Dryland Winter Wheat Planting Date and Russian Wheat Aphid Studies in Southwestern Colorado, 1990-1998.

R.W. Hammon[1], D.V. Sanford[2], M.W. Stack[3], A. Berrada[3] and F.B. Peairs[4]

[1] Fruita Research Center, 1910 L Rd , Fruita CO 81521
[2] P.O. Box 535, Dolores CO 81323
[3] Southwestern Colorado Research Center, 16910 Co. Rd. Z, P.O. Box 233 Yellow Jacket CO 81335
[4] Bioagricultural Sciences and Pest Management, Colorado State University, Fort Collins CO 80523

When to plant winter wheat is an important management decision made by dryland producers. Planting dates are chosen within a window of opportunity defined by cropping system and available soil moisture. Planting date dictates to a large degree how many tillers a plant will make, how tall the plants will get, and the potential impact of certain insects and diseases on the crop. It also determines the size of the root system, which in turn determines how much stored water the plant can utilize.

Dryland winter wheat planting date studies have been performed at the Southwestern Colorado Research Center annually since 1990. The objectives of these experiments have been to:

- 1) Determine the relative yield potential of dryland winter wheat planted on different dates.

- 2) Determine the impact of Russian wheat aphid (RWA), *Diuraphis noxia* (Mordvilko), on dryland winter wheat planted on different dates.

- 3) Determine the interaction between planting date and seeding rate of dryland winter wheat under Southwestern Colorado conditions.

Winter wheat planting date and seeding rate studies have been performed for many years, in almost every area that winter wheat is grown. One study conducted in southwestern Colorado (Brengle et al., 1976) concluded that there was no clear optimum planting date for annually cropped wheat, but the later seeded wheat yielded the least in their studies. Available moisture at any given planting time was the most important factor to consider. Generally, planting date and seeding rate studies have shown that:

- Planting date is usually more important than seeding rate. Increased seeding rate can compensate for the reduced tillering associated with later planting dates. (Martin, 1926; Robertson et al., 1942; Blue et al., 1990; Ferguson and Finkner, 1969; Dahlke et al., 1993).

- Optimum planting dates vary from region to region, and depend on local environmental conditions (Martin, 1926; McLeod et al., 1992; Hammon et al., 1996; Epplin et al., 1993).

- Winter wheat does best if it receives about 400 growing degree days prior to winter dormancy (Dahlke, 1993; Fowler, 1983).

- Later planted wheat does not develop roots deep enough to fully utilize deep soil moisture. The lack of root development in late planted wheat may make it susceptible to drought and winter injury (Winter and Musick, 1993).

- Earlier planted wheat is more vulnerable to insects and viral infection (Hammon et al., 1996; Snidaro, 1990; Pike and Schaffner, 1985).

- Russian wheat aphid fall infestation is typically higher in earlier seeded wheat (Hammon et al., 1996; Butts, 1992), but spring Russian wheat aphid infestations may be greater in later seeded wheat in some areas (Walker and Peairs, 1992).

METHODS AND MATERIALS

Eightplanting date experiments were conducted between 1990 and 1998. Experimental details are summarized in Table 1. The experiments are arranged in three groups, according to experimental design and objectives:

- Planting date effect on yield.
- Planting date effect on Russian wheat aphid.
- Planting date and seeding rate interaction effect on yield.

All experiments had five planting dates at 10-14 day intervals, beginning in late August or early September, and four replications. All were planted on summer fallow ground. Some dates were delayed because of wet soil conditions (Table 2). Russian wheat aphids were sampled in each experiment by choosing 25 random tillers per plot, counting those with Russian wheat aphid damage symptoms, extracting aphids in Berlese funnels for 24 h, and counting the aphids under a dissecting microscope. Russian wheat aphids were sampled in the fall of each year, and during the spring and summer if they were present. Harvest dates are listed in Table 1. Harvested grain was subsampled for subsequent laboratory test weight or seed weight measurements.

Statistical analysis of the data was done with MSTAT-C (Freed et al., 1988). Insect data was $(X+0.5)^{½}$ transformed before analysis. Regression analysis and r^2 value calculation was done with Sigma Plot 3.0. Separation of means was done with the Student-Neuman-Keuls test at a=0.05.

Precipitation data was obtained from the Yellow Jacket 2W weather station listed with the Colorado Climate Center (http://ulysses.atmos.colostate.edu). This station was chosen because it had a complete data set for the entire experimental period, and was located within three miles of the Southwest Colorado Research Center. Precipitation totals for experiment years are displayed in Figure 1, and summarized in Table 1.

Planting date effect on yield

Planting date effects on yield can be interpreted from all experiments in this publication, but two experiments were dedicated to this effect. They were conducted during the 1990-91 and 1991-92 growing seasons. The experiments were identical in design, arranged as randomized complete blocks, with four replications. There were no treatments other than planting date. Russian wheat aphids were not controlled. Russian wheat aphids were sampled in the fall of both years, after the final seeding was made. The aphids did not survive either winter, and spring and summer infestations were negligible, so no further sampling was done.

Planting date effect on Russian wheat aphid

Four split plot experiments were conducted (1992-93, 1994-95, 1995-96 and 1997-98) to determine the influence of Russian wheat aphids on wheat planted on different dates. For these experiments, two plots were planted in each replication on each date. Russian wheat aphids were controlled in one, and left uncontrolled in the other. In 1992, multiple applications of chlorpyrifos (Lorsban 4E; 0.5 lb a.i./a; 20 gal/acre spray material; applied with pop bottle type CO_2 sprayer @ 25 psi) were used to control aphids. Sprays were applied to emerged wheat plants on Sep 15, Oct 2 and Nov 19, 1992. Aphids were sampled prior to each spray. Russian wheat aphids winter killed from the experimental area, and were present in negligible numbers during the spring and summer, so they were not sampled again. In 1994-95 and 1995-96, an imidocloprid seed treatment (Gaucho 480 FS; 0.5 oz/cwt) was used to control aphids. Russian wheat aphids were sampled in the fall after all plots had

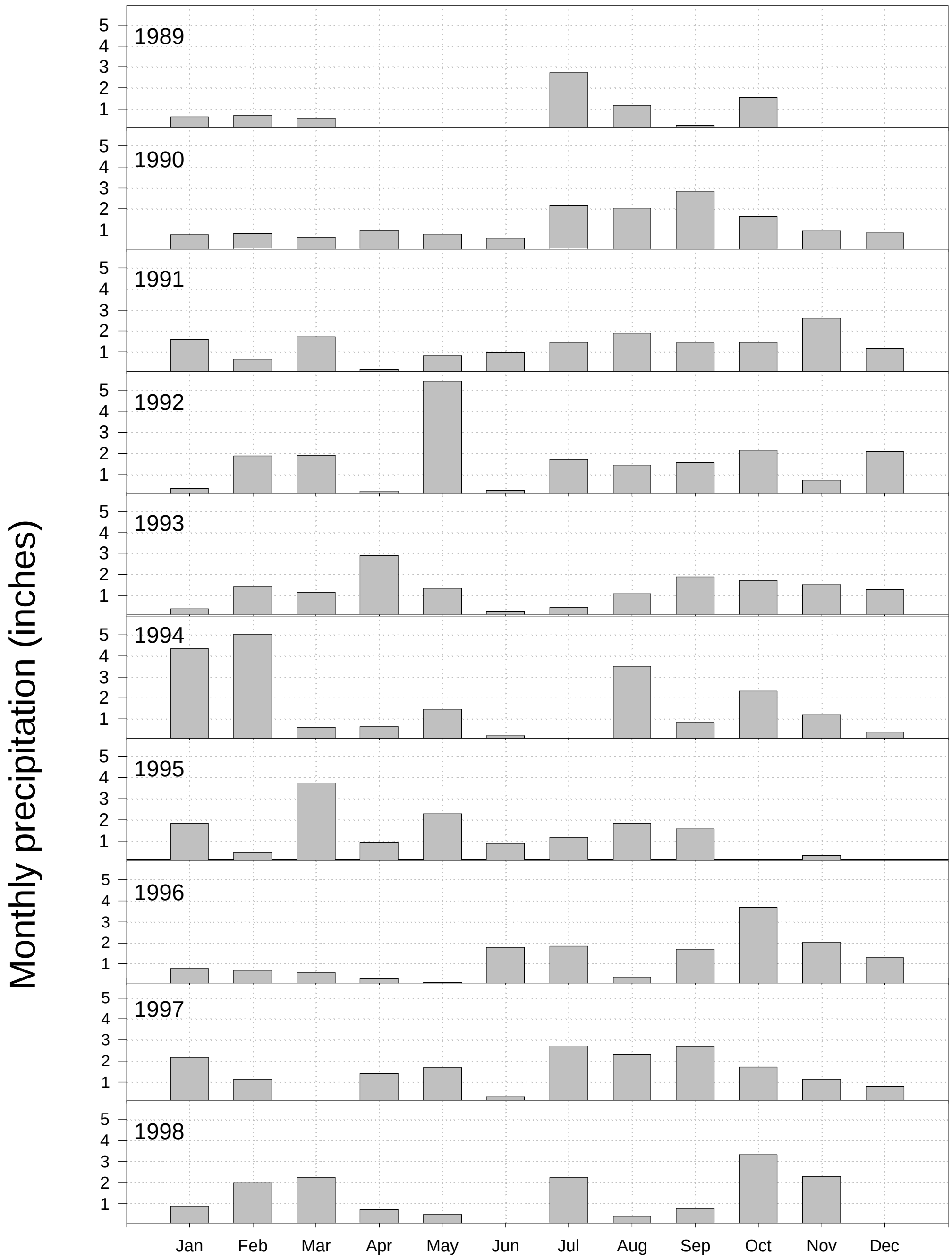

Figure 1. Monthly precipitation totals from weather station located 2 mi W of Yellow Jacket. Data was obtained from Colorado Climate Center (http://ulysses.atmos.colostate.edu).

emerged. Russian wheat aphids winter killed during the winter of 1994-95, and they were not sampled during the spring or summer because of low numbers. They survived the winter of 1995-96, and were sampled on May 13, 1996. In 1997, the experimental design was the same as in previous years, but carbofuran (Furadan 4F; 0.5 lb a.i./a) was used as the insecticide. This was to see if any impact of wheat curl mite (*Aceria toschiella* Keifer) could be measured. Russian wheat aphids appeared in the plots briefly during the fall of 1997, but died out after heavy rains in mid-September. Wheat curl mites were never found in the plots, so there was no sampling for either pest.

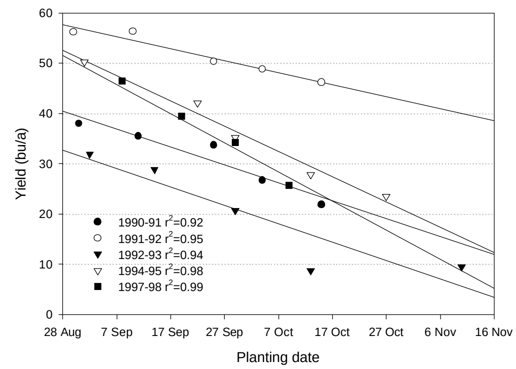

Figure 2. Planting date versus yield regression for five experiment years**.**

Interaction of planting date and seeding rate on yield

Two experiments were carried out during the 1994-95 and 1995-96 growing seasons to determine the effect of varying seeding rates on different planting dates. Wheat was seeded at six rates (20, 30, 40, 50, 60,and 70 lb/a) on each of five planting dates. Planting dates were arranged as main plots, in a randomized complete block design, and seeding rates were randomized within each main plot. Russian wheat aphids were not sampled or controlled in these experiments.

RESULTS

Planting date effect on yield

Results from the 1990-91 and 1992-93 experiments are in Table 3. Yield data from the 1990-91, 1991-92, 1992-93, 1994-95 and 1997-98 experiments are displayed in Figure 2. There was no Russian wheat aphid control in the first two experiments, and only the untreated plots from the last three experiments were used in calculating the regressions. These are the five years that Russian wheat aphid was not present in the spring and summer. Planting date had a significant effect on yield in all years, with earliest seeded plots having the greatest yield, and latest planted plots having the least yield. There was a near linear trend of planting date on yield in all years, with correlation (r^2) values greater than 0.9 in four of the five years. The slopes of the regressions are similar for all five years of the plotted data, with a greater planting date influence during the 1994-95 growing season. Planting date significantly influenced test weight in 1994-95 and 1997-98, when earlier planted wheat had greater test weight. The planting date effect on test weight was not statistically significant in other years.

Planting date effect on Russian wheat aphid

Results from the 1992-93, 1994-95, 1995-96 and 1997-98 experiments are in Table 4. Planting date had an effect on fall Russian wheat aphid infestation in all years that they were present. Regressions of percent Russian wheat aphid infestation versus planting date are presented for five experiment years in Figure 3. Correlation was high (>0.75) in three years and the trend was for greater infestations in the earlier planting dates in all years. Russian wheat aphid winter killed in all years except 1995-

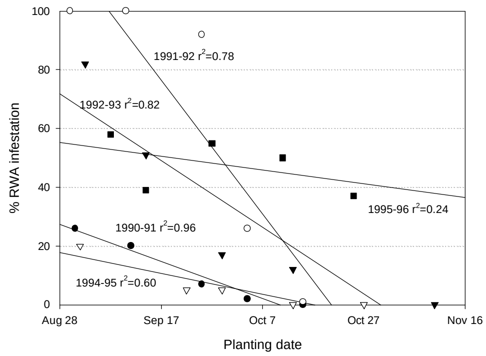

Figure 3. Planting date versus percent fall Russian wheat aphid infestation for five experiment years.

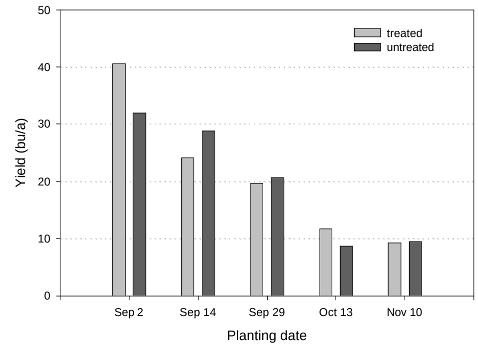

Figure 5. Yield from 1992-93 experiment.

96. On May 13, 1996, infestations followed the same trend as in the fall, with earlier planting dates having more aphids (Figure 4).

Chemical treatments were effective in controlling Russian wheat aphid in all years. The impact of fall infestations on yield is determined when treated and untreated plots are compared. In 1992, there were significant differences in yield between planting dates and the date x insecticide interaction was statistically significant. When treated versus untreated plots were compared within a planting date there were significant differences in yield only in the first planting date (Figure 5). Fall Russian wheat aphid infestations were much higher in the first planting date (2.7 Russian wheat aphids/tiller in first planting date versus 0.3 Russian wheat aphids/tiller in the second planting date and fewer in later planting dates) and were at a high enough level to affect yield. Excellent moisture during the 1992-93 growing season contributed to the good yield.

The 1994-95 growing season was similar to the 1992-93 in precipitation and high yields. The greater yield in 1994-95 was probably due to greater precipitation during March, April and May. It differed from the 1992-93 season in Russian wheat aphid infestation. Fall 1994 Russian wheat aphid infestations were low, with only the untreated plots in the first planting date having statistically different percent infestation than any other plot. In untreated plots, 20% of the tillers were damaged in the first planting date, but only 5% or less in the other planting dates. There were only 0.17 Russian wheat aphids per tiller in the untreated first planting date, and less than 0.03 Russian wheat aphids per tiller in other plots. Rain during the fall had reduced Russian wheat aphid numbers to these low levels by the Nov 10, 1994 sample date. Russian wheat aphid suffered complete mortality during the winter of 1994-95. There was no effect of Russian wheat aphid

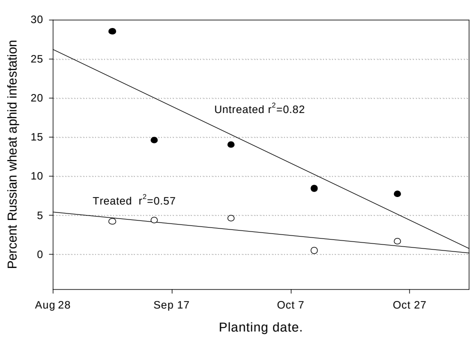

Figure 4. Russian wheat aphid infestation on May 13, 1996 after successful overwintering.

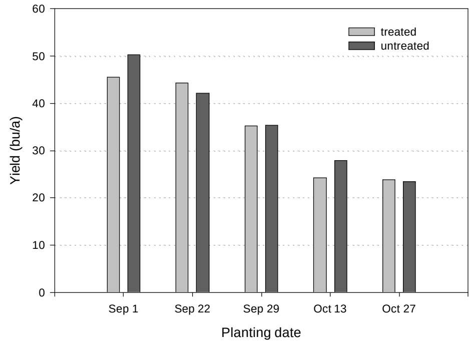

Figure 6. Yield from the 1994-95 experiment.

on yield during the 1994-95 growing season, but the planting date effect was significant (Figure 6).

The 1995-96 growing season was very different than other seasons in which experiments were conducted. Severe drought limited yield, and the lack of winter snow cover allowed Russian wheat aphid to survive and infest the crop during the spring and summer, when significant damage occurred. Also, the first planting date was affected by a driving rain the same day that it was planted. This caused severe soil crusting which reduced the stand. The low yield in the first planting date in the 1995-96 experiment is a direct result of this crusting. Planting date and fall chemical treatment effects on yield were statistically significant, but the interaction of the two was not. This

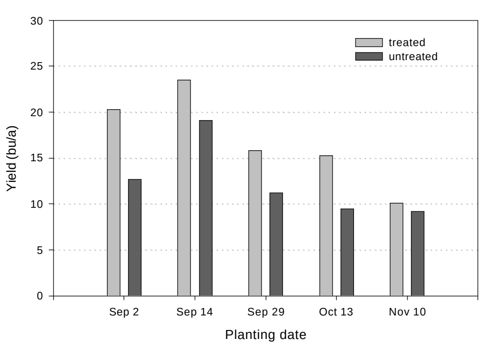

Figure 7. Yield from 1995-96 experiment.

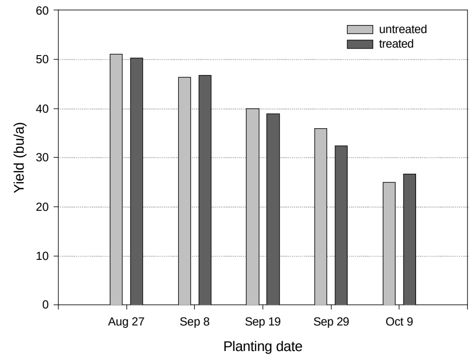

Figure 8. Yield from 1997-98 experiment.

means that both planting date and fall chemical treatment affected yield, but the effect of chemical treatment was the same in all planting dates (Figure 7). It increased yield in all planting dates because it was successful, in part, in controlling Russian wheat aphid.

There were no effects of Russian wheat aphid during the 1997-98 experiment. This is because the aphid population died after an extended rainstorm in September 1997 and the field was never reinfested in significant numbers. Yield was highly affected by planting date in this experiment year. There was little moisture during the 1998 portion of the crop season, and stored moisture was utilized for grain fill. Earlier planted wheat had larger root systems and could utilize more moisture.

Interaction of planting date and seeding rate

Results from the 1994-95(b) and 1995-96(b) experiments are in Table 5. There was a significant planting date effect on yield in the 1994-95(b) experiment, but seeding rate and the planting date x seeding rate interaction were not statistically significant. There was a general trend of higher seeding rates yielding more grain, especially in the last four planting dates. Moisture conditions were excellent

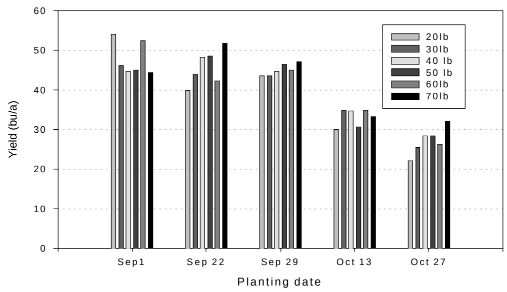

Figure 9. Results from 1994-95 planting date x seeding rate experiment.

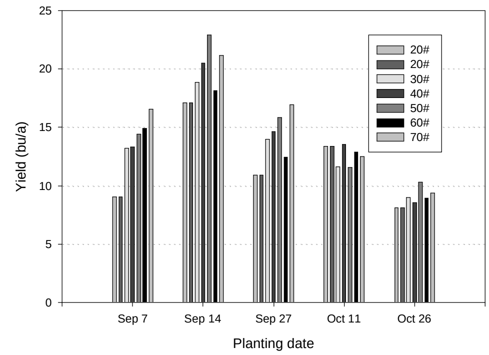

Figure 10. Results from 1995-96 planting date x seeding rate experiment.

throughout the season, which is reflected in very good yields. Results of this experiment are displayed in Figure 9.

The 1995-96 season was one of severe drought and spring Russian wheat aphid infestations that stressed plants. Planting date and seeding rate effects on yield were both statistically significant. The interaction was not statistically significant. In the first three planting dates, there was an increase in yield with increasing seeding rates (Figure 10). The drought condition that existed during the 1995-96 growing season made seeding rates more important than in the wetter 1994-95 season.

Virus diseases

Wheat streak mosaic and high plains disease are two important virus diseases that may severely reduce wheat yields. They were not present during the period that most of these experiments were conducted. High plains disease was found at the Southwest Colorado Research Center on volunteer wheat in the summer of 1996. Wheat streak mosaic was discovered in some volunteer wheat near Cortez in the spring of 1997. A survey during the spring of 1997 for the diseases found them in early germinated volunteer wheat from Towaoc to Dove Creek and Monticello UT. Both diseases are transmitted by wheat curl mites, *Aceria tosichella* Keifer. These very small mites can be seen only with the aid of a hand lens or microscope. Techniques for controlling the viruses focus on avoiding the times when mites are actively moving from diseased plants. Winter wheat planting date is an important management technique for controlling these diseases, which are more severe in earlier planting dates. The diseases were present on much of the early germinated (by mid-August) volunteer wheat inspected during the 1997 survey. At this time it appears that September 1 planting dates are late enough to avoid the virus diseases if there is no volunteer wheat present. If volunteer wheat is present in the field at planting time, problems may occur.

CONCLUSIONS

Several conclusions can be drawn from these experiments. Some of these confirm what every southwestern Colorado dryland wheat grower already knows.

- Earlier planted dryland wheat yields more. This is due, in large part, to the greater rooting depth of earlier seeded plants. The greater amount of roots allow plants better access to a limited amount of soil moisture.

- Planting date affects fall Russian wheat aphid populations. Plants that exist for a longer period of time in the fall have greater chances of becoming infested, and once infested, aphid reproduction allows populations to increase. Also, larger plants in the fall may be more attractive to immigrating aphids, making them more susceptible to infestation. Planting date effects on fall infestations can carry over to spring infestations if winter conditions permit.

- Fall Russian wheat aphid infestations can reach levels which impact yield. This does not happen every year, and the economic threshold levels for fall Russian wheat aphid infestations remain unclear.

- Higher seeding rates may allow greater yield in later planting dates. Seeding rates appear to have greater impact on yield in drier years. If adequate moisture exists, influence of seeding rate on yield is less.

- Studies in other regions have shown that winter wheat planting dates affect many virus diseases, including wheat streak mosaic. Virus diseases may become a more important consideration of southwestern Colorado wheat producers in the future. The September 1 planting date appears to be late enough to minimize virus diseases. Control of early germinated volunteer grain will be critical in the management of virus diseases in the earliest planted winter wheat crop.

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Planting Year	Design[1]	Variety	Plot size (ft)	Fertilizer (#/a)	Harvest date	Rainfall (inches)[2]
1990	RCB - date	Jeff	27 x 50	45 N, 20 P	Aug 16, 1991	15.66
1991	RCB - date	Jeff	27 x 50	50 N	Aug 28, 1992	18.93
1992	SP - date, Russian wheat aphid	Fairview	13.5 x 30	50 N, 40 P	Aug 4, 1993	19.87
1994a	SP - date, Russian wheat aphid	Fairview	5 x 40	65 N	Sep 6, 1995	16.77
1994b	SP - date, rate	Fairview	5 x 40	65 N	Sep 6, 1995	16.77
1995a	SP - date, Russian wheat aphid	Fairview	5 x 40	40 N	Jul 22, 1996	9.15
1995b	SP - date, rate	Fairview	5 x 40	40 N	Jul 22, 1996	9.15
1997	SP - date, Russian wheat aphid	Fairview	5 x 50	50 N	Aug 12, 1998	12.42

Table 1. Design and agronomic treatments of experiments discussed.
[1] RCB=Randomized complete block, SP=split plot (main plot, sub plot).
[2] Rainfall calculated from August prior to planting until July 31 before harvest.

	1990-91	1991-92	1992-93	1994-95a	1994-95b	1995-96a	1995-96b	1997-98
PD1[1]	Aug 31	Aug 30	Sep 2	Sep 1	Sep 1	Sep 7	Sep 7	Aug 27
PD2	Sep 10	Sep 9	Sep 14	Sep 22	Sep 22	Sep 14	Sep 14	Sep 8
PD3	Sep 25	Sep 19	Sep 29	Sep 29	Sep 29	Sep 27	Sep 27	Sep 19
PD4	Oct 4	Oct 1	Oct 13	Oct 13	Oct 13	Oct 11	Oct 11	Sep 29
PD5	Oct 15	Oct 11	Nov 10	Oct 27	Oct 27	Oct 24	Oct 24	Oct 9

Table 2. Planting dates for experiments discussed in this publication. [1] PD = Planting Date

	1990-91					1991-92				
	Russian wheat aphid Oct 31, 1990		Yield	Test weight	Plant height	Russian wheat aphid Oct 22, 1991		BCO[1] 10/22/91	Yield	Test weight
	%	/tiller	bu/a	lb/bu	in	%	/plant	/plant	bu/a	lb/bu
PD1	26 a	1.44 a	38.0 a	60.1	31.1	100 a	26.9 a	4.3 a	56.2 a	63.6 b
PD2	20 a	0.88 a	35.5 ab	58.2	30.9	100 a	6.6 b	0.3 b	56.3 a	63.4 bc
PD3	7 b	0.36 b	33.7 ab	58.5	30.6	92 a	2.4 b	0.03 c	50.3 b	62.9 c
PD4	2 bc	0.08 b	26.7 bc	59.1	28.2	26 b	0.5 c	0.03 c	48.8 b	63.6 b
PD5	0 c	0.0 b	21.9 c	59.1	25.5	1 c	0.04 d	0.0 c	46.2 b	64.5 a
F-value	25.46	21.73	7.49	2.32	**	176.1	51.85	28.47	16.55	11.48
P-value	<0.0001	<0.0001	0.0029	0.1158	**	<0.0001	<0.0001	<0.0001	0.0001	0.0005

Table 3. Results from two simple planting date experiments at Southwestern Colorado Research Center in 1990 and 1991. Means within a column followed by the same latter are not significantly different (SNK, a=0.05). ** not replicated
[1]Bird cherry-oat aphid, *Rhopalosiphum padi* L.

	1992-93				1994-95				1995-96					1997-98	
	RWA Nov 19, 1992		Yield	Test weight	RWA		Yield	400 seed wt	RWA Nov 11, 1995		RWA May 13, 1996		Yield	Yield	Test weight
	%	/tiller	bu/a	lb/bu	%	/tiller	bu/a	gm	%	/tiller	%	/tiller	bu/a	bu/a	lb/bu
PD1	48.0 a	1.40 a	36.2 a	59.7	13.0 a	0.1	47.9 a	8.92 a	27.0 a	1.2048 a	36.5	16.33 a	18.4 b	50.7 a	57.33 a
PD2	38.5 a	0.32 b	26.4 b	59.7	3.0 b	0.005 b	43.2 b	8.73 ab	13.5 a	0.2952 b	29.4	9.47 ab	21.3 a	46.5 b	55.89 b
PD3	16.5 c	0.44 b	20.1 c	58.8	3.0 b	0.005 b	35.2 c	8.68 ab	15.0 a	0.31 b	39.0	9.3 ab	13.5 bc	39.4 c	54.06 c
PD4	9.0 bc	0.05 b	10.2 d	58.9	0.0 b	0 b	26.1 d	8.52 bc	1.50 b	0.0552 c	27.5	4.42 c	12.4 bc	34.2 d	52.84 d
PD5	0.0 c	0.0 b	9.4 d	59.8	0.0 b	0 b	23.6 d	8.30 c	0.00 b	0 c	27	4.71 bc	9.7 c	25.7 e	51.33 e
F-value	23.24	4.64	27.7	0.93	10.90	5.94	64.79	7.32	16.62	32.69	1.824	7.61	9.05	123.96	44.79
P-value	<0.0001	0.017	<0.0001	0.479	0.0006	0.0071	<0.0001	0.003	0.0001	<0.0001	0.189	00.0027	0.0013	<0.000 1	<0.000 1
Treated	12.8 a	0.13 a	21.0	59.1	16.0 a	0.008	34.6	8.70	5.60 a	0.068 a	16.0 a	3.048 a	17.0 a	38.97	54.32
Untreated	32.4 b	0.76 b	19.9	59.6	60.0 b	0.036	35.8	8.56	17.20 b	0.678 b	47.8 b	14.64 b	12.3 b	39.65	54.25
F-value	95.54	8.50	1.4	4.32	17.29	2.51	0.449	1.924	11.15	39.25	32.94	25.678	21.21	0.466	0.025
P-value	<0.0001	0.011	0.255	0.055	0.0008	0.1338	0.513	0.186	0.0045	<0.0001	<0.0001	0.0001	0.0003	0.505	0.875
PD1-T[1]	14.0 c	0.15 b	40.5 a	59.2	6.0 b	0.03	45.5	8.99	9.0 bcd	0.14 bc	15.0	4.17	20.3	50.22	57.35
PD1-U	82.0 a	2.66 a	31.9 b	60.1	20.0 a	0.17	50.3	8.85	45.0 a	2.272 a	58.0	28.49	12.7	51.12	57.30
PD2-T	26.0 b	0.34 b	24.1 c	59.2	1.0 b	0	44.3	8.75	5.0 bcd	0.06 bc	20.0	4.35	23.6	46.67	55.82
PD2-U	51.0 c	0.31 b	28.8 b	60.1	5.0 b	0.01	42.1	8.71	22.0 b	0.528 b	39.0	14.59	19.1	46.39	55.95
PD3-T	16.0 c	0.14 b	19.6 c	58.5	1.0 b	0.01	35.2	8.72	13.0 bcd	0.128 bc	23.0	4.59	15.8	38.92	54.30
PD3-U	17.0 c	0.75 b	20.7 c	59.1	5.0 b	0	35.3	8.63	17.0 bc	0.488 b	55.0	14.01	11.2	39.98	53.82
PD4-T	6.0 c	0.02 b	11.7 d	58.8	0.0 b	0	24.3	8.55	1.0 d	0.02 c	5.0	0.46	15.3	32.42	52.72
PD4-U	12.0 c	0.08 b	8.7 d	59.0	0.0 b	0	27.9	8.50	2.0 cd	0.1 bc	50.0	8.38	9.5	35.89	52.95
PD5-T	0.0 c	0.0 b	9.2 d	59.8	0.0 b	0	23.9	8.48	0.0 d	0 c	17.0	1.67	10.1	26.59	51.42
PD5-U	0.0 c	0.0 b	9.5 d	59.9	0.0 b	0	23.5	8.12	0..0 d	0 c	37.0	7.75	9.2	24.89	51.22
F-value	39.24	5.02	5.50	0.35	5.86	2.54	0.55	0.32	3.26	10.10	1.38	0.80	1.19	0.719	0.0689
P-value	<0.0001	0.009	0.0061	0.841	0.0048	0.083	0.700	0.859	0.041	0.0004	0.287	0.545	0.356	0.592	0.990

Table 4. Results from four planting date x Russian wheat aphid management experiments at the Southwestern Colorado Research Center. Means with a column group above any F-and P-value followed by the same letter are not significantly different (SNK a=0.05). [1] PD?-T = Treated plots in planting date ?; PD?-U = Untreated plots in planting date ?.

		1994-95 (b)		1995-96 (b)
Planting date	Seeding rate	Yield	250 seed wt	Yield
	(lb/a)	bu/a	gm	bu/a
1		47.8 a	9.18 a	14.0 b
2		45.7 a	9.12 a	20.4 a
3		45.1 a	8.80 ab	14.6 b
4		33.0 b	8.67 b	13.0 b
5		27.0 b	8.53 b	9.3 c
F-value		18.014	6.989	36.723
P-value		0.0001	0.0038	<0.0001
	20	37.9	8.89	12.1 b
	30	38.8	8.95	13.8 ab
	40	40.1	8.78	14.5 a
	50	39.8	8.78	15.5 a
	60	40.1	8.91	13.9 ab
	70	41.7	9.86	15.8 a
F-value		0.961	1.141	4.601
P-value		0.465	0.3464	0.0010

Table 5. Data from two planting date x seeding rate experiments at the Southwestern Colorado Research Center in 1994 and 1995. Means with a column group above any F-and P-value followed by the same letter are not significantly different (SNK a=0.05).

		1994-95(b)		1995-96(b)
Planting date	Seeding rate	Yield	250 seed wt	Yield
	(lb/a)	bu/a	gm	bu/a
1	20	54.1	9.52	9.4
1	30	46.1	9.16	13.6
1	40	44.7	9.03	13.7
1	50	45.0	9.11	14.9
1	60	52.4	9.28	15.4
1	70	44.3	8.99	17.1
2	20	39.8	9.06	17.7
2	30	44.0	9.31	19.5
2	40	48.2	9.06	21.2
2	50	48.5	8.93	23.7
2	60	42.2	9.16	18.7
2	70	51.7	9.22	21.9
3	20	43.6	8.79	11.3
3	30	43.6	8.90	14.5
3	40	44.7	8.66	15.1
3	50	46.4	8.78	16.4
3	60	45.0	8.92	12.8
3	70	47.1	8.78	17.5
4	20	30.0	8.55	13.8
4	30	34.9	8.88	12.0
4	40	34.6	8.77	13.8
4	50	30.7	8.45	11.9
4	60	34.9	8.72	13.3
4	70	33.2	8.64	12.9
5	20	22.0	8.56	8.4
5	30	25.5	8.48	9.3
5	40	28.3	8.39	8.9
5	50	28.3	8.62	10.6
5	60	26.2	8.49	9.2
5	70	32.1	8.65	9.7
F-value		1.415	0.825	1.1711
P-value		0.142	0.6767	0.303

Table 5 (cont.). Data from two planting date x seeding rate experiments at the Southwestern Colorado Research Center in 1994 and 1995. Means with a column group above any F-and P-value followed by the same letter are not significantly different (SNK a=0.05).