AN EVALUATION OF SEED DRILLS WITH VARIOUS OPENERS FOR SEEDING WINTER WHEAT IN SOUTHWEST SASKATCHEWAN

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ABSTRACT

Four seed drills were evaluated for seeding winter wheat in South West Saskatchewan. Furrow opener types were the Swift Current 0-till offset disc, an air seeder with Dutch banding knives, the Swift Current 0-till hoe, and Versatile Noble 0-till hoe. Soil disturbance varies from least to greatest in order listed, however, sufficient stubble is retained with all openers to normally ensure winter survival and adequate plant stands. No yield differences were observed for plots seeded by the various drills on chemical fallow on a clay loam soil. There is a tendency for the 0-till disc to show better yield on stubble on a clay loam soil whereas a hoe opener tends to show better yields on stubble for a sandy loam soil. However, other factors such as weather between fall and spring, GSP and spring soil moisture interacting with plant densities appear to affect yields equally as great. More years of data are required to confirm these trends.

INTRODUCTION

In 1985 a substantial amount of ERDA funding was earmarked for developing a production package for winter wheat. Previous experience had shown that zero-till planting the crop into standing stubble is an essential first step for the survival and production of winter wheat in most of Saskatchewan (Anderson, 1969; Austenson and Anderson, 1969; Fowler et al., 1976). Therefore, at the Swift Current Research Station, it was decided to evaluate seed drills having a variety of furrow openers for their performance in the 0-till seeding of winter wheat into standing stubble.

MATERIALS AND METHODS

Winter wheat (Triticum aestivum L. cv. Norstar) was seeded into wheat stubble in the fall of 1984, 1985 and 1986, in a split plot design, with seed row openers as main plots and seeding rates as subplots. The subplot size was 6 x 13.5 m. Seeding rates were 40, 60 and 80 kg/ha.

In 1984-85 the experiment was carried out at only one location, on a clay loam soil. In 1985-86, it was expanded to 3 sites at the clay loam location, and 2 sites on sandy loam soil and heavy clay soil, respectively. Five sites at the same three locations were again used in 1986-87.

In 1984-85 treatments were seeded between Sept. 18-20, except for the

air seeder treatments which were seeded on Oct. 9. In 1985-86, sites at the clay loam location were seeded on Sept. 21-26, while the other two sites were seeded on Sept. 26-30. In 1986-87, all sites were seeded on Sept. 2-9.

All treatments were fertilized rate with 30 kg P_2O_5/ha, placed with the seed as 11-55-0, and 60 kg N/ha broadcast in the spring as 34-0-0.

The following mix of common commercial experimental drills were used for the experiment:

1. The Swift Current Zero-till disc drills (Dyck and Tessier, 1986). An experimental drill featuring an offset disc opener at 17.5 cm row spacing and conventional closed pan packer wheels 4.5 cm wide by 66 cm in diameter.

2. The Swift Current Zero-till hoe drill (Dyck and Tessier, 1986). An experimental drill featuring a narrow hoe point (Thompson Slim Line knife) spaced at 17.5 cm with 4.5 cm x 66 cm diameter packer wheels. The openers are arranged in four ranks 45 cm apart.

3. A Versatile Noble 2000 series hoe drill equipped with zero-till points and 7.5 cm x 56 cm packer wheels. The openers are at 20 cm spacing arranged in three ranks 45 cm apart.

4. A Morris heavy duty cultivator equipped with a Beline air seeder attachment, 1.9 cm Dutch banding knives at 30 cm spacing and Vale farms gang style poly packer wheels 3.8 cm wide x 40 cm diameter. Packing pressure is the least of all the machines used.

Data collected were stand density in the spring, heading date, date of maturity height, grain yield, test mass, kernel mass and grain protein. ANOVA were performed on the data.

In 1985-86, grain yield data from the heavy clay site was lost because of a hail storm. This same site, as well as a site at the clay loam location were abandoned in 1986-87 because of heavy winter wheat volunteer infestation. Weather conditions were very different in each year. In 1984-85, freeze up occurred in mid-October resulting in poor hardening. This was followed by severe winter temperature and a very dry summer. In 1985-86, hardening conditions in fall were good followed by a fairly mild winter and good early spring moisture. In 1986-87, fall conditions were moist, the winter was mild, but spring was warm and dry and the rains came late in summer.

RESULTS AND DISCUSSION

All the drills left sufficient stubble standing to catch snow and ensure reasonable winter survival. Soil disturbance is judged to be least for the Swift Current 0-till disc drill to greatest for the Noble hoe. The air seeder is next to the disc and the Swift Current 0-till hoe between it and the Noble hoe (Figure 7). There are differences in plant densities, however, all drills gave sufficient plant stands to give reasonable yields. The results are presented in Table I and in figures 1 to 6. Significant

TABLE 1. Mean performance of Norstar winter wheat seeded with four different row openers and three seeding rates in S.W. Saskatchewan in 1984-87.

Location (soil texture)	Treatments		Stand density (p/m2) 84-85	85-86	86-87	Grain yield (kg/ha) 84-85	85-86	86-87	Kernel mass (mg) 84-85	85-86	86-87	Grain protein + (%) 84-85	85-86	86-87
Stubble (Clay loam)	Drill	O-Till Hoe	33 c	91 a	153 bc	775	1459 ab	1363 bc	28.0 a	26.1 b	27.5	12.8	9.7	12.3
		O-Till Disc	66 b	106 a	176 ab	877	1779 a	1500 a	25.1 b	27.5 a	25.6	12.9	9.8	12.2
		Noble Hoe	92 a	63 b	201 a	797	1163 b	1236 c	23.7 b	25.5 b	26.2	12.8	9.9	12.5
		Air Seeder	26 c	51 b	135 c	901	1272 b	1412 ab	27.4 a	25.7 b	26.4	12.7	10.0	12.3
			**	**	**	NS	*	**	**	*	NS	NS	NS	NS
	Seeding rate (kg/ha)	40	40 b	63 c	129 c	810	1236 c	1387	26.8 a	25.6 b	27.5 a	12.8	10.0	12.3
		60	59 a	75 b	158 b	859	1418 b	1390	25.3 c	25.9 b	26.4 b	12.9	9.7	12.3
		80	64 a	96 a	211 a	843	1601 a	1357	26.0 b	27.1 a	25.4 c	12.7	9.8	12.4
			**	**	**	NS	**	NS	**	**	**	NS	NS	NS
Cont. W.W. (Clay loam)	Drill	O-Till Hoe		112 b			2231 ab			27.7 a			9.9	
		O-Till Disc		137 a			2324 a			28.6 a			9.5	
		Noble Hoe		117 b			2093 b			27.3 ab			9.7	
		Air Seeder		63 c			1839 c			26.0 b			9.9	
				**			**			**			NS	
	Seeding rate	40		94 b			2048 b			26.9			9.7	
		60		105 b			2106 ab			27.4			9.7	
		80		126 a			2201 a			27.8			9.8	
				**			*			NS			NS	
Chem-fallow (Clay loam)	Drill	O-Till Hoe		136 b	177 c		2097	2569		26.2 a	27.6 b		8.5	12.8
		O-Till Disc		151 a	197 b		2046	2532		27.8 ab	27.3 b		8.4	12.9
		Noble Hoe		134 b	217 a		2022	2524		25.6 ab	27.4 b		8.4	12.5
		Air Seeder		88 c	143 d		1865	2497		24.3 b	28.4 a		8.5	12.4
				**	**		NS	NS		*	*		NS	NS
	Seeding rate (kg/ha)	40		100 c	123 c		1866 c	2540		24.9 b	28.3 a		8.5	12.7
		60		126 b	186 b		2034 b	2542		26.2 a	27.7 b		8.4	12.5
		80		156 a	240 a		2124 a	2509		26.9 a	27.1 c		8.4	12.8
				**	**		**	NS		**	**		NS	NS
Cont. W.W. (Sandy loam)	Drill	O-Till Hoe		100 a	179 a		1365 ab	1533		29.8	28.1		13.2 a	13.8
		O-Till Disc		110 a	196 a		1492 ab	1281		29.7	28.2		13.2 a	14.7
		Noble Hoe		101 a	210 a		1678 a	964		28.9	27.4		12.4 b	14.7
		Air Seeder		70 b	132 b		1137 b	1272		29.6	27.2		13.1 a	14.5
				**	**		*	NS		NS	NS		*	NS
	Seeding rate (kg/ha)	40		68 c	135 c		1265 c	1220 b		29.6	27.2		13.2	14.4
		60		96 b	182 b		1433 b	1208 b		29.3	27.7		12.9	14.3
		80		122 a	220 a		1555 a	1359 a		29.7	28.3		12.8	14.5
				**	**		**	*		NS	NS		NS	NS
Cont. W.W. (Heavy clay)	Drill	O-Till hoe		113 a						29.1			9.4	
		O-Till Disc		112 a						28.4			9.3	
		Noble Hoe		110 a						27.9			9.6	
		Air Seeder		75 b						28.9			9.7	
				**						NS			NS	
	Seeding rate (kg/ha)	40		75 c						28.8			9.4	
		60		104 b						28.3			9.6	
		80		129 a						28.7			9.6	
				**						NS			NS	

\+ N X 5.7

**,* Significant differences at P<0.10 and p<0.05, respectively; NS, not significant.

a-d Means within columns and locations sharing the same letter do not differ significantly according to Duncan's multiple range test, P<0.05.

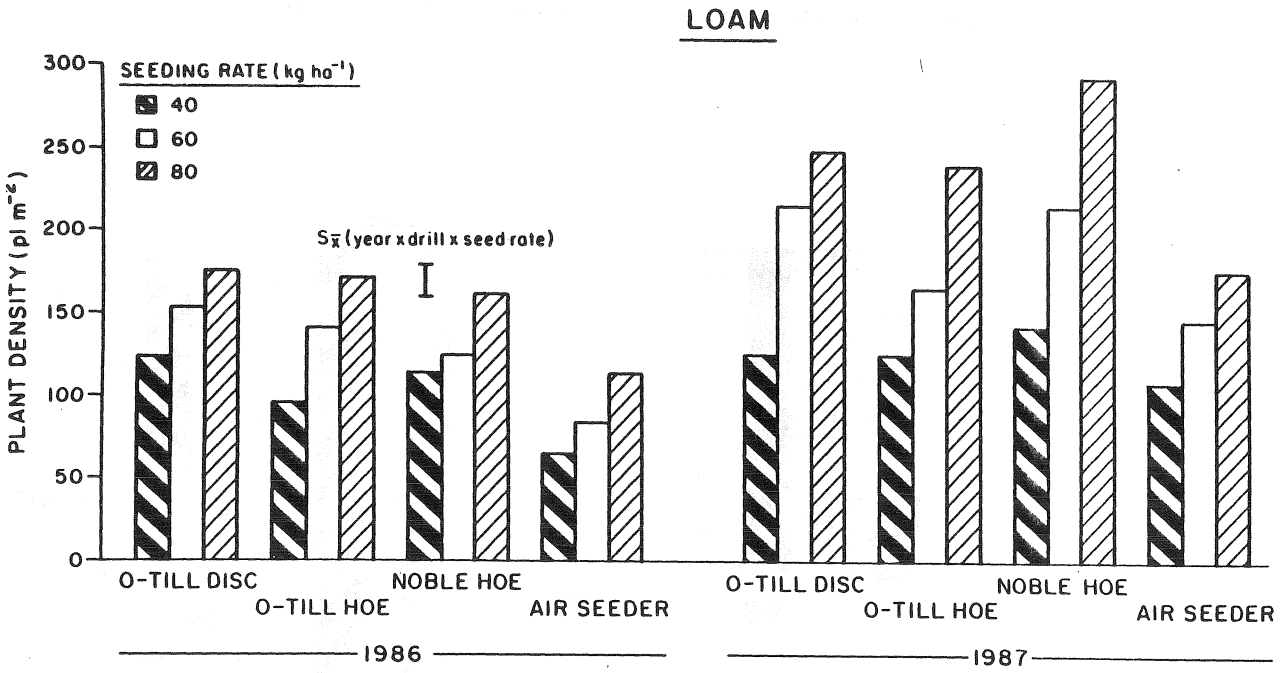


Figure 1. The effect of furrow opener and seed rate on plant density for chemical fallow on a clay loam soil.

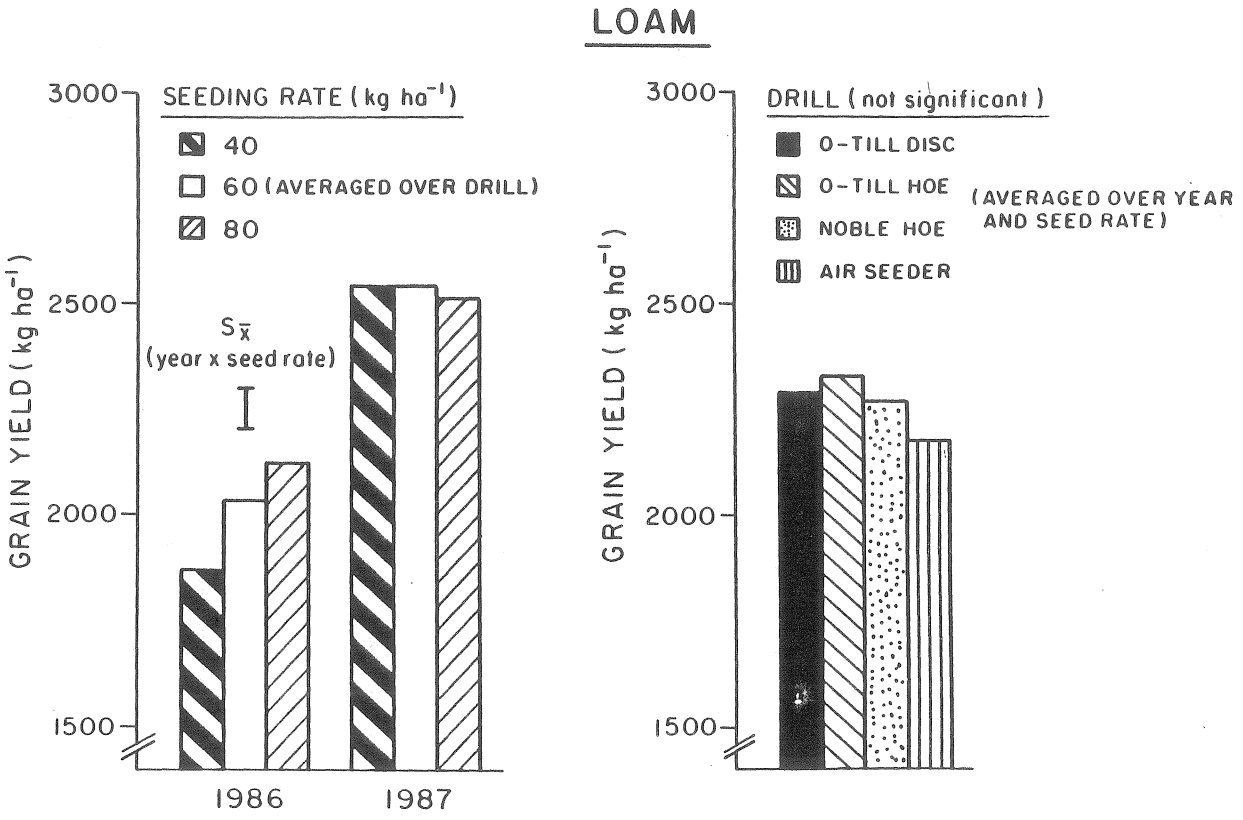


Figure 2. The effect of seeding rate and furrow opener on grain yield for chemical fallow on clay loam soil.

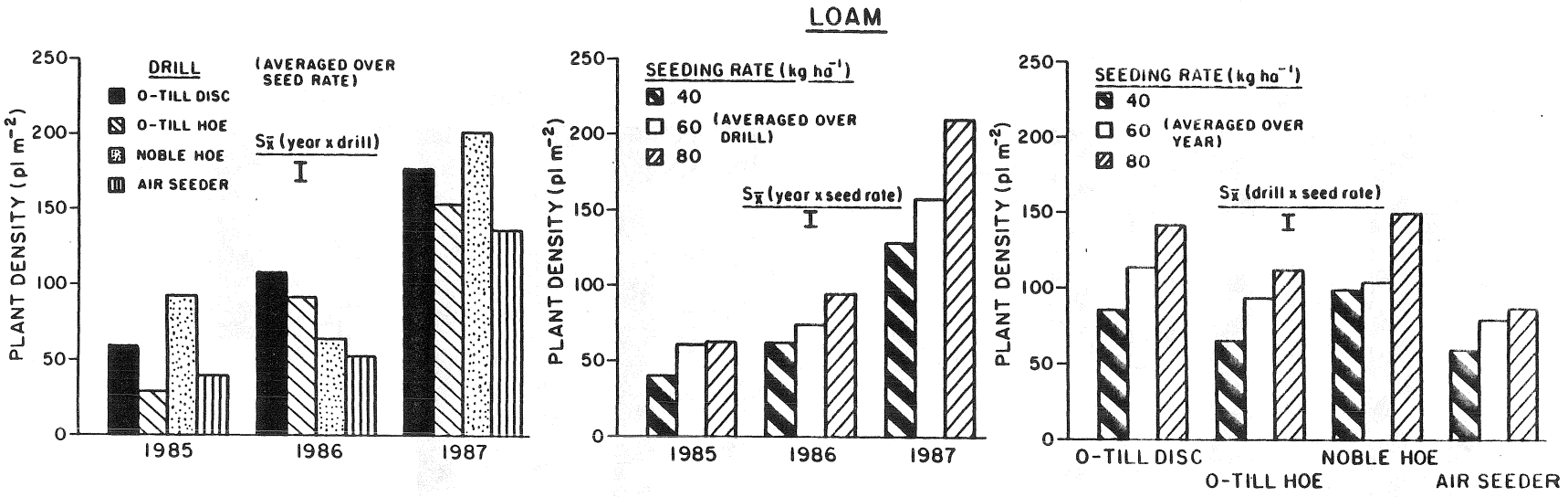


Figure 3. The effect of year, seed rate and furrow opener on plant densities for stubble seeding on a clay loam soil.

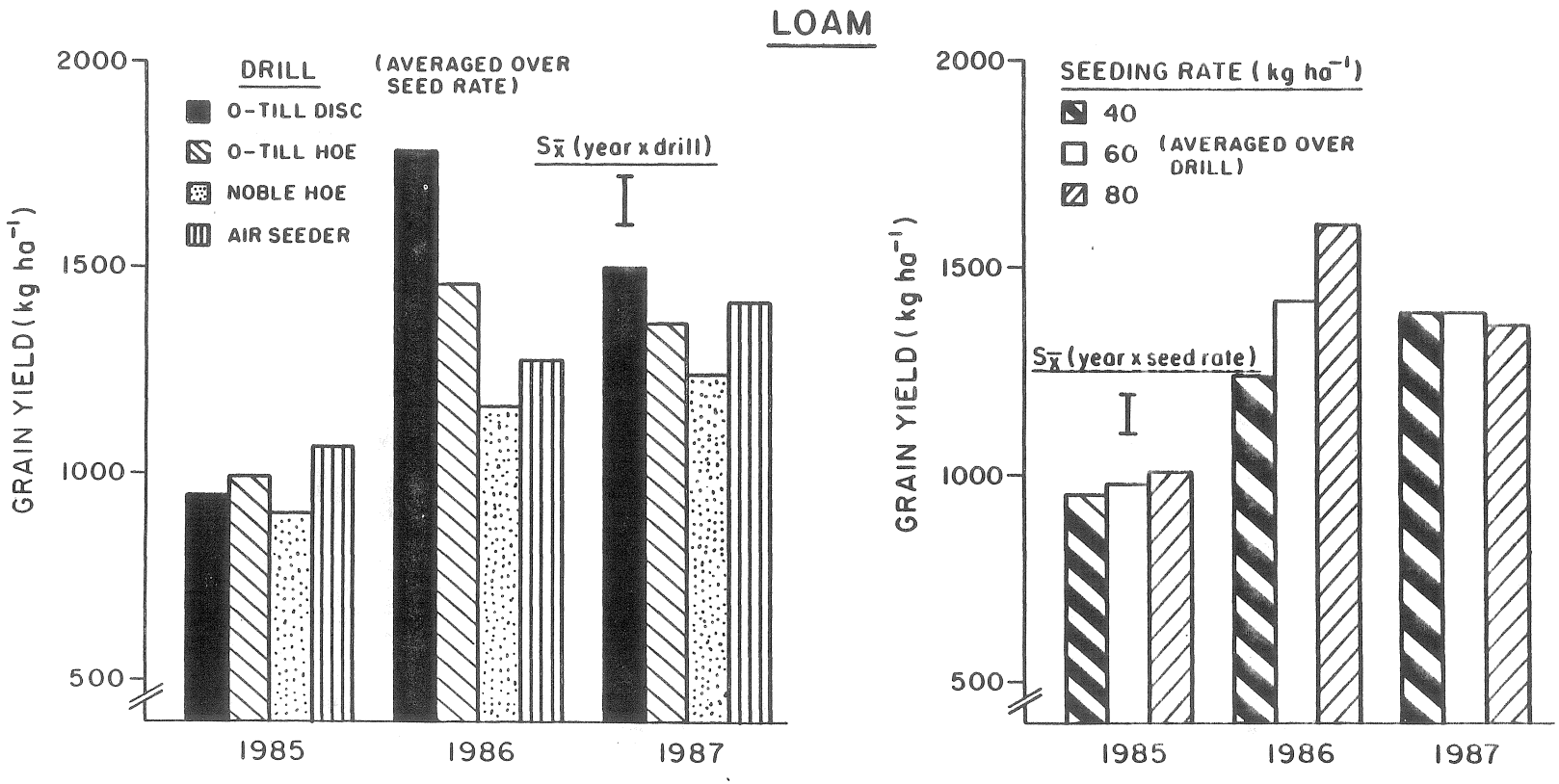


Figure 4. The effect of year, seed rate and furrow opener on grain yield for stubble seeding on a clay loam soil.

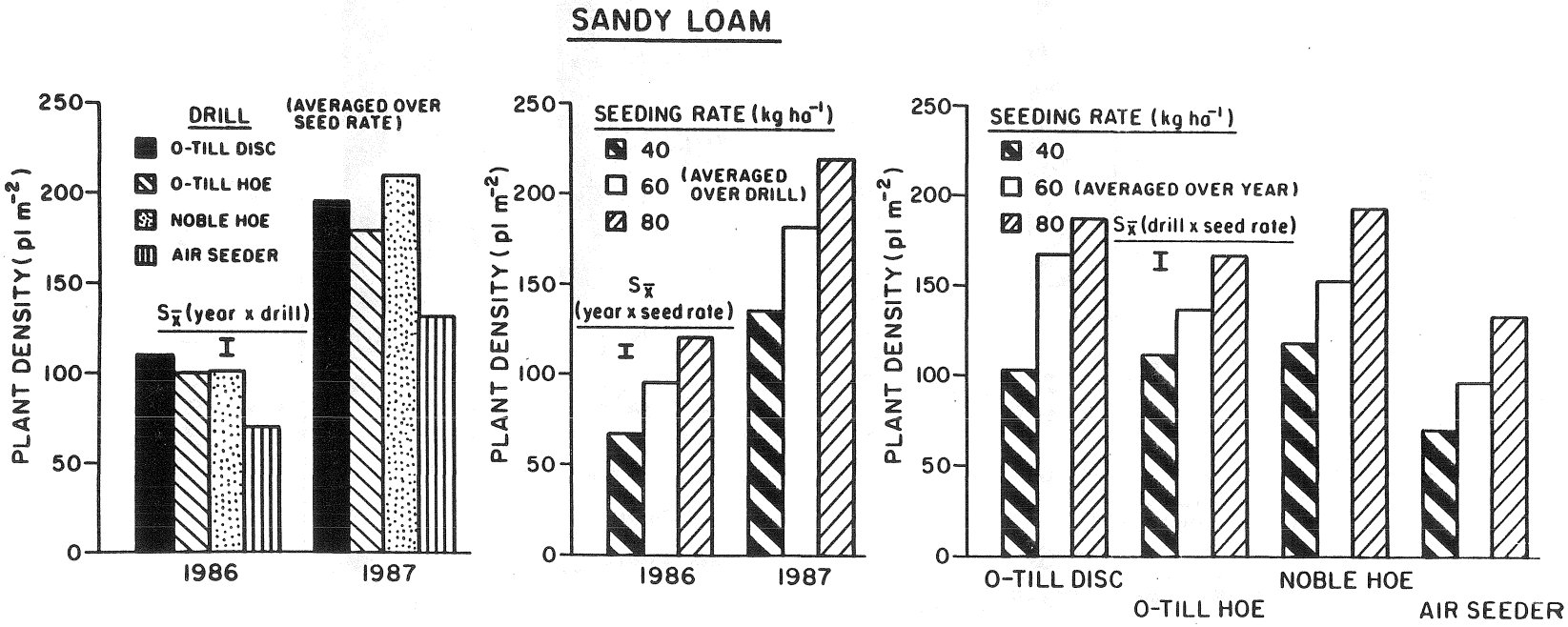


Figure 5. The effect of year, seed rate and furrow opener for stubble seeding on a sandy loam soil.

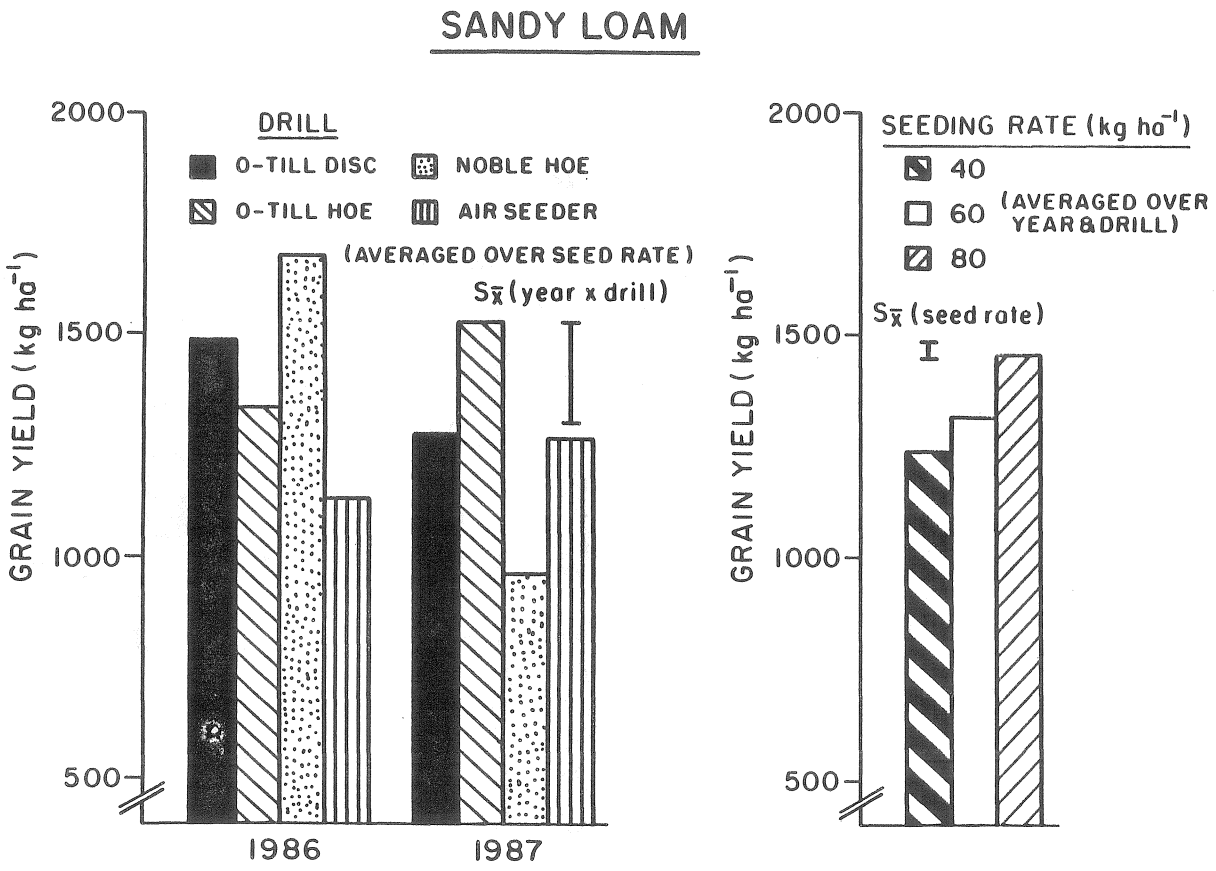
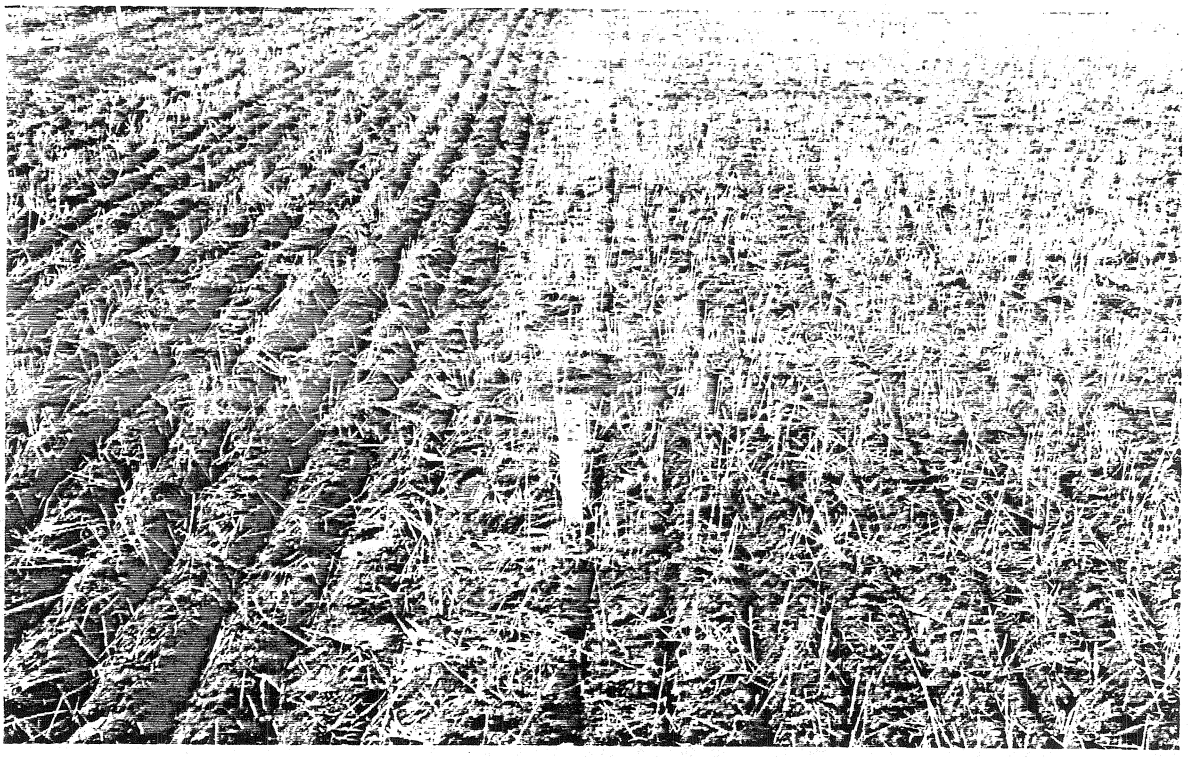


Figure 6. The effect of year, seed rate and furrow opener on grain yield for stubble seeding on a sandy loam soil.

Noble 0-till hoe

0-till disc



0-till hoe

air seeder

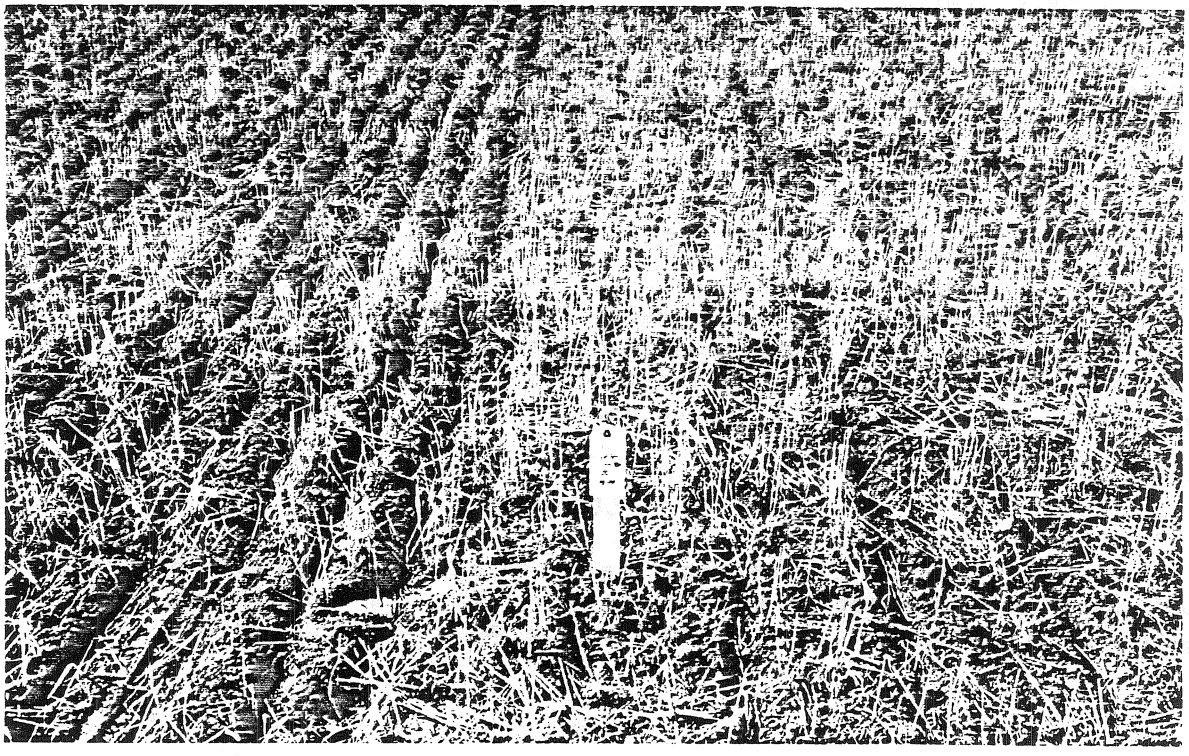


Figure 7. Soil disturbance for the various drills.

interaction exists between the variables as illustrated in Figures 1 to 6.

Chemical Fallow on Clay Loam: Plant densities were much higher in 1986-87 than in 1985-86 due to much more favourable soil moisture conditions in the fall and the prolonged mild winter of 1986-87, while an early cold period in the fall of 1985 and another one following a warm period in February of 1986 must have reduced over-winter survival. Plant density increased with seeding rate and was generally lowest for the air seeder.

Seed drill row opener had no effect on yields suggesting good soil to seed contact in all cases and compensation by stored moisture for any moisture lost due to soil dry-out at seeding. Yields in 1987 were greater than in 1986 even though 1987 was much drier (129 vs 205 mm growing season precipitation). The greater yield is attributed to higher plant density in 1987.

Stubble Wheat on Clay Loam: Plant densities were low in 1985 due to later than optimal seeding time and a very cold winter. In 1986 and 1987 plant densities were as described for chemical fallow. Generally, the air seeder resulted in the lowest plant densities. In all years plant densities were directly proportional to seeding rates.

Grain yield responded to drill treatment in 1986 and 1987 and to seed rate in 1986 (the wet year) mimicking plant density response, but in dry years such as 1985 and 1987, high plant density resulted in early consumption of moisture which later restricted seed size and yields. Yields were lowest in 1985 because of lowest GSP (73 mm) and lowest plant density; yield in 1986 were similar to those in 1987 because although 1987 had much higher GSP (205 vs 129 mm) it had much lower plant density (78 vs 166 plants/m_2). In 1985 drill had no significant influence on yield. In 1986 and 1987 the 0-till disc tended to give the highest yield while the Noble hoe tended to give the lowest.

Stubble Wheat on Sandy Loam: In 1986 and 1987 plant densities were of similar magnitude and responses to the treatments similar to those observed on the clay loam. As on the clay loam, the greater GSP in 1986 was counterbalanced by a much lower plant density (95 vs 179 plants/m_2), thus yields in 1986 and 1987 were not significantly different. In general, yields on sandy loam were not significantly different from those on clay loam in either 1986 or 1987. However, drills with hoe points tended to show better yields.

CONCLUSIONS

The main factors influencing yields appear to be spring soil moisture, GSP and their interaction with plant density. The main factor influencing plant density appears to be the weather between fall and spring.

No significant differences in yield can be attributed to seed drill type on chemical fallow clay loam plots. There is a tendency for the 0-till disc to show better yields on stubble on a clay loam soil whereas a hoe

opener tends to show better on stubble for a sandy loam. However, sufficient years of data have not been accumulated to definitely establish the trend. With the climatic variability present in this area, more data is required for this purpose.

REFERENCES

1. ANDERSON, C.K., 1969. Cultural developments in winter wheat production. Canada Agriculture 14(3) 3-5.

2. AUSTENSON, H.M., and ANDERSON, C.H., 1969. Winter wheat in Saskatchewan: A new frontier. AIC Review 24(6) 22-24.

3. DYCK, F.B. and TESSIER, S., 1986. Zero-till drill developments at the Swift Current Research Station. Paper No. 86-210, Ann. Meeting, Can. Society Agric. Engineers, July 6-10, 1986, Saskatoon, Sask.

4. FOWLER, D.B., GUSTA, L.V., BOWREN, K.E., CROWLE, W.L., MALLOUGH, E.D., McBEAN, D.S., and McIVER, R.N., 1976. Potentials for winter wheat production in Saskatchewan. Can. J. Plant Sci. 56: 45-50.