

A Comparison of Aerial and Conventional Methods
for Seeding Winter Wheat.

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INTRODUCTION

Seeding practices are very important in the production of a successful winter wheat crop in western Canada. Seeding the crop within the optimum dates is of major importance (Fowler 1982). However, in some years fall seeding overlaps with the end of harvest delaying the seeding operation until after the optimum date. One possible alternative to this potential problem is aerial seeding. Aerial seeding of winter wheat is a unique practice in which winter wheat seeds are broadcast into an existing spring crop in July or August.

The theory behind aerial seeding is rather simple. Once the spring seeded crop is established in the summer, winter wheat is broadcast from an airplane into the spring crop's canopy. The winter wheat will begin to grow beneath the existing spring crop. Once the spring crop is harvested in the fall the winter wheat seedlings will already be established and will continue to develop. Not much work has been done in this area, thus the object of this research was to evaluate the feasibility of aerial seeding of winter wheat in east central Saskatchewan and compare the results with conventional seeding methods.

MATERIALS AND METHODS

Aerial and conventional seeding methods were carried out in field trials at four locations in east central Saskatchewan. Five different seeding dates and five different seeding rates were investigated.

Aerial seeding of winter wheat is a relatively new farming practice. The method of application is very similar to aerial spraying of chemicals. The airplanes are equipped with very large powered engines (340 kW). The particular plane that was used commercially in the Yorkton area had a capacity of 725 kg of wheat. The plane would spread seed over the ground at a speed of 160 km h⁻¹ and at a height of 12 m. The effective spread width was approximately 12 m. The Norstar winter wheat was broadcast at a rate of 170 kg ha⁻¹. As an example, if the field being seeded was 1.6 km long, the plane could make 2 passes and cover 3.9 ha before landing to reload. The down time for the refilling takes less than five minutes which means a large number of hectares can be seeded in a day.

In the present plot work, aerial seeding was simulated by hand spreading Norstar winter wheat into an existing spring crop. Each plot was 1.5 m x 5.5 m in size. A split-split block design was used at all four locations (Clair, Porcupine Plain and two sites near Yorkton). All trials were conducted on canola fields except for one trial at Yorkton which was located in a flax field.

The five seeding dates considered were July 15, August 1, August 15, September 1 and September 15. Winter wheat was broadcast on all five of these dates. In addition, a small plot hoe drill was used on September 1 to conventionally seed winter wheat. The hoe drill was equipped with eight openers on 20 cm centers.

The five broadcast seeding rates were 67, 100, 134, 168 and 202 kg ha⁻¹. On August 1 a phosphate coated seed (triple super phosphate) treatment was included to determine if there is a practical method of applying phosphate fertilizer with aerial seeding. The seed rate for this treatment was 134 kg ha⁻¹ with phosphate applied at 22 kg ha⁻¹.

The conventionally seeded winter wheat was sown at a seed rate of 100 kg ha⁻¹ and at a depth of approximately 2 cm. Two phosphate applications were included in the drill treatments (coated seed and seed placed phosphate). The seed placed phosphate treatment consisted of 11-51-0 at a rate of 22 kg ha⁻¹ granular P₂O₅.

Plant samples were removed from the field mid-October and the following measurements were made: Haun scale, number of plants per square meter, total number of tillers per plant (sum of primary and secondary tillers), crown depth, plant erectness and individual plant dry weight.

RESULTS AND DISCUSSION

The germination of broadcast seeds differed from the conventionally sown seeds in the sense that the former were exposed to the sunlight, wind, evaporation, and fluctuating air temperatures. However, some protection was provided for the germinating seeds by the canola or flax canopies.

There was evidence that some broadcast seeds did initially germinate, but were unable to survive because of either hot dry temperatures or a lack of rainfall. Very few broadcast seeds seeded on September 1 germinated and there was no germination of seeds broadcast on September 15. However, the treatments that were drilled in on September 1 had high germination. This was expected because the optimum conventional seeding dates for winter wheat in east central Saskatchewan are August 23 to September 7.

Figure 1 shows the daily precipitation values for July, August and September at Clair, Porcupine Plain and Yorkton. There were very small amounts of precipitation in the last two weeks of July at all locations. Also Fig. 1 shows how dry it was at Clair and Yorkton in September.

Evaporation is another climatic factor that is important in understanding plant development. However, at the present time, the evaporation values for 1988 are not available.

Plants m⁻²

Figure 2 shows the effect of seeding rate, method and date on the number of plants per square meter. Each broadcast seeding rate was found to have a significant effect on the plants m⁻². Higher seeding rates generally resulted in higher plant counts.

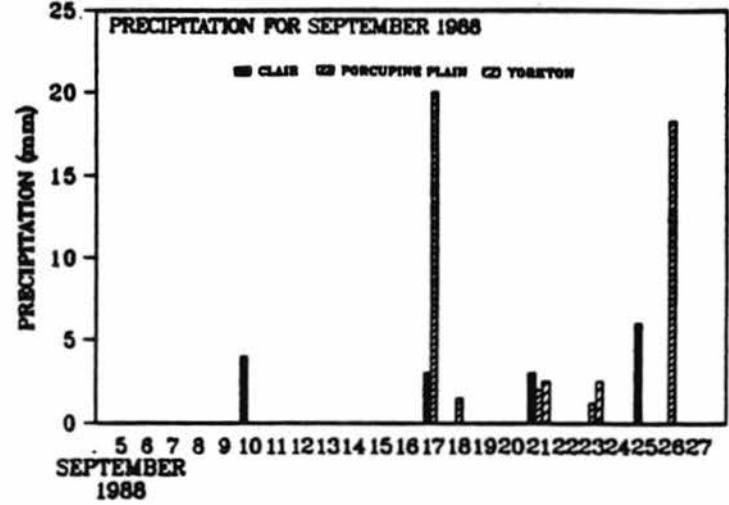
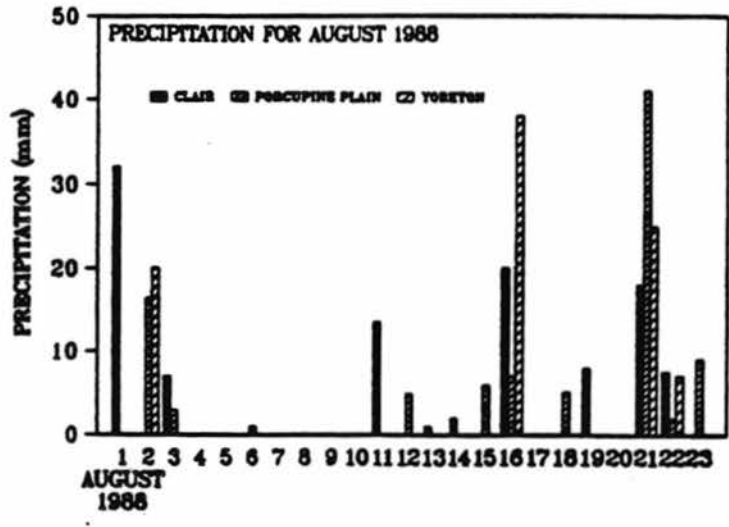
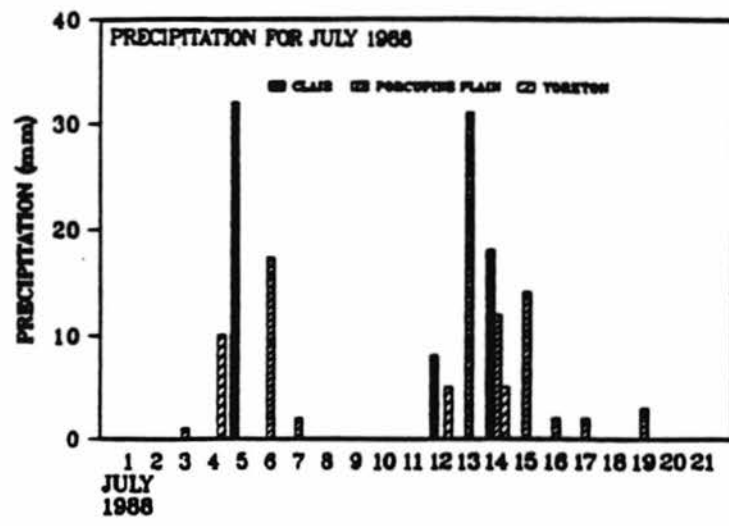


Figure 1. July, August and September daily precipitation values for three locations.

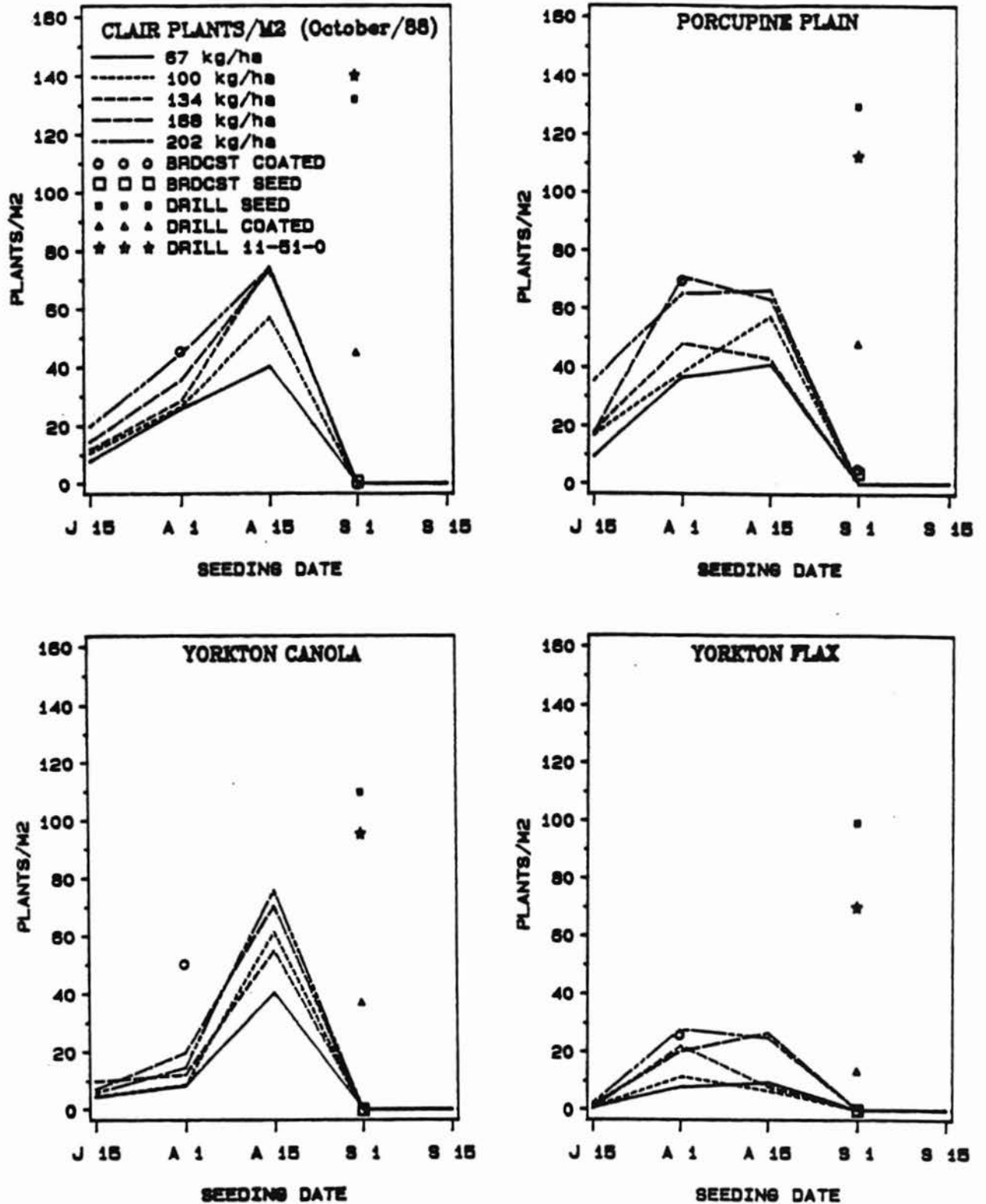


Figure 2. Plants m⁻² versus seeding date for four locations.

Both the Clair and Yorkton canola sites had a maximum plant establishment (approx. 70 plant m^{-2}) on the August 15 seeding date. Plant numbers were more consistent for the Porcupine Plain and Yorkton flax sites seeded on August 1 and August 15.

Regardless of the seeding date, the broadcast treatments in flax at Yorkton had fewer plants per unit area than the other three locations. A possible explanation for this may be associated with differences in canola and flax canopies. Flax has a canopy that is more open than canola. Therefore the winter wheat seedlings that were beneath the flax canopy were more exposed than were the seedlings beneath the canola canopy.

When the seeds were drilled into the soil on September 1, the number of plants m^{-2} was significantly higher than the number counted for the various broadcast seeding rates.

The coated phosphate drilled seed had plant counts per square meter that were only about 30% of those for the uncoated seed and the seed that had 11-51-0 seed placed. The uncoated conventionally seeded treatments resulted in plant counts ranging from 100 to 140 plants m^{-2} . Germination tests were performed on both the coated and uncoated Norstar. The percent germination for the uncoated seed was 88% and only 24% for the coated seed. The seed coating manufacturer suggested that the high rate of phosphate coating on the Norstar may have created an acidic reaction in the seed thus inhibiting germination.

The coated seed was broadcast on two dates (August 1 and September 1). However, as previously mentioned, essentially no plants survived from seed that was broadcast on or after September 1. Germination of the coated seed broadcast treatment on August 1 was similar to that of the highest seeding rate of the broadcast uncoated seed .

Haun Scale

Figure 3 shows the effect of seeding date and method of seeding on Haun scale values. Haun scale is a measurement of plant leaf development. It assigns a numerical value to the leaf stage of a seedling.

There were no significant differences in the haun scale values for the various broadcast seeding rates, thus an average for all seed rates was plotted in Fig. 3. Since very few plants survived from seed that was broadcast in September, the line in Fig. 3 extends only until August 15.

Three of the four locations in Fig. 3 showed only small changes in haun scale values for the first three dates. The Yorkton flax site showed a significant increase in haun values from July 15 to August 1 seeding dates. This was probably due to the poor germination of the material seeded on July 15. For all locations, the haun scale values for the broadcast seeds reached a peak between 3.0 and 3.5. Depending on location, August 1 or 15 were the seeding dates that resulted in the most advanced seedlings.

At Clair and Porcupine Plain, the drilled seed treatments had leaf stages that were comparable to the first three broadcast treatments (which were seeded two to six weeks earlier). Figure 1 shows that there was greater precipitation the last two weeks in September at Clair and Porcupine Plain

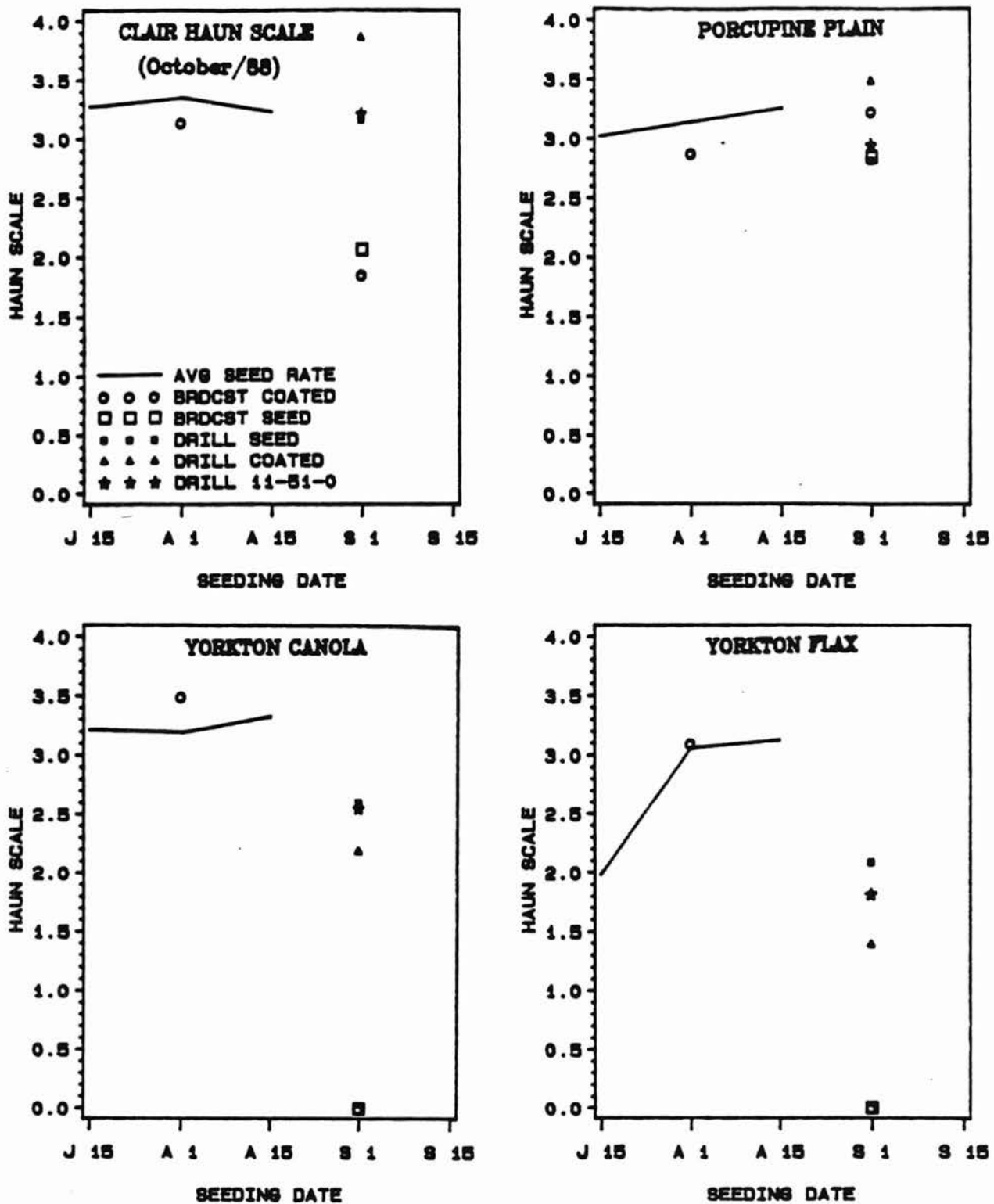


Figure 3. Haun scale versus seeding date for four locations.

than there was at Yorkton. This probably had a large effect on the success of the drilled seeded treatments.

Figure 3 shows that, at Clair and Porcupine Plain, the drilled coated seed had leaf development that was more advanced than the drilled uncoated seed. This is contrary to the results shown in Figure 2 for plants m^{-2} . Once again, differences in moisture accumulation was probably responsible. The uncoated seed placed P_2O_5 and the drilled uncoated seed had similar haun scale values.

Although essentially no seed germinated for treatments broadcast on September 1st, the few that did germinate produced plants with a leaf stage that was usually less advanced than the drilled in treatments. At the two Yorkton trials the drilled in treatments were significantly less advanced in leaf stage than the first three broadcast treatments. This was because only 5 mm of rain fell in the entire month of September at Yorkton.

Tiller number

Figure 4 shows the effect of broadcast seeding rate on the number of tillers per plant. Plants from earlier seeding dates usually had greater number of tillers.

With the exception of Porcupine Plain, the broadcast coated seeds (August 1) produced seedlings with essentially the same number of tillers as the uncoated broadcast seeds. At Porcupine Plain the broadcast coated seed produced seedlings with significantly fewer tillers than the uncoated seed.

The two Yorkton sites had fewer tillers per plant than either Clair or Porcupine Plain. These differences were probably due to the lower rainfall received at Yorkton throughout the entire growing season (see Figure 1). As an example, on July 15 at Clair there were 12 tillers per plant and at Yorkton (canola) there were only 6 tillers per plant.

The drill treatments did not show any significant differences in tiller numbers. They were considerably lower than the tiller numbers associated with the early broadcast treatments. Seedlings from Clair and Porcupine Plain that were seeded with the drill had 2 or 3 tillers and the two Yorkton sites had no more than one tiller per seedling.

Plant Erectness

The method of seeding had a large effect on plant erectness. Seeds that were broadcast tended to produce plants with a prostrate growth habit and seeds that were sown with a drill produced plants with a more erect appearance (see Figure 5). Broadcast seed rate did not influence plant erectness, therefore an average value for all seed rates was plotted in Figure 5.

The plants from drilled seed were approximately 3 to 6 cm more erect than the plants from broadcast seed. The most erect seedlings came from Clair. There the conventionally seeded coated seeds produced seedlings that stood 10 cm above the soil surface while the broadcast coated seedlings were much more prostrate and stood only 4 cm above the surface. The coated seed had an effect on plant erectness only for the drilled treatments. There was no

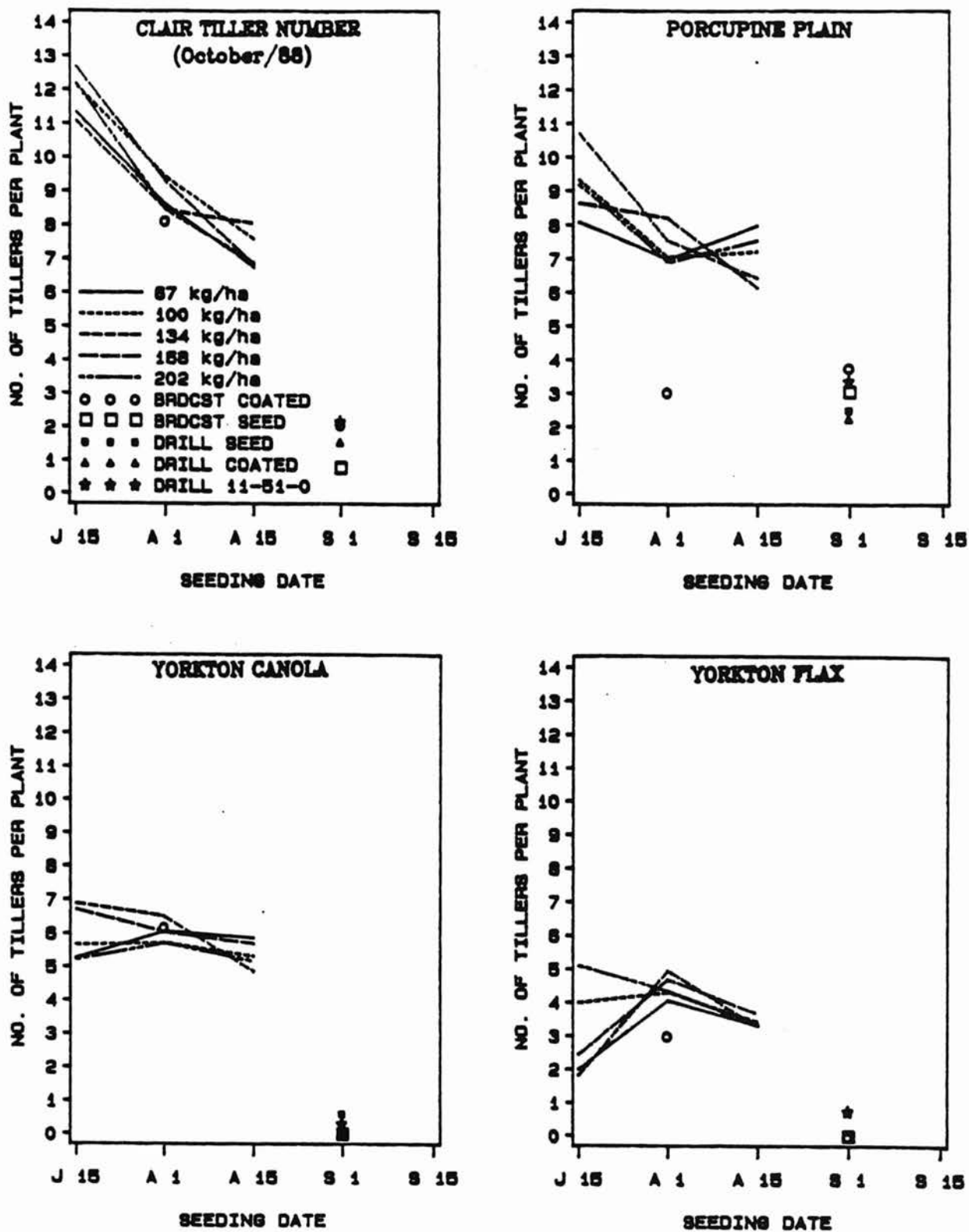


Figure 4. Tiller number versus seeding date for four locations.

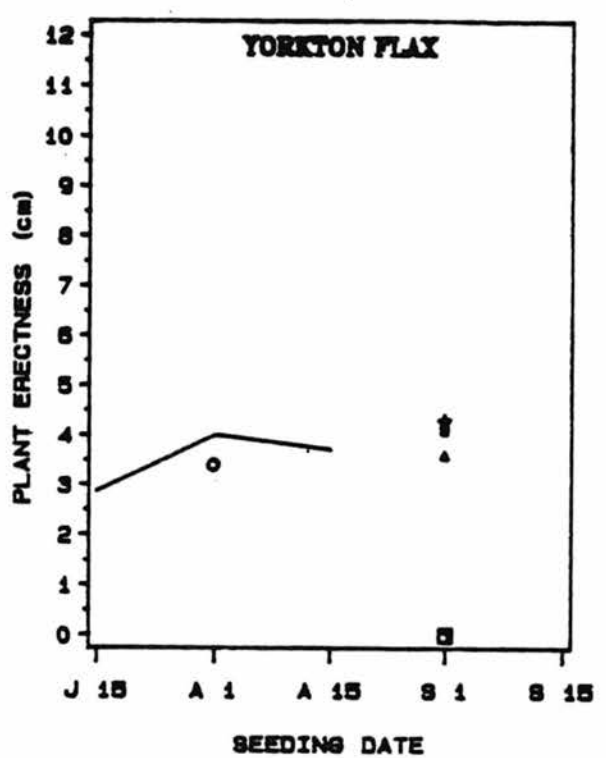
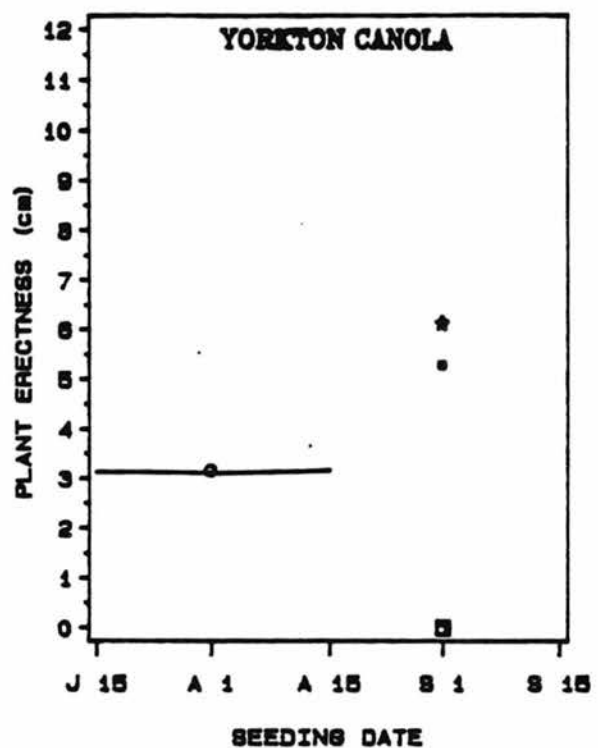
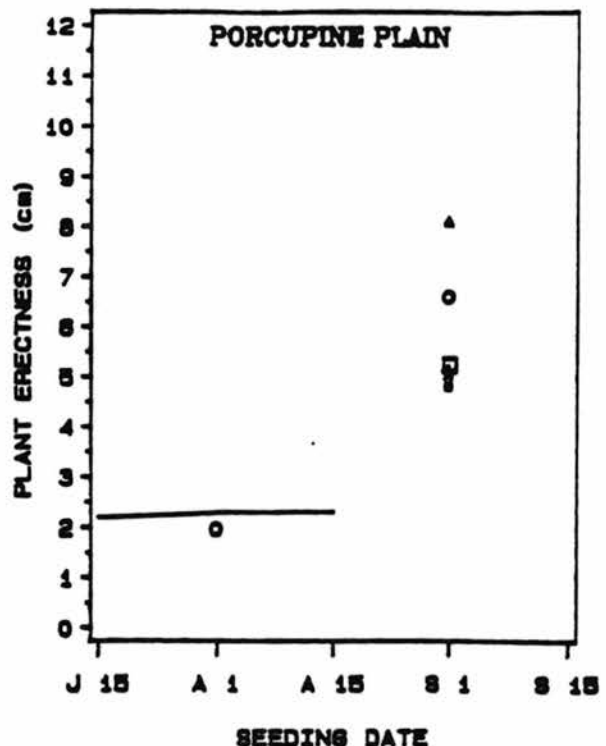
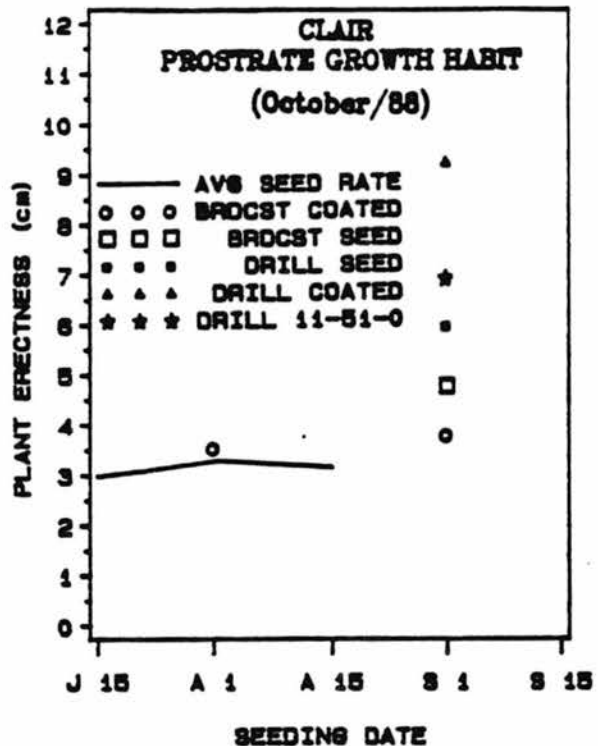


Figure 5. Plant erectness versus seeding date for four locations.

significant difference in plant erectness between plants from coated and uncoated broadcast seeds.

Crown Depth

Figure 6 shows the effect of seeding methods on crown depth. The crown depth essentially measures the seeding depth of the seed. The broadcast treatments theoretically should have had a crown depth of 0 cm, however since the canola at Clair and Porcupine Plain was seeded with a hoe drill, large furrows were left in the soil surface. This allowed the broadcast winter wheat seeds to fall down into the furrows. Thus with any "caving in" of the furrows, the effective seeding depth was increased. Figure 6 also shows that the crown depth for the conventionally seeded winter wheat ranged from 1.5 to 2.5 cm depending on location.

Plant Weights

Broadcast seeding rates did not affect the individual plant weights, thus an average fall seed rate is plotted in Figure 7. Similar to the work reported by Fowler (1982), the earlier the seeding date produced larger plants.

With the exception of the Yorkton flax trial, all locations produced larger plants with early broadcast seeding compared to the conventional seeding method. Once again this is probably due to a difference in seeding date rather than seeding method. At each of the four locations, the different drill treatments produced plants with similar weights.

Conclusions

Aerial seeding resulted in a quicker seeding operation. The seedlings from broadcast seeding dates before September 1 were more prostrate and had a greater number of tillers than the conventional seeding methods. However, since the broadcast seeds were lying on top of the soil surface, they were more vulnerable to extreme weather conditions. Unlike conventional seeding methods, pre-seeding soil moisture did not encourage germination of broadcast seed.

References

Fowler, D.B. 1982. Date of seeding, fall growth, and winter survival of winter wheat and rye. *Agron. J.* 74: 1060-1063.

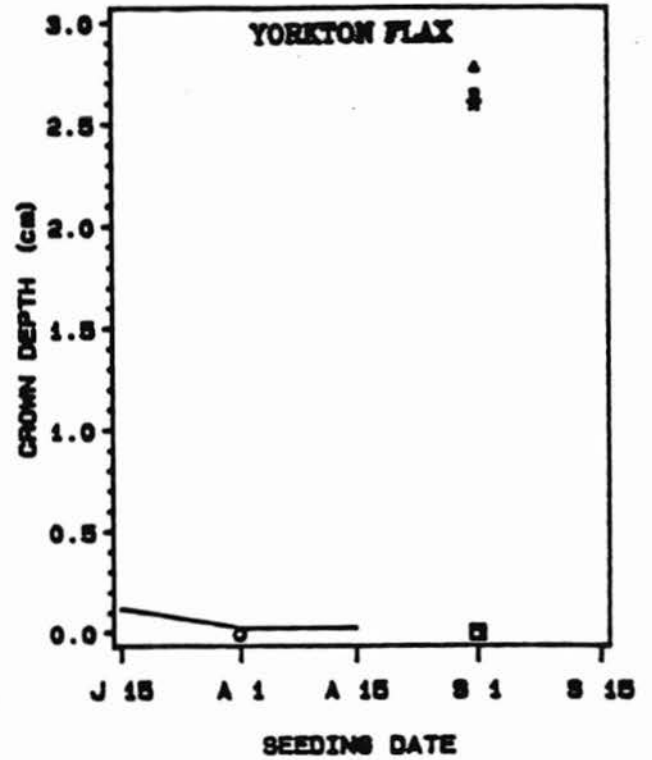
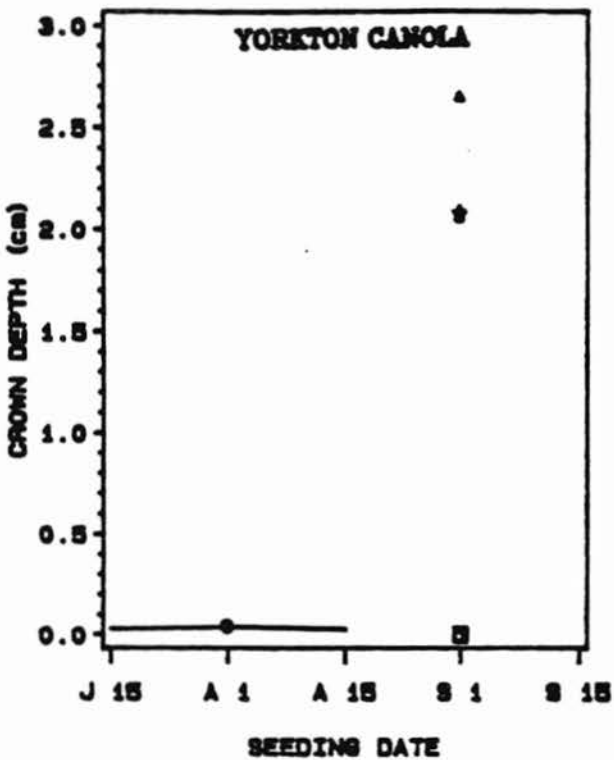
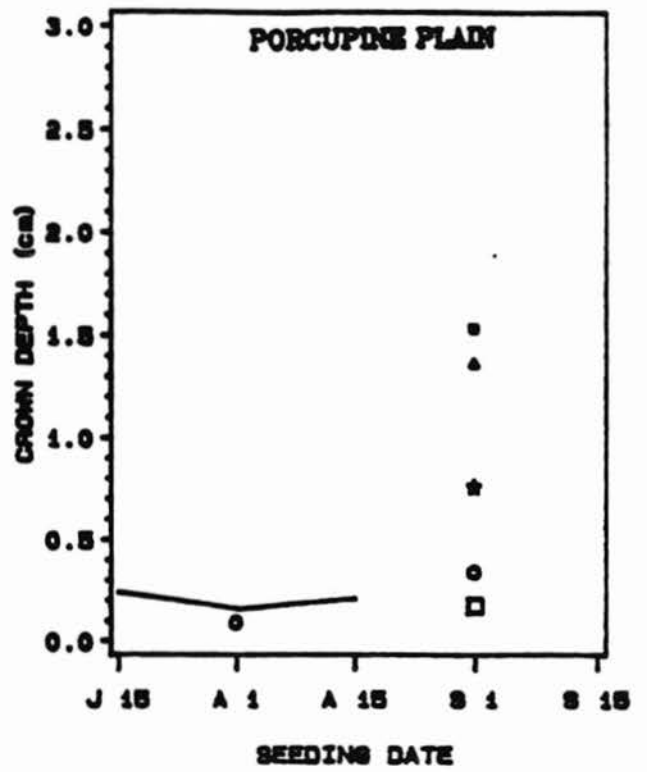
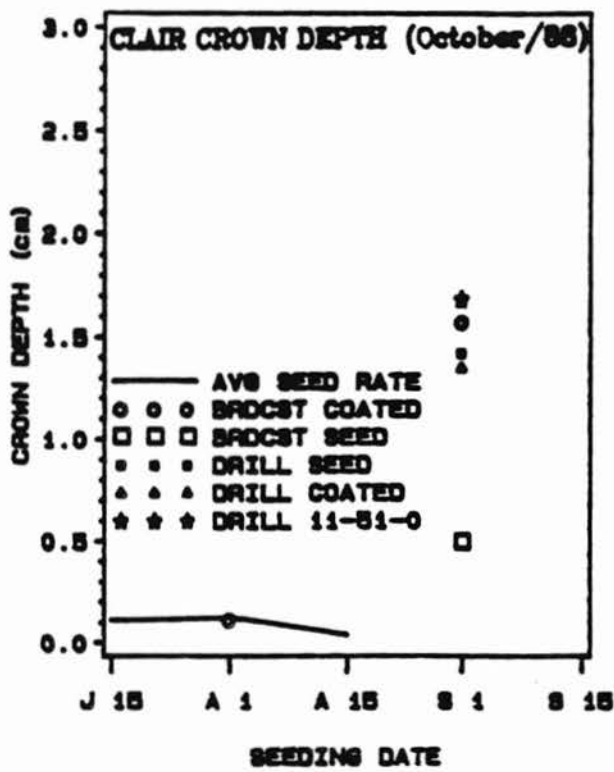


Figure 6. Crown depth versus seeding date for four locations.

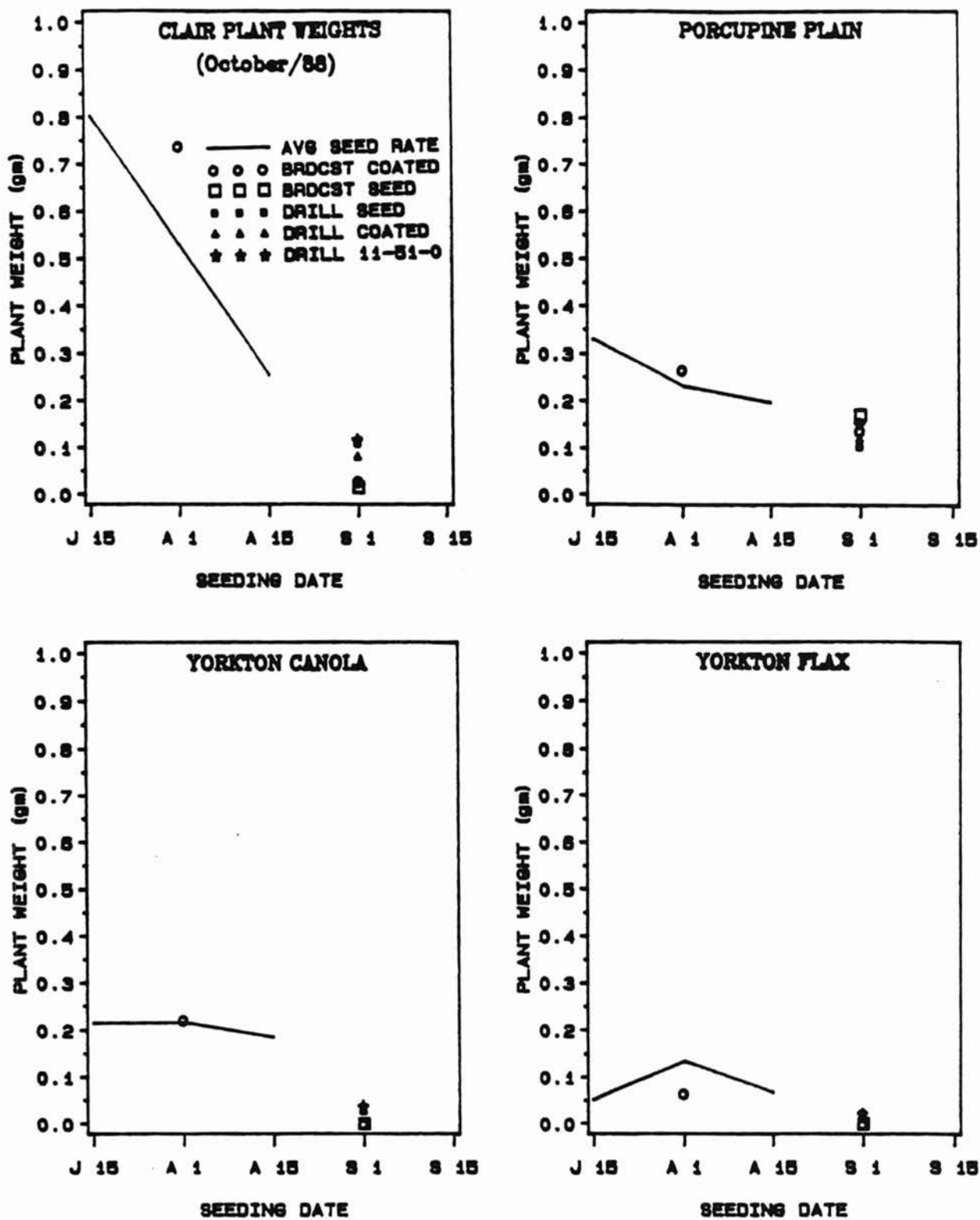


Figure 7. Plant weight versus seeding date for four locations.