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## **N Response of Two-row Barley and Economic N Rates**



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**NDSU** NORTH DAKOTA  
STATE UNIVERSITY Department of Soil Science

## ND Barley Production

- North Dakota ranks 3<sup>rd</sup> nationally in barley production
- Traditionally, six-row varieties were grown
- Current N recommendations based on six-row barley
- Recent processor-driven shift from six-row to two-row barley

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Source: [www.kvrr.com/2017/07/20/budweiser-celebrates-barley-growers-midwest-region/](http://www.kvrr.com/2017/07/20/budweiser-celebrates-barley-growers-midwest-region/)

## Malting Quality

- Why the shift from six- to two-row?
  - Malting quality
  - Consistency
- Quality parameters
  - Grain protein
  - Kernel plump

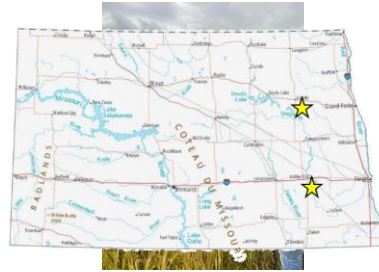


Source: Lauri Herrin, USDA-Agricultural Research Service.

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## Field Trials

- Determine the amount N which will maximize yield and optimize grain quality for malting at a level of **maximum profitability**
- Two Experimental sites over two years
  - Valley City (VC) and Logan Center (LC)
- Five N rates
  - 0, 40, 80, 120, and 160 lb ac<sup>-1</sup>
- Two malting barley cultivars
  - AAC Synergy and ND Genesis



Picture source: Abbey Wick

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## Crop Management

- Standard barley production practices
- Planting and in-season management by cooperating farmers
- N fertilizer application
  - Broadcast applied after planting
  - *SUPERU* urea



Picture source: Abbey Wick

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## Total Known Available N

- Total *quantifiable* N available to a plant during the growing season

$$TKAN = N_{PC} + N_{TC} + N_S + N_{Fert}$$

- $N_{PC}$  and  $N_{TC}$ : N credits from prior crops and tillage
- $N_S$ : Soil nitrate to 2 feet
- $N_{Fert}$ : N added as fertilizer



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## Grain Yield and Quality

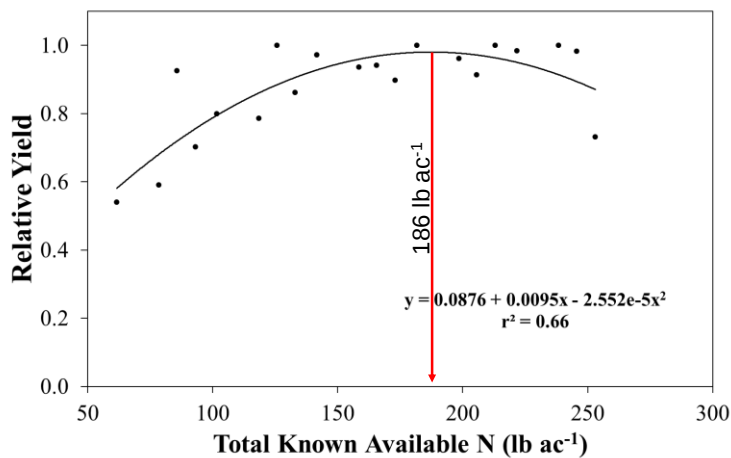
**N rate means combined across varieties and environments**

| N Rate              | Grain Yield         | Grain Protein | Kernel Plump | Test Weight         |
|---------------------|---------------------|---------------|--------------|---------------------|
| lb ac <sup>-1</sup> | bu ac <sup>-1</sup> | %             | %            | lb bu <sup>-1</sup> |
| 0                   | 39.4a†              | 11.2a         | 92.2a        | 47.1a               |
| 40                  | 51.7ab              | 11.9b         | 93.2a        | 47.3a               |
| 80                  | 58.9b               | 12.5c         | 93.7a        | 47.9a               |
| 120                 | 60.3b               | 12.9d         | 93.3a        | 47.8a               |
| 160                 | 60.0b               | 13.3d         | 93.0a        | 47.8a               |

† Means with the same letter are not significantly different at the 0.05 probability level.

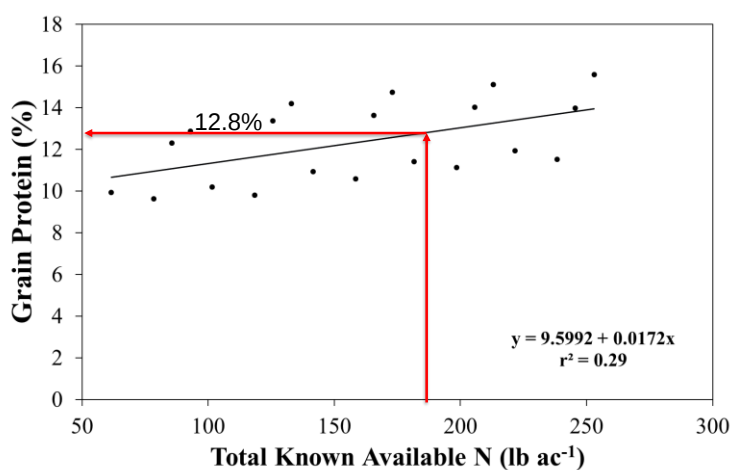
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## Maximum Potential Yield



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## Protein Content at Max Yield



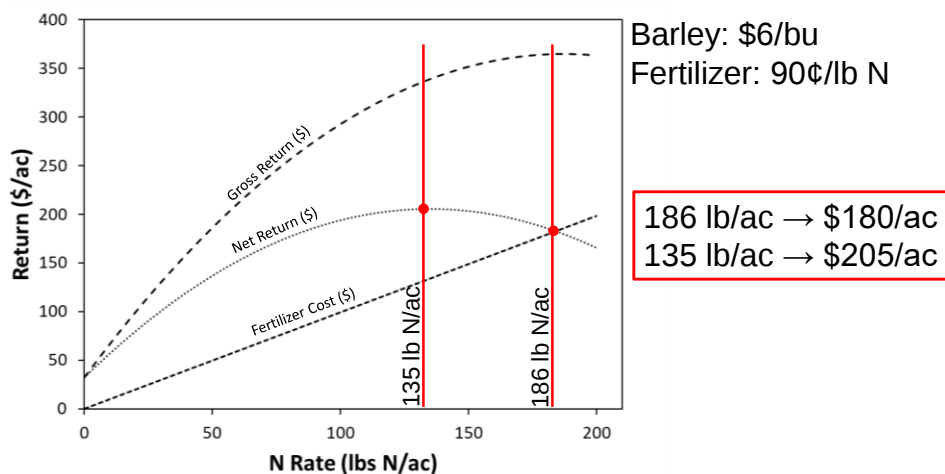
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# Economical N Rates

| Economic Optimum N Rate (lbs TKAN/ac) |             |     |     |     |     |     |     |     |     |      |      |
|---------------------------------------|-------------|-----|-----|-----|-----|-----|-----|-----|-----|------|------|
| Barley Price<br>(\$/bu)               | \$/Ton Urea |     |     |     |     |     |     |     |     |      |      |
|                                       | 184         | 276 | 368 | 460 | 552 | 644 | 736 | 828 | 920 | 1012 | 1104 |
| 3.5                                   | 169         | 160 | 151 | 142 | 133 | 124 | 115 | 106 | 97  | 88   | 79   |
| 3.75                                  | 170         | 162 | 154 | 145 | 137 | 128 | 120 | 111 | 103 | 94   | 86   |
| 4                                     | 171         | 164 | 156 | 148 | 140 | 132 | 124 | 116 | 108 | 100  | 92   |
| 4.25                                  | 172         | 165 | 157 | 150 | 143 | 135 | 128 | 120 | 113 | 105  | 98   |
| 4.5                                   | 173         | 166 | 159 | 152 | 145 | 138 | 131 | 124 | 117 | 110  | 103  |
| 4.75                                  | 174         | 167 | 161 | 154 | 147 | 141 | 134 | 127 | 121 | 114  | 107  |
| 5                                     | 175         | 168 | 162 | 156 | 149 | 143 | 137 | 130 | 124 | 118  | 111  |
| 5.25                                  | 175         | 169 | 163 | 157 | 151 | 145 | 139 | 133 | 127 | 121  | 115  |
| 5.5                                   | 176         | 170 | 164 | 159 | 153 | 147 | 141 | 135 | 130 | 124  | 118  |
| 5.75                                  | 176         | 171 | 165 | 160 | 154 | 149 | 143 | 138 | 132 | 127  | 121  |
| 6                                     | 177         | 171 | 166 | 161 | 156 | 150 | 145 | 140 | 135 | 129  | 124  |
| 6.25                                  | 177         | 172 | 167 | 162 | 157 | 152 | 147 | 142 | 137 | 132  | 127  |
| 6.5                                   | 178         | 173 | 168 | 163 | 158 | 153 | 148 | 143 | 139 | 134  | 129  |
| 6.75                                  | 178         | 173 | 169 | 164 | 159 | 154 | 150 | 145 | 140 | 136  | 131  |
| 7                                     | 178         | 174 | 169 | 165 | 160 | 156 | 151 | 147 | 142 | 138  | 133  |

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## A Tale of Two N Rates



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## Implementing ND Recommendations

- $TKAN = N_{PC} + N_{TC} + N_S + N_{Fert}$ 
  - Collect all your N credits
  - Soil nitrate-N testing!
  - Balance with fertilizer

North Dakota Fertilizer  
Recommendation Tables  
and Equations

| Credits                                                                    |               |
|----------------------------------------------------------------------------|---------------|
| Previous crop                                                              | Credit        |
| Soybean                                                                    | 40 lb N/acre  |
| Dry edible bean                                                            | 40 lb N/acre  |
| Other grain legume crops<br>(field pea, lentil, chickpea, fababean, lupin) | 40 lb N/acre  |
| Harvested sweet clover                                                     | 40 lb N/acre  |
| Alfalfa that was harvested and<br>unharvested sweet clover:                |               |
| >5 plants/sq. ft.                                                          | 150 lb N/acre |
| 3-4 plants/sq. ft.                                                         | 100 lb N/acre |
| 1-2 plants/sq. ft.                                                         | 50 lb N/acre  |
| <1 plant/sq. ft.                                                           | 0 lb N/acre   |
| Sugar beet                                                                 |               |
| Yellow leaves                                                              | 0 lb N/acre   |
| Yellow/green leaves                                                        | 30 lb N/acre  |
| Dark green leaves                                                          | 80 lb N/acre  |

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## Take-Home Points

- TKAN drives both yield and grain protein
- N recommendations
  - Max potential yield
    - 186 lb TKAN ac<sup>-1</sup>
    - Adequate grain protein (12.8%)
  - Maximum profitability
    - Based on barley price and N cost: 79-178 lb TKAN ac<sup>-1</sup>
- TKAN must be calculated correctly:
  - Soil nitrate testing
  - N credits from *North Dakota Fertilizer Recommendation Tables and Equations*

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# Thank You

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