University of Minnesota - Northwest Research and Outreach Center
Plant Health Research, Dr. Larry Smith

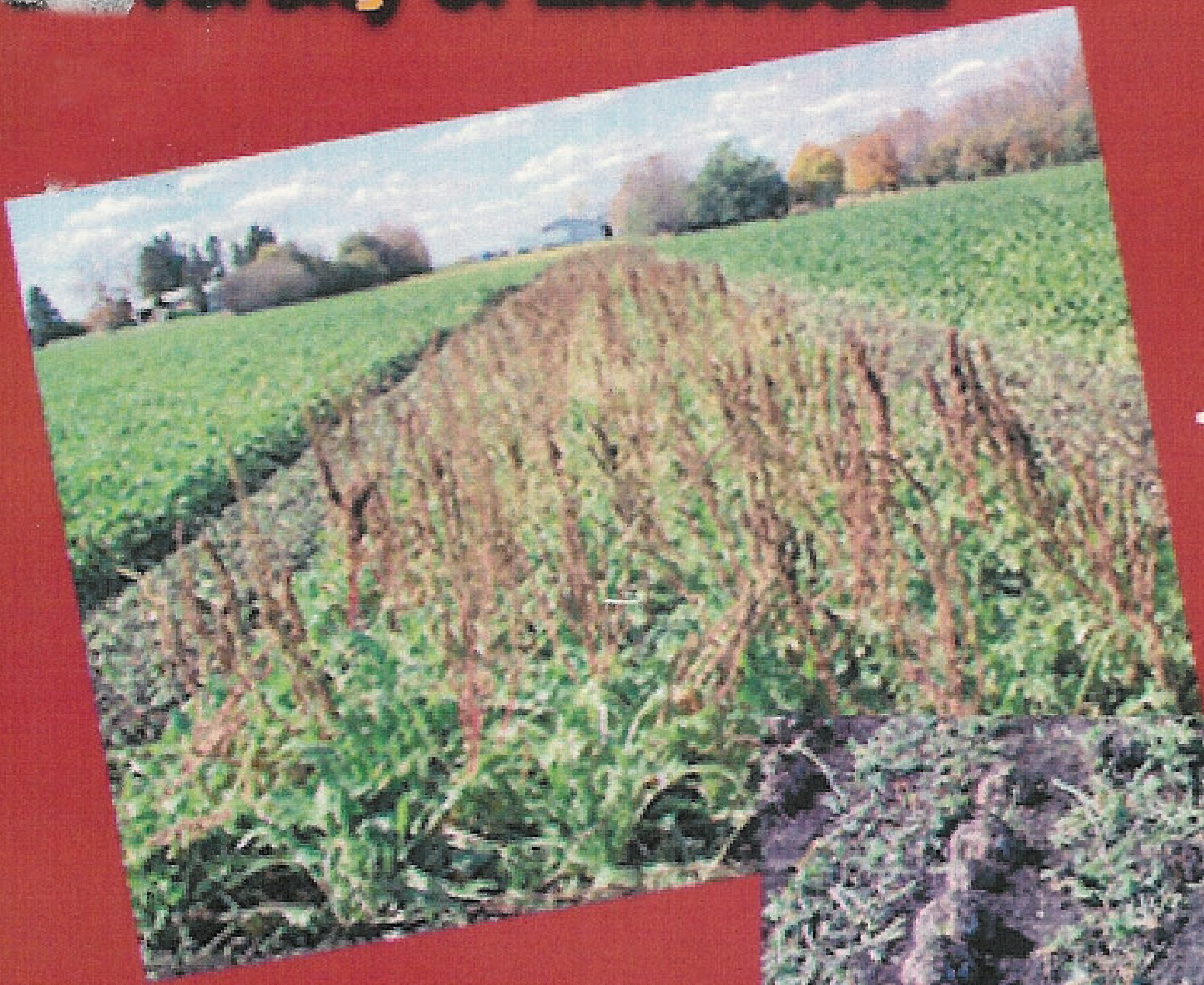
2009 Growth Regulator

* Cmpd	** Timing	Rate oz/A	Tmt	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Sugar (%)	Gross ($/A)
H	L	9.0	2	7877 a	303 a-d	26.0 a	16.1 c-h	971 ab
H	L	6.0	18	7722 a-c	301 c-e	25.7 ab	15.9 gh	942 a-d
H	L	4.5	20	7254 f-h	307 a-d	23.6 h-j	16.3 a-e	908 c-g
H	E	9.0	1	7125 g-i	309 a-c	23.1 e-h	16.4 a-d	896 d-h
H	E	6.0	17	6969 hi	302 b-d	23.1 jk	16.1 c-g	854 gh
I	L	7.0	6	7793 ab	301 a-d	25.9 a	16.0 f-h	951 a-d
I	L	3.5	22	7731 a-c	311 a	24.8 c-f	16.5 ab	982 a
I	E	7.0	5	7119 g-i	311 a	22.9 jk	16.4 a-c	902 c-g
I	E	3.5	21	6979 hi	304 a-d	23.0 jk	16.2 c-g	862 f-h
P	L	5.0	12	7597 a-e	309 a-c	24.6 c-g	16.4 a-d	956 a-d
P	L	2.5	25	7362 e-g	302 b-d	24.4 e-h	16.1 d-h	902 c-h
P	E	5.0	11	7356 e-g	307 a-d	24.0 g-i	16.2 a-g	918 b-f
P	E	2.5	24	7009 hi	300 de	23.4 ij	16.0 f-h	852 gh
P/H	E/L	5/6	26	7773 ab	307 a-d	25.3 a-c	16.3 a-f	971 ab
P/H	E/L	5/9	13	7722 a-c	305 a-d	25.3 a-d	16.2 a-g	959 a-c
P/P	E/L	5/5	15	7405 d-g	307 a-d	24.1 f-i	16.3 a-g	927 a-e
H/P	E/L	9/5	14	7402 d-g	309 a-c	24.0 g-i	16.4 a-d	931 a-e
I/H	E/L	7/6	23	7716 a-d	310 ab	24.9 b-f	16.4 a-d	975 ab
I/I	E/L	7/7	9	7572 a-e	311 a	24.4 e-h	16.5 a	959 a-c
I/H	E/L	7/9	7	7564 a-f	306 a-d	24.7 c-g	16.3 a-f	942 a-d
H/I	E/L	9/7	8	7549 b-f	300 de	25.2 a-e	15.9 gh	918 b-f
H/H	E/L	9/9	3	7597 a-e	308 a-d	24.7 c-g	16.3 a-d	953 a-d
H/H	E/L	6/6	19	7428 c-g	303 a-d	24.5 d-g	16.2 a-g	915 b-f
CK1		-	4	7012 hi	305 a-d	23.0 jk	16.2 a-f	871 e-h
CK2		-	10	6842 i	304 a-d	22.5 kl	16.2 a-f	845 h
CK3		-	16	6458 j	293 e	22.0 l	15.8 h	764 i

* Cmpd - H = Headline, I = Inspire XT, P - Proline + Induce (0.125% v/v)
** E = Application on July 27, L - application on August 25

Harvest - October 26
No Cercospora Leafspot present

Northwest Research and Outreach Center
University of Minnesota 2007



The Good

The Bad

The Ugly

Headline (F500) Timing for Maximizing Physiological Yield Benefits in the Absence of Cercospora Leaf Spot (CLS)

Larry J. Smith, Head, University of Minnesota, Northwest Research and Outreach Center, Crookston, MN

Increases in sugarbeet yield from applications of the fungicide Headline, in the absence of CLS have been previously documented by the author. The timing of application to maximize the benefit, however, has varied somewhat from year to year. In an effort to more closely predict optimal timing of application, a trial was established at the Northwest Research and Outreach Center, University of Minnesota in 2007 to investigate the effects of various application timings on sugarbeet yield, quality and gross return.

Materials and Methods

Seedex Alpine sugarbeet seed was planted in 22-inch rows on April 30, 2007. The trial area was over planted and hand thinned to a uniform plant population of 41,500 plants/acre on June 8. The design of the trial was a RBD with four replications. Plot size was 11 x 35 ft, with the center four rows of each six row plot receiving the Headline treatments, and the two center rows of the four treated rows harvested for final yield and quality measures. All other cultural and chemical treatments were as recommended.

Application of 9 oz/A of Headline were made with a tractor-mounted sprayer, delivering 20 gpa and operated at 100 psi. Application dates were July 25, August 1, August 8, August 15, August 22,August 29. September 5, September 12 and September 19, 2007. The trial was harvested on October 16 and quality determined at the ACSC Quality Laboratory, East Grand Forks, MN.

Results and Discussion

Results of the trial are shown in Table 1. Application timings of 8/15, 8/22, 8/29, and 9/5 had statistically higher RSA and yield than the check, but were not statistically different from each other. The applications on 9/12 and 9/19 both produced significantly less RSA and yield than the 8/22, 8/29 and 9/5 applications. All applications except the 7/25, 8/1, and 9/19 significantly increased RSA and yield over the check.

While results were discouraging relative to more accurately pinpointing an application timing that maximizes RSA and yield, they show similar variability to other application timing trials conducted on the same variety, with similar planting dates in 2005 and 2006 (Tables 3 and 4). As an example in 2005, there was no significant difference in RSA and yield between the 8/22 and 9/16 application timings, whereas in 2006 and 2007 applications on 8/24 and 8/29 produced significantly greater RSA and yield than the mid-September timings.

In the three years that research on application timing was done, the primary benefit has been an increase in yield and subsequently RSA and gross return (Table 4). Applications of Headline have not had a significant effect on sugar %, LTM % or RST.

Why the inconsistency in application timing effects is thought to be related to the vastly different environmental stress factors (temperature, moisture, solar radiation and frost) in the past three years the trials were conducted. While a precise timing is not clearly visible in looking at the data, an application window of August 20 - September 7 has consistently produced the highest RSA, yield and gross return.

Table 1. Effect of Headline application timings on yield, quality and gross return- 2007.

Application Date	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Sugar (%)	LTM (%)	Gross Return* ($/A)
8/29	11018	345	31.9	18.30	1.03	1545
9/5	11006	342	32.2	18.17	1.07	1532
8/22	10971	343	32.0	18.27	1.10	1531
8/15	10652	341	31.2	18.23	1.17	1481
8/8	10546	339	31.1	18.13	1.20	1456
9/12	10405	343	30.4	18.27	1.13	1450
8/1	10099	338	29.9	18.03	1.13	1392
9/19	10088	341	29.6	18.17	1.13	1400
Check	9745	336	29.0	18.00	1.20	1338
7/25	9723	335	29.0	17.97	1.20	1332
LSD_{05}	451	NS	1.2	NS	NS	92

* Basis ACSC November 15, 2007 payment

Table 2. Effects of Headline application timings on yield, quality and gross return - 2005

Application Date	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Sugar (%)	LTM (%)	Gross Return* ($/A)
8/22	9690	337	27.8	17.91	1.03	1198
9/16	9507	334	28.4	17.76	1.05	1162
9/2	9464	338	28.0	17.92	1.03	1168
8/5	9148	339	27.0	17.98	1.03	1133
7/22	8645	343	25.2	18.14	1.00	1081
7/8	8265	336	24.6	17.88	1.09	1014
Check	8036	336	23.9	17.88	1.07	988
LSD_{05}	450	NS	1.3	NS	NS	

* Basis ACSC, November 15, 2005 payment

Table 3. Effects of Headline application timing on yield, quality and gross return - 2006.

Application Date	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Sugar (%)	LTM (%)	Gross Return* ($/A)
8/24	13225	324	40.8	17.45	1.25	1608
9/7	13031	327	39.9	17.62	1.28	1597
8/10	12231	330	37.1	17.70	1.22	1513
9/21	11972	325	36.9	17.50	1.27	1458
7/13	11539	328	35.2	17.75	1.33	1421
7/27	11513	324	35.5	17.47	1.25	1400
Check	11306	329	34.4	17.77	1.32	1396
LSD_{05}	469	NS	1.3	NS	NS	

* Basis ACSC, November 15, 2006 payment.

Table 4. Gains in RSA, yield and gross return over the check at various application timings

'05				'06				'07			
Appl Date	RSA (lb/A	Yield (T/A)	Gross Return ($/A)	Appl Date	RSA (lb/A	Yield (T/A)	Gross Return ($/A)	Appl Date	RSA (lb/A	Yield (T/A)	Gross Return ($/A)
7/8	229	0.7	26	7/13	223	0.8	25	7/25	-22	0	-6
7/22	609	1.3	93	7/27	207	1.1	4	8/1	354	0.9	54
8/5	1112	3.1	145	8/10	925	2.7	117	8/8	801	2.1	118
8/19	1654	4.9	206	8/24	1919	6.4	212	8/15	907	2.2	143
9/2	1428	4.1	180	9/7	1725	5.5	201	8/22	1226	3.0	183
9/16	1471	4.6	174	9/21	666	2.5	62	8/29	1273	2.9	207
7/22 + 9/2	1676	4.9	210	7/13 + 9/7	1921	6.4	213	9/5	1261	3.2	194
				7/27 + 9/21	843	2.5	105	9/12	660	1.4	112
								9/19	343	0.6	62

Maximizing Yield with Fungicide and Application Timing in the Absence of Disease

Larry J. Smith, Head, University of Minnesota and Northwest Research Outreach Center, Crookston, MN

The introduction of new triazole chemistry (fungicides), along with current strobilurin chemistry, provides for improved sugarbeet disease control, as well as yield enhancement potential. The author has shown the yield enhancing benefit of the strobilurin fungicide, Headline, in seven trials over the past three growing seasons. Dr. Mark Stevens, Mike May and Dr. Mike Asher, Broom's Barn, reported in the British Sugar Beet Review [1] that in the absence of disease, " the presence of a triazole either at full rate alone or a half rate within a mixture, produced a yield response of between seven and nine adjusted tonnes/ha." In their fungicide recommendations of 2007, it is stated, "triazole or strobilurin fungicides will give at least 5% yield increase in the absence of disease and treatments should be considered for all crops."

To further investigate the yield enhancement ability of the triazole and strobilurin fungicide chemistries, a trial was initiated at the Northwest Research and Outreach Center to study the timing of application on yield, quality and gross return with two strobilurin fungicides, currently registered for Cercospora leaf spot (CLS) control, and three experimental triazole fungicides.

Materials and Methods

Seedex Alpine sugarbeet seed was overplanted in 22-inch rows on April 30, 2007. The trial was hand thinned to a uniform plant population of 41, 500 plants/A on June 8. All other cultural and chemical treatments were as recommended for maximum yield. The design of the trial was a split plot with four replications.

The fungicides tested were: Headline (9 oz/A), Gem (3.5 oz/A), Inspire (7 oz/A), Proline + Induce (5 oz/A +0.125% v/v), and Punch (6 oz/A). Headline and Gem are strobilurins and the other's triazoles. Fungicide timings were July 25 (E) and September 5 (L). A control receiving no fungicide was included for each fungicide chemistry. The fungicides were applied with a tractor mounted sprayer delivering 20 gpa at 100 psi to the center four rows of a six row plot 35 ft in length. The center two rows of the six row plot were harvested for yield on October 16, and quality determined at the ACSC Quality Laboratory, East Grand Forks, MN. At harvest there was no visible sign of CLS, or any other foliar disease.

Results

The results of the trial and the ANOVA are shown in Tables 1 and 2. Main fungicide (F) effects were non-significant for all variables measured (Tables 2 and 3). Application timing (AT)significantly increased all variables measured except % LTM (Table 2 and 4). Significant F x AT interactions were present for RSA and yield.

Discussion

Comparisons of the various fungicide and application timings, compared to the control, as well as L vs E, for the variables measured are shown in Table 5. The triazoles Inspire and Punch had significantly higher RSA and yield than the strobulurins Gem and Headline, which were non-statistically different from the control, at the July 25 application timing. All fungicides significantly increased RSA, yield and gross return when applied on September 5, compared to the control. Headline, Inspire and Proline, however,

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[1]Stevens, M., M May and M. Asker. (2007). Fungicides for 2007: Options for control and maximizing yield. British Sugar Beet Review 74(2): 19-22.

produced significantly greater RSA , yield, and gross return than Gem and Punch. Comparing the L vs E application, Headline produced significantly higher RSA and yield than the other fungicides, with the triazole Punch showing the least gains for these variables (Figures 1-2). For the most part, the September 5 application had the greatest effects on % sugar and RST. The significant F x AT interaction for RSA and yield are graphically illustrated in Figures 3 & 4. Headline, which had non-significant increases in RSA and yield with the July 25 application and the largest increase compared to the control when applied on September 5, most likely was responsible for most of the interactions. Also adding to the interactions was the fungicide Punch, which had the least response to RSA and yield when comparing the L vs E application timings.

<u>Summary</u>
As a group, the new triazole fungicides had greater influence on RSA and yield when applied early. This raises the possibility of fungicide stacking to improve yield and quality.

Table 1. Effect of Different Fungicide Chemistries and Application Timings in the Absence of Disease on Yield, Quality and Gross Return

Fungicide	Appl Timing	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Sugar (%)	LTM (%)	Gross Return* ($/A)
Gem	0 (Control)	10746	341	31.5	18.17	1.13	1492
	7/25 (E)	10939	343	31.9	18.23	1.10	1524
	9/5 (L)	11336	346	32.8	18.35	1.08	15.90
Headline	0	10680	341	31.7	18.15	1.13	1482
	E	10841	342	31.7	18.17	1.08	1509
	L	10840	344	34.4	18.30	1.10	1655
Inspire	0	10507	340	31.0	18.10	1.13	1453
	E	11045	341	32.4	18.18	1.13	1534
	L	11617	346	33.6	18.35	1.08	1630
Proline	0	10552	341	31.0	18.13	1.10	1464
	E	10884	343	31.7	18.25	1.10	1518
	L	11455	347	33.0	18.45	1.10	1612
Punch	0	10691	340	31.4	18.13	1.13	1481
	E	11122	340	32.7	18.10	1.10	1541
	L	11341	345	32.9	18.35	1.13	1587

* Basis - ACSC November 15, 2007 payment

Table 2. ANOVA

Source[1]	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Sugar (%)	LTM (%)	Gross Return ($/A)
Fungicide (F)	NS	NS	NS	NS	NS	NS
Application Timing (AT)	***	**	***	*	NS	***
F x AT	*	NS	**	NS	NS	NS

[1] NS, *, **, *** represent non-significant and significance levels at 0.05, 0.01 and 0.001 respectively

Table 3. Main Effects of Fungicide (across application timing)

Fungicide	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Sugar (%)	LTM (%)	Gross Return* ($/A)
Headline	1120	342.3	32.5	18.21	1.10	1549
Inspire	11056	342.0	32.3	18.21	1.11	1539
Punch	11051	341.5	32.4	18.19	1.12	1536
Gem	11006	343.0	32.1	18.25	1.10	1535
Proline	10964	343.5	31.9	18.26	1.10	1531
Stat. Sign	NS	NS	NS	NS	NS	NS

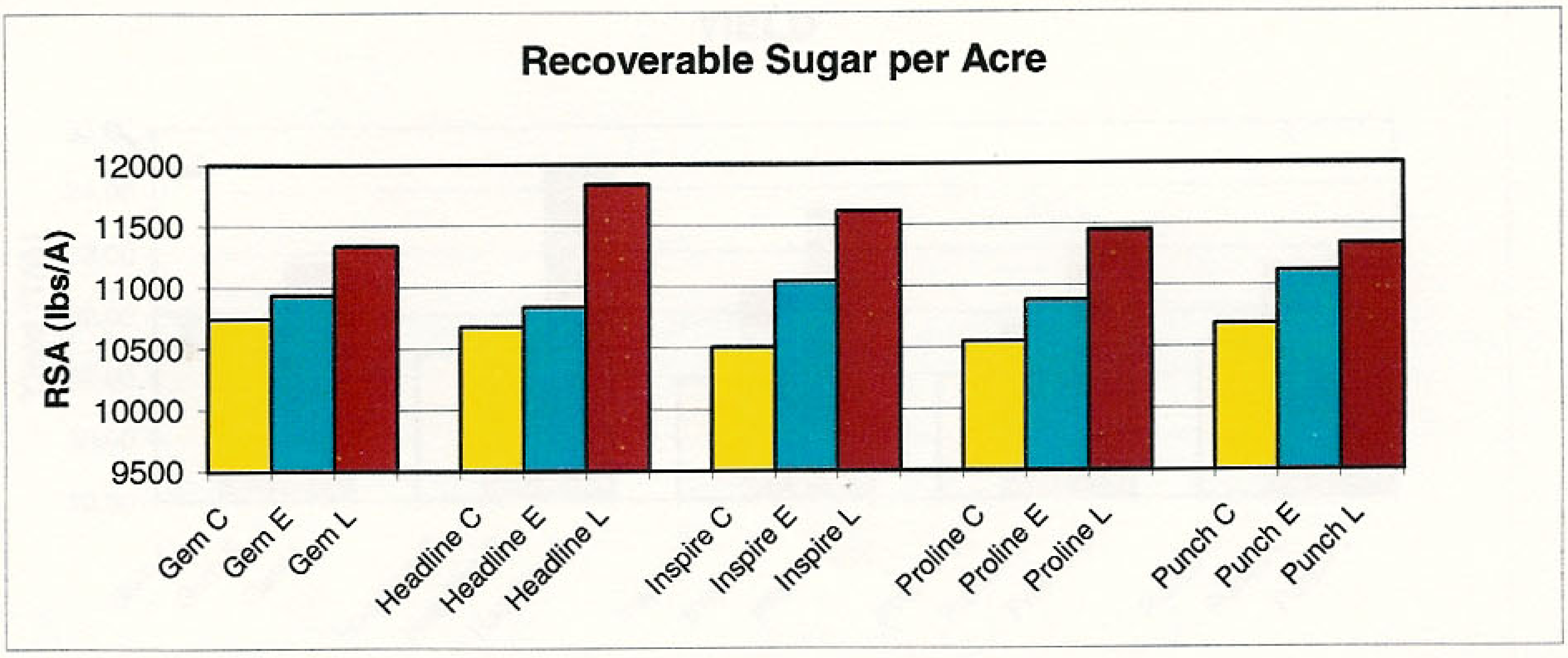
* Basis - ACSC November 15, 2007 payment

Table 4. Main Effects of Application Timing (across fungicides)

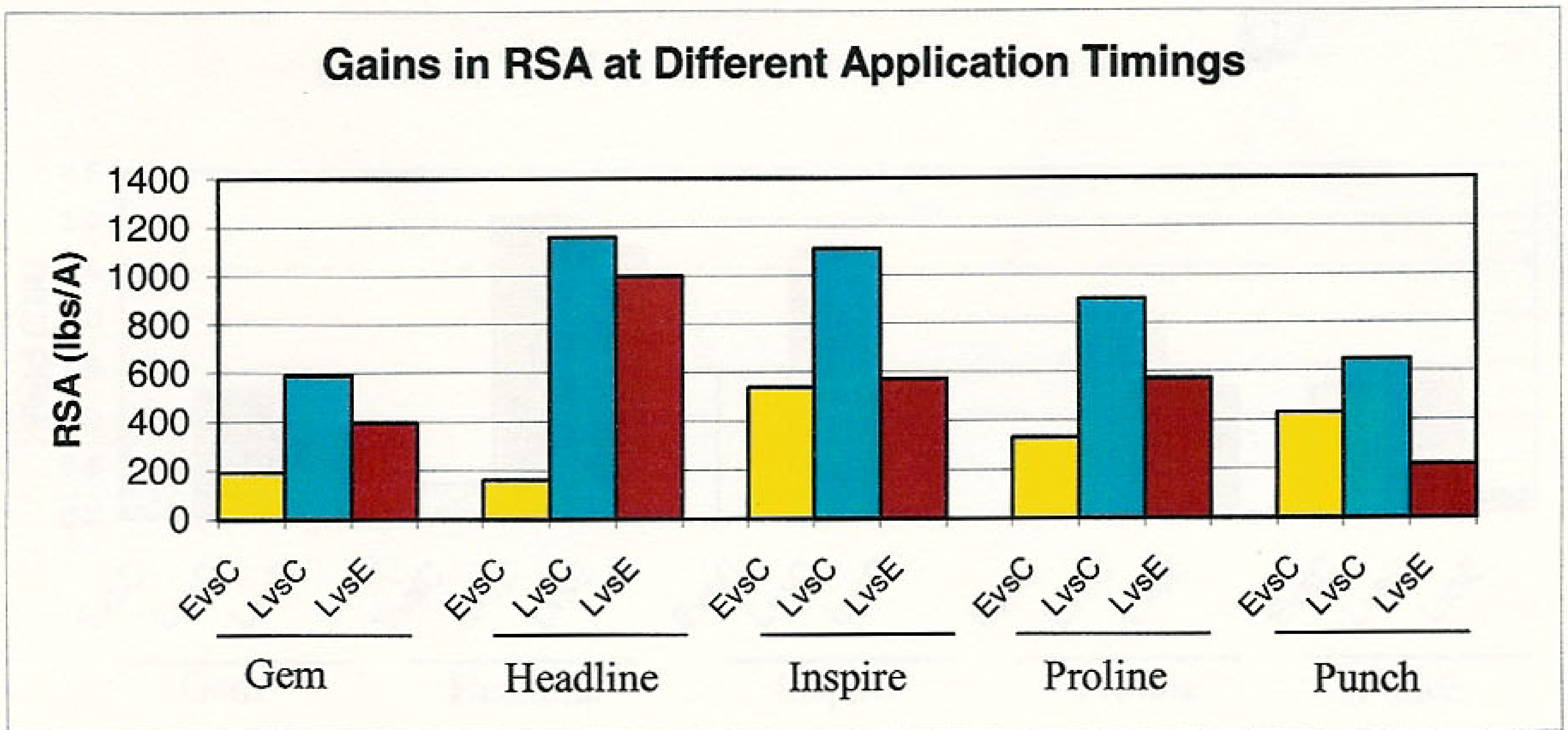
Application Timing	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Sugar (%)	LTM (%)	Gross Return* ($/A)
L (9/5)	11518	345.3	33.4	18.36	1.12	1615
E (7/25)	10966	341.7	32.1	18.18	1.10	1525
Control	10635	3403	31.3	18.14	1.10	1474
LSD_{05}	136	3.4	0.4	0.15	NS	27

* Basis - ACSC November 15, 2007 payment

Figure 1.

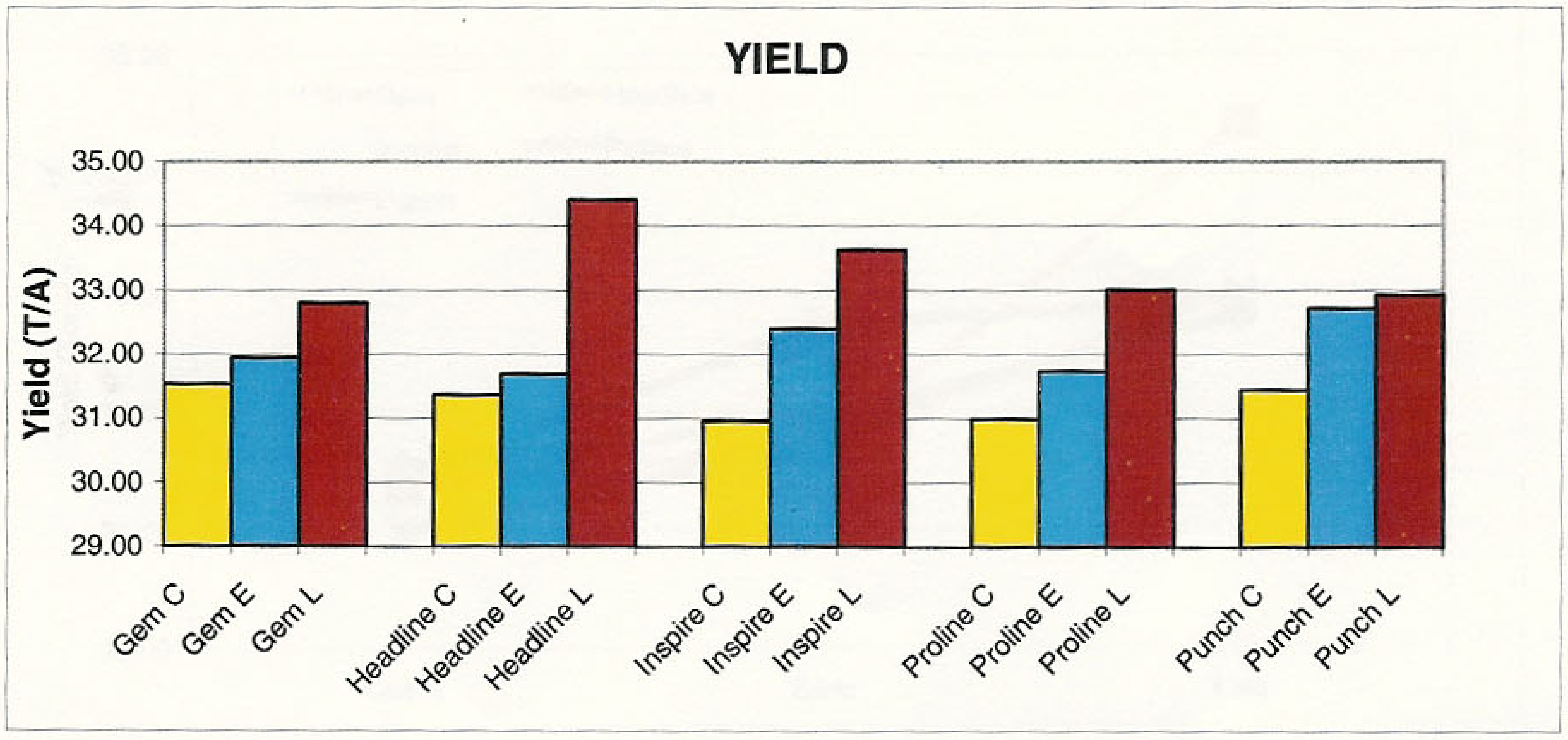


Recoverable Sugar per Acre
RSA (lbs/A)
12000
11500
11000
10500
10000
9500
Gem C
Gem E
Gem L
Headline C
Headline E
Headline L
Inspire C
Inspire E
Inspire L
Proline C
Proline E
Proline L
Punch C
Punch E
Punch L



Gains in RSA at Different Application Timings
RSA (lbs/A)
1400
1200
1000
800
600
400
200
0
EvsC
LvsC
LvsE
Gem
Headline
Inspire
Proline
Punch

Figure 2.


YIELD
Yield (T/A)
35.00
34.00
33.00
32.00
31.00
30.00
29.00
Gem C
Gem E
Gem L
Headline C
Headline E
Headline L
Inspire C
Inspire E
Inspire L
Proline C
Proline E
Proline L
Punch C
Punch E
Punch L

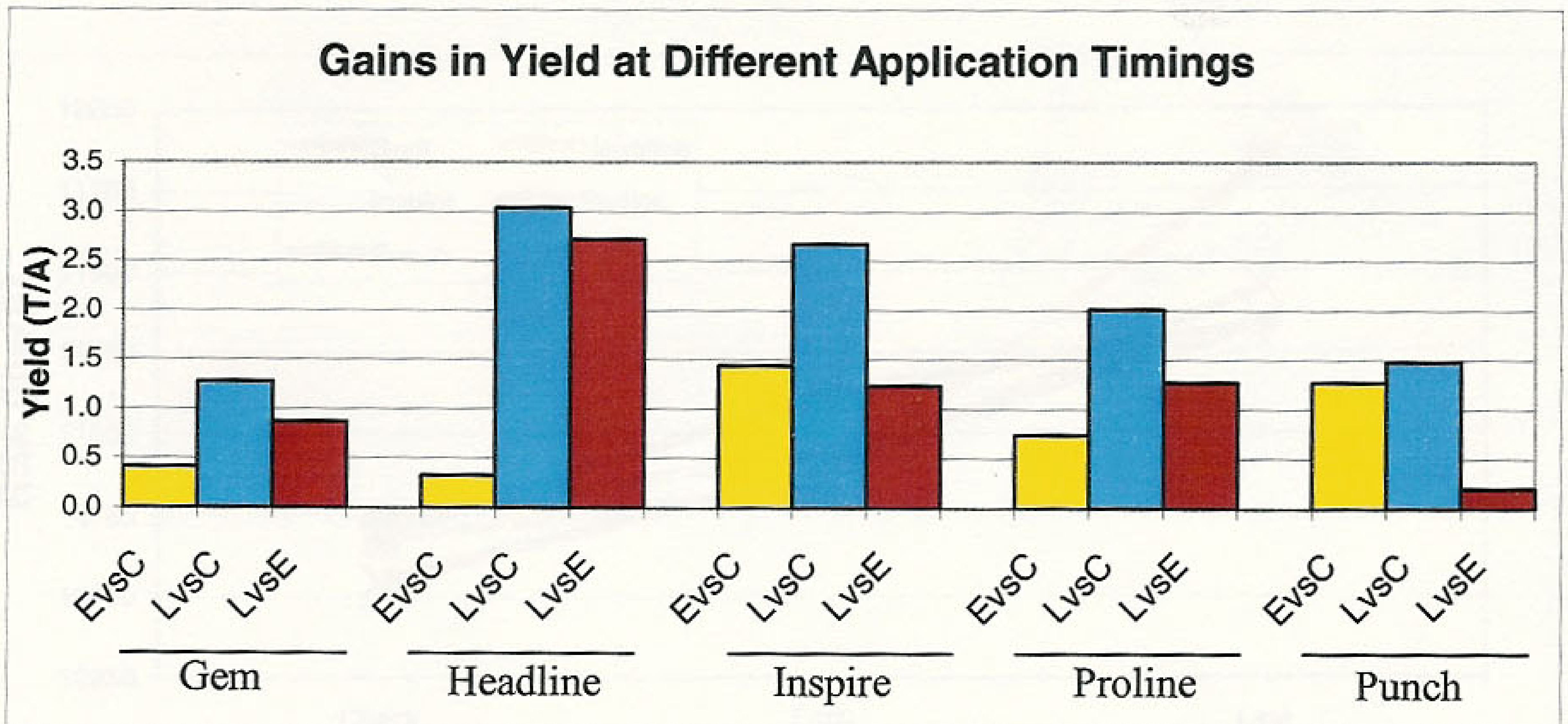
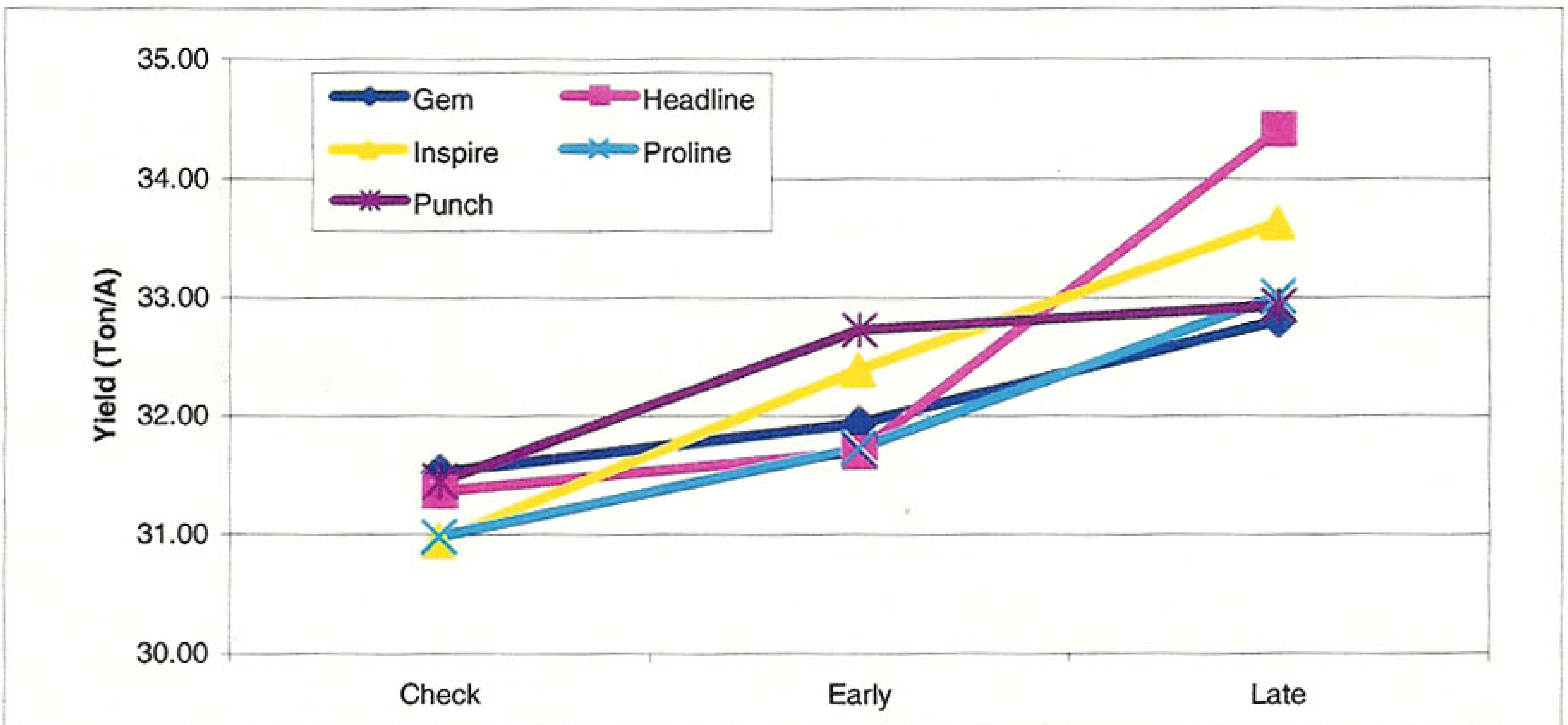
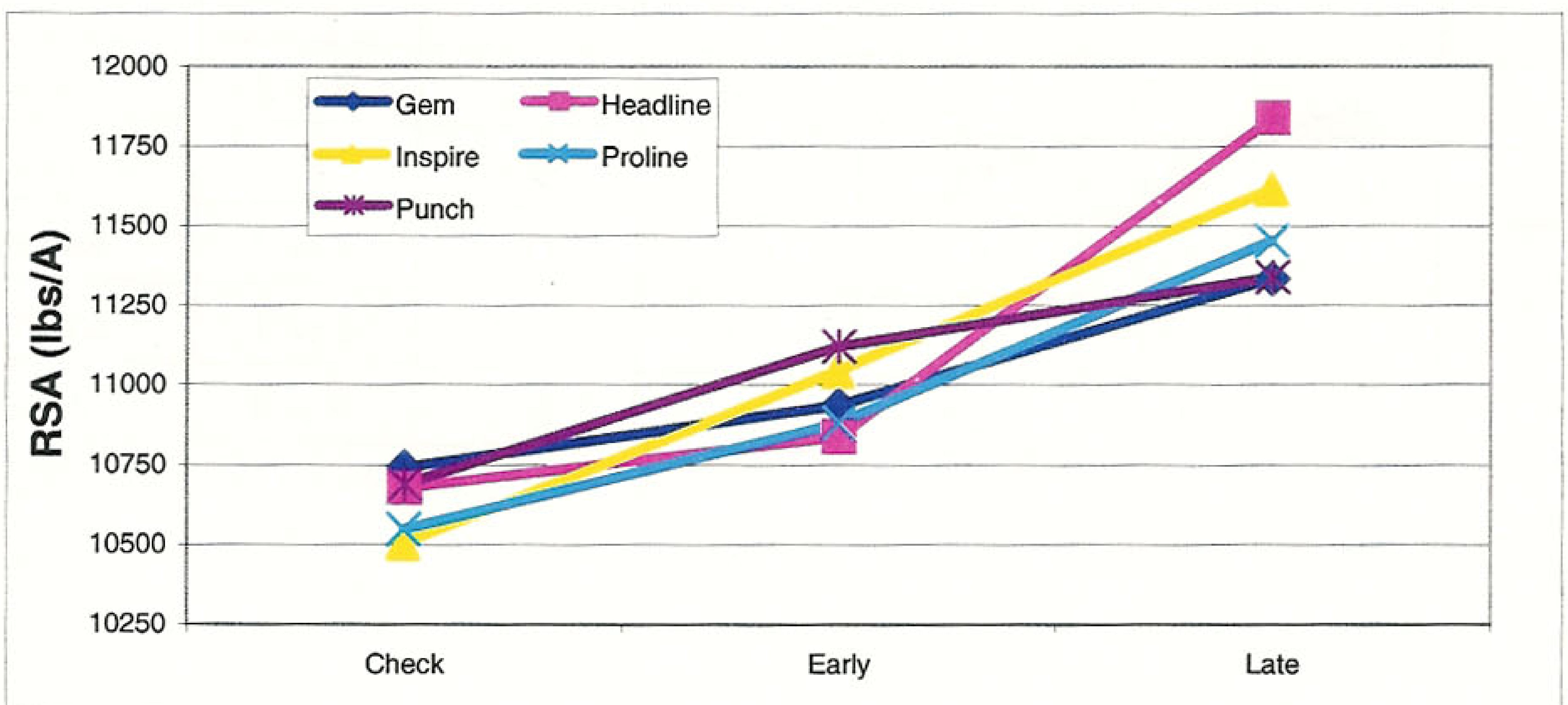
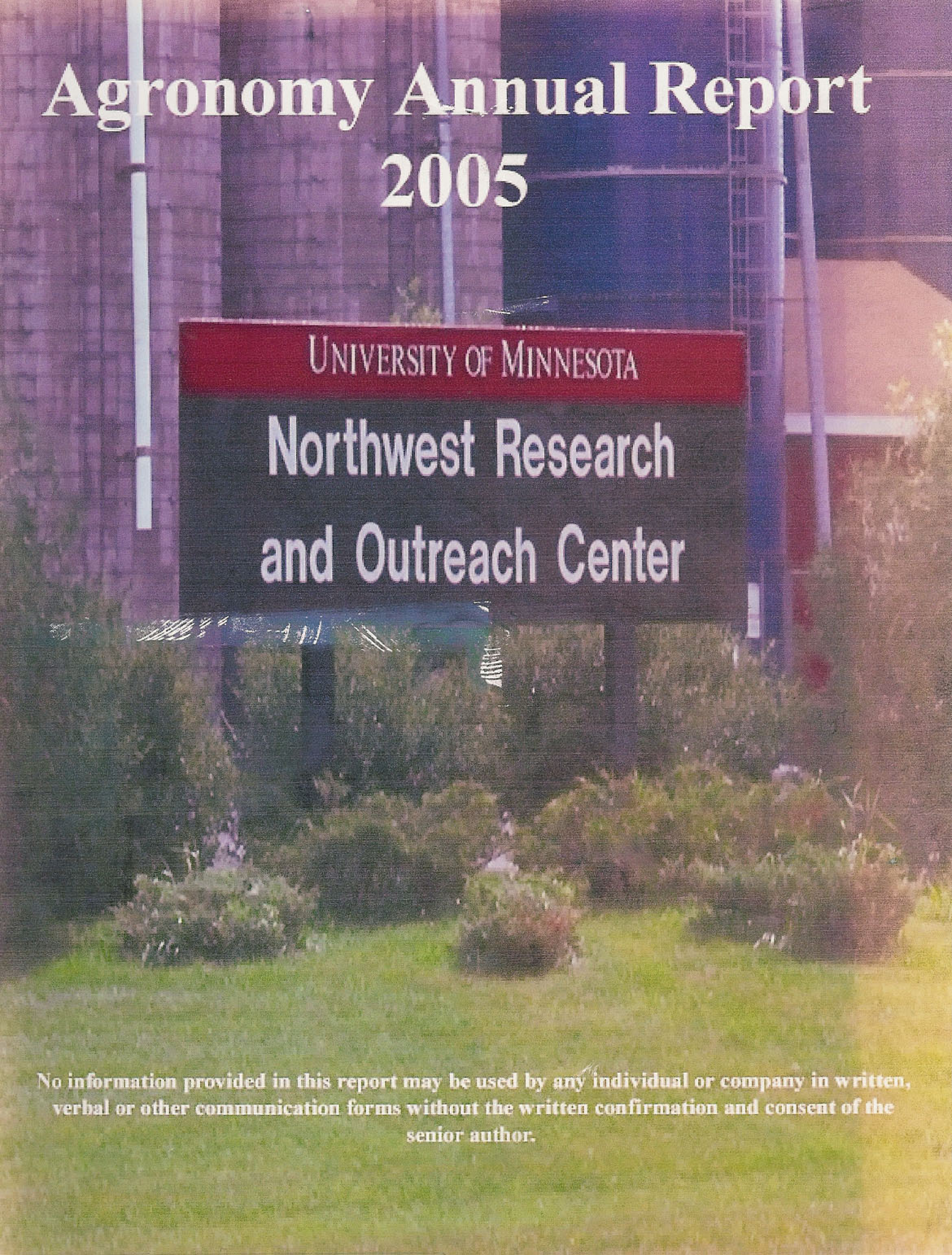

Gains in Yield at Different Application Timings
Yield (T/A)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
EvsC
LvsC
LvsE
Gem
Headline
Inspire
Proline
Punch

Figure 3.


35.00
34.00
33.00
32.00
31.00
30.00
Yield (Ton/A)
Gem
Headline
Inspire
Proline
Punch
Check
Early
Late


12000
11750
11500
11250
11000
10750
10500
10250
RSA (lbs/A)
Gem
Headline
Inspire
Proline
Punch
Check
Early
Late

Agronomy Annual Report
2005



Yield Enhancement Benefits of Fungicide Chemistries

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Increases in recoverable sucrose per acre (RSA) from the application of fungicides used for Cercospora leaf spot (CLS) control cannot be explained solely on the basis of disease control. From 2000-2005, fungicide screening trials at the Northwest Research and Outreach Center (NWROC) were rated not only for CLS control (KWS), but also a visual vigor rating at harvest. Statistical correlation between the visual vigor rating and increase observed in RSA were stronger (higher) than those observed when using the KWS disease rating scale. In fact, in four out of the six seasons, there was a non-significant correlation between disease control ratings and the increase in RSA, if the control plot was removed. In some years, treatments having equal control of CLS had differences of up to 1000 pounds of RSA.

The "stay green" effect of the triazole (T) and strobulurin (S) fungicide chemistries is well documented in wheat. Similar "greening" effects and subsequent increases in sugar yield in the sugarbeet crop have been reported by Ober, Clark and Jaggard[1]. While their research does not explain the mechanism by which increased sugar production occurs, they speculate the "greening" effect increases photosynthetic efficiency especially in the middle canopy. Trials were established at the NWROC in 2004 and 2005 to determine the effects of the triazole and strobulurin fungicide chemistries on sugarbeet yield, quality and plant vigor at various application timing, sequencing and number of applications.

Materials and Methods

In 2004, Van der Have 66626 and Hilleshog 7172 sugarbeet seed were planted on April 27, in 22-inch rows, and hand thinned to uniform populations of 35640 plants/A on June 4. These varieties had KWS CLS disease ratings of 4.87 (3 year mean) and 3.15 (2 year mean) respectively. In 2005, the seed varieties Seedex Alpine and Hilleshog 7172 were planted on April 27 and thinned to similar populations on June 6. These varieties had KWS CLS disease ratings of 3.96 (2 year mean) and 3.32 (3 year mean) respectively. Treatments and timings in 2004 are shown in Tables 1 and 2 and for 2005 in Tables 3 and 4. The rate of application of the strobulurin, triazole and triphenyltin hydroxide chemistries was 9.0, 13.0 and 5.0 oz/A respectively. All fungicide treatments were applied to the center 4 rows of a 6-row plot, 35 foot in length with a tractor mounted sprayer, operated at 100 psi and delivering a spray volume of 19 gpa. Recommended fertility, herbicide and insecticide practices were applied during the growing season. The 2004 trial was rated for disease control, vigor and frost damage on October 10 and machine harvested October 11. The 2005 trial was rated on October 11 and harvested on October 12. The center two rows of the four treated rows were harvested for yield and sub-sampled for quality. Quality factors were determined at the ACSC quality laboratory at East Grand Forks, MN.

Results - 2004

The treatments used in this study did not follow CLS resistance management strategies, but were designed to test the effects of the triazole and strobulurin fungicide chemistries at different timings and sequencings on sugarbeet yield, quality and physiological factors.

The growth regulator effects of the two fungicide classes are harder to separate with the variety VDH 66626 (Table 1). The control had a KWS CLS rating of 4.13 at harvest and two applications of fungicide were required to reduce CLS to levels where disease was not a factor in yield and quality. It is generally

[1]Ober, E., C. Clark and K. Jaggard. 2004. Physiological effects of fungicides provide yield benefits. British Sugar Beet Review. 72:44-48.

accepted that a significant loss in RSA will not occur with a KWS CLS rating of 3.0 or lower. It should be noted for this variety however, that four applications of the strobulurin fungicide increased RSA by 2295 pounds/acre, compared to 877 and 1301 for the triazole and triphenyltin hydroxide (TPTH) chemistries, compared to the check. How much of these increases are directly attributable to disease control is unknown. The strobulurin chemistry had significantly less frost damage and a higher visual vigor rating than the other two chemistries when applied separately.

No CLS developed on the variety Hilleshog 7172. A single application of a triazole or strobulurin fungicide applied on 8/2 or alternating double application applied on 8/2 and 8/16 did not increase RSA compared to the check (Table 2). Alternating fungicides applied three times (8/2, 8/16 and 8/30) significantly increased RSA by 782-952 pounds compared to the check. Alternating fungicides applied four times maintained this scope of increase only if the application on 9/14 was a strobulurin. A significant difference in RSA and yield occurred between the T/S/T/S and S/T/S/T sequencing when the triazole was applied as the last chemistry. This phenomenon has been observed in prior years in fungicide screening trials at the NWROC. This is further evidenced by the application of the straight triazole applied four times versus the straight strobulurin applied four times.

The highest visual vigor rating occurred with four applications of the strobulurin fungicide. The amount of visible frost damage to the canopy was also significantly reduced with an application of the strobulurin fungicide, if applied approximately 45 days prior to harvest.

Results 2005

2005 was an excellent year for studying growth regulator effects. Low CLS inoculum levels and weather conditions prevented the development of CLS on the varieties used in this study. Unfortunately, no major frost incident occurred prior to harvest.

The 2005 trial was changed to include resistance management strategies. In all applications, no more than one triazole or strobulurin application was used in any treatment, the exception being a control of four applications of each, as a comparison with the check.

A single application of both chemistries applied on July 26, did not improve RSA or yield (Tables 3 & 4) compared to the check. A single application applied late (9/6) increased RSA and yield for both varieties if the strobulurin chemistry was used. The triazole applied as a single application late significantly increased RSA for the variety Alpine, but had no effect on yield. This was due mainly to an increase in sucrose content. The single application of the strobulurin on 9/6 had significantly higher RSA and yield than the single application of the triazole however, with the Alpine variety.

If the strobulurin chemistry was the last treatment applied in the two, three or four application scenarios, significant increases in both RSA and yield occurred for both varieties. Increases ranged from 480-1259 pounds RSA for Alpine and 608-1488 for H-7172. If the triazole chemistry was applied last in the above scenario, a significant increase in RSA (718 pounds) only occurred for the S/T treatment applied on 8/23 and 9/6 on the variety Alpine, and for the three and four application scenarios for H-7172. Increases for these two application timings ranged from 590-604 pound RSA. One could question if the increase observed on the variety Alpine was due to the strobulurin application on 8/23 rather than the triazole application on 9/6.

Four applications of the single chemistry was similar for H-7172 in both years in the absence of CLS. Only the strobulurin chemistry gave significant increases in RSA and yield compared to the check with four applications.

Visual canopy growth and vigor differences were noted for the 8/23 and 9/6 applications of the strobulurin fungicide with the Alpine variety. These differences were undistinguishable for the most part for the Hilleshog variety, which had a larger canopy and was still very dark green at harvest.

Discussion

Based on two years of study, it appears the primary benefit (growth regulator effects) observed is on yield and is the result of the strobulurin chemistry. In the absence of CLS, no differences in sucrose%, LTM % or RST occurred on either H-7172 (2004, 2005) or Alpine (2005). Sequencing and time of application are major factors in the results obtained. It should also be noted that only one of the approved strobulurin chemistries was tested in these trials.

The results obtained in these studies are not implying any negative effect from the triazole fungicide used. The benefit of its control of CLS is clearly evident in Table 2, and it is of major importance in resistance management.

The big picture question relative to this research is how the information obtained will be used in a resistance management program for CLS control. Applying one chemistry continuously late in the growing season, while it may give financial benefit for a short amount of time, may lead to CLS resistance to that chemistry over time.

As to what the growth enhancing mechanism of the strobulurin chemistry is, I will leave that to plant physiologists.

Table 1 . Effect of fungicide chemistry on agronomic factors at different application date (2004). Variety VDH 66626

Treatment	Application Date	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Sucrose (%)	LTM (%)	CR (1-9)	Visual Frost Damage (1-5)	Visual Vigor (1-10)	Gross Return ($/A)
Check	-----	7089	337.0	21.0	17.85	1.00	4.13	2.75	2.00	861
T	8/2	7632	340.0	22.5	17.98	0.98	2.75	2.38	3.50	933
S	8/2	8123	342.0	23.8	18.03	0.93	2.88	2.38	4.75	999
T	9/14	7439	346.0	21.5	18.35	1.05	3.00	2.63	4.50	922
S	9/14	8533	351.0	24.3	18.35	0.80	2.50	2.38	5.50	1071
S/T	8/2, 8/16	8275	340.0	24.3	18.08	1.08	1.63	2.63	4.75	1013
T/S	8/2, 8/16	8592	351.0	24.5	18.55	1.00	1.50	2.00	4.75	1078
T/S/T	8/2, 8/16, 8/30	8645	349.0	24.8	18.38	0.93	1.00	1.75	6.00	1080
S/T/S	8/2, 8/16, 8/30	9036	353.5	25.6	18.60	0.93	1.00	1.50	6.50	1140
T/S/T/S	8/2, 8/16, 8/30, 9/14	9088	352.5	25.8	18.55	0.93	1.00	1.38	7.00	1144
S/T/S/T	8/2, 8/16, 8/30, 9/14	8811	353.0	25.0	18.63	0.98	1.13	1.88	6.50	1110
S/TPTH/ T/TPTH	8/2, 8/16, 8/30, 9/14	8562	351.0	24.4	18.53	0.98	1.00	1.75	6.00	1074
T/TPTH/ S/TPTH	8/2, 8/16, 8/30, 9/14	9026	358.0	25.2	18.80	0.90	1.00	1.63	6.75	1150
S	8/2, 8/16, 8/30, 9/14	9384	359.0	26.1	18.88	0.93	1.00	1.25	8.00	1199
T	8/2, 8/16, 8/30, 9/14	7966	351.5	22.7	18.48	0.90	1.00	1.75	6.00	1001
TPTH	8/2, 8/16, 8/30/9/14	8390	345.0	24.3	18.28	1.03	1.13	2.38	5.50	1039
LSD_{05}		549	12.4	1.2	0.56	0.14	0.46	0.39	0.67	90

T = Triazole
S = Strobilurin
TPTH = Triphenyltin Hydroxide
KWS 1-9: 1 = no disease, 9 = regrowth only
Visual Frost Damage: 1 = no damage, 5 = severe
Visual Vigor: 1 = poor, 10 = excellent
Gross Return : Basis ACSC Nov 15, 2004 payment

Table 2 . Effect of fungicide chemistry on agronomic factors at different application dates (2004)
Variety — Hilleshog 7172

Treatment	Application Date	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Sucrose (%)	LTM (%)	CR (1-9)	Visual Frost Damage (1-5)	Visual Vigor (1-10)	Gross Return ($/A)
Check	-----	7520	325.0	23.1	17.28	1.03	1.00	2.75	4.00	885
T	8/2	7492	325.0	23.1	17.30	1.05	1.00	2.75	4.25	882
S	8/2	7788	328.0	23.8	17.45	1.05	1.00	2.50	4.50	924
T	9/14	7878	234.5	23.6	17.67	0.95	1.00	1.88	4.75	951
S	9/14	8234	336.5	24.5	17.80	0.98	1.00	1.83	5.50	999
S/T	8/2, 8/16	7534	325.5	23.1	17.30	1.03	1.00	2.68	4.25	888
T/S	8/2, 8/16	7658	327.0	23.4	17.40	1.05	1.00	2.50	4.50	906
T/S/T	8/2, 8/16, 8/30	8302	325.5	24.8	17.75	0.98	1.00	2.25	5.25	1004
S/T/S	8/2, 8/16, 8/30	8472	334.5	25.3	17.65	0.93	1.00	1.63	6.25	1023
T/S/T/S	8/2,8/16, 8/30, 9/14	8571	339.5	25.2	17.88	0.90	1.00	1.38	6.75	1047
S/T/S/T	8/2, 8/16, 8/30, 9/14	7857	331.0	23.8	17.58	1.03	1.00	2.13	6.25	939
S/TPTH/ T/TPTH	8/2, 8/16, 8/30, 9/14	7630	328.5	23.2	17.50	1.08	1.00	1.88	5.75	907
T/TPTH/ S/TPTH	8/2, 8/16/, 8/30, 9/14	8191	337.5	24.3	17.83	0.95	1.00	1.75	6.25	996
S	8/2, 8/16, 8/30, 9/14	8338	339.5	24.6	17.93	0.95	1.00	1.38	7.25	1018
T	8/2, 8/16, 8/30, 9/14	7595	334.5	22.7	17.70	0.98	1.00	3.13	5.75	917
TPTH	8/2, 8/16, 8/30, 9/14	8007	334.5	24.0	17.65	0.93	1.00	2.25	5.75	966
LSD_{05}		465	NS	1.2	NS	NS	NS	0.38	0.72	77

T = Triazole
S = Strobilurin
TPTH = Triphenyltin Hydroxide
KWS 1-9: 1 = no disease, 9 = regrowth only
Visual Frost Damage: 1 = no damage, 5 = severe
Visual Vigor: 1 = poor, 10 = excellent
Gross Return: Basis ACSC Nov 15, 2004 payment

Table 3 . Effect of fungicide chemistry on agronomic factors at different application dates (2005)
Variety — Seedex Alpine

Treatment	Application Date	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Sucrose (%)	LTM (%)	CR (1-9)	Visual Top Growth (1-5)	Visual Vigor (1-5)	Gross Return ($/A)
Check	-----	8466	321.5	26.4	17.15	1.1	1.00	3.1	3.0	987
T	7/26	8515	325.0	26.2	17.25	1.0	1.00	3.3	3.3	1001
S	7/26	8498	319.0	26.6	17.00	1.1	1.00	3.3	3.1	983
T	9/6	8917	331.0	26.9	17.50	1.0	1.00	3.1	3.1	1066
S	9/6	9564	321.0	29.8	17.08	1.0	1.00	3.5	3.9	1112
T/S	7/26, 8/9	8946	320.5	27.9	17.17	1.2	1.00	3.5	3.5	1040
S/T	7/26, 8/9	8767	327.0	26.8	17.40	1.1	1.00	3.4	3.3	1038
T/S	8/23, 9/6	9553	319.5	29.9	17.10	1.1	1.00	4.1	4.1	1107
S/T	8/23, 9/6	9184	318.0	28.9	17.00	1.1	1.00	3.8	3.9	1059.
T/TPTH/S	7/26, 8/9, 8/23	9711	327.5	29.7	17.35	1.0	1.00	3.9	4.1	1151
S/TPTH/T	7/26, 8/9, 8/23	8840	314.5	28.1	16.88	1.2	1.00	3.6	3.6	1009
TPTH/T/ TPTH/S	7/26, 8/9, 8/23, 9/6	9725	327.5	29.7	17.42	1.1	1.00	4.0	3.9	1152
TPTH/S/ TPTH/T	7/26, 8/9, 8/23, 9/6	8862	315.5	28.1	16.83	1.1	1.00	3.8	3.4	1013
T	7/26, 8/9, 8/28, 9/6	8515	326.5	26.1	17.35	1.0	1.00	3.5	3.1	1006
S	7/26, 8/9, 8/28, 9/6	9979	327.5	30.5	17.38	1.0	1.00	4.3	4.1	1182
LSD_{05}		418	NS	1.4	NS	0.1	NS	0.6	0.5	73

Visual Top Growth :1 = poor, 5= good
Visual Vigor: 1= poor, 5= good
Gross Return: Basic ACSC November 15, 2005 payment

Table 4 . Effect of fungicide chemistry on agronomic factors at different application dates (2005)
Variety — Hilleshlog 7172

Treatment	Application Date	RSA (lb/A)	RST (lb/T)	Yield (T/A)	Sucrose (%)	LTM (%)	CR (1-9)	Visual Top Growth (1-5)	Visual Vigor (1-5)	Gross Return ($/A)
Check		6461	317.0	20.4	16.95	1.1	1.00	4.0	3.6	742
T	7/26	6625	310.5	21.3	16.65	1.1	1.00	3.8	3.8	747
S	7/26	6693	312.5	21.4	16.73	1.1	1.00	3.9	3.9	760
T	9/6	6607	314.0	21.0	16.80	1.1	1.00	4.0	3.9	753
S	9/6	7358	311.5	23.6	16.70	1.1	1.00	4.1	4.6	832
T/S	7/26, 8/9	7069	313.5	22.6	16.78	1.1	1.00	4.0	4.4	804
S/T	7/26, 8/9	6760	309.5	21.8	16.60	1.1	1.00	3.8	4.1	760
T/S	8/23, 9/6	7362	315.0	23.4	16.88	1.1	1.00	4.3	4.4	842
S/T	8/23, 9/6	6879	316.0	21.8	16.95	1.2	1.00	4.1	4.1	789
T/TPTH/S	7/26, 8/9, 8/23	7603	314.0	24.3	16.85	1.2	1.00	4.0	4.4	865
S/TPTH/T	7/26, 8/9, 8/23	7065	315.5	22.4	16.90	1.1	1.00	3.9	4.3	809
TPTH/T/ TPTH/S	7/23, 8/9, 8/23, 9/6	7949	316.5	25.1	16.95	1.1	1.00	4.1	4.4	913
TPTH/S/ TPTH/T	7/23, 8/9, 8/23,9/6	7051	310.5	22.7	16.65	1.1	1.00	4.0	4.0	796
T	7/26, 8/9, 8/28, 9/6	6611	315.0	21.0	16.85	1.1	1.00	4.0	3.9	755
S	7/26, 8/9, 8/28, 9/6	7465	308.5	24.2	16.58	1.2	1.00	4.3	4.6	836
LSD_{05}		425	NS	1.0	NS	NS	NS	0.4	NS	77

Visual Top Growth: 1 = poor, 5= good
Visual Vigor: 1= poor, 5= good
Gross Return: Basic ACSC November 15, 2005 payment

January 4, 2006