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Annual Cereal Fall Pasture Strategies

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Providing pasture forage that meets beef cow nutritional requirements during late fall (mid November to mid December) is a problem for producers in the Northern Plains. Beef cows grazing native rangeland pastures after mid October have negative weight performance (Manske 2003a), and the pasture and forage costs per day for grazing native rangeland during the fall are extremely high (Manske 2003c). Decline in animal performance begins in mid summer, because the crude protein levels of native grass lead tillers drop below a lactating cow's dietary requirements in mid to late July (Manske 1999b). However, secondary tillers can remain at or near lactating cow crude protein requirements until late September or mid October (Sedivec 1999), and defoliation management that stimulates vegetative reproduction of secondary tillers from axillary buds can minimize the late-summer decline in animal performance and extend by two to two and a half months the length of time that native rangeland grasses meet beef cow dietary requirements (Manske 1999a, 2003b). Because of biological limitations of native grasses in the Northern Plains, these species cannot be manipulated to maintain crude protein levels adequate to meet beef cow requirements after mid October. Wildryes like Altai and Russian, which retain aboveground crude protein levels near cow requirements until about mid November (Manske 2003b), can be used to extend the grazing period another month, but no perennial grass species in the Northern Plains has nutritional quality that consistently meets beef cow dietary requirements later than mid November (Manske 2002). Further extending the grazing period requires finding annual pasture forages that meet beef cow dietary requirements economically from mid November to mid December. The most likely candidates for late fall pastures are spring-seeded winter cereals or southern annual cereals that do not produce seed heads before the end of the growing season in the Northern Plains. This project was conducted to evaluate spring-seeded winter rye planted separately and planted with spring cereal oat. Spring cereal oat planted separately was used as a control.

Procedure

The project was conducted in 2003 at the NDSU Dickinson Research Extension Center ranch, located near the Little Knife River. The Ranch Headquarters is 20 miles north of Dickinson, in western North Dakota, U.S.A. (47 14' N. lat., 102 50' W. long.). The study site was on the west half of the NW¼ of section 24-143-96 and consisted of 73.4 acres of cropland with some erodible areas covered with crested wheatgrass. The project area (figure 1) was divided by barbed wire fence into four fields of 18.3 acres each and designated as fields A, B, C, and D. Each field was subdivided into three 6.1-acre treatments. Treatment I was planted with spring oats separately. Treatment II was spring planted with winter rye separately. Treatment III was planted with both spring oats and winter rye at the full seeding rate of treatments I and II, respectively. The combined total of each treatment on the four fields was 24.5 acres.

Two sampling sites, designated east and west, were established for each treatment of each field. Data were collected once a month from June through December with rectangular quarter-meter square frames set across the seeded rows. Plant density was determined by counting all the plants rooted within the frame. Leaf heights of each forage type were measured from ground level to the extended leaf tip of twelve plants per frame. Herbage biomass was determined by clipping the plant material within a frame to ground level and separating it into annual cereal and weeds. Herbage samples were oven dried and weighed. Differences between means of plant data were analyzed by a standard paired-plot t-test (Mosteller and Rourke 1973).

The oats on treatments I and III were swathed and baled for hay at the late milk to early dough stage. Dry cows grazed the four study fields from mid November to mid December. Field A was grazed about a week, and the additional fields were opened for grazing at a rate of about one field per week. Cows were weighed individually at the start and end of the grazing period. In mid December, cows were intended to be fed the oat hay harvested from the four fields; this portion of the project, designed to determine the AUM's of forage per acre from the harvested oat hay, was not carried out.

Results

The environmental conditions during the growing season of 2003 were not conducive to abundant plant growth. Precipitation during June, July, August, and October was below normal long-term levels (table 1). The three months in the middle of the growing season, June, July, and August, received only 54.8% of the long-term mean precipitation. August had water deficiency conditions, in which the rainfall amount was below the evapotranspiration demand (Manske 2004b). This situation placed plants in water stress, reducing growth rate and new herbage accumulation. These conditions also increased the rate of drying (senescence) of older leaf material, which was accompanied by herbage weight loss.

The plant density of oat III planted with winter rye III was not significantly different ($P<0.05$) from that of oat I planted separately for all sample dates (table 2). The plant density of winter rye III planted with spring oat III was not significantly different ($P<0.05$) from that of winter rye II planted separately for all sample dates (table 2).

Leaf height of oat III planted with winter rye III was not significantly different ($P<0.05$) from that of oat I planted separately for all sample dates (table 3). Leaf height of winter rye III planted with spring oat III was not significantly different ($P<0.05$) from that of winter rye II planted separately for all sample dates except 11 August (table 3). The leaf height of winter rye II was significantly greater ($P<0.05$) than that of winter rye III on 11 August. The oats on treatments I and III were harvested for hay at the late milk to early dough stage, between the sample dates on 7 July and 11 August. A portion of the leaf material of the winter rye plants on the mixed oat-winter rye treatment III was cut and removed during the harvesting of the oats; the defoliation reduced the leaf height of the winter rye.

Cereal herbage biomass of oat I planted separately, winter rye II planted separately, and oat-winter rye III planted together was not significantly different ($P<0.05$) on the 12 June and 9 September sample dates (table 4 and figure 2). Spring oat has a faster growth rate than winter rye during the early portion of the growing season. On 7 July, oat I and oat-winter rye III had significantly greater ($P<0.05$) cereal herbage weight than winter rye II planted separately.

The oats on treatments I and III were harvested for hay between sample dates 7 July and 11 August. Seventy-nine large round bales were harvested from 48.9 acres, at an average rate of 1.62 bales per acre. The weight of these bales is unknown. On 11 August, the cereal herbage weight for oat I and oat-winter rye III was significantly lower ($P<0.05$) than the cereal herbage weight for winter rye II planted separately and not harvested for hay.

The herbage weight loss on oat I treatments between sample dates 7 July and 11 August averaged 3500.65 lbs/acre. Most of this herbage weight was removed as hay. The effects of defoliation during mechanical harvest of the hay caused some additional plant and weight loss. The remaining weight loss was caused by the increased rate of senescence resulting from plant water stress during July and August.

The herbage weight loss on oat-winter rye III treatments between sample dates 7 July and 11 August averaged 3043.50 lbs/acre. Most of this herbage weight was removed as hay. The effects of defoliation during mechanical harvest of the hay caused some additional plant and weight loss. The remaining weight loss on the oat-winter rye III treatments was caused by the increased rate of senescence resulting from plant water stress during July and August.

Cutting and removing some leaf material of the winter rye plants during the harvesting of the oat hay reduced the leaf height of the winter rye. During the September through November period, the winter rye plants on the winter rye II treatments had an average leaf height of 8.52 inches, which was significantly greater ($P<0.05$) than that of the winter rye plants that had been defoliated by the swather during the oat hay harvesting process on the oat-winter rye III treatments.

The oat plants cut for hay and the oat tillers that grew after the hay was removed senesced during the middle portion of the growing season and were dry during the sample dates of October, November, and December. During October and November, cereal herbage weight of oat I planted separately was significantly lower ($P<0.05$) than the cereal herbage weight of winter rye II planted separately (table 4 and figure 2). The cereal herbage weight on oat-winter rye III was not different from that on oat I or winter rye II (table 4).

The weed herbage biomass visually appeared to be less on the oat-winter rye III treatments, but the weight of the weed herbage was not significantly different ($P<0.05$) among the three treatments for all sample dates (table 4).

Dry cows grazed the four fields from 20 November to 22 December. At the end of the grazing period, the cereal herbage weight that remained on oat I treatments was not significantly different ($P<0.05$) from the weight that remained on winter rye II treatments. The cereal herbage weight that remained on the oat-winter rye III treatments was significantly greater ($P<0.05$) than the weight that remained on either of the other two treatments (table 4 and figure 2). During the 32 days of the grazing period, an average of 318.44 lbs/acre of herbage was removed from the oat I treatments, an average of 1779.54 lbs/acre of herbage was removed from the winter rye II treatments, and an average of 390.25 lbs/acre of herbage was removed from the oat-winter rye III treatments. Not all of the herbage weight utilized during the grazing period was consumed by the cows. Some of the herbage weight loss was from leaf material broken from the plant or soiled by animal waste, and some weight was reduced through the senescence process. During the grazing period, the greatest amount of herbage material was removed from the winter rye II planted separately treatments. The quantity of forage utilized from the winter rye II treatments was 1.95 AUM/acre, or 0.51 acres/AUM. There wasn't much forage available for the dry cows to graze on the oat I planted separately treatments because the plants had senesced during mid summer and did not produce late-season tillers. The herbage removed from the oat-winter rye III treatments was only about one-third of that available for grazing. The 637.11 lbs/acre of available herbage that was not grazed was primarily winter rye that was shorter than the stiff, dry oat stubble. About 0.70 AUM's of forage per acre remained ungrazed on the oat-winter rye III treatments.

Cow weight performance during the 32-day grazing period from 20 November to 22 December was positive. The average starting weight of the 53 dry cows was 1246.60 pounds and the average weight at the end of the grazing period was 1280.28 pounds, with an average gain of 33.68 lbs, at a rate of 24.33 lbs per acre and 1.05 lbs per day. The 53 cows grazed the four fields of 73.36 acres at a stocking rate of 0.79 AUEM/acre, or 1.27 acres/AUEM. The stocking rate on the two treatments with winter rye forage was 1.18 AUEM/acre, or 0.84 acres/AUEM. Cow weight gain from the two winter rye treatments was 36.50 lbs per acre. The forage contribution from the three treatments to the average daily cow utilization was oat I, 4.59 lbs; winter rye II, 25.16 lbs; oat-winter rye III, 5.34 lbs; and weeds, 0.78 lbs, for a total of 35.87 lbs of herbage per cow per day.

Two methods were used to harvest the annual cereal forage. The spring oat forage was mechanically harvested as hay during early summer, and the oat residue and winter rye forage were grazed by beef cows during late fall. During the haying and grazing periods, an average of 3819.09 lbs/acre of herbage was removed from the oat I treatments, an average of 3433.75 lbs/acre of herbage was removed from the oat-winter rye III treatments, and an average of 1779.54 lbs/acre was removed from the winter rye II treatments. During both harvesting periods, the greatest amount of herbage material was removed from the spring oat I planted separately treatments.

Discussion

Spring-seeded winter rye planted separately can be used as late fall annual cereal pasture forage for beef cows. The dry cows gained weight grazing winter rye pastures from mid November to mid December.

Winter cereals planted at the traditional time in mid summer have a lesser chance of providing sufficient forage during late fall than spring-seeded winter cereals. Western North Dakota has a good chance of having water deficiency conditions sometime during the last three months of the growing season. The long-term (112 years) water deficiency rate is 50.9% for August, 50.9% for September, and 48.2% for

October (Manske 2004a). Only 11% of the years have not had water deficiency sometime during these three months: there is an 89% chance that summer-seeded winter cereals would be subjected to water deficiency while the seedlings were small and had limited soil area from which to absorb water. Spring seeding would give the plants time to develop larger root systems to reduce the impact of the water stress. Because of the low amount of precipitation received, a mid summer seeding of a winter cereal in 2003 would not have provided forage for fall grazing. The spring-seeded winter rye, however, provided fall forage in 2003 at a fairly high stocking rate (0.84 acres/AUEM).

Spring seeding winter cereals for fall forage pasture has generally been perceived by producers as losing a growing season for crop production. The mixed oat-winter rye III treatment was included in this trial to address this producer concern. Double cropping with a spring cereal and a winter cereal should be biologically possible during May, June, and the first two weeks of July, when soil water is usually at its highest levels. May and June have had water deficiency conditions in only 14.3% and 8.9% of the past 112 years, respectively (Manske 2004a).

The data for the mixed oat-winter rye III treatments indicate that the double cropping practice has two major problems requiring attention during planning for late fall annual cereal pastures. The first problem is that the winter rye plants that had a portion of their leaf material removed during haying of the oat plants showed a measurable reduction in leaf height and herbage weight; the reduction was not present in the winter rye plants not defoliated by the haying process. The second problem is that the dry oat stubble restricted the availability and utilization of a substantial quantity of winter rye forage.

Conclusion

Late fall pasture forage that meets beef cow nutritional requirements can be provided by winter cereals planted separately in the spring. Summer-seeded winter cereals have a small chance of providing adequate forage during late fall. Planting spring cereals separately and harvesting them for hay at the late milk to early dough stage produces greater quantities of forage per acre than grazing winter cereal pastures during the late fall.

In most years, enough soil water will be available to make double cropping winter cereals with spring cereals biologically possible, because the early growing season months have low chances for water deficiency conditions. However, double cropping does not appear to be a compromise practice that will successfully provide both a summer hay crop and forage for late fall pasture. Cutting and removing some leaf material of the winter cereal plants during the harvesting of the spring cereal reduces the height and weight of the winter cereal, and the dry stubble of the spring cereal greatly restricts animals' utilization of shorter winter cereal forage.

Management Implications

A basic strategy for providing both late fall pasture and harvested hay on the same cropland area is to spring plant a portion of a field with winter cereal separately and to spring plant another portion of the field with spring cereal separately. The spring cereal is mechanically harvested for hay at an early stage in summer, stored nearby, and delivered as feed to cows on the cropland acres during winter. The spring-seeded winter cereal is grazed during the late fall. About 0.5 to 1.0 acres of winter cereal will be needed per cow for a month of grazing. Dividing the cropland area into four pastures permits opening successive segments with ungrazed forage at a rate of about one pasture per week.

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Figures and Tables

Figure 1. Annual Forage Pasture Study Map

Figure 2. Annual Cereal Herbage Weight

Table 1. Precipitation in inches for growing-season months at Ranch Headquarters DREC, North Dakota.

	Apr	May	Jun	Jul	Aug	Sep	Oct	Growing Season
Long-term mean	1.41	2.15	3.27	2.72	1.80	1.44	1.22	14.01
2003	1.30	4.34	1.42	2.03	0.82	2.37	0.74	13.02
% of LTM	92.20	201.86	43.43	74.63	45.56	164.58	60.66	93.01

Table 2. Annual cereal plant density per square foot, comparing treatments I and II to treatment III, Ranch Headquarters DREC, North Dakota, 2003.

	12 Jun	7 Jul	11 Aug	9 Sep	6 Oct	19 Nov	22 Dec
Separate Planting							
Oat I	12.36a	8.41a	7.99a	9.89a	9.76a	8.87a	8.55a
Winter Rye II	11.80x	8.45x	6.18x	6.69x	7.34x	5.85x	7.48x
Mixed Planting							

Oat III	9.71a	9.29a	7.62a	9.85a	9.66a	8.55a	7.25a
Winter Rye III	7.48x	7.85x	6.04x	6.55x	6.55x	5.25x	6.88x
Oat + Winter Rye III	17.19	17.14	13.66	16.40	16.63	13.80	14.12

Means of the same forage type that are in the same column and followed by the same letter are not significantly different (P<0.05).
Plant density data for oat were from dry plant material on October, November, and December.

Table 3. Annual cereal plant leaf heights in inches, comparing treatments I and II to treatment III, Ranch Headquarters DREC, North Dakota, 2003.

	12 Jun	7 Jul	11 Aug	9 Sep	6 Oct	19 Nov	22 Dec
Separate Planting							
Oat I	12.14a	27.72a	10.77a	9.41a	6.75a	8.07a	5.85a
Winter Rye II	9.22x	12.22x	12.89x	8.73x	8.31x	8.53x	5.69x
Mixed Planting							
Oat III	12.83a	26.19a	8.65a	8.11a	6.91a	7.48a	6.89a
Winter Rye III	7.75x	12.83x	9.25y	7.69x	6.27x	7.53x	5.99x

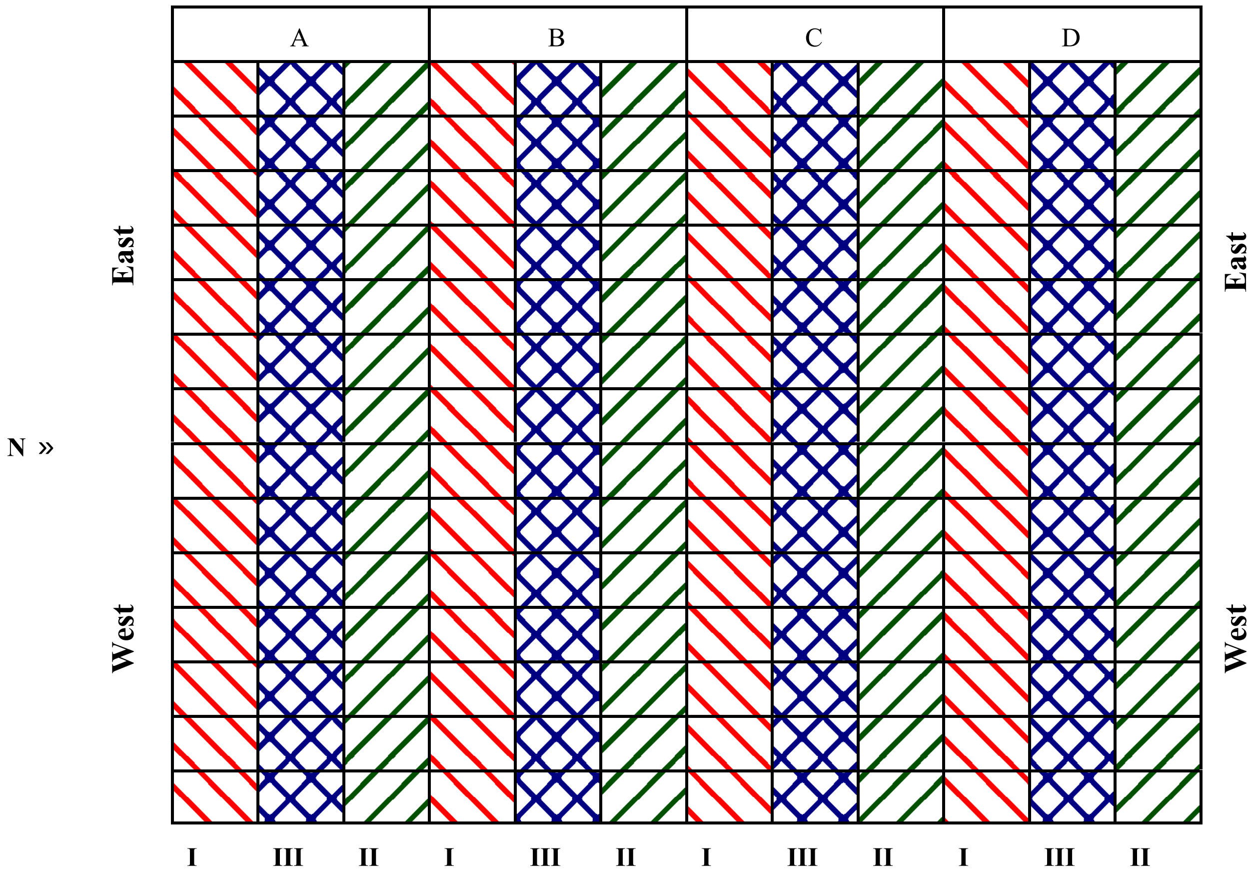
Means of the same forage type that are in the same column and followed by the same letter are not significantly different (P<0.05).
Leaf height measurements for oat were from dry leaf material on October, November, and December.

Table 4. Cereal and weed herbage biomass in pounds per acre, Ranch Headquarters DREC, North Dakota, 2003.

	12 Jun	7 Jul	11 Aug	9 Sep	6 Oct	19 Nov	22 Dec
	Cereal Herbage						
Treatments							
Oat I	660.97a	4388.19a	1004.84b	777.38a	642.69b	992.80b	674.35b
Winter Rye II	705.57a	2210.82b	2531.94a	1381.71a	1637.27a	2486.90a	741.70b
Oat-Winter Rye III	892.00a	4206.67a	1214.46b	1159.15a	1169.41ab	1715.32ab	1345.14a
	Weed Herbage						

Oat I	220.32x	340.74x	223.45x	198.47x	359.03x	255.11x	389.80x
Winter Rye II	154.76x	261.80x	605.22x	625.74x	297.04x	261.36x	227.01x
Oat-Winter Rye III	125.33x	225.23x	173.94x	196.69x	171.71x	156.99x	136.92x

Means of each herbage category that are in the same column and followed by the same letter are not significantly different (P<0.05). Herbage biomass data for oat were from dry plant material on October, November, and December.



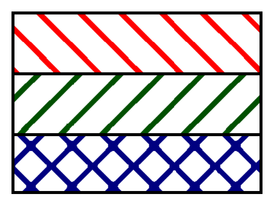
4 Fields named A, B, C, D

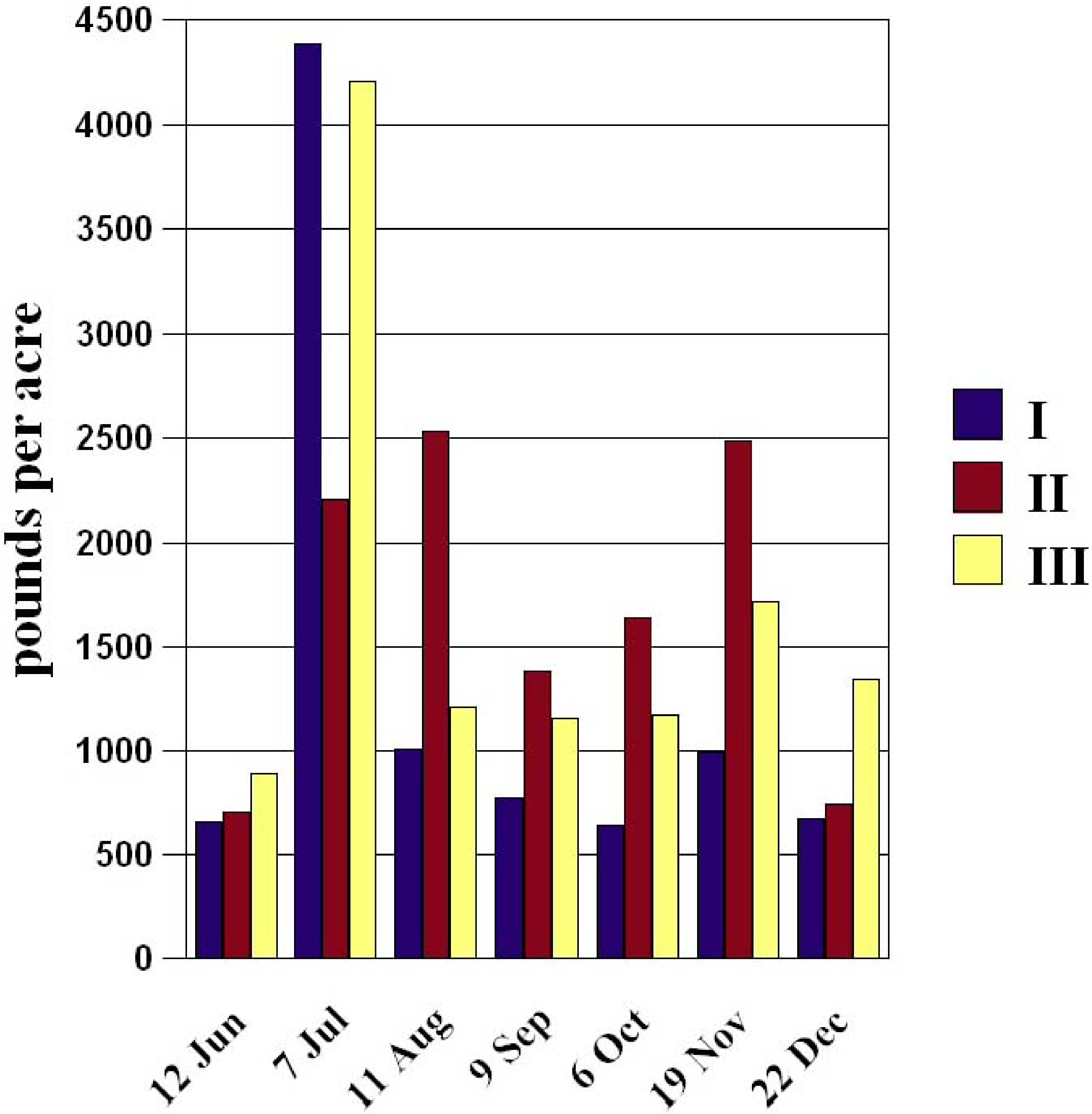
3 Treatments I Spring Cereal (Oats)

II Winter Cereal (Winter Rye)

III Spring and Winter Cereal

2 Sample Sites/Treatment East, West




4500
4000
3500
3000
2500
2000
1500
1000
500
0
pounds per acre
12 Jun
7 Jul
11 Aug
9 Sep
6 Oct
19 Nov
22 Dec
I
II
III