ANNUAL WEED CONTROL

S1. Wild buckwheat is weed in broadleaf row crops and there are few effective chemical control options. Wild buckwheat disrupts swathing and combining by wrapping around the crop and becoming entangled on the sides of the header. Herbicide resistance has not been documented but high populations and natural tolerance to glyphosate may increase its prevalence in locations of high glyphosate use. Wild buckwheat is a problem in small grains because of tolerance to both 2,4-D and MCPA. These herbicides kill other competitive weeds while allowing wild buckwheat to increase. High 2,4-D rates may control buckwheat but are not normally used because of crop injury risk. Control of wild buckwheat with glyphosate depends on application rate, plant size, environment, and water quality. Early wild buckwheat germination, lack of soil-applied foundation herbicides, delayed POST applications until most weeds have emerged, and only one glyphosate application to large wild buckwheat plants are all factors that result in inadequate control. Reduced glyphosate rates may kill small wild buckwheat plants and temporarily suppress the growth of others. Applying glyphosate at 0.75 lb. ae/A and buckwheat growing in adverse conditions may result in erratic control.
Refer to the following sources for biology and management of wild buckwheat:
http://www.extension.purdue.edu/extmedia/GWC/GWC-10-W.pdf

S2. Downy and Japanese brome has increased because of reduced tillage practices, renewed interest in winter wheat, and lack of proper identification. Bromes typically germinate from late August to early October and mature in early July. Bromes can establish in early spring and still be very competitive with cereals. Lack of control can result in rapid invasion through prolific seed production. Bromes are drought tolerant and strongly compete with crops. Bromes mature and desiccate early in the summer and dry plant material promote wildfires. Tillage is a very effective control method. Japanese brome is often easier to control with herbicides than downy brome. Fall herbicide treatments are more effective than spring treatments on fall-emerged plants while allowing chemical control before spring crop planting. Glyphosate is very effective on young brome plants but will not prevent new plants from emerging. Olympus, PowerFlex, Goldsky, Rimfire Max, and Beyond can be used in spring and winter wheat. Relying on herbicides after spring wheat emergence is not recommended as the downy brome will be at an advanced growth stage and will still produce seed.

S3. Foxtail is most competitive when small grains are seeded late and soil temperatures are warm for foxtail germination and rapid growth. Fields regularly chisel plowed generally have more foxtail than moldboard plowed fields. Moldboard plowing buries the foxtail seed, which prevents emergence and reduces viable seed for subsequent years. Foxtail may not decrease wheat and barley yields but high foxtail infestations can cause harvest problems (especially when straight combining) and dockage at the elevator. Herbicide treatment for foxtail may not be warranted when foxtail infestations are less than 30 plants/sq ft and when foxtail emerges after the crop is in the 3- to 4-leaf stage because the crop can compete with emerging foxtail. This is especially true for barley. Chemical control is warranted when the foxtail population is over 100 plants/sq ft. Foxtail also may contribute to moisture stress and cause yield loss under drought conditions. For high foxtail infestation emerging with the crop harrow or rotary hoeing as soon as possible. Harrowing or rotary hoeing is not effective once foxtail has 2 to 3 leaves. Small grains can be harrowed or rotary hoed until the 3- to 4-leaf stage with little effect on yield. Apply effective herbicides if a harrow or rotary hoe is not an option. Control of low foxtail populations is optional but seed may contribute to weed infestations in subsequent crops.

S4. Narrowleaf hawksbeard is a problem weed in Canada and Montana, but has infested many fields in northwest ND. Narrowleaf hawksbeard is a winter annual or annual that reproduces by seed. It resembles perennial sowthistle with yellow flower heads but does has only a single stem and leaves are at the base of the plant. It germinates primarily in the spring and fall from late August through early November. It grows 2 to 3 feet tall from a taproot and all parts of the plant exude a milky sap. Flower heads are 1/2 to 3/4 inches in diameter. Each plant is capable of producing over 49,000 seeds and seeds are dispersed by wind. It is a common contaminant in alfalfa seed. No dormant period is required for germination. It is listed as noxious weed in Manitoba. Control measures should begin in the fall at the rosette stage. Herbicides with good activity on narrowleaf hawksbeard include 2,4-D (1 pt, lower rates not as effective), Glyphosate (1.125 lb ae/A), Express, glyphosate + Express, glyphosate + dicamba, or glyphosate + Sharpen. For residual control, consider Glyphosate + Valor + 2,4-D applied in the fall. Fall-applied herbicides are more effective than spring-applied. Spring-applied herbicides that are effective include glyphosate, Express, Sharpen, Curtail, WideMatch, and Liberty. Narrowleaf hawksbeard should be controlled in the rosette stage. Control is much more difficult after the plant starts to bolt. Tillage will effectively control narrowleaf hawksbeard. In wheat, several options are available for hawksbeard control such as Affinity BS + 2,4-D, GoldSky, Starane Flex + 2,4-D, Quelex, Talinor, Huskie, Kochiavore, and others.

S5. Horseweed (marestail) a winter annual or summer annual. Horseweed seed germinates shortly after soil contact, thrives in no-till systems, and tillage only 0.5 inch deep can kill emerging populations. Horseweed forms a basal rosette after emergence in the fall and bolts in the spring growing to a height up to 6 feet. Horseweed can germinate in the spring. Horseweed seed has pappus like dandelion seed and can travel for several miles. Reduced tillage, wind dispersal, and herbicide resistance from overuse of glyphosate and other herbicides make control difficult. Horseweed is resistant to glyphosate, paraquat, atrazine, and ALS herbicides. Control horseweed in no-till soybean prior to planting. Soybeans planted before in mid-May will require a residual herbicide to control later emerging plants. This strategy will reduce the need for POST herbicide treatments which are less effective. The following principles are important in horseweed control programs:
- Include 2,4-D ester in preplant treatments in corn and soybean.
- Apply herbicides before horseweed plants are 4 to 6 inches tall.
- Fall-applied herbicides may not control spring-emerging plants.
- Spring applications should include a residual herbicide.

Refer to the following sources for biology and management of horseweed:
http://www.extension.purdue.edu/extmedia/GWC/GWC-9-W.pdf

S6. Kochia is an exceptionally competitive weed and a few uncontrolled plants can cause severe yield loss. Kochia is resistant to 2,4-D and MCPA due to resistance from repeated use and near eradication of susceptible kochia biotypes over 7 decades of use. 2,4-D and MCPA does not translocate readily in kochia. Stinger is not effective. ALS resistance in kochia occurred soon after introduction of SU herbicides in the late 1980s. All kochia is considered ALS resistant.

Kochia is resistant to Group 2, 4, and 9. Group 14 resistance is suspected leaving few herbicides for weed control, especially in soybean and legume crops. Spartan PRE and Flexstar POST can control kochia but mat results in Group 14 resistance. Kochia population have already been documented surviving dicamba and Starane (fluoxypyr). Long-term kochia control will require using sustainable cultural and chemical weed management strategies. Refer to paragraph S7 (Lambsquarters) for other cultural practices to use for kochia management.

Soil-applied herbicides with activity on kochia are: acetochlor (suppression), Anthem/ATZ, atrazine, Balance Flexx, Boundary, Callisto/Xtra, dicamba, Fierce, Gangster, Lumax, metribuzin, Nortron, Prefix (restricted geography), Sharpen, Verdict, and Zidua. Soil-applied Spartan gives good to excellent kochia control if activated but Valor is less effective and has less soil residue to control later flushes. DNA herbicides do not control kochia.

Post-applied herbicides with activity on small (<3 inches tall) kochia include: Aim (less than 2 inches), atrazine, Buctril, dicamba, Flexstar/Reflex (E of Hwy 281 only - also see paragraph E4), Huskie/Complete, Impact + atrazine, Laudis + atrazine, Liberty, Lumax, paraquat, Starane (including all premixes), and Status.

Sequential applications of the Dry Bean Tank-Mix as listed in the dry bean section will also control kochia. Applications must be made to small weeds and use of MSO adjuvant is required (See paragraph E3). For other effective herbicides for kochia control see the weed rating chart in the back of the weed guide.

Most kochia seed dies after 1 year and less than 5% can germinate in the second growing season. This is the most critical weakness in kochia biology. Application of this short seed life means two or three years of excellent season-long control can reduce kochia populations. Plant 1 planter width of corn or sunflower around the perimeter of the fields to prevent kochia plants from other areas from rolling across your field.

S7. Lambsquarters is a member of the goosefoot family which also includes kochia, Russian thistle, and sugarbeet. Lambsquarters is a summer annual that can emerge throughout the summer, with peak emergence in mid to late spring. A lambsquarters plant can produce more than 70,000 seeds. Brown seeds germinate readily, while black seeds are more dormant. Seed dormancy is mainly responsible for survival. Seed can remain viable in the soil for several decades but light, wide day and night temperature fluctuations, and nitrate in the soil increase seed germination. There are at least 16 Chenopodium (Goosefoot) species that are confused with lambsquarters, including Atriplex species, and spreading orach.

There are many effective PRE herbicides in all crops which is the most effective control practice recommended. All POST herbicides give erratic control.

Lambsquarters has become resistant to triazine herbicides since the early 1970s and resistance to ALS herbicides in the 1990s. Glyphosate resistance has been suspected for many years as lambsquarters has become more prevalent. Lambsquarters size at application also affects common lambsquarters response to glyphosate. Poor management decisions and unfavorable weather have caused inconsistent lambsquarters control with glyphosate. Differences in glyphosate sensitivity have been documented in several states. Lambquarters is considered the most 'hard-to-wet' broadleaf species with spray droplets. Without an effective surfactant and an adequate surfactant concentration many spray droplets bounce off lambsquarters leaves and are not retained. Many glyphosate formulation claim to be 'full-load' adjuvant formulations and do not recommend additional NIS which may cause inconsistent herbicide response. NDSU research has shown wide variability among surfactants in enhancing lambsquarters control from glyphosate. In general, adding more surfactant enhances control of lambsquarters, grasses, and other 'hard-to-wet' species. Use NIS at 0.5 to 1% v/v for no-load, 0.25 to 0.5% v/v for partial-load, and 0.25% v/v for full load glyphosate formulations. Lambsquarters populations have survived glyphosate applied at 1 lb ae/A and the resistant trait was passed on to the next generation. Other populations may require a glyphosate rate of 2 to 4 times the labeled rate of 0.75 lb. ae/A. Cultural practices that help control common lambsquarters include anything that makes the crop more competitive and reduces the success of the weed. Such practices include selecting crops with quick emergence, altering planting dates relative to weed emergence, planting to narrow rows and using higher seeding rates for greater crop competition, placing fertilizer with the crop (not the weed), and implementing crop rotations that discourage summer annual weed success. Late seeding in particular can give some control because common lambsquarters tends to germinate early in the season and those seedlings are killed through soil preparation or with a burndown herbicide. Delayed planting crop may not yield as well as earlier planting, especially for full-season crops like corn. Crop rotation interrupts pest life cycles and allows alternative tillage and herbicide options. When following corn or soybean with a fall- or spring-seeded small grain, common lambsquarters may not emerge, compete, or set seed the year of the cereal grain. In addition, because common lambsquarters seeds persist in the soil, removing escapes before seed set is useful for long-term management. Clean up tillage, mowing, or an effective herbicide application after cereal grain harvest can often prevent seed production. Alternatively, underseeding a legume cover or forage crop in the small grain, or after harvest, can compete effectively with common lambsquarters if the grain and cover crops are dense and vigorous. Mechanical weed control operations, such as rotary hoeing and row cultivating, can help reduce herbicide dependence and effectively control seedling weeds. Because common lambsquarters seedlings are very small and fragile, and the seeds germinate in response to soil disturbance, stirring the top 1 to 2 inches of soil is highly effective at controlling emerging seedlings during the first 4 to 6 weeks after planting. Row cultivators must be used when weeds are small. The potential to use in-crop cultivation depends on tillage system in corn, and on tillage system and row spacing in soybean. Refer to the weed rating chart in the back of the weed guide for effective herbicides for lambsquarters control.

S8. Nightshades thrive in high rainfall and human activity associated with crop production like moving tillage and harvesting equipment from field to field or planting crop seed contaminated with nightshade seed. Birds and wildlife consume nightshade berries and can transport seed through droppings. Four nightshade species are found in North Dakota: black nightshade, eastern black nightshade, hairy nightshade, and cutleaf nightshade. Hairy nightshade is the only species densely covered with small hairs. The berries of cutleaf and hairy nightshade remain green at maturity. Only the underneath side of black and eastern black nightshade leaves are black or dark-purple and berries turn black or dark purple at maturity. Eastern black nightshade is very difficult to distinguish from black nightshade before berry formation. Eastern black nightshade forms berries in umbrella-like clusters with berry stems arising from a common point, the calyx of eastern black nightshade is the smallest of the four, and the lobes of the calyx recurve away from the berry. Black nightshade and hairy nightshade berries connect in a racemose fashion (similar to grapes). The calyx of black nightshade is mid-size and the lobes extend outward, while the calyx of hairy nightshade is large and encloses half the berry. It has been reported that leaves from eastern black nightshade plants are translucent and leaves from black nightshade are opaque when held to sunlight.

Nightshade emergence may continue from June through September and is strongly influenced by moisture. Rain events cause multiple flushes of nightshade, so plants can emerge even after normal crop spraying is complete. Hairy nightshade emerging in early fall can produce viable seed before frost while eastern black nightshade requires a longer growing season. Nightshade can compete after crops form a shaded canopy. Consequently, growth of nightshade can accelerate after small grain harvest, which exposes nightshade to sunlight. Nightshade seeds become viable shortly after berry formation and seeds can remain viable in soil for 15 years when deeply buried. Studies show that one nightshade plant can produce 178,000 seeds under competitive situations or 800,000 without competition. Therefore, successful nightshade management requires prevention of seed production.

Nightshade plants remain green after several frosts and can cause harvest problems. Berries are poisonous and the juice from ruptured berries can stain crop seed and glue nightshade seed and dirt to harvested seed. In addition, dry nightshade berries are similar in size to soybean or field pea seed and are difficult to separate. Nightshade can be spread to other fields by equipment and contaminated seed used for planting. Nightshade biotypes are tolerant to many classes of herbicides, including SUs (except Express). Eastern black nightshade resistance to imidazolinone herbicides has been documented in North Dakota. Thus, herbicides may remove competing broadleaf weeds allowing nightshades to proliferate.

Only a few residual soil herbicides, e.g. Balance Flexx, Extreme, Gangster, Pursuit, Python, Spartan, and Valor control nightshade flushes and may leave a residue the following year. Nightshade can be controlled in herbicide resistant crops (Clearfield, Liberty Link, and Roundup Ready). Basagran may control hairy nightshade but not eastern black nightshade. Black nightshade is more tolerant to some herbicides (Matrix) than eastern black nightshade. Flexstar/Reflex gives poor hairy nightshade control.
Refer to pages 114 to 119 for chemical control options. Other options for nightshade management include planting of uncontaminated seed, using crop rotations, multiple herbicide applications to control late flushes, and inter-row cultivation.

S9. Common ragweed is an annual, composite weed species that is common in eastern and central ND. A single common ragweed plant can produce up to 64,000 seeds. Common ragweed emerges early in the growing season and germination ceases in early July when hot temperatures arrive. Common ragweed biotypes resistant to Group 2 and 9 are common and Group 14 resistance is quickly increasing. Special management of common ragweed in all crops is necessary to maintain effective control with herbicides into the future.

To successfully management common ragweed apply soil-residual herbicides at 100% of the maximum rate followed by the most effective POST herbicide at maximum labeled rates in all crops. It can be managed with only POST herbicides in corn and cereal crops but difficult in broadleaf crops. Apply the maximum rate of soil-residual herbicides when planting conventional soybean or where glyphosate-resistance is present at a high frequency.

S10. Giant ragweed is a member of the composite family, has a summer annual life cycle, produces up to 5,000 seeds per plant, and produces greater than a billion pollen grains/plant. Giant ragweed is a very large and fast growing plant capable of growing to a height of 17 feet making it a very competitive broadleaf weed species. It emerges early spring and continues through early August making control difficult. Giant ragweed is found predominately along river bottoms and field perimeters, although it is becoming more frequent across fields. Giant ragweed seed can easily moved by water and machinery, especially a combine. Giant ragweed seeds can persist in the soil for > 5 years. Rapid growth, extended germination, fewer herbicides to effectively control it, and the selection of herbicide resistant biotypes makes control difficult. Biotypes have developed resistance to Group 2, 9, and 14 herbicides with resistance to all three mechanisms of action possible. The only way to effectively manage giant ragweed is to apply soil-applied herbicides after planting tilled fields and prior to planting no-tillage fields.

In no-tillage fields, apply non-selective herbicides in addition to a soil-residual herbicide prior to planting. Apply POST herbicides before plants are 3 inches tall and scout 7 to 14 days later to determine the need for a second POST application. Fewer herbicides effectively control giant compared to common ragweed.

S11. Waterhemp is in the pigweed (Amaranth) family, has a summer annual life cycle, is dioecious (male and female flowers found on separate plants), and has stems and petioles with little to no hair compared to redroot pigweed and Powell amaranth. The leaves are longer, narrower, and waxier (looks shinier) than other pigweed species. For proper identification of pigweed species consult “Pigweed Identification” from Kansas State University Ext. Service (919-532-5776). Waterhemp can easily produce 300,000 seeds per plant, up to 5 million seeds per plant, and usually produces 1.5 times more seed than other pigweed species of similar size. Seed can remain viable in the soil for at least 4 years and maybe longer causing rapid changes in population density when large quantities of seed are allowed to reach maturity. Waterhemp seeds can easily be distributed by water and machinery, but also likely by fowl and animals. Waterhemp emergence begins late-April to mid-May and continues through early August. Waterhemp is a moderate competitor, capable of reducing corn, soybean, and sugarbeet yield by 15, 44, and 70%, respectively. Waterhemp is established in eastern ND and western MN.

Waterhemp is resistant to Group 2, 4, 5, 9, 14, 15, and 27 herbicides as well as multiple-resistant (combinations of more than one of these mechanisms of action) biotypes. Because of the presence of herbicide-resistant biotypes, wide genetic diversity, late emergence, rapid growth, increased leaf waxes, and high plant densities, waterhemp is difficult to manage. Apply effective soil-applied herbicides followed by effective POST herbicides to small (1 to 3 inch) waterhemp. Choose residual POST herbicides to improve season long control. Utilize row-crop cultivation and hand-weeding as necessary to achieve zero tolerance (100% weed control) so as to not increase the frequency of single and multiple herbicide-resistant biotypes.

S12. Biennial wormwood plants in ND emerge throughout the spring and summer, behave like an annual species, and produce up to 1 million seeds/plant. B. wormwood seeds are very small and can be dispersed easily by wind, water, and all human-related operations. B. wormwood thrives in undisturbed (no- or minimum-till) areas, low areas, and areas where soil may remain wet for extended periods of time. Consequently, with every rain event a new flush of wormwood seedlings may appear.

Biennial wormwood survives most PPI, PRE, and POST herbicides and is misidentified as common ragweed. Also, biennial wormwood can emerge late after most POST herbicides have been applied.

Rescue treatments with herbicides that control common ragweed, such as Ultra Blazer and FirstRate, have little or no effect on wormwood. Wormwood plants can grow six feet tall with a woody stem that averages 1 to 2 inches in diameter and can impede grain harvest, including damage to harvesting equipment.

Biennial wormwood is difficult to control because of an extended emergence period and tolerance to many PPI, PRE (Harness*/ Surpass*, Dual*, Prowl, Sonalan, and Treflan*) and POST (most ALS herbicides, Cobra, Flexstar/Reflex, and Ultra Blazer) herbicides used in row crops. Sencor*, Huskie, Python, Spartan, Valor, and Wolverine provide residual biennial wormwood control. Growth regulator herbicides of 2,4-D, dicamba, Curtail*/M*, Hornet, Status, Stinger*, Widematch* and the non-selective herbicides Liberty and glyphosate control wormwood. However, biennial wormwood can emerge after most non-residual POST herbicides have been applied and produce seed the same season.

Basagran may not control wormwood with one application. Wormwood becomes tolerant to herbicides as plant size increases requiring application to small plants. Basagran applied with MSO and in repeat applications to small plants will improve control.

S13. Wild oat is difficult to eradicate because the seeds shatter before crops are harvested and because seed dormancy causes delayed germination. Wild oat is a cool season plant and seeds germinate in the spring and fall when favorable temperature and moisture conditions exist. Cultural approaches available for wild oat control in small grains include delayed small grain seeding, post seeding cultivation, and competitive crops. The most practical cultural method of wild oat control is delayed small grain seeding, which involves early soil cultivation to stimulate wild oat germination followed by tillage or chemical control to kill emerged wild oat prior to crop seeding. Delayed seeding may cause a significant wheat yield reduction when compared with early seeding.

Other cultural control practices are planting competitive crops like barley and rye. Wild oat eradication is not practical or economically sound; therefore, a combination of cultural and chemical control methods should be used to manage wild oat populations and minimize yield losses.

Apply POST wild oat herbicides to wild oat and crops at precise leaf stages. Early application may result in better yield because of less competition with the crop, but later flush of wild oat may require a second application. In general, any population warrants chemical control to prevent yield losses and reduce seed production. Wheat yield reduction from foxtail and wild oat competition in NDSU research follows.

Grass Weed Competition in Wheat

Weeds/sq. yard	Foxtail	Wild oats
	% wheat yield reduction	
10	0	8-9%
50	4-5%	18%
75	6-7%	25%
100	8-9%	34%
150	15%	40%

*Or generic equivalent.

S14. Powell amaranth is in the pigweed (Amaranth) family, is native to the southwestern United States, but it is common throughout the United States including North Dakota. Seedling characteristics that are very similar to redroot pigweed include small fine hairs found throughout the plant along rough leaf and stem surfaces. First leaves are more tapered and pinched toward the end. Powell amaranth grow erect from 4 to 6 feet. The inflorescence is several long, narrow clusters of both male and female flowers interspersed with spiny green bracts. Inflorescence is less branched than redroot pigweed or smooth pigweed. Branches of the flowering structure are usually 4 to 8 inches long. There is no known herbicide resistance Powell amaranth in ND, although there is some evidence to suggest that redroot pigweed is more susceptible to glyphosate than Powell amaranth.