INDIANHEAD LENTIL AS A FALLOW SUBSTITUTE IN THE DARK BROWN SOIL ZONE

Dr. A.E. Slinkard
Crop Development Centre
University of Saskatchewan, Saskatoon, Sask.

Dr. V.O. Biederbeck
Agriculture Canada Research Station
Swift Current, Sask.

Over 30% of the cultivated land in Saskatchewan is fallowed each year, nearly 6 million hectares. Much of this land is subject to serious degradation through such mechanisms as accelerated oxidation of organic matter, wind erosion, water erosion and redistribution and concentration of soluble salts into salt-affected areas.

Fallowing is often justified by the increased availability of nitrogen (from degradation of organic matter), increased supply of available water (an extra 3 to 6 cm increase over the 18 to 20 months between harvest and seeding a fallow crop) and improved weed control (by clean cultivation). However, the question may well be asked: Are these benefits worth the cost of reduced land quality? Many farmers would say, "No, but I don't have any choice under today's economic conditions". I would submit that we do have a choice. We cannot afford to continue to destroy our soil. For the benefit of our farms, our children, our province and our country we must start doing something about it today, this year. We cannot afford to wait until tomorrow as tomorrow never comes.

Farmers and researchers alike must develop and evaluate new cropping systems in an effort to reduce soil degradation in Western Canada. We have developed a cropping system that promises to revolutionize farming in the Dark Brown soil zone and has potential benefits in other parts of Western Canada. It only remains to be fully and properly evaluated by the farmers in the Dark

Brown soil zone, who are currently fallowing between 25% and 50% of their cultivated land.

This new cropping system is the ultimate in simplicity. It merely involves growing Indianhead lentil as an annual legume green manure crop during the fallow year. What could be simpler than that?

Previous research plus ongoing cooperative research with Dr. Bailey (AC, Brandon), Drs. Olsen and Rice (AC, Beaverlodge), L. Townley-Smith (AC, Melfort) and H. Campbell (Qu'Appelle farmer) indicate that various annual legume green manure crops have beneficial effects on yield and quality of the succeeding cereal crop. Species tested include Tangier flatpea (**Lathyrus tingitanus**), common flatpea (**Lathyrus sativus**), pea (**Pisum sativum**), faba bean (**Vicia faba**), lentil (**Lens culinaris**) and non-dormant alfalfa (**Medicago sativa**). In general, dry matter yields were highest for pea, lowest for the non-dormant alfalfa and the others were intermediate. A similar relationship usually existed for nitrogen yield and amount of nitrogen fixed, based on an acetylene reduction assay.

Only peas, Indianhead lentil and Tangier flatpea were grown at all sites and a summary of their performance on the Brown and Dark Brown soil sites is presented in Table 1. Peas were the highest in both dry matter and nitrogen yields and they fixed the largest amount of nitrogen. Indianhead lentil and Tangier flatpea performed similarly, but produced only a little over half as much dry matter and nitrogen as peas.

Wheat yields the year following incorporation of the annual legume green manure crops are presented in Table 2. Wheat yields following peas, Indianhead lentil and Tangier flatpea were similar (Table 2), even though pea dry matter and nitrogen yields the previous year were nearly twice those for Indianhead lentil and Tangier flatpea (Table 1). This suggests that the inclusion of an

annual legume green manure crop in the rotation is more important than the amount of dry matter and nitrogen produced by that crop, at least after a certain minimum threshold level of production has been reached.

Table 1. Dry matter yield, nitrogen yield and nitrogen fixed in three annual legume green manure crops at Saskatoon, Swift Current and Qu'Appelle, Saskatchewan, 1984-86

Trait and site	Peas †	Indianhead lentil	Tangier flatpea
Dry matter yield (kg/ha)			
Saskatoon (3 years)	4412	2630	1930
Swift Current (3 years)	2379	1496	1353
Qu'Appelle (2 years)	3440	1821	2266
Average (8 site-years)	3407	2002	1798
Nitrogen yield (kg/ha)			
Saskatoon (3 years)	114	76	53
Swift Current (3 years)	65	41	37
Qu'Appelle (2 years)	77	38	47
Average (8 site-years)	86	53	46
Nitrogen fixed ‡ (kg/ha)			
Saskatoon (3 years)	45	12	16
Swift Current (3 years)	37	25	20
Qu'Appelle (2 years)	31	16	19
Average (8 site-years)	38	20	18

†Trapper field peas were grown at Saskatoon; Semu S.I. feed peas were grown at Swift Current and Qu'Appelle.
‡Nitrogen fixation estimated by acetylene reduction at Saskatoon and Swift Current and data extrapolated to Qu'Appelle.

Table 2. Wheat yields after annual legume green manure crops at Saskatoon, Swift Current and Qu'Appelle, Saskatchewan 1984-1986

Site	Green Manure Crop			Fallow	Continuous wheat
	Peas †	Indianhead lentil	Tangier flatpea		
	kg/ha				
Saskatoon (2 years)	1964	1978	2024	2460	1669
Swift Current (3 years)	2005	2110	1956	2380	--
Qu'Appelle (2 years)	1682	1633	1626	1959	1087
Average (7 site-years)	1901	1936	1881	2283	

†Trapper field peas were grown at Saskatoon; Semu S.I. feed peas were grown at Swift Current and Qu'Appelle.

If dry matter and nitrogen yields (above a certain minimum) are not important, then selection of the best annual legume green manure crop is dependent on cost of seed per acre. Based on cost of pedigreed seed, seed cost of Indianhead lentil is $12.00 per acre (30 lbs. @ $0.40), seed cost of Trapper field pea is $24.00 per acre (120 lbs @ $0.20), seed cost of Semu S.I. feed pea is even higher, and seed cost of Tangier flatpea is more than $24.00 per acre (60+ lbs at more than $0.40). Thus, the annual legume green manure crop of choice then becomes Indianhead lentil.

These kinds of results prompted us to establish two acre plots in fallow fields of 14 different cooperators in 1986. Paired comparisons of different management practices were made at each site. Plots were harvested for dry matter and nitrogen yields in late October after many leaves had been lost so the yield data are underestimates of the performance of Indianhead lentil. Nevertheless, as an average of all sites and all treatments, the average dry matter yield of these plots was 1497 kg/ha and the average nitrogen yield was 24 kg/ha. At $0.25 per lb of nitrogen, the value of this nitrogen was $6.00 per acre. It is conservatively estimated that there was another $3.00 of nitrogen in the leaves lost prior to the delayed harvest for a total of $9.00 worth of nitrogen per acre in the top growth. In 1988 when there will be an adequate supply of Indianhead lentil seed available, the seed cost should be reduced to $9.00 per acre (30 lbs @ $0.30). Thus, the value of nitrogen in the top growth will be approximately equal to the cost of seed.

Since production of an Indianhead lentil crop for green manure will require fewer field operations than fallowing, its use as a fallow substitute will be cost-effective, i.e. no additional cost plus the allied benefits of nitrogen fixation, rapidly decomposible organic matter, protection of the soil against wind and water erosion and the benefit of snow trapping if managed

properly. Other studies have shown that best results occur if Indianhead lentil is seeded at 30 kg/ha with 20 kg/ha seed-placed phosphate following pre-seeding tillage to control annual weeds and volunteer cereals.

Four different management systems are being further evaluated under commercial conditions. The fact that the Indianhead lentil produces most of its dry matter yield and nitrogen in the first 60 days after seeding permits some flexibility in its management, even in the relatively short growing season in the Dark Brown soil zone of Saskatchewan. The four management options are:

1. Pretill stubble in spring after other crops are seeded. Seed inoculated Indianhead lentil at 30 kg/ha with seed-placed phosphate soon afterward. If volunteer cereals and weeds are a serious problem, incorporate all top growth about 60 days after seeding.
2. Pretill stubble in spring after other crops are seeded. Seed inoculated Indianhead lentil at 30 kg/ha with seed-placed phosphate soon afterwards. If volunteer cereals and weeds are not too serious, spray with a medium rate of 2,4-D (about 1 L/ha = 0.4 L/ac) about 6 weeks after seeding, but before flowering starts. This treatment will suspend growth for 3 to 4 weeks and then the lentil plants will start growing again and remain green right up to soil freeze-up in the fall. The top growth traps snow over the winter and helps compensate for the soil moisture used during August and September.
3. Pretill stubble in the spring after the other crops are seeded. Seed inoculated Indianhead lentil at 30 kg/ha with seed-placed phosphate soon afterward. If volunteer cereals and weeds are not too serious, spray with a medium rate of 2,4-D (about 1 L/ha = 0.4 L/ac) about 10 days after flowering starts. This treatment will prevent seed production, and most of the lentil plants will die. The erect plants

then go into the winter and trap snow. Since little or no moisture is used during and after August, this management system appears to have the greatest potential in the drier areas.

4. Pretill and pack stubble in spring after the other crops are seeded. Cultivate the field again about June 14 and immediately seed inoculated Indianhead lentil (7.5 cm or 3 in deep if needed to place seeds in moist soil) at 30 kg/ha with seed-placed phosphate. Few volunteer cereals or annual weeds will survive this system and no seed will be produced on the lentil plants. The green lentil plants go into the winter and trap snow to partially compensate for the moisture used during August and September.

NOTE: Problems with winter annual weeds such as stinkweed, flixweed and shepherd's purse can be greatly reduced by spraying the cereal stubble the previous October with 2,4-D.

The use of Indianhead lentil as an annual legume green manure crop in place of fallow in the Dark Brown soil zone of Saskatchewan has the potential of revolutionizing agriculture. However, the extent and rate of farmer acceptance will determine whether this potential is attained. The renewed interest in conservation of our soil resource should assist in this transition.