ALFALFA SEED PRODUCTION IN THE PEACE RIVER REGION

UPDATE 1989

PEACE BRANCH
ALBERTA ALFALFA SEED
PRODUCERS' ASSOCIATION

CONTINUING EDUCATION
FAIRVIEW
COLLEGE

ALFALFA SEED PRODUCTION IN THE PEACE RIVER REGION

UPDATE 1989

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CONTENTS

PREFACE

The Annual Alfalfa Seed Production Seminar organized by the Peace River Branch of the Alberta Alfalfa Seed Producers' Association and Fairview College provides a unique forum for discussion among all participants of the alfalfa seed industry in the Peace River region. This publication contains some of the subjects that have been discussed at the 9th Annual Seminar. It is by no means a complete treatise on either alfalfa seed production or the proceedings of the seminar. It does however, highlight some areas of interest, and hopefully will give the reader some insight into the alfalfa seed industry in the Peace River region.

D.T. Fairey
Scientific Advisor
Peace Branch
Alberta Alfalfa Seed
Producers' Association

RECOMMENDED FORAGE CROP VARIETIES FOR 1989

B.P. Goplen*

NOTE:

Although a variety is recommended in a province or a region, it may not be adapted to a local area. Check your provincial recommendation for details.

RECOMMENDED FORAGE CROP VARIETIES

	Canadian distributor	Year Registered	B.C.	Alta.	Sask.	Man.	Ont.	Que	Atlantic
LEGUMES									
ALFALFA									
Admiral	32	1985	*	*			*		
Advance	32						*		
Algonquin	36	1973	*	*	*	*	*		*
Alouette	32	1986	*				*	*	
Ambassador	32	1986	*				*	*	
Anchor	31	1972	*	*	*	*	*	*	*
Angus			*	*		*	*	*	*
Anik	6	1975	*	*					
Apica	44,9,3	1982	*	*	*	*	*	*	*
Apollo II	30	1985	*				*		
Armor	31	1985	*				*	*	
Arrow	32	1986	*				*		
Award	42	1986		*			*		
Barrier	40	1986	*	*	*				
Beaver	36	1961	*	*	*	*			
Bell Ringer	21						*		
Blazer	31	1984					*	*	
Centurion	44	1987					*		
Chief	19	1988					*		

* Agriculture Canada, Saskatoon, Saskatchewan

	Canadian distributor	Year Registered	B.C.	Alta.	Sask.	Man.	Ont.	Que	Atlantic
Citation	27	1977		*		*	*	*	*
Classic	44	1979					*		
Comsel	42						*		
Crown	49	1988					*		
Crusader	21	1987					*		
DK-125	11	1987					*		
DK-135	11	1985					*	*	
Drylander	40	1971	*	*	*				
Eagle	26	1986					*		
Edge	12	1987					*		
Excalibur	44	1984	*				*		
G-2852	14	1987					*		
Glory	42	1982				*	*		
Heinrichs	40	1981	*	*	*				
Hunter	32	1982				*	*		
Husky	31	1986					*		
Iroquois	36	1968					*	*	*
Magnum	14	1978					*		
Magnum +	14						*		
Maxim	32	1987	*						
Mohawk	43,47,48	1987					*	*	
Noble	44	1986					*		
OAC Minto	4,41,42	1983				*	*	*	
Olinda	40	1986					*		
Oneida VR	32	1986					*	*	
Pacer	4,15,31	1977	*	*		*		*	*
Peace	40	1980	*	*					
Peak	30	1983				*	*		
Pinnacle	17						*		
Preserve	29	1984					*		
Primal	21	1978		*			*		
Rambler	7	1955	*	*	*	*			
Rangelander	40	1978	*	*	*	*			
Regal	44	1982					*		
Riel	32	1986						*	

	Canadian distributor	Year Registered	B.C.	Alta.	Sask.	Man.	Ont.	Que	Atlantic
Roamer	39	1966	*	*	*	*			
Saranac	36	1966	*			*	*	*	*
Shield	38						*		
Spectrum	23,24,17	1984					*	*	
Spredor 2	29	1983	*	*		*			
Sure	29						*		
Surpass	31	1988					*		
Thor	29,41	1972	*	*			*	*	*
Thunder	30	1985					*	*	
Tomahawk	42						*		
Trek	40	1975	*	*					
Trumpetor	29	1982	*	*		*	*		
Turbo	32	1983				*	**		
Ultra	17	1988					*		
Valor	38	1976				*	*		
Vernal	36	1954	*	*	*		*		
Verta +	42	1988					*		
Vertus	31	1986	*						
Vista	32	1977		*		*	*		
WL222	21,42	1985					*		
WL316	21,41,42	1984	*				*	*	
88	27,32	1985					*	*	
120	11	1979		*	*		*	*	*
524	34	1980	*						
526	34	1983					*	*	
532	34	1981		*			*	*	*
BIRD'S-FOOT TREFOIL									
Cree	40	1979	*	*	*	*			
Empire	36	1951				*	*	*	*
Leo	36	1963	*	*	*	*	*	*	*
Maitland	27,32	1969					*		
Mirabel	23	1976	*				*		
Upstart	32	1986					*	*	
Viking	36	1956					*	*	*
CICER MILKVETCH									
Oxley	35	1971	*	*					

	Canadian distributor	Year Registered	B.C.	Alta.	Sask.	Man.	Ont.	Que	Atlantic
CLOVER, ALSIKE									
Aurora	7	1961	*	*	S				
Dawn	32	1974	*	*	S				
Tetra	31	1968	*	*					
CLOVER, RED									
Arlington (D.C.)	36	1979	*				*	*	*
Altaswede (S.C.)	36,50	1923	*	*	S				*
Atlas (D.C.)	29	1988						*	
Florex (D.C.)	27,29,32	1977		*			*	*	*
Hungaropoly (D.C.)	23	1988							*
Jubllatka (D.C.)									*
Lakeland (D.C.)	36	1964					*	*	*
Marino (D.C.)	32	1986							*
Norlac	35			*	S				
Ottawa (D.C.)	36	1936	*				*	*	
Pacific (D.C.)	37	1976	*						
Persist (D.C.)	29						*	*	
Prosper I (D.C.)	21,41	1978					*	*	*
Tapiology (D.C.)									*
Tristan (D.C.)	9,31	1982						*	*
Violetta R.v.P. (D.C.)	31	1983							*
CLOVER, SWEET									
Norgold	40	1981	*	*	*	*			
Yukon	7	1970	*	*	*	*			

	Canadian distributor	Year Registered	B.C.	Alta.	Sask.	Man.	Ont.	Que	Atlantic
CLOVER, WHITE									
California Ladino	9,13		*				*	*	
Grasslands Hula	36	1923	*						
Merit	36	1966	*				*	*	
Sacramento	43	1982					*	*	
CROWN VETCH									
Chemung		1972					T		
Penngift	31,32	1970	R				T		
SAINFOIN									
Melrose	40	1969	*	*	*				
Nova	40	1980	*	*	*				

	Canadian distributor	Year Registered	B.C.	Alta.	Sask.	Man.	Ont.	Que	Atlantic
GRASSES									
BLUEGRASS, CANADA									
Canon	32	1966	R			R	T		
Reubens	1	1980	R	T		R	T		R
BLUEGRASS, KENTUCKY									
A34	32	1984	T	T		T	T		
Adelphi	38	1979	T	T		T	T		T
America	32	1982	T	T			T		
Argyle	38	1986		T					
Banff	32,43	1974	T,R	T			T		
Baron	31	1971	T	T		T	T		T
Bristol	18	1978	T	T		T	T		
Chen	32	1974	T	T		T	T		
Dormie	32,28	1977	R	T	T		T		
Eclipse	38	1984	T	T		T	T		
Enmundi	38	1979	T	T		T	T		T
Fylking	32	1966		T		T	T		T
Georgetown	10	1986	T	T			T		
Geronimo	37	1978	T	T		T	T		
Glade	38	1981	T	T		T	T		
Gnome	31	186	T						
Haga	31	1981	T	T			T		
Harmony	38	1985		T			T		
Majestic	31	1978	T	T			T		
Merion		1952	T	T					T
Midnight	31,38	1985	T	T		T			
Mystic	37	1983	T			T	T		
Nassau	31	1986	T	T					
Nugget	32	1970	T,R	T	T	T	T		T
Park		1959	T	T			T		
Plush	44	1981		T			T		
Ram I	32	1979	T	T		T	T		
Regent				T					
Sydsport	31	1970	T	T		T	T		T
Touchdown	32	1975	T	T	T	T	T		T

	Canadian distributor	Year Registered	B.C.	Alta.	Sask.	Man.	Ont.	Que	Atlantic
Trampas	6	1986	T			T			
Troy	37	1972	*	*		*			
Victa	18	1975	T	T			T		
Welcome	38	1984		T		T	T		
BLUEGRASS, ROUGH									
Sabre	6,38	1981	T,R	T			T		
BROMEGRASS, MEADOW									
Fleet	40	1987			*				
Paddock	28	1987			*				
Regar	36	1980	*	*	*				
BROMEGRASS, SMOOTH									
Baylor	31	1969	*	*	*		*	*	
Beacon	9,31,44	1976					*	*	
Blair	27	1977					*		
Bravo	32	1983					*	*	
Carlton	7	1961	*	*	*	*			
Magna	28	1968	*	*	*	*			
Manchar	36	1958	*	*					
Saratoga	36	1966				*	*	*	
Signal	39	1983			*				
Tempo	27,32	1975					*	*	*
BROMEGRASS, SWEET									
Deborah	6	1986	*						
CANARYGRASS, REED									
Castor	32	1973	*	*					
Grove		1970	*						
Palaton	25		*		*		*		
Raval	5	1985	*						
Vantage	31	1981	*	*	*		*	*	*
Venture	25	1987	*				*		

	Canadian distributor	Year Registered	B.C.	Alta.	Sask.	Man.	Ont.	Que	Atlantic
FESCUE, CHEWING'S									
Agram	32	1981	T	T		T			
Banner	31	1980	T	T		T	T		
Barfalla	38	1980		T		T	T		
Highlight	31	1969	T	T		T	T		T
Jamestown	32	1972	T	T		T	T		T
Koket	37,38	1973	T	T		T	T		
Luster	38	1985	T			T			
Menuet	25	1975	T						
FESCUE, CREEPING RED									
Boreal	7	1966	*	T	*	T			
Dawson	31	1970	T	T			T		
Durlawn		1971		T			T		
Ensylva	38	1983	T,R	T			T		
Fortress	31	1981	T,R,	T			T		
Pennlawn		1958	T	T			T		T
Reptans	31	1968	*	*					
FESCUE, HARD									
Biljart	18	1973	T	T		T	T		
Durar				R					
Reliant	24	1986	T	T			T		
Tournament	32	1981		T		T	T		
FESCUE, MEADOW									
Beaumont	2	1982				T,R	T		
Ensign	45	1944				*			
Trader	31	1964		*		*			*
FESCUE, TALL									
Alta	36	1956	*	*					
Barcel	37	1988	*						
Courtenay	10	1987	*						
Johnstone			*						*
Kenhy	43	1984							*
Mustang	32	1985	T				T		
Rebel	31	1985	T	T			T		

	Canadian distributor	Year Registered	B.C.	Alta.	Sask.	Man.	Ont.	Que	Atlantic
FOXTAIL, MEADOW									
Dan	31	1986					*		
ORCHARDGRASS									
Amba	6	1986	*						
Chinook	36	1959	*	*					
Dactus	6	1987	*						
Frode	27,36	1959	*				*	*	
Hallmark	44	1972	*				*		
Ina	32	1972			*		*		
Juno	27,32	1973					*		*
Kay	31,37	1970	*	*	*	*	*	*	*
Mobite	10	1987	*						
Napier	31	1976	*				*		
Pennlate	36	1972	*				*		
Potomac	6	1986	*						
Prairial	37	1983	*						
Rancho	44	1987					*		
Sterling	36	1969	*						
Sumas	6,37,31	1974	*				*	*	
RED TOP									
Reton				T			T		
RYEGRASS, ITALIAN									
Aubade	23,24,25	1982	*					*	*
Barmultra	32	1981	*					*	*
Barspectra	27,32	1983						*	*
Bartolini	32	1985						*	*
Lemtal R.V.P.	31	1973	*					*	*
Maris Ledger	31	1979	*					*	*
Marshall	7,14	1985							*
Promenade	25	1979							*

	Canadian distributor	Year Registered	B.C.	Alta.	Sask.	Man.	Ont.	Que	Atlantic
RYEGRASS, PERENNIAL									
Allstar				T					
Barlano	37	1984	*						
Barry	31	1984	T			T	T		
Bastion	31	1986	*						
Belfort			*						
Blazer	32	1980	T	T		T	T		T
Bonita			*						
Citadel	6	1986	*						
Condesa			*						
Crown	37	1986	T						
Bounty	24,23	1966	*	*			*		
Derby	6,38	1979	T	T					
Diplomat	38	1981	T	T			T		
Elka	37	1984	T	T					
Ensilo	6	1983	*						
Fantoom	37	1986	*						
Fiesta	32	1980	T	T			T		
Frances	6	1986	*						
Gator						T			
Loretta	18	1980	T				T		
Manhattan II	6	1986	T			T			
Melle	31	1986	*						
Norlea	31	1958							*
Palmer	32	1985	T	T			T		
Pennant	38	1984	T	T			T		
Prelude	24	1986	T	T			T		
Repell	10	1986	T	T		T			
Tove	6	1988					T		
Yorktown II	31	1981	T	T		T	T		
TIMOTHY									
Alexander	42	1987					*		
Basho	40	1974	*	S	*		*	*	*
Bottnia II	16	1985	*	*					

	Canadian distributor	Year Registered	B.C.	Alta.	Sask.	Man.	Ont.	Que	Atlantic
Bounty	24,23	1966	*	*			*		
Champ	36	1967	*	*	S	*	*	*	*
Clair	36	1971							*
Climax	36	1947	*	*	S	*	*	*	*
Drummond	32	1940							*
Farol	31	1985	*						*
Hokuo	25,9	1982					*		
Itasca	44,9	1972		*		*	*	*	*
Mariposa	9,32	1984					*	*	
Richmond	27,32	1976	*	*			*	*	*
Salvo	40	1980	*				*	*	*
Tiiti	16	1985	*	*					
Timfor	29	1975	*	*		*	*	*	*
Toro	31,41	1972	*	*			*	*	*
Winmor	29	1984					*		
WHEATGRASS, BEARDLESS									
Whitmar	36	1983	*						
WHEATGRASS, CRESTED									
Fairway	36	1932	*	T	*	*			
Kirk	40	1987			*				
Nordan	36	1958	*	*	*	*			
Parkway	40	1969	*	R	*	*			
Summit	40	1953	*	*	*				
WHEATGRASS, INTERMEDIATE									
Chief	28	1961	*	*	*	*			
Clarke	40	1980	*	*	*				
Greenleaf (Pubescent)	40	1966	*	*	*				

	Canadian distributor	Year Registered	B.C.	Alta.	Sask.	Man.	Ont.	Que	Atlantic
WHEATGRASS, NORTHERN									
Elbee	40	1980		*					
WHEATGRASS, SLENDER									
Revenue	40	1970	*	*	*	*			
WHEATGRASS, STREAMBANK									
Sodar	36	1959	*	T,R,	*				
WHEATGRASS, TALL									
Orbit	40	1966	*	*	*	*			
WHEATGRASS, WESTERN									
Walsh	35	1982	*	*					
WILD RYEGRASS, ALTAI									
Prairieland	7	1976	*	*	*				
WILD RYEGRASS, RUSSIAN									
Cabree	20	1976		*	*				
Mayak	7	1971		*	*				
Swift	40	1978		*	*	*			
Tetracan		1988			*				
ANNUALS									
FORAGE KALE									
Gruner Angeliter	24	1976							*
Maris Kestral	36	1969							*
FORAGE RAPE									
Barcoli									*

	Canadian distributor	Year Registered	B.C.	Alta.	Sask.	Man.	Ont.	Que	Atlantic
SORGHUM-SUDANGRASS									
Funk 83F	8,9	1973						*	
Sudax St-6B	11	1981						*	
877F	34	1985		*					
988	34	1970						*	
SUDANGRASS									
Piper		1960					*		

S: Recommended primarily for seed production
D.C.: Double cut
S.C.: Single cut
T: Turf or lawn type
R: Roadsides or land reclamation

CODED LIST OF CANADIAN DISTRIBUTORS

1 Aimers Seeds Ltd., R.R. #1, King, Ontario L0G 1K0
2 Albion Seeds, Box 492, Bolton, Ontario L0P 1A0
3 Atlantic Coop
4 Bishop Seeds Ltd., Box 338, Belleville, Ontario K8N 5A5
5 Brett-Young Seeds Ltd., Box 99, St. Norbert Sta., Winnipeg, Manitoba R3V 1L5
6 Buckerfield's Ltd., P.O. Box 1030, Abbotsford, British Columbia V2S 5B5
7 Canadian Forage Seed Project, Seed Division, Plant Health and Plant Products Division, Ottawa, Ontario K1A 0C6
8 Ciba-Geigy, Box 29, Hyde Park, Ontario N0M 1Z0
9 Cooperative Federee de Quebec, 1055 Rue du Marche-Central, Montreal, Que. H2P 2W2
10 Dawson Seed Co., P.O. Box 1204, West Vancouver, British Columbia V7V 3N6
11 DeKalb Canada Inc., P.O. Box 430, Chatham, Ontario N7M 5K5
12 First Line Seeds, R.R. #2, Guelph, Ontario N1H 6H8
13 Frank Nemec Agricultural Consultants
14 Funk Seeds, Box 29, Hyde Park, Ontario N0M 1Z0
15 General Seeds
16 Henri Malon Ltd., 15 Woodland Hts., Toronto, Ontario M6S 2W3
17 Hyland Seeds
18 ITT Canada
19 Jacques Canada Ltd., P.O. Box 100, Emeryville, Ontario N0R 1C0
20 Ken Long Seeds Ltd.
21 King Agro Ltd.
22 King Grain Ltd., P.O. Box 1088, Chatham, Ontario N7M 5L6
23 Labon Inc., 1350 Newton, Boucherville, Quebec J4B 5H2
24 Labonte Seed Ltd., P.O. Box 1660, New Liskeard, Ontario P0J 1P0
25 Landis Seed Canada Ltd., P.O. Box 217, Lindsay, Ontario K9V 4S1
26 Maple Leaf Mills Ltd., P.O. Box 490, Chatham, Ontario N7M 5K6
27 Mapleseed Inc., R.R. #2, Oakwood, Ontario K0M 2M0
28 Newfield Seeds Ltd., Box 100, Nipawin, Saskatchewan S0E 1E0
29 Northrup King Seeds Ltd., P.O. Box 20, Fort Saskatchewan, Alberta T8L 3T2
30 Oseco Farm Seed Centre, 75 Cardigan Street, Guelph, Ontario N1H 3Z7
31 Oseco Inc., P.O. Box 219, Brampton, Ontario L6V 2L2
32 Otto Pick and Sons Seeds Ltd., Box 126, Richmond Hill, Ontario L4C 4X9
33 PAG Seeds, Box 490, Princeton, Ontario N0J 1V0
34 Pioneer Hi-bred Ltd., Box 730, Chatham, Ontario N7M 5L1
35 Prairie Seeds Ltd., Edmonton, Alberta
36 Public
37 Richardson Seed Company Ltd., 4055 McConnell Drive, Burnaby, B.C. V5A 3A7
38 Rothwell Seeds Ltd., P.O. Box 511, Lindsay, Ontario K9V 4S5
39 Saskatchewan Wheat Pool
40 SeCan Association, 512-885 Meadowlands Drive, Ottawa, Ontario K2C 3N2
41 Semico Inc., 35, boul. Laurier, Ste-Rosalie, Que. J0H 1Y0
42 Speare Seeds, Box 171, Harriston, Ontario N0G 1Z0
43 Tib Szego Associates Ltd., Box 366, Lindsay, Ontario K9V 4S3
44 United Cooperatives of Ontario, Box 527, Station A, Mississauga, Ontario L5A 3A4
45 United Grain Growers Ltd
46 Nickerson American Plant Breeders, Ames, Iowa
47 Nutrite Inc., 7005 boul. Taschereau, Brossard, Que. J4Z 3N2
48 P.A. Caron & Fils, 500 Montes Lebeau C.P. 143, Cowansville, Que. J2K 3H6
49 Cargill Hybrid Seeds
50 Alberta Wheat Pool

FORAGE PRODUCTION OF SOME LICENSED ALFALFA CULTIVARS IN THE PEACE RIVER REGION

D.T. Fairey, N.A. Fairey and J.A.C. Lieverse*

Registered alfalfa cultivars were seeded at different sites at the Beaverlodge Research Station over a period of 14 years. The number of cultivars at each site varied between years. However, at all sites and in each year, the cultivar Beaver was the control. Data on both herbage and seed production were recorded between 1974-88.

For herbage production, each entry was seeded at 7.5 kg/ha in rows 6 m long and at a row spacing of 230 cm. There were six replicates, each consisting of four rows. The two center rows were harvested for herbage at 5-10% bloom. Only a single harvest was made each year.

For seed production, each entry was seeded at 2.5 kg/ha in a row 6 m long and at a row spacing of 90 cm in six replicates; 2 m of each row was harvested for seed. Leafcutting bees, Megachile rotundata (Fab.), were provided for pollination, and plots were harvested when 80-90% of the seed heads were mature.

Table 1 presents herbage and seed yield data. The performance of cultivars with less than 5 data years of results should be interpreted with caution.

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* Agriculture Canada, Beaverlodge, Alberta

Table 1. Forage yield of some licensed alfalfa cultivars

Cultivar	Dry matter yield of herbage			Seed yield		
	Number of data years	Yield (t/ha)	% of Beaver[1]	Number of data years	Yield (kg/ha)	% of Beaver[1]
Algonquin	14	295	100	11	280	100
Anchor	19	282	93	11	236	89
Angus	11	295	100	11	295	105
Anik	17	316	104	8	242	78
Apica	9	266	92	8	333	142
Apollo II	20	253	87	17	213	83
Beaver	27	298	100	20	272	100
Blazer	5	253	91	4	249	98
Drylander	3	313	96	5	244	79
Heinrichs	10	274	102	11	262	83
Pacer	8	263	87	4	301	95
Peace	17	297	98	10	309	111
Rambler	26	307	103	20	293	107
Rangelander	8	288	103	4	202	66
Roamer	3	327	100	5	254	83
Spectrum	5	246	89	4	244	96
Spredor 2	12	294	95	5	275	108
Thor	11	279	90	4	268	100
Trek	10	298	95	9	235	82
Trumpetor	9	248	86	8	260	111
Vernal	26	294	99	20	246	90
Vista	5	230	83	4	297	117
WL 215	3	272	94	2	269	102
WL 316	6	228	79	6	222	100

[1] Based on the performance of Beaver only in those data years when the performance of the candidate cultivar was recorded.

LEAFCUTTER BEE FOLIAR MOULD RESEARCH AND DEVELOPMENT OF CONTROL METHODS IN SASKATCHEWAN

D.W. Goerzen*

In order to investigate foliar moulds and their effects on populations of the alfalfa leafcutter bee (*Megachile rotundata*), the Saskatchewan chalkbrood/foliar mould project has as its objectives to survey leafcutter bee populations for chalkbrood and foliar moulds, to identify and monitor foliar moulds, to study causes of leafcutter bee mortality, to determine mould species which may be hazardous to producer health, and to develop and test methods of foliar mould control.

Surveys of Saskatchewan populations, combined with trapnest deployment in alfalfa seed-producing areas throughout the province during the past three years, have indicated that while classic chalkbrood (*Ascosphaera aggregata*) is not present at detectable levels, a large number of mould, yeast, and bacterial species are commonly associated with domestic leafcutter bee populations. The most prevalent moulds (i.e. *Alternaria*, *Aspergillus*, *Eurotium*, *Penicillium*, *Rhizopus*, and *Trichoderma* spp.) occur saprophytically on pollen balls or dead bee larvae. While the damage caused to leafcutter bees is generally due to spoiling of provisions, some *Aspergillus* and less commonly isolated *Trichothecium* spp. are known to act as facultative parasites of bees. Several apparently native *Ascosphaera* spp., generally occurring in association with other fungi, have also been isolated and identified. These include *A. variegata*, all of which appear to be saprophytic but may act as pathogens.

The most common yeast associated with leafcutter bees in Saskatchewan is the genus *Trichosporonoides*, which may be found in every component of the system, from nest material through working adults, pollen balls, larval cadavers, and cell exteriors. *Saccharomyces* sp. yeasts have also been cultured from nest material. A number of bacterial isolates recently identified include *Bacillus*, *Corynebacterium*, *Enterobacter*, *Flavobacterium*, and *Pseudomonas* spp,; these bacterial species have been isolated from nest material, adult female bees, and cell exteriors.

The presence of these various moulds, yeasts and bacteria in leafcutter bee population can lead to problems for alfalfa seed producers. Bacteria, in conjunction with yeasts, have been implicated in the fermentation of nectar and pollen provisions, which may cause egg or larval mortality and lead to subsequent overgrowth of the cell by moulds. The concurrent isolation of mould, yeast, and bacterial species from

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single pollen ball of larval cadaver specimens indicates that all three groups may contribute to leafcutter bee mortality.

Chalkbrood survey data for the years 1985 through 1988[a] are presented in Table 1. Pollen mould levels can be seen to fluctuate widely, with the early 1988 level 3.2% lower than that of 1987. Larval mould variations are less pronounced, with levels ranging between 0.3 and 0.6% over the four year period. Pollen chalkbrood and native larval Ascosphaera spp. levels during the 1985 to 1988[a] period have also shown little variation.

Table I. 1985 - 1988a Chalkbrood survey data summary (%)

CATEGORY	1985	1986	1987	1988[a]
HEALTHY PREPUPAE	76.1	71.8	76.2	78.2
DEAD LARVAE/PREPUPAE				
Discoloured	5.0	6.0	4.2	4.3
Mouldy	0.5	0.6	0.6	0.3
Ascosphaera aggregata	-	-	-	-
Other Ascosphaera spp.	0.021	-	0.045	0.006
MOULDY COCOONS				
Pollen Mould	1.9	5.0	5.4	2.2
Pollen Chalkbrood	0.5	0.3	1.0	0.5
PARASITES	0.5	1.5	0.5	2.4
SECOND GENERATION	0.9	0.5	1.4	0.6
POLLEN BALLS	12.0	13.1	9.6	10.1
CRUSHED COCOONS	2.2	1.1	0.7	1.4
OTHER	0.5	0.2	0.4	0.1
LIVE COUNT/KG.	8580	8277	8752	8688
NO. OF SAMPLES	60	42	59	25[a]

[a] no. of samples analysed to 15.Dec.1988

Although pollen chalkbrood levels have remained relatively low (0.3 to 1.0% range), a large number of producers submitting samples (61.0% in 1987) do have Ascosphaera pollenicola and/or A. variegata among the pollen moulds in their leafcutter populations. Native larval Ascosphaera spp. data indicate that while the incidence of native Ascosphaera species on mouldy larvae is also very low (0.0 to 0.045% range), a total of 20.3% of producers submitting samples in 1987 had A. larvis and/or A. variegata on larval cadavers in their bee populations.

Data collected in the chalkbrood survey have been supplemented by use of trapnests in various alfalfa seed producing areas of the province. During evaluation of leafcutter bee cocoons collected as part of the 1987 trapnest deployment, a sample from one location was found to contain high levels of native larval Ascosphaera species. Both domestic (M. rotundata) and wild (M. relativa) leafcutter bee species occupying the trapnest were affected; the M. rotundata component of the sample contained 4.3% mouldy larvae (A. larvis/A. variegata), while the M. relativa portion of the sample had a level of larval mould (A. variegata) in excess of 15%. These data clearly illustrate the invasive potential of native Ascosphaera species when conditions are favourable for their growth.

Many of the moulds found in association with populations of the alfalfa leafcutter bee are potentially harmful not only to the bees, but to alfalfa seed producers as well. Table II lists a number of foliar mould species isolated from Saskatchewan populations and known to be associated with human disease processes.

Table II. Some foliar moulds of medical significance which have been isolated from Saskatchewan alfalfa leafcutter bee populations.

Alternaria alternata
Aspergillus glaucus
Aspergillus niger
Cylindrocarpon sp.
Mucor sp.
Penicillium purpurogenum
Penicillium spinulosum
Rhizopus oryzae
Trichoderma sp.
Ulocladium sp.

Moulds including Aspergillus, Alternaria, Rhizopus, and Penicillium species have been implicated in allergic reactions and bronchopulmonary disease and are major fungal allergens. Aspergillus infection is usually acquired via the respiratory tract and may cause problems ranging from pulmonary hypersensitivity disease (e.g. allergy, asthma) to life-threatening infection. Several of the microorganisms listed in Table II are not ordinarily associated with human diseases but under certain conditions may act as opportunistic pathogens.

Alfalfa seed producers, working in close proximity to leafcutter bees and cocoons on a regular basis, are exposed to high levels of spores from leafcutter bee-related fungi at a time when occurrence of invasive fungal disease is becoming recognized as a major medical problem. Individuals working with leafcutter bees should observe basic safety precautions, particularly during bee incubation and harvesting operations when large numbers of cocoons or emerging bees concentrated in confined areas lead to high levels of fungal spores in the immediate environment. The use of efficient ventilation systems and appropriate safety equipment, combined with safe work habits, can minimize contact with potentially harmful spores. Work clothes, dust masks, and gloves should be worn to minimize contamination carried into the living environment. As well, facilities used for cocoon incubation and stripping should be thoroughly cleaned and disinfected following use.

In addition to these precautions, incorporation of foliar mould control techniques has been shown to be extremely effective in reducing foliar mould levels. Dipping of nest material in sodium hypochlorite (NaOCI) bleach solution is presently under widespread use in Saskatchewan. Bleach dipping is most compatible with those operations utilizing polystyrene nest material, since wood material may warp if not properly dried following wetting. Research undertaken to assess the efficacy of various bleach concentrations has indicated that dipping polystyrene nest material in a 5% active chlorine solution yields effective control of moulds, yeasts, and bacteria at treatment times of 1, 3, or 5 minute treatment time. In order to enhance penetration of bleach solution into nest tunnels, the use of a wetting agent (e.g. Triton X-100, Agral 90, or Amway LOC) is recommended. As well, a bleach test kit should be used to determine the active chlorine concentration of the dipping solution periodically.

Experiments have also been carried out to assess the efficacy of bleach dipping in control of moulds on cocoon surfaces and to determine whether dipping has a deleterious effect on diapausing prepupae within cocoons. Three minute treatments in 2.0, 2.5, and 5.0% active chlorine bleach solutions were shown to be highly effective in eliminating fungi and bacteria from cocoon surfaces. This reduction in foliar contamination has a great impact on the number of spores found on adult leafcutter bees. Spore counts taken on female bees emerging from trays of dipped cocoons showed a 94% reduction in spore numbers when compared with counts on females emerging from trays of undipped cocoons. Viability of prepupae was apparently unaffected by NaOCI bleach treatment in small-scale studies carried out in the laboratory. However, recent research undertaken on a larger scale in Manitoba has indicated that there may be a degree of prepupal mortality associated with bleach dipping cocoons; work in this area is thus continuing.

In order to develop alternative methods to NaOCI bleach dipping for control of mycoflora in leafcutter bee nest material, a number of potential decontamination techniques have been evaluated. These have included kiln heating, macrowave treatment, and the use of a number of fumigants.

Research on kiln and macrowave heating of nest material involved determination of critical temperature and time treatments required to eliminate microorganisms from wood block, wood laminate, and polystyrene laminate nest material. In wood blocks, kiln treatments of 6 and 12 h at 80° C effectively controlled a wide range of fungal and bacterial species; short period (i.e. 20 min.) macrowave treatments yielded similar results when a threshold temperature of 75 to 80° C was achieved in wood laminate material. Kiln heating of polystyrene nest material at 80° C gave acceptable control of moulds and yeast, but several bacterial species were able to survive a 12 h treatment at 80° C.

Initial experiments in the fumigation of nest material were carried out using ethylene oxide, methyl bromide, aluminum phosphide, and anhydrous ammonia. Ethylene oxide was found to be extremely effective in controlling moulds, yeasts, and bacteria in wood and polystyrene material, but the toxicity of this fumigant, combined with requisite high concentrations and specialised treatment facilities, was found to limit its practicality for this application. Preliminary work with the fumigant methyl bromide indicated possible control of yeasts in wood block material and bacteria in polystyrene laminate material, but subsequent tests at various concentrations under low and high humidity conditions showed no significant control of mycoflora in either wood or polystyrene nest material. Experiments with aluminum phosphide and anhydrous ammonia indicated that these fumigants were also inefficient in controlling foliar moulds.

Research is currently underway to determine the efficacy of the fumigant paraformaldehyde for control of nest material contaminants. Paraformaldehyde is a white, crystalline substance available in powder or pill form. It has a melting range of 120 to 170° C and can therefore be sublimated to gas phase at relatively low temperatures. A research permit obtained from the Pesticides Directorate of Agriculture Canada allows for testing of this fumigant to be carried out under specific safety and experimental guidelines.

Following an initial test which showed an overall reduction in mycoflora of 97.7% in paraformaldehyde-treated polystyrene laminate nest material, a large-scale field test was undertaken utilizing polystyrene laminate nest material from two sources and wood block nest material. Nest boxes and blocks were placed in an insulated metal shed with a concrete floor. The chamber was then heated to 25° C and humidified (60 to 70% RH) for 72 h prior to fumigation with paraformaldehyde at a rate of 10.0 g/m^3.

Analyses of pre- and post-treatment samples indicate that paraformaldehyde fumigation yielded variable control of mycoflora in polystyrene laminate and wood block nest material. A brief summary of level of control among treatments is listed in Table III. Overall reduction of microorganisms was 99.7% in polystyrene sample 01, 81.1% in polystyrene sample 02, and 69.3% in wood blocks tested. The lower efficacy of paraformaldehyde in wood material is partially due to the large amount of organic material in the wood blocks tested; as well, a small number of yeast colonies were cultured from post-treatment samples but not seen in pre-treatment sample cultures. This same yeast, Trichosporonoides sp. was totally eliminated in polystyrene laminate nest material fumigated with paraformaldehyde.

Inspection of wood and polystyrene nest material following fumigation treatment indicated that no visible paraformaldehyde residue was present. Both types of nest material exuded a slight formaldehyde odor which dissipated following several days in the open air. Treated polystyrene laminate and wood block nest material was subsequently deployed in the

Table III. Efficacy of paraformaldehyde in polystyrene laminate and wood block nest material.

Type of Mycoflora	Polystyrene 01 (% control)	Polystyrene 02 (% control)	Wood Block (% control)
Moulds	99.9	75.3	75.9
Yeasts	100.0	97.6	0.0
Bacteria	99.2	100.0	81.4

field for comparison with untreated control material. Research is continuing in order to determine acceptability and toxicity of treated nest material to adult bees working in the field. The possible toxicity of paraformaldehyde residue in nest material to progeny within cocoons during larval, prepupal, and pupal development is currently under investigation in the laboratory. Further paraformaldehyde fumigation experiments, including treatment of wood laminate and polystyrene block nest material, are planned prior to the next field season.

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COCOON TESTING CENTRE SUMMARY
November 1, 1988 - January 31, 1989

by Lori-Ann Kaminski *

Samples (Producers)	Prov./ Canada	Live Prepupae per lb.	Prepupae Live	Prepupae Immature	Prepupae Dead	Dead Larvae	Pollen Balls	Second Generation	Parasites	Pred./& SPP Damage	Machine Damage	Chalkbrood	Females % (No. of samples)
			Percent										
173 (87)	Alta./	3764	74.8	0.1	1.8	0.8	13.7	1.0	2.5	0.1	3.5	1.7	39.0
Range	B.C.	2060-4961	47.3-92.6	0-1.31	0-6.9	0-3.9	2.3-36.9	0-8.7	0-19.5	0-1.7	0.2-13.0	0-26.5	(37)
65 (42)		4121	80.5	0.0	2.5	0.9	10.7	0.9	1.9	0.0	2.7		34.5
Range	Sask.	3002-5179	61.8-92.6	0-0.95	0-13.5	0-2.8	4.0-23.2	0-9.0	0-11.6	0-0.2	0-11.6	1 CASE	(27)
71 (51)		3884	79.5	0.1	2.8	1.1	11.6	0.5	2.0	0	2.5	1 CASE	38.5
Range	Man.	2132-4689	47.2-89.0	0-1.13	0.6-7.6	0-3.9	4.2-31.1	0-5.1	0-16.2	0	0-12.5		(23)
309 (180)	Canada	3867	77.08	0.08	2.19	0.91	12.56	0.83	2.26	0.04	3.12	0.93	37.4 (87)

* Canadian Cocoon Testing Centre, Brooks, Alberta

CHALKBROOD IN ALBERTA AS OF MARCH, 1989*

Percent Chalkbrood	Number of samples
0 - 1	37
1 - 2	28
2 - 3	8
3 - 4	5
4 - 5	4
5 - 6	2
6 - 7	4
7 - 8	1
8 - 9	8
9 - 10	1
10 - 11	0
11 - 12	1
12 - 13	0
13 - 14	1
TOTAL	101

* 87 producers submitted samples; chalkbrood was found in samples submitted by 46 of these producers

ALTERNATIVE FLORAL SOURCES FOR LEAFCUTTING BEES

By

D.T. Fairey* and L.P. Lefkovitch**

The leafcutting bee, Megachile rotundata (Fab.) has been observed pollinating a number of different legume species in experimental plots. These observations, made over a 15-year period at various locations in the Peace River region of Alberta and British Columbia, include clovers (Trifolium spp.), birdsfoot trefoil (Lotus corniculatus L.), sainfoin (Onobrychis viciaefolia Scop.) and milk vetch (Astragalus cicer L.). In many instances a preference for some floral sources has been recorded with respect to different cultivars within a species, and also among different species. For example, while there has been an abundance of observed pollinating activity on single-cut diploid red clover, few observations of pollination of tetraploid cultivars have been recorded. Furthermore, from 1985-7, inclusive, the leafcutting bee has been used successfully for pollinating canola (Brassica campestris) in the greenhouse, to obtain early generation seed production in a breeding program.

Based on the above observations, studies on the use of the leafcutting bee for pollination and seed production in a number of legume species are currently underway. In the field studies in progress, bee reproduction, pollinating behaviour and seed set are being documented, while cage studies are being used to demonstrate the relative effects of insect pollination versus the absence of a pollinator. In current greenhouse studies, floret morphology, seed formation and behaviour of the insect are being studied in some detail. In this report, some of the results of a 5-year field study on single-cut diploid red clover, Trifolium pratense L., and a 1-year cage study on diploid alsike clover, Trifolium hybridum L., are presented.

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I. Red Clover

In each year of the 5-year study described here, a single-cut, diploid red clover seed field of about 40 ha was selected. The field was divided into two rectangular areas of equal size, one for each of treatments (Trt) 1 and 2, with an isolation strip of about 300 m between the treatments. In Trt 1, six shelters for leafcutting bees, M. rotundata were provided for pollination. Bees were not provided in the area allocated to Trt 2, but six stakes were positioned in the field in a manner similar to that for the six shelters in Trt 1. It should be noted that other pollinating insects were not excluded in both treatments. Samples of the red clover seed crop were harvested when 80 to 90% of the seed heads were brown. The harvested crop was dried and threshed for seed. Seed samples were then cleaned and weighed.

The culture and management of leafcutting bees and the methods of isolation of shelters from each other in this red clover study, were identical to those described by Fairey and Lieverse (1986)ǂ for alfalfa. All bees came from a population maintained since 1966 at the Agriculture Canada, Research Station, Beaverlodge, Alberta. If the leafcutting bee can pollinate red clover successfully, the cell increase of bees on this crop will be compared with that obtained when foraging on alfalfa, the crop for which this bee is the currently recommended pollinator in western Canada. Therefore, in each year of study a cell increase with that on alfalfa was also made. Differences attributable to location are accepted as factors that cannot be altered, while differences attributable to crop irrespective of location effects are deemed to be of interest. For each shelter of red clover and alfalfa, the total yield of viable male and female bees was determined. The ratio of viable cell increase at the end of the season was also calculated.

Seed yield

Since the coefficient of variation appeared to be small, an analysis of variance of the logarithm of the yields, equivalent to a generalized linear model assuming a small, constant coefficient of variation, was performed. The seed yields based on 5-year averages were 410 kg/ha and 291 kg/ha for Trts 1 and 2, respectively (Table 1). Furthermore, in four of the five years of study, significantly greater amounts of seed were obtained with the provision of leafcutting bees for pollination. These yields ranged from 343 to 498 kg/ha for Trt 1 and 240 to 347 kg/ha for Trt 2.

ǂ J. Appl. Ent. 102: 148-153, 1986.

Table 1. Seed yield

Year	Treatment: With bees	Treatment: Without bees	Seed increase with bees %
1983	498 a+	240 b	208
1984	466 a	256 b	182
1985	343 a	347 a	99
1986	390 a	306 b	127
1987	373 a	320 b	117
Mean	410	291	

\+ Means, within years, followed by the same letter are not significantly different at the 5% level of probability according to an analysis of variance of the logarithm of yield.

Leafcutting bee cell increase

Comparisons of viable cell production, as expressed as a proportion of the total weight of cells produced for red clover and alfalfa were made. There was no significant difference (P > 5%) between crops for both viable cell production and number of female bees. There was a significant crop x year interaction (P < 2%) implying that year/location of fields had a significant effect on bee reproduction. A large proportion of the cells produced were viable. On an average, this was about 96 percent, irrespective of whether the crop being pollinated was alfalfa or red clover. About 32 percent of these cells were female.

Table 2. Ratio of cell increase

Year	Crop: Alfalfa	Crop: Red clover
1983	2.39 (0.216)+	1.50 (0.178)
1984	2.70 (0.106)	1.69 (0.149)
1985	2.16 (0.106)	2.23 (0.160)
1986	2.66 (0.104)	2.59 (0.082)
1987	3.24 (0.088)	2.12 (0.080)
Mean	2.63 (0.081)	2.03 (0.085)

\+ Standard error

The ratio of bee cell increase was influenced by the crop being pollinated. This ratio of increase was usually greater for alfalfa.

Average values of 2.63 and 2.03 were recorded for alfalfa and red clover, respectively. For alfalfa, cell increase ratios ranged from 2.16 to 3.24, the range for red clover was 1.50 to 2.59.

These results show that there was an increase in seed production in red clover associated with the provision of leafcutting bees in four of five years. Since, up to 347 kg/ha of seed was produced in the treatment where these bees were not provided, other pollinating insects were also active in the seed fields studied. However, the results of the present study indicate that the leafcutting bee is a candidate pollinator for red clover that merits further investigation.

II. Alsike Clover

Two cultivars of alsike clover, 'Dawn' and 'Aurora' were used in this study. For each cultivar, 14 screen cages were used, 7 for each of treatments (Trt) 1 and 2. Each cage was 1.2m x 1.2m x 1.2m in size. In Trt 1, 300 leafcutting bees were introduced into the cage at weekly intervals commencing on July 1 at first bloom and continuing until August 20 when the crop was ready for harvest. Leafcutting bees and all other pollinating insects were excluded from Trt 2. The entire crop under each of the cages was harvested on August 20.

Seed yield

The yield data were analysed using a general linear model assuming a constant coefficient of variation, since the latter was relatively large. The significant differences in seed yield observed between cultivars could partly be attributed to the fact that the stand of Aurora appeared to be more uniform and vigorous before the commencement of treatments. There was approximately an eight-fold increase in seed yield with the provision of bees, again emphasizing the importance of insect pollination in this predominantly cross pollinated species.

Table 3. Seed yield in cages

Cultivar	With bees	Without bees
	Yield kg/ha (Standard Error)	
Aurora	270.15 (62.16)	24.86 (5.74)
Dawn	136.57 (31.52)	28.15 (6.41)

Acknowledgements

We thank John Lieverse and Owen Lee for their capable technical assistance.

THE ROLE OF BENEFICIAL INSECTS IN ALFALFA SEED PEST MANAGEMENT

Michi Okuda*

Beneficial insects play a major role in controlling pest insects in alfalfa seed fields. The primary insect pest in northern seed fields is the lygus bug. This insect is fed on by the generalist predator, the damsel bug. Pea aphids can also build up to high numbers and cause damage. Aphid predators include the damsel bug, ladybird beetle, green lacewing, and hover fly.

The damsel bug adult is a greyish brown colour and is 8 to 9 mm long and 1.5 to 2 mm wide. It has enlarged front legs that are used for grasping its prey and piercing-sucking mouthparts for feeding. It feeds on the juices from other insects, killing them in the process.

Adult damsel bugs overwinter in alfalfa fields as well as in other areas. In the spring eggs are laid in the alfalfa plant and the nymphs hatch in the summer. There are five nymphal stages that look a lot like the adult except that they do not have wings.

Nymphs and adults feed during the entire growing season. Medium to large nymphs and adult damsel bugs feed on lygus bugs and aphids. When lygus bugs and aphids are present damsel bugs prefer aphids to lygus bugs. Therefore, when aphid populations are high it is likely that the damsel bug does not do as good a job of controlling the lygus bug as when they are low. In seed fields a ratio of two damsel bugs to one lygus bug (based on 90° sweep counts) during the green seed stage is sufficient to control the lygus bug.

Larvae and adults of the ladybird beetle are voracious predators of the pea aphid. Some species eat over 1000 aphids during their lifespan. Adults move into the alfalfa seed fields when aphids are present in the early summer, lay eggs and develop in the fields. When aphid numbers are high the orange and black striped larvae and adults are seen feeding on aphids on the leaves and stems. Also, the orange and black pupae (resting stage between the larval and adult stages) may be seen attached to the leaves.

Hover fly and green lacewing adults will move into fields when aphid populations are present. Hover fly adults look like bees and are often seen hovering around flowers. Green lacewing adults are a pale green colour with large lacy wings. They both feed on honeydew, a sticky substance produced by aphids and lay their eggs in infested fields. The larvae feed on aphids. Hover fly larvae are small maggots that come in different colors (i.e. orange, green, pink) while green lacewing larvae

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are creamy coloured with brown blotches. They have sickle shaped mouthparts that suck juice from prey. Each hover fly larva can eat 150 to 400 aphids while each green lacewing larva eats up to 75 aphids.

A pre-bloom application of insecticide for lygus bug control will often control the damsel bugs as well. It is not known how well they recuperate to provide control of lygus bugs during the latter part of the season when the seed is maturing. Ladybird beetles, green lacewings, and hoverflies are also killed with insecticide applications.

In southern Alberta burning of the alfalfa before growth in the spring did not have a detrimental effect on the beneficial insects. However, when the alfalfa was burned when it was 20-25 cm high ladybird beetle populations were reduced.

In all cases where pest insects are controlled in alfalfa seed fields it is important to take into consideration the impact the control measure will have on beneficial insects. If the pest insect in question does not threaten to cause economic damage then it is best to leave things alone.

WEED CONTROL IN FORAGE CROPS

D. Cole* and A.L. Darwent**

Weeds can be a major problem in forage crop production in Alberta. In stands used for seed production losses caused by weeds are quite obvious. Canada thistle, at a density of 20 plants per square metre, has been shown to reduce the seed yield of alfalfa by 50 per cent. Similarly, heavy infestations of wild oats and stinkweed in the year of seeding of creeping red fescue have caused up to a 75 per cent reduction in seed yields the following year.

In forages grown for purposes of feeding to livestock losses caused by weeds are less obvious than in forages grown for seed. Some weeds have feed value and this must be considered. In a study near Lethbridge, alfalfa grown under irrigation and heavily infested with weeds in the year of seeding did not have large losses due to weeds. Over a four-year-period weedy plots produced only 1.6 tonnes per acre less forage than under weed-free conditions. Losses occurred only in the first year. However, factors other than yield must be considered, e.g. the spread of perennial weeds and the build-up of weed seeds.

Decisions on how to manage weed populations in forages must take into consideration factors such as the age of the stand, the types of weeds present, and the way in which the forage crop is used.

Cultural Control

The key to controlling weeds in a forage crop lies in the establishment and maintenance of a vigorous, highly competitive crop stand. Some suggestions for obtaining and maintaining such a stand are as follows:

- Seed into a clean field. Heavy weed infestations should be controlled prior to the seeding of the forage crop through either cultural or chemical means. Perennial weeds, such as Canada thistle, perennial sow-thistle and quack grass, are extremely difficult and costly to eradicate in a forage stand and should be eliminated before the stand is established. The herbicide Roundup is useful for this purpose.

- Seed into fields free of any herbicide residues. Residues of herbicides such as Glean and Tordon 202C can remain in the soil for one or more years and seriously reduce the emergence and growth of seedling grasses and/or legumes. (See section on cropping restrictions - Table 1).

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- Use seed that is either weed-free or free of problem weed seeds. When purchasing certified seed check the seed testing certificate. This certificate provides information on the type and quantity of weed seeds present. Make sure that the list does not contain too many weed seeds or seeds of weeds not present where the forage crop is to be seeded. It is particularly important to avoid seed stock containing seeds of any noxious or restricted weeds such as nodding thistle, diffuse knapweed, spotted knapweed, scentless chamomile, toadflax, quack grass, perennial sow-thistle, Canada thistle, leafy spurge, and field bindweed.

- Use forage crops and varieties recommended for your area and the field to be planted.

- Seed into a firm, well prepared seedbed at the recommended rate and depth.

- Seed at a time to coincide with favorable moisture conditions. In the north, seed of forage in the spring is most successful while in southern areas the appropriate time can be in the early spring or in the fall.

- Use fertilizer according to soil test results and inoculate legumes properly with the appropriate inoculum.

- Evaluate the option of seeding without a companion crop. Since soil type, weather and economic conditions and type of farming operation are all important factors, the choice is an individual one. In general, where soil crusting or erosion is not a problem and maximum forage production is a primary objective, seeding without a companion crop is advisable. While companion crops suppress weeds and enhance herbicide efficacy, they also suppress forage seedling development and yield in subsequent years. Less competitive companion crops such as flax should be considered. If a cereal companion crop is to be used, harvesting of the companion crop early as greenfeed or silage can sometimes aid in the establishment of the forage crop.

- Mow at a height just above the forage crop as this is an effective method of preventing annual weeds from smothering seedling forages. Seed set of the weeds is also reduced. A flail-type mower, or one that distributes the plant material evenly over the field, is preferable to a swather.

- Harvest the established forage crop at the appropriate time. Harvesting at the wrong time can cause crop injury. For example, alfalfa in northern and central Alberta should not be harvested in August while in southern Alberta, where a three-cut system is used, it should not be harvested in September. Harvesting during these periods can predispose alfalfa to potential winterkill and reduce its competitiveness. Such weakened stands allow weeds to become established.

- Cut hay or silage crops early before weeds go to seed.

- Do not overgraze pastures. Fertilize older forage stands.

- Pull by hand or spot spray problem weeds such as Canada thistle. Failure to control small patches of problem weeds will lead to problems in the future.

- Clean up the weeds in the adjoining fence-lines, roadways and rights-of-way.

- Break up old, depleted or winter-killed stands where there is no longer a vigorous forage stand to compete with weeds.

Chemical Control

Herbicides should be used only when needed and to supplement, not replace, good cultural management of weeds in forage crops. The selection of herbicides for use on forages is limited when compared with that for cereal crops.

Herbicide selection depends upon:

- The problem weeds present and the effectiveness of the herbicide on these weeds. Chart 1 gives a summary of herbicides for the control of the main problem weeds in forage crops in Alberta. For other weeds check with the local district agriculturist or agricultural fieldman.

- The forage crop(s) grown and the tolerance to the herbicides registered for this use. When mixed stands of grasses and legumes are grown, herbicide choice is especially limited. For grass-legume mixes, use of herbicides for broadleaf weed control will be most limited by the legume, for grassy weed control herbicide choice will be most restricted by the presence of forage grasses. Consult the selector Charts (1 & 2) to determine herbicides that can be used in mixed grass-legume stands. The herbicide must be registered on all crops present in the stand.

- The companion crop, if used, and its tolerance.

- The stage of growth of both crop and weeds. See the herbicide label for the recommended stage of application.

- The age of the stand i.e. seedling (within approximately 3 months of the time of seeding) or established (3 months or more after seeding).

- The purpose or use for which the stand is being grown, i.e. pasture, hay or seed production.

- The cost of the herbicide. Is the herbicide application economical in the short term and/or in the long term?

When the herbicide is selected for use in a forage crop, several points should be kept in mind:

- Follow all label directions closely, particularly as they relate to stage of crop and weed development, water volume, and grazing or feeding restrictions.

- Spray at the appropriate stage. In the year of seeding, spray post-emergent herbicides as early as label direction will permit. Young weeds, i.e. in the 2-4 leaf stage, are easier to kill than those in the more advanced stages. Early removal of weeds will enhance forage seedling vigor as forage seedlings do not compete effectively with faster growing weeds. Seedling legumes are most resistant to herbicides for broadleaved weed control from the first to the third trifoliate leaf stage. They should not be sprayed after reaching 10 cm in height.

- Check label instructions closely when applying herbicides for grassy weed control to seedling forage grasses. Tolerance is specific for each herbicide i.e. Hoe-Grass can be used on bromegrass but will completely kill timothy.

- Use extra precautions when applying herbicides to stands that are being grown for seed. Research has shown that applications of 2,4-D in the fall of the year of seeding can drastically reduce seed yields of creeping red fescue and timothy the following year. Spring application should be made prior to the shot blade stage. Do not exceed 0.45 L/ac of 2,4-D (500 g/L formulation) on grass stands grown for seed.

- Consider other options than 2,4-D or MCPA on forage legume crops. The use of 2,4-D and MCPA, while registered for use on certain seedling legumes, is not recommended as serious damage to the legume may result.

- Calibrate the sprayer for uniform application of the correct amount of herbicide.

- Avoid drift onto sensitive crops growing in nearby areas.

- Spray according to environmental conditions. If conditions are very dry, consider delaying spraying until a few days after a substantial rain. The performance of most herbicides is frequently reduced under dry conditions.

- Do not use herbicides with long lasting residues on forage crops that may be worked under in 1 or 2 years. Injury will occur to crops seeded in soil containing these residues.

- Consult the Guide to Crop Protection in Alberta. Part 1 - Chemical. Alberta Agriculture. Agdex 606-1 or the label on the herbicide container for further information on each herbicide listed in the selector charts.

There are a number of options for dealing with weed problems in forage crops. It may pay to spray and it always pays to use good agronomic practices.

CHART 1.

HERBICIDES FOR USE IN FORAGE CROPS AND THE WEEDS CONTROLLED - ALBERTA, 1987

Herbicide	Grassy Weeds								Broadleaved Weeds																									
Consult the label for final detailed instructions	Barnyard grass	Blue grass	Downy brome	Foxtail barley	Green foxtail	Quack grass	Timothy	Wild oats	Annual smartweed	Bluebur	Canada thistle	Chickweed	Cleavers	Clovers	Common groundsel	Corn spurry	Cow cockle	Dandelion	Flixweed (seedlings)	Hemp-nettle	Kochia	Lamb's-quarters	Narrow-leaved hawk's-beard	Night-flowering catchfly	Perennial sow-thistle	Redroot pigweed	Russian Thistle	Scentless chamomile (seedlings)	Shepherd's-purse (seedlings)	Stinkweed (seedlings)	Toadflax	Volunteer canola	Wild buckwheat	Wild mustard
Asulox F	■				■			●	■	■																				■			■	■
Avadex BW								●																										
Avenge								●																										
Banvel								●	●		■		■	●		●	●								■								●	
Buctril M									●	●	■				●		●		●	■	●	●		●	■	●	●	●	●	●		●	●	●
Carbyne								●																										
Embutox/Butyric/Cobutox									●		■							■				●	■		■	●			●	●			●	●
Eptam	●	●			●	●		●				●				●						●				●								
Hoe-Grass	●				●			●																										
Kerb		●		●		●	●	●				●																						
Mataven								●																										
MCPA										●	■							■	●	■	●	●			■	●			●	●		●		●
Princep	●							●	●					●								●											●	
Sinbar	●	●	●	●	●	■						●						■				●				●				●				●
Torch DS/Pardner									●						●		●				●	●		●		●	●	●		●			●	●
Tropotox Plus											■									■		●			■	●			●	●		●		●
2,4-D amine										●	■							■	●		●	●	■		■	■	■		●	●		●		●

● Controlled by rates recommended for crops. ■ Top growth control or suppression only.

CHART 2.

HERBICIDES FOR USE IN GRASSES AND LEGUMES FOR SEED AND FORAGE - ALBERTA, 1987

Stand	Herbicide (Consult the label for final detailed instructions.)	Grasses: Brome grass	Creeping red fescue	Crested wheat grass	Inter. wheat grass	Kentucky blue grass	Meadow fescue	Meadow foxtail	Orchard grass	Reed canary grass	Russian wild rye grass	Slender wheat grass	Tall wheat grass	Timothy	Legumes: Alfalfa	Alsike clover	Bird's-foot trefoil	Cicer milkvetch	Red clover	Sainfoin	Sweet clover	White clover	Cover Crop: Barley	Canola	Flax	Oats	Wheat
SEEDLING* STAND FOR SEED	Asulox F																										
	Avadex BW														1	1	1		1		1	1					
	Avenge	1	1	1		1	1		1	1	1			1	1		1		1		1						2
	Banvel		3																								
	Buctril M																										
	Carbyne																										
	Embutox/Butyric/Cobutox																										
	Eptam																										
	Hoe-Grass																										
	Mataven																										2
	MCPA	4	4	4	4	4	4	4	4	4	4	4	4	4													
	Torch DS/Pardner																										
	Tropotox Plus																										
	2,4-D amine	4	4	4	4	4	4	4	4	4	4	4	4	4													
SEEDLING* STAND FOR FORAGE	Avadex BW														1	1	1		1		1	1					
	Avenge	1	1	1		1	1		1	1	1			1	1		1		1		1						2
	Carbyne																										
	Embutox/Butyric/Cobutox																										
	Eptam																										
	Hoe-Grass																										
	MCPA																										
	Tropotox Plus																										
	2,4-D amine																										
ESTABLISHED* STAND FOR SEED	Asulox F																										
	Banvel																										
	Carbyne																										
	Kerb														5		5										
	MCPA	6	6	6	6	6	6	6	6	6	6	6	6	6													
	Princep														7												
	Sinbar														7												
	2,4-D amine	6	6	6	6	6	6	6	6	6	6	6	6	6													
ESTABLISHED* STAND FOR FORAGE	Banvel																										
	Carbyne																										
	Embutox/Butyric/Cobutox														8	8	8					8					
	Kerb	9	9	9	9	9	9	9	9	9	9	9	9	9	9		9										
	MCPA																										
	Princep														7												
	Sinbar														7												
	Tropotox Plus															8			8			8					
	2,4-D amine																										

☐ - Herbicide is recommended for the crop.

* Seedling - within approximately 3 months of the time of seeding. Established - 3 months or more after the time of seeding.

1. Use only if forage crop is underseeded with a companion crop for which herbicide is registered.
2. Check label for varietal restrictions.
3. Apply when crop is 5 cm tall. If mixed with 2,4-D, do not apply in the fall of the year of seeding if forage grass is seeded without a companion crop.
4. DO NOT apply to timothy or fescue (beyond 4 leaf stage of crop) in the fall of the year of seeding when a seed crop is expected the following year. 2,4-D or MCPA may be applied to fescue in the fall of the year of seeding if a companion crop is used since a seed crop is not normally expected the following year. The effect of applying 2,4-D or MCPA in the fall of the year of seeding on other grasses is not known at this time, although in preliminary tests, brome grass appears to have some tolerance. DO NOT exceed 0.45 L/ac of 2,4-D or MCPA (500g/L formulation) except for narrow-leaved hawk's-beard, on creeping red fescue only (0.90 L/ac). Rates above 0.45 L/ac may cause seed yield losses.
5. Fall application only on trefoil, fall or spring application on alfalfa.
6. May be applied prior to shot-blade in the seed production year or in the fall after a seed crop has been removed. Applications made during flower development and during pollination will reduce seed yield. Apply 2,4 - D in the fall for narrow-leaved hawk's-beard. Limited information is available on the effect of MCPA on seed production. Although most crops usually are more tolerant of MCPA than 2,4-D, it would be prudent to follow the guidelines outlined for 2,4-D until more data are available.
7. Established at least one year.
8. In established legume pasture spray after grazing or cutting when regrowth is not above 7 cm. Damage to the crop is related to amount of foliage present when sprayed.
9. For foxtail barley control in established pastures (grass, grass/legumes, alfalfa, trefoil). Creeping red fescue, Kentucky blue grass and timothy are less tolerant than other grasses and may experience some yield reduction (10-15%). Brome grass, orchard grass and wheat grass are the most tolerant grasses.

TABLE 1.

GRAZING AND FEEDING RESTRICTIONS FOR HERBICIDES USED IN FORAGE CROPS

Herbicide	Restriction
Asulox F	Do not graze or feed treated crop.
Avadex BW	Do not harvest legumes as forage in year of treatment.
Avenge	Do not graze or harvest forage crops for feed in year of treatment.
Banvel	**Dairy Cattle** - do not graze or cut for hay for 7 to 60 days after treatment, depending on rate of Banvel applied. See product label for additional detail. **Beef Cattle and other meat animals** - do not graze or feed slaughter animals for 30 days after treatment.
Buctril M	No restrictions specified.
Carbyne	Do not graze or feed crop for 5 weeks after treatment.
Embutox/Butyric/Cobutox	No restrictions specified.
Eptam	No restrictions specified.
Hoe-Grass	Do not use for forage in year of treatment.
Kerb	Do not harvest or graze for 90 days after application of the 1.3 kg/ac rate or for 60 days after application of rates below this level.
Mataven	Do not graze or harvest forage crops for feed in year of treatment.
MCPA	Do not graze dairy cattle for 7 days after treatment.
Princep	Do not graze for 30 days after application. Do not cut for hay for 60 days after application.
Sinbar	No restrictions specified.
Torch DS/Pardner	Do not graze or harvest forage grasses for feed in the year of treatment with Torch DS.
Tropotox Plus	No restrictions specified.
2,4-D amine	Do not graze for 24 hours after treatment.

CROPPING RESTRICTIONS

Herbicide	Forage Crops Which May Be Affected The Year Following Use of the Herbicide
Atrazine (including all products containing atrazine)	Seedling legumes and grasses may be affected for 1 or more years after Atrazine application.
Banvel	Legumes and seedling grasses if high rates of Banvel were used for perennial weed control the year before.
Glean	Seedling legumes and grasses may be affected for 2 or more years after Glean application. A test strip should be seeded the year before seeding a forage crop. The time interval between application of the herbicide and seeding of the forage crop is increased when the pH of the soil is greater than 7.0, the organic matter content is less than 5% and/or there is less than 250 mm of rainfall in a season.
Lontrel	Small seeded legumes may be affected 2 or more years after application. Only wheat, oats, barley, rye, flax, or canola should be seeded the following season. Residual carryover 2 years after application has not been fully evaluated.
Princep	All crops except established forage legumes. Soil residues may persist for 2 or more years.
Rival/Treflan/Triflurex Heritage, Fortress	Small seeded grasses should not be seeded for 21 months after application. Drought conditions in the year of treatment or the use of a granular formulation may result in higher levels of carryover into the next year.
Sinbar	All crops except established alfalfa as recommended. DO NOT plant treated area to any crop within 2 years after last treatment.
Tordon 202C	Do not plant alfalfa until at least the third growing season after the year of treatment. Seed only wheat, barley, oats, flax or canola for 2 years following treatment.

New registrations of herbicides for weed control in alfalfa grown for seed. - To January, 1989.

1. Treflan

Crops: Alfalfa, sainfoin and sweet clover (seed or forage). (sainfoin and sweet clover - spring only).
Weeds controlled: Wild oats, green foxtail, barnyard grass, bromegrass, Persian darnel, annual bluegrass, wild buckwheat, cow cockle, pigweed, lamb's-quarters, Russian thistle, chickweed, purslane, knotweed.
Grazing restrictions: None
Cropping restrictions: Oats, creeping red fescue and other small seeded grasses should not be grown in rotation following a Treflan treated crop.

2. Poast

Crops: Alfalfa (seed or forage).
Weeds controlled: Wild oats, volunteer barley, foxtail, Persian darnel, quackgrass
Grazing restrictions: Do not graze treated fields or harvest for feed for 70 days after treatment.
Cropping restrictions: None.

LEGUME SEED MARKETS

Al Dooley*

Legume seed prices have dropped sharply from the relatively high levels of 1986 and 1987. Buyer interest in the clovers has been very low for some time, in large part a consequence of the drought in the US. Dry conditions limited seedings in 1988 leaving dealers with stocks of high-priced, unsold product. Since that time, the trade has been operating on a hand-to-mouth basis. Moisture conditions have improved in many parts of the US but, as yet, this has not been translated into greater buyer interest. Prices are at levels which should not discourage buyers. The weather over the next few months will be a main factor in dictating price prospects, through the remainder of the current crop year and into the next.

Alfalfa Seed

The alfalfa seed market is seasonally quiet with little buyer interest expected prior to April. The 1988-89 crop year began with relatively high commercial stock levels; 2.3 mln kg as compared to 1.9 mln on July 1, 1987. Canadian alfalfa seed production in 1988-89 is estimated at 8.4 mln kg, 73 per cent higher than a year earlier and a new record. while conditions for cereal production on the Prairies were generally poor, alfalfa seed did extremely well in all provinces. In Alberta, production is estimated at 1.5 mln kg, 23 per cent above 1987-88 output. Yields under irrigation are thought to be very good, perhaps about 400 pounds per acre on average. Despite the increase in production locally, Alberta's share of total Canadian alfalfa seed output continues to decline. As recently as 1986, Alberta's share of national output was over 40 per cent. In 1988-89 Alberta production was just 18 per cent of the total.

Large increases in production were recorded for both Saskatchewan and Manitoba where output increased by 128 per cent and 58 per cent, respectively. Saskatchewan alfalfa seed production this year is close to 50 per cent of the Canadian total as compared to just 35 per cent one year earlier.

Preliminary estimates of pedigreed area in Canada are put at 56,149 acres, almost 10,000 acres more than one year earlier. Alberta's area, at 13,348 acres, was 24 per cent of the total, the smallest share since 1978. There are significant acres of common seed in the province but a reliable estimate of this area is unavailable.

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* Alberta Agriculture, Market Analysis Branch, Edmonton, Alberta

Alfalfa seed prices have declined from 1987-88 levels. Producer prices for certified seed are presently about $1.10 per pound as compared to about $1.35 for the 1987-88 crop year. Much of the seeding takes place in the April to June period in Canada and more will be known about prices in the coming months. The large 1988 crop will make it difficult for prices to strengthen significantly. Alternatively, the spread between certified and common seed may widen. At this time certified seed prices are expected to remain fifteen to twenty cents per pound below prices in 1987-88.

Alsike Clover

Commercial carryover of alsike clover seed at July 1, 1988 amounted to about 700,000 kg, up substantially from the 400,000 kg of July 1, 1987. However, since 1981-82, stocks have been below the 700,000 kg level only once. Despite the increase, therefore, stocks are not considered excessive.

Alsike clover production in Canada in 1988-89 is relatively high, well above the ten-year average and the greatest production since the 1977-78 crop year. Canadian production is estimated at 4.5 mln kg, up from 2.6 mln kg in 1987-88. Alberta is the largest producing province with 1988-89 output of 3.4 mln kg or about 75 per cent of the national total.

Pedigreed acreage in alsike clover in 1988 was 4,346 acres. Alberta had almost 80 per cent of this total or 3,443 acres. Pedigreed acreage is thought to be only a small fraction of the total area in alsike clover. The 1981 census reported over 30,000 acres devoted to alsike clover in Alberta. Given the relatively attractive prices of the past several years, it is probable that the area in 1988 would be as high or higher than that census estimate.

Alsike prices have dropped sharply from the highs of 1987. Current prices for common seed are about 20 cents per pound. A year earlier prices averaged about 55 cents. Buyer interest has been very slow and, to date, has been unresponsive to the price decline. Further downside prices risk appears limited. At the same time, upside potential will be restricted by more than adequate supplies and a lack of buyer interest. Some improvement in activity is expected in the coming months but whether or not this will be reflected in prices is questionable. Prices are anticipated to remain very close to current levels through the remainder of the crop year.

Red Clover

The market for single-cut red clover seed remains inactive despite much lower prices currently than in the 1987-88 crop year.

Canadian production in 1988-89 was up significantly from a year earlier. From 2.6 mln kg a year ago, output increased to 4.2 mln kg this year, the highest production in a decade. Alberta is the largest producing province accounting for at least 40 per cent of Canadian single-cut production in most years. Alberta output this year is pegged at 2.4 mln kg, the biggest crop since 1983-84. The increased production locally is primarily related to the much larger area seeded to red clover. Yields this year were thought to be relatively poor and a considerable area was ploughed down or hayed and consequently never combined.

Alberta accounted for about 73 per cent of total Canadian pedigreed single-cut acreage in 1988. Total pedigreed acreage for the country as a whole was just 1,365 acres. As for the other clover seeds, the pedigreed area is thought to be only a fraction of total acreage. Some estimates put red clover acreage for 1988-89 in Alberta alone at close to 90,000 acres.

Fall and early winter rains in US winter wheat growing areas should encourage buyers back into the market. Supplies will be more than adequate for expected needs. Prices are currently about 20 to 25 cents per pound to the farmer, well below the ten-year average. Active buyer interest will be necessary to have prices move above these levels and even then, increases would likely be relatively modest.

Sweet Clover

Sweet clover seed prices have declined to their lowest level in at least a decade. At 5 to 8 cents per pound, prices have fallen close to 20 cents from the 1987-88 crp year. Commercial stocks at the beginning of the 1988-89 crop year were estimated at 1.8 mln kg, well above year earlier levels but not unusually high historically.

Canadian production was very good; at 5.2 mln kg the largest crop since 1978-79. Output fell in both Alberta and Saskatchewan but increased by an estimated 43 per cent in Manitoba, the major producing province. In 1988-89 Manitoba accounted for more than 75 per cent of national output or 4.0 mln kg of seed. In Alberta production fell from 200,000 kg to just 90,000 kg this crop year. Since 1981-82, Alberta has not produced more than 6.3 per cent of Canadian production in any crop year.

Alberta had some 207 pedigreed acres of sweet clover in 1988. Nationally, the pedigreed area amounted to 2,834 acres. Many in the trade feel that total acreage in sweet clover is more likely in the thousands of acres in Alberta, many times more than is indicated by pedigreed area alone.

The low prices that have been experienced in past months have not measurably affected the marketplace. The market for sweet clover seed remains as sluggish as for the other clovers. At these prices there is obviously little downside risk. Again, however, US buyer interest must be forthcoming in the next couple of months for prices to strengthen. Given available supply levels and stagnant trade interest, a return to even the 10 cent per pound range before the new crop year seems unlikely.

TABLE I

ALFALFA SEED STATISTICS

Crop Year	Imports	Dealer Carryover, July 1	Production Canada	Production Alberta	Exports	Average Producer Price[1]	Pedigreed Area
	mln kilograms					$/kg	-acres-
1981-82	1.4	2.0	3.5	1.5	0.7	1.98	24,129
1982-83	2.2	1.4	2.9	2.5	0.4	2.09	30,258
1983-84	2.6	0.9	3.8	1.5	0.8	2.09	32,320
1984-85	2.0	1.0	4.0	2.0	0.6	2.09	34,638
1985-86	2.3	1.9	3.4	3.0	0.3	2.60	39,582
1986-87	3.6	1.4	4.2	1.8	1.0	2.98	41,840
1987-88	2.1	1.9	4.9	1.3	1.1	2.98	46,623
1988-89P	N/A	2.3	8.4	1.5	N/A	2.43	56,149

P Preliminary

1 Certified Seed

Sources: Agriculture Canada, Canadian Seed Growers Association, Statistics Canada

TABLE 2

ALSIKE CLOVER SEED STATISTICS

Crop Year	Dealer Carryover, July 1	Production Canada	Production Alberta	Exports	Average Producer Price[1]	Pedigreed Area
	mln kilograms				$/kg	-acres-
1981-82	1.4	2.0	1.5	2.8	0.22	2,419
1982-83	1.2	1.2	0.8	5.7	0.55	1,548
1983-84	1.5	2.9	2.3	2.3	0.51	2,887
1984-85	0.8	3.2	2.5	2.3	0.40	4,447
1985-86	1.2	1.6	1.3	2.7	0.60	1,941
1986-87	1.0	2.5	2.0	2.8	0.82	1,687
1987-88	0.4	2.6	2.0	2.4	1.21	1,828
1988-89P	0.7	4.5	3.4	N/A	0.49	4,346

P Preliminary

Sources: Agriculture Canada, Canadian Seed Growers Association, Statistics Canada

TABLE 3

SINGLE CUT RED CLOVER SEED STATISTICS

Crop Year	Dealer Carryover, July 1	Production Canada	Production Alberta	Exports[1]	Average Producer Price[1]	Pedigreed Area
	mln kilograms	mln kilograms	mln kilograms	mln kilograms	$/kg	-acres-
1981-82	4.9	2.8	2.0	5.1	0.33	3,732
1982-83	3.2	2.2	1.0	10.2	0.99	2,807
1983-84	0.9	3.5	2.5	3.9	0.88	2,658
1984-85	1.2	3.8	2.3	2.6	0.77	1,816
1985-86	1.5	2.3	1.3	3.2	1.10	655
1986-87	1.3	2.8	1.5	4.2	1.48	461
1987-88	1.2	2.6	1.1	6.2	0.99	1,219
1988-89P	1.8	4.2	2.4	N/A	0.55	1,365

P Preliminary

1 All red clover

Sources: Agriculture Canada, Canadian Seed Growers Association, Statistics Canada

TABLE 4

SWEET CLOVER SEED STATISTICS

Crop Year	Dealer Carryover, July 1	Production Canada	Production Alberta	Exports	Average Producer Price[1]	Pedigreed Area
	---------------- mln kilograms ----------------				$/kg	-acres-
1981-82	2.6	5.0	0.2	2.7	0.33	216
1982-83	2.2	4.1	0.1	9.9	0.44	369
1983-84	0.5	3.7	0.2	3.3	0.51	589
1984-85	1.4	3.7	0.2	2.6	0.31	1,788
1985-86	2.3	1.9	0.1	4.3	0.40	495
1986-87	2.0	3.2	0.2	4.7	0.62	568
1987-88	1.2	4.5	0.2	3.7	0.55	1,500
1988-89P	1.8	5.2	0.1	N/A	0.17	2,834

P Preliminary

Sources: Agriculture Canada, Canadian Seed Growers Association, Statistics Canada

COMMUNICATING INTERNATIONALLY: THE HIDDEN DIFFERENCES*

European businessmen often misunderstand each other because of cultural differences. They equally have difficulty with Americans, Arabs and Japanese, who in turn have problems with them. To help all international executives become better intercultural communicators, Dr. Edward Hall and Mildred Reed Hall have provided a series of books, 'Hidden Differences', for Stern magazine. In this article, reprinted from PROFILE, the magazine of Alcatel N.V., John Ritchhart of Stern outlines a clear path to international managerial understanding.

A Japanese, a Frenchman, an American and a German once met for crucial international negotiations. After hearing the pros and cons the Japanese turned and stared out of the window for several minutes with apparent disinterest, much to the disgruntlement of the others. The American felt the German was a frightful pedantic bore, thinking "When is he ever coming to the point?" The Frenchman was also frustrated. Because he didn't think to have the points he wanted to discuss put on the formal agenda, they weren't covered. And the German, offended at the American's cordially calling him "Hans" rather than the respectful "Herr Müller," viewed the proceedings with baleful aloofness.

The negotiations, not surprisingly, collapsed. Yet not a single participant felt that he had committed a mistake, but had acted with complete propriety. What had happened? All too often, we concentrate on our verbal language only - our written and spoken word - and forget that we are simultaneously sending and receiving countless non-verbal messages. The majority of what we communicate to others is in fact non-verbal in nature. And just what is non-verbal communication? In a word, everything. Everything we are, we have, we do. It all sends a message. Wearing a fur coat, a bow tie, driving a Mercedes, a smile or handshake, even our silence. However, just as the various cultures speak different verbal languages, their non-verbal languages also differ greatly and pervasively. Here are some examples: a moustache carries a different message in Baghdad than it does in Baltimore. Wearing a jacket with leather elbow patches is fashionable in some countries, in others it signifies a low income. Germans prefer hardbound books as a symbol of their intelligence; American prefer paperback books to read, absorb the information and discard. And two Russian politicians kissing in Moscow's Red Square send a rather different message than two men who embrace in San Francisco.

Here is precisely where the problems arise in understanding a person from another culture. If we can understand him verbally, we also reason that we can understand what he really means. But we ignore the fact that he is also sending countless, subtle non-verbal messages which we don't understand or badly misinterpret. Misunderstandings are unavoidable.

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The tempo of communication.

There are different "languages" of time just as there are different spoken ones. Dr. Hall maintains that there are two basic systems with which cultures deal with time. The first is called 'monochronic' from the Greek and meaning 'one time,' the second is 'polychronic', or 'many times'. As the term implies, a monochronic person does one thing at a time. He is well-organised, methodical, his day is structured to do one thing after another, like pearls on a string. His time is tangible, like a solid object - it can be lost and of course it can also be wasted. (For a monochronic executive, wasting time is as unprofessional as wasting money).

A polychronic person, on the other hand, does many things at once. His day isn't a chain of isolated, successive blocks, or frames, within which the day's tasks must be completed, but is rather more like a vast ocean extending in every direction and never-ending. Monochronic cultures include the Scandinavians, Germans, Swiss to a large extent the Americans, and the Japanese when dealing with foreigners. Polychronic persons are South Americans, Spaniards, Italians, French, the peoples of the Middle East and the Japanese when by themselves. As one can imagine, the two systems are virtually incompatible. Two examples illustrate this.

When a Swiss executive receives an important visitor he gives that person his entire attention, because he has scheduled a part of his day solely for that visit. But when he travels to Rome to visit an Italian businessman he soon becomes miffed. The Italian, far from giving his guest his undivided attention, is busy with constant, countless interruptions - talking to subordinates, making a telephone call, signing papers, scheduling new appointments. The Swiss can only view this as disrespect - the Italian doesn't feel he's important enough to give him his total attention.

A methodical, organised German visits a Frenchman and after viewing the apparent chaos can only conclude that his host is disorganised and inefficient. The Frenchman feels the German's strict adherence to his daily agenda makes vital interpersonal relationships impossible. Both have totally misread the other's language of time.

Because a monochronic person has scheduled his day to do one thing after another, if his schedule becomes disturbed his whole day will break down. For him punctuality is crucial. As a polychronic person is busy doing many things simultaneously, his schedule is much more flexible. Punctuality isn't essential. An American kept waiting 45 minutes in the other office before an appointment in Mexico City is insulted. But no snub is intended; in polychronic Mexico, constant interruptions and conversational detours cause unavoidable delays. A Mexican interprets this correctly; the American wrongly applied his own time system to interpret Mexican behaviour.

An important corollary of time is the speed or tempo with which a culture communicates. Some are fast, some much slower communicators.

These differing cultural speeds affect the business community in myriad ways. As a rule, the Americans have a faster business tempo than the Germans. German corporations issue a financial report annually, American ones quarterly or even monthly. Because the German tempo is slower, the decision making process, built upon well thoughtout foundations, takes longer. Americans wrongly interpret this as indecision or disinterest.

The most flagrant differences in cultural and managerial speeds are between the Americans and Japanese. American management is expected to produce instant results. Japanese conduct their business by the 'Nemawashi' principle - by the time it takes to grow a tree. They think in terms of seasons or even years, time frames which are inexplicable to Americans. This puts them at a tremendous disadvantage. As one Japanese explained: "You Americans have one terrible weakness. If we make you wait long enough, you will agree to anything".

Languages of space.

A second vital area where cultures subtly, but invariably, differ from one another is the way in which they deal with space. An individual's space or territory, is like an invisible bubble surrounding a person which he carries around like a turtle's shell. We feel uncomfortable when someone 'invades' our personal sphere. The size of our bubble, and how rigidly we defend its borders, expands and contracts depending on the situation and the other persons involved.

As with time, each culture has a different language of space - different sized bubbles. Southern Europeans and Arabs feel comfortable when they stand quite close to another person, touching and breathing in the other's face. Northern Europeans feel most comfortable at arm's length. And what happens when a territorial Englishman meets a Saudi businessman? The Arab gets too close, puts his hand on the Englishman to make a point and generally 'crowds' the former's physical being.

So what does the Englishman automatically, subconsciously do? He takes a step backwards and feels more comfortable. But this makes the Arab uncomfortable and he takes another step forward. And around and around they go like in a Viennese waltz, both basically ill at ease because of differing languages of space.

Territoriality extends to our offices. An American CEO occupies a large corner office. A French executive will ordinarily be found in the middle of the floor, at the hub of communication and influence. Corner rooms are reserved for the lower-most subordinates.

The manner in which we speak to another person also affects his or her personal territorial sphere. The American penchant for calling everybody by their first names is viewed as a rude intrusion in many of the world's cultures. Don't do it!

Getting to the point, formally.

The third area where intercultural differences are especially prominent, and where many pitfalls await the unwary, is how cultures deal with information - gather it, transmit it and store it for later use. Basically, according to Dr. Hall, cultures can be classified into two groups those that rely on formal channels of information, and those that do so informally.

In a culture with informal channels of information, persons have extensive networks among family, friends, colleagues, and clients. They do not require much indepth background information because they keep themselves constantly informed about everything. Conversely, cultures which carefully, methodically do one thing after another, and whose members have rigid territorial 'walls' around them, require formal, detailed background information. They aren't as 'in the know'. And here is the problem. Give someone who has kept himself informally informed too much information (which he already knows) and he will be irritated: give someone who relies on formal channels too little background data and he will be mystified.

Informally communicating cultures are the Japanese, French, Italians, Spaniards and peoples of the Middle East. Northern Europeans like the Swiss and Germans, Scandinavians and the Japanese when dealing with foreigners, on the other hand, require and rely on formal channels or information - on meetings, memoranda, minutes and reports.

Germans are addicted to formal, background data. And where does every respectable German message start? In the past, preferably all the way back to Charlemagne. This frustrates Americans to distraction - they want to get 'right down to the point'.

One of the greatest challenges facing international business is providing the appropriate balance of formal versus informal information in its activities in the respective cultures. Too much detail bores some, too little frustrates others.

Concepts of intercultural differences are of course not concepts of absolute values; there is not the 'typical' Frenchman or Japanese, and there are often greater cultural differences between the members of one country than between different nations. The model presented here should be viewed as a set of general guidelines aimed at explaining another person's behaviour. If we bear in mind that subtle, pervasive differences do exist between the individual cultures - how they deal with time, space, possessions, information, formality, power and familiarity - and can tailor our actions and reactions to take these differences into account, we will be going in the right direction in explaining hitherto unexplainable problems we have had with other cultures. And once we are going in the right direction, deciphering foreign behaviour will be just that much easier, like deciphering a secret, hidden foreign code.