THE EFFECT OF ROW SPACING ON THE HARVESTABLE YIELD AND DRY MATTER PRODUCTION OF RUSSIAN WILD RYEGRASS

A.J. Leyshon, H. Cutforth, and J. Waddington
Agriculture Canada Research Station
Swift Current, Sask. S9H 3X2

Many tests, both at Swift Current and at other locations, have shown that higher yields are obtained when forage crops are seeded in rows as much as 90 cm apart. In 1981, Leyshon et al. suggested that the yield advantage of the wider row spacings may be due more to sampling technique than to an actual increase in aboveground biomass. They had observed that the wider row spacings produced taller plants that were easier to harvest by machine. It was suggested that this was a result of the smaller number of plants per unit area. Lodge et al. (1972) reported that 54% of the total herbage of crested wheatgrass was produced within 10cm of the ground. Unpublished data by Lodge suggest that this proportion may be greater with Russian wild ryegrass due to the prostrate nature of its lower leaves.

The results presented herein test the sampling effect hypothesis by comparing the yields of Russian wild ryegrass obtained by machine harvest with hand harvested yields at two row spacings.

MATERIALS AND METHODS

Four adjacent areas of Russian wild ryegrass were established in the spring of 1979 on a flat, uniform area of Swinton loam soil at Swift Current. Two areas were seeded with a row spacing of 15cm, the other two were seeded in rows spaced at 60 cm. One area from each row spacing was designated for harvesting by machine, the other area was used for hand sampling and for destructive sampling of above- and below-ground biomass.

No cut was taken in the establishment year. In the following year all the plots were uniformly cut by machine and the clippings removed, but no measurements were taken. This was to allow the plants, particularly those in the 60cm rows, further time to become established.

Two cuts were taken to estimate yield in the years 1981 to 1983; one in early June and the second when there was sufficient regrowth. In 1984, only one cut was taken since drought resulted in insufficient regrowth for a second cut.

Machine-harvest yields were estimated at each harvest by taking six samples, at random, from rows that had not been previously sampled. Each sample consisted of four rows from the 15cm spacing or one row from the 60cm spacing and were the length of the plot (30m). Samples were taken using a flail type mower set to collect all plant material above a 7 to 8 cm height.

Hand-harvest yields were taken at the same time as the samples were taken by machine. Five 30 cm row segments were randomly selected and each segment was sampled by cutting to the same stubble height of 7 to 8 cm as the machine-cut samplings; however, prostrate leaves were included in the sample since they were lifted and cut to the same stubble height. The remaining above-ground tissue (the "crown") and the shallow root mass of each hand harvested segment were obtained to a depth of 15cm by extracting a block 30cm long by 15cm wide and 15cm deep. The soil was removed by gentle hand washing.

After each yield estimate, all areas were cut by machine. An estimate of the tissue carry-over from the first cut to the second cut was obtained by comparing machine-harvested and hand-harvested yields from cut one and was subtracted from the hand-harvested cut two yields.

Data from each harvest and for the 4 year mean were statistically analysed by ANOVA as a completely randomized design. Previous experience on this site had shown no advantage to blocking. Using new rows for each sampling avoided the problem of correlation between successive harvests. Where significant differences were indicated by ANOVA, single degree (t-test) or multiple degree (LSD) tests were applied as appropriate.

RESULTS AND CONCLUSIONS

Significant positive correlations are known to occur between forage yields and precipitation during March, April, May, and the previous September. Precipitation during these months in the establishment year was close to the long-term mean. In the following year, designated a stabilization year, the precipitation for the same period was below average. The first three harvest years, 1981 to 1983, received above average rainfall during the growing period. Excellent yields were obtained by hand-harvest from the first cut in those years, and there was no significant differences due to row spacing (Table 1). First-cut yields harvested by machine were much lower and there were significant differences in favour of the wider row spacing. In 1984, which was a drought year with lower than average precipitation in all growing season months, the difference between row spacings when harvested by machine was very large; rows on 15 cm centres produced almost nothing. Harvesting by hand also produced low yields but differences between the two row spacings was not significantly different.

The differences in dry matter collected at cut 1 by the two harvesting methods showed that when Russian wild ryegrass was grown in 15cm rows, only 7 to 26% of the dry matter yield harvested by hand was collected by the machine. With rows spaced at 60cm, the proportion of the dry matter collected by the machine increased to between 32 and 48% of the total harvested by hand.

At the second cut, differences in dry matter caused by row spacing were not significant in 1981 and 1982 with either harvesting method (Table 1). In 1983, widely spaced rows produced significantly more than the narrow rows when harvested by machine and less than the narrow rows when harvested by hand. Why this occurred is unclear. There was no second cut in 1984.

A greater proportion of the hand-harvested yield was collected by the machine in the second cut. For the narrowly spaced rows, the machine collected between 30 and 67% of the hand-harvested yield; and for the rows spaced 60cm apart the proportion was 62 to 68%. It is clear that variations in the growing season precipitation had a greater effect upon the amount of growth above the 7 to 8cm cutting height in the narrowly spaced rows.

For both the first and the second cuts, the machine harvested a higher proportion of the aboveground tissue in rows spaced 60 cm apart than with the narrower (15 cm) rows despite there being no differences in total yield, as measured by hand sampling, between the row spacings.

In all years the widely spaced rows had approximately double the amount of crown and shallow root dry matter of the narrower rows (data not shown). However, for every row at 60 cm there were four rows at 15 cm. Therefore, on a unit area basis, the crowns and shallow roots of plants in narrow rows contained about twice the dry matter beneath the rows as those in wide rows.

Much of the dry matter produced by Russian wild ryegrass and collected in the first cut is from flowering stems. These are much taller and more abundant in the widely spaced rows and are more easily collected by machine, hence the higher yields from wider rows.

During regrowth, Russian wild ryegrass rarely produces new culms; leaf tissue is produced in a denser, more prostrate stand. In the absence of the flowering stems, the flail type mower used in this study was able to lift, by wind action caused by the flails, more of these prostrate leaves and include them in the sample. As a result, there was a narrower range of variation in the second cut than occurred earlier in the season with the first cut.

These results demonstrate that total above-ground biomass production is not significantly changed by changes in row spacing. Hand harvesting techniques which collect prostrate leaves result in higher yields than machine harvesting, and appear to show no advantages for wide row spacing. The results, together with visual observations, also show that when competition between plants is reduced by growing them in wide rows, the plants increase the biomass in the crowns and above-ground portions resulting in bushier, taller plants that have proportionately more of their tissue at a more easily harvested height. The advantage of wide row spacings lies not in increased biomass production. In fact, the total biomassd production of wide row spacings including crowns and shallow roots is somewhat less than narrow row spacings. It is

Table 1. Effect of row spacing and harvesting methods on above ground biomass.

Harvest Method	Row Spacing	Cut 1 1981	1982	1983	1984	Mean	Cut 2 1981	1982	1983	Mean	Overall Mean
	cm	kg/ha									
Machine (M)	15	156	730	285	41	303	848	731	237	464	384
	60	467	1818	646	276	802	928	769	311	582	692
Level of significance		*	**	*	**	**	NS	NS	*	NS	**
Hand (H)	15	1626	3008	2044	667	1949	1658	1111	795	1058	1503
	60	1529	3675	1542	591	1796	1440	1314	482	957	1377
Level of Significance		NS	NS	NS	NS	NS	NS	NS	*	NS	NS
Diff+ (D=H-M)	15	1471	2278	1759	626	1646	810	380	558	593	1120
	60	1062	1857	896	315	994	511	500	171	374	684
Level of significance		*	*	**	*	*	NS	NS	*	NS	*
		%									
Ratio++ (D/H)	15	88	74	86	93	85	45	33	70	60	73
	60	68	45	58	52	53	33	34	34	38	46
Level of significance		*	**	*	**	*	*	NS	**	*	*

* = Significance at P < 0.05
** = Significance at P < 0.01

\+ Diff = amount of available (hand-harvested) grass not harvested by machine.
++ Ratio = percentage of available grass (hand-harvested) not harvested by machine.

the change in plant configuration that accounts for the higher yields reported in the literature, justifying the adoption of wide row spacings in semi-arid environments.

LITERATURE CITED

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