Corbel/Dithane M-22 fungicides in Indiana and Ohio had positive influences on yield when included in the ICM system even though Adder has relatively good resistance to both powdery mildew and leaf rust diseases and disease severity was rated as low at the experimental locations. Yield increases for Titan required both fungicide and PGR in Indiana and Ohio but only the Corbel/Dithane M-22 application with the ICM system was required in Wisconsin. Titan is a tall variety and has only moderate lodging resistance and moderate resistance to leaf rust. Thus, control of foliar diseases and lodging were necessary when the ICM system was used for the Titan variety.

Four varieties, Becker, Caldwell, Cardinal, and Scotty, responded to fungicide application with either the ICM or CRM systems. Yields for Becker and Caldwell in Indiana and Wisconsin were increased when Tilt fungicide was included with the CRM system as compared to CRM alone. This variety is susceptible to powdery mildew and it increased in severity where fungicides were not applied. Control of powdery mildew resulted in a yield increase. The yield increase from fungicide application on Caldwell in Indiana and Wisconsin and Cardinal and Scotty in Ohio and Wisconsin occurred despite low incidences of powdery mildew and leaf rust on these three varieties.

Three varieties, Argee, HW-3021, and Lincoln, had yield increases from ICM plus fungicide and PGR application in comparison to CRM at individual locations. Argee in Ohio, HW-3021 in Indiana and Ohio, and Lincoln in Wisconsin required both disease and lodging control measures to obtain a response to ICM. Argee is a tall, late-maturing variety that is adapted to the northern corn belt. As such it was relatively low yielding in Ohio and Indiana, but PGR application in Ohio shortened plants and increased the harvest index to result in a yield increase. Yields for HW-3021, a soft red winter wheat hybrid, were increased from Corbel/Dithane M-22 and Terpal C applications in both Indiana and Ohio and from Corbel/Dithane M-22 and cycocel applications in Ohio. This hybrid is susceptible to leaf rust and is moderately lodging resistant allowing response to fungicide and PGR applications. In Indiana lodging was decreased by the Terpal C application. Disease incidence was low at both locations on the HW-3021 hybrid. Lincoln responded to Corbel/Dithane M-45 and cycocel applications in Wisconsin. The fungicide plus PGR had a favorable impact on numbers of kernels per spike to result in a yield response.

Three varieties, Augusta, Fillmore, and 2551, did not respond to ICM practices in comparisons to CRM at any of the locations although there was a trend toward a yield increase with 2551 from Corbel/Dithane M-22 application in Ohio.

Since ICM inputs are typically applied during the flag-leaf emergence to boot growth stages, predictability of a yield response to either a fungicide or PGR application is required for profitable responses to these inputs. From these data it is difficult to predict a response based on a specific variety and location interaction. Several

varieties that have only fair to moderate resistance to powdery mildew and leaf rust responded to fungicide applications. These include Becker, Scotty, Titan. and HW-3021 and could reasonably have been expected to respond. Several varieties that have good to excellent resistance ratings for powdery mildew and leaf rust also responded to fungicides. These include, Adder, and Caldwell. Conversely, Fillmore did not respond to fungicide application and it is rated as only moderately resistant to powdery mildew. Disease resistance of a variety and disease progression on plants were not always good predictors of yield responses to fungicides in this experiment.

Similarly with PGRs, several varieties that have only fair to moderate lodging resistance responded to PGR application. These included Argee, Cardinal, Titan, HW-3021, and Lincoln. Other varieties with fair to moderate lodging resistance did not respond to PGRs. These include Augusta and Fillmore. Resistance to lodging for a variety and lodging ratings did not predict responses to PGR's.

Some of the basics of wheat management provide an opportunity for high wheat yields with recently developed varieties in the Corn Belt. Intensifying wheat management by increasing the plant populations and N fertilization rates may require the inclusion of fungicides to control plant diseases and PGR's to control lodging; however, yield responses to these products were difficult to predict during the growth stages for application of these products. A profitable return on investment in these products could not be predicted based on variety, location, and ICM practices at these three locations in 1987.

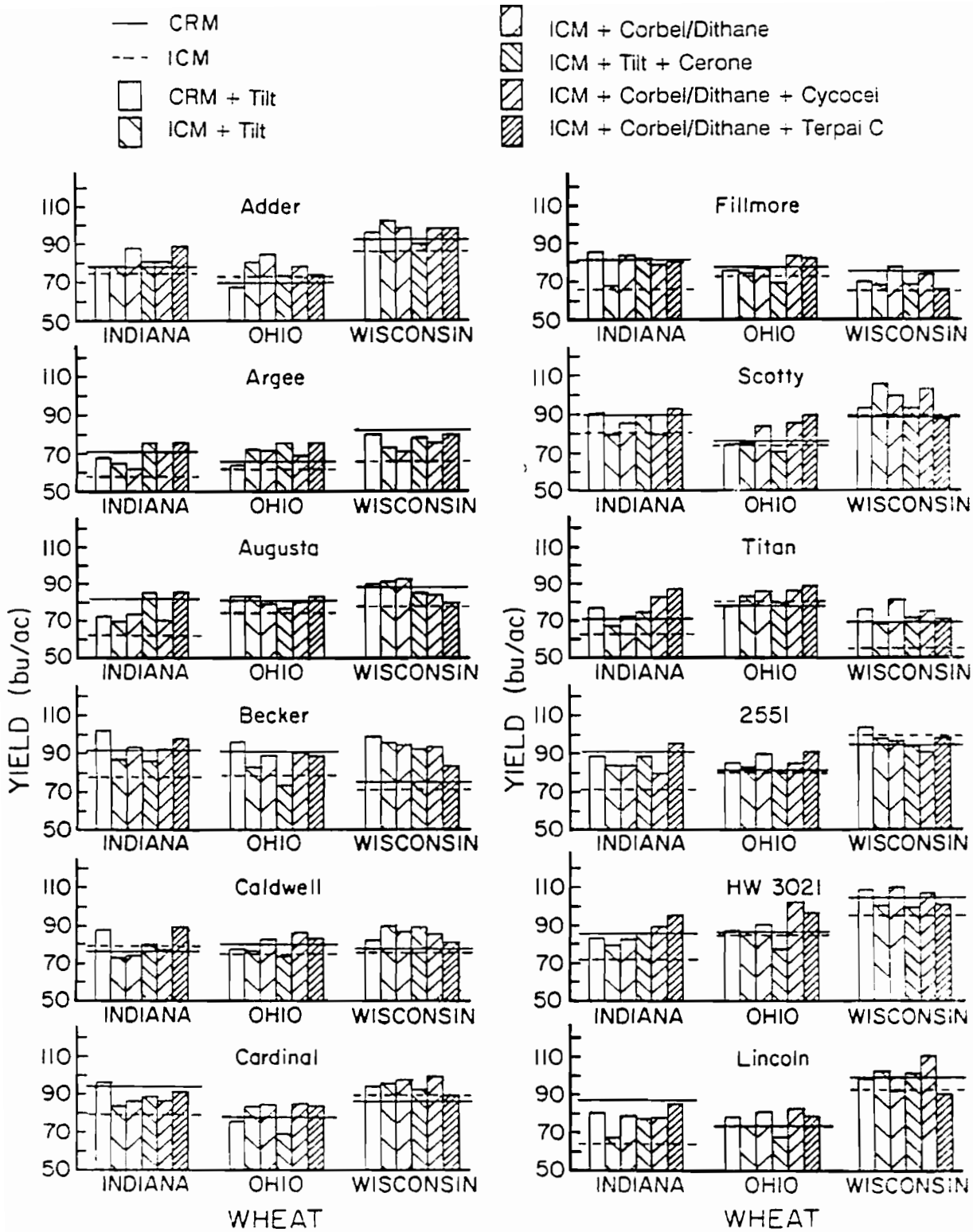


Figure 1. Grain yields of 12 soft winter wheat varieties as affected by current (CRM) and intensive (ICM) cereal management systems. ($LSD_{0.05}$=9.6 bu/a for comparing management systems within a variety and location).

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