Nutrient Turnover and Availability From Crop Residues in a Potato Rotation System

Sponsored By:

Washington State Potato Commission

JUSTIFICATION:

- The residue decomposition and subsequent release of nutrients in inorganic forms from vegetative crop residues renders the nutrient in available form. With respect to nitrogen (N) nutrition, we are referring to decomposition of crop residue and production of ammonium and nitrate forms of N.

- Nitrogen mineralization is important for two major reasons:

  (i) potential release of nitrogen for potato nutrition during the growing season.

  (ii) potential release of nitrogen when a crop is not growing that could result in nitrate transport and losses.

JUSTIFICATION:

- Nitrogen mineralization is related to many different factors.

- The purpose of this study is to increase the understanding of soil organic nitrogen release in potato rotations to improve our ability to predict in season nitrogen availability for potato based on changes in soil temperature and crop residue. Potato is often rotated after corn, wheat, or other crops. The management of these rotational crops and the nutrient contribution from the residue of different crops is important to fine tune the nutrient requirement for potato.

OBJECTIVES:

- To evaluate N mineralization from crop residue following potato, corn, wheat, or alfalfa.

OBJECTIVES:

- To quantify the available N in the subsequent spring that could contribute to crop requirement.

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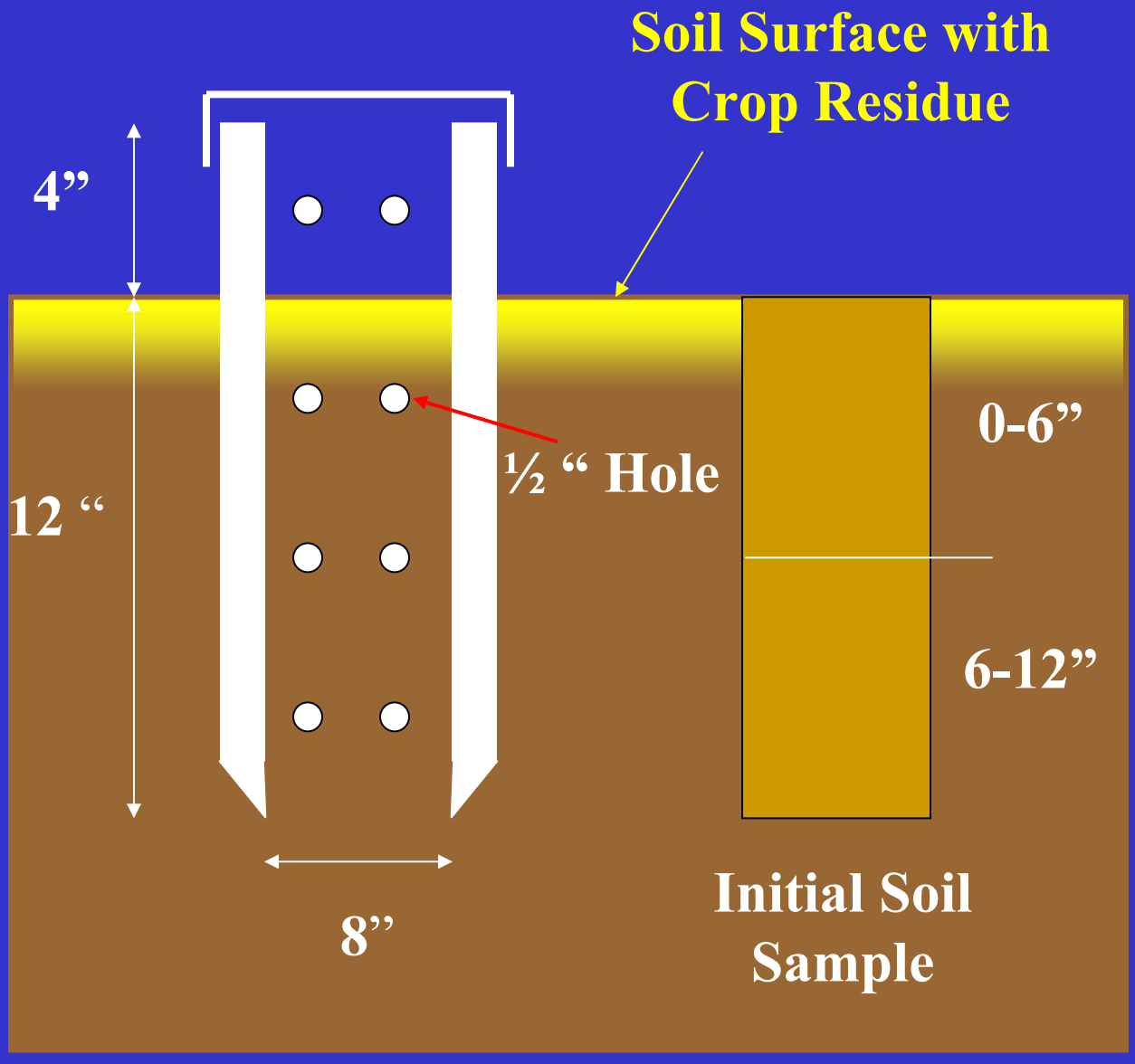
- To evaluate the N mineralization as percent of total potentially mineralizable N soon after harvest as well as during the subsequent crop growing season.

PROCEDURES:

- The experiment was conducted in Quincy sand soil near Paterson, WA.
- The technique adapted in this study is widely recognized and used in several in-situ mineralization studies (Cabrera, et al, 1994; Schepers and Meisinger, 1994; Cassman and Munns, 1980; Dou, et al, 1997).
- PVC columns (5 inch diameter x 14 inch height) was driven into soil to 12 inch depth.

In-Situ N Mineralization



For : Gravimetric Soil Moisture, Plant Residue, pH and KCl extraction for NO_3 and NH_4

PROCEDURES:

- The columns were capped to prevent any precipitation or irrigation application on the soil inside the column which could leach the mineralized nutrients beyond the depth of sampling, thus, could underestimate the mineralization.

- Soil samples were taken adjacent to the column at 0-6 inch and 6-12 inch depths. This initial soil sample was used to characterize the initial content of nitrate (NO_3-N) and ammonium (NH_4-N) at the time of installation of the incubation columns.

PROCEDURES:

- Each depth soil sample was sieved to separate all plant residue.
- The soil was air dried and weight recorded.
- The plant residue was cleaned in tap water with final rinse in distilled water, dried at 74^0 C for 72 hours, and dry weight was recorded.

PROCEDURES:

- The N concentration and dry weight of the plant residue will be used to calculate the total amount of N present in the plant residue at the beginning of the experiment within the area of soil column. i.e. potentially mineralizable N.

- The soil columns were excavated at the incubation period and analysis of KCl extractable NH_4-N and NO_3-N in the 0-6 inch and 6-12 inch depth soil sample.

PROCEDURES:

- The difference in concentrations of NH_4-N and NO_3-N in the soil sample at the end of incubation period and those at initial time represents the amount of N being mineralized.

2000 Nitrogen Mineralization lb/ac

Depth of Sampling	Dry Weight of residue (March)		
	Wheat	Corn	Potato
0 – 6 “	5,003	8,283	2,372
6 – 12”	1,773	3,017	1,694

Depth of Sampling	Potential Mineralizable Nitrogen (March)*		
	Wheat	Corn	Potato
0 – 6 “	75	124	36
6 – 12”	27	45	25

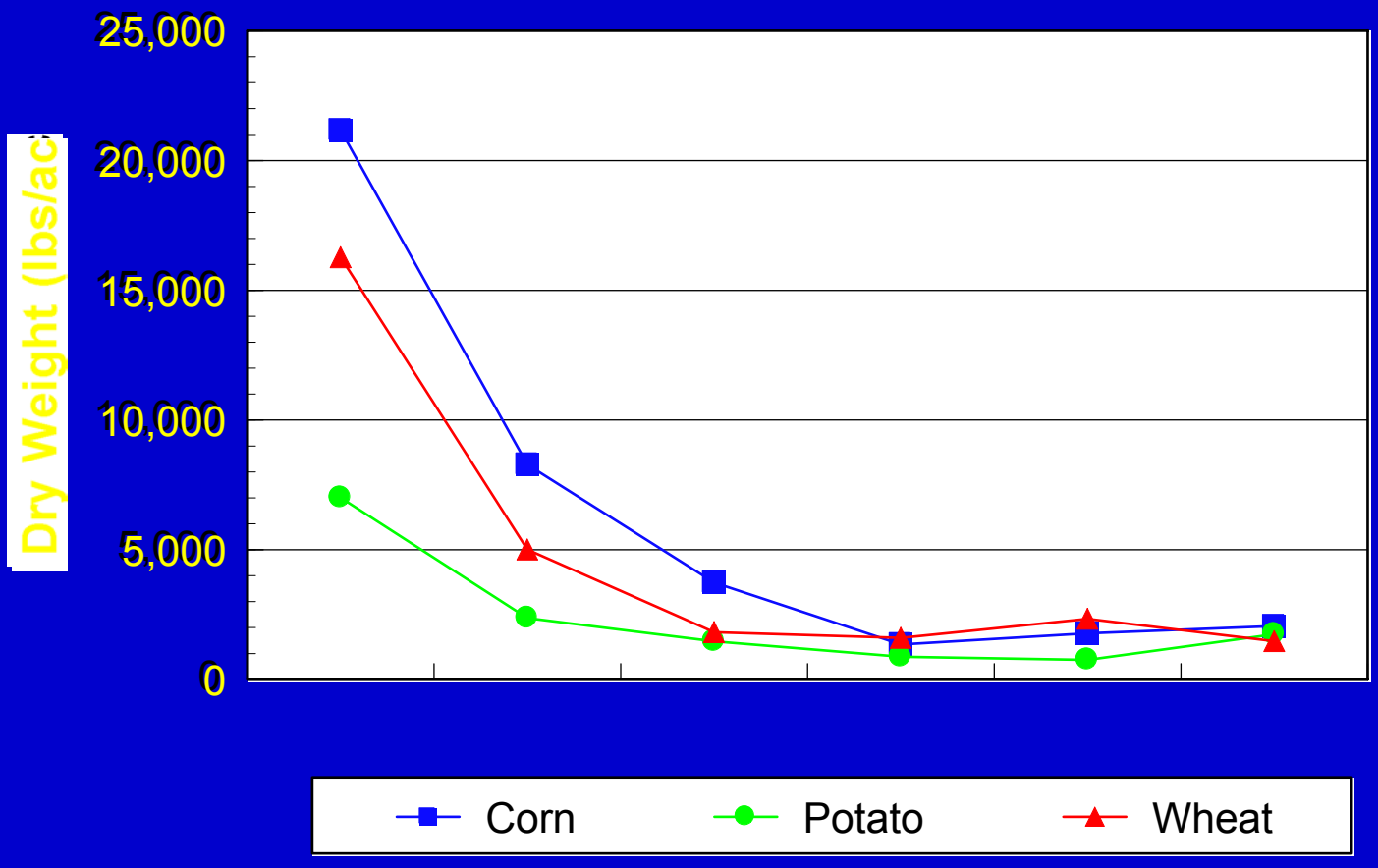
*Residue dry weight x percent total N (residue N is taken as 1.5 %)

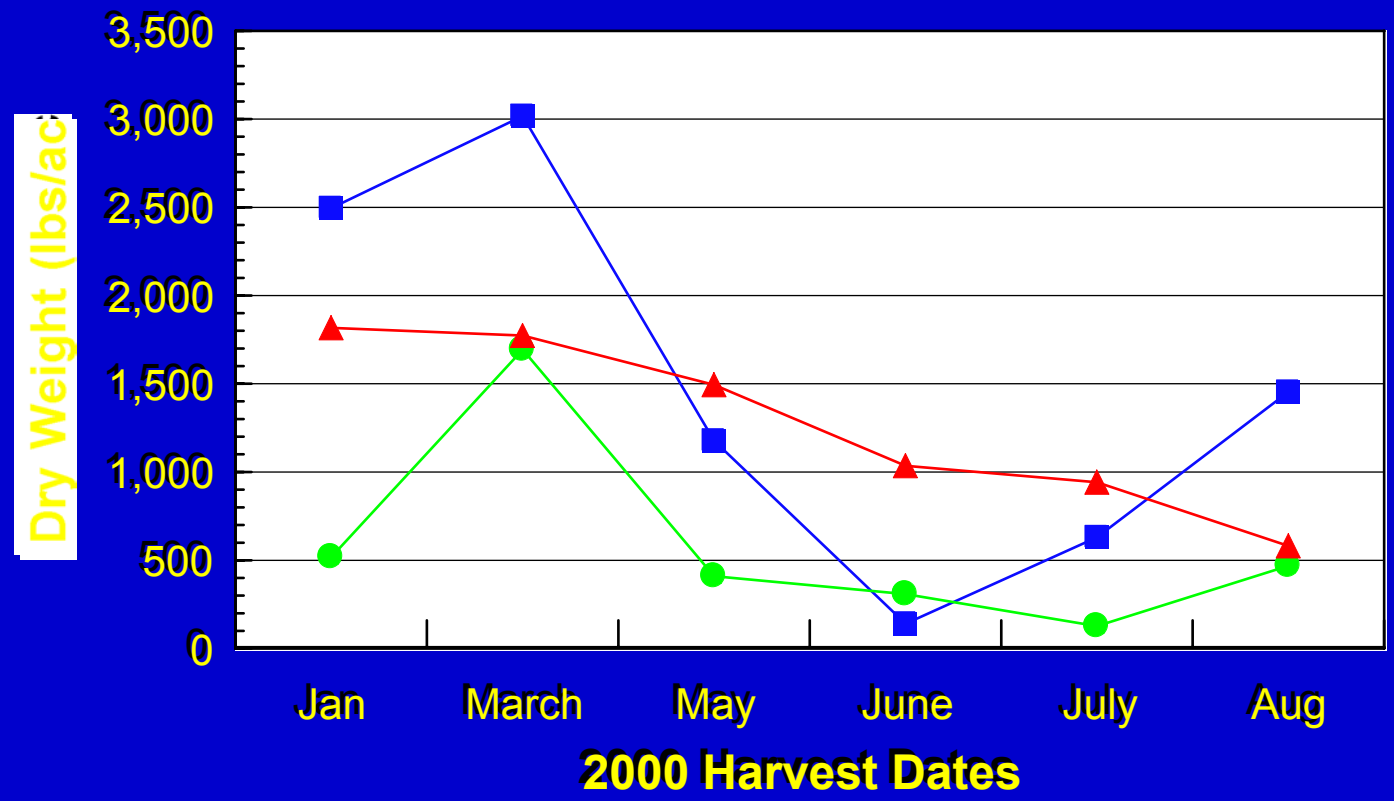
Nitrogen Mineralized from different residue

	March - September		
	Wheat	Corn	Potato
0-6” NO3-N	47	25	21
0-6” NH4-N	3	7	4
6-12 NO3-N	13	42	9
6-12 NH4-N	2	2	1
Total	65	76	35

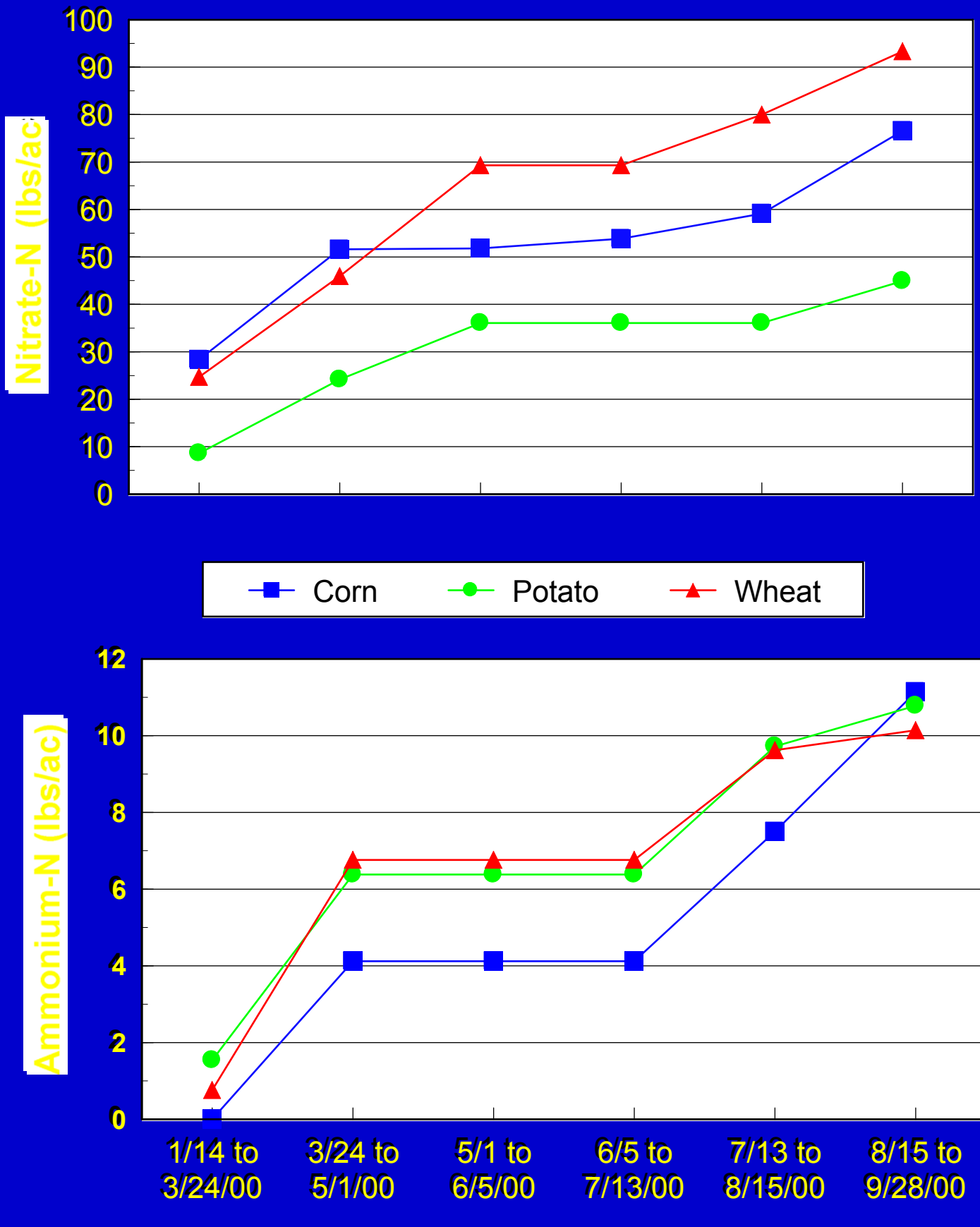
	March – July		
	Wheat	Corn	Potato
0-6” NO3-N	23	2	12
0-6” NH4-N	0	0	0
6-12 NO3-N	5	36	9
6-12 NH4-N	0	0	0
Total	28	38	21

Plant Residue on Dry Wieght Basis (lbs/ac)

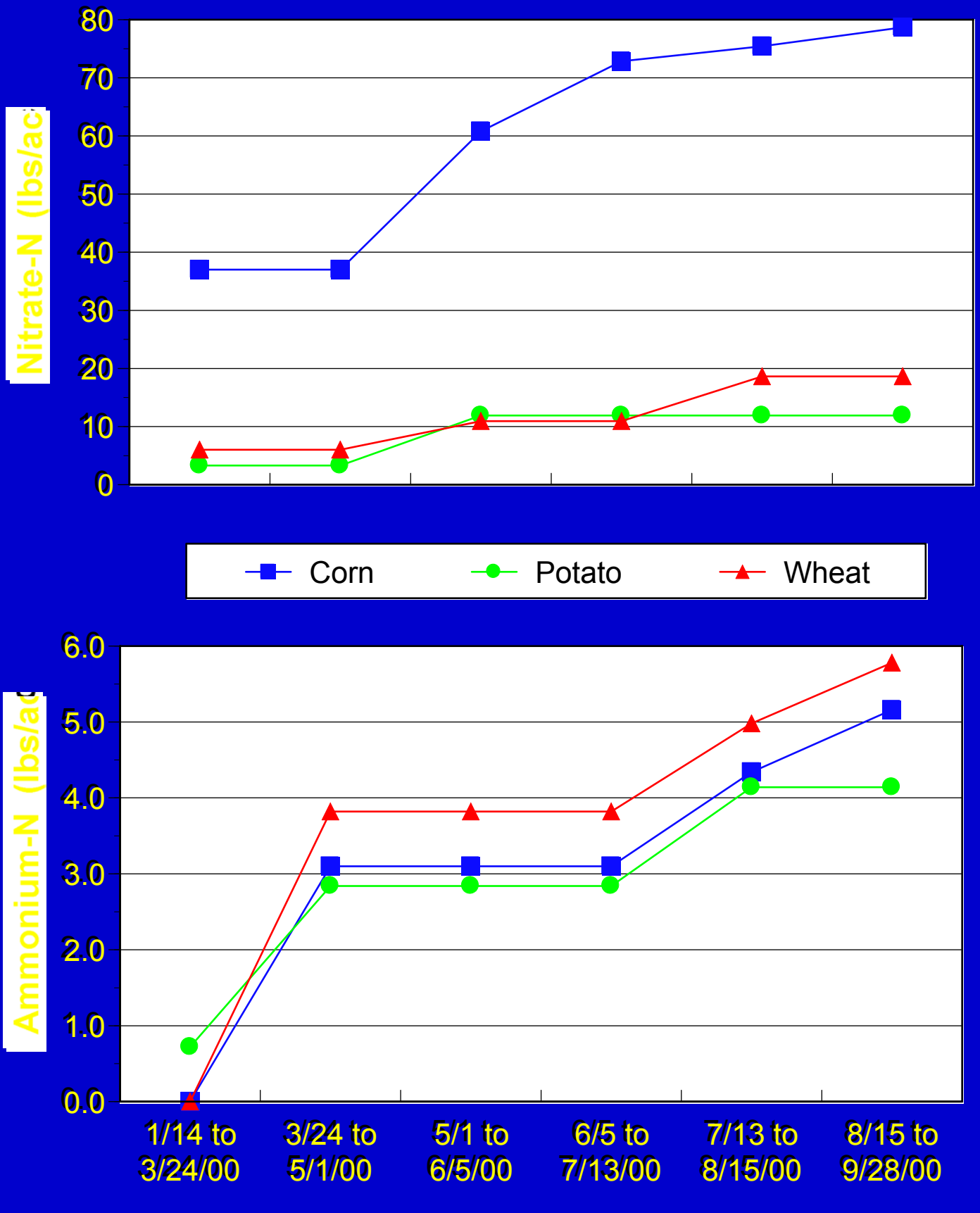




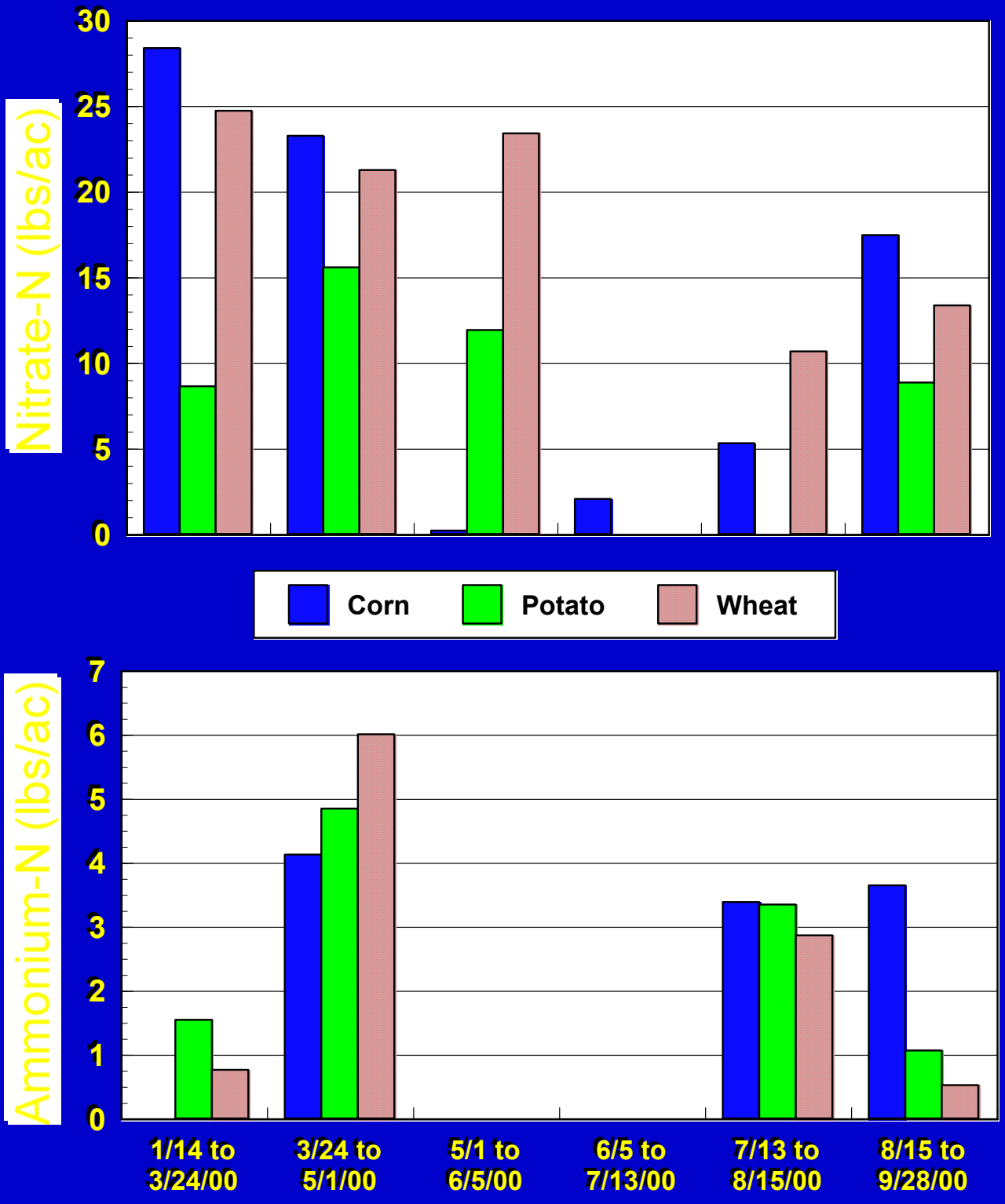
Cumulative N Mineralized (lbs/ac) 0 - 6"



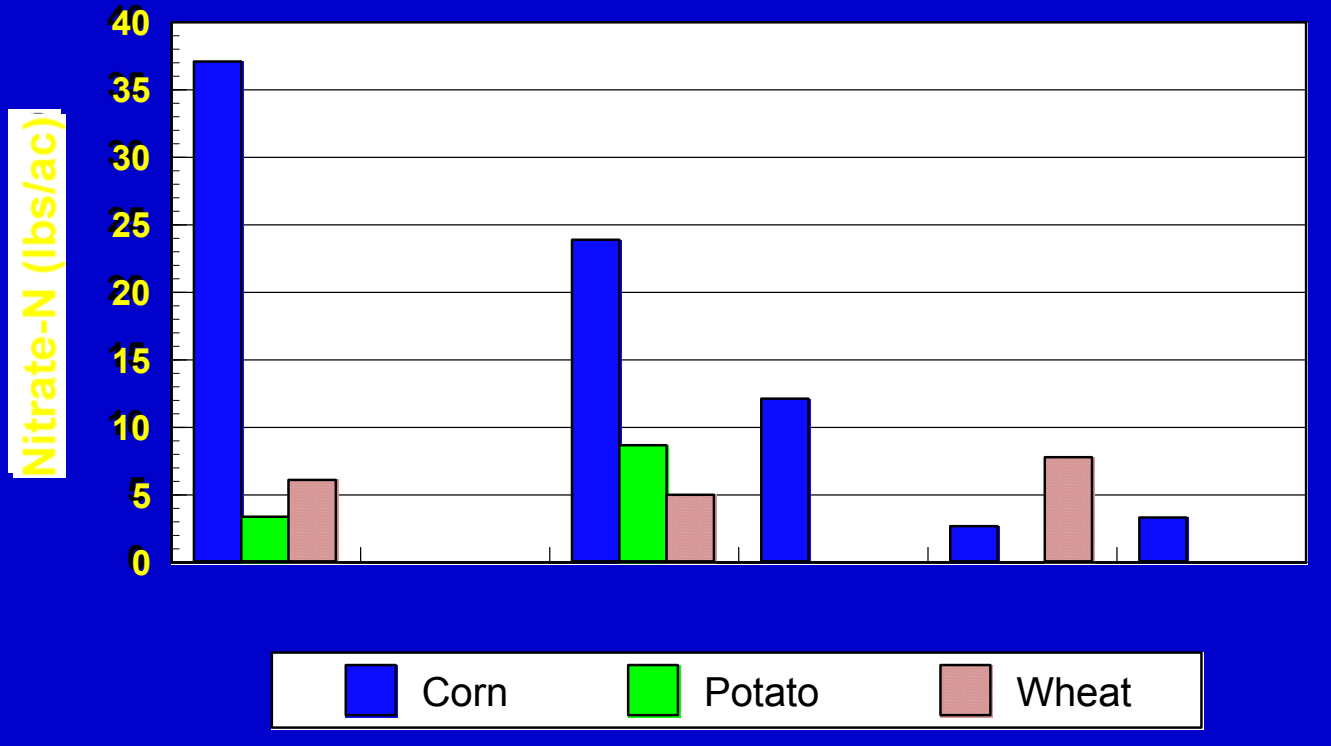
Cumulative N Mineralized (lbs/ac) 6 - 12"

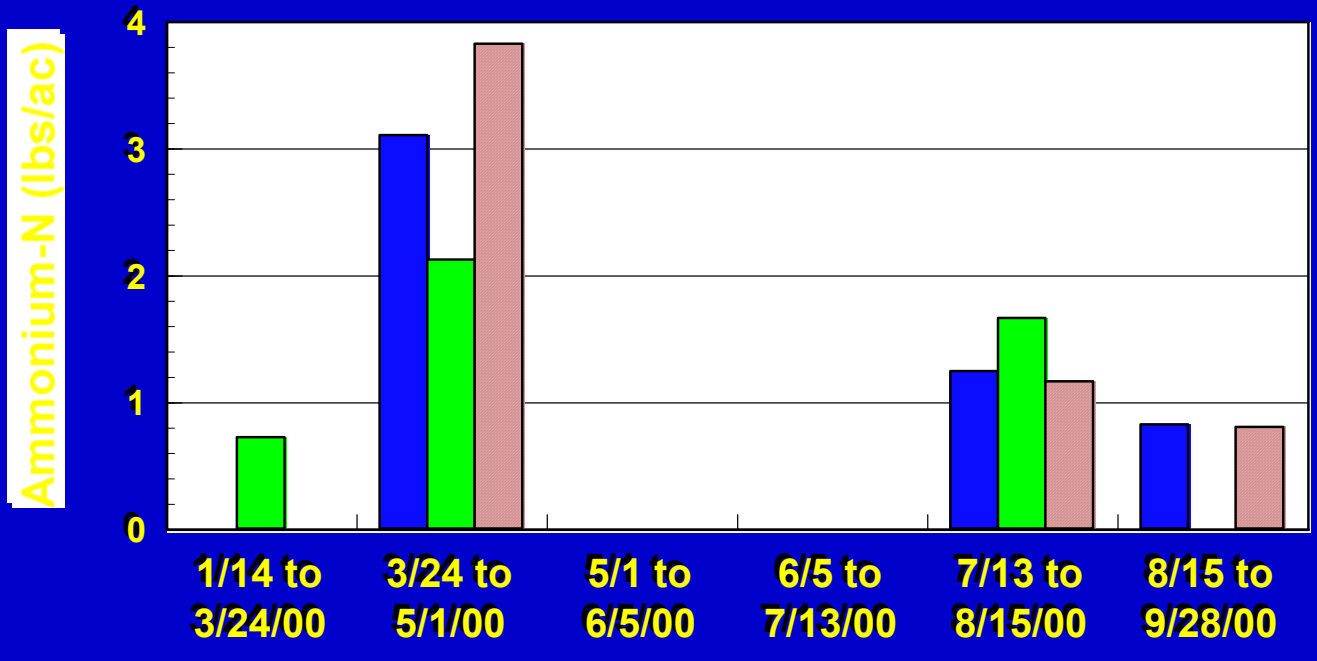


Nitrogen Mineralized at Different Incubation Periods (lbs/ac) 0-6"

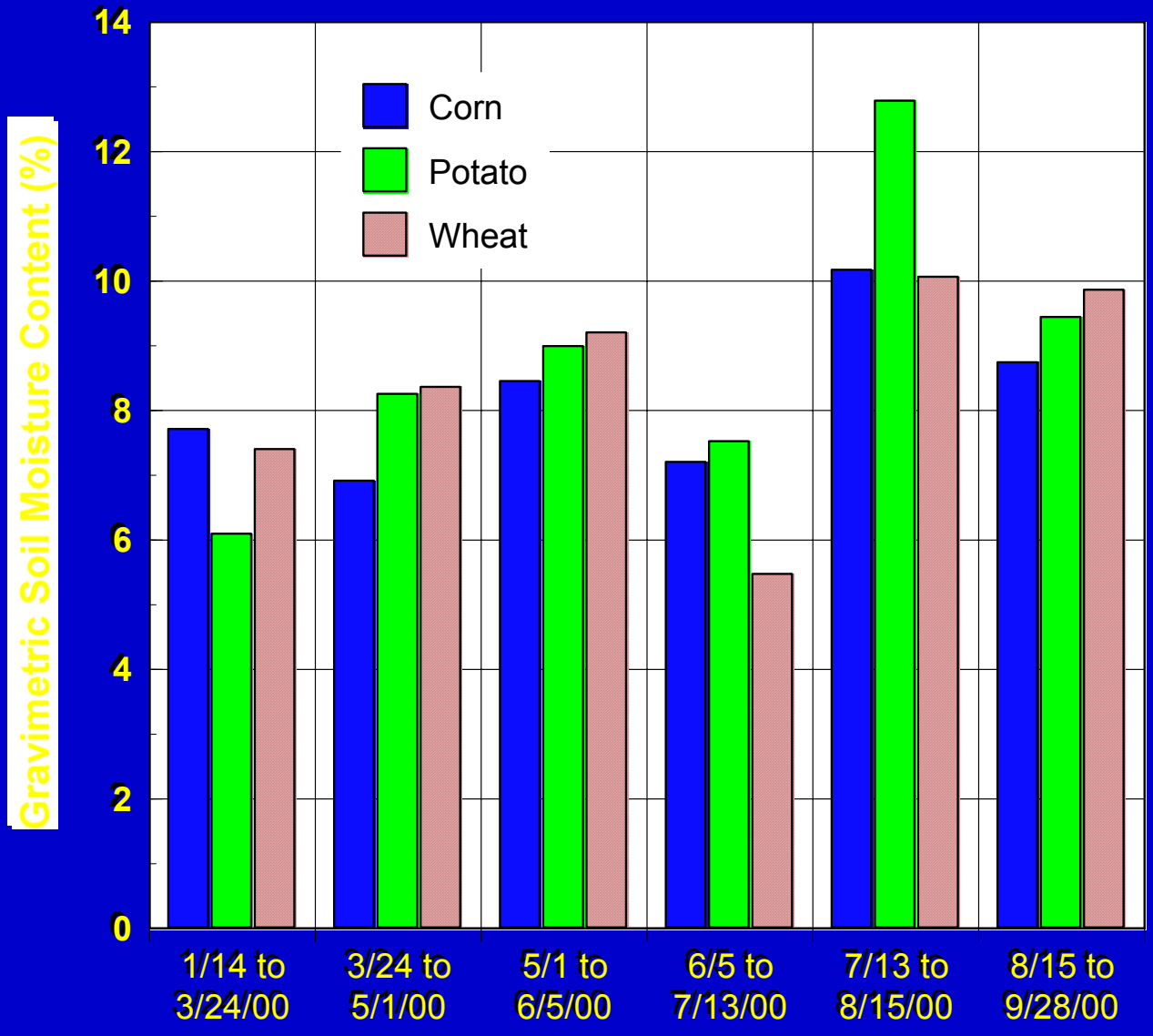


Nitrogen Mineralized at Different Incubation Periods (lbs/ac) 6 - 12"

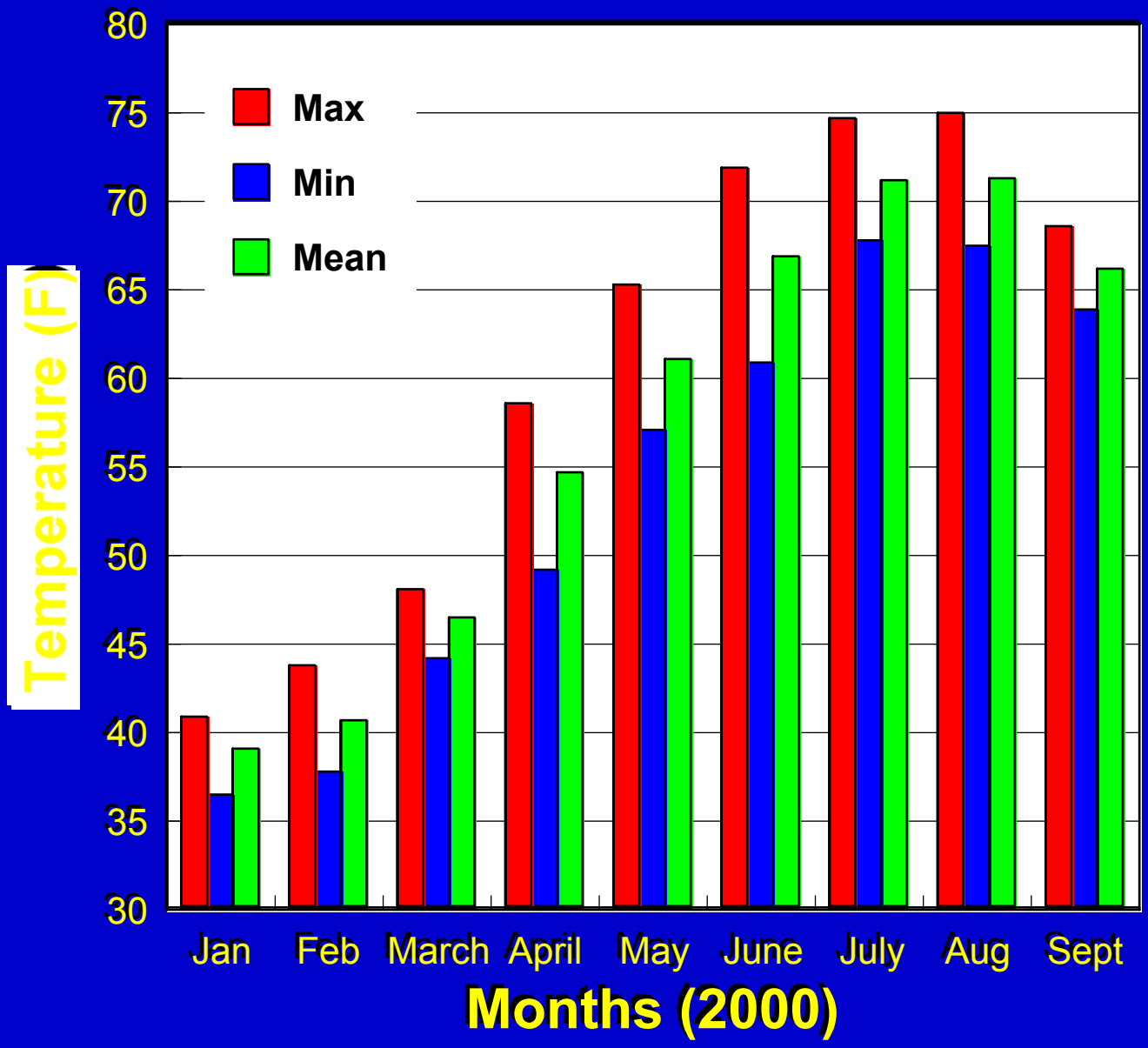




Soil Moisture



Soil Temperature at 8" Depth



CONCLUSIONS

- Field Corn or Wheat crop would contribute residue of about 11,000 and 7,000 lbs in the top foot soil at the time of spring planting.

- The N content in the above residues accounts for 170 and 100 lbs, respectively.

CONCLUSIONS

- N mineralization from Corn and Wheat residue, during March – September, accounts for 76 and 65 lbs, respectively.

CONCLUSIONS

- **The percent mineralization of organic N during the growing period accounts 45 and 65%, respectively.**

CONCLUSIONS

- N mineralization was rapid during March through May, followed by January through March.