Cover Cropping Guide

For British Columbia

BRITISH COLUMBIA | Ministry of Agriculture and Food

BRITISH COLUMBIA | AgriServiceBC

Cover Cropping Guide For British Columbia

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B.C. Ministry of Agriculture and Food

May 2024

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Benefits of Cover Cropping

An increasing number of farmers integrate crops into their cash-crop rotation that are not harvested or utilized as forage but grown to improve soil quality. This farm practice is called cover cropping.

The list of benefits that cover cropping provides to soils and to the cash crop is long. However, cover cropping can also help farmers to achieve their environmental sustainability goals and to improve their business performance.

The **protection of soil against erosion** has historically been one of the most prominent reason for cover cropping. Bare soil is an invitation for water and wind to wash or blow away fertile topsoil. This erosion results in both a loss of soil fertility and contamination of local rivers and lakes with sediment and nutrients.

Cover crops enhance soil fertility and reduce reliance on fertilizer. An example are leguminous cover crops. Legumes (also called pulses) are a plant family that include species like beans, peas, and clover. The roots of legumes are colonized by a special group of soil bacteria. These bacteria convert nitrogen from the air into a form that can be used by the host plant. When the legume plant dies and decomposes, the nitrogen is released into the soil for use by other growing plants.

While nitrogen-fixation is limited to legume species, there is an equally important nutrient cycling role for all cover crops. Cover crops capture residual nutrients so they are not lost by leaching into deeper soil layers. This is particularly critical for nitrate which is very mobile in the soil.

Grasses and some brassica species (mustard and rapeseed) have extensive root systems, making them particularly good at absorbing excess soil nitrate. This ability is why these cover crop species are often referred to as “scavenger” or “catch” crops. Combining legumes and grasses in a cover crop mix can be an efficient approach to both increase and retain soil nitrogen.

Cover cropping improves soil structure. Soil structure describes how small soil particles (clay, silt, sand, and organic matter) are arranged into larger units called soil aggregates. A well-structured soil, with many aggregates, absorbs and retains water, has good air circulation, and protects soil carbon. These soil properties directly impact nutrient cycling and water use efficiency.

Cover crops enhance soil structure because their roots stabilize soil aggregates and drill pores into the soil. Furthermore, the space around living roots is a very fertile environment for soil micro-organisms. Those micro-organisms produce biological glues that bond soil particles and organic matter into aggregates.

Mycorrhizal Fungi

In some soils, a special fungus called mycorrhizae colonize plant roots, forming a mutually beneficial partnership called symbiosis. Mycorrhizal hyphae, a web of tiny root-like filaments help the plant to access water and nutrients from a larger volume of soil in exchange for carbohydrates. When mycorrhizae colonize several plants concurrently, the plants become connected through the network of hyphae. This allows an effective nutrient transfer from one plant to the other. These are only a couple examples of the many beneficial functions that mycorrhizae play for plant growth.

Good soil management practices like cover cropping can enhance the presence of mycorrhizae in the soil. However, mycorrhizal hyphae can also be easily destroyed by intensive tillage. It is estimated that mycorrhizae form symbiotic relationships with around 85% of plant species. However, some agriculturally important plant families, like brassica (e.g., canola, mustard), amaranth (e.g., spinach, beet), and buckwheat (e.g., buckwheat, rhubarb) do not associate with mycorrhizae.

Legumes as a nitrogen source

The nitrogen-fixing capacity of some bacteria living in association with legumes can be impressive. Red and white clovers, as well as vetches have been reported to provide over 80 kg of nitrogen per hectare – enough to cover the nitrogen needs of many crops. Similar to fertilizers, the nitrogen released from a terminated legume cover crop is best utilized when immediately followed by another crop.

Nitrogen-fixing bacteria live in small growths called nodules located on the roots of the legume.

Biological Cultivators

Heavy equipment, regular tillage and livestock can compact soil layers. Compaction reduces airflow, water absorption and retention, and limits root growth and crop yield. Compacted soils are at increased risk of erosion, puddling, and have higher greenhouse gas emissions.

The ability of some plants to penetrate compacted soil layers is called “biodrilling.” Tillage radish, for example, produces large taproots that can penetrate more than one foot deep, creating large pores. The effect can be superior and often longer lasting compared to mechanical cultivation.

Cover crops can help to control diseases and pests. Using cover crops to diversify the plant families in a crop rotation can interrupt disease and pest cycles. In addition, some plants contain substances that can naturally repel pests. Mustard or rape, for example, produce chemicals that act as a natural fumigant against nematodes.

Cover crops can be effective at controlling weeds. Buckwheat or vetches are examples of plants that grow rapidly and produce a dense canopy that smothers weeds.

Cover crops can also play an important ecological role. Species like phacelia, buckwheat, peas, and sunflower **enhance the presence of pollinators and beneficial insects.** This can also have significant economic advantages. For example, many blueberry producers have reported an increase in the number of wild bees after cover cropping. As a result, the producers have become much less reliant on the rental of bee hives.

Many studies and field observations indicate that cover cropping can **sequester soil carbon** and reduce greenhouse gas emissions from soils.

Buckwheat establishes fast, smothers weeds, and attracts beneficial insects and pollinators. However, it does not tolerate cold and drought. Buckwheat is sometimes also called a phosphorus scavenger because it can absorb this nutrient more efficiently than many other plants.

Cover Cropping and Carbon Sequestration

Many studies indicate that cover crops have the potential to build up soil organic matter and sequester carbon. However, effectiveness depends on initial soil carbon content, soil texture, climate, topography, management activities, and other factors. An important determinant is the amount and type of biomass produced by the cover crop. Investing some effort and resources into a cover crop will help maximize biomass production and your carbon and soil health returns. Extending the duration of the cover crop growing season can help to maximize carbon additions from cover crops.

Be patient and cover cropping will pay off in time. Long-term studies suggest that measurable changes in soil carbon can take 5 years. This also applies to changes in many other soil properties. Growers that have been cover cropping for many years often report that it took several years before the first signs of improved soil health became obvious.

Considerations when Choosing Cover Crops

Producers often select cover species for specific operational objectives or ecosystem services (erosion control, weed suppression, soil building, etc.). There is not a single species that excels in meeting all operational objectives. Each cover crop species has its benefits and limitations. Clover species, for example, will increase soil nitrogen but has limited capacity to control erosion (although still better than bare soil!). Conversely, a grass cover can substantially reduce erosion but will not produce nitrogen. If a producer has several objectives, a mixed-species cover crop can combine benefits.

The tolerance of each cover crops species to site-specific environmental conditions is an equally important consideration. All cover crops will grow decently well during warm summer months on well-drained soils with a neutral pH and sufficient water. However, the suitability of cover crop species and varieties for times of the year or for environments with growth limiting conditions differs widely.

This manual helps to identify cover crop species that will thrive on your farm with details on tolerance to cold, heat, drought, flooding, and acidic or alkaline soils. For example, sorghum-sudan grass does well under drought conditions but is not at all frost tolerant.

Cover Crop Systems

The selection of suitable cover crop species is also dictated by **timing** in relation to the commercial crop. Most annual cover crops need about two full months to realize their benefits. A few species, like buckwheat, grow fast enough to fill short gaps in the cropping cycle.

Cover cropping is a beneficial practice in many cropping systems. The cover crop in this blueberry field contributes soil carbon, reduces nutrient leaching, counters compaction by equipment, reduces erosion while providing habitat for pollinators.

In most cases, cover and commercial cropping is sequential as the cover crops are grown before and after the commercial crop (see Figure 1). Some growers put a field into cover crop for an entire year, a practice that is sometimes called a "set-aside". Another variation is the permanent establishment of cover crops in the alleyways between perennial row crops, like fruit orchards and berries. Cover crops can also be under-seeded into the commercial crop (for example red clover in wheat). Relay cropping is another variation where the cover crop is seeded into a standing commercial crop well before harvest, for example ryegrass into corn. After harvest the cover crop is left to grow until the next crop, or through the winter.

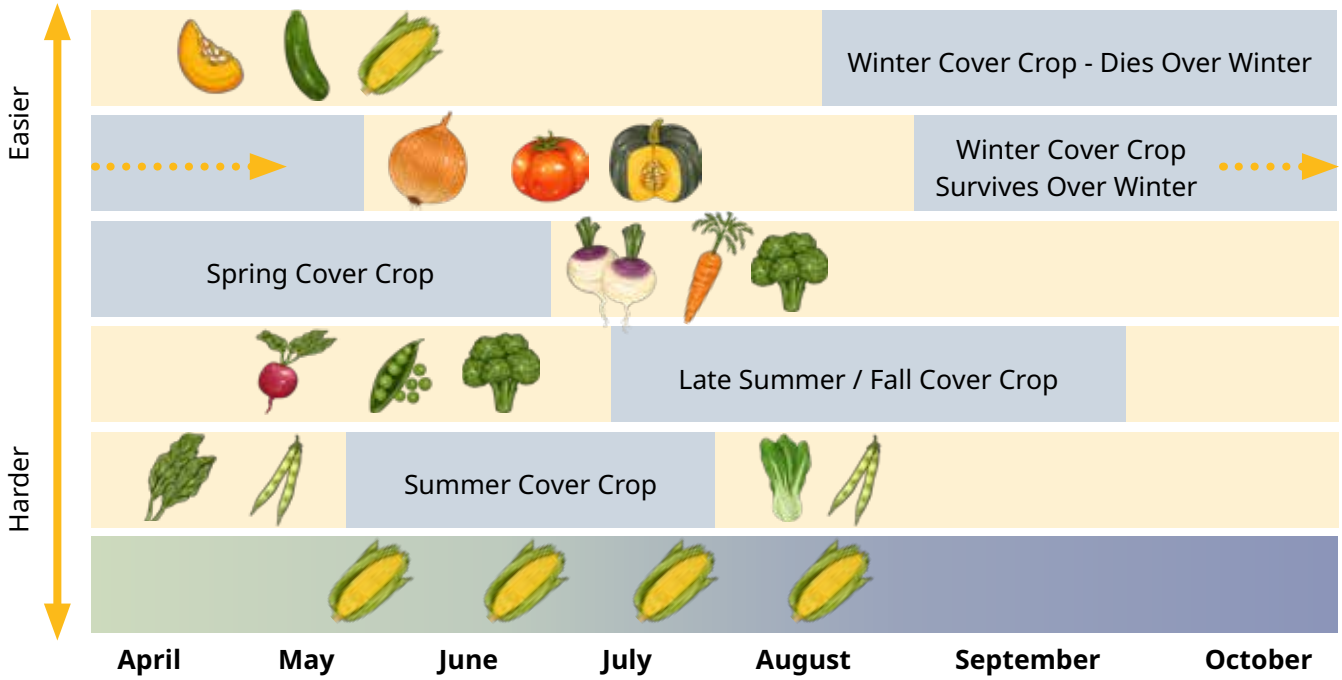

Figure 1 Ways of integrating cover crops into annual cropping systems

Considerations to find the most suitable cover crop systems are:

- operational factors: Time of the year between existing crop rotations (fallow period), availability of labor and machinery at the time of seeding or termination, pesticide rotational or carryover restrictions, cover crop goals, nutrient application schedule, etc. Taking your operation's needs into account will help to narrow down the most suitable cover crop system.
- environmental conditions. Sufficient temperature and moisture for cover crop establishment, drainage, trafficability of fields for timely seeding or termination of the cover crops, occurrence of extreme heat, winter temperature
- cover crop characteristics. Growth rate, amount and quality of residue at time of termination, palatability for birds or other wildlife, phenological stages (times of vegetative growth, flowering and fruit development, etc.).

Seeding

Seeding cover crops can be done using **drills** or by **broadcasting**. Drills (conventional or no-till) result in a more consistent cover crop stand and place the seeds at the right depth and spacing. This provides better growth conditions and protection from birds.

Broadcast seeding covers large areas quickly, but germination rates will be lower, especially when soils are dry. Higher seeding rates, light cultivation and packing will help improve cover crop establishment. Broadcast seeding may be the best option for sowing into established crop stands.

Seed depths vary between species but are usually in a range of ½ to one inch. Small seeds (i.e., clover) need to be planted very shallow. Optimal seed depth also depends on soil moisture conditions. In wetter conditions, seeds should be placed towards the shallower end of the range while in dry conditions deeper seeding helps to improve establishment.

The rule of thumb is to plant seeds at a depth that is equal to about two to three times their width.

Cover Crop Termination

Options for terminating cover crops include winterkill, mowing, ploughing, grazing, and herbicides. There is also specialized equipment like the roller-crimper (see picture).

Depending on where in B.C. your farm is located, some cover crops will die naturally in winter. Different varieties of the same species can have variable cold tolerance. Spring barley easily winterkills in most parts of B.C., while some winter barley varieties can survive several days at -15°C.

The *timing* of termination before seeding the following crop is sometimes crucial. If the cover crop is to be incorporated, a general rule is to work it into the soil 2 – 4 weeks before planting. This allows the cover crop time to decompose. Decomposing cover crops, especially grasses rich in carbon, can temporarily tie up nitrogen. If the following crop is sown too soon it may be stunted by a temporary nitrogen deficiency. Conversely, considerable nitrogen losses can occur when too much time is left between the termination of legumes and planting of the next crop.

Incorporating the plant residues into the soil usually accelerates decomposition. However, it needs to be done carefully as tillage can destroy soil structure and accelerate losses of soil organic matter.

Limitations of Cover Cropping

While cover crops benefit both farm production and the environment, there are also challenges. Cover cropping adds to production costs, taxes limited labour resources and can host pests and diseases.

Remember, what works on one farm, may not work on yours. For example, hairy vetch is the preferred choice for some growers looking for weed suppression and nitrogen fixation. Yet in a grain production system this species can become an invasive nuisance that complicates combining.

Picture Credit: Martin Entz, University of Manitoba

Roller-crimpers are commonly used to terminate rye, triticale and vetch. They flatten and kill cover crops by 'crimping' or kinking plant stems, leaving a dense mulch that can be directly sown into.

Roller-crimpers can be a viable option for organic no-till production.

This booklet

This booklet is intended to help B.C. farmers make informed cover cropping decisions. The information provided is based on studies conducted in B.C. and the experiences of B.C. farmers. It consists of two parts:

(a) A quick reference summary to help narrow down cover crop selection based on plant properties and operational objectives

(b) Detailed Factsheets for 23 cover crop species.

This booklet covers the major cover crop species that are well-suited to B.C. There are many more potential cover crop species, and the range of cover cropping techniques is only limited by imagination. However, available documented information on cover cropping across the diversity of climates and productions systems across the province is still sparse.

Therefore, we need your help! If you have cover cropping experience that you are willing to share, or if you would like to provide feedback on this booklet, **we would love to hear from you.**
You can reach us by sending an email to AgriServiceBC@gov.bc.ca.
Our team is looking forward to your response!

Quick Summary of Cover Crop Characteristics

*Rating Scale: 1 (least effective) --> 5 (most effective) | n/d = not determined

Cover crop	Type	Life Cycle	Growth Habit	Nitrogen Fixation *	Nitrogen Scavenging *	Quick Growth *	Lasting Residue *	Organic Matter - Soil Builder *	Weed Suppression *	Compaction Reduction *	Erosion Reduction *	Forage Harvest Value *	Grain/Seed Harvest Value *	Biofumigation *	Flood Tolerance *
Barley, Spring	Grass	WSA	u	n/a	4	4	4	4	3	2	5	4	3	1	2
Barley, Winter	Grass	CSA	u	n/a	4	4	5	4	4	3	5	3	4	1	2
Buckwheat	Broadleaf	CSA	u,su	n/a	2	5	1	3	5	1	2	1	2	1	2
Clover, Alsike	Legume	CSA	u,su	n/d	n/d	2	3	n/a	2	n/d	3	3	n/d	1	3
Clover, Berseem	Legume	CSA	u,su	5	2	2	3	3	3	2	3	4	3	n/d	3
Clover, Crimson	Legume	CSA	u,su	4	3	4	3	4	4	2	4	4	3	n/d	3
Clover, Red	Legume	CSA	u	4	3	2	2	4	3	4	3	4	3	n/d	3
Clover, Subterranean	Legume	CSA	p,sp	5	2	3	4	4	5	1	3	2	1	n/d	3
Clover, White	Legume	CSP	u	4	2	2	2	3	3	3	3	4	2	n/d	3
Mustard	Broadleaf	CSA	u	n/a	3	4	2	3	4	3	3	3	2	3	2
Oats, Spring	Grass	CSA	u	n/a	3	4	3	3	3	2	3	3	3	1	3
Peas, Field	Legume	CSA	p,c	5	2	2	2	3	2	2	2	3	4	1	2
Phacelia	Broadleaf	CSA	u	n/a	3	3	2	2	2	3	3	3	n/d	n/d	3
Radish, Forage	Broadleaf	CSA	u	n/a	4	4	2	2	4	5	2	3	2	3	2
Rye, Fall	Grass	CSA	u	n/a	5	5	5	5	3	2	5	3	2	1	2
Ryegrass, Annual	Grass	CSA/BI	u	n/a	4	4	4	4	4	3	4	4	2	1	4
Sorghum-Sudangrass	Grass	WSA	u	n/a	5	4	5	5	3	5	5	4	3	3	3
Sweetclover	Legume	CSA/BI	u	5	2	3	4	5	3	4	4	3	3	1	3
Triticale, Winter	Grass	CSA	u	n/a	5	3	5	4	4	4	5	3	3	1	3
Vetch, Common	Legume	CSA	p,c	5	2	4	1	3	3	2	3	2	2	n/d	2
Vetch, Hairy	Legume	CSA	p,c	5	2	4	1	4	3	2	3	1	2	n/d	2
Wheat, Spring	Grass	CSA	u	n/a	4	4	4	4	3	3	3	5	5	1	2
Wheat, Winter	Grass	CSA	u	n/a	4	4	4	4	4	3	4	5	5	1	2

Growth Habit: u = Upright | su = Semi-Upright | p = Prostrate | sp = Semi-Prostrate | c = Climbing
Drainage Classification: p = poorly drained | sp = somewhat poorly drained | mw = Moderately well drained | w = Well drained | e = Excessivly drained
Life Cycle: CSA = Cool Season Annual | CSP= Cool Season Perennial | WSA= Warm Season Annual | B=Biennial

Quick Summary of Cover Crop Characteristics

*Rating Scale: 1 (least effective) --> 5 (most effective) | n/d = not determined

Cover crop	Heat Tolerance *	Drought Tolerance *	Shade Tolerance *	Low Fertility Tolerance *	Salinity Tolerance *	Drainage Class	pH	Winter Hardiness Zone	Seeding Rate lbs/acre	Broadcast lbs/acre	Frost Seeding	Minimum Germ Temp (˚F)	Interseed Potential *	Volunteer Estab *	Nitrogen Contribution lbs/acre
Barley, Spring	2	3	2	3	3	mw-w	6.0-8.5	9	50-100	80-150	N	38	4	4	n/d
Barley, Winter	2	3	2	3	3	mw-w	6.0-8.5	5-9	50-100	80-150	N	38	4	5	n/d
Buckwheat	4	2	2	4	2	mw-w	5.0-7.0	n/a	30-70	50-90	N	50	2	5	n/d
Clover, Alsike	n/d	2	3	n/d	2	pd-wd	n/d	4-9	6-12	8-14	Y	n/d	n/d	n/d	n/d
Clover, Berseem	4	3	3	3	3	sp-wd	6.2-7.0	8-9	8-15	15-20	Y	42	4	5	75-200
Clover, Crimson	4	3	4	3	2	sp-wd	5.5-70	5-9	15-18	22-30	N	42	4	5	70-130
Clover, Red	3	3	4	3	2	sp-wd	6.0-7.5	4-9	8-10	10-12	Y	41	4	5	70-150
Clover, Subterranean	3	3	4	5	n/d	sp-wd	5.5-7.0	7-9	10-20	20-30	n/d	38	5	5	75-200
Clover, White	4	3	4	3	2	sp-wd	6.0-7.0	4-9	3-14	4-17	Y	40	3	5	80-200
Mustardz	3	3	2	2	3	pd-wd	5.5-8.0	7-9	4-15	5-18	N	40	2	5	n/d
Oats, Spring	2	3	2	3	n/d	pd-e	4.5-8.0	n/a	50-110	110-140	N	38	4	5	n/d
Peas, Field	2	3	3	3	2	sp-e	6.0-7.5	5-9	50-90	60-108	Y	42	4	4	90-150
Phacelia	3	3	3	3	1	pd-e	6.5-8.5	9	2-10	2-12	N	38	n/d	3	n/d
Radish, Forage	3	2	3	2	3	sp-e	6.0-7.5	6-9	8-13	10-20	N	45	2	3	50-200
Rye, Fall	3	4	4	5	4	sp-e	5.0-7.0	4-9	60-120	90-160	Y	34	4	5	0-20
Ryegrass, Annual	3	2	4	2	3	sp-e	5.5-7.0	6-9	10-35	12-42	N	40	4	5	n/d
Sorghum-Sudangrass	3	5	3	2	3	sp-e	5.5-8.0	n/a	15-35	18-42	N	65	1	4	n/d
Sweetclover	4	5	3	4	3	sp-e	6.5-7.5	4-9	6-15	15-20	N	42	3	2	20-170
Triticale, Winter	2	3	3	3	2	sp-e	5.5-8.0	4-9	50-120	60-144	N	38	4	5	n/d
Vetch, Common	3	3	3	3	3	sp-wd	6.0-8.0	7-9	10-60	11-72	N	58	3	5	50-100
Vetch, Hairy	3	3	3	3	2	sp-wd	6.0-7.5	4-9	15-30	25-40	N	58	3	5	90-120
Wheat, Spring	2	3	2	3	2	sp-e	5.5-8.0	8-9	70-150	77-165	N	38	4	5	n/d
Wheat, Winter	3	3	3	3	2	sp-e	5.5-8.0	4-9	63-125	75-150	N	38	3	5	n/d

Growth Habit: u = Upright | su = Semi-Upright | p = Prostrate | sp = Semi-Prostrate | c = Climbing
Drainage Classification: p = poorly drained | sp = somewhat poorly drained | mw = Moderately well drained | w = Well drained | e = Excessivly drained
Life Cycle: CSA = Cool Season Annual | CSP= Cool Season Perennial | WSA= Warm Season Annual | B=Biennial

ALSIKE CLOVER

TRIFOLIUM HYBRIDUM- COOL SEASON PERENNIAL LEGUME

PRODUCTION GOALS

Not Effective — *Very Effective*

Quick Growth	▮▮▯▯▯
Lasting Residue	▮▮▮▯▯
Soil Builder	n/d
Nitrogen Fixation	▮▮▮▮▮
Nitrogen Scavenging	n/d
Erosion Reduction	▮▮▮▯▯
Compaction Reduction	n/d
Biofumigation Potential	n/d
Weed Suppression	▮▮▯▯▯
Forage Harvest Value	▮▮▮▯▯
Grain Harvest Value	n/d

Alsike clover is a short-lived cool season perennial with an upright to semi-upright growth habit and a taproot. Alsike clover does well in areas with high soil moisture. Alsike clover can be potentially toxic to some livestock species, and care should be taken when grazing.

TOLERANCES

Flood	▮▮▮▮▯
Heat	n/d
Drought	▮▮▯▯▯
Shade	▮▮▮▯▯
Low Fertility	n/d
Salinity	▮▮▯▯▯
Optimal pH	n/d

SOIL DRAINAGE CLASS

Very Well	▯
Well	▮
Moderately Well	▮
Somewhat Poor	▮
Poorly	▮
Very Poorly	▯

AREA & ADAPTABILITY

Alsike clover is suitable for all regions of British Columbia. It can handle harsh winters with adequate snow cover.

Winter Hardiness Zone 4-9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
6-12 lbs/ac (7-13 kg/ha)	8-14 lbs/ac (9-16 kg/ha)	0-0.5 in (0-1.25 cm)	Yes	n/d	680,000 /lb (308,000 /kg)

Inoculation type: Use red or white clover inoculant to ensure rhizobia development and adequate nitrogen fixation.

Management Considerations

Alsike clover can be slow to establish and a nurse crop can be beneficial for weed control. It is also prone to lodging and difficult to dry for hay production.

In some environments, alsike clover can be weedy in nature. It establishes better on acidic soils than red clover, but is generally lower yielding.

Alsike clover can cause photosensitization and big liver syndrome and should not be fed to horses. Photosensitivity can also be an issue with some light-coloured cattle.

Interseeding Potential	No data
Volunteer Establishment	No data
Nitrogen Concentration	2.4%

Dry Matter Yield

1700-2100 lbs/acre
1900-2350 kg/ha

Nitrogen Contribution

No data

Termination

Alsike clover can be terminated using tillage or the application of a suitable herbicide.

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FACTSHEET DEVELOPED BY:

BRITISH COLUMBIA FORAGE COUNCIL

ANNUAL RYEGRASS

LOLIUM MULTIFLORUM- COOL SEASON ANNUAL/BIENNIAL GRASS

PRODUCTION GOALS

	Not Effective	Very Effective
Quick Growth		
Lasting Residue		
Soil Builder		
Nitrogen Fixation	*n/a*	
Nitrogen Scavenging		
Erosion Reduction		
Compaction Reduction		
Biofumigation Potential		
Weed Suppression		
Forage Harvest Value		
Grain Harvest Value		

Annual ryegrass has two subspecies grown in BC: Westerwold and Italian ryegrass. It is a rapidly growing, highly tillered cool season bunchgrass with an upright growth habit and a medium depth fibrous root. Annual ryegrass is commonly grown as a forage crop or for rapid ground cover. Italian ryegrass is a possible biannual that requires exposure to cold for flowering.

TOLERANCES

Flood	
Heat	
Drought	
Shade	
Low Fertility	
Salinity	
Optimal pH	5.5 - 7.0

SOIL DRAINAGE CLASS

- Very Well
- Well
- Moderately Well
- Somewhat Poor
- Poorly
- Very Poorly

AREA & ADAPTABILITY

Annual ryegrass is suitable for all regions of British Columbia. Italian ryegrass can overwinter in zones with milder winter and/or adequate snowcover.

Winter Hardiness Zone - 4-9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
10-35 lbs/ac (11-39 kg/ha)	12-42 lbs/ac (13-47 kg/ha)	0-0.5 in (0-1.25 cm)	No	4°C (40°F)	227,000 /lb (102,965 /kg)

Management Considerations

Westerwold annual ryegrass behaves as an annual and sets seed in the first season. It has more upright growth than Italian ryegrass and can volunteer if allowed to set seed. It is commonly used as a nurse crop for forage stands, interseeded within a cereal forage for a fall relay crop, and as a quick ground cover.

Inter-seeding Potential ▮▮▮▮▯

Volunteer Establishment ▮▮▮▮▮

Nitrogen Concentration 0.8-3.6%

Italian ryegrass is winterkilled in many regions of Canada and thus commonly confused as an annual. However, it is a biennial that will overwinter in southern BC and produce seed the following spring if allowed to mature. It has higher forage quality than Westerwold and can also volunteer if allowed to set seed. It is commonly used for forage for grazing or silage and interseeded with other annuals for relay or blend use. Italian ryegrass is a heavy user of nutrients and water, and an aggressive cutting schedule can produce large forage yields of high quality feed.

Dry Matter Yield
1000-9000 lbs/acre
1120-10,080 kg/ha

Both types of annual ryegrass have seed available as diploid and tetraploid (2 or 4 sets of chromosomes). Generally diploid ten to have a more vigorous establishment and smaller seed size allowing for reduced seeding rates, however tetraploids generally have higher forage quality.

Termination

Annual ryegrass can be terminated by tillage or chemical means. Mowing is not effective before seed heads are set as regrowth will occur, and multiple passes may be necessary.

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FACTSHEET DEVELOPED BY:

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BERSEEM CLOVER

TRIFOLIUM ALEXANDRINUM - COOL SEASON ANNUAL LEGUME

PRODUCTION GOALS

	Not Effective ▮▯▯▯▯	Very Effective ▮▮▮▮▮
Quick Growth	▮▮▯▯▯	
Lasting Residue	▮▮▮▯▯	
Soil Builder	▮▮▮▯▯	
Nitrogen Fixation	▮▮▮▮▮	
Nitrogen Scavenging	▮▮▯▯▯	
Erosion Reduction	▮▮▮▯▯	
Compaction Reduction	▮▮▯▯▯	
Biofumigation Potential	*n/d*	
Weed Suppression	▮▮▮▯▯	
Forage Harvest Value	▮▮▮▮▯	
Grain Harvest Value	▮▮▮▯▯	

Berseem clover has an upright to semi-upright growth habit. Its shallow taproot causes berseem to be susceptible to drought. Berseem uses soil nitrogen in the first third of its lifecycle before supplying nitrogen in the later parts of its lifecycle. Berseem can make a high quality animal feed when planted with oats.

TOLERANCES

Flood	▮▮▮▯▯
Heat	▮▮▮▮▯
Drought	▮▮▮▯▯
Shade	▮▮▮▯▯
Low Fertility	▮▮▮▯▯
Salinity	▮▮▮▯▯
Optimal pH	6.2 - 7.0

SOIL DRAINAGE CLASS

Very Well	▯
Well	■
Moderately Well	■
Somewhat Poor	■
Poorly	▯
Very Poorly	▯

AREA & ADAPTABILITY

Berseem clover is suitable as an annual across British Columbia. It is the least cold-hardy of all the clovers but is more tolerant to high salinity soils than alfalfa or red clover.

Winter Hardiness Zone - 8-9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
8-15 lbs/ac (9-17 kg/ha)	15-20 lbs/ac 17-22 kg/ha	0-0.5 in (0-1.25 cm)	Yes	6°C (42°F)	140,000 /lb (63,500 /kg)

Inoculant: Use a berseem or crimson clover inoculant to ensure rhizobia development and adequate nitrogen fixation.

Management Considerations

Berseem clover is the tallest of the annual clovers but does not tolerate shading. Its performance at interior locations has been lower than anticipated.

As a grazing species, berseem clover has low risk of bloat, but does not tolerate close grazing and heavy traffic and should be managed accordingly.

Inter-seeding Potential ▮▮▮▮▯

Volunteer Establishment ▮▮▮▮▮

Nitrogen Concentration 2.5%

Dry Matter Yield

6000-10,000 lbs/acre
6720-11,200 kg/ha

Nitrogen Contribution

75-200 lbs/acre
84-224 kg/ha

Termination

Berseem Clover can be terminated through tillage, mowing or a chemical application. It is easily winterkilled in most parts of B.C.

References

- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Midwest Cover Crop Council. (n.d.)
- Northeast Cover Crop Council. (n.d.)
- Odhiambo, J., Temple, W.D., A. Bomke. 2012. Managing Cover Crops for Conservation Purposes in the Fraser River Delta, British Columbia. In: Crop Management - Cases and Tools for Higher Yield and Sustainability.
- Sustainable Agriculture Research and Education (SARE). 2012. Managing Cover Crops Profitably: 3rd Ed. National Institute of Food and Agriculture, USDA, University of Maryland & University of Vermont.
- U.S. Department of Agriculture. (n.d.). Pacific Northwest Cover Crop Selection Tool.

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BUCKWHEAT

FAGOPYRUM ESCULENTUM - COOL SEASON ANNUAL NON-LEGUME BROADLEAF

PRODUCTION GOALS

Not Effective — *Very Effective*

Quick Growth	●●●●●
Lasting Residue	●○○○○
Soil Builder	●●●○○
Nitrogen Fixation	*n/a*
Nitrogen Scavenging	●●○○○
Erosion Reduction	●●○○○
Compaction Reduction	●○○○○
Biofumigation Potential	●○○○○
Weed Suppression	●●●●●
Forage Harvest Value	●○○○○
Grain Harvest Value	●●○○○

Buckwheat has an upright growth habit and medium depth taproot. Buckwheat is commonly used for attracting pollinators, weed suppression and organic matter addition on summer fallow ground. Buckwheat needs warm conditions but has little tolerance for drought or excessive heat and water-logged soils. It is known to increase availability of phosphorus for the next crop.

TOLERANCES

Flood	●●○○○
Heat	●●●○○
Drought	●●○○○
Shade	●●○○○
Low Fertility	●●●●○
Salinity	●●○○○
Optimal pH	5.0 - 7.0

SOIL DRAINAGE CLASS

Very Well	○
Well	●
Moderately Well	●
Somewhat Poor	○
Poorly	○
Very Poorly	○

AREA & ADAPTABILITY

Buckwheat is adapted to all areas of the province as a summer annual

Winter Hardiness Zone - Does not overwinter

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
30-70 lbs/ac (34-78 kg/ha)	50-90 lbs/ac (56-101 kg/ha)	0.5-1.5 in (1-4 cm)	No	10°C (50°F)	20,000 /lb (9072 /kg)

Management Considerations

Buckwheat has the ability for quick growth which can be advantageous as a summer smother crop, especially in areas with a short growing season. Its ability to set seed quickly needs to be considered to avoid volunteer issues. It does not tolerate wet, saturated soils or drought conditions, but its quick growth may avoid drought conditions.

Inter-seeding Potential

Volunteer Establishment

Nitrogen Concentration No data

Dry Matter Yield

1000 - 2500 lbs/acre
1120 - 2800 kg/ha

Termination

Can be terminated through tillage, mowing or chemical means. Buckwheat sets seed quickly so termination should occur before seeds are viable to prevent volunteer establishment.

References

- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Midwest Cover Crop Council. (n.d.)
- Northeast Cover Crop Council. (n.d.)
- Odhiambo, J., Temple, W.D., A. Bomke. 2012. Managing Cover Crops for Conservation Purposes in the Fraser River Delta, British Columbia. In: Crop Management - Cases and Tools for Higher Yield and Sustainability.
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- U.S. Department of Agriculture. (n.d.). Pacific Northwest Cover Crop Selection Tool.

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COMMON VETCH

VICIA SATIVA - WINTER ANNUAL LEGUME

PRODUCTION GOALS

Not Effective — *Very Effective*

Quick Growth	
Lasting Residue	
Soil Builder	
Nitrogen Fixation	
Nitrogen Scavenging	
Erosion Reduction	
Compaction Reduction	
Biofumigation Potential	n/d
Weed Suppression	
Forage Harvest Value	
Grain Harvest Value	

Common vetch has prostrate climbing growth habit and a medium depth fibrous root. It is commonly used for green manure and in pasture mixes. Its blue-purply flowers attracts insects and pollinators.

TOLERANCES

Flood	
Heat	
Drought	
Shade	
Low Fertility	
Salinity	
Optimal pH	6.0 - 8.0

SOIL DRAINAGE CLASS

- Very Well
- Well
- Moderately Well
- Somewhat Poor
- Poorly
- Very Poorly

AREA & ADAPTABILITY

Common vetch is a suitable annual across BC and can overwinter in areas with milder winters. Common vetch is not as winter hardy as hairy vetch but is more drought tolerant.

Winter Hardiness Zone - 7-9

Seeding Considerations

Rate Drilled	Rate Broadcast lbs	Depth	Frost Seeding	Minimum Germination Temperature	Seeds
10-60 lbs/ac (11-68 kg/ha)	11-72 lbs/ac (12-80 kg/ha)	0.5-1in (1-2.5cm)	No	14°C (58°F)	54,000 /lb (12,000 /kg)

Important Note: Use a pea or vetch inoculant at planting to ensure rhizobia development.

Management Considerations

Common vetch is a competitive cover crop that can handle some weed competition and fixes large amounts of nitrogen. if allowed to go to seed, it can volunteer with a high number of hard seeds and for multiple years. For the least risk of volunteer and highest nitrogen availability, terminate at the early bud stage.

There can be livestock poisoning risks if grazing a pure vetch stand that has set seed. If using for grazing be sure to include multiple other species and graze the crop before it reaches maturity.

Inter-seeding Potential

Volunteer Establishment

Nitrogen Concentration 2.5 - 3.8%

Dry Matter Yield

850 - 5980 lbs/acre
1000 - 6700 kg/ha

Nitrogen Contribution

50 - 100 lbs/acre
56 - 112 kg/ha

Termination

Common vetch can be terminated by tillage, mowing, or a chemical application. Common vetch has a natural resistance to glyphosate, glufosinate and Group 2 herbicides. Terminate at the late bud stage to maximize the amount of plant available nitrogen for the next crop.

References

- Dobb, A., S. Burton. 2013. Rangeland Seeding Manual for British Columbia. B.C. Min. Agri., Sust. Agri. Mgmt. Br., Abbotsford, B.C.
- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
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- U.S. Department of Agriculture. (n.d.). Pacific Northwest Cover Crop Selection Tool.

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CRIMSON CLOVER

TRIFOLIUM INCARNATUM - COOL SEASON ANNUAL LEGUME

PRODUCTION GOALS

Not Effective — *Very Effective*

Quick Growth	▮▮▮▮▯
Lasting Residue	▮▮▮▯▯
Soil Builder	▮▮▮▮▯
Nitrogen Fixation	▮▮▮▮▯
Nitrogen Scavenging	▮▮▮▯▯
Erosion Reduction	▮▮▮▮▯
Compaction Reduction	▮▮▯▯▯
Biofumigation Potential	n/d
Weed Suppression	▮▮▮▮▯
Forage Harvest Value	▮▮▮▮▯
Grain Harvest Value	▮▮▮▯▯

Crimson clover has a medium depth tap root and upright to semi-upright growth habit. Its large colorful flowers attract an array of pollinators. When compared to other clovers, crimson clover has a large seed and better seedling vigour.

TOLERANCES

Flood	▮▮▮▯▯
Heat	▮▮▮▮▯
Drought	▮▮▮▯▯
Shade	▮▮▮▮▯
Low Fertility	▮▮▮▯▯
Salinity	▮▮▯▯▯
Optimal pH	5.5 - 7.0

SOIL DRAINAGE CLASS

Very Well	▯
Well	■
Moderately Well	■
Somewhat Poor	■
Poorly	▯
Very Poorly	▯

AREA & ADAPTABILITY

Crimson clover is suitable as an annual in nearly all regions of British Columbia. It may overwinter in regions with mild conditions.

Winter Hardiness Zone 5-9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
15-18 lbs/ac (17-20 kg/ha)	22-30 lbs/ac (25-34 kg/ha)	0.25-0.5 in (0.6-1.25 cm)	No	6°C (42°F)	140,000 /lb (63,500 /kg)

Use a crimson or berseem clover inoculant to ensure development of rhizobia and adequate nitrogen fixation

Management Considerations

Crimson clover has rapid growth, early spring N release, vigorous reseeding ability, deep red flower colour and abundant nectar production that attracts many bee species. Larger seeds with better seedling vigor than most clovers, later seeding than white or red clover. Compared to hairy vetch it can be earlier-seeded, has more fall growth, and earlier spring bloom. However, it has slower residue breakdown of stems and therefore slower N release.

Inter-seeding Potential ▮▮▮▮▯

Volunteer Establishment ▮▮▮▮▮

Nitrogen Concentration 1.8 - 2.9%

Dry Matter Yield

2250-6000 lbs/acre
2520-6720 kg/ha

Nitrogen Contribution

70-130 lbs/acre
78.4-145.6 kg/ha

Termination

To maximize the amount of plant available nitrogen for the next crop, crimson clover should be terminated at the early bud stage. Crimson clover is the easiest clover to kill by mowing and can also be terminated through tillage or the use of herbicides.

References

- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Ismail, I. 1994. Establishment and Evaluation of Cover Crops Underseeded in Sweet Corn in Delta, British Columbia. University of British Columbia.
- Midwest Cover Crop Council. (n.d.)
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- U.S. Department of Agriculture. (n.d.). Pacific Northwest Cover Crop Selection Tool.
- Young-Mathews, A. 2013. Plant guide for crimson clover (Trifolium incarnatum). USDA-NRCS, Plant Materials Center, USA.

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FALL RYE

SECALE CEREALE L. - BIENNIAL GRASS

PRODUCTION GOALS

	Not Effective ▯▯▯▯▯	Very Effective ▮▮▮▮▮
Quick Growth		▮▮▮▮▮
Lasting Residue		▮▮▮▮▮
Soil Builder		▮▮▮▮▮
Nitrogen Fixation		*n/a*
Nitrogen Scavenging		▮▮▮▮▮
Erosion Reduction		▮▮▮▮▮
Compaction Reduction		▮▮▯▯▯
Biofumigation Potential		▮▯▯▯▯
Weed Suppression		▮▮▮▯▯
Forage Harvest Value		▮▮▮▯▯
Grain Harvest Value		▮▮▯▯▯

Fall Rye is has an upright growth habit and a medium depth fibrous root. Extremely winter hardy, fall rye requires a period of prolonged cold temperatures before becoming reproductive. It can tolerate low-fertility, acidic and wet soils making it an excellent choice for marginal land. Fall rye begins growing quickly in the spring allowing for rapid soil coverage.

TOLERANCES

Flood	▮▮▯▯▯
Heat	▮▮▮▯▯
Drought	▮▮▮▮▯
Shade	▮▮▮▮▯
Low Fertility	▮▮▮▮▮
Salinity	▮▮▮▮▯
Optimal pH	4.8 - 8.0

SOIL DRAINAGE CLASS

Very Well	▮
Well	▮
Moderately Well	▮
Somewhat Poor	▮
Poorly	▯
Very Poorly	▯

AREA & ADAPTABILITY

Fall rye is a suitable fall-seeded annual for all regions of British Columbia. It is able to tolerate a wide range of conditions making it suitable for many field locations and soil types.

Winter Hardiness Zone - 4-9

Seeding Considerations

Rate Drilled lbs/acre (kg/ha)	Rate Broadcast lbs./acre (kg/ha)	Depth in (cm)	Frost Seeding	Minimum Germination Temp °C (°F)	Seeds/lb (/kg)
60-120 lbs/ac (67-135 kg/ha)	90-160 lbs/ac (100-180 kg/ha)	0.5-2 in (1-5 cm)	Yes	1°C (34°F)	8600 (19,000)

Planting in late September has been shown to increase winter survivability compared to a late August planting date. Earlier planting dates allow for more ground cover going into the winter and earlier spring growth than very late planting dates.

Management Considerations

Fall rye is a very adaptable cover crop with its excellent winter hardiness and rapid cool season growth. It can use significant amounts of moisture in the spring which can be an advantage or disadvantage depending on location and goals. It is also important to consider the amount of nitrogen immobilized by incorporating a large biomass cereal crop. Fall rye can also have some allelopathy affecting germination of weeds and subsequent crops (e.g. alfalfa). Hybrid fall rye varieties are available which can be seeded at a lower seeding rate with higher yields and lower ergot risk.
Fall rye is a risk for ergot. It is preferred over oats or spring barley by waterfowl in Delta, BC, in the late fall and early winter.

Inter-seeding Potential 

Volunteer Establishment 

Nitrogen Concentration 1.0 - 4.6%

Dry Matter Yield

3000 - 9000 lbs/acre
3360 - 10,800 kg/ha

Termination

Fall Rye should be terminated at stem elongation. This minimizes the amount of nitrogen immobilization ensuring nitrogen is available for the next crop.

References

- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Furey, G. 2015. Functional Diversity in Cover Crops and Ecosystem Services. University of British Columbia.
- Midwest Cover Crop Council.
- Odhiambo, J., Temple, W.D., A. Bomke. 2012. Managing Cover Crops for Conservation Purposes in the Fraser River Delta, British Columbia. In: Crop Management - Cases and Tools for Higher Yield and Sustainability.
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- Grubinger, V. 2021. Winter Rye: A Reliable Cover Crop. University of Vermont, Extension.
- U.S. Department of Agriculture. (n.d.). Pacific Northwest Cover Crop Selection Tool.
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FIELD PEAS

PISUM SATIVUM - COOL SEASON ANNUAL LEGUME

PRODUCTION GOALS

Not Effective — Very Effective

Quick Growth	
Lasting Residue	
Soil Builder	
Nitrogen Fixation	
Nitrogen Scavenging	
Erosion Reduction	
Compaction Reduction	
Biofumigation Potential	n/d
Weed Suppression	
Forage Harvest Value	
Grain Harvest Value	

Peas have a prostrate climbing growth habit and medium depth taproot. Peas grow rapidly in cool conditions with adequate moisture and flower early in the season. They can be used as a cover crop, for forage or brought to harvest maturity.

TOLERANCES

Flood	
Heat	
Drought	
Shade	
Low Fertility	
Salinity	
Optimal pH	6.0 - 7.5

SOIL DRAINAGE CLASS

- Very Well
- Well
- Moderately Well
- Somewhat Poor
- Poorly
- Very Poorly

AREA & ADAPTABILITY

Peas are a suitable spring-seeded annual for all regions of British Columbia. Some varieties such as Austrian winter peas can overwinter in mild winter conditions with adequate snow cover.

Winter Hardiness Zone 5-9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
50-110 lbs/ac (56-125 kg/ha)	60-110 lbs/ac (67-125 kg/ha)	1-1.5 in (2.5-4 cm)	Yes	6°C (42°F)	900 /lb (2,000 /kg)

Use a pea/vetch inoculant. Peas have a wide range of seed sizes so seeding rate can vary.

Management Considerations

Field peas are commonly used in mixtures with cereals for forage and grazing use where they add tonnage, forage protein and moisture. They are known to work well with oats, barley, triticale and combinations of cereals. They grow best in cool conditions and can tolerate some early spring frosts.

Generally, peas are not as good for weed suppression as grass cereals are, and they require a supporting cereal crop to stand. They do not tolerate mechanic traffic well. There are a wide range of pea varieties available with many focused for food use. Field peas are also available with a fall seeded biennial habit such as Austrian Winter Peas.

Inter-seeding Potential ▮▮▮▮▯

Volunteer Establishment ▮▮▮▮▯

Nitrogen Concentration 2.8 - 3.8%

Dry Matter Yield

760-5000 lbs/acre
851-5600 kg/ha

Nitrogen Contribution

90-150 lbs/acre
100.8-168 kg/ha

Termination

Peas can be terminated through tillage, mowing or a chemical application. They have a rapid breakdown due to their high nitrogen content. To maximize amount of nitrogen available termination should occur at the early bud stage.

References

- Cloverdale Soil Conservation Group. 1994. Final Report: Part 2 Reports, Newsletters and Bulletins.
- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Midwest Cover Crop Council. (n.d.)
- Northeast Cover Crop Council. (n.d.)
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FORAGE RADISH

RAPHANUS SATIVUS L. - COOL SEASON ANNUAL NON-LEGUME BROADLEAF

PRODUCTION GOALS

	Not Effective	Very Effective
Quick Growth		▮▮▮▮▯
Lasting Residue		▮▮▯▯▯
Soil Builder		▮▮▯▯▯
Nitrogen Fixation		*n/a*
Nitrogen Scavenging		▮▮▮▮▯
Erosion Reduction		▮▮▯▯▯
Compaction Reduction		▮▮▮▮▮
Biofumigation Potential		▮▮▮▯▯
Weed Suppression		▮▮▮▮▯
Forage Harvest Value		▮▮▮▯▯
Grain Harvest Value		▮▮▯▯▯

Forage radish also referred to as daikon or tillage radish, it has an upright growth habit. Its deep taproot is known for reducing compaction. Winterkilled plants decompose rapidly in the spring, releasing nitrogen quickly. Some brassica varieties have biofumigant uses as well.

TOLERANCES

Flood	▮▮▯▯▯
Heat	▮▮▮▯▯
Drought	▮▮▯▯▯
Shade	▮▮▮▯▯
Low Fertility	▮▮▯▯▯
Salinity	▮▮▮▯▯
Optimal pH	6.0 - 7.5

SOIL DRAINAGE CLASS

Very Well	▮
Well	▮
Moderately Well	▮
Somewhat Poor	▮
Poorly	▯
Very Poorly	▯

AREA & ADAPTABILITY

Forage Radish is suitable in all regions of British Columbia. It has the potential to overwinter in areas with mild winter conditions.

Winter Hardiness Zone 6-9

Seeding Considerations

Rate Drilled lbs/acre (kg/ha)	Rate Broadcast lbs./acre (kg/ha)	Depth in (cm)	Frost Seeding	Minimum Germination Temp °C (°F)	Seeds #
8-13 lbs/ac (9-14 kg/ha)	10-20 lbs/ac (11-22 kg/ha)	0.25-0.75 in (0.5-2 cm)	No	7°C (45°F)	13,600 /lb (30,000 /kg)

Forage radish is best establishment is in a firm seedbed with shallow placement. Seeding rates would be much lower when used in a blend.

Management Considerations

There are a wide range of forage brassica species available including radish, turnip, rape, kale and crosses between them. Forage brassicas have extremely high forage quality and moisture and if used for livestock feed must be grazed with a high level of management to ensure balanced ration (e.g. brassica stands should be treated as a supplement).

They are very effective in blends with cereals, annual grass and legumes. When seeded in a blend with other cover crops, it can commonly be seeded too heavy due to it's comparatively smaller seed size.

Inter-seeding Potential

Volunteer Establishment

Nitrogen Concentration No data

Dry Matter Yield

4000 - 7000 lbs/acre
4480 - 7840 kg/ha

Termination

Forage Radish can be terminated through tillage, mowing or the application of a suitable herbicide.

References

- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Midwest Cover Crop Council. (n.d.)
- Northeast Cover Crop Council. (n.d.)
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HAIRY VETCH

VICIA VILLOSA - WINTER ANNUAL LEGUME

PRODUCTION GOALS

Not Effective — *Very Effective*

Quick Growth	●●●●○
Lasting Residue	●○○○○
Soil Builder	●●●●○
Nitrogen Fixation	●●●●●
Nitrogen Scavenging	●●○○○
Erosion Reduction	●●●○○
Compaction Reduction	●●○○○
Biofumigation Potential	n/d
Weed Suppression	●●●○○
Forage Harvest Value	●○○○○
Grain Harvest Value	●●○○○

Hairy vetch displays a prostrate climbing growth habit with a medium depth tap root. It can be an annual or biennial. Hairy vetch has blue-purple flowers that attract insects and pollinators, if permitted to go to flowering stage. Known for its winter hardiness, hairy vetch is more cold tolerant than common vetch. Compared to other legumes, hairy vetch can fix the highest quantity of nitrogen.

TOLERANCES

Flood	●●○○○
Heat	●●●○○
Drought	●●●○○
Shade	●●●○○
Low Fertility	●●●○○
Salinity	●●○○○
Optimal pH	6.0 - 7.5

SOIL DRAINAGE CLASS

Very Well	
Well	■
Moderately Well	■
Somewhat Poor	■
Poorly	
Very Poorly	

AREA & ADAPTABILITY

Hairy vetch is suitable for all regions of British Columbia. It is very cold tolerant allowing for overwintering in many areas of the province.

Winter Hardiness Zone - 4-9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
15-30 lbs/ac (17-34 kg/ha)	25-40 lbs/ac (28-45 kg/ha)	0.5-1 in (1-2.5 cm)	No	14°C (58°F)	5400 /lb (12,000 /kg)

Germination is reduced in dry conditions. Hairy vetch should be seeded 30-45 days before the first killing frost for winter management; recommended to be in a seed mix (e.g. with fall rye) for fall seeding. Can be seeded in early spring for summer growth or in July if the goal is to terminate before winter. Use a pea or vetch inoculant at planting to ensure rhizobia development.

Management Considerations

Hairy vetch is a competitive cover crop. It is slow to start growing, and provides little weed control when young, but once established becomes vigorous with excellent weed suppression.

It can volunteer if allowed to go to seed, so for the least risk of volunteer and highest nitrogen availability terminate at the early bud stage. If used in an annual forage silage crop, early harvest should be considered to ensure hairy vetch does not bind in harvest equipment.

There can be livestock poisoning risks if grazing a pure hairy vetch stand that has set seed. If using for grazing be sure to include multiple species and graze before maturity.

Inter-seeding Potential

Volunteer Establishment

Nitrogen Concentration 3.0 - 4.9%

Dry Matter Yield

900 - 5000 lbs/acre
1008 - 5600 kg/ha

Nitrogen Contribution

90 - 200 lbs/acre
100.8 - 224 kg/ha

Termination

Hairy vetch can be terminated through tillage, mowing or in combination. Terminate during early flower to recognize value of crop as a pollinator/beneficial insect attractant. A roller crimper can be used when it is in flower. Glyphosate on its own is not always effective. For maximum nitrogen availability terminate at the early bud stage.

References

- Dobb, A., S. Burton. 2013. Rangeland Seeding Manual for British Columbia. B.C. Min. Agri., Sust. Agri. Mgmt. Br., Abbotsford, B.C.
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MUSTARD

BRASSICA SPP. - COOL SEASON ANNUAL NON-LEGUME BROADLEAF

PRODUCTION GOALS

Not Effective — *Very Effective*

Quick Growth	●●●●○
Lasting Residue	●●○○○
Soil Builder	●●●○○
Nitrogen Fixation	*n/a*
Nitrogen Scavenging	●●●○○
Erosion Reduction	●●●○○
Compaction Reduction	●●●○○
Biofumigation Potential	●●●○○
Weed Suppression	●●●●○
Forage Harvest Value	●●●○○
Grain Harvest Value	●●○○○

Mustard has an upright growth habit and medium depth taproot. Mustard is a blanket term for a number of brassica species such as white/yellow mustard and indian/brown mustard. Mustards are good weed suppressors and can act as a biofumigant.

TOLERANCES

Flood	●●○○○
Heat	●●●○○
Drought	●●●○○
Shade	●●○○○
Low Fertility	●●○○○
Salinity	●●●○○
Optimal pH	5.5 - 8.0

SOIL DRAINAGE CLASS

Very Well	○
Well	●
Moderately Well	●
Somewhat Poor	●
Poorly	●
Very Poorly	○

AREA & ADAPTABILITY

Mustard is a suitable spring seeded annual for all regions of British Columbia. It is able to tolerate a wide range of conditions making it suitable for many field locations and soil types.

Winter Hardiness Zone - 7 - 9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
4-15 lbs/ac (5-17 kg/ha)	5-18 lbs/ac (5-20 kg/ha)	0.25-0.5 in (0.5-1 cm)	No	4°C (40°F)	80,000 /lb (180,000 /kg)

Mustard is a small seed and should be seeded shallow in a firm seedbed for best establishment.

Management Considerations

Select a more drought tolerant mustard such as brown mustard in low precipitation environments. Bolting will occur quickly if the crop is seeded in hot weather.

Mustard needs some nitrogen to ensure good establishment.

If planted too late in the fall, use of mustard for biofumigation may be ineffective. Mustard should be incorporated into the soil when being used as a biofumigant, with high biomass increasing effectiveness.

Inter-seeding Potential

Volunteer Establishment

Nitrogen Concentration No data

Dry Matter Yield

1200 - 3000 lbs/acre
1334 - 3360 kg/ha

Termination

Mustards may be terminated through tillage, mowing or a chemical application.

References

- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Midwest Cover Crop Council. (n.d.)
- Northeast Cover Crop Council. (n.d.)
- Sustainable Agriculture Research and Education (SARE). 2012. Managing Cover Crops Profitably: 3rd Ed. National Institute of Food and Agriculture, USDA, University of Maryland & University of Vermont.
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PHACELIA

PHACELIA TANACETIFOLIA - COOL SEASON ANNUAL NON-LEGUME BROADLEAF

PRODUCTION GOALS

Not Effective — *Very Effective*

Quick Growth	●●●○○
Lasting Residue	●●○○○
Soil Builder	●●○○○
Nitrogen Fixation	*n/a*
Nitrogen Scavenging	●●●○○
Erosion Reduction	●●●○○
Compaction Reduction	●●●○○
Biofumigation Potential	*n/d*
Weed Suppression	●●○○○
Forage Harvest Value	●●●○○
Grain Harvest Value	*n/d*

Phacelia has an upright growth habit and deep taproot. Phacelia is often used to attract pollinators and other insects due to its long flowering period. Phacelia has a high nitrogen content causing it to breakdown quickly after being incorporated.

TOLERANCES

Flood	●●●○○
Heat	●●●○○
Drought	●●●○○
Shade	●●●○○
Low Fertility	●●●○○
Salinity	●○○○○
Optimal pH	6.5 - 8.5

SOIL DRAINAGE CLASS

Very Well	■
Well	■
Moderately Well	■
Somewhat Poor	■
Poorly	■
Very Poorly	□

AREA & ADAPTABILITY

Phacelia is a suitable spring-seeded annual for all regions of British Columbia. It is able to tolerate a wide range of conditions making it suitable for many locations and soil types, but it is unlikely to reach full-maturity in most locations.

Winter Hardiness Zone - 9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
2-10 lbs/ac (3-12 kg/ha)	2-12 lbs/ac (3-13 kg/ha)	0.25-0.5 in (0.5-1 cm)	No	3°C (38°F)	108,000 /lb (240,000 /kg)

Phacelia seeds must be buried for germination to occur, broadcasting is not recommended. Shallow seeding into a firm seedbed will yield the best results.

Management Considerations

Phacelia is often used in blends or as a pure stand to attract pollinators. It has a very high tolerance of a wide range of conditions making it an option for many farms.

Inter-seeding Potential No data

Volunteer Establishment 

Nitrogen Concentration No data

Dry Matter Yield

2000-6000 lbs/acre
2240-6720 kg/ha

Termination

Phacelia can be terminated through tillage, mowing and chemical application. Decomposition occurs quickly.

References

- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Northeast Cover Crop Council. (n.d.)
- U.S. Department of Agriculture. (n.d.). Pacific Northwest Cover Crop Selection Tool.

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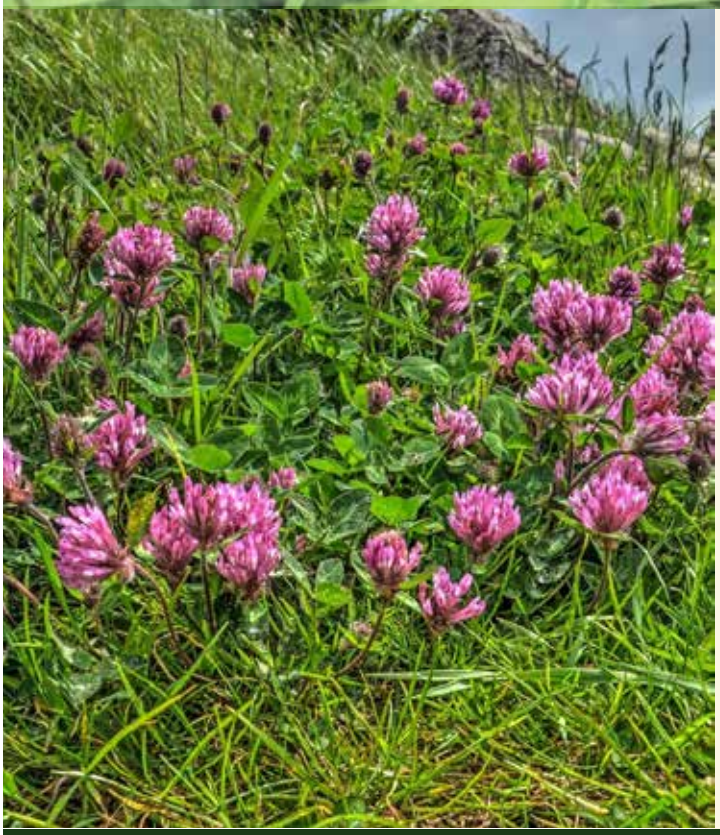
RED CLOVER

TRIFOLIUM PRATENSE - COOL SEASON PERENNIAL LEGUME



PRODUCTION GOALS

Not Effective ▮▯▯▯▯ ▮▮▮▮▮ *Very Effective*

Quick Growth	▮▮▯▯▯
Lasting Residue	▮▮▯▯▯
Soil Builder	▮▮▮▮▯
Nitrogen Fixation	▮▮▮▮▯
Nitrogen Scavenging	▮▮▮▯▯
Erosion Reduction	▮▮▮▯▯
Compaction Reduction	▮▮▮▮▯
Biofumigation Potential	n/d
Weed Suppression	▮▮▮▯▯
Forage Harvest Value	▮▮▮▮▯
Grain Harvest Value	▮▮▮▯▯

Red clover has an upright growth habit and a deep taproot. It is a short lived perennial legume capable of fixing ample nitrogen. In a monoculture, weed suppression is limited due to the slow development of red clover. Red clover does well when planted with cereals as it can establish without decreasing yields and increases weed suppression.

TOLERANCES

Flood	▮▮▮▯▯
Heat	▮▮▮▯▯
Drought	▮▮▮▯▯
Shade	▮▮▮▮▯
Low Fertility	▮▮▮▯▯
Salinity	▮▮▯▯▯
Optimal pH	6.0 - 7.5

SOIL DRAINAGE CLASS

Very Well	▯
Well	▮
Moderately Well	▮
Somewhat Poor	▮
Poorly	▯
Very Poorly	▯

AREA & ADAPTABILITY

Red clover is a suitable perennial legume for all regions of British Columbia. It is able to tolerate a wide range of conditions making it suitable for many field locations and soil types.

Winter Hardiness Zone - 4-9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
8-10 lbs/ac (9-11 kg/ha)	10-12 lbs/ac (11-13 kg/ha)	0.25-0.5 in (0.5-1 cm)	Yes	5°C (41°F)	122,000 /lb (270,000 /kg)

There are single cut and multi-cut varieties to select from.
Inoculant: Use red clover inoculant to ensure rhizobia development and adequate N fixation.

Management Considerations

Red Clover is adapted to many different environments, including cool climates, and though it germinates quickly, it is slow to grow. For this reason it is recommended to be overseeded or frost seeded into standing crops, to ensure soils have a cover and do not dry out or become eroded.

Red Clover is a legume and can cause bloat in ruminants. Producers should be aware of this and manage grazing accordingly. For example, avoid grazing in wet or damp conditions.

Inter-seeding Potential ▮▮▮▮▯

Volunteer Establishment ▮▮▮▮▮

Nitrogen Concentration 2.4 - 4.5%

Dry Matter Yield
2000-5000 lbs/acre
2240-5600 kg/ha

Nitrogen Contribution
70 -150 lbs/acre
78.4 -168 kg/ha

Termination

Red clover can be terminated through tillage or herbicide application at the early bud stage to maximize plant available nitrogen. Vegetative and actively growing clover can be difficult to terminate mechanically and can require multiple tillage passes.

References

- Cloverdale Soil Conservation Group. 1994. Final Report: Part 2 Reports, Newsletters and Bulletins.
- Dobb, A., S. Burton. 2013. Rangeland Seeding Manual for British Columbia, B.C. Min. Agri., Sust. Agri. Mgmt. Br., Abbotsford, B.C.
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- Ismail, I. 1994. Establishment and Evaluation of Cover Crops Underseeded in Sweet Corn in Delta, British Columbia. University of British Columbia.
- Midwest Cover Crop Council. (n.d.)
- Northeast Cover Crop Council. (n.d.)
- Odhiambo, J., Temple, W.D., A. Bomke. 2012. Managing Cover Crops for Conservation Purposes in the Fraser River Delta, British Columbia. In: Crop Management - Cases and Tools for Higher Yield and Sustainability.
- Pavek, P. and D.M. Granatstein. 2016. Legume cover in orchard drive alleys final report. No. 12864. USDA-NRCS Plant Materials Center, Pullman, WA.
- Sullivan, D.M., Andrews, N. and L.J. Brewer. 2020. Estimate Plant-Available Nitrogen Release from Cover Crops. Pacific Northwest Extension Publishing 636.
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SORGHUM-SUDANGRASS

SORGHUM BICOLOR X SORGHUM BICOLOR Var. Sudanese

WARM SEASON ANNUAL GRASS

PRODUCTION GOALS

	Not Effective	Very Effective
Quick Growth		▮▮▮▮▯
Lasting Residue		▮▮▮▮▮
Soil Builder		▮▮▮▮▮
Nitrogen Fixation	*n/a*	
Nitrogen Scavenging		▮▮▮▮▮
Erosion Reduction		▮▮▮▮▮
Compaction Reduction		▮▮▮▮▮
Biofumigation Potential		▮▮▮▯▯
Weed Suppression		▮▮▮▯▯
Forage Harvest Value		▮▮▮▮▯
Grain Harvest Value		▮▮▮▯▯

Sorghum-sudangrass has an upright growth habit and a deep fibrous root. If given appropriate fertility, the biomass production is substantial, with plants growing 6-12 feet tall. With thick roots systems, sorghum sudangrass can decrease compaction. Mid- season cutting has been shown to increase both yields and root penetration.

TOLERANCES

Flood	▮▮▮▯▯
Heat	▮▮▮▯▯
Drought	▮▮▮▮▮
Shade	▮▮▮▯▯
Low Fertility	▮▮▯▯▯
Salinity	▮▮▮▯▯
Optimal pH	5.5 - 8.0

SOIL DRAINAGE CLASS

Very Well	■
Well	■
Moderately Well	■
Somewhat Poor	■
Poorly	▯
Very Poorly	▯

AREA & ADAPTABILITY

Sorghum-sudangrass is a true warm season crop (C4 photosynthesis) and as such thrives under as much heat as possible. While it may contribute to a seed-blend throughout the province, it is best suited to the southern regions.

Winter Hardiness:
Does not overwinter

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
15-35 lbs/ac (17-39 kg/ha)	18-42 lbs/ac (20-47 kg/ha)	0.25-1.5in (0.6-3.8 cm)	No	18°C (65°F)	8600 /lb (19,000 /kg)

Sorghum-sudangrass should be planted into warm soils and increasing temperatures in the early summer as it does not tolerate cool soils. Heavy water user and can be seeded to 2" maximum if chasing moisture availability. Irrigation may be necessary if there is little soil moisture. There are varietal differences in seeding rate to consider. Brown mid-rib varieties are also available for higher fiber digestibility for forage use.

Management Considerations

As a warm season crop, under cool, sub-optimal growing conditions, sorghum-sudangrass becomes a poor weed competitor, as other cool-tolerant species can thrive. In adapted regions it produces a very large amount of biomass which can be challenging to incorporate back into the soil. Sorghum sudangrass is a hybrid between forage sorghum and sudangrass which can also be considered as a cover crop.

Nitrate poisoning can occur in times when soil nitrogen levels are high but growth is limited. Such as during a drought, cool cloudy conditions or after a frost. Feed should be tested for high nitrate levels so feed out can be monitored appropriately in livestock.

Sorghum-sudan grass can produce prussic acid poisoning that can be fatal to cattle under some conditions. However, there is varietal differences in prussic acid content. Grazing when plants are young or stressed (e.g. drought or frost-killed) poses the highest risk.

Inter-seeding Potential ▮▯▯▯▯

Volunteer Establishment ▮▮▮▮▯

Nitrogen Concentration No data

Dry Matter Yield

2000-10,000 lbs/acre

2240-11,200 kg/ha

Termination

Sorghum-sudangrass can be terminated with tillage, mowing or the application of herbicide. Sorghum-sudangrass has zero frost tolerance and clear nights near 0°C will also terminate it. If there is sufficient biomass before a killing frost, sorghum sudangrass can be used as mulch. Termination by mowing can be difficult as regrowth is rapid, which is why it can be used as a multiple-cut forage.

References

- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Midwest Cover Crop Council. (n.d.)
- Northeast Cover Crop Council. (n.d.)
- Odhiambo, J., Temple, W.D., A. Bomke. 2012. Managing Cover Crops for Conservation Purposes in the Fraser River Delta, British Columbia. In: Crop Management - Cases and Tools for Higher Yield and Sustainability.
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SPRING BARLEY

HORDEUM VULGARE - COOL SEASON ANNUAL GRASS

PRODUCTION GOALS

	Not Effective	Very Effective
Quick Growth		
Lasting Residue		
Soil Builder		
Nitrogen Fixation	n/a	
Nitrogen Scavenging		
Erosion Reduction		
Compaction Reduction		
Biofumigation Potential		
Weed Suppression		
Forage Harvest Value		
Grain Harvest Value		

Spring barley can produce high levels of biomass and can be used as a cover crop, forage, brought to maturity for grain or plow down. It is often used in multispecies mixes for silage and tolerates alkalinity. Spring and winter barley are the same species but spring barley varieties are generally not as cold tolerant but do not require a cold period to flower.

TOLERANCES

Flood	
Heat	
Drought	
Shade	
Low Fertility	
Salinity	
Optimal pH	6.0 - 8.5

SOIL DRAINAGE CLASS

Very Well	
Well	■
Moderately Well	■
Somewhat Poor	
Poorly	
Very Poorly	

AREA & ADAPTABILITY

Spring barley is a suitable spring seeded annual for all regions of British Columbia. It is able to tolerate a wide range of conditions making it suitable for many field locations and soil types.

Winter Hardiness Zone - 9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
50-125 lbs/ac (560-140 kg/ha)	80-150 lbs/ac (90-168 kg/ha)	0.75-2 in (2-5 cm)	No	3°C (38°F)	6170 /lb (13,600) /kg

Management Considerations

A range of barley varieties are available with characteristics including 2 or 6 kernel row, smooth or rough awns and various expected growth heights from semi-dwarf to tall.

Cereals can accumulate nitrates after a period of stress (e.g. drought or killing frost) and/or high nitrate levels in the soil and should be tested before feed out. Moreover, smooth awn varieties may be preferably to improve palatability for livestock.

Inter-seeding Potential ▮▮▮▮▯

Volunteer Establishment ▮▮▮▮▯

Nitrogen Concentration 1.2 - 4.3%

Dry Matter Yield

700 - 6000 lbs/acre
784 - 6720 kg/ha

Termination

Spring barley can be terminated by tillage, mowing after stem elongation, and chemical means. It will also winterkill in the majority of the province and provide good winterkilled mulch.

References

- Cloverdale Soil Conservation Group. 1994. Final Report: Part 2 Reports, Newsletters and Bulletins.
- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Midwest Cover Crop Council. (n.d.)
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SPRING OATS

AVENA SATIVA - COOL SEASON ANNUAL GRASS

PRODUCTION GOALS

Not Effective — *Very Effective*

Quick Growth	●●●●○
Lasting Residue	●●●○○
Soil Builder	●●●○○
Nitrogen Fixation	●○○○○
Nitrogen Scavenging	●●●○○
Erosion Reduction	●●●○○
Compaction Reduction	●●○○○
Biofumigation Potential	●○○○○
Weed Suppression	●●●○○
Forage Harvest Value	●●●○○
Grain Harvest Value	●●●○○

Spring oats are a relatively inexpensive, rapid growing cool season annual. It is well suited as a spring or fall cover crop alone or in a mixture with other species. Oats grows tall with better tolerance of saturated soils than other spring cereals.

TOLERANCES

Flood	●●●○○
Heat	●●○○○
Drought	●●●○○
Shade	●●○○○
Low Fertility	●●●○○
Salinity	n/d
Optimal pH	4.5 - 7.5

SOIL DRAINAGE CLASS

Very Well	■
Well	■
Moderately Well	■
Somewhat Poor	■
Poorly	■
Very Poorly	□

AREA & ADAPTABILITY

Spring oats are a suitable spring-seeded annual for all regions of British Columbia. It is able to tolerate a wide range of conditions making it suitable for many field locations and soil types.

Winter Hardiness Zone - Does not overwinter

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
50-110 lbs/ac (56-124 kg/ha)	110-140 lbs/ac (124-156 kg/ha)	0.5-1.5 in (1-4 cm)	No	3°C (38°F)	5400 /lb (12,000 /kg)

In warm areas of the province, oats should be seeded early spring or late summer. It can also be used as a summer seeded cover crop where cool conditions prevail.

Management Considerations

Oats can be very competitive and have a wider range of tolerances than other spring cereals.

Forage specific varieties of oats are available, these varieties are often taller, leafier and bred for more biomass. Cereals can accumulate nitrates after a period of stress (e.g. drought or killing frost) and/or high nitrate levels in the soil and should be tested before feed out.

Inter-seeding Potential

Volunteer Establishment

Nitrogen Concentration 0.6 - 0.9%

Dry Matter Yield

2000 - 10,000 lbs/acre
2240 - 11,200 kg/ha

Termination

Oats can be terminated by a killing frost, tillage or a chemical application. Termination should occur before seeds reach the reproductive stage to prevent volunteers.

References

- Cloverdale Soil Conservation Group. 1994. Final Report: Part 2 Reports, Newsletters and Bulletins.
- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
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SPRING WHEAT

TRITICUM AESTIVUM- COOL SEASON ANNUAL GRASS

PRODUCTION GOALS

	Not Effective	Very Effective
Quick Growth		
Lasting Residue		
Soil Builder		
Nitrogen Fixation	n/a	
Nitrogen Scavenging		
Erosion Reduction		
Compaction Reduction		
Biofumigation Potential		
Weed Suppression		
Forage Harvest Value		
Grain Harvest Value		

Spring wheat has an upright growth habit and medium depth fibrous root system. It is capable of being used as a cover crop, forage or brought to maturity for grain. Wheat will flower in the same year it is planted. It is an excellent N scavenger with high quality forage potential. Winter and spring wheat are the same species but spring wheat varieties do not require cold exposure for flowering but tend to somewhat less effective in weed suppression

TOLERANCES

Flood	
Heat	
Drought	
Shade	
Low Fertility	
Salinity	
Optimal pH	5.5 - 8.0

SOIL DRAINAGE CLASS

Very Well	■
Well	■
Moderately Well	■
Somewhat Poor	■
Poorly	■
Very Poorly	■

AREA & ADAPTABILITY

Spring wheat is a suitable spring seeded annual for all regions of British Columbia. It is able to tolerate a wide range of conditions making it suitable for many field locations and soil types.

Winter Hardiness - Zone 8-9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds
70-150 lbs/ac (78-168 kg/ha)	77-165 lbs/ac (86-185 kg/ha)	0.75-2 in (2-5 cm)	No	3°C (38°F)	6800 /lb (15,000 /kg)

Spring wheat can be a spring seeded crop, but produces less biomass than oats or barley. It may be seeded in late summer or early fall for nutrient (nitrogen) scavenging, ground cover and/or fall grazing opportunities. Earlier planting dates improve N scavenging ability.

Management Considerations

There are 9 varietal classes of spring wheat in Western Canada. Many of the commonly available hard red spring genetics have been bred for relatively short straw under grain production, while some of the soft white wheats have improved cover crop characteristics. Understanding what the variety was bred for (e.g. grain vs. silage) should inform selection. Spring wheat can have high forage quality if harvested at a vegetative stage. Cereals can accumulate nitrates after a period of stress (e.g. drought or killing frost) and/or high nitrate levels in the soil and should be tested before feed out.

Inter-seeding Potential ▮▮▮▮▯

Volunteer Establishment ▮▮▮▮▮

Nitrogen Concentration 0.5 - 5.2%

Dry Matter Yield

900 - 4000 lbs/acre

1008 - 4480 kg/ha

Termination

Spring wheat can be terminated by a killing frost, tillage or a chemical application. Tillage may require several passes. Termination should occur before seeds the reproductive stage to prevent volunteers.

References

- Cloverdale Soil Conservation Group. 1994. Final Report: Part 2 Reports, Newsletters and Bulletins.
- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Midwest Cover Crop Council. (n.d.)
- Northeast Cover Crop Council. (n.d.)
- Odhiambo, J., Temple, W.D., A. Bomke. 2012. Managing Cover Crops for Conservation Purposes in the Fraser River Delta, British Columbia. In: Crop Management - Cases and Tools for Higher Yield and Sustainability.
- Sustainable Agriculture Research and Education (SARE). 2012. Managing Cover Crops Profitably: 3rd Ed. National Institute of Food and Agriculture, USDA, University of Maryland & University of Vermont.
- U.S. Department of Agriculture. (n.d.). Pacific Northwest Cover Crop Selection Tool.

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SUBTERRANEAN CLOVER

TRIFOLUM SUBERRANEUM, T. YANNINICUM, T. BRACHUCALCYCINU

PRODUCTION GOALS

Not Effective — Very Effective

Quick Growth	
Lasting Residue	
Soil Builder	
Nitrogen Fixation	
Nitrogen Scavenging	
Erosion Reduction	
Compaction Reduction	
Biofumigation Potential	n/d
Weed Suppression	
Forage Harvest Value	
Grain Harvest Value	

Subterranean clover has a prostrate to semi-prostrate growth habit and a deep tap root. This low growing legume is suitable for grazing but is not suitable as hay due to its growth habit. Subterranean clover has vigorous seedlings that form nodules quickly.

TOLERANCES

Flood	
Heat	
Drought	
Shade	
Low Fertility	
Salinity	n/d
Optimal pH	5.5 - 7.0

SOIL DRAINAGE CLASS

Very Well	
Well	■
Moderately Well	■
Somewhat Poor	■
Poorly	
Very Poorly	

AREA & ADAPTABILITY

Subterranean clover is suitable as an annual across British Columbia. It thrives in Mediterranean climates (hot, dry summers and mild, wet winters).

Winter Hardiness - Zone 7-9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
10-20 lbs/ac (11-23 kg/ha)	20-30 lbs/ac (23-34 kg/ha)	0.25-0.5 in (0.5-1 cm)	No	3°C (38°F)	31,700 /lb (70,000 /kg)

Subterreanean clover is best seeded shallowly into a firm seedbed.
Inoculant: Use red/white clover inoculant.

Management Considerations

There are several subspecies and varieties that have different suitability for water-logged soils and for soil pH. Subterranean clover is able to vigorously reseed itself, so it has the potential to volunteer if allowed to set seed. It is also very competitive and works well in suppressing weeds. Producers in other areas have used Subterranean clover as an interseeded crop in cereal grains to boost nitrogen availability.

Inter-seeding Potential ▮▮▮▮▮

Volunteer Establishment ▮▮▮▮▮

Nitrogen Concentration 2.2 - 2.4%

Dry Matter Yield
3000 - 8500 lbs/acre
3360 - 9520 kg/ha

Nitrogen Contribution
75 - 200 lbs/acre
84 - 224 kg/ha

Termination

Subterranean clover can be terminated through tillage and the application of herbicides. It should be terminated during the late bud stage to maximize plant available nitrogen.

References

- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Friddle, M. 2018. Plant guide for subterranean clover (*Trifolium subterraneum*). USDA-Natural Resources Conservation Service, Corvallis Plant Materials Center, Corvallis, OR.
- Pavek, P. and D.M. Granatstein. 2016. Legume cover in orchard drive alleys final report. No. 12864. USDA-NRCS Plant Materials Center, Pullman, WA.
- Sustainable Agriculture Research and Education (SARE). 2012. Managing Cover Crops Profitably: 3rd Ed. National Institute of Food and Agriculture, USDA, University of Maryland & University of Vermont.
- U.S. Department of Agriculture. (n.d.). Pacific Northwest Cover Crop Selection Tool.
- Lusk, Mike. 2015. Photo 2533331 Subterranean Clover. iNaturalist. inaturalist.org/photos/2533331

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SWEET CLOVERS

MELILOTUS SPP. - COOL SEASON ANNUAL/BIENNIAL LEGUME

PRODUCTION GOALS

Not Effective — *Very Effective*

Quick Growth	
Lasting Residue	
Soil Builder	
Nitrogen Fixation	
Nitrogen Scavenging	
Erosion Reduction	
Compaction Reduction	
Biofumigation Potential	
Weed Suppression	
Forage Harvest Value	
Grain Harvest Value	

Sweet clover has an upright growth habit and deep taproot. It can be either an annual (white flower) or biennial (yellow flower). Its deep taproot is thought to decrease compaction and allows sweet clover to be drought tolerant once established. It can be used for grazing, however mature sweet clover has decreased palatability. White flowering sweet clover does not produce as much as the yellow flowering and is less drought-tolerant.

TOLERANCES

Flood	
Heat	
Drought	
Shade	
Low Fertility	
Salinity	
Optimal pH	6.5 - 7.5

SOIL DRAINAGE CLASS

- Very Well
- Well
- Moderately Well
- Somewhat Poor
- Poorly
- Very Poorly

AREA & ADAPTABILITY

Sweet clover can be grown successfully across BC. It is very drought tolerant and does not tolerate waterlogged soils well. Yellow sweet clover has better cold tolerance than white sweet clover.

Winter Hardiness Zone - 4-9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds
6-15 lbs/ac (7-17 kg/ha)	15-20 lbs/ac (17-22 kg/ha)	0.25-1 in (0.5-2.5 cm)	No	6°C (42°F)	79,000 /lb (174,000 /kg)

Based on cover crop goals select for an annual or biennial variety. Choose a low coumarin variety if using sweet clover for livestock feed. Use an alfalfa or sweet clover inoculant to ensure rhizobia formation and adequate nitrogen fixation. Use scarified seed to improve germination.

Management Considerations

Sweet Clover is able to produce large amounts of biomass from marginal land and can be a useful partner in blends with fall-seeded biennials such as winter cereals. It thrives anywhere where alfalfa grows well.

Sweet clover contains coumarin which can be converted to dicoumaral if mold occurs even in very small amounts. Dicoumaral is poisonous to livestock so feed should be tested for the toxic compound to avoid adverse reactions in livestock even when mold is not observed. Sweet clover also has bloat risk; however the risk is reduced in mixes because young sweet clover tends to be bitter and livestock select other plants at that stage.

Inter-seeding Potential ▮▮▮▯▯

Volunteer Establishment ▮▮▯▯▯

Nitrogen Concentration No data

Dry Matter Yield

2500-5000 lbs/acre
2800-5600 kg/ha

Nitrogen Contribution

20-170 lbs/acre
22-190 kg/ha

Termination

Sweet clover can be terminated through tillage, mowing or the use of a herbicide. Terminate at the late bud stage to maximize the amount of plant available nitrogen.

References

- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Midwest Cover Crop Council. (n.d.)
- Northeast Cover Crop Council. (n.d.)
- Sustainable Agriculture Research and Education (SARE). 2012. Managing Cover Crops Profitably: 3rd Ed. National Institute of Food and Agriculture, USDA, University of Maryland & University of Vermont.
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WHITE CLOVER

TRIFOLIUM REPENS- COOL SEASON PERENNIAL LEGUME

PRODUCTION GOALS

Not Effective — Very Effective

Quick Growth	▮▮▯▯▯
Lasting Residue	▮▮▯▯▯
Soil Builder	▮▮▮▯▯
Nitrogen Fixation	▮▮▮▮▯
Nitrogen Scavenging	▮▮▯▯▯
Erosion Reduction	▮▮▮▯▯
Compaction Reduction	▮▮▮▯▯
Biofumigation Potential	n/d
Weed Suppression	▮▮▮▯▯
Forage Harvest Value	▮▮▮▮▯
Grain Harvest Value	▮▮▯▯▯

White clover has an upright growth habit. Seedlings have a taproot but as the plant matures fibrous roots develop from detached stolons. White clover does best on heavy soils with little drought stress. White clover can be used as a living mulch due to its high tolerance for traffic. It tends to spread into adjacent plant rows and does not die off easily when dug under on some soils.

TOLERANCES

Flood	▮▮▮▯▯
Heat	▮▮▮▮▯
Drought	▮▮▮▯▯
Shade	▮▮▮▮▯
Low Fertility	▮▮▮▯▯
Salinity	▮▮▯▯▯
Optimal pH	6.0 - 7.0

SOIL DRAINAGE CLASS

Very Well	▯
Well	▮
Moderately Well	▮
Somewhat Poor	▮
Poorly	▯
Very Poorly	▯

AREA & ADAPTABILITY

White clover is winter hardy and is suitable across British Columbia. White clover can tolerate poor conditions better than other clovers and can withstand heavy traffic.

Winter Hardiness Zone - 4-9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
3-14 lbs/ac (4-16 kg/ha)	4-17 lbs/ac (5-19 kg/ha)	0.25-0.5 in (0.5-1 cm)	Yes	4°C (40°F)	226,000 /lb (500,000 /kg)

A clover stand will survive 3-4 years. It is slower growing but very vigorous once established.

Management Considerations

White clover works great as a living mulch crop and a ground cover for inter-row areas and to compete with weeds. White clover also has better tolerances than the other clovers and is relatively easy to establish. White clover is very aggressive once established.

Red Clover is a legume and can cause bloat in ruminants. Producers should be aware of this and manage grazing accordingly. For example, avoid grazing in wet or damp conditions.

Inter-seeding Potential ▮▮▮▯▯

Volunteer Establishment ▮▮▮▮▮

Nitrogen Concentration 2.2 - 5.1%

Dry Matter Yield
2000 - 6000 lbs/acre
2240 - 6720 kg/ha

Nitrogen Contribution
80 - 200 lbs/acre
89.6 - 224 kg/ha

Termination

White clover may be terminated through tillage, although it will require multiple passes, or an herbicide application. Termination should occur at the late bud stage to maximize plant available nitrogen.

References

- Dobb, A., S. Burton. 2013. Rangeland Seeding Manual for British Columbia. B.C. Min. Agri., Sust. Agri. Mgmt. Br., Abbotsford, B.C.
- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Midwest Cover Crop Council. (n.d.)
- Northeast Cover Crop Council. (n.d.)
- Pavek, P. and D.M. Granatstein. 2016. Legume cover in orchard drive alleys final report. No. 12864. USDA-NRCS Plant Materials Center, Pullman, WA.
- Sustainable Agriculture Research and Education (SARE). 2012. Managing Cover Crops Profitably: 3rd Ed. National Institute of Food and Agriculture, USDA, University of Maryland & University of Vermont.
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WINTER BARLEY

HORDEUM VULGARE - WINTER BIENNIAL GRASS

PRODUCTION GOALS

Not Effective — *Very Effective*

Quick Growth	●●●●○
Lasting Residue	●●●●●
Soil Builder	●●●●○
Nitrogen Fixation	n/a
Nitrogen Scavenging	●●●●○
Erosion Reduction	●●●●●
Compaction Reduction	●●●○○
Biofumigation Potential	●○○○○
Weed Suppression	●●●●○
Forage Harvest Value	●●●●○
Grain Harvest Value	●●●●○

Winter barley is capable of being used as a cover crop, forage or brought to maturity for grain. It can produce high levels of biomass for forage production, ground cover or plow down. It also has potential use as a spring seeded nurse crop as a component of a blend. Winter and spring barley belong to the same species but winter barley varieties tend to produce more biomass and often require exposure to a cold period for flowering.

TOLERANCES

Flood	●●○○○
Heat	●●○○○
Drought	●●●○○
Shade	●●○○○
Low Fertility	●●●○○
Salinity	●●●○○
Optimal pH	6.0 - 8.5

SOIL DRAINAGE CLASS

Very Well	
Well	■
Moderately Well	■
Somewhat Poor	
Poorly	
Very Poorly	

AREA & ADAPTABILITY

Winter barley is a suitable fall seeded crop for areas of BC with milder winters and/or adequate snow cover for insulation.

Winter Hardiness Zone 5-9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
50-125 lbs/ac (560-140 kg/ha)	80-150 lbs/ac (90-168 kg/ha)	0.5-2 in (1-5 cm)	No	3°C (38°F)	6170 /lb (13,600 /kg)

When fall seeded, winter barley should be seeded earlier than other fall cereals by up to two weeks to ensure enough growth to avoid winterkill.

Management Considerations

A range of winter barley varieties are available with characteristics including 2 row or 6 row heads, smooth or rough awns and various expected growth heights. Winterhardiness is a concern in much of BC with variable success in the southern interior.

Cereals can accumulate nitrates after a period of stress (e.g. drought or killing frost) and/or high nitrate levels in the soil and should be tested before feed out.

Inter-seeding Potential ▮▮▮▮▯

Volunteer Establishment ▮▮▮▮▮

Nitrogen Concentration No data

Dry Matter Yield

2000 - 5000 lbs/acre

2240 - 5600 kg/ha

Termination

Winter barley can be terminated by tillage, mowing after stem elongation and by chemical means. Though a biennial, it will still winterkill in the majority of the province and provide good winterkilled mulch.

References

- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Midwest Cover Crop Council. (n.d.)
- Northeast Cover Crop Council. (n.d.)
- Odhiambo, J., Temple, W.D., A. Bomke. 2012. Managing Cover Crops for Conservation Purposes in the Fraser River Delta, British Columbia. In: Crop Management - Cases and Tools for Higher Yield and Sustainability.
- Sustainable Agriculture Research and Education (SARE). 2012. Managing Cover Crops Profitably: 3rd Ed. National Institute of Food and Agriculture, USDA, University of Maryland & University of Vermont.
- U.S. Department of Agriculture. (n.d.). Pacific Northwest Cover Crop Selection Tool.

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WINTER TRITICALE

X TRITICOSECALE - WINTER BIENNIAL GRASS

PRODUCTION GOALS

Not Effective — *Very Effective*

Quick Growth	
Lasting Residue	
Soil Builder	
Nitrogen Fixation	n/a
Nitrogen Scavenging	
Erosion Reduction	
Compaction Reduction	
Biofumigation Potential	
Weed Suppression	
Forage Harvest Value	
Grain Harvest Value	

Winter triticale has an upright growth habit and a medium depth fibrous root system. Triticale is a cross between wheat and rye. The crop must overwinter before stem elongation, flowering and grain fill can occur (vernalization). High biomass potential similar to fall rye, but has less weed suppression than fall rye.

TOLERANCES

Flood	
Heat	
Drought	
Shade	
Low Fertility	
Salinity	
Optimal pH	5.5 - 8.0

SOIL DRAINAGE CLASS

- Very Well
- Well
- Moderately Well
- Somewhat Poor
- Poorly
- Very Poorly

AREA & ADAPTABILITY

Winter triticale is a winter annual suitable for all regions of British Columbia. It is able to tolerate a wide range of conditions making it suitable for many field locations and soil types.

Winter Hardiness Zone - 4-9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
50-120 lbs/ac (56-124 kg/ha)	60-144 lbs/ac (67-161 kg/ha)	0.5-2 in (2-4 cm)	No	3°C (38°F)	12,000 /lb (5500 /kg)

Planting date impacts N scavenging ability, spring biomass production and fall ground cover. Early seedings have opportunity to take up more N before fall/winter precipitation, provide more time for ground cover and have higher spring biomass production.

Management Considerations

Winter triticale has high forage quality if harvested at a vegetative stage, and is often blended with Italian ryegrass in areas where the ryegrass will overwinter for additional yield and quality. There are genetics available that have reduced awn expression for higher palatability for livestock.

When seeding later than the optimal seeding date, higher seeding rates can be beneficial to increase the stand density. There is a wide range of winter triticale varieties available with varying disease resistance and winterhardiness.

Inter-seeding Potential ▮▮▮▮▯

Volunteer Establishment ▮▮▮▮▮

Nitrogen Concentration No data

Dry Matter Yield

1000 - 6000 lbs/acre
1120 - 6720 kg/ha

Termination

Winter triticale can be terminated by tillage, mowing after stem elongation or through a chemical application.

References

- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Midwest Cover Crop Council. (n.d.)
- Northeast Cover Crop Council. (n.d.)
- Odhiambo, J., Temple, W.D., A. Bomke. 2012. Managing Cover Crops for Conservation Purposes in the Fraser River Delta, British Columbia. In: Crop Management - Cases and Tools for Higher Yield and Sustainability.
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WINTER WHEAT

TRITICUM AESTIVUM - WINTER BIENNIAL GRASS

PRODUCTION GOALS

Not Effective — *Very Effective*

Quick Growth	●●●●○
Lasting Residue	●●●●○
Soil Builder	●●●●○
Nitrogen Fixation	n/a
Nitrogen Scavenging	●●●●○
Erosion Reduction	●●●●○
Compaction Reduction	●●●○○
Biofumigation Potential	●○○○○
Weed Suppression	●●●●○
Forage Harvest Value	●●●●●
Grain Harvest Value	●●●●●

Winter wheat has an upright growth habit and a medium depth fibrous root system. Winter and spring wheat are the same species but some winter wheat varieties must overwinter before stem elongation, flowering and grain fill can occur (vernalization) but are better weed suppressors. Winter wheat can provide an excellent quality forage.

TOLERANCES

Flood	●●○○○
Heat	●●●○○
Drought	●●●○○
Shade	●●●○○
Low Fertility	●●●○○
Salinity	●●○○○
Optimal pH	5.5 - 8.0

SOIL DRAINAGE CLASS

Very Well	■
Well	■
Moderately Well	■
Somewhat Poor	■
Poorly	■
Very Poorly	■

AREA & ADAPTABILITY

Winter wheat is a suitable fall seeded biennial for all regions of British Columbia. It is very winter hardy and can tolerate wet conditions and some flood tolerance.

Winter Hardiness Zone - 4-9

Seeding Considerations

Rate Drilled	Rate Broadcast	Depth	Frost Seeding	Minimum Germination Temperature	Seeds #
63-125 lbs/ac (70-140 kg/ac)	75-150 lbs/ac (85-168 kg/ac)	0.5-2 in (1-5 cm)	No	3°C (38°F)	6800 /lb (15,000 /kg)

Winter wheat can be seeded late in the fall and requires little growth to overwinter. Higher seeding rates should be used for later planting dates. When seeded in fall, planting date impacts N scavenging ability, and early seedings have the opportunity to take up more N before fall/winter precipitation.

Management Considerations

Winter wheat has high forage quality if harvested at a vegetative stage, and is often blended with Italian ryegrass in areas where the ryegrass will overwinter for additional yield and quality.

When seeding later than the optimal seeding date, higher seeding rates can be beneficial to increase the stand density. There is a wide range of winter wheat varieties available with varying disease resistance and winterhardiness.

Inter-seeding Potential 

Volunteer Establishment 

Nitrogen Concentration 0.75 - 4.5%

Dry Matter Yield

1500 - 8500 lbs/acre
1680 - 9520 kg/ha

Termination

Terminate in the early stem elongation phase to minimize nutrient immobilization. Winter wheat can be terminated through a chemical application, tillage (multiple passes may be required) or mowing.

References

- Cloverdale Soil Conservation Group. 1994. Final Report: Part 2 Reports, Newsletters and Bulletins.
- Elmy, K. 2020. Cover Cropping in Western Canada. Friesen Press.
- Midwest Cover Crop Council. (n.d.)
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