

DEPTH OF SAMPLING FOR SOIL TESTING - REVISITED

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INTRODUCTION

Historical databases for deriving Nitrogen recommendations are based on a O-24" sampling depth. This is primarily based on the work by Soper et al. (1971) and a variety of studies carried out throughout the prairies. Carefoot et al. (1989) cautioned the use of soil testing nitrogen values at depths for soft white wheat under irrigation at face value. Henry (personal communication) carried out an extensive sampling program in 1991-93 to establish the spatial variability of nitrate-nitrogen at various depths. An example of his findings is given in Table 1. Henry concluded that a O-12" (O-30cm) sample was more "reproducible" compared to either a O-6" or O-24" sample as far as spatial variability of soil nitrate-nitrogen is concerned.

Table 1. Number of samples required for ± 10 lb N /acre from the true mean (Henry, personal communication)

Producer	Number of samples required		
	12 inches (30 cm)	24 inches (60 cm)	36 inches (90 cm)
Pederson	3	47	56
Carlson	12	23	19
Mitchell	41	172	26
Mickelson	5	40	30

Soil testing laboratories have devised their "preferred" soil sampling schemes based either on O-6" or O-12" sampling depths. Recommendations are usually still based on a O-24" depth but ratios of nitrogen in the O-6" or O-12" depths over the that in the O-24" depth are utilized from historical data to convert nitrogen content to the O-24" depth and thus provide fertilizer recommendations. Research in North Dakota by Gelderman et al. (1988) concluded that only the nitrate-N of the O-30 cm (O-12") depth was significant among the soil depths used (O-15, O-30, O-60, O-90 and O-120 cm) in predicting nitrogen

fertilizer recommendations for wheat. The Saskatchewan Soil Testing Laboratory introduced the use of O-12" (O-30cm) depth in 1990 (Karamanos and Kruger, 1990). Karamanos and Kruger (1990) found that the percentage coefficient of variation (% CV) of 0-24"/0-6" ratios from historical data of the laboratory was extremely high for a O-6" depth to afford a reliable soil testing depth for prediction of the nitrogen fertility status of soils. In contrast, the %CV of 0-24"/0-12" ratios was considerably smaller.

In a Newsletter (June 1990), the Saskatchewan Soil Testing Laboratory compared the recommendations derived from O-6" and O-12" depths to those of O-24" depths for 2,700 fields submitted to the laboratory in the spring of 1990 as 0-6", 6-12" and 12-24" samples. Those comparisons are reproduced in Figures 1-8 for the benefit of the reader.

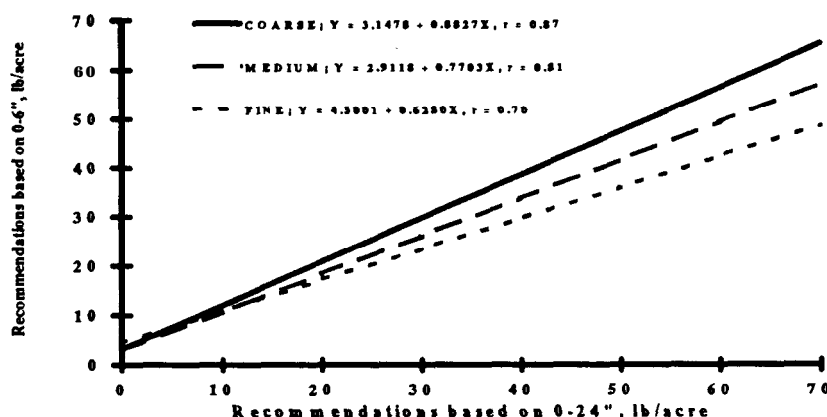


Figure 1. Comparison of fertilizer nitrogen recommendations based on O-6" depth to those based on 0-24" from soils submitted to the Saskatchewan Soil Testing Laboratory from the Brown soil zone in the spring of 1990.

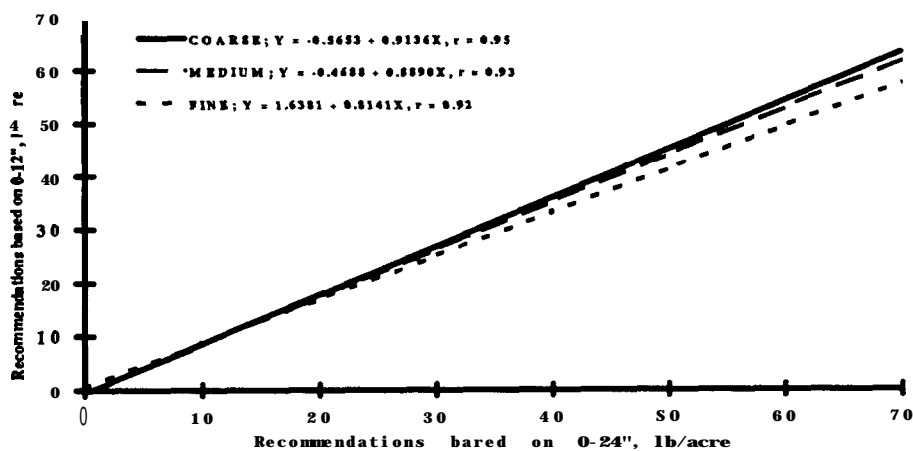


Figure 2. Comparison of fertilizer nitrogen recommendations based on O-12" depth to those based on O-24" from soils submitted to the Saskatchewan Soil Testing Laboratory from the Brown soil in the spring of 1990.

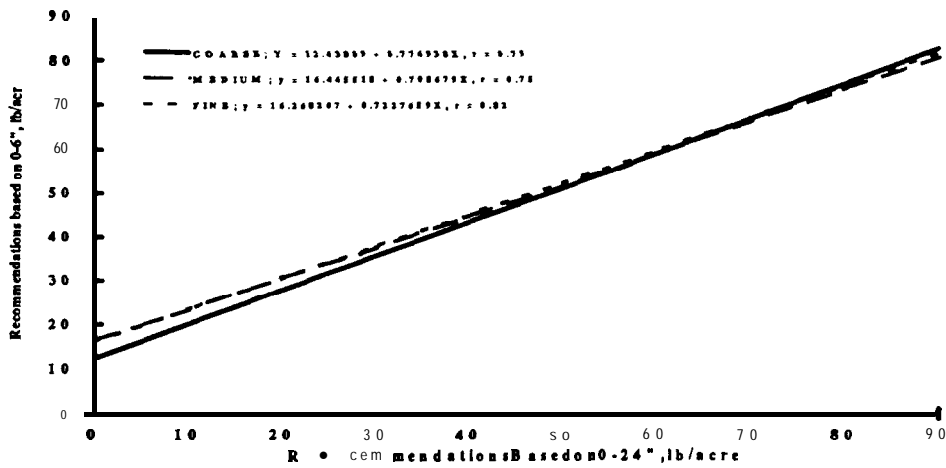


Figure 3. Comparison of fertilizer nitrogen recommendations based on 0-6" depth to those based on 0-24" from soils submitted to the Saskatchewan Soil Testing Laboratory from the Dark Brown soil in the spring of 1990.

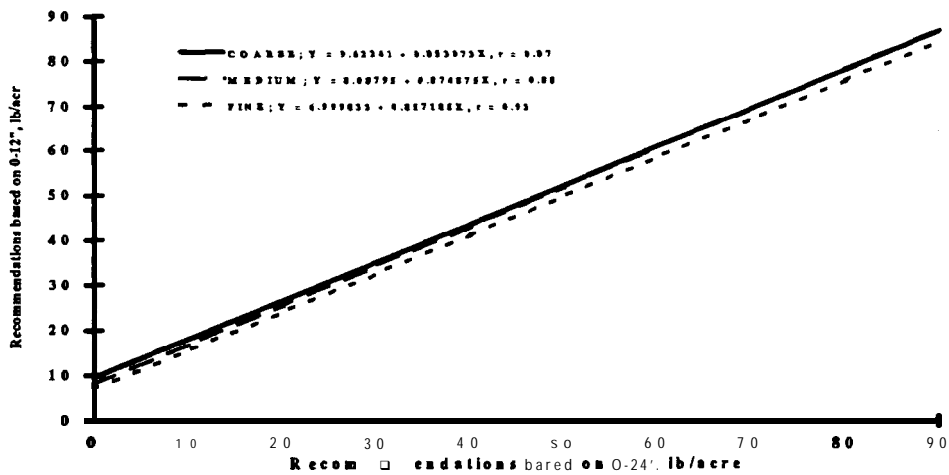


Figure 4. Comparison of fertilizer nitrogen recommendations based on 0-12" depth to those based on 0-24" from soils submitted to the Saskatchewan Soil Testing Laboratory from the Dark Brown soil in the spring of 1990.

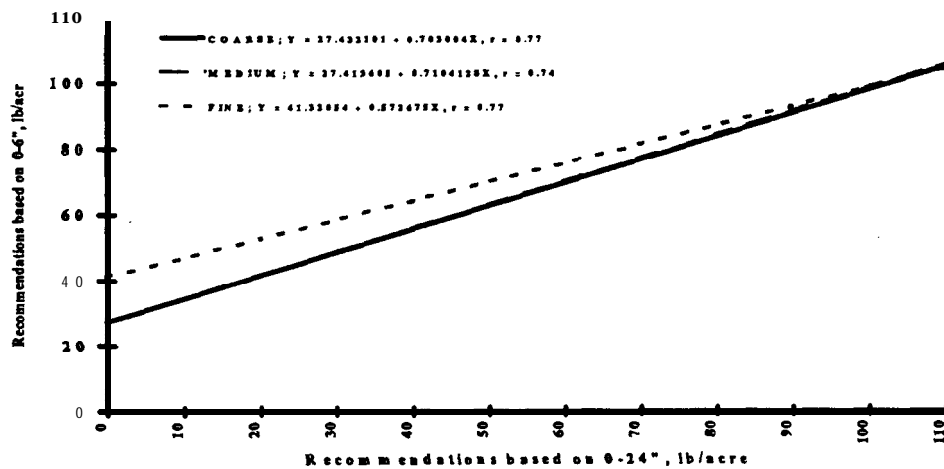
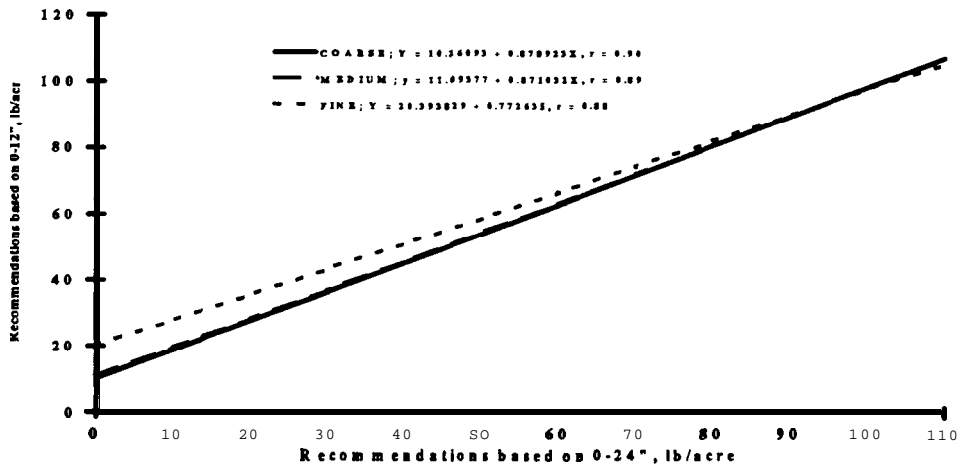


Figure 5. Comparison of fertilizer nitrogen recommendations based on 0-6" depth to those based on 0-24" from soils submitted to the Saskatchewan Soil Testing Laboratory from the Black soil zone in the spring of 1990.



Comparison of fertilizer nitrogen recommendations based on 0-12" depth to those based on 0-24" from soils submitted to the Saskatchewan Soil Testing Laboratory from the Black soil in the spring of 1990.

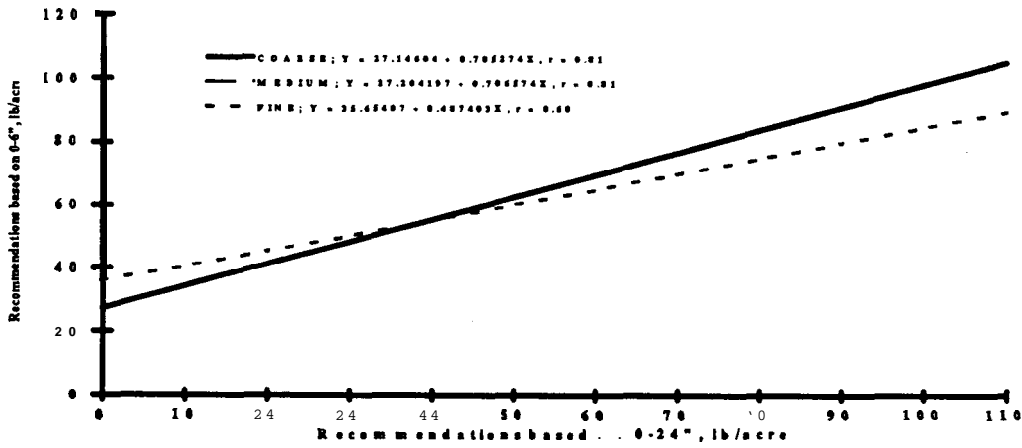


Figure 7. Comparison of fertilizer nitrogen recommendations based on 0-6" depth to those based on 0-24" from soils submitted to the Saskatchewan Soil Testing Laboratory from the Gray soil zone in the spring of 1990.

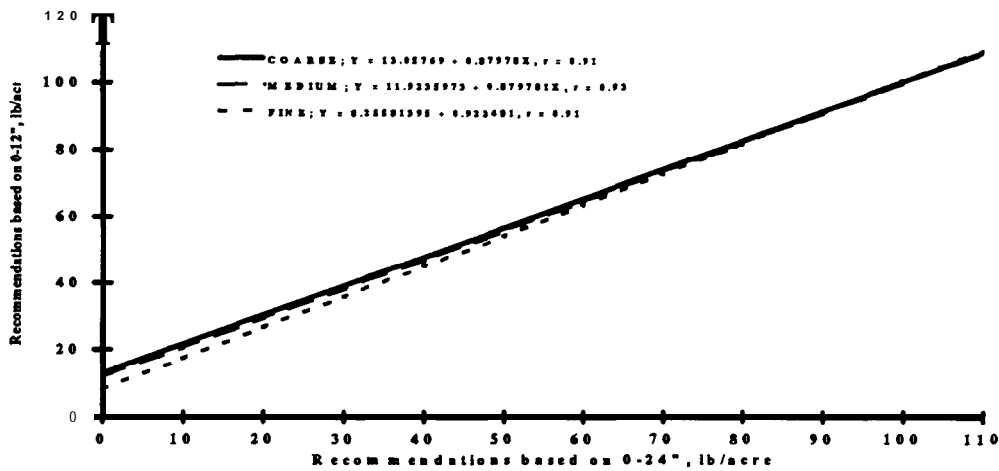


Figure 8. Comparison of fertilizer nitrogen recommendations based on 0-12" depth to those based on 0-24" from soils submitted to the Saskatchewan Soil Testing Laboratory from the Gray soil in the spring of 1990.

RECENT TRENDS

Data collected for the period of 1992 to 1995 by Enviro-Test Laboratories Saskatoon (formerly the Saskatchewan Soil Testing Laboratory) were summarized on a per Crop District basis. The precipitation data from the Crop and Weather Reports of Saskatchewan Agriculture and Food were utilized to establish weather patterns.

The 0-6"/0-12" ratios for nitrate-nitrogen levels in the various Crops Distrcits over the period of 1992 to 1995 are illistrated in Figures 9-12.

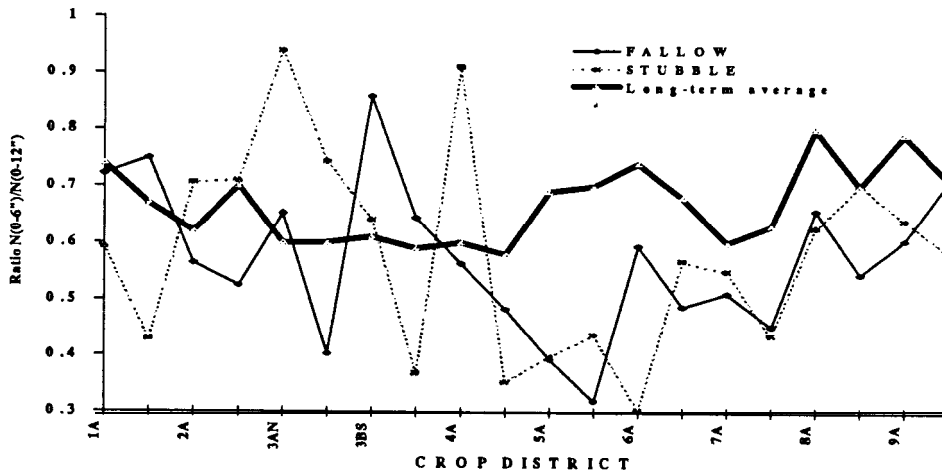


Figure 9. Comparison of 0-6"/0-12" ratios from fall 1992 soil testing data in the various Saskatchewan Crop Districts to the corresponding long-term ratios.

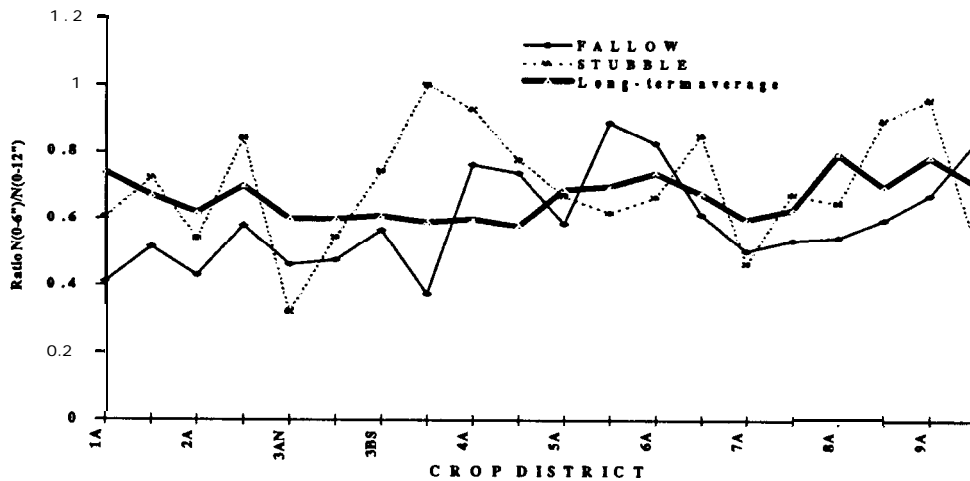


Figure 10. Comparison of 0-6"/0-12" ratios from fall 1993 soil testing data in the various Saskatchewan Crop Districts to the corresponding long-term ratios.

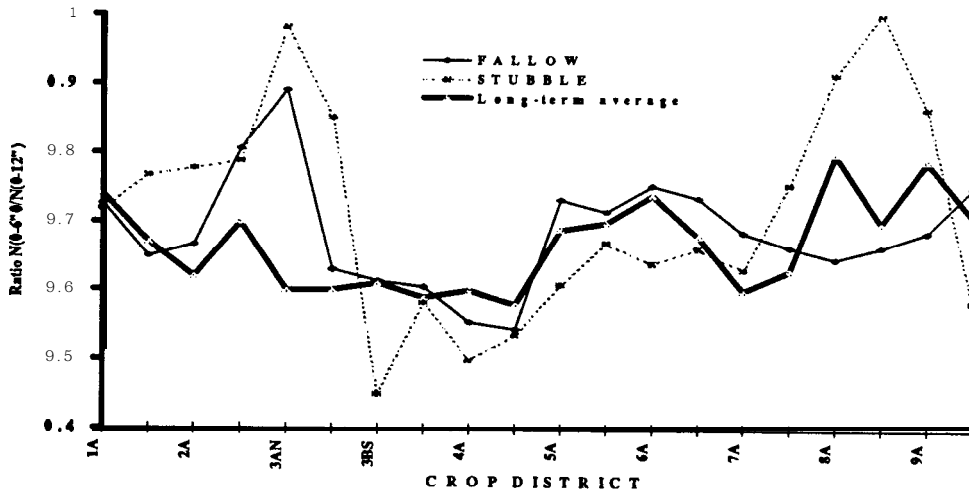


Figure 11. Comparison of 0-6"/0-12" ratios from fall 1994 soil testing data in the various Saskatchewan Crop Districts to the corresponding long-term ratios.

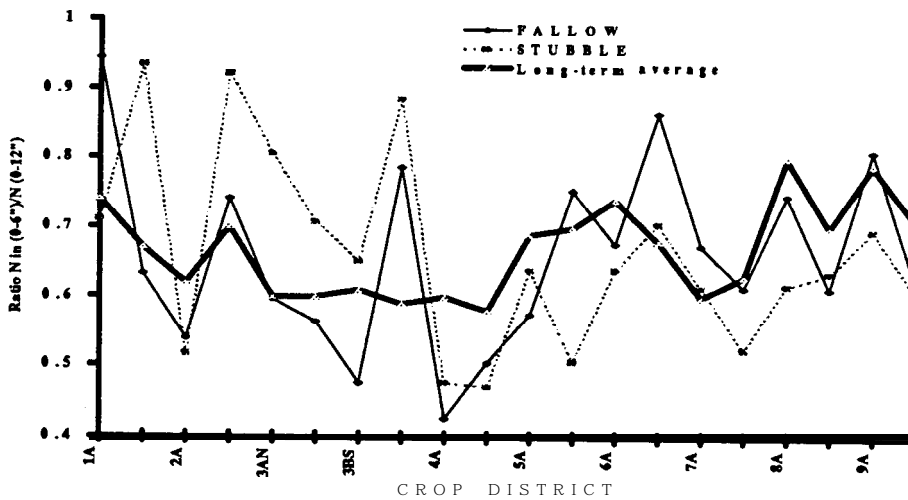


Figure 12. Comparison of 0-6"/0-12" ratios from fall 1995 soil testing data in the various Saskatchewan Crop Districts to the corresponding long-term ratios.

Due to the extremely large database, only the 1992 and 1995 databases were utilized to assess the differences in recommendations generated by using O-6" and O-12" depth samples. These two years were chosen as differences in precipitation during the growing season covered the whole spectrum, i.e., from drier conditions in Crop Districts 7A and 7B to considerably wetter conditions in other Crop Districts. The corresponding growing season precipitation is shown in Figure 13. To assess differences in recommendations

based O-6" and O-12" ratios, the soil test summaries for all Crop Districts were compiled for 1992 and 1995.

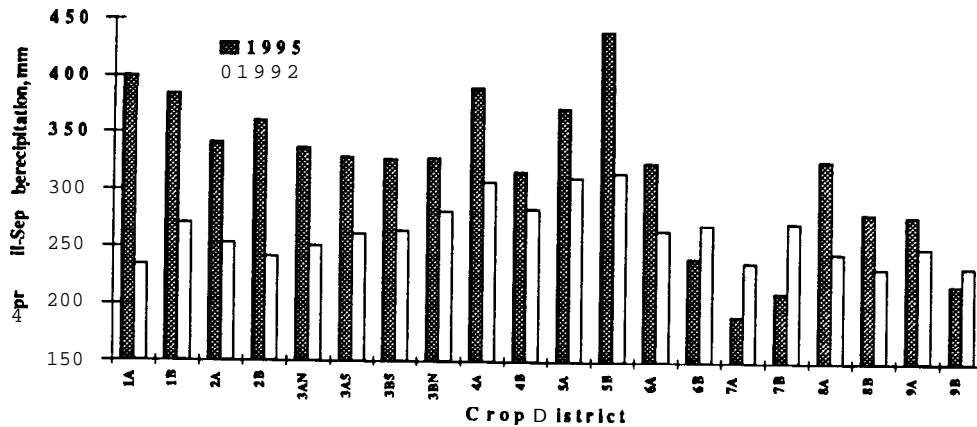


Figure 13. Comparison of 1992 and 1995 growing season precipitation for Saskatchewan Crop Districts.

The mean soil testing data for each Crop District were entered into the F.A.R.M. System of recommendations for both the O-6" and O-12" data. "Average" fertilizer Nitrogen recommendations for fallow and stubble fields for these two years were generated based on the predominant Soil Climatic Zone in each Crop District. The differences in Nitrogen recommendations (Δ Fertilizer) based on O-6" depth from those based on O-12" depth were then compared to the differences between the actual ratio of O-6"/O-12" for the year from the long-term ratio (Δ Ratio) utilized in the F.A.R.M. System (Figures 14-17).

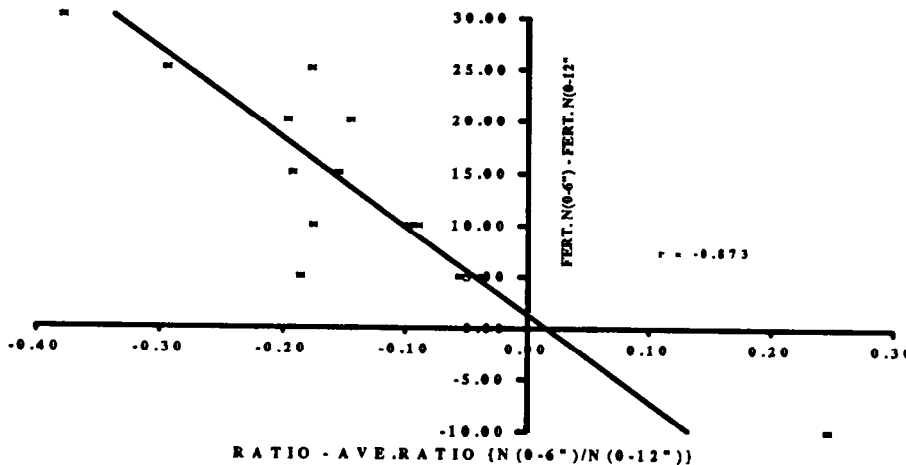


Figure 14. Δ Fertilizer vs. Δ Ratio for fallow fields in 1992.

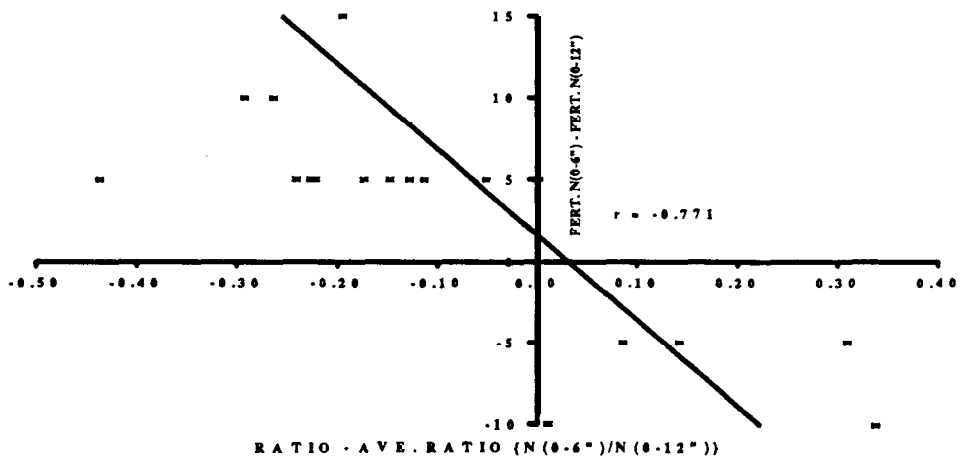


Figure 15. Δ Fertilizer vs. Δ Ratio for stubble fields in 1992.

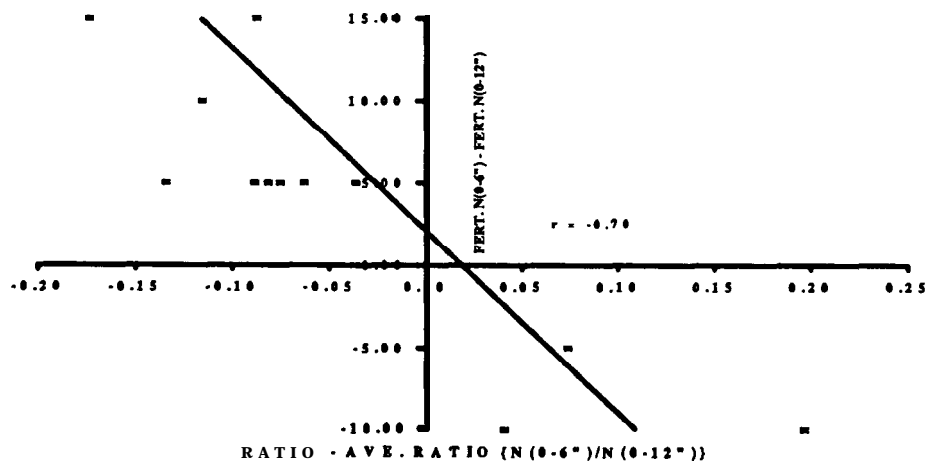


Figure 16. Δ Fertilizer vs. Δ Ratio for fallow fields in 1995.

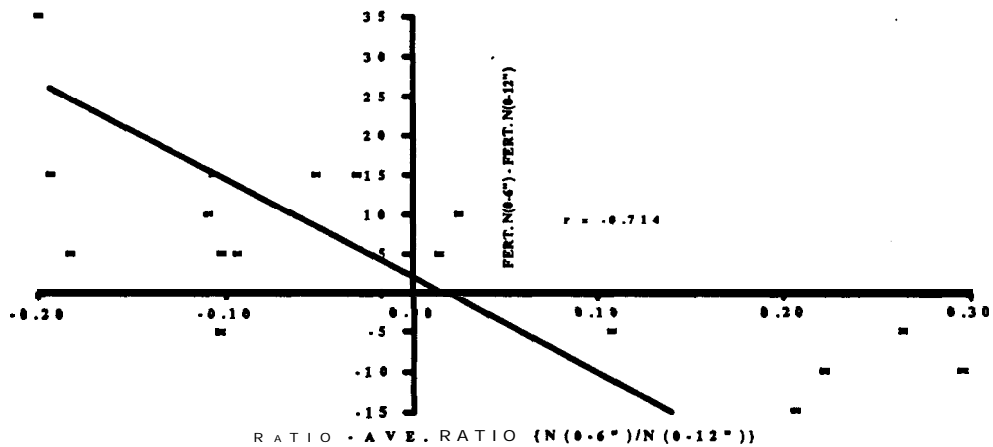


Figure 17. Δ Fertilizer vs. Δ Ratio for stubble fields in 1995.

When the ratio of soil test levels in the O-6" depth over those in the O-12" depth was below the long-term average, Nitrogen fertilizer recommendations based on O-6" depth tended to be considerably higher than those based on O-12" depth. The 0-6"/0-12" Nitrogen soil test ratios tended to be below the long-term average for those Crop Districts with higher than average precipitation during the growing season. However, precipitation in September had also an impact on these ratios (data not shown).

A random sample of 70 fields submitted to Enviro-Test Laboratories as O-24" depths in the fall of 1995 was used to compare recommendations based on O-6" and O-12" depths to those based on O-24".

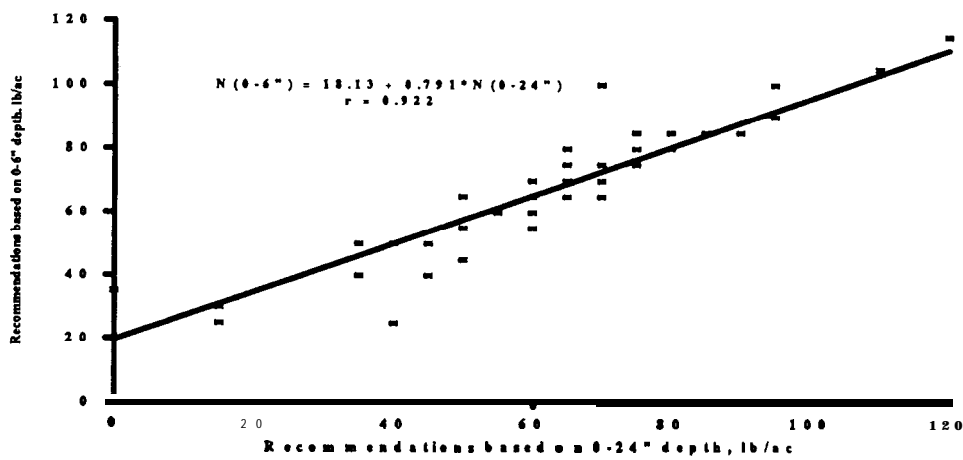


Figure 18. Comparison of fertilizer nitrogen recommendations based on O-6" depth to those based on 0-24" from a random sample of soils submitted Enviro-Test Laboratories in the fall of 1995.

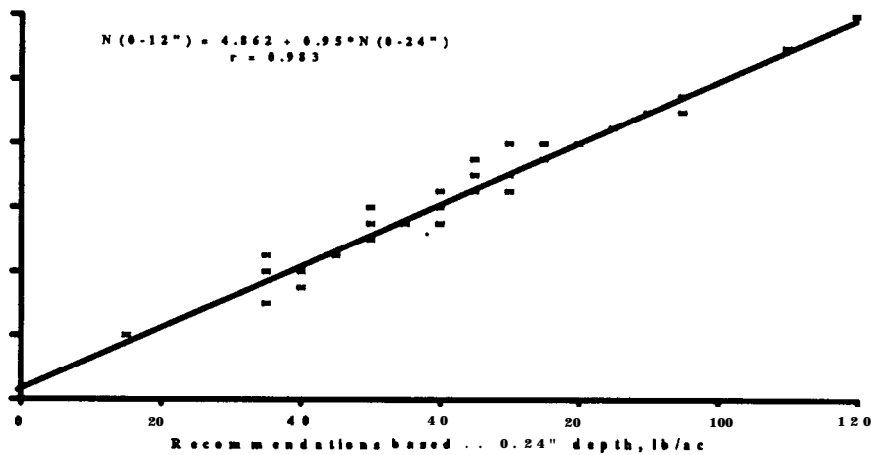


Figure 18. Comparison of fertilizer nitrogen recommendations based on O-12" depth to those based on O-24" from a random sample of soils submitted Enviro-Test Laboratories in the fall of 1995.

The results in Figures 18 and 19 corroborate the findings from the 1990 study (Figures 1-8).

CONCLUSIONS

Nitrogen recommendations based on O-12" depth samples still remain a reliable alternative to those based on O-24" depth samples.

Nitrogen recommendations based on O-6" depth samples tend to be erratic and tend to overestimate Nitrogen requirements at high and underestimate Nitrogen requirements at low soil Nitrogen tests.

REFERENCES

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- Gelderman, R.H., Dahnke, W.C. and Swenson, L. 1988. Correlation of several soil N indices for wheat. *Commun. Soil Sci. Plant Anal.* 19: 755-772.
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- Soper, R.J., Racz, G.J. and Fehr, P.I. 1971. Nitrate nitrogen in the soil as a means of predicting the fertilizer requirements of barley. *Can. J. Soil Sci.* 51: 45-49.