# Kentucky No-tillage Update[1]

Edited by W. W. Frye[2]

Kentucky farmers were among the first in the U.S. to adopt no-tillage, and the practice has grown rapidly in the state, particularly or production of corn and soybeans. Its inherent advantages in controlling soil erosion; conserving soil water; saving time, labor, tractor fuel, and machinery costs; and improving timeliness in planting double-cropped soybeans have been major factors accounting for the rapid adoption of no-tillage. The estimated acres of no-tillage corn and soybeans planted in Kentucky from 1969 through 1985 are show in Table 1.

The current no-tillage research projects in Kentucky are in several broad categories, including (1) long-term effects of no-tillage and other conservation tillage practices on soil properties and crop productivity, (2) role of legume cover crops in no-tillage, (3) N management for improved efficiency in no-tillage systems, (4) weed control for no-tillage crop productions (5) effects of tillage on soil erosion and runoff water quality, (6) production of burley tobacco using no-tillage and reduced tillage, and (7) no-tillage cropping systems and rotations.

## Lona-term No-ti11aae and Conventional Tillaae

Corn has been grown continuously with no-tillage and conventional tillage on a Maury silt loam soil since 1970. Average grain yields during that time are shown in Table 2. After 15 years, there was a trend toward declining yields with all N rates and both tillage treatments, however, the

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1 Contributors to this report include: M. Aswad, M.J. Bitzer, R.L. Blevins, E.H. Earles, S.A. Ebelhar, J.E. Espinosa, J.H. Grove, J.H. Herbek, B.F. Hicks, L.W. Murdock, R.E. Phillips, M. Rasnake, H.B. Rice, S.D. Robertsonr M.S. Smith, G.W. Thomas, M. Utomo, J.J. Varco, K.L. Wells, W.W. Witt, and J.M. Zeleznik.

2 Professor of Agronomy, Dep. of Agronomy, Univ. of Kentucky, Lexington, KY 40546.

Table 1. Estimated‡ Acres of No-tillage Corn and Soybeans Planted in Kentucky, 1969-1985.

| Year | No-till corn: Acres no-till (X 1000) | No-till corn: % of all corn | No-till soybeans: Acres no-till (X 1000) | No-till soybeans: % of all soybeans | Corn and soybeans: Total acres no-till corn and soybeans (X 1000) |
|---|---|---|---|---|---|
| 1969 | 80 | 7.4 | 30 | 6.2 | 110 |
| 1970 | 133 | 12.0 | 50 | 9.0 | 183 |
| 1971 | 213 | 16.0 | 110 | 15.0 | 323 |
| 1972 | 204 | 18.0 | 197 | 21.1 | 401 |
| 1973 | 250 | 21.6 | 300 | 28.9 | 550 |
| 1974 | 330 | 26.6 | 320 | 30.5 | 650 |
| 1975 | 300 | 22.6 | 350 | 30.4 | 650 |
| 1976 | 277 | 18.0 | 308 | 28.0 | 585 |
| 1977 | 248 | 15.0 | 338 | 25.0 | 586 |
| 1978 | 150 | 9.5 | 300 | 21.4 | 450 |
| 1979 | 173 | 12.0 | 464 | 27.0 | 637 |
| 1980 | 248 | 15.0 | 495 | 30.0 | 743 |
| 1981 | 316 | 18.8 | 570 | 34.0 | 886 |
| 1982 | 336 | 20.0 | 595 | 35.0 | 931 |
| 1983 | 265 | 23.1 | 545 | 34.0 | 810 |
| 1985 | 443 | 24.6 | 385 | 33.8 | 828 |

‡ Estimates by University of Kentucky Agric. Extension grain specialists for all years except 1981, 1983, and 1985, which were determined by a survey conducted by the Kentucky Crop and Livestock Reporting Service (1981) and estimates by Conservation Tillage Information Center (1983 and 1985).

Table 2. Average Corn Grain Yields During 16 Years of No-tillage and Conventional Tillage (1970-1985).

| Tillage treatment | N rate, lb/acre: 0 | 75 | 150 | 300 |
|---|---|---|---|---|
| | ---------Grain yield, bu/acre--------- | | | |
| No-tillage | 71 | 114 | 125 | 128 |
| Conventional tillage | 84 | 118 | 120 | 126 |

most notable change was the reversal of the response of no-tillage and conventional tillage corn to the low N fertilizer rates. During the first ten years, conventional tillage treatments at the low N fertilizer rates always produced higher grain yields. However, since 1980 without N fertilizer, no-tillage corn yields have not been significantly different from yields of conventional tillage corn, and in 1984 and 1985, there was a strong trend toward higher yields with no-tillage. The higher organic matter and organic N levels observed with no-tillage now appear to be contributing more to the N needs of the corn crop than in the case of conventional tillage.

After **10** years, the organic matter content in the surface **2** inches of soil receiving annual applications of 150 lb/acre fertilizer N was 4.82% for no-tillage, 2.40% for conventional tillage and 5.1856 for the adjacent, nontilled bluegrass sod. The higher amount of organic matter near the soil surface with no-tillage than with conventional tillage can be attributed to the lack of mechanical mixing of plant residues into the soil and slower decomposition of organic matter.

The method of tillage did not affect bulk density (1.25 and 1.29 $g/cm^3$ for no-tillage and conventional tillage, respectively), but hydraulic conductivity was 0.75 inches/hour for no-tillage and 0.59 inche/hour for conventional tillage. This suggests greater pore continuity and possibly more large pores in the no-tillage soil.

Soil acidity increased more rapidly in no-ti1lage than conventional tillage and was closely related to the amount of N fertilizer applied. As acidity increased, exchangeable calcium and magnesium decreased, especially calcium, and exchangeable al uminum and manganese increased greatly. Exchangeable aluminum in the surface 2 inches of the unlimed soil ranged from 2 to 30 times higher under no-tillage than conventional tillage, making aluminum toxicity a serious threat to crop productivity. The high acidity and, probably to some extent the high organic matter, decreased activity of the triazine herbicides, resulting in poor weed control. The acidity problems were corrected by surface applications of lime.

Exchangeable potassium in the surface 2 inches was about twice as high under no-tillage as conventional tillage. The Maury soil on which this study was conducted has a very high labile phosphorous content, end we did not apply phosphorus fertilizer, but **if** we had, higher levels of soil phosphorus would be expected to accumulate near the surface as potassium did. This distribution pattern does not appear to be a problem in crop production and may actually increase availability of phosphorus. The higher soil water content near the surface under no-tillage enhances phosphorus diffusion and encourages root proliferation in that zone.

Another experiment was begun in 1983 to study the effects of disk tillage and chisel-plow tillage along with no-tillage and conventional tillage. Measured properties and yields to date suggest that the effects of disk tillage and chisel-plow tillage are between the extreme conditions of no-tillage and conventional tillage and are closely related to the amount of soil disturbance and residue left on the surface.

Long-Term Sovbean Tillage Study

A long-term study comparing tillage methods for single-cropped and double-cropped soybeans was initiated at Princeton in 1980 and continued through 1985. Tillage methods for both cropping systems include: **(1)** conventional tillage (plow, disk and roterra), (2) minimum tillage (chisel plow and field cultivate), and **(3)** no-tillage. Yields are shown in Table 3.

Table 3. Effects of Tillage on Yield of Single-Cropped and Double-Cropped Soybeans (Average of 1980-1985).

| Cropping system | Tillage method | Yield |
|---|---|---|
| | | bu/acre |
| Single-crop | Conventional tillage | 35 |
| | Minimum tillage | 35 |
| | No-tillage | 36 |
| Double-crop | Conventional tillage | 24 |
| | Minimum tillage | 26 |
| | No-tillage | 27 |

After six years, there have been no apparent detrimental effects of reduced tillage on soybean yields. Soil data is currently being analyzed to determine the long-term effects on certain soil properties.

Leaume Winter Cover Crops in No-Tillage

To obtain maximum benefits from the advantages inherent in the no-tillage system, a winter cover crop is needed to produce additional residue for mulch. A legume mulch provides all of the advantages of a nonlegume mulch (e.g., erosion control, increased infiltration, and decreased evaporation), while also supplying a substantial quantity of N to the corn crop.

The effects of winter cover and N fertilizer on yield of no-tillage corn from 1977 through 1981 are shown in Table 4. Hairy vetch significantly increased corn grain yield, and its effect was still apparent with 90 lb/acre fertilizer N. Big flower vetch, crimson clover, and rye cover crops also increased yields of corn compared to corn residue, but their effects were much smaller than for hairy vetch. This difference was due in part to the yield and N content of the cover crops, as shown in Table 5. Hairy vetch outyielded and produced more N than the other cover crops, and in turn, enhanced corn yield the most.

Table 4. Effect of Cover Treatment and N Fertilizer Rates on No-tillage Corn Grain Yield (Average of 1977-1981).

| | N rate, lb/acre | | |
|---|---|---|---|
| Cover treatment | 0 | 45 | 90 |
| | --------Yield of corn, bu/acre--------- | | |
| Hairy vetch | 102 | 108 | 143 |
| Big flower vetch | 67 | 105 | 105 |
| Crimson clover | 70 | 91 | 118 |
| Rye | 64 | 91 | 121 |
| Corn residue | 60 | 83 | 104 |

Table 5. Dry Matter Yield and N Content of Cover Crops at Corn Planting (Average of 1980–1981).

| Cover crop | Yield of cover crops | % N | N content |
|---|---|---|---|
| | tons/acre | | lb/acre |
| Hairy vetch | 2.3 | 4.1 | 189 |
| Big flower vetch | 0.8 | 3.2 | 52 |
| Crimson clover | 1.1 | 2.4 | 52 |
| Rye | 1.5 | 1.15 | 35 |

In 1984, the plots of this experiment, which had been in continuous no–tillage corn, were split into conventional tillage and no–tillage treatments. The average grain yields for 1984 and 1985 are shown in Table 6. Without N fertilizer applied, yields were considerably higher with conventional tillage than with no–tillage. However, with N fertilizer, yields were about the same for both tillage methods, with a very slight tendency to be higher for no–tillage. Lower N mineralization probably accounted for lower yields under no–tillage with no N fertilization, and the better soil moisture conditions in no–tillage probably accounted for the trend toward higher yields at the higher N rate.

Table 6. Effects of Cover Treatments, N Fertilizer Rates, and Tillage Methods on Corn Grain Yield (Average of 1984-1985).

| | N fertilizer applied, lb/acre | | | | | |
|---|---|---|---|---|---|---|
| | 0 | | 75 | | 150 | |
| Cover treatment | CT | NT | CT | NT | CT | NT |
| | Yield of corn, bu/acre | | | | | |
| Hairy vetch | 113 | 102 | 108 | 115 | 123 | 123 |
| Big flower vetch | 87 | 64 | 121 | 121 | 100 | 109 |
| Rye | 56 | 45 | 95 | 86 | 110 | 105 |
| Corn residue | 64 | 44 | 94 | 90 | 105 | 107 |

Grain yields with the hairy vetch cover crop treatment without N fertilizer were about equal to yields with the other cover treatments and 150 lb/acre fertilizer N. Our results indicate that N fertilizer application to the corn should not be decreased substantially following a legume winter cover crop because the effect of hairy vetch appears to augment corn yield rather than replace N fertilizer needs.

Cover crops may deplete available soil water and cause poor germination, slow seedling growth, and early water stress during a dry spring. Soil water at corn planting (May 14, 1985) is shown in Table 7). Clearly, the potential for a serious water stress existed, but timely rainfall averted any problems.

Table 7. Effect of Hairy Vetch Cover Crop on Soil Water at Corn Planting, May 14, 1985.

| Soil depth | Corn residue | | Hairy vetch | |
|---|---|---|---|---|
| | CT | NT | CT | NT |
| inches | % water by weight | | | |
| 0–6 | 24.0 | 23.5 | 19.7 | 21.0 |
| 6–12 | 20.5 | 20.5 | 15.0 | 14.8 |
| 12–18 | 22.0 | 23.5 | 15.2 | 15.0 |
| 18–24 | 24.2 | 25.5 | 18.2 | 17.8 |

Shortly after being killed, the mulch formed by the cover crops with no–tillage began to conserve soil water. For example, in mid–July 1984, soil water in the 0– to 6–inch depth was 28% (weight basis) under the hairy vetch - no–tillage treatment and 23% with the hairy vetch - conventional tillage treatment. In mid–August 1985, soil water was still about 2.5 percentage points greater with hairy vetch - no–tillage than with hairy vetch - conventional tillage.

## Nitrogen Fertilizer Management in No-tillage

The unique microenvironmental conditions and the application of crop residues and soil amendments at the soil surface with no–tillage greatly influence soil fertility relative to conventional tillage. Most of the research in Kentucky on improving N fertilizer efficiency has emphasized three management tecniques: (1) delayed or split application of N fertilizer, (2) subsurface band placement of N fertilizer, and (3) chemical inhibition of nitrification.

Time of Application. Denitrification and leaching are more likely to occur early in the growing season, because the higher soil water content at that time makes conditions more favorable for both losses. No–tillage also enhances potentials for both losses. By delaying most of the N fertilizer for no–tillage fields until after the greatest potential for denitrification and leaching has passed, N losses are largely averted. Additionally, availability of the major portion of N coincides more closely with rapid N uptake demand by corn. Approximately, 98.5 to 99% of the N uptake by corn during the growing season is taken up after 30 days following planting.

Our research has shown clearly that delayed application of N fertilizer improves N efficiency and increases corn yield with no–tillage, especially at the lower rates (Table 8). Yields were generally not increased by delayed or split application with conventional tillage (data not shown).

Nitrogen fertilizer recommendations for corn in Kentucky include the recommendation that the amount of fertilizer N can be decreased by 35 lb/acre for no–tillage corn on moderately well–drained soils, or for conventional tillage corn on moderately well–drained to poorly drained

Table 8. Effect of Delayed Application of N Fertilizer on Yield of No-tillage Corn at Nine Locations in Kentucky.

| Soil | Drainage class† | Fertilizer N applied: 75 lb/acre, At plant | 75 lb/acre, Delay | 150 lb/acre, At plant | 150 lb/acre, Delay |
|---|---|---|---|---|---|
| | | ----------Yield of corn, bu/acre---------- | | | |
| Allegheny | wd | 142 | 152 | 166 | 164 |
| Baxter | wd | 176 | 172 | 176 | 184 |
| Lowell | wd | 136 | 163 | 197 | 181 |
| Pope | wd | 121‡ | 147‡ | -- | -- |
| Cavode | spd | 138 | 140 | 156 | 148 |
| Hampshire | mwd | -- | -- | 104 | 131 |
| Monongahela | mwd | 111 | 127 | 169 | 134 |
| Tilsit | mwd | 106 | 119 | 132 | 126 |
| Tilsit | mwd | 107 | 129 | 129 | 156 |

† wd = well-drained; mwd = moderately well-drained; spd = somewhat poorly drained.

‡ 80 lb/acre N.

soils if as much as two-thirds of the N fertilizer is applied 4 to 6 weeks after planting. No-tillage is not recommended on poorly drained soils.

N Fertilizer Placement. Recent research at three locations in Kentucky showed that subsurface banding of N fertilizer for no-tillage corn was more efficient than surface broadcast application (Table 9). Since the N fertilizer was placed below the zone of high organic matter and high microbial biomass and activity, the advantage was probably due to a decrease in both immobilization and denitrification.

Table 9. Effect of N Fertilizer Placement on Corn Yield (Average of 2 Years).

| Soil | N fertilizer | Method of application: Surface broadcast | Subsurface band |
|---|---|---|---|
| | ---lb/acre--- | ---Corn yield, bu/acre---- | |
| Donerail | 100 | 114 | 124 |
| Pope | 80 | 108 | 141 |
| Tilsit-Johnsburg | 75 | 91 | 117 |

Denitrification and leaching losses of fertilizer N are probably most influential in less than well-drained soils during wet years. On the other hand, immobilization might be likely to decrease N fertilizer uptake and efficiency every year under no-tillage. Table 10 shows that, on a Maury silt loam soil, labeled fertilizer N lost, presumably by denitrification and leaching, was about the same in no-tillage and conventional tillage.

Table 10. Fate of Fertilizer N in No-tilled and Conventionally Tilled Maury Soil.

| N rate | Tillage | Fertilizer N In grain | Immobilized | Lost |
|---|---|---|---|---|
| lb/acre | | --- | % | --- |
| 75 | No-tillage | 23 | 42 | 29 |
| 75 | Conventional | 40 | 27 | 26 |
| 150 | No-tillage | 29 | 39 | 25 |
| 150 | Conventional | 28 | 37 | 27 |

However, at the lower N fertilizer rate much more of the N was immobilized in no-tillage, consequently less was taken up by the plants.

If the N fertilizer contains urea, another potential loss is averted by subsurface banding. Ammonia volatilization from surface-applied urea may range from 0 to about 30% of that applied, depending on how soon it rains after the application.

Chemical Inhibitors. We have tested the use of the nitrification inhibitors, nitrapyrin (N-Serve) and dicyandiamide (DCD), as another means of improving the efficiency of N fertilizer in no-tillage corn production. In most of these studies, nitrapyrin was sprayed directly onto granular urea and ammonium nitrate just before broadcasting them on the soil surface at planting time. Averaged over several years at several locations in Kentucky, yield increases of no-tillage corn attributed to nitrapyrin were generally near 25% when used with suboptimum N rates applied at planting. We obtained no consistent response to nitrapyrin for conventional tillage corn.

In recent studies, nitrapyrin and DCD were applied with ammonium sulfate. Monitoring soil N throughout the growing season showed clearly that both chemicals functioned adequately as nitrification inhibitors, but neither affected corn yields significantly.

## Other Nitrogen Management Studies

To determine whether substantial fertilizer N was carried over in a Pope silt loam soil from applications of 80 and 160 lb/acre N for no-tillage corn in 1984, an experiment was conducted in which no fertilizer N was applied in 1985. Also, a fertilizer N response curve was determined from broadcast applications of 80, 160, and 240 lb/acre N as ammonium nitrate.

The control treatment, which received no N fertilizer in 1985 nor during four previous years, yielded 32 bu/acre. Yields from plots which had received either 80 or 160 lb/acre in 1984 were no greater than the control, indicating no carryover N effect on corn yields in 1985. Fertilizer N broadcast at planting at 80, 160, and 240 lb/acre resulted in yields of 89, 148, and 172 bu/acre, respectively.

Tillage and Soil conservation

In 1984, a set of erosion plots was established at Lexington, Ky. on a Maury silt loam soil with 8 to 9% slope to study the effects of conventional tillage, chisel-plow tillage, and no-tillage on runoff, erosion, and water quality in corn production. Some of the results from 1985 are shown in Table 11.

Table 11. Runoff, Erosion, and Corn Yields with Conventional Tillage, Chisel-Plow Tillage, and No-tillage on Maury silt loam soil (1 January - 31 December 1985).

| Tillaae | Runoff loss | Soi1 loss | Corn Yield |
|---|---|---|---|
| | acre-inch | ton/acre | bu/acre |
| Conventional tillage | 1.16 | 8.00 | 125 |
| Chisel-plow tillage | 0.34 | 0.18 | 126 |
| No-tillage | 0.48 | 0.16 | 133 |

Conventional tillage resulted in the highest runoff and soil loss by far, while there was little difference in soil loss from chisel-plow and no-tillage treatments. The chisel-plow treatment had somewhat lower volume of runoff, probably because of the rough surface left by chisel-plowing. Soil loss under conventional tillage exceeded by about two times the tolerance limit for the Maury soil established as T = 4 tons/acre/year by the universal soil loss equation (USLE). Soil loss was far below the T value with no-tillage and chisel-plow tillage. Nitrates, phosphates, and atrazine in the runoff were greatest for conventional tillage; nitrates and phosphates were least for no-tillage, but atrazine was slightly higher in no-tillage runoff than in chisel-plow runoff. Most of the differences in water quality factors, however, were not statistically significant because of wide variations in the data collected.

A similar study was begun in 1985 at Princeton, Ky. with five different tillage and cropping systems for soybeans on a Zanesville silt loam soil with 7 to 9% slope and T value of 3 tons/acre/year. Table 12 shows the average runoff and soil loss during the 1985 growing season (15 May–28 October). No-tillage with full-season soybeans decreased soil loss from about 4 tons/acre to about 0.20 ton/acre or lower. Double-cropping soybeans with wheat was also effective in decreasing soil loss. Soil loss was not directly proportional to water loss.

Tillage-soil erosion research has been conducted since 1982 on a Lowell silt loam soil with 8 to 15% slope in Clark County, Ky. Four corn tillage treatments were applied, each on a different small watershed. Results are shown in Table 13 for 1982–1984. Corn yield was significantly highest from no-tillage, and soil loss was significantly higher from conventional and chisel-plow tillage than from no-tillage and disk tillage. Soil loss from the watersheds with conventional tillage and chisel-plow tillage slightly exceeded the tolerance limit (T) of 3 tons/acre/year. No-tillage and disk tillage kept soil loss far below the T value.

Table 12. Effect of Soybean Tillage and Cropping System on Runoff and Soil Loss on Zanesville silt loam soil.

| Cropping and tillage system | Runoff loss† | Soil loss† |
|---|---|---|
| | acre-inch | ton/acre |
| Full season soybeans: | | |
| Conventional tillage | 7.5 | 4.04 |
| No-tillage | 2.8 | 0.19 |
| No-tillage into wheat cover crop | 3.0 | 0.12 |
| Double-crop wheat--soybeans: | | |
| Conventional tillage | 5.5 | 0.51 |
| No-tillage | 4.2 | 0.08 |

† 15 May–28 October 1985.

Table 13. Three-Year Average Seasonal Soil Loss and Corn Yield on Lowell silt loam soil (1982-1984).

| Tillage treatment | Soil loss | Corn Yield |
|---|---|---|
| | ton/acre | bu/acre |
| No-tillage | 0.10 | 141 |
| Chisel-plow tillage | 3.24 | 113 |
| Disk tillage | 0.17 | 127 |
| Conventional tillage | 3.68 | 115 |

Burley Tobacco Production Using No-tillage

An experiment including no-tillage and conventional tillage techniques for production of burley tobacco was initiated in 1984. In no-tillage, the tobacco plants were transplanted directly into killed bluegrass-fescue sod (at Lexington) or into killed wheat cover crop (Grant County). Transplant survival was 96 to 100% in both no-tillage and conventional tillage. Yield and average market value of leaf are shown in Table 14. Leaf quality, as indicated by the support price of federal grade, tended to be higher for no-tillage tobacco than for conventional tillage tobacco.

Table 14. Effect of Tillage on Yield and Market Value of Burley Tobacco.

| | Leaf yield | | Market value | |
|---|---|---|---|---|
| | Lexington† | Grant Co.‡ | Lexington† | Grant Co.‡ |
| | --------lb/acre-------- | | ----------$/acre---------- | |
| Conventional tillage | 2,575 | 3,175 | 4,550 | 4,800 |
| No-tillage | 2,588 | 3,375 | 4,650 | 5,150 |

† Average of 1984 and 1985.
‡ 1985 only.

We concluded that no-tillage could be a viable management tool in the production of burley tobacco, since equal yields and value were obtained with no-tillage and conventional tillage in both a dry year (1984) and a wet year (1985).

No-tillage Weed Research

Research in Kentucky on weeds and herbicides in no-tillage has emphasized four main areas: (1) weed management systems, (2) herbicides and their persistence and movement, (3) weed population dynamics, and (4) weed biology and ecology.

Development of Weed Management Systems. An intensive program of identifying herbicides that perform satisfactorily in no-tillage is being conducted. Foliar herbicides applied either before or after crop emergence and soil active herbicides are being tested in tall fescue sod, small grain cover crops, wheat stubble, and corn residue for weed control in corn, soybeans, and grain sorghum. Associated with these studies, we are evaluating low-volume applications and various formulations in an effort to develop as many weed control options as possible for no-tillage conditions.

Effect of Tillage on Herbicides and Their Persistence and Movement. During the past 5 years, alachlor, linuron, metolachlor oryzalin, pendimethalin, and trifluralin have been studied under conventional tillage and no-tillage soybeans to determine their effectiveness in weed control and persistence and movement in the soil. Weed control has genrally been as good under no-tillage as conventional tillage, but the depth that these herbicides moved in the soil was generally greater with no-tillage. The persistence has varied depending on the herbicide and tillage system.

Effect of Tillage on Weed Population Dynamics. A long-term study to evaluate no-tillage, minimum tillage, and conventional tillage on weed populations is in its seventh year. More winter annual and biennial species have been present in the minimum tillage, and johnsongrass has been more prevalent under no-tillage and minimum tillage than under conventional tillage. No differences in perennial or annual broadleaf species have been noted among tillage systems. Slightly fewer species have been found in a corn and soybean rotation compared to either crop grown continuously.

Weed Bioloav and Ecoloay. Velvetleaf was found to be equally competitive in both conventional tillage and no-tillage corn, even though the emergence of velvetleaf was delayed in no-tillage. The requirements for germination of eastern black nightshade, cutleaf groundcherry, and smooth groundcherry are such that they have the potential to establish equally well in either no-tillage or conventional tillage.

No-tillaae Grain Croppina Svstems

Wheat After Corn. Wheat is often established after corn in Kentucky. Nitrogen management of the previous crop, as well as the residue management system used in wheat seeding, may be an important consideration in N management for the wheat crop. No-tillage management offers growers the opportunity to improve the timeliness of wheat establishment, but fertilizer N losses from the early spring applications to wheat are likely to be larger under no-tillage residue management.

An experiment was conducted on a Maury silt loam soil to evaluate tillage, corn N fertllizer rates, and wheat N fertilizer rates on N nutrition and yields of wheat. Average wheat yields for 1983 and 1984 are shown in Table 15. At lower levels of N availability, conventional tillage wheat outyielded no-tillage wheat. At realistic corn N fertilization rates, however, no-ti11age wheat equaled or outperformed conventional tillage wheat. The optimum level of applied N, however, was generally higher for the no-tillage wheat. No-tillage wheat appears to require more N than conventional tillage wheat when N availability in the soil is low. On the other hand, when an excessive soil N supply combines with the environment to increase lodging pressure, no-tillage wheat seems less likely to succumb to that lodging pressure.

Table 15. Wheat Grain Yield Response to Tillage, Applied N, and Prior Corn N Fertilization Rate (Average 1983 and 1984).

| Corn | Wheat | Wheat yield No-ti11 | Wheat yield Conv. til1 |
|---|---|---|---|
| --------lb/acre-------- | | ------------bu/acre------------ | |
| 0 | 0 | 34 | 50 |
| | 40 | 53 | 69 |
| | 80 | 63 | 70 |
| 100 | 0 | 45 | 57 |
| | 40 | 67 | 62 |
| | 80 | 63 | 58 |
| 200 | 0 | 58 | 52 |
| | 40 | 64 | 52 |
| | 80 | 59 | 50 |

<u>Double-Cropped Wheat and Soybeans</u>. Higher levels of fertilizers are often recommended to growers who double-crop. Fertility requirements have been evaluated under continuous no-tillage double-cropping for 3 years on a Maury silt loam soil. When managed in split application, only 60 lb/acre N was required for wheat. Wheat yields were increased, but not greatly *so,* by increasing soil test P to the 'medium-high' range. Application of K according to soil test recornmendation influenced soybean yields very substantially but only when soil test K was increased from 'low' to 'medium' test levels.

It is apparent that fertilization for double-cropping should be based on the needs of individual crops in the system. Wheat is more responsive to P, therefore, the P fertilizer rate should come from the recommendation guide for that crop. Similarly, the K fertilizer rate should be based on the needs of the soybean crop. These data suggest that it is not appropriate to add together the two single-crop fertilizer rate recommendations for either P or K. All P and K fertilizer may be applied prior to wheat planting.