RECENT TRENDS IN N, P, K AND S SOIL TEST LEVELS IN SASKATCHEWAN

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INTRODUCTION

Traditionally the available plant nutrient levels in Saskatchewan soils have been compiled and reported on a soil zone basis. The soil test data has been further subdivided within each soil zone into three broad textural classes: coarse, medium and fine textured soils. Although compilation of soil test nutrient levels in this manner is justified by soil genesis theory, growth conditions may vary dramatically from area to area within a soil zone. Soil moisture maps for stubble cropping generated by Saskatchewan Agriculture every fall, rarely resemble the zonal distribution of genetic soil zones. This has prompted the Saskatchewan Soil Testing Laboratory to re-structure its data base on an Rural Municipality basis. The reorganization of soil test nutrient levels from 1985 to the present has recently been completed. The objective is to generate yield curves based on fertilizer recommendations for climatic zones within Saskatchewan and incorporate moisture data in fertilizer recommendations.

This is the final year that soil testing nutrient levels will be compiled and presented on a soil zone basis. Historical trends over the last six years of fall soil test levels are presented and discussed.

Nitrogen Levels

Nitrogen levels in both fallow and stubble soils were higher in 1988 compared to the

previous four years and a further overall increase was observed in the fall of 1989 (Fig. 1). This rise in the overall N soil testing levels primarily reflects the drought conditions of 1988, which led to both fertilizer applied N and mineralized soil N remaining unutilized. The better overall growth conditions of 1989 were still not at optimum, which contributed to further increase in the soil test N levels of the already N - charged provincial soils. In spite of the relatively favorable spring soil moisture, extremely dry conditions in the summer of 1989 may have also contributed to additional N accumulating in the soil profile.

The soil test N levels in the Brown, Dark Brown, Thin Black, Thick Black, Grey Black and Grey soil zones are illustrated in Fig. 2, 3 and 4. Separation of soil test N levels on a soil zone basis suggests that the overall increase in the N levels of provincial soils in 1989 was contributed by the increase in the levels of the Thin Black, Thick Black, Grey Black and Grey soils. Relatively favorable moisture conditions in areas within the Brown and Dark Brown soil zones has led to better utilization of both soil N supplies and fertilizer applied N in these soils and an overall decline in the soil testing N levels (Fig. 2). However, these overall trends hardly describe the growth conditions and nutrient levels in all areas within a soil zone. To illustrate the need for further and/or different separation of provincial soils in order to provide a more accurate and sensitive data base for yield responses and fertilizer recommendation, the soil test N levels in selected Agricultural Districts within a soil zone were compiled. For example, comparison of soil test N levels in the Dark Brown soils of Districts 6 and 22 revealed that levels in both Districts were much higher than the provincial average for those soils (Fig. 5). A further comparison between Districts 13 and 34, revealed that N levels in District 13 were higher and District 34 lower than the provincial average for these soils (Fig. 6). Since maximum fertilizer N efficiency is being sought, differences in N levels reflecting different climatic conditions would render a common yield curve for both areas insufficient.

Distribution of Nitrogen Levels in Soils

Although averages of nutrient levels in an area, however confined or generalized it may be, do offer a general indication of the nutrient status and levels of recommendations, they may not represent the true picture for the area. The average of 0 and 100 is 50 but 50 is also the average of 55 and 65. Thus, true trends in the nutrient levels can be better represented by the frequency at which various soil testing levels occur. Any change in the frequency distribution of soil nutrient levels will better represent changes for the levels of recommendations.

The overall frequency distribution of soil test N levels arranged in 15 lb N/ac increments is illustrated in Fig. 7. A shift of the frequency distribution to the right points out that recommendations for N fertilizer were lower in 1988 and 1989. The most dramatic shift was in the N levels of stubble soils. Forty percent of the stubble soils submitted to the Saskatchewan Soil Testing Laboratory in 1985 contained between 0 and 15 lb N/ac, whereas only 8% of the stubble soils fell into this category in 1989. The importance and significance of the frequency distribution versus averages can be illustrated by the trends obtained for the Brown and Dark Brown soil zones (Fig. 8). Although average soil testing N levels in these two zones dropped in 1989 compared to 1988, the shift in the frequency distribution to the right was similar to that observed in the remaining four soil zones where N levels were actually increased (Fig. 9 and 10).

Nitrogen Recommendation based on 0-6" Depth

The Saskatchewan Soil Testing Laboratory has traditionally discouraged the submission of 0-6" depth samples for complete nutrient analysis and fertilizer recommendations. Although charging the same fee for a 0-6" to that of the 0-6, 6-12 and 12-24" field sample may be considered a questionable approach from a business point of view, agronomically the choice of the 0-6" sample still does not appear to be a good one. Various laboratories,

including the Saskatchewan Soil Testing Laboratory, utilize the 0-6" sample as a quick and efficient way of physically sampling a field. A data base based on a 0-6" depth does not exist. Hence, laboratories have resorted to taking average ratios of the nitrogen levels of 0-24" to 0-6" depths and applying these ratios to predict soil nitrogen levels in the 0-24" profile. The danger of following this approach is illustrated in Fig. 11 and becomes of especially paramount importance in stubble soils in general and fine textured soils in particular. Hence, utilization of an average ratio established from historical data previous to 1989 may have led almost double the true fertilizer recommendations in fine textured soils and almost 60% higher recommendations than what they should have been in the Grey and Grey-Black soils, respectively. In contrast, recommendations in the fine Brown soils could have been almost 20% lower than the true ones. Coefficients variation of the average ratios over the 1986, 1987, 1988 and 1989 growing seasons would suggest that variation even by including the 1989 data into the ratios can be as high as 37% (Fig. 12).

If this approach was to be used, the Saskatchewan Soil Testing Laboratory would much rather receive samples from the 0-12" depth as they are considerably less variable, presumably because of the larger soil mass that is being sampled (Fig. 13). Although an average ratio from previous years would still add an error in the fine textured Grey-Black and Grey soils, increased in the 1989 ratios over the previous years only amounted to 15-20%. Moreover, the coefficients of variation for the (0-24")/(0-12") ratios are considerable less (Fig. 12) than those of the (0-24")/(0-6") ratios.

Phosphorus Levels and Distribution

"Available" phosphorus levels determined by sodium bicarbonate in provincial soils was at its maximum levels in 1988 (Fig. 14). The trend suggests that build up of phosphorus has occurred since 1985. Soil testing phosphorus levels in 1989 were slightly less than those in 1988 except for the Thick Black summerfallow soils (Fig. 14). Again the frequency

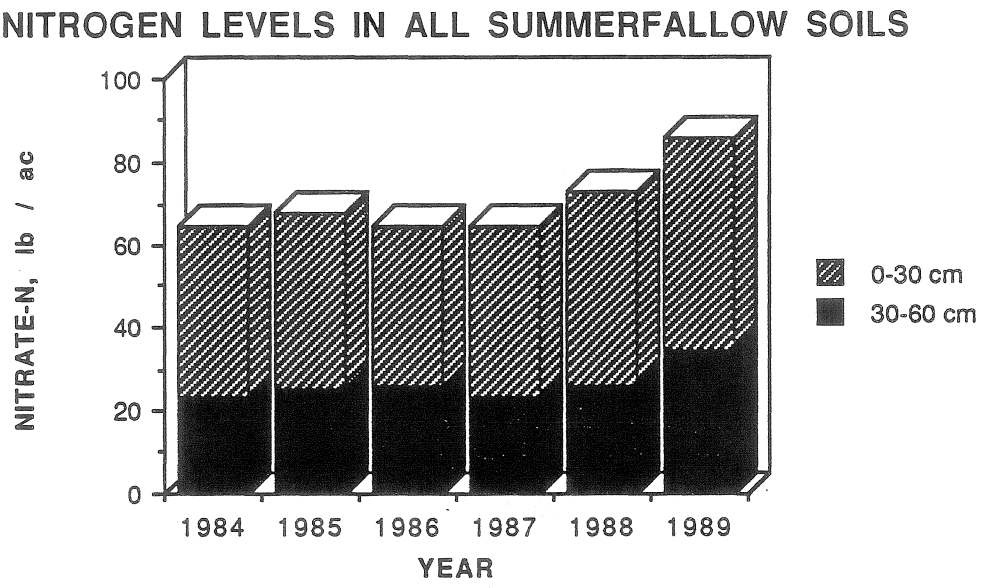
distribution of soil test levels shows a shift of the distribution to the right in both fallow and stubble soils (Fig. 15). However, a slight reversal in the frequency distribution curves was observed in 1989. Trends in the soil test phosphorus levels for various soil zones were pretty well the same (Fig. 16, 17 and 18).

Potassium Levels

Average available potassium levels in fallow and stubble fields were slightly lower in 1989 than the previous year across all soil zones (Fig. 19). Overall, however, the potassium level of Saskatchewan soils in the different soil zones has remained constant over the past six years. Any fluctuations from year to year are overshadowed by the predominant influence of parent materials in the potassium status of the soil in the different soil zones.

Sulphur levels

Sulphate levels in Saskatchewan soils have been increasing over the past two years. Most of the increase has occurred in the 12-24" depth (Fig. 20). These changes reflect weather pattern and their effect on the fluctuation of salinity in saline soils as well as changes in the sulphur fertility of soil sulphate levels in stubble fields are higher than in fallow fields. This effect is consistent across most years. This may indicate the upward movement of sulphate in cropped land on the input of sulphate from straw to the topsoil.



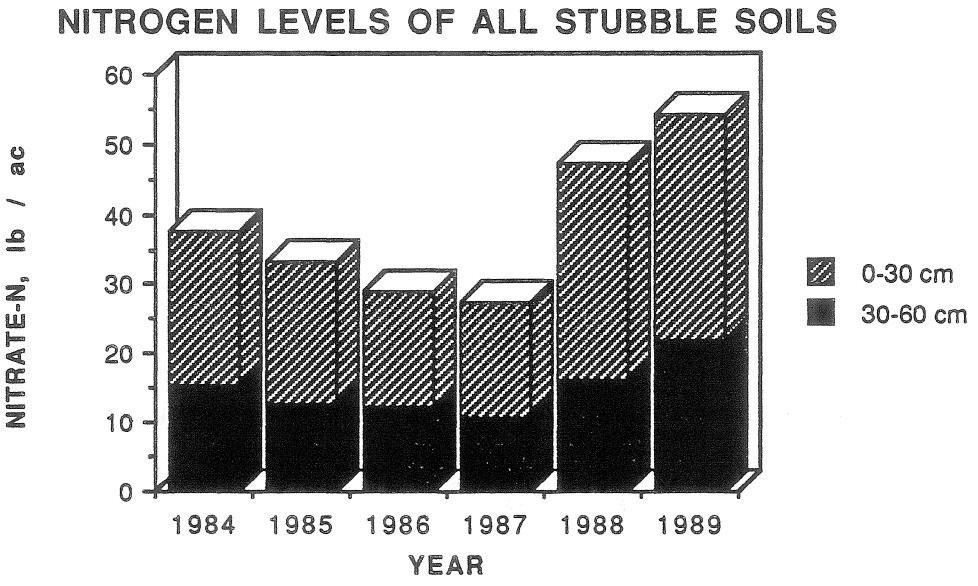
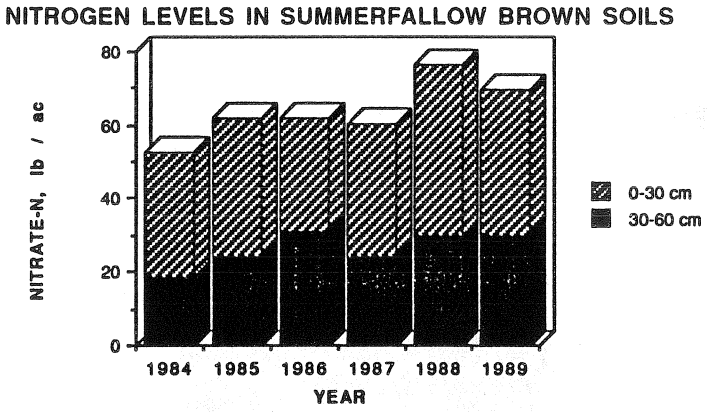
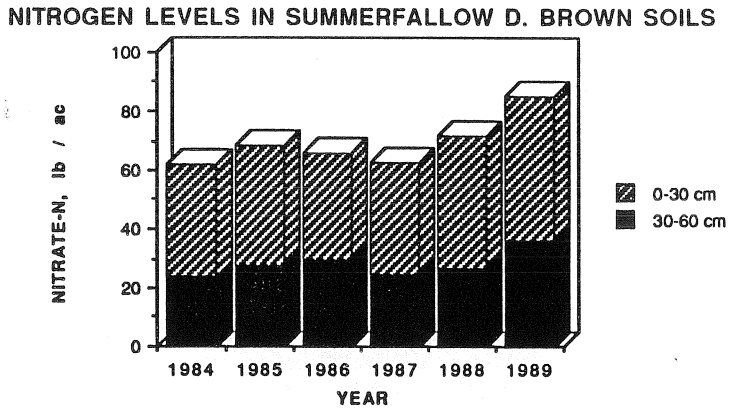
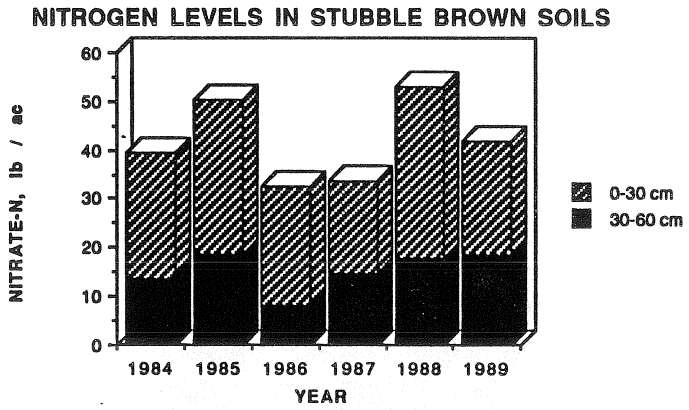


Fig. 1. Average Nitrogen levels in Saskatchewan soils.







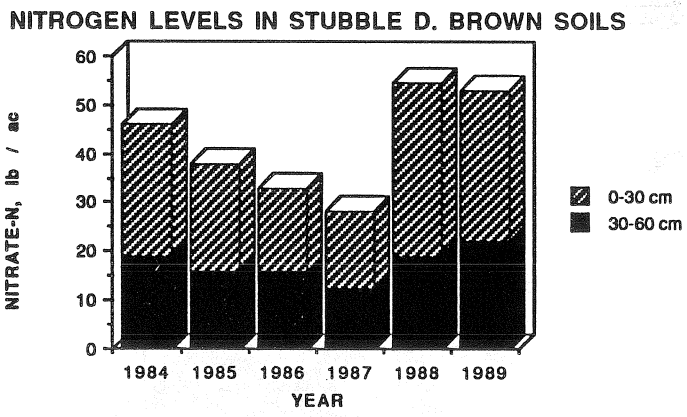


Fig. 2. Average soil testing Nitrogen levels in the Brown and Dark Brown soil in Saskatchewan.

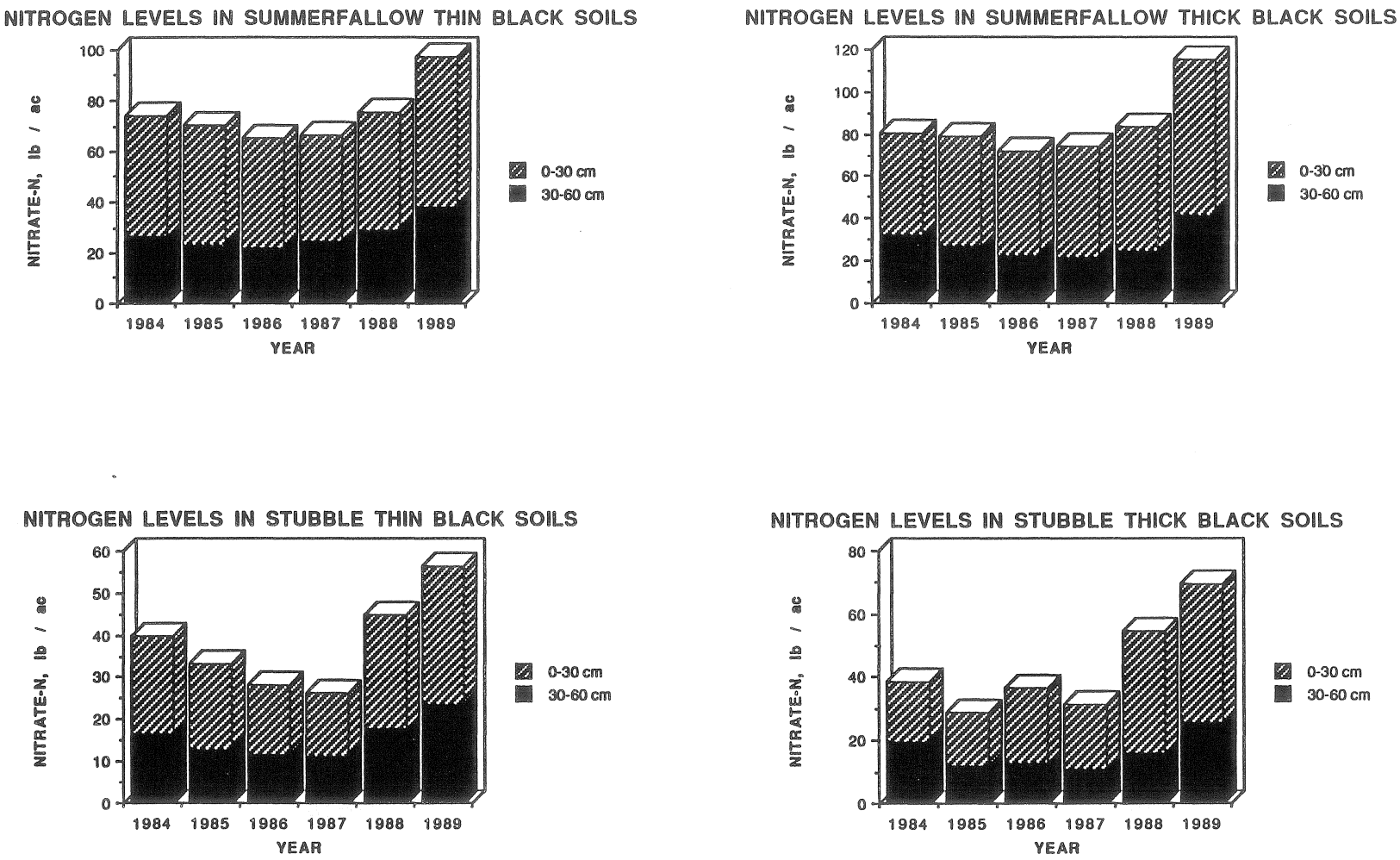


Fig. 3. Average soil testing Nitrogen levels in the Thin and Thick Black soils in Saskatchewan.

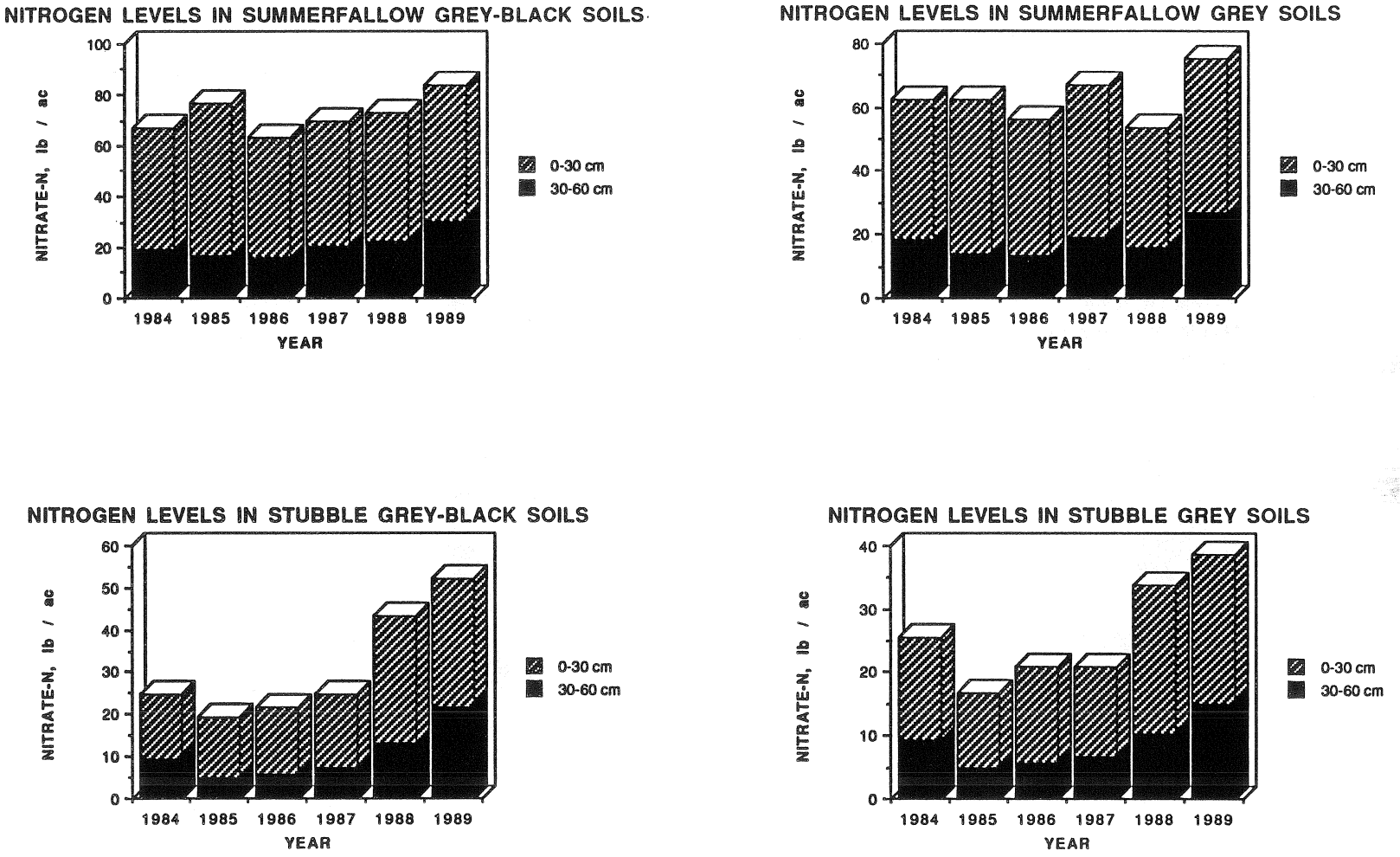
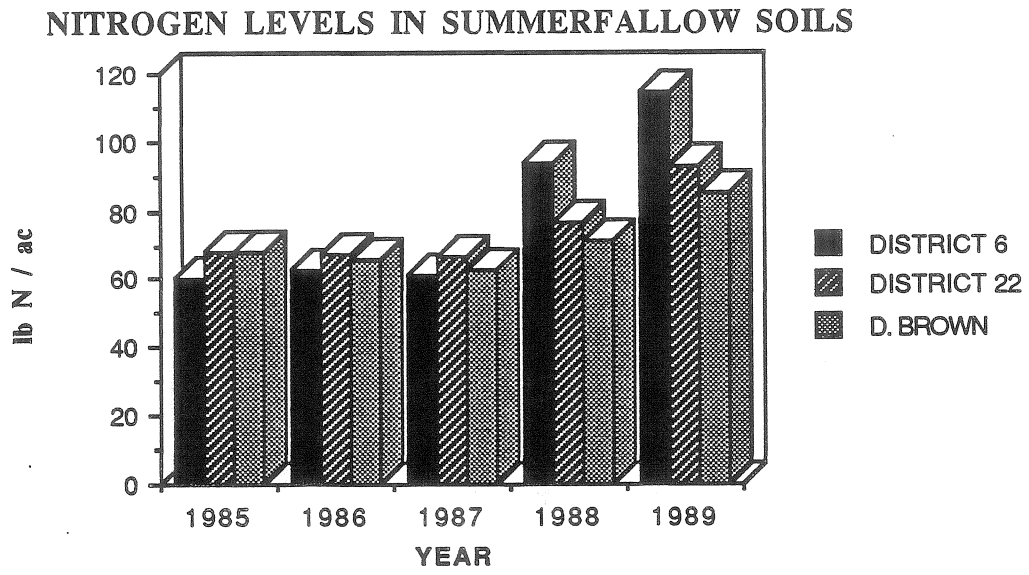


Fig. 4. Average soil testing Nitrogen levels in Grey-Black and Grey soils in Saskatchewan.



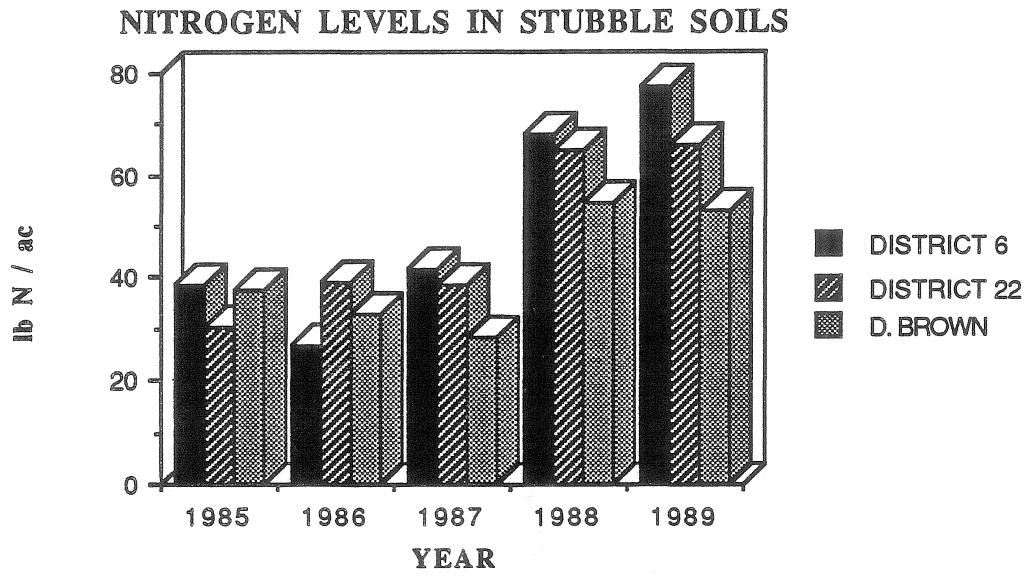
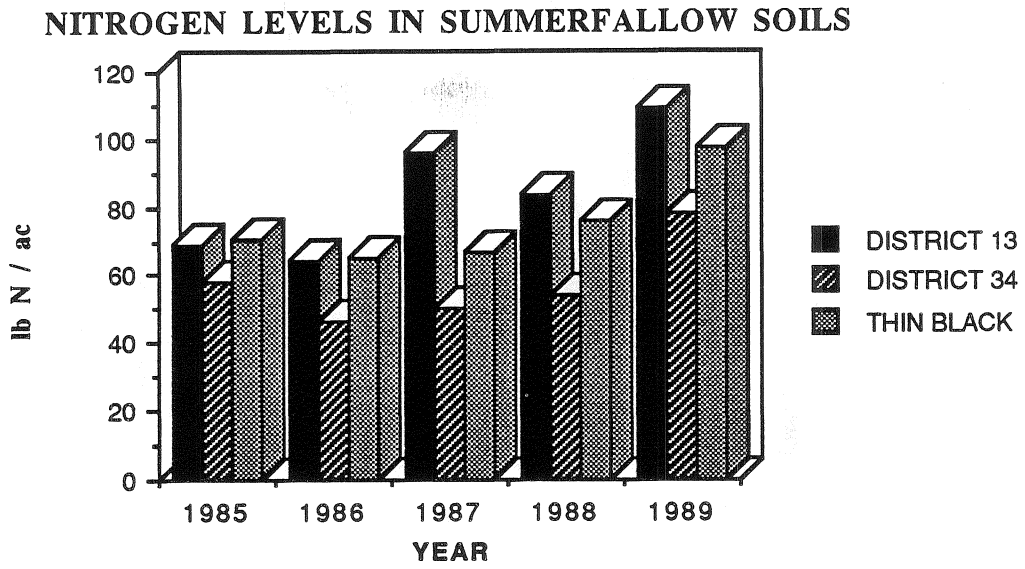


Fig. 5. Comparison of average soil testing Nitrogen levels in the soils of two Districts in Saskatchewan.



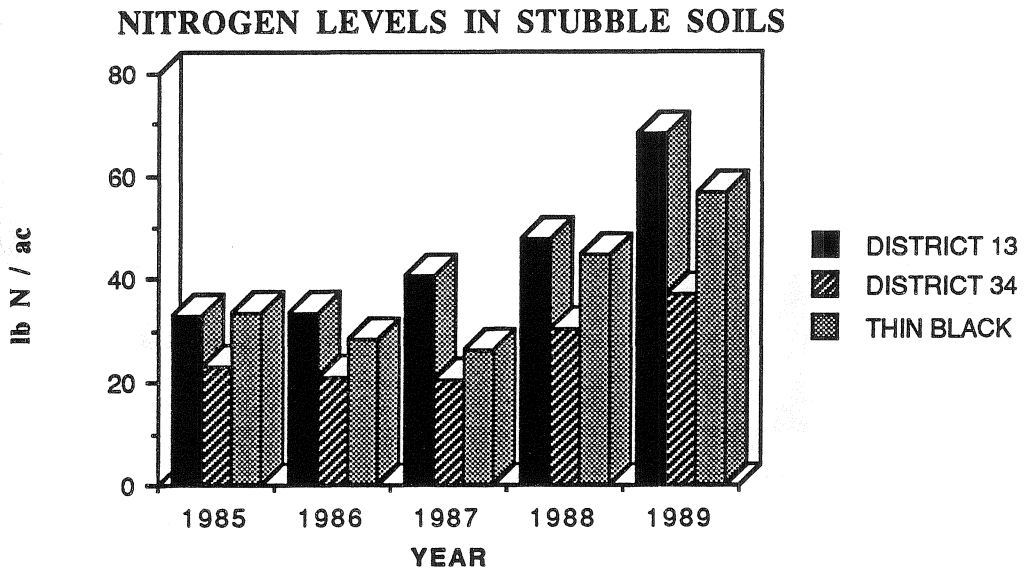
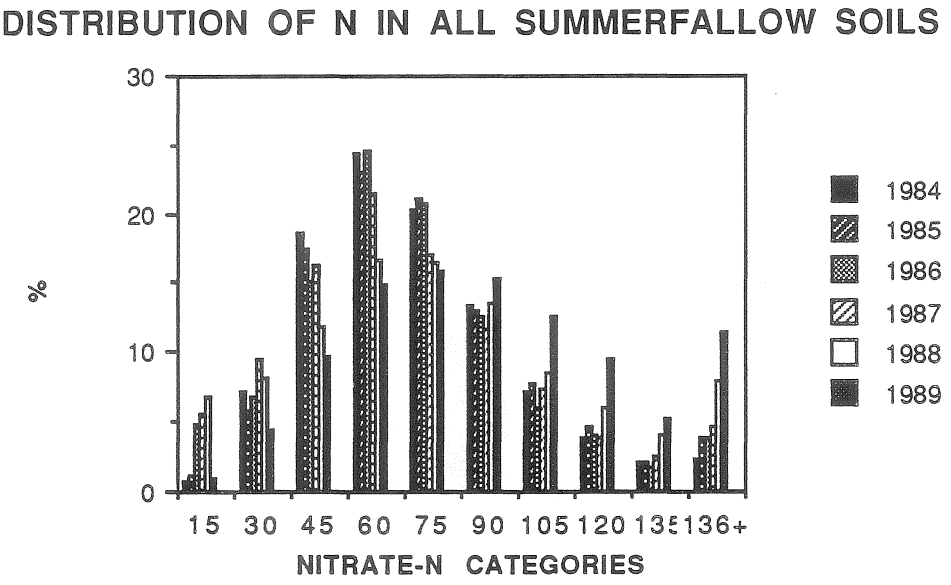


Fig. 6. Comparison of average soil testing Nitrogen levels in the soils of two Districts in Saskatchewan.



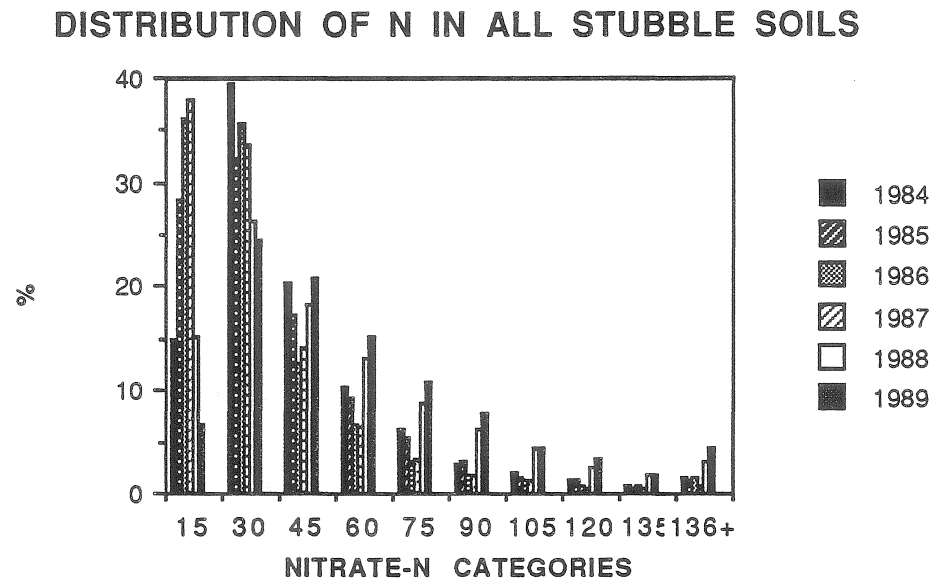
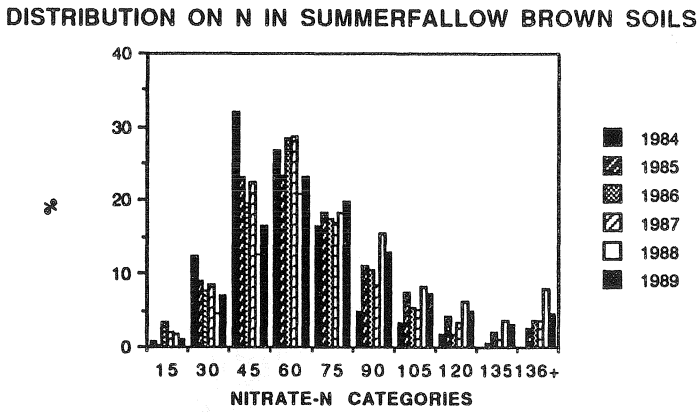
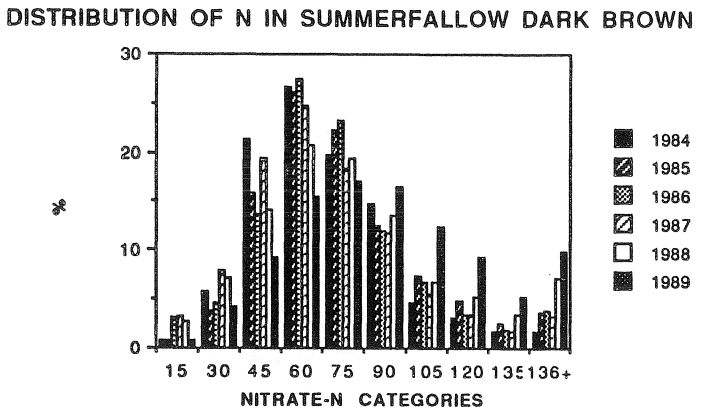
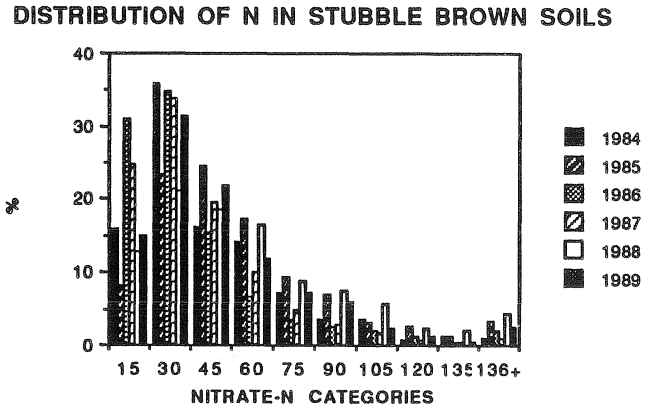


Fig. 7. Distribution of soil testing Nitrogen levels in the province of Saskatchewan.







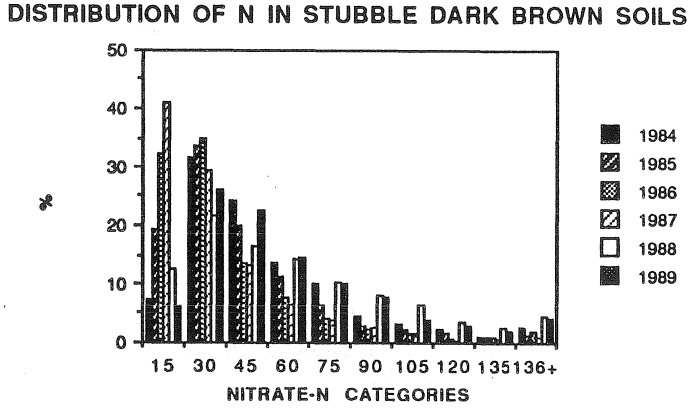
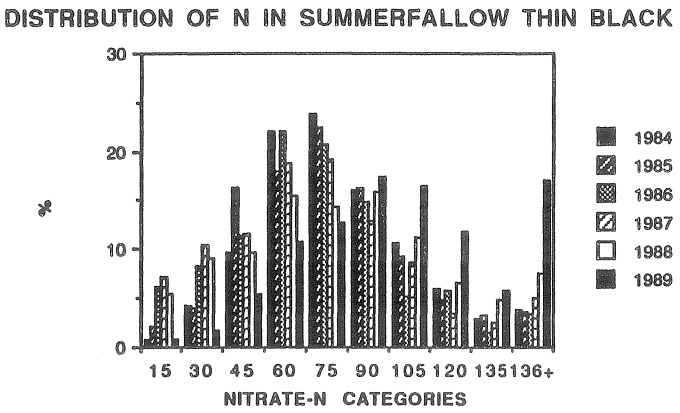
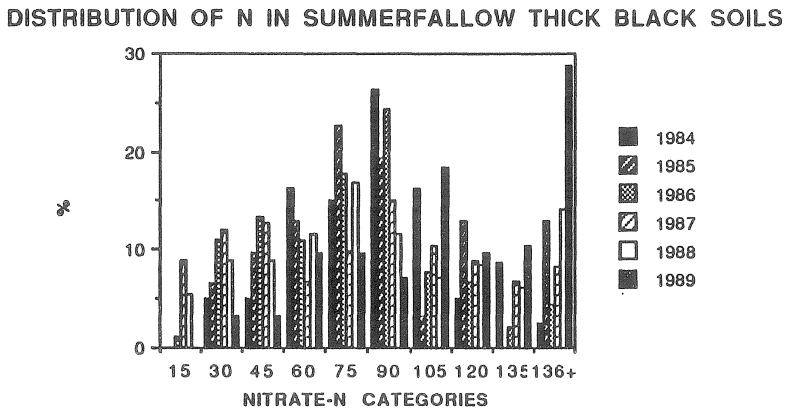
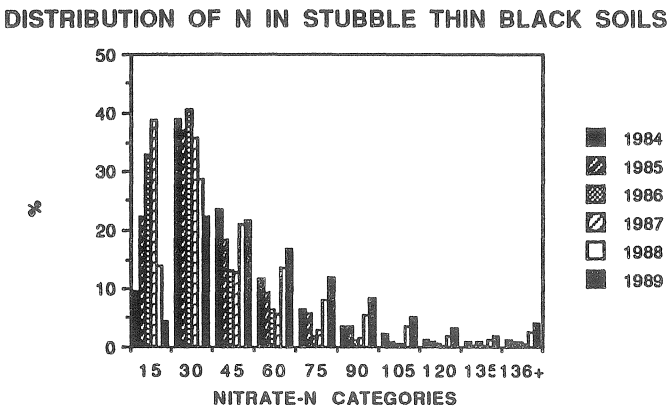


Fig. 8. Distribution of soil testing Nitrogen levels in Brown and Dark Brown soils in Saskatchewan.







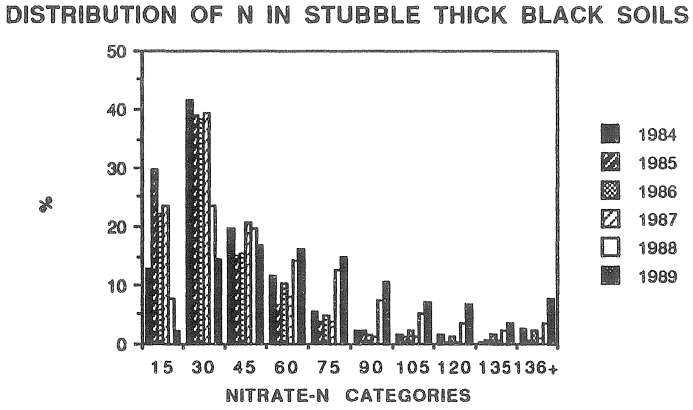


Fig. 9. Distribution of soil testing Nitrogen levels in the Thin and Thick Black soils in Saskatchewan.

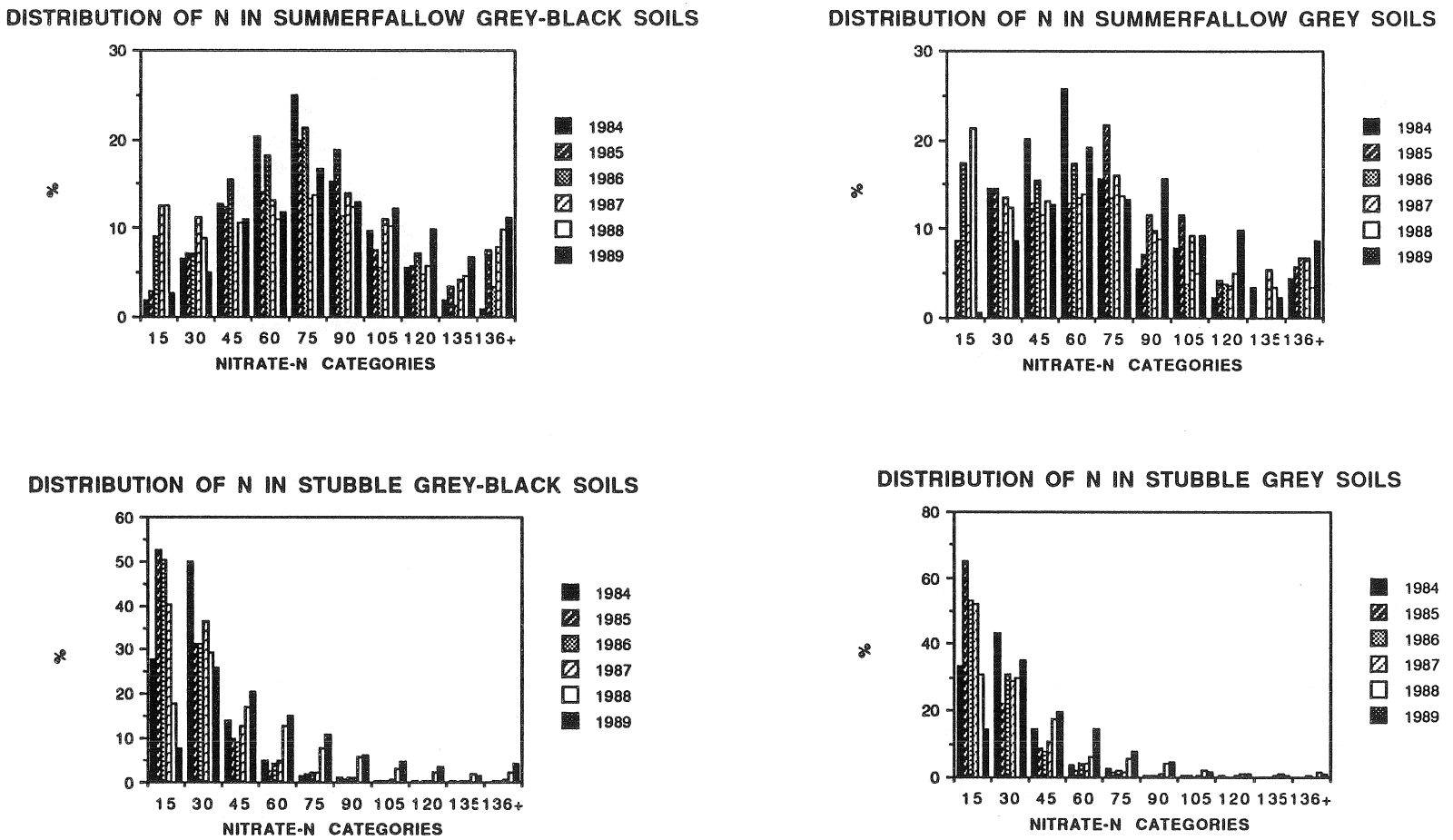


Fig. 10. Distribution of soil testing Nitrogen levels in the Grey-Black and Grey soils in Saskatchewan.

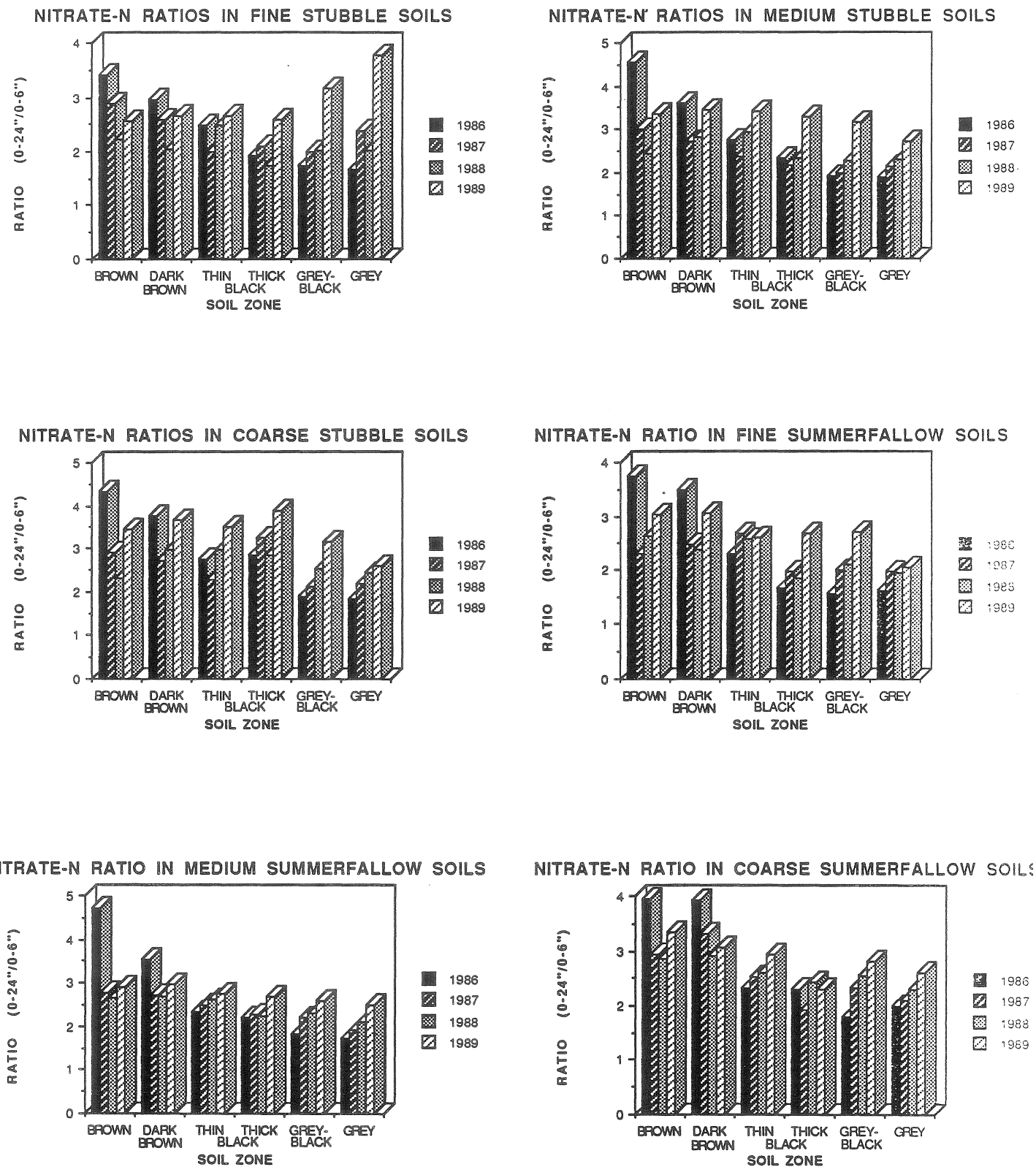


Fig. 11. Nitrate Nitrogen ratios in various depths of soils in Saskatchewan.

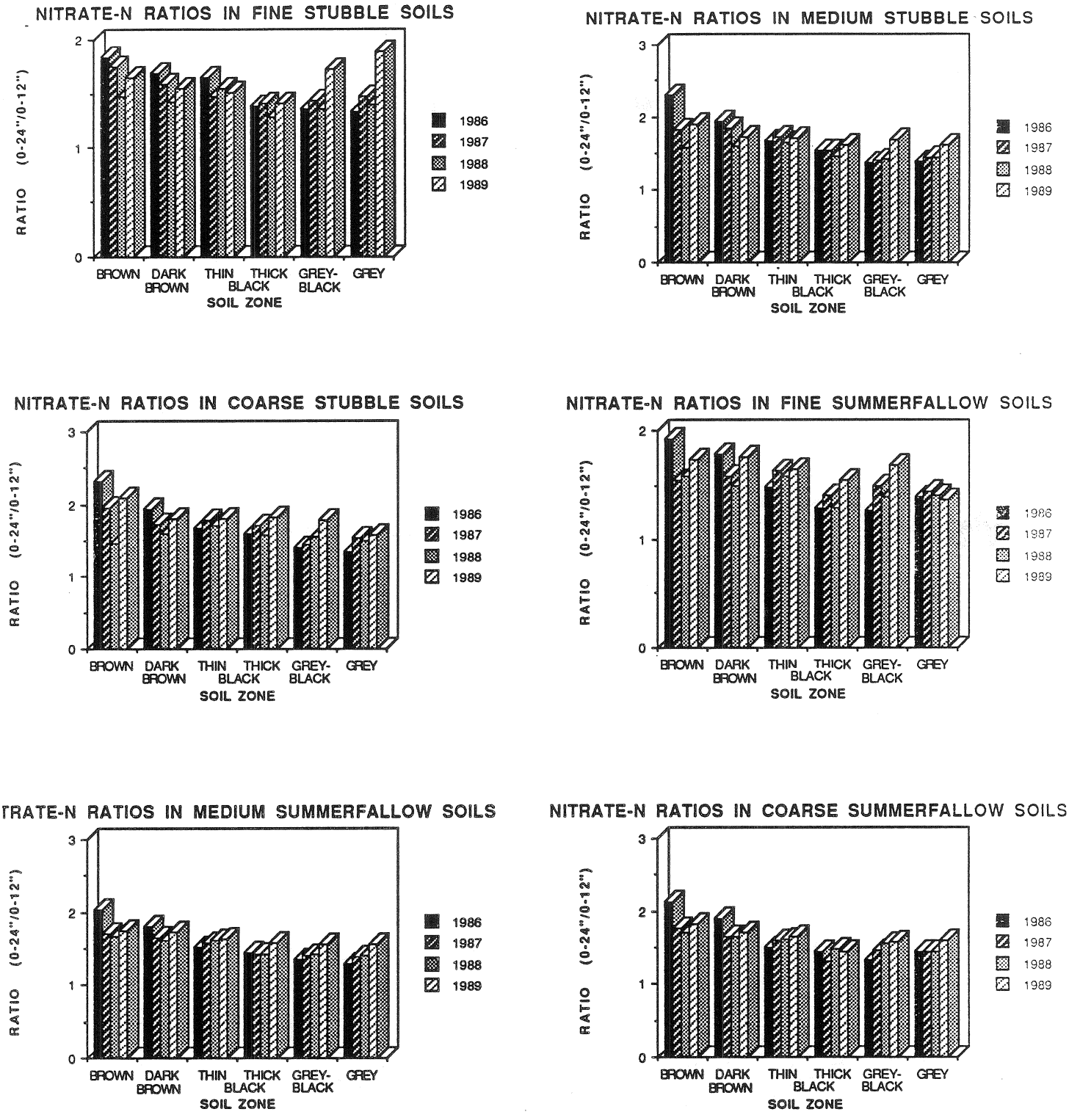


Fig. 12. Nitrate Nitrogen ratios in various depths of soils in Saskatchewan.

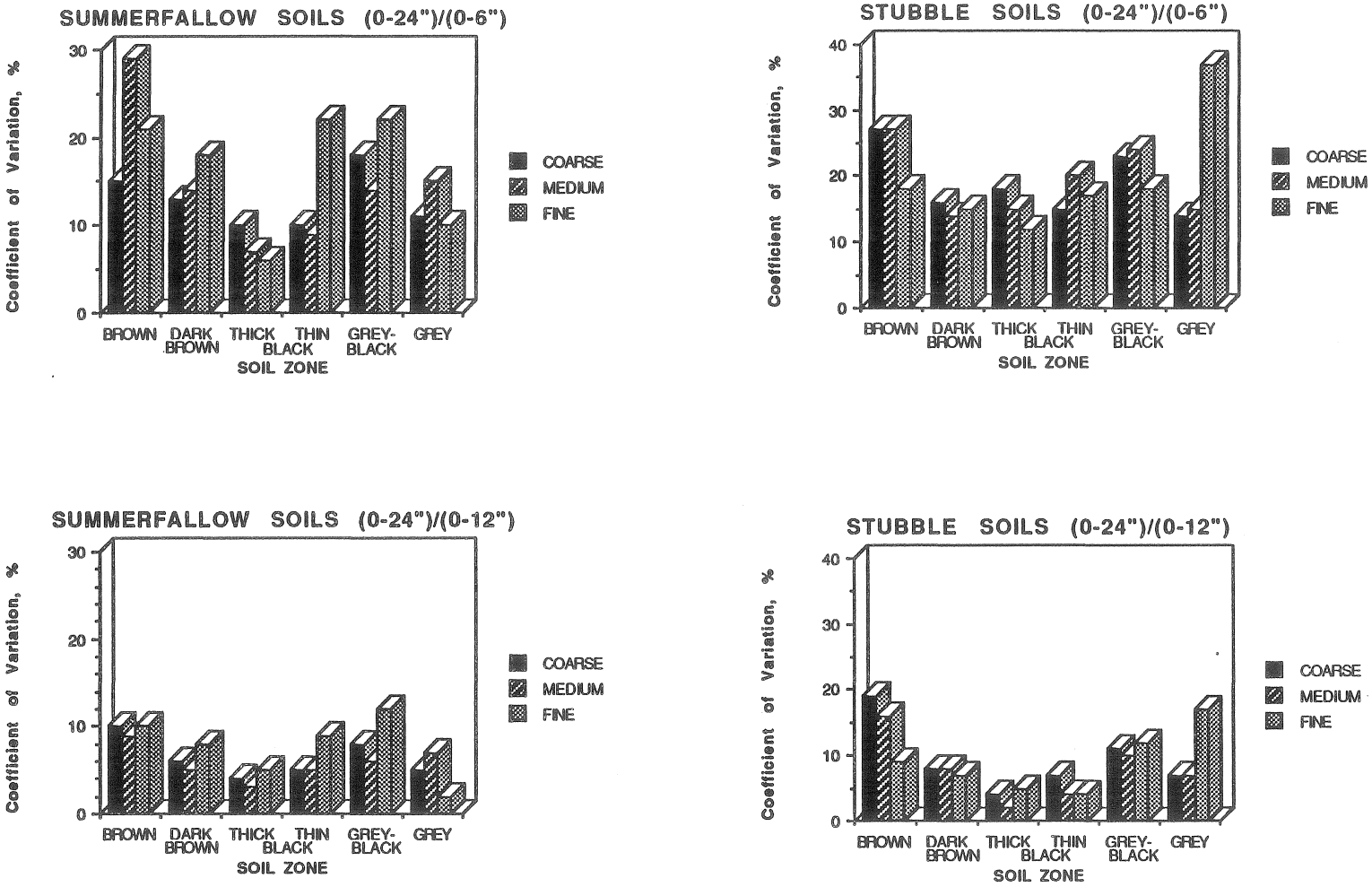


Fig. 13. Variation of ratios of Nitrate Nitrogen in various depths over the 1986-89 mean values.

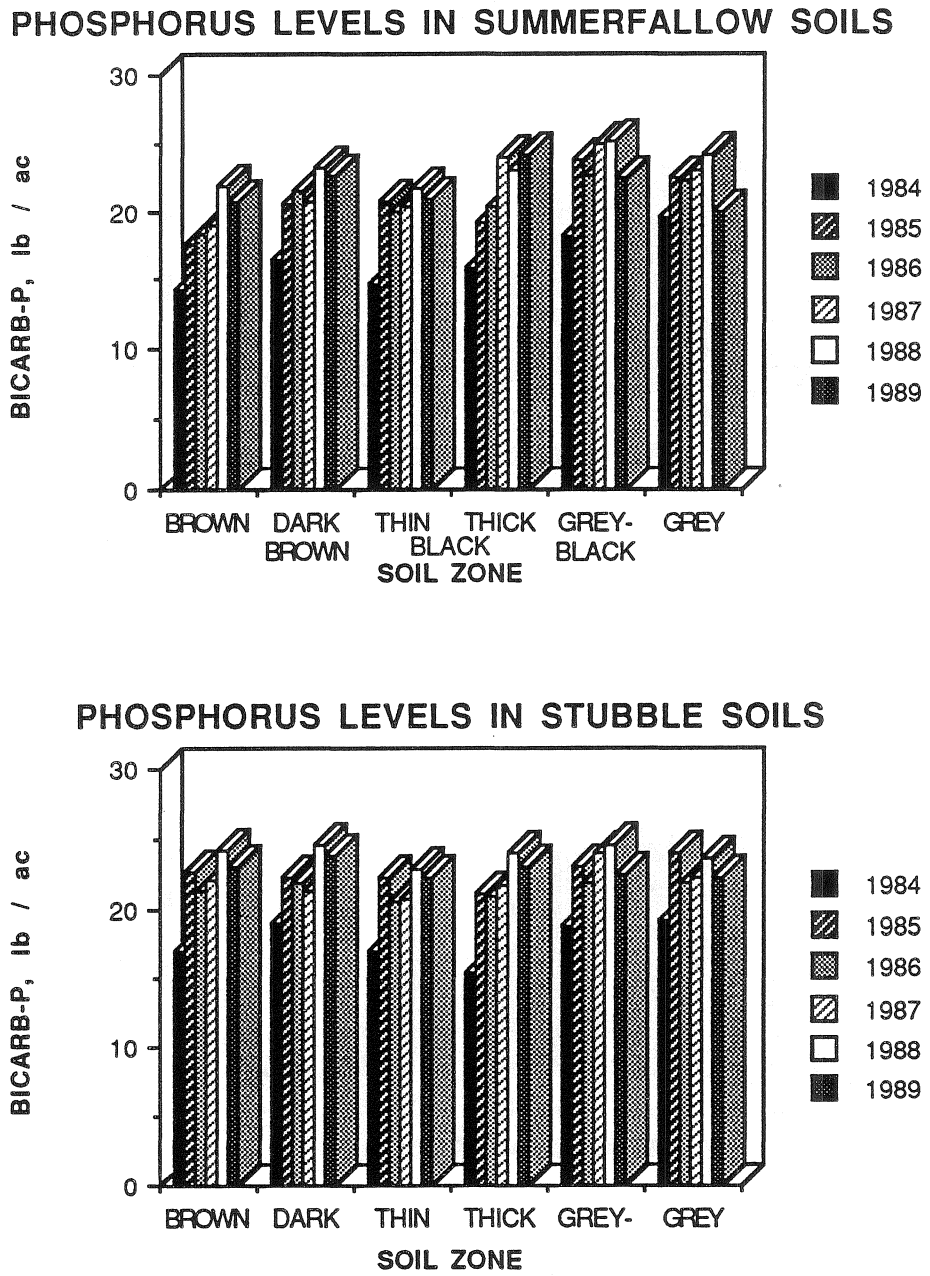
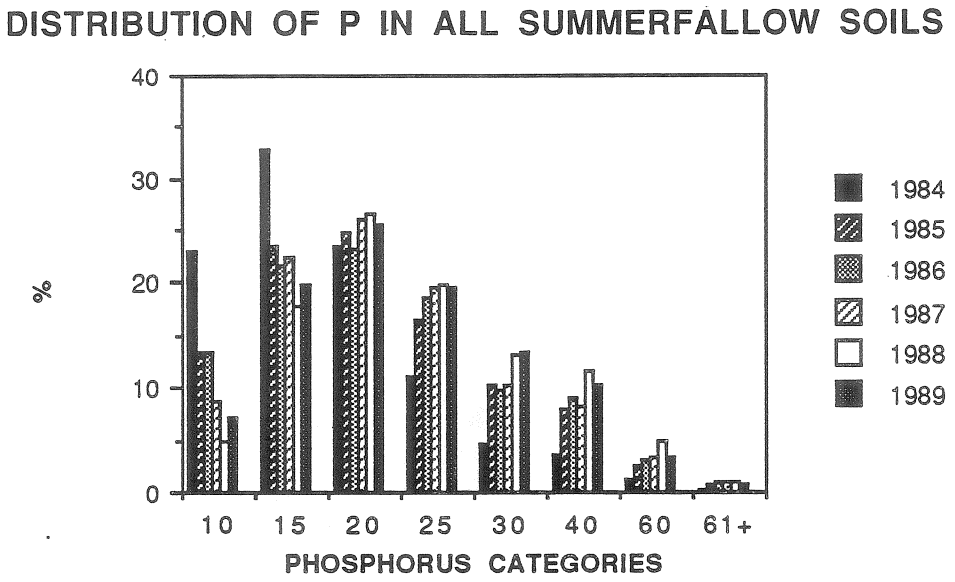


Fig. 14. Average soil "available" Phosphorus levels in Saskatchewan soils.



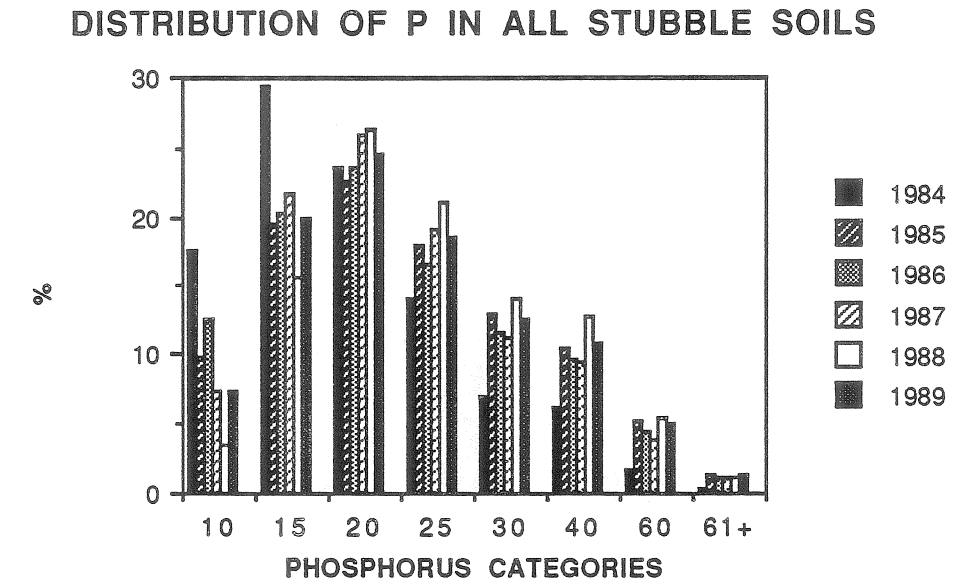
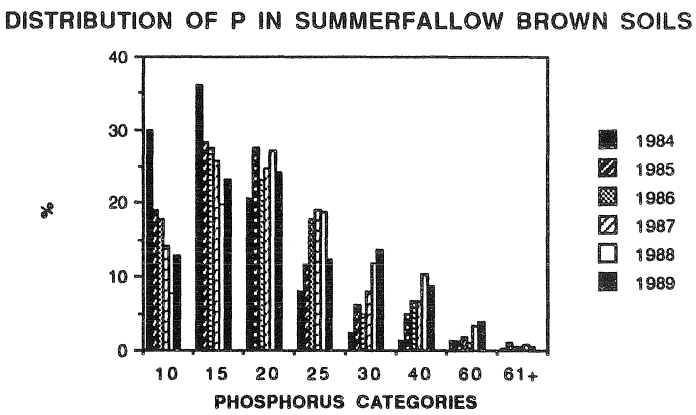
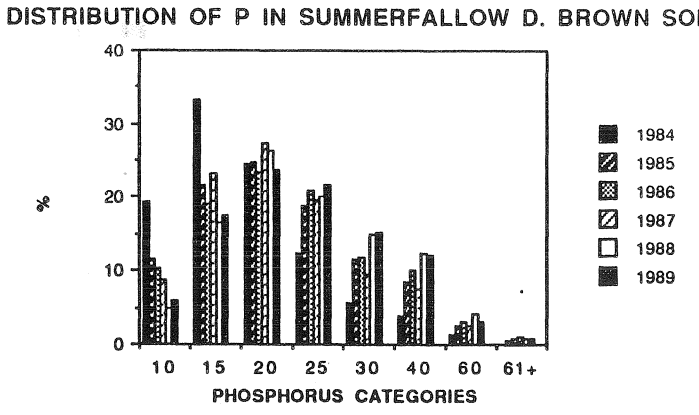
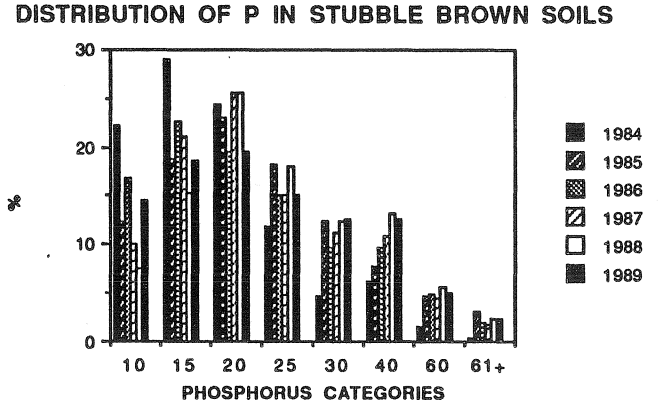


Fig. 15. Distribution of soils testing "available" Phosphorus levels in the province of Saskatchewan.







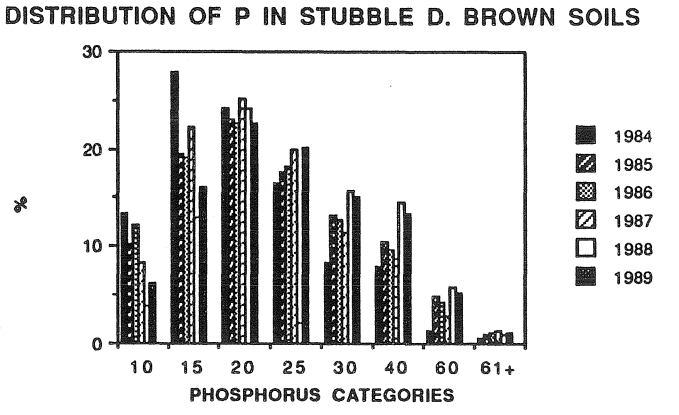


Fig. 16. Distribution of soil testing "available" Phosphorus levels in the Brown and Dark Brown soils.

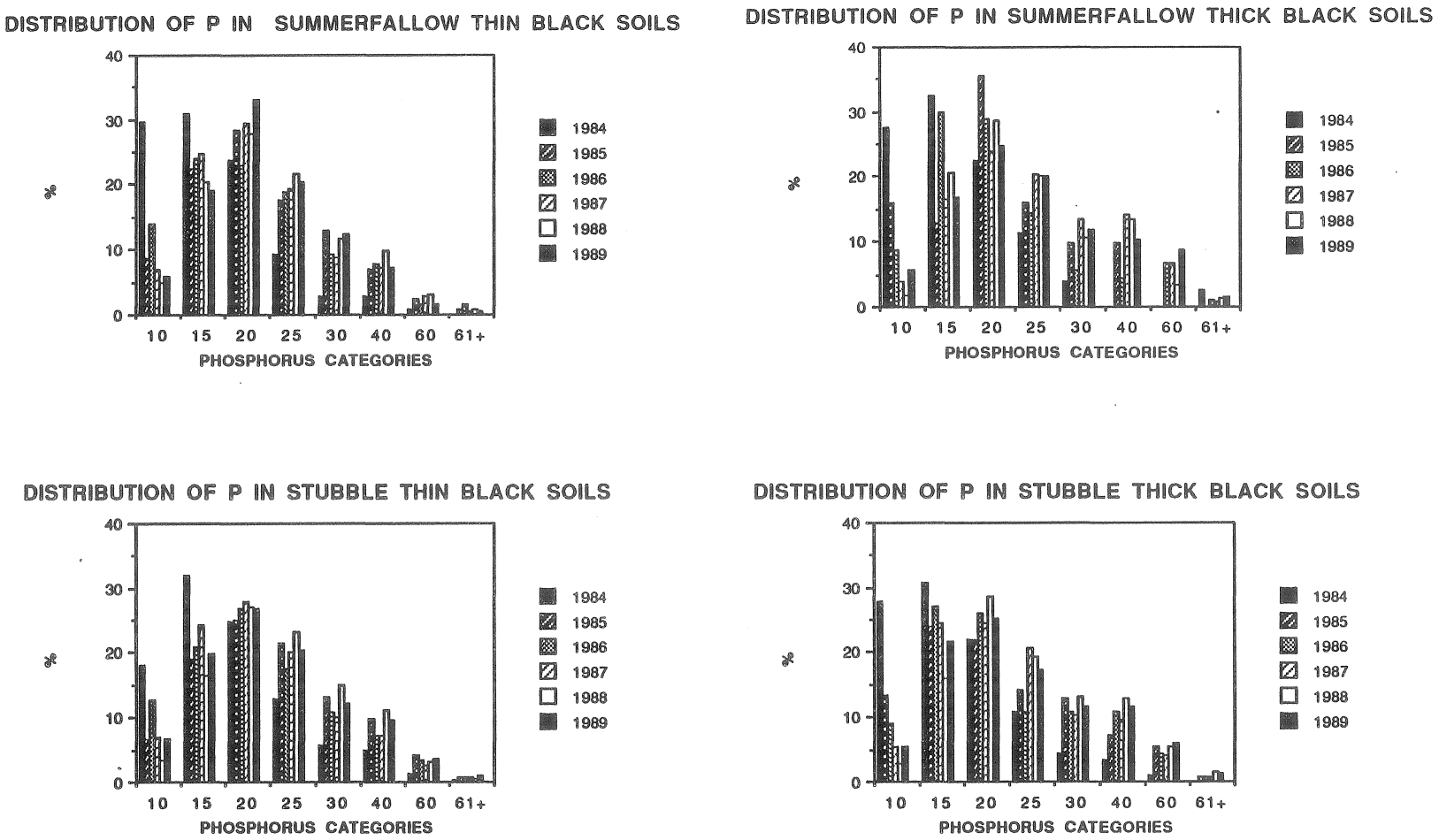


Fig. 17. Distribution of soil testing "available" Phosphorus levels in Thin and Thick Black soils.

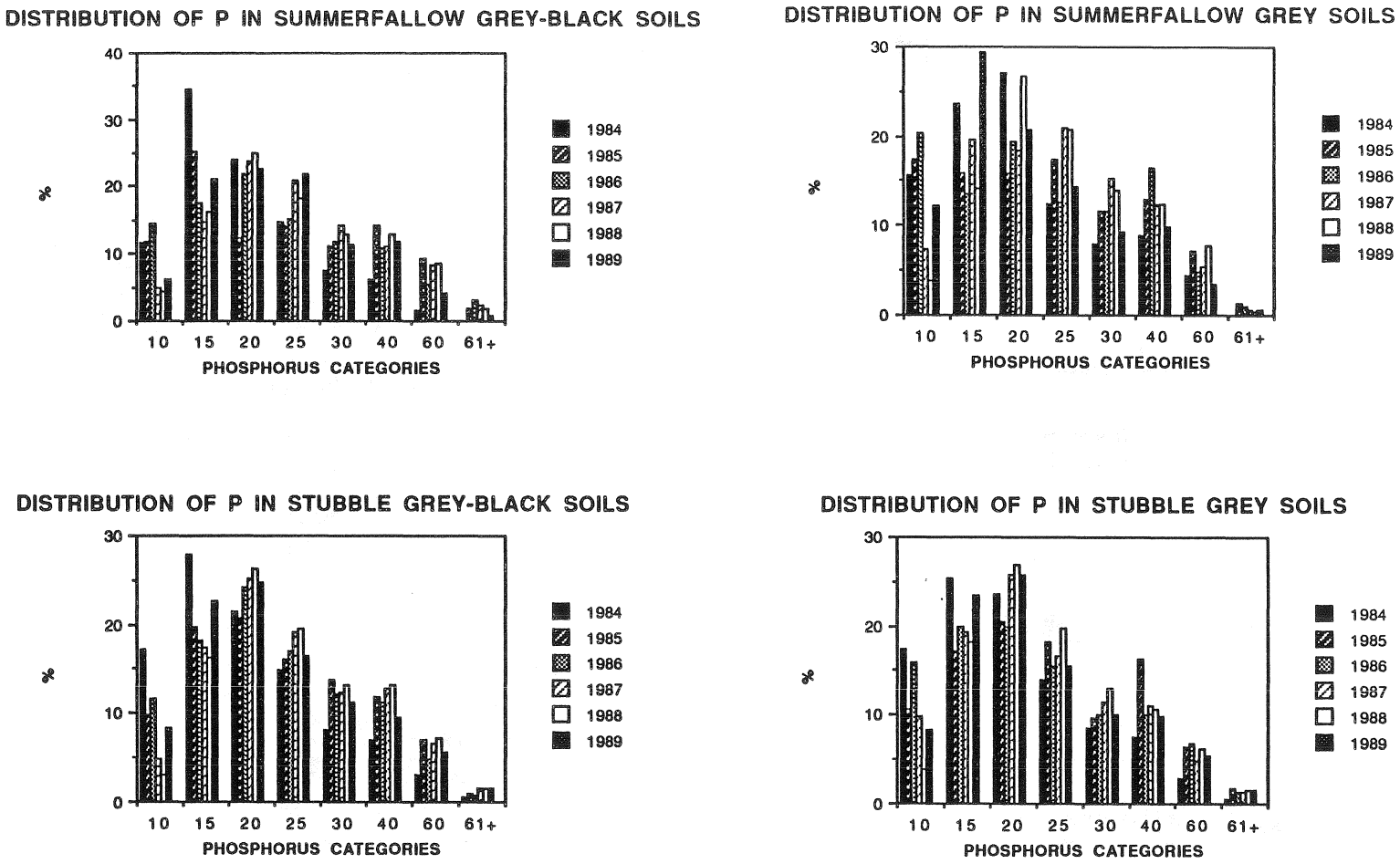


Fig. 18. Distribution of soil testing "available" Phosphorus levels in Grey-Black and Grey soils.

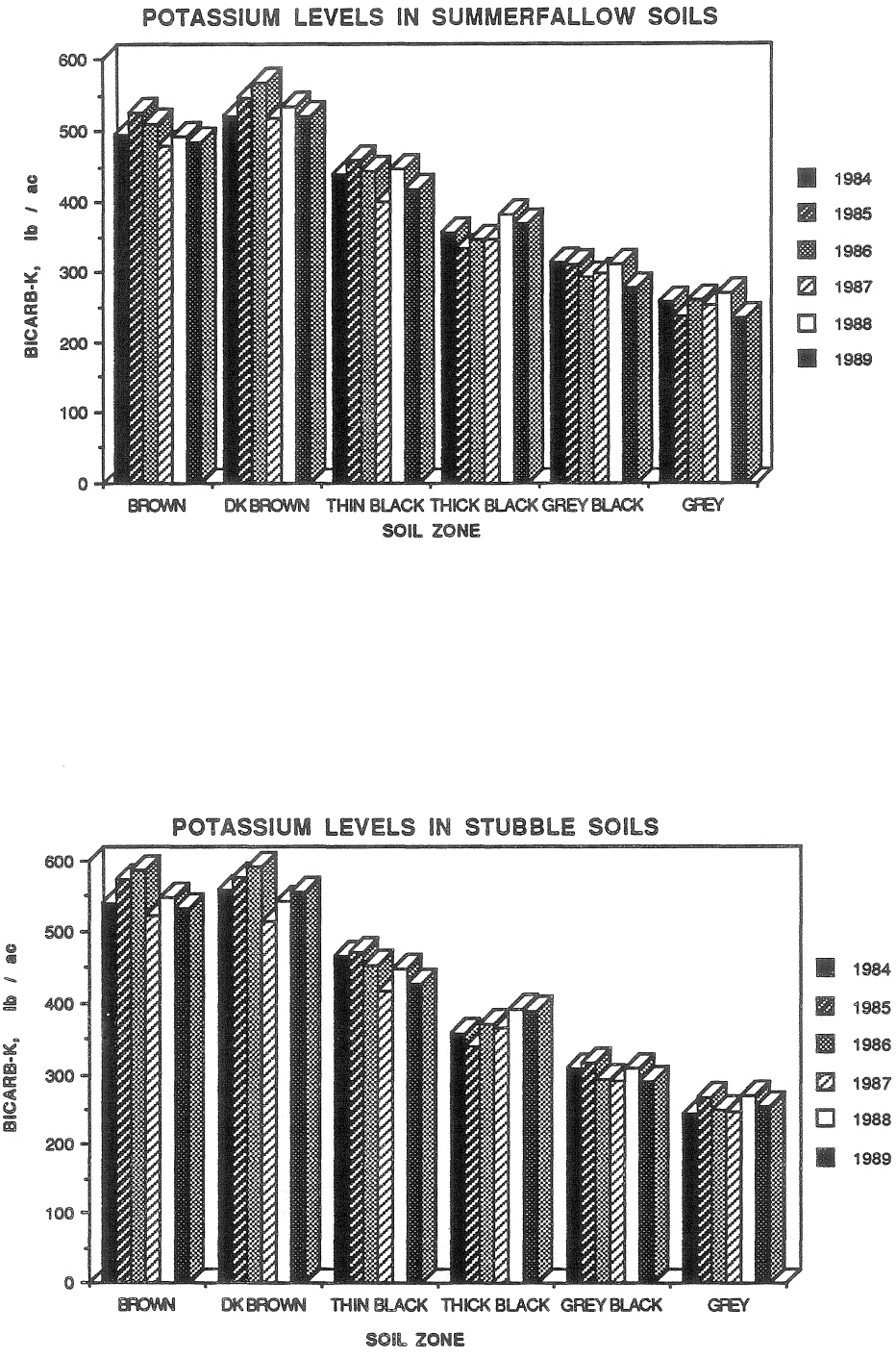
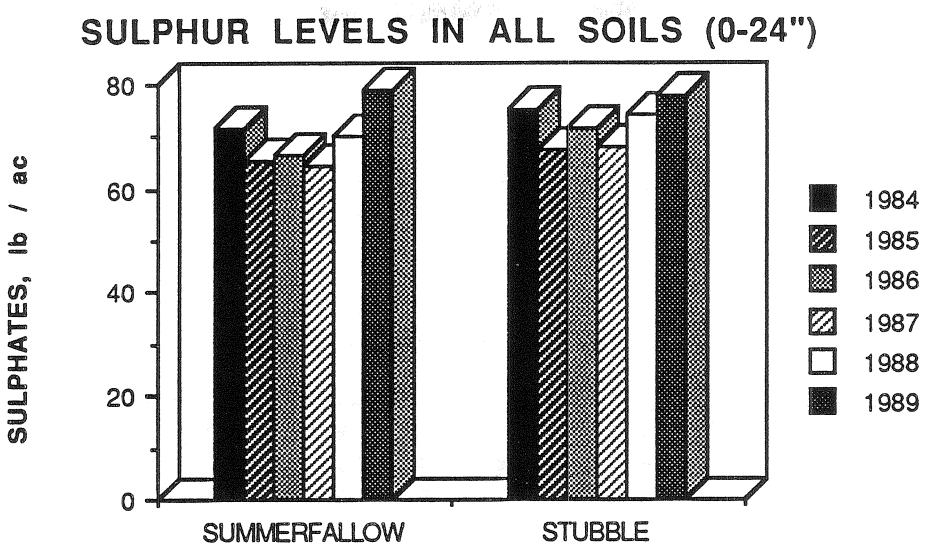


Fig. 19. Average soil testing Potassium levels in Saskatchewan soils.



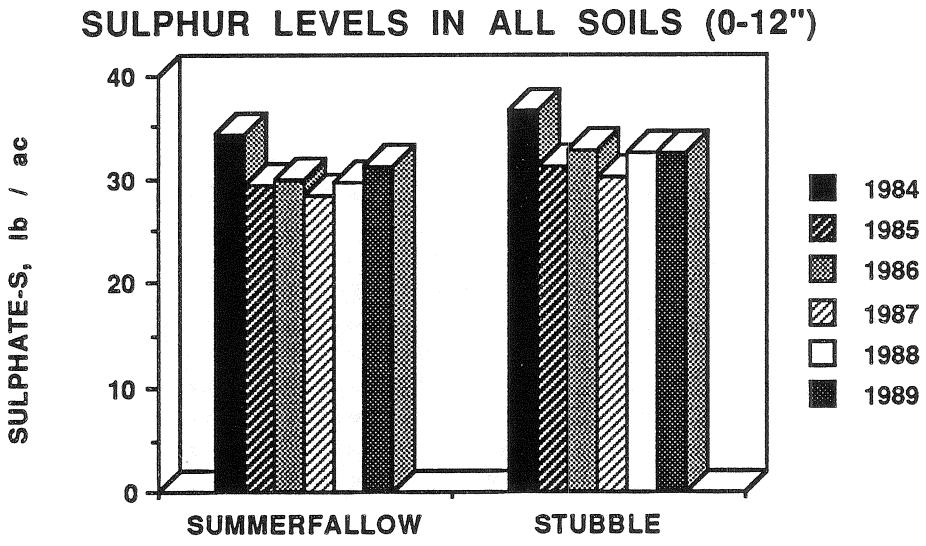


Fig. 20. Average soil testing Sulphate Sulphur levels in Saskatchewan soils.