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Project 1105-1 Evaluation of Kura Clover in Ontario

Final Report to:

Ontario Forage Council

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Contents

1. Trial # 1 - Comparison of kura clover and white clover in grass-legume mixtures

This trial was conducted at 4 locations: Emo and Thunder Bay in northwestern Ontario, New Liskeard in northeastern Ontario, and Winchester in southeastern Ontario. These sites were chosen to test the winterhardiness of the treatments under conditions of severe cold in the north and frequent icing in the south. Various grasses were sown in mixtures with kura clover or white clover (Table 1) and the forage yield and composition was measured for 3 or 4 growing seasons following establishment. In addition, forage quality data was collected from the New Liskeard and Emo sites.

All field experiments were sown as a randomized complete block design in a split plot arrangement with four replicates. The main plots were species of grass and the subplots were species of clover. The seeding rates of kura clover and white clover were adjusted to give approximately equal number of seeds per plot. Grass seeding rates in white clover mixtures were based on OMAFRA recommendations, while seeding rates in kura clover mixtures were determined based on earlier studies and an estimate of the competitiveness of the grass. Data was analysed using MSTAT-C and consisted of analysis of variance within harvests and over harvests at each location.

Table 1. Treatments used in kura clover - white clover comparison test.

Mixtures	Varieties	Seeding Rates (kg/ha)
Orchardgrass - kura clover	Kay - Endura	4 + 10
Orchardgrass - white Clover	Kay - Osceola	9 + 2
Smooth brome - kura clover	Baylor - Endura	6 + 10
Smooth brome - white clover	Baylor - Osceola	10 + 2
Reed canary - kura clover	Venture - Endura	10 + 6
Reed canary - white clover	Venture - Osceola	8 + 2
Grass mix - kura clover	All grasses above - Endura	2 + 4 + 4 + 10
Grass mix - white clover	All grasses above - Osceola	2 + 4 + 4 + 2

Results: Forage Yield

New Liskeard: Results at New Liskeard were different from the other sites in that kura clover outproduced white clover mixtures in every year, including the first production year (Table 2). The catch of kura clover at New Liskeard was exceptional as compared to previous seedings (in 1993 and 1994) which were much slower to establish. Overall forage yields at New Liskeard were excellent and were relatively constant over the 4 harvest years. The legume content of the mixtures was always higher for kura clover than for white clover. The kura content was relatively constant over the 4 years, while the white clover content declined dramatically between years 1 and 2, and then increased somewhat in years 3 and 4, but ended at only ½ of the amount that was present in year 1. No difference in total yield occurred among the 4 grass mixtures,

although the orchardgrass mixtures and the 3-grass mixtures usually had the lowest legume content.

Table 2: Forage yield (kg DM/ha) and clover content (%) of mixtures at New Liskeard.

Factor	Yield Year1	Yield Year 2	Yield Year 3	Yield Year 4	Clover Year 1	Clover Year 2	Clover Year 3	Clover Year 4
A)Grass								
Orchard	8154	8616	8561	9007	45%	37%	44%	31%
Brome	8370	8596	8411	8132	70	47	57	58
Reed Canary	9141	8413	8115	8124	48	39	66	50
Mixture	8776	9680	9053	8870	43	37	47	40
Sig.	ns	ns	ns	ns	***	*	**	*
B) Legume								
Kura	9606	11535	9748	10345	62	69	81	68
White Clover	7615	6118	7322	6721	41	11	26	21
Sig.	***	***	***	***	***	***	***	***
C) Interaction								
Orchard-Kura	9014	10843	10640	10332	58	71	66	49
Orchard-White	7295	6389	6482	5912	32	2	22	13
Brome-Kura	10088	11971	8663	9849	77	77	93	81
Brome-White	6652	5220	8159	6400	64	17	20	34
Reed-Kura	9707	11247	9324	10437	58	65	90	86
Reed-White	8575	5579	6907	7577	38	13	42	14
Mixture-Kura	9614	12077	10365	10743	56	62	73	56
Mixture-White	7937	7282	7741	6997	31	12	22	24
Sig.	*	ns	ns	ns	ns	ns	ns	*
Mean	8610	8826	8535	8533	52	40	53	45
CV (%)	8.5	17.2	6.9	9.8	15	18	22	27

Winchester Results: The results from Winchester demonstrate the strength and also potential problems with kura clover. In year 1, white clover mixtures outyielded kura clover mixtures and also had significantly higher legume content (Table 3). However, in year 2, severe winterkill had eliminated the white clover from the stand and also killed out much of the orchardgrass, resulting in increased yield and legume content for the kura clover mixtures. In year 3, the white clover re-established but was still much lower yielding than the kura clover mixtures. The difference in yield between year 1 and 2 demonstrates the excellent winter survival of kura clover. However, notes indicate that in year 2 the orchard-kura clover mixtures were pure kura clover, since the orchard had killed out over the winter. In a grazing situation, this would result in a very high risk of bloat. In year 1 at Winchester, reed canary mixtures were lowest yielding, but following the difficult winter, reed canary and smooth brome mixtures were higher yielding than orchardgrass mixtures.

Table 3. Forage yield (kg DM/ha) and legume content (%) of mixtures at Winchester.

Factor	Yield Year1	Yield Year 2	Yield Year 3	Clover Year 1	Clover Year 2	Clover Year 3
A)Grass						n/a
Orchard	12268	1127	5758	20%	46%	
Brome	11606	2471	6139	29	25	
Reed Canary	10001	2389	6884	73	35	
Mixture	12068	1934	5887	27	33	
Sig.	*	*	ns	***	**	
B) Legume						
Kura	10749	2428	7850	29	69	
White Clover	12222	1533	4483	45	0	
Sig.	*	***	***	***	**	
C) Interaction						
Orchard-Kura	11510	1582	7797	14	91	
Orchard-White	13025	671	3719	26	0	
Brome-Kura	10882	3047	8180	24	50	
Brome-White	12331	1896	4098	34	0	
Reed-Kura	10072	2974	8479	61	70	
Reed-White	9930	1805	5289	84	0	
Mixture-Kura	10531	2111	6946	16	65	
Mixture-White	13604	1758	4827	38	0	
Sig.	ns	ns	ns	ns	***	
Mean	11486	1980	6167	37	34.5	
CV (%)	10.4	24.4	19.5	26.0	19.8	

Thunder Bay Results: In year 1 at Thunder Bay, white clover mixtures were significantly higher yielding than kura clover mixtures although the kura clover mixtures had a higher legume content (Table 4). In years 2 to 4, kura clover mixtures were always significantly higher in yield than white clover mixtures and also always had higher legume content in the mixtures. Yield differences among grass mixtures occurred only in year 1, when orchard mixtures were higher yielding. In years 3 and 4, legume content was higher in smooth brome mixtures than in orchardgrass mixtures.

Table 4. Forage yield (kg DM/ha) and legume content (%) of mixtures at Thunder Bay.

Factor	Yield Year1	Yield Year 2	Yield Year 3	Yield Year 4	Clover Year 1	Clover Year 2	Clover Year 3	Clover Year 4
A)Grass								
Orchard	3398	3589	3953	3154	21	29	40	35
Brome	1862	3771	4453	3547	22	35	50	56
Reed Canary	2115	3169	4092	3151	19	32	42	48
Mixture	2313	3493	4302	3664	22	33	45	41
Sig.	**	ns	ns	ns	ns	ns	**	***
B) Legume								
Kura	2202	4387	6234	4740	34	56	80	66
White Clover	2642	2624	2166	2018	8	8	8	24
Sig.	**	***	***	***	***	***	***	***
C) Interaction								
Orchard-Kura	2983	4421	6100	4714	16	52	75	54
Orchard-White	3814	2757	1806	1593	6	5	5	16
Brome-Kura	1729	4826	6705	5068	21	62	89	85
Brome-White	1994	2714	2202	2025	5	8	11	26
Reed-Kura	1757	3873	5688	4233	22	51	79	68
Reed-White	2474	2464	2496	2070	8	12	6	27
Mixture-Kura	2340	4427	6445	4945	14	58	79	56
Mixture-White	2285	2560	2159	2383	6	9	11	26
Sig.	ns	ns	ns	ns	ns	ns	ns	ns
Mean	2422	3506	4200	3379	12	22	44	45
CV (%)	16.0	12.3	12.7	13.7	43.6	27.0	8.9	25.1

Emo Results: The 1997 seeding in Emo was not successful, so the test was re-seeded in 1998 and harvested in 1999 to 2001. In year 1, white clover mixtures were higher yielding than kura clover mixtures and also had a higher legume content (Table 5). However, by year 2, kura clover mixtures were higher in yield than white clover mixtures, while there were no differences in year 3. Legume content was also higher in the kura mixtures in year 2. There were few differences in forage yield among the grass mixtures at Emo.

Table 5. Forage yield (kg DM/ha) and legume content (%) of mixtures at Emo.

Factor	Yield Year1	Yield Year 2	Yield Year 3	Clover Year 1	Clover Year 2	Clover Year 3
A)Grass						n/a
Orchard	3747	6149	6768	35	73	
Brome	3819	5014	6971	35	90	
Reed Canary	3649	5637	6771	34	77	
Mixture	3858	5665	6804	30	76	
Sig.	ns	*	ns	ns	***	
B) Legume						
Kura	2852	5862	6990	28	81	
White Clover	4684	5370	6668	39	77	
Sig.	***	*	ns	***	**	
C) Interaction						
Orchard-Kura	3261	6669	6841	28	76	
Orchard-White	4233	5629	6695	43	70	
Brome-Kura	2589	5242	7033	30	90	
Brome-White	5049	4786	6909	40	90	
Reed-Kura	3094	5698	6788	25	80	
Reed-White	4204	5576	6755	43	74	
Mixture-Kura	2465	5839	7298	28	79	
Mixture-White	5251	5491	6312	33	73	
Sig.	ns	ns	ns	*	ns	
Mean	3768	5616	6829	33	79	
CV (%)	42.0	8.4	26.1	10.1	4.1	

2. Forage Yield Distribution:

The distribution of dry matter yield over the 3 cuts at the northern sites (New Liskeard, Thunder Bay, and Emo) was similar both across locations and between the kura clover and white clover mixtures (Table 6). Overall, from 42% to 53% of the seasonal yield was obtained from the first cut, 25% to 35% on the second cut, and 14% to 27% on the final cut. At Winchester, yield distribution varied among years due to a different number of cuts being taken each year, but little variation in yield distribution occurred between the two legume mixtures. In 1998, 4 cuts were taken with an average distribution of 43%, 12%, 28%, and 19% in cuts 1 to 4 respectively. In 1999, the plots had been damaged by winterkill and only one cut was taken (100% of yield from cut 1). In 2000, three cuts were taken and the yield distribution in cut 1 was higher for white clover mixtures then for kura clover mixtures, with subsequent cuts having a lower proportion of the total yield from white clover mixtures than from kura clover mixtures. The high proportion of total yield in the white clover mixtures in cut 1 is likely related to the high grass content of those mixtures. Grasses typically have a greater proportion of their seasonal yield in spring and early summer than legumes, especially in dry summer conditions. Under

cooler temperatures and more even rainfall distribution (ie: the northern locations), the yield distribution did not vary despite the fact that the kura clover mixtures had a higher legume content than the white clover mixtures.

Table 6. Yield distribution (% of total yield per cut) of kura clover and white clover mixtures at 4 locations.

Location	Legume	Cut 1	Cut 2	Cut 3	Cut 4
New Liskeard (3 year average)	Kura White	46 46	31 30	23 24	n/a
Thunder Bay (3 year average)	Kura White	44 53	35 33	21 14	n/a
Emo (3 year average)	Kura White	49 43	25 31	26 27	n/a
Winchester 1998	Kura White	43 42	8 15	29 26	21 17
Winchester 1999	Kura White	100 100	n/a	n/a	n/a
Winchester 2000	Kura White	59 72	24 14	17 15	n/a

3. Forage Quality

Forage quality samples were collected from the New Liskeard site in 1998, 1999, and 2000, as well as the Emo site in 2000 only. All samples were collected from the second cut, except the 1998 New Liskeard samples which were from the third cut. Samples were analyzed using wet chemistry for crude protein (CP), acid detergent fibre (ADF), and neutral detergent fibre (NDF) by a commercial forage testing lab in Ontario. Total Digestible Nutrient (TDN) content was calculated from ADF using the standard Ontario equation for mixed hay, while Relative Feed Value (RFV) was calculated from ADF and NDF using the standard RFV equations.

Absolute quality values were acceptable but generally poorer than those reported from grazed pastures. Under clipping management, longer rest periods between harvests can lead to more stemmy growth and more senescent material in the sward, which results in reduced quality. Significant differences occurred among sites for all quality parameters (Table 7), although the three years at New Liskeard usually had more similar quality than between New Liskeard and Emo. Orchardgrass mixtures always had the poorest absolute quality and were always significantly poorer than brome mixtures, which had the highest quality. These differences are a reflection of the composition of the mixtures as opposed to differences in the grass species per se. Orchard mixtures consistently had the lowest legume content and brome the highest. Similarly,

kura clover mixtures always had higher quality than white clover mixtures, but this reflects the higher legume component in kura clover mixtures. In practice, this higher quality would have to be weighed against the increased risk of bloat due to pasturing high legume swards.

The location by legume interaction was significant for all quality parameters. The superior quality of kura mixtures as compared to white clover mixtures was evident in all cases, the interactions were related to changes in the magnitude of the difference across locations. Some other interactions occurred but were inconsistent over parameters and have little practical importance.

Table 7. Forage quality of kura clover and white clover mixtures.

Factor	CP (%)	ADF (%)	NDF (%)	TDN (%)	RFV
A) Location					
NL 1998	13.4	26.5	47.1	68.5	136
NL 1999	15.6	34.7	51.1	61.4	117
NL 2000	16.4	34.6	48.8	61.1	120
EM 2000	22.1	36.6	42.0	59.3	135
Sig.	***	***	***	***	***
B) Grass					
Orchard	15.6	34.2	49.8	61.5	118
Brome	18.2	32.0	43.9	63.9	139
Reed Canary	17.1	32.8	46.9	62.8	128
Mixture	16.5	33.3	48.4	62.3	123
Sig.	***	**	***	***	***
C) Legume					
Kura	17.7	32.0	43.1	63.7	139
White	16.0	34.2	51.4	61.5	115
Sig.	***	**	***	***	***
Interactions					
Loc. x Grass	NS	NS	*	NS	**
Loc. x Leg.	***	**	***	***	***
Grass x Leg.	*	NS	NS	NS	NS
Loc. x Grass x Leg.	NS	*	NS	NS	NS
Mean	16.8	33.1	47.2	62.6	127
C.V. (%)	4.7	4.9	4.2	2.0	5.6

Summary of Trial 1: In year 1, white clover mixtures outyielded kura clover mixtures at 3 of 4 sites. However, in all subsequent years, kura clover mixtures outyielded white clover mixtures with one exception, where there was no difference. At the 4th site, kura mixtures outyielded white clover mixtures in all harvest years. Kura mixtures also tended to have a higher legume content in the 2nd and later years. The reason for the superior performance of the kura clover

mixtures at Winchester was almost certainly due to better winter survival. Inspection of the Winchester plots in mid-May of 1999 showed that the orchardgrass and white clover had been virtually wiped out since the previous fall. At New Liskeard, 2 of the 4 years had very dry springs and the kura clover was very clearly more productive under those conditions. Only at Emo, a site with frequent excess moisture, did the white clover mixtures yield comparably with kura clover mixtures after 3 harvest years. In general, kura clover mixtures were also very consistent over time, with the yield in the final year being higher than the yield in year 1 at all sites except Winchester, where the 4th year yield was about 75% of the 1st year yield.

There was no particular grass mixtures that was superior at all sites. Orchardgrass was severely damaged at Winchester in year 2 but had recovered by year 3. At the other sites, yields among grass mixtures were generally similar.

Yield distribution did not vary substantially between kura clover and white clover mixtures. It appears that under good moisture conditions, kura and white clover mixtures will both produce well throughout the growing season.

Forage quality is closely related to the legume content of the mixture. Those with higher legume content have higher crude protein, lower NDF, and higher Relative Feed Value. Absolute quality values were acceptable for all mixtures.

4. Trial 2. Kura Clover Mixtures and Seeding Rates

This trial was designed to examine the compatibility of kura clover with one of three forage grasses: orchard, smooth brome, or reed canarygrass. In addition, two grass seeding rates and 3 kura clover seeding rates were examined (Table 8). This trial was conducted in New Liskeard and Kemptville. The field layout was a randomized complete block design with a split-split plot arrangement. Main plots were companion grass species, subplots were grass seeding rates, and sub-subplots were kura clover seeding rates. Both tests were seeded in 1997. Forage yield data was collected along with species composition data in the first two years.

Table 8. Treatments in kura clover mixtures and seeding rates trial.

Factor	Details
A) Companion Grass	
Orchard	Variety Kay
Brome	Variety Baylor
Reed Canary	Variety Venture
B) Grass Seeding Rate	
Low	Kay 2 vs 4 kg/ha
High	Baylor 3 vs 6 kg/ha
	Venture 3 vs 6 kg/ha
C) Kura Seeding Rate	Variety Endura
Low	4 kg/ha
Medium	8 kg/ha
High	12 kg/ha

New Liskeard Results: Kura clover seeding rate significantly affected forage yields in the first two years after seeding (Table 8). In both years, seeding rates of 8 and 12 kg/ha outyielded the 4 kg/ha rate. By year 3 this effect was no longer evident, likely due to the kura clover in the 4 kg/ha plots filling in bare spots in the plots and thus having a higher forage yield. The percentage of clover in the plots was also lower in the 4kg/ha plots in years 1 and 2. Data on sward composition is not available for years 3 and 4. There was no significant effect of grass species or grass seeding rate on forage yield in any year. Brome mixtures tended to have higher legume content than the orchard or reed canary mixtures, but this was only significant in year 2. Higher level interactions were all non-significant except for the AxB interaction in year 3.

Table 9. Effect of grass species, grass seeding rate, and kura clover seeding rate on forage yield (kg DM/ha) and composition of mixtures (%) at New Liskeard.

	Yield Year 1	Yield Year 2	Yield Year 3	Yield Year 4	Clover Year 1	Clover Year 2	Clover Year 3
A) Grass							
Orchard	7139	10338	10025	9052	28	67	51
Brome	7296	10817	10066	9498	43	82	77
Reed Canary	8037	10375	10094	9309	29	71	76
Sig.	ns	ns	ns	ns	ns	*	**
B) Grass Rate							
Low	7491	10255	9975	9118	36	74	68
High	7491	10799	10148	9455	31	73	68
Sig.	ns	ns	ns	ns	ns	ns	ns
C) Kura Rate							
4 kg/ha	6834	9812	10086	8993	27	69	65
8 kg/ha	7801	10777	10217	9635	32	74	69
12 kg/ha	7837	10992	9887	9231	41	78	70
Sig.	***	***	ns	ns	*	***	*
Interactions							
AxB	ns	ns	*	ns	ns	ns	ns
AxC	ns	ns	ns	ns	ns	ns	ns
BxC	ns	ns	ns	ns	ns	ns	ns
AxBxC	ns	ns	ns	ns	ns	ns	ns
Mean	7490	10527	10061	9286	69	74	68
CV (%)	8.6	9.1	14.3	10.6	15.7	10.3	10.2

Kemptville Results: Kura clover seeding rate had a significant effect on forage yield in year 1, with higher seeding rates resulting in higher yields (Table 10). In year 1, brome and orchard mixtures outyielded reed canary mixtures, but in years 2 and 3 orchard mixtures were lowest in yield as a result of severe orchard winterkill after the first year. The composition data shows that the orchard mixtures were almost pure legume in year 2 and 3. The other mixtures also increased

dramatically in legume content, but not to the extent that the orchard mixtures did. The overall increase in legume content in brome and reed canary mixtures likely reflects the increasing vigour of kura clover rather than winter damage to the grasses, since these particular species are known to be extremely winter hardy. Grass seeding rate had no effect on forage yield.

Table 10. Effect of grass species, grass seeding rate, and kura clover seeding rate on yield and composition of mixtures at Kemptville.

	Yield Year 1	Yield Year 2	Yield Year 3	Yield Year 4	Clover Year 1	Clover Year 2	Clover Year 3
A) Grass							
Orchard	9787	5155	4885		33	100	97
Brome	10149	7020	6576		46	61	74
Reed Canary	9145	6696	5887		55	75	88
Sig.	*	**	*		ns	***	**
B) Grass Rate							
Low	9774	6330	5706		48	79	86
High	9614	6251	5859		41	78	87
Sig.	ns	ns	ns		**	ns	ns
C) Kura Rate							
4 kg/ha	8862	6136	5745		31	77	87
8 kg/ha	9702	6320	5858		47	79	87
12 kg/ha	10517	6415	5845		56	80	86
Sig.	*	ns	ns		***	*	ns
Interactions							
AxB	ns	ns	ns		*	ns	ns
AxC	ns	ns	ns		ns	ns	ns
BxC	ns	ns	ns		ns	*	ns
AxBxC	ns	ns	ns		ns	*	ns
Mean	9694	6290	5783		45	79	86.5
CV (%)	9.1	9.7	15.6		32	5.2	5.5

Summary of Trial 2: At both locations, increased kura clover seeding rates resulted in higher forage yields, but only in the first one or two years of the stand. By year 3 no yield differences could be attributed to kura clover seeding rate. Grass species only affected forage yield when orchard grass suffered severe winter kill. However, at both locations, the legume content of the mixtures increased dramatically after year 1. This is of concern, since the legume content of these mixtures was sufficient to be a serious bloat risk to grazing livestock.

5. Trial 3:

Trial 3 involved applying sheep grazing pressure to plots of both kura clover and white clover mixtures. The test was established in 1998. Notes indicated that the establishment was slow. Treatments were similar to Trial 1 (Table 1) with the exception that Alice white clover was used instead of Osceola white clover. Previous experience at New Liskeard has shown that Alice is more persistent than Osceola. The entire test area was grazed at the same time for a period of 3 to 4 days, followed by a sufficient rest period for the plots to regrow to a height of 15 to 25 cm. The test was grazed 3 times per year during 1999 and 2000, and was clipped once in 2001 prior to yield data being collected in August.

Table 11. Yield and composition of kura clover and white clover mixtures following 2 years of sheep grazing at New Liskeard.

	DM Yield	% Legume	% Grass	% Dead	% Weed
A)Grass					
Orchard	1610	15	75	8	2
Brome	1581	52	37	16	6
Reed Canary	1691	39	46	13	2
Mixture	1650	20	68	9	2
Sig.	ns	***	***	ns	*
B) Legume					
Kura	1973	45	48	5	3
White Clover	1293	18	60	18	4
Sig.	***	***	***	***	*
C) Interaction					
Orchard-Kura	1692	23	70	5	2
Orchard-White	1527	6	79	11	3
Brome-Kura	2016	70	20	6	4
Brome-White	1146	35	33	26	7
Reed-Kura	2111	57	36	5	2
Reed-White	1272	21	56	20	3
Mixture-Kura	2074	29	65	4	2
Mixture-White	1225	11	71	15	3
Sig.	**	**	ns	*	ns
Mean	1633	31.5	54	12	3
CV (%)	7.6	14.5	12.1	32.6	40.1

Results were similar to Trial 1. The kura clover-grass mixtures significantly outyielded the white-clover grass mixtures (Table 11). No difference in yield occurred among the different grass mixtures. There was however, a significant interaction between grass species and legume species. This was due to a lack of response in yield between orchard-kura and orchard-white clover, while for all other grasses, kura mixtures outyielded white clover mixtures. The legume

content of the orchard mixtures was lower than for the other grasses, thus the legume had little impact on forage yield. Significant differences occurred in mixture composition, with kura mixtures having higher legume content, lower grass content, lower dead tissue content, and lower weed content as compared to white clover mixtures (Table 10). Legume content was highest in brome mixtures, intermediate in reed canary mixtures, and lowest in orchard and mixed grass mixtures. Bromegrass mixtures had higher weed content than the other mixtures.

Summary of Trial 3: Kura clover response to grazing was similar to cutting management. Kura clover mixtures outyielded white clover mixtures and had higher legume component following two years of sheep grazing. Given that a more persistent variety of white clover was used in the grazing trial, we can be fairly certain of the adaptation of kura clover at this site.

6. Conclusions:

From this series of trials we can draw the following conclusions:

1) Kura clover appears to be well adapted to a range of environments within Ontario.

2) Kura clover is more winter hardy than some other common forage species such as white clover and orchardgrass, as demonstrated by trials at Winchester and Kemptville.

3) Kura clover mixtures produce dry matter yields at least equal to and often greater than white clover mixtures over a range of locations. The forage yield advantage to kura clover mixtures tends to increase with stand age.

4) Kura clover is well adapted to grazing, and will outyield white clover mixtures under grazing.

5) Kura clover can be mixed successfully with orchardgrass, bromegrass, or reed canarygrass, as well as in complex mixtures with several grasses. Legume content is typically lowest in orchardgrass mixtures except following severe winters. Reed canarygrass and bromegrass did not increase in stand contribution as the stands aged.

6) Seeding rates of 8 kg/ha of kura clover appear to optimize the forage yield of kura clover mixtures in the first two years, however in subsequent years lower seeding rates appear to be equally effective. Within the normal range, grass seeding rates do not appear to have a significant influence on subsequent forage yield of kura clover grass mixtures.