Agronomy 375
Key - Exam I – February 20, 2009

6 pts 1. A producer can monitor input use efficiency by following the cost of production per bushel. Optimum input mix efficiency and maximum profit are associated with the position where **cost per bushel is minimized**. A producer is justified in adding further inputs as long as the cost per bushel continues downward in response. Optimum input mix is attained when inputs are added up to the point where **marginal cost equals marginal revenue** (the last dollar of input cost returns only one dollar in additional revenue).

6 pts 2. Yes. Over the long run, a producer who is watching their input costs as noted in question 1 above, will be adding optimal input levels and avoiding excessive input levels or abusive practices which may prove harmful to the environment or to the long term productive potential of the soil. In addition, effective management of productive fields leaves other, less productive areas out of production and in alternative uses for which they are better suited (e.g. pasture, wildlife refuge, etc.). Example: efficient utilization of applied N fertilizer (as influenced by the timing and rate of application) also means low levels of nitrate leaching into the groundwater. In addition, other less productive acres which would require greater inputs per bushel produced, may then be left out of production.

8 pts. 3. **GIS** is an acronym for "Geographic Information System" and refers to the acquisition and GPS based spatial mapping of a wide range of data. including crop yield, pH, P and K soil test levels, field tile location, field boundaries, and soil type maps. Site-specific data has much potential to improve crop system efficiency when used in management decision-making. Examples may include the following;

Historical yield data coupled with P and K soil test data may be used to determine unique P and K fertilizer application rates for unique management zones (VRT), thereby increasing return on investment in P and K fertilizer.

Historical yield data may be used to define management zones for which unique targeted soil test levels may be established based upon consistency of yield from year to year (i.e. P and K soil test levels in the upper end of the maintenance plateau may be established as goals for management zones yielding consistently at high levels and lower P and K goals may be established for zones where yield varies greatly from year to year).

Historical yield data for zones directly over field tile laterals (GIS mapped in each case) may be compared with yield data from zones between tile laterals as a way to evaluate the potential return on investment which might be realized were additional field tile to be installed (e.g. split the middles of an earlier installed field tile system).

Spatially mapped soil type and prior crop yield data (GIS) may be used to establish application zone maps for variable rate irrigation which would be more efficient than uniform irrigation.

6 pts 4. a) **Soil type** (as denoted on soils maps and visually by color, texture, slope, drainage).

b) **Prior management** Records are used to indicate prior management differences within a field. These might include differences in yield, prior ownership, crop rotation, etc.

Once a field's yield and soil test level histories are established, areas of similarly productive soils with a history of equivalent soil test levels and yields can be consolidated for representative sampling as units or unique management zones).

2 pts 5. a) 8 inches
2 pts b) 8 inches

3 pt. 6. a) **15 ppm**

2 pt. b) **15 ppm to 30 ppm**

2 pt. c) **31 ppm to 40 ppm**

3 pt.. d) **(15 ppm - 11 ppm) (5) = 20 pounds $P_2 0_5$ / acre**

3 pt. 7. a) **75 + (2.5 X 12) = 75 + 30 = 105 ppm**

2 pt. b) **105 ppm to 135 ppm**

2 pt. c) **136 ppm to 155 ppm**

3 pt. d) **(105 – 85) [1 + (0.05 X 12)] = (20) [1.6] = 32 pounds $K_2 0$ / acre**

6 pts 8. Primary symptoms are indicative of direct cause and effect relationships (e.g. hail impact on a corn leaf results in leaf tearing and tissue removal).

Secondary symptoms are indicative of indirect cause and effect relationships (e.g. plant twisting and stunting as leaves are unable to unfurl from the whorl after an earlier hail impact).

6 pts 9. The line transect method measures percent surface cover (by residue).

The measurement is conducted by observing the percent of regularly spaced points (e.g. the foot interval marks on a measuring tape or evenly spaced knots on a knotted rope) which are in direct visual contact with surface residue on a line laid on the soil surface at a 45 degree angle to the previous crop's row direction.

10 pts 10. No-till systems will typically demonstrate higher bulk density (initial tillage lessens bulk density for the first few weeks of the season), lower temperature (insulating blanket of residue retains low soil temperature and residue reflects warming sunlight away), and higher moisture (less evaporative loss under residue means wetter, cooler conditions) near the surface (where young roots are forming) vs. a conventionally-tilled system.

All of these factors result in less total root growth and a more shallow placement of root growth in the no-till system.

6 pts 11. a) Latitude, previous crop residue, and soil drainage all influence soil temperature, which is critical in determining early season corn crop growth rate. Any one or a combination of northern latitude, heavy crop residue and poor soil drainage could result in cool conditions would slow crop growth and lower yield potential.

2 pts. b) An example would be Coulter planted (no-till) corn at a northern Indiana location where the soil is poorly drained, corn is following high yield corn (so here is heavy non-fragile surface residue), and there is an early planting date in an unusually cool spring.

2 pts. c) Possible management in this case would include improvement in soil drainage, rotate corn after soybeans to lessen surface residue at planting or use zone (strip) tillage and/or row residue removal in the fall. One may also use starter fertilizer at plant (or zone placement of P and K fertilizer if zone tillage is used) to provide greater access to applied P and K where roots are restricted in growth.

4 pts 12. a) Reduced yield
b) Decreased height
c) Delayed maturity
d) Tabled (horizontal) roots
e) Visible nutrient deficiency symptoms
f) Heightened drought stress
g) Increased sensitivity to herbicide injury
h) Slowed infiltration of water (surface ponding, evidence of poor drainage such as mottled color or slow crop residue decomposition)
i) High bulk density as reflected by resistance to soil probe or knife
j) Surface crusting indicates shallow compaction resulting from heavy rainfall
k) Seedling lateral roots restricted to seed slot (sidewall compaction).

5 pts 13. a) Shallow rooting and poor root uptake of mineral nutrition
b) Increased soil compaction potential
c) Delayed planting
d) Delayed harvest
e) Late-season drought stress
f) Non-uniform herbicide incorporation
g) Potential delay in field access for post-emergence herbicide application
h) Greater N losses to denitrification

2 pts 14. a) Typical depth of subsurface tile placement is 3 to 4 feet so drainage can be effective through the likely full depth of the corn root zone.

3 pts b) Grassed Waterway.
Conservation and Reduced Tillage Systems.
Contour Cropping.
Surface Ditches (High Water Table Management).
Land Forming (Terraces or Shallow Cut and Fill Or Shallow Cut Waterway)
WASCOB Installation (Water and Sediment Control Basin)

4 pts 15. <u>Examples Of Cultural Practices Which Impact Weed Control In Cropping Systems:</u>
Crop Rotation
Narrow Row Width
High Plant Population
Crop Residue Management (e.g. Remove From Row Area and Consolidate Between Rows)

5 pts BONUS At the Economic Goal (Critical Level) there remains a 10 to 40% probability of yield response to additional P and/or K fertilizer application. However, even though yield level may climb in some years in response to higher soil test levels, other factors such as rainfall amount and distribution, delayed planting date, abnormally cold or hot temperature, disease and insect pressure etc. may be more limiting than soil fertility in a given year. In light of these other potentially yield limiting factors it would not pay (cost per bushel would be high) were a manager to fertilize at the never limiting level. Soil fertility goals may be fine tuned within the maintenance plateau as data is collected regarding the frequency with which soil fertility vs. other factors become most limiting to yield.