Agriculture Canada

Research Branch | Direction générale de la recherche

Technical Bulletin 1983-2E

Intermediate wheatgrass

Canada

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Technical Bulletin 1983-2E

Research Branch
Agriculture Canada
1983

Copies of this publication are available from
Director
Research Station
Research Branch, Agriculture Canada
Swift Current, Saskatchewan
S9H 3X2

Produced by Research Program Service

Cat. No. A54-8/1983-2E
ISBN 0-662-16962-X
Printed 1983
Reprinted 1989

Cover illustration
The dots on the map represent Agriculture Canada research establishments.

SUMMARY

Intermediate wheatgrass is an excellent hay and pasture grass for semiarid or irrigated land in Western Canada. This grass is a winter-hardy, drought-tolerant, long-lived perennial with weakly to strongly creeping rootstocks that form a tough sod under moist conditions. The vigorous seedlings establish readily and tend to remain in a rosette stage during the first year of growth.

Points to remember:

- Clarke, Chief, and Greenleaf are the recommended cultivars.
- For hay, seed either in the spring in a well-prepared seedbed or in late fall into stubble that has been sprayed with herbicide for control of winter annuals. Seed at 60-100 seeds per metre of row and at 2-3 cm deep. Seed in alternate rows with alfalfa. In dry areas, space the rows of grass and alfalfa 45-90 cm apart; in moist areas and on irrigated land, 15-45 cm apart.
- For pasture, seed as for hay except use a cross-seeding pattern for the grass and alfalfa in rows spaced 60-90 cm apart in dry areas and 30-45 cm apart in moist areas and on irrigated land.
- Seed a legume such as Heinrichs, Rambler, or Rangelander alfalfa with intermediate wheatgrass on dryland and Roamer or Beaver alfalfa on irrigated land.
- For a seed crop, drill the seed at 4.5 kg/ha in rows 90 cm apart and provide adequate fertilization.
- Harvest the seed in the late-milk to firm-dough stage.

RÉSUMÉ

Sur les terres semi-arides ou irriguées de l'ouest du Canada, l'agropyre intermédiaire est une excellente graminée en régime de fauche ou de pâture. C'est une plante vivace de longue durée, résistante à l'hiver et à la sécheresse, qui porte des racines variant de faiblement à fortement rampantes et formant une prairie résistante en milieu humide. Les plantules sont vigoureuses et s'installent facilement; pendant la première année de croissance, elles restent le plus souvent au stade de rosette.

Points importants:

- Le Clarke, le Chief et le Greenleaf sont les cultivars recommandés.
- En régime de fauche, les semis se font au printemps en sol bien préparé, ou tard à l'automne dans le chaume qu'on a pulvérisé avec un désherbant contre les plantes annuelles d'hiver. La densité recommandée pour les semis est de 60 à 100 graines au mètre, à une profondeur de 2 à 3 cm, en alternance avec des lignes de luzerne. Dans les endroits secs, écarter les lignes de graminée et de luzerne de 45 à 90 cm, tandis que dans les endroits humides et irrigués, les espacer de 15 à 45 cm.
- En régime de pâture, semer comme en régime de fauche, sauf que l'ensemencement de la graminée et de la luzerne se fait en lignes croisées, écartées de 60 à 90 cm dans les endroits secs et de 30 à 45 cm dans les endroits humides et irrigués.
- Sur terrain sec, semer une légumineuse comme la luzerne Heinrichs, Rambler ou Rangelander avec l'agropyre intermédiaire, tandis que sur terrain irrigué, semer la luzerne Roamer ou Beaver.
- Pour la production de semences, semer à raison de 4,5 kg/ha en lignes espacées de 90 cm et bien fertiliser.
- Les grains sont récoltés au stade laiteux final ou au stade pâteux ferme.

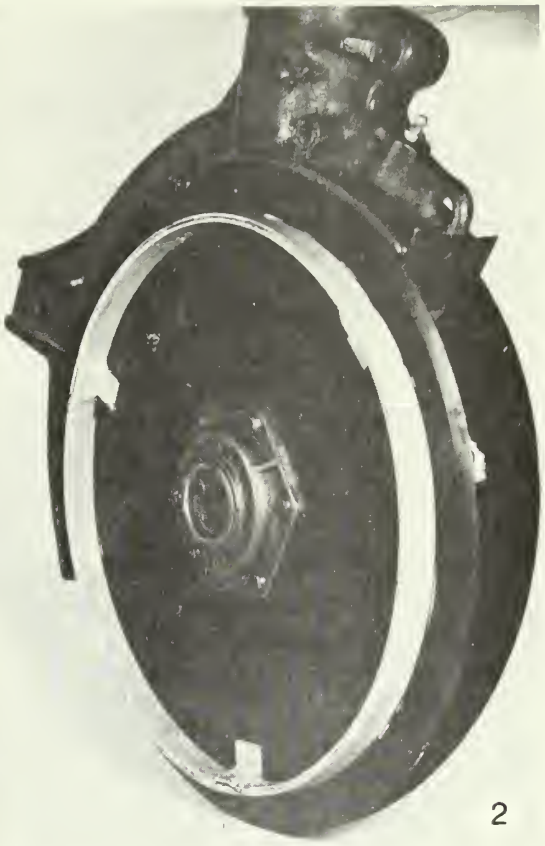

Fig. 1 Individual plant of intermediate wheatgrass. Note occurrence of leaves well up on the stems.

Fig. 2 Flange rings spot-welded to drill discs to control depth of seeding.

Fig. 3 Control of winter annuals by fall spraying of stubble fields. Photo taken in late spring. (left) plots not sprayed the previous fall; (right) plots sprayed with 2,4-D ester at 420 mL/ha the previous fall.

A GRASS FOR HAY OR PASTURE

Intermediate wheatgrass, Agropyron intermedium (Host) Beauv. (Fig. 1), is an excellent hay and pasture grass. It begins growth early in the spring, and produces a high yield of nutritious, palatable forage. Intermediate wheatgrass was introduced into the USA from Trans-Ural Siberia in 1907. A later introduction made in 1932 from the Maikop region of USSR soon found its way into Canada. It was first grown at the Agriculture Canada Research Station, Swift Current, in 1937. Ree, a South Dakota variety released in 1945, was used as a commercial seed source for hay and pasture seedings in Western Canada for many years.

Intermediate wheatgrass is a winter-hardy, drought-tolerant, long-lived perennial grass. It has weakly to strongly creeping rootstocks that form a tough sod under moist conditions. The many long basal leaves surround leafy stems 90-150 cm tall, which end in a long spike. The foliage varies in color from bright green to dull blue green. The edges of the leaves, the heads, and the seeds vary from glabrous to pubescent. The inflorescence is a narrow spike 15-25 cm long, with spikelets spaced alternately on the rachis. Each spikelet contains 2-6 florets. The glumes are pointed and about half the length of the spikelet. There are approximately 194 000 seeds per kilogram. The vigorous seedlings establish readily and tend to remain in a rosette stage during the first year of growth.

ADAPTATION

Intermediate wheatgrass is well adapted for hay and pasture use in Manitoba, Saskatchewan, Alberta, and the Northern Great Plains of the United States. It has a large seed (Fig. 4), good seedling vigor, and is easily established.

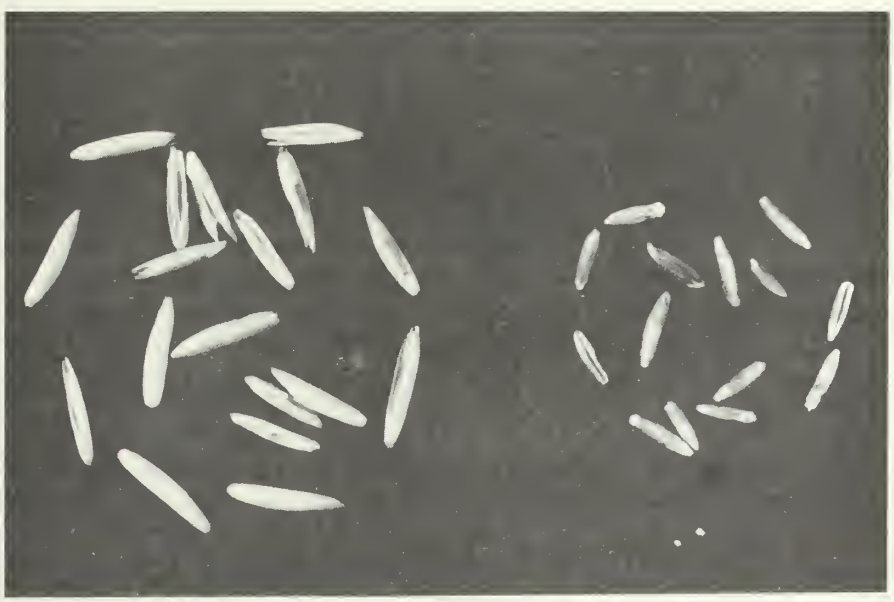

Fig. 4. Typical seeds of intermediate wheatgrass: (left) hull-covered; (right) hulless.

CULTIVARS

Clarke, Chief, and Greenleaf are the recommended cultivars in Canada. Clarke was developed at the Agriculture Canada Research Station, Swift Current, Saskatchewan, and released in 1980. Its main attributes are improved drought tolerance, winterhardiness, and high seed yield. Clarke was compared with Chief and Greenleaf, the two older Canadian cultivars of the intermediate wheatgrass complex. Greenleaf has sometimes been described as a cultivar of pubescent wheatgrass, Agropyron trichophorum (Link) Richt. However, there is overwhelming evidence to support the author's view that the separation of A. trichophorum and A. intermedium is entirely artificial and that they are part of the same species complex. In cooperative tests across Western Canada, the dry matter yield of Clarke equaled that of Chief and was 7% higher than that of Greenleaf (Table 1). Clarke yielded 20% more seed than Chief and 45% more than Greenleaf (Table 1). Chief, developed at the Agriculture Canada Research Station, Saskatoon, Saskatchewan, and released in 1961, yields more dry matter and seed than Greenleaf, which was released by the Agriculture Canada Research Station, Lethbridge, Alberta, in 1966.

TABLE 1. Dry matter and seed yields of three cultivars of intermediate wheatgrass across Western Canada

Cultivar	Dry matter yield kg/ha	Seed yield kg/ha
Clarke	6425	639
Chief	6386	499
Greenleaf	6000	441
Number of Station-years	21	15

UTILIZATION AND MANAGEMENT

Hay

Intermediate wheatgrass is an excellent hay grass for both dryland and irrigated land. It will equal crested wheatgrass and outyield bromegrass under drought conditions on dryland (Table 2). At the same time it possesses the potential and elasticity of growth to outyield both crested wheatgrass and bromegrass under favorably moist years on dryland (Table 3). Intermediate wheatgrass will outyield bromegrass and reed canarygrass when grown on fertile well-drained irrigated land (Table 4). It is less competitive with alfalfa than bromegrass or crested wheatgrass and maintains a more desirable grass-alfalfa balance when grown with alfalfa (Table 5).

On dryland, intermediate wheatgrass should be seeded in alternate rows with alfalfa at the rate of 4 kg of intermediate wheatgrass to 1 kg of alfalfa per hectare for maximum hay production (Table 6). Dryland yields will also be maximized by seeding the rows of grass and alfalfa 60-90 cm apart.

TABLE 2. Mean 9-yr dry matter yield of grass and alfalfa on dryland

	Dry matter yield - kg/ha			
	Pattern of seeding of grass-alfalfa			
	Alternate rows		Mixed in row	
	kg/ha	% alfalfa	kg/ha	% alfalfa
Intermediate wheatgrass	1759	45	1274	30
Crested wheatgrass	1824	22	1301	14
Bromegrass	1569	44	1105	31

TABLE 3. Mean 5-yr dry matter yield of three grasses grown for hay on dryland

Grass	Dry matter yield - kg/ha
Intermediate wheatgrass	2921
Crested wheatgrass	2606
Bromegrass	2353

TABLE 4. Mean 4-yr dry matter yield of irrigated intermediate wheatgrass, bromegrass, and reed canarygrass grown on a well-drained loam soil

Grass	Dry matter yield - kg/ha
Intermediate wheatgrass	10067
Bromegrass	8542
Reed canarygrass	8497

TABLE 5. Composition of 4-yr-old stands of grass-alfalfa mixtures grown for hay on dryland

Grass component	Composition (%)			
	Test 1		Test 2	
	Grass	Alfalfa	Grass	Alfalfa
Intermediate wheatgrass	44	56	39	61
Crested wheatgrass	66	34	67	33
Bromegrass	68	32	67	33

TABLE 6. Comparative yield of intermediate wheatgrass and crested wheatgrass grown in alternate rows with alfalfa or in mixture with alfalfa on dryland

Grass with alfalfa	Mean 4-yr dry matter yield - kg/ha	
	Alternate row	Mixed in row
Intermediate wheatgrass	5242	4368
Crested wheatgrass	4480	4166

On irrigated land, intermediate wheatgrass and alfalfa should be seeded in mixture in rows 15 cm apart, with grass at 11 kg/ha and alfalfa at 3 kg/ha. Many stockmen prefer a mixed grass-legume fodder as a balanced feed that requires little or no supplementation. A pure grass roughage may require supplementation with protein and a pure legume fodder would likely be a luxury feed requiring dilution with lower quality roughage for economical use. Also, mixed stands are more suitable for mechanical harvesting. They do not lodge easily, the cut swath separates cleanly from the uncut portion, drying is more rapid, and the stack spoilage and loss are reduced. A mixture reduces the bloat hazard, the grass can benefit from alfalfa's ability to use nitrogen from the air to supply its own requirements, and if the alfalfa winterkills, the grass will provide a partial hay crop.

In some irrigated areas the alfalfa component will dominate a mixed stand and crowd out the grass. Where this happens the grass-alfalfa balance can be controlled by supplying annually N fertilizer at about 80 kg/ha (Table 7).

TABLE 7. Proportion of grass-alfalfa in a mixed stand as influenced by N fertilizer

	Dry matter yield - kg/ha	
	0 fertilizer	N fertilizer at 80 kg/ha
Grass	747	3827
Alfalfa	8213	5506
Total	8960	9333

High productivity of intermediate wheatgrass can be maintained by careful management. The best balance between yield and quality can be obtained by cutting at the flowering stage (Table 8). Height of cutting should not be lower than 7.5 cm, cutting at the shot blade stage in mid-June should be avoided, and a recovery period of at least 42 days should be observed between cuttings. There is probably no advantage in taking more than two hay cuts

per season, even if there is some regrowth after the second cut. A single annual application of N fertilizer at a rate not exceeding 225 kg/ha should be made each spring. Applications of N fertilizer at rates in excess of 225 kg/ha should be avoided because of danger of nitrate toxicity.

TABLE 8. Effect of stage of harvest on the dry matter yield of three grasses

	Dry matter yield - kg/ha			
	Vegetative	Shot blade	Flower	Seed
Intermediate wheatgrass	6547	7488	10067	10268
Bromegrass	5986	5852	8542	9147
Reed canarygrass	6076	6614	8497	9013

Pasture

Intermediate wheatgrass begins growth early in the spring (Table 9) and is a valuable pasture grass (Tables 10 and 11). In many areas it consistently outyields bromegrass and crested wheatgrass. It is rated as one of the best grasses because it produces more pasturage and adds more fiber to the soil than most other grasses.

In pasture tests at the Agriculture Canada Research Station, Lethbridge, Alberta, intermediate wheatgrass-legume mixtures consistently outyielded other grass-legume mixtures under irrigation. Because of the higher forage yield, intermediate wheatgrass pastures can be stocked heavier than pastures of other grasses. Slow regrowth following grazing may present some management problems on irrigated pasture, and it may be necessary to move the cattle to spare pasture for the first 3 weeks of July.

Intermediate wheatgrass provides excellent irrigated or dryland pasture from early spring to late summer and is palatable to all classes of livestock. Most growth is produced in spring and early summer. Regrowth is better than that of bromegrass, but overgrazing should be avoided to prevent rapid deterioration of stands in intermediate wheatgrass pastures.

Early spring and late fall have been the most successful seeding times for establishing intermediate wheatgrass. For spring seeding, firm the seedbed to ensure shallow seeding. Depth controls attached on the drill discs help to seed at a uniformly shallow depth of less than 2.5 cm (Fig. 2). Because grass seedlings develop slowly, destroy weeds before seeding either by cultivating or by using a herbicide. Weeds compete with the grass seedlings for moisture and light. Chemical weed control may be used again after the grass has developed beyond the three-leaf stage. Because alfalfa is sensitive to certain herbicides, care must be exercised when spraying stands that include it. Check with your local extension specialist for the latest herbicide recommendations.

TABLE 9. Dry matter yield of grasses cut in the spring (mean of five weekly cuttings each taken on a previously uncut plot 18 May-22 June)

Grass	Dry matter yield - kg/ha
Chief intermediate wheatgrass	2457
Summit crested wheatgrass	2003
Carlton bromegrass	1226

TABLE 10. Mean productivity of two pastures grazed by yearling Hereford steers for 6 yr (Melfort dryland)

	Intermediate wheatgrass and alfalfa	Bromegrass and alfalfa
Steer days/hectare	227	220
Average daily gain, kilograms/steer	0.95	1.00
Dry matter produced, kilograms/hectare	2685	2436
Dry matter consumed, kilograms/hectare	2467	2304
Beef produced, kilograms/hectare	222	210

TABLE 11. Mean productivity of two irrigated pastures grazed by yearling heifers for 4 yr

	Intermediate wheatgrass, alfalfa, and creeping red fescue	Bromegrass, alfalfa, and creeping red fescue
Dry matter yield - kilograms/hectare	12,478	11,192
Carrying capacity - Animal unit days/hectare	1,125	1,075

Fall seeding is best done after mid-October in weed-free stubble. About 10 days before or soon after seeding, spray the stubble field with a herbicide to control winter annual weeds such as flixweed, stinkweed, or narrow-leaved hawk's-beard. These weeds reduce stands of fall-seeded forage crops through competition the next spring (Fig. 3). Spraying, rather than cultivating, leaves a firm seedbed that makes depth control easier, and the stubble traps snow to ensure a better moisture supply for early spring germination and growth.

On irrigated land an intermediate wheatgrass-alfalfa mixture may be established with a cereal or companion crop. To reduce the competitive effect of the nurse crop use a less competitive crop, such as wheat, and seed it at right angles to the rows of grass-alfalfa and at half the normal seeding rate. The companion crop should also be harvested for hay. This will allow the grass-alfalfa mixture to get more light for growth in late summer and fall.

Row spacing, seeding pattern, and fertilizer use

Moisture is the principal factor that limits dryland forage production in most of the area to which intermediate wheatgrass is adapted. These limiting effects of low precipitation and high evaporation can be reduced somewhat by adjusting the plant population to suit the available moisture. This is most easily achieved by varying the space between rows. Row spacings of 60-90 cm are recommended for the dry southern prairies, 30-45 cm for the northern prairies, and 15 cm for irrigated land.

Several studies have shown the advantage of including alfalfa with grasses for hay (Table 12), and pasture seedings (Fig. 5). Other studies have shown the advantage of growing grass and alfalfa in alternate rows or in cross-seeded rows rather than as mixtures in the same row (Fig. 6). The use of an alternate-row for hay or a cross-seeded pattern for pasture results in better and more lasting production than a mixed grass-alfalfa stand (Table 13). The cross-seeded pattern has additional advantages for pasture but is too rough for hay fields. Small pockets are formed to reduce runoff and water erosion. Also, the grass can be seeded at its correct seeding rate in one direction and the alfalfa at its correct seeding rate in a second seeding, either diagonally or at right angles to the rows of grass.

TABLE 12. Average yields of grasses grown alone or with alfalfa

Grass	Dry matter yield - kg/ha	
	Alone	With alfalfa
Intermediate wheatgrass	1288	1970
Crested wheatgrass	1399	2043
Bromegrass	1011	1758

Fertilizer is not usually required in the Brown and Dark Brown soil zones when a legume is included in the pasture. When grass is grown alone or with legumes, rely on soil tests to determine the fertilizer requirements.

SEED PRODUCTION

Growing grass seed is a specialized business. However, if you are going to grow grass seed you should join the Canadian Seed Growers' Association and grow pedigreed seed. Foundation seed is usually grown under contract and only well-established growers are chosen to do this. Certified seed is the

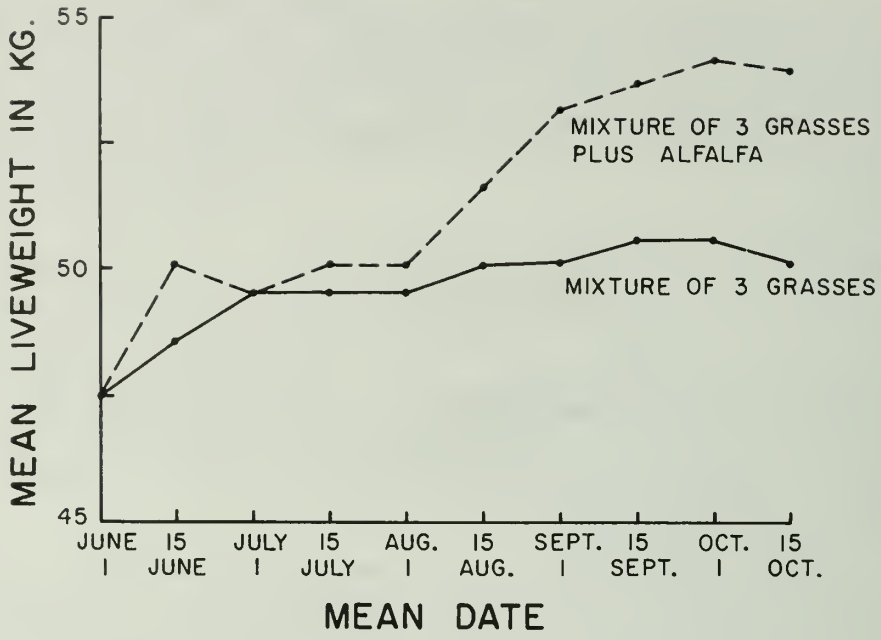

Fig. 5. Average 6-yr weight of yearling ewes following shearing to end of grazing season.

TABLE 13. Comparative yield of grass and alfalfa as influenced by pattern of seeding

Stand pattern	Mean 5-yr dry matter yield as percentage of 30-cm mixed stand
30-cm mixed rows	100
60-cm mixed rows	121
90-cm mixed rows	129
30-cm crossed rows	119
60-cm crossed rows	136
90-cm crossed rows	125
30-cm alternate rows	126
60-cm alternate rows	134
90-cm alternate rows	103

class of seed sold commercially and it is produced from Foundation seed. Foundation seed of Greenleaf and Chief can be obtained from the Canadian Forage Seeds Project through your provincial forage crop specialist. Foundation seed of Clarke is available through SeCan Association, Suite 512, 885 Meadowlands Drive, Ottawa, Ontario, K2C 3N2.

Fig. 6 Example of stand patterns: (from top to bottom) mixture, alternate rows, and crossed rows.

Fig. 7 A field of intermediate wheatgrass sown for seed production in rows 90 cm apart.

Seed production studies at the Agriculture Canada Research Station, Swift Current, Saskatchewan, have shown that row spacings of 90 cm are required for reliable seed production on dryland (Fig. 7). On irrigated land, row spacings of 45 cm are suitable. After the first seed crop year nitrogen fertilizer will be required for sustained production. Growers should rely on results from soil testing for proper fertilizer recommendations.

Intermediate wheatgrass is susceptible to shattering, and serious shattering losses can occur if the seed is left until it is ripe. The best time to harvest is when the seed is in the firm-dough stage.

A satisfactory method of harvesting is to swath the crop and then thresh with a combine several days later. You may have to slow down the operating speed of the pickup because high speed may cause excessive shattering and seed loss. Light crops can be combined directly if care is taken to dry the seed before storage.

Combines equipped with rub-bar cylinders are most suitable. Correct combine adjustments come by trial and error and vary with the make of machine. To start, adjust the concaves to the same setting as for wheat. If the straw is broken too much so that a great deal of it comes into the hopper with the seed, increase the clearance between the cylinder and the concaves. You may need to open up the concaves as wide as possible. If this does not give the desired effect, slow down the cylinder slightly. Be careful not to slow it too much because this reduces the capacity of the combine and tends to plug it in heavy swaths. Set the adjustable sieves one-third to one-half open. You can find the best setting only by repeated trials. To clean the seed properly, slow the fan as much as possible and adjust the wind control doors. With some machines it may be necessary to insert pieces of cardboard to reduce the air intake. Direct the air blast toward the front of the sieves. This provides for better separation and avoids seed being blown over the back of the combine.

When harvesting and processing intermediate wheatgrass seed, care must be taken to minimize the removal of the hulls from the seed. Hulless seeds are inferior to hull-covered seeds in maintaining viability during storage and in emergence potential (Fig. 8). The ordinary fanning mill usually cleans the seed well enough to seed through a drill, but it does not remove all weed seeds; an indent disc separator with appropriate discs is necessary to remove them. If you try to remove all weed seeds with the fanning mill, a lot of good grass seed may be lost. Metal sheet screens are more suitable than wire screens for cleaning grass seed. The wire screens tend to plug up too easily, making it necessary to remove and clean them frequently. Scalping the seed over a 0.6 cm (No.16) round-hole screen will remove about 90% of the inert material. It may be necessary to run the seed through twice to obtain clean seed. The appropriate screen size depends on the quality of the seed; therefore a larger or smaller one than that suggested above may be used.

If cleaning equipment is not available on the farm, the seed can be cleaned at a commercial seed cleaning plant. It is best to make the arrangements well before harvest.

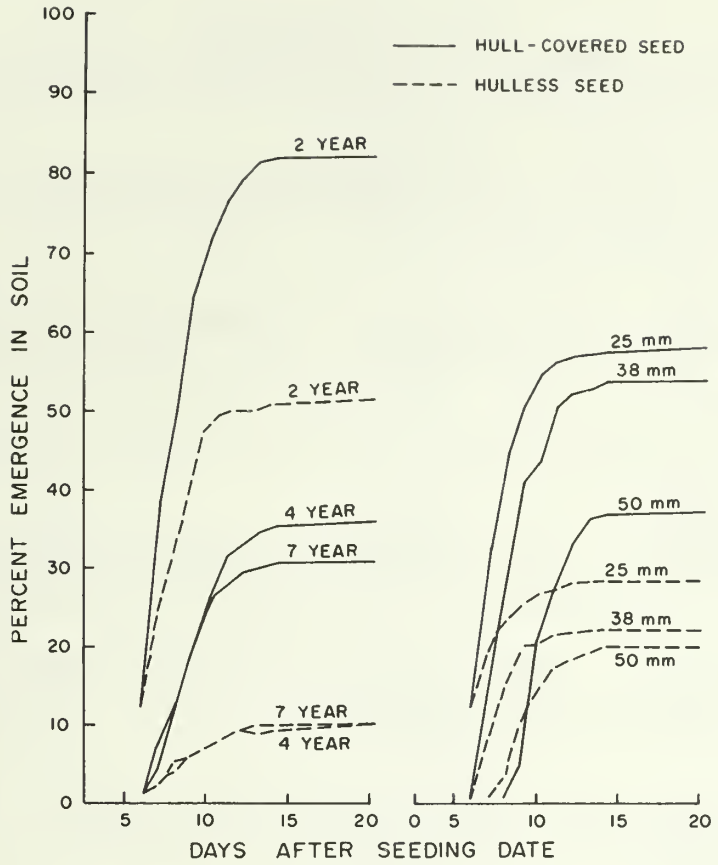

Fig. 8. Average rate and final seedling emergence from hull-covered and hulless seed of intermediate wheatgrass as affected by age of seed and depth of planting.

Most seed is sold to commercial seed houses. If you grow a large quantity of seed it is advisable to invest in cleaning machinery and clean the seed yourself. If you grow a small quantity, it may be marketed through commercial seed houses in uncleaned form. There is a charge for cleaning the seed, and the dockage increases the shipping cost.

OTHER HELPFUL INFORMATION

Ashford, R.; Troelsen, J. E. 1965. The effect of nitrogen fertilizer and clipping frequency upon the yield and in vitro digestibility of intermediate wheatgrass. J. Br. Grassl. Soc. 20:139-143.

Cooke, D. A.; Beacom, S. E.; Dawley, W. K. 1965. Pasture productivity of two grass-alfalfa mixtures in northeastern Saskatchewan. Can. J. Plant Sci. 45:162-168.

Kilcher, M. R.; Lawrence, T. 1960. Quality of intermediate wheatgrass seed, with and without hulls. Can. J. Plant Sci. 40:482-486.

Lawrence, T. 1973. Productivity of intermediate wheatgrass as influenced by date of initial cutting, height of cutting and N fertilizer. Can. J. Plant Sci. 53:295-301.

Lawrence, T. 1977. Productivity of intermediate wheatgrass, crested wheatgrass, and bromegrass as influenced by length of ley and pattern of seeding. Forage Notes 22(1):43-49.

Lawrence, T. 1978. An evaluation of thirty grass populations as forage crops for southwestern Saskatchewan. Can. J. Plant Sci. 58:107-115.

Lawrence, T.; Ashford, R. 1966. The productivity of intermediate wheatgrass as affected by initial harvest dates and recovery periods. Can. J. Plant Sci. 46:9-15.

Lawrence, T.; Ashford, R. 1969. Effect of stage and height of cutting on the dry matter yield and persistence of intermediate wheatgrass, bromegrass, and reed canarygrass. Can. J. Plant Sci. 49:321-332.

Lawrence, T.; Ashford, R. 1969. Effect of nitrogen fertilizer and clipping frequency on the dry matter yield and persistence of intermediate wheatgrass. Can. J. Plant Sci. 49:435-446.

Lawrence, T.; Warder, F. G.; Ashford, R. 1968. Nitrate accumulation in intermediate wheatgrass. Can. J. Plant Sci. 48:85-88.

Lawrence, T.; Warder, F. G.; Ashford, R. 1970. Effect of fertilizer nitrogen and clipping frequency on the crude protein content, crude protein yield and apparent nitrogen recovery of intermediate wheatgrass. Can. J. Plant Sci. 50:723-730.

Lawrence, T.; Warder, F. G.; Ashford, R. 1971. Effect of stage and height of cutting on the crude protein content and crude protein yield of intermediate wheatgrass, bromegrass, and reed canarygrass. Can. J. Plant Sci. 51:41-48.

CONVERSION FACTORS

Metric units	Approximate conversion factors	Results in:
LINEAR		
millimetre (mm)	X 0.04	inch
centimetre (cm)	X 0.39	inch
metre (m)	X 3.28	feet
kilometre (km)	X 0.62	mile
AREA		
square centimetre (cm^2)	X 0.15	square inch
square metre (m^2)	X 1.2	square yards
square kilometre (km^2)	X 0.39	square mile
hectare (ha)	X 2.5	acres
VOLUME		
cubic centimetre (cm^3)	X 0.06	cubic inch
cubic metre (m^3)	X 35.31	cubic feet
cubic metre (m^3)	X 1.31	cubic yards
CAPACITY		
litre (L)	X 0.035	cubic foot
hectolitre (hL)	X 22	gallons
hectolitre (hL)	X 2.5	bushels
WEIGHT		
gram (g)	X 0.04	oz avdp
kilogram (kg)	X 2.2	lb avdp
tonne (t)	X 1.1	short tons
AGRICULTURAL		
litres per hectare (L/ha)	X 0.089	gallons per acre
litres per hectare (L/ha)	X 0.357	quarts per acre
litres per hectare (L/ha)	X 0.71	pints per acre
millilitres per hectare (mL/ha)	X 0.014	fl. oz per acre
tonnes per hectare (t/ha)	X 0.45	tons per acre
kilograms per hectare (kg/ha)	X 0.89	lb per acre
grams per hectare (g/ha)	X 0.014	oz avdp per acre
plants per hectare (plants/ha)	X 0.405	plants per acre