

Fall-Applied / Early Preplant Herbicides

B1. FALL APPLICATION - HERBICIDES

Several herbicides may be applied in the fall. Some include Harness/Surpass*, Eptam, Far-Go, Dual*, Ro-Neet, Prowl, Sonalan, Spartan, and Treflan*. Optimum activity occurs when herbicides are applied in late fall during consistent cold temperatures (below 50 F) to reduce degradation and winter moisture provides adequate activation for residual spring weed control. Application after October 15, when soil temperature is cold, minimizes herbicide loss by volatilization and microbial and chemical degradation. Many labels recommend application after October 1 or 15. Some herbicides, such as Eptam, Far-Go, and Ro-Neet, require immediate tillage for incorporation while many do not require tillage for incorporation. Some herbicides, such as Sonalan, can be incorporated with a V-blade plow or undercutter. Harness/Surpass*, Dual*, Eptam, and Spartan fall-applied may give poor weed control in spring because of warmer than normal weather between application and seeding which causes insufficient residual activity.

Both granular and liquid formulations of herbicides are registered for use in fall. Fall applied, granular herbicides usually give more effective weed control than the liquid formulations, especially under heavy crop residue situations. Research at NDSU with fall application of Far-Go indicates that, at similar rates, granular formulations performed more effectively than the liquid formulation but fall surface-applied Far-Go gave less consistent weed control than when fall incorporated.

B2. FALL APPLICATION - WEED CONTROL

Fall is an effective time to control winter annual weeds, simple perennials such as curly dock and dandelion, biennials such as biennial wormwood, and in some cases cool-season perennial weed species. This is especially true for no-tillage fields, but also for those fields receiving tillage other than moldboard plowing. For fields in which tillage is planned, apply POST herbicides at least 5 days prior to tillage. Herbicides may be applied within a few days of crop harvest or until the soil is frozen. Based upon research across the Midwest, the most consistent and effective control of dandelions is obtained with fall herbicide applications. The best way to reduce or stop seed production of winter annual species is with fall herbicide applications or effective fall tillage. It is always better to apply herbicides in the fall even under less than ideal conditions, rather than use spring application and obtain less weed control compared to fall application, especially less dandelion control.

The most effective fall herbicide treatment with the most cropping flexibility next spring is an application of Roundup* at 0.75 pound ae/A plus 2,4-D ester* at 0.5 lb ai/A. The addition of 2,4-D* is most important for dandelion control but will antagonize Canada thistle and perennial grass weed control from Roundup*.

Another herbicide option is the addition of Valor (flumioxazin) at 2 to 3 oz/A to the Roundup* plus 2,4-D* mixture. Valor is a residual PRE herbicide that controls many broadleaf weeds. Valor applied with Roundup* improves control of many small broadleaf weeds but the rapid contact action may antagonize control from Roundup* on larger and less susceptible weeds.

Fall applications including Valor will be most beneficial west of the Red River Valley where spring rains may not be sufficient to activate Valor. Fall and winter moisture will activate Valor even in the drier areas of the state. Preliminary studies with fall-applied

Valor have shown potential to control or suppress weeds such as kochia, seedling dandelion, canola, and chamomile.

Valor should only be applied in no-tillage fields and any substantial soil movement next spring during planting will reduce the effectiveness of Valor on spring emerging weed species. Refer to the Valor label for crop rotation guidelines for fall applications. Only certain crops can be planted in the spring following fall-applied Valor.

B3. 2,4-D plus Roundup* applied as a preplant application up to emergence of small grains has been considered safe and legal. However, 2,4-D has never been approved for this use. Label wording requires a period of 29 to 30 days before planting most crops, including small grains. Under normal conditions, any crop can be planted without risk of injury if at least 90 days of above freezing soil temperatures have elapsed since application. Amine formulations have a longer residue and are more water soluble than ester formulations. As a consequence, amines will last longer in the soil and can leach with rain injuring germinating seedlings of broadleaf crops.

For soybean, delay planting:

7 days for 1 pt (0.5 lb ai)/A 2,4-D ester

15 days for 1 pt (0.5 lb ai)/A of 2,4-D amine

30 days for 2 pt (1 lb ai)/A of 2,4-D amine or ester

15 days for 1.33 pt (1 lb ai)/A of E-99 2,4-D ester

15 days for 1.33 pt (1 lb ai)/A of Weedone 650 2,4-D ester

2,4-D applied with Roundup* improves broadleaf weed control, reduces resistant weeds, and may antagonize grass control depending rates, formulation, and timing of application.

Plant soybean seed at least 1.5 inches deep. Planter press wheels should completely cover seed and separate seed from herbicide layer. Risk of soybean injury from preplant 2,4-D will depend on weather, rainfall, amount of weed vegetation, and previous crop residue. 2,4-D should not be applied if risk of injury and possible stand and yield loss cannot be accepted. Use only 2,4-D products registered for preplant application prior to planting soybean. Always read and follow 2,4-D label directions.

B4. Aim (carfentrazone) is a non-residual, contact herbicide, requires thorough coverage, and controls some small broadleaf weeds. Petroleum oil adjuvants may increase weed control. Aim applied with Roundup* improves control of many small broadleaf weeds but the rapid contact action may antagonize control from Roundup* on larger and less susceptible weeds. Aim requires NIS at 0.25% v/v when applied alone. Refer to Aim label for adjuvant use when mixing with Roundup*.

B5. Banvel* (dicamba) is an economical and residual herbicide. Banvel* applied alone controls many broadleaf weeds but usually is applied with other herbicides such as 2,4-D, MCPA, Roundup*, and SU herbicides to reduce the rate of Banvel* and increase control of wild mustard and other annual and perennial broadleaf weeds.

Banvel* applied with Roundup* improves control of many annual and perennial broadleaf weeds. Allow 45 days/pt of Banvel*, excluding days when ground is frozen, to rotate to any broadleaf crop.

*Or generic equivalent.

B6. DNA herbicides must be thoroughly and uniformly mixed in the top 2 to 3 inches of soil. The number of incorporation passes differ depending on formulation. For Treflan*, incorporation must be performed within 24 hours after application. Sonalan must be incorporated within 48 hours after application. Prowl incorporation may be delayed 7 days. The second incorporation of liquid DNA herbicides can be done anytime after the first, but the second incorporation of trifluralin 10G granules must be done no sooner than 5 days after the first. The second incorporation of Sonalan 10G must be done no sooner than 3 to 5 days after the first. Delay between first and second incorporation of 10G formulations allows the active ingredient to release from granules. The first incorporation is to cover the granule and the second is to thoroughly mix the soluble active ingredient in the soil. The second incorporation can also be done in the spring.

*Or generic equivalent.

Treflan* may be fall applied for foxtail control on ground to be planted to wheat or barley the following spring. Some crop stand reduction may occur from fall applied Treflan* but generally no yield loss occurs. Granular formulations may be applied to standing stubble; liquid or granular formulations may be used when residue will not interfere with incorporation. Seed wheat or barley no more than 2 inches deep into a moist seedbed. Refer to the chemical fallow section for information on Treflan* applied in the fallow year for foxtail control in small grains the next year.

B7. Paramount (quinclorac) plus MSO adjuvant controls some broadleaf weeds and is the most effective herbicide for field bindweed control in fallow, postharvest, and preplant in spring prior to seeding wheat including durum. Wheat and sorghum have a 0 hour plant back restriction. Paramount controls green and yellow foxtail, barnyardgrass, cleavers/bedstraw, volunteer flax, and may suppress small kochia and Russian thistle. Apply with MSO adjuvant at 1.25 pt/A plus UAN at 1 gal/A to bindweed at least 4 inches long. Apply after harvest but prior to frost. Use in a 3-year program by applying 0.33 lb DF/A the first year and 0.17 to 0.33 lb DF/A in following years. Paramount may also control foxtail, barnyardgrass, and flax.

B8. Paraquat* is a non-selective, non-residual, contact herbicide that can be used as a crop desiccant or as a substitute for tillage applied alone or with residual herbicides. Apply in 5 to 10 gpa by air or 10 to 20 gpa of water by ground before crop emergence. Add NIS at 0.25% v/v. Paraquat* is corrosive to aluminum spray equipment and aircraft structures requiring immediate rinsing after use. Paraquat* is toxic and can be fatal if swallowed or from excessive exposure. Avoid contact with skin. Paraquat* is a Restricted Use Pesticide (RUP). 2,4-D or Banvel* applied with paraquat* will improve control of larger annual broadleaf weeds. However, the rapid contact action of paraquat* will antagonize Roundup* if mixed together. The antagonism will be most pronounced on larger, less susceptible broadleaf weeds.

B9. Sharpen (saflufenacil) provides contact burndown and rate dependant residual PRE broadleaf weed control prior to planting chickpea, corn, fallow, field pea, small grain, and soybean. Sharpen at 1 fl oz/A does not give adequate residual weed control. Refer to label for rates labeled on each crop. Apply Sharpen with an MSO adjuvant at 1% v/v but no less than 1.25 pt/A + AMS at 8.5 to 17 lb/100 gal of water or UAN at 1.25 to 2.5% v/v if weeds have emerged prior to application. Apply to small weeds. Do not apply after crop has emerged or injury or death may result. Residual activity requires rainfall for activation. Sharpen is an PPO inhibitor mode of action herbicide and may control weeds resistant other herbicides. Sunflower is the most susceptible crop more than sugarbeet. Sharpen is registered for sunflower desiccation before harvest. Listings on the Crop Rotation Chart does NOT include time that soil is frozen. Refer to label for tank-mix options.

Small Grains - Spring, Durum and Winter Wheat, Barley and Oat

IDENTIFYING LEAF STAGES OF SMALL GRAIN:

The plant leaf stage is determined by the number of leaves present on the main stem. Leaves arise on opposite sides of the stem and develop a collar at the junction of the leaf sheath and leaf blade. The first leaf has a blunt tip. Position the small grain plant with the first leaf pointing to the left. All leaves on the left side of the main stem are designated with an odd number and those on the right side with an even number. Count the youngest leaf when it is at least one-half the length of the leaf below it. Follow this procedure to properly stage small grain plants. Tillers (stooling) appear at the third to fifth leaf stage. Most tillers arise between the main axis (stem) and leaf. A coleoptilar tiller may also be present. The coleoptilar tiller originates below the soil (near the seed) and is located on the opposite side of the stem from the first leaf. Frequently, tiller leaves are confused with leaves of the main stem when determining correct leaf stage.

Remember to count the leaves on the main stem, but do not include tiller leaves in the leaf stage count. Leaf stage determination in the field can be complicated by loss of older leaves; for example, the first and second leaves may have been removed by abrasion from wind blown soil, drought, frost, disease, or some other form of weathering. The base of the stem should be carefully examined for evidence of scars from lower leaves that have been removed. Such leaves must be counted when making correct leaf stage determination.

Plant growth rate varies considerably and the approximate days after emergence for appearance of a given leaf stage is influenced mostly by temperature. Daytime highs less than 55 F delay development, while warm temperatures advance development. Days to emergence can vary greatly depending on soil temperature and moisture.

HARROWING FOR WEED CONTROL

Harrowing a few days after a spring sown crop has sprouted but before emergence is effective in reducing stands of foxtails, wild oat and other weeds. The weeds should be emerging. Since foxtails are shallow rooted, set the teeth back on the harrow to minimize crop injury. Also, small grains can be harrowed after they have 2 or 3 leaves but before tillering. Harrowing should be performed when the soil surface is dry so damaged weeds will desiccate rather than be transplanted. Wheat can be harrowed one to three times but barley only once. Oat normally is not harrowed because risk of injury is greater than to wheat or barley.

HERBICIDE USE IN SMALL GRAINS

C1. Weed control in small grains is required to achieve a profitable yield. Applicable cultural control techniques plus use of herbicides or mixtures may be required to control all weeds. Normal height wheat varieties, rye, and winter wheat are more competitive than semi-dwarf wheat. Herbicides generally are most effective when the crop is competitive. Small grains underseeded to sweetclover, alfalfa, or other legumes should not be treated with growth regulator or non-registered herbicides because serious injury or death of the legumes may result. However, Buctril* is registered for use on small grain/legume mixtures even though some legume injury may occur.

C2. Small grains are susceptible to 2,4-D during the seedling stage but can be treated safely with MCPA from emergence until prior to the boot stage. Do not treat small grains in the boot stage. Wheat and barley, when treated from 5-leaf until prior to the boot stage, are more tolerant than oat to 2,4-D. Wheat and

barley varieties differ little in tolerance to MCPA and 2,4-D. Oat is more tolerant to MCPA than to 2,4-D but injury to oat is possible with either chemical at any growth stage. Use 2,4-D on oat only for such hard-to-kill weeds as Russian thistle, common ragweed, and redroot pigweed and only when the crop is in the 3- to 4-leaf stage. While oat injury may occur, greater weed control from 2,4-D usually will compensate for any yield loss caused by oat injury. Several brands of 2,4-D are available, but there are some differences in application information; for example, Hi-Dep allows use at spray volumes as low as 1 gpa by ground or 0.5 gpa by air.

C3. Achieve (tralkoxydim) is labeled for use only in certain geographic areas. Do not apply Achieve on spring wheat in South Dakota, Minnesota, or east of ND Hwy 281 or in the following counties in North Dakota: Dickey, La Moure, Stutsman, Foster, Eddy, Ramsey, and Towner. Achieve applied in these restricted areas may injure spring wheat. Syngenta is not liable for injury to spring wheat if Achieve is used in restricted areas. Forage grasses have good tolerance to Achieve. Grass weed control may be poor and retiling may occur if plants are stressed at application.

Apply Achieve at 10 to 15 gpa by ground or 3 to 5 gpa by air. Greater water volumes than listed may result in reduced grass weed control. Achieve Liquid is formulated with Supercharge adjuvant. One box of Achieve (herbicide + adjuvant) will treat 40 acres at 6.9 oz DG/A. Always add AMS at 7 to 15 lb/100 gallon water to reduce antagonism from water sources with high bicarbonate levels (> 400 ppm bicarbonate ions), or broadleaf herbicide tank-mixture, or to increase control of stressed weeds. Achieve can be tank-mixed with 2,4-D/MCPA ester* + or - Buctril*, Curtail M*, Harmony*, Starane*. Tank-mixing Banvel* or ALS herbicides, will result in reduced grass weed control. If other herbicides are used, apply Achieve five or more days before the broadleaf herbicide.

C4. Affinity* (thifensulfuron & tribenuron) are formulated alone and in combination as DF and SG (soluble granule) herbicides. Harmony DF* is available in generic products and as Harmony SG. Express DF* is available in generic products and as Express SG. Affinity* is available in different combined generic DF formulations (1:1, 2:1, 3:1, and 4:1 ratio). SU herbicides require NIS at 0.125 to 0.25% v/v when applied alone. Refer to label for adjuvant use when mixing with Roundup*.

Affinity BroadSpec* (1:1 ratio of thifensulfuron + tribenuron) contains the same amount of tribenuron as Express DF*. SU herbicides applied EPP with Roundup* improves control of many broadleaf weeds, including wild buckwheat. Apply to broadleaf weeds, including Russian thistle, volunteer RR canola, and Canada thistle, and when antagonism of POST grass herbicide is not a concern.

Harmony Extra DF* (2:1 ratio of thifensulfuron + tribenuron) is no longer marketed for small grains. However, several generic formulations are available for weed control in small grains.

Audit (3:1 ratio of thifensulfuron + tribenuron) contains a mix ratio to balance weed spectrum, broadleaf antagonism, and potential for improved yellow foxtail control because of the tribenuron. This ratio also is sold as Supremacy that includes fluroxypyr for control of kochia and to strengthen control of other broadleaf weeds.

Affinity TankMix* (4:1 ratio of thifensulfuron + tribenuron) contains a similar amount of thifensulfuron as Harmony Extra DF* but the amount of tribenuron is reduced. Express* antagonizes ACCase POST grass herbicides more than Harmony*. Apply the 4:1 ratio for wild buckwheat, redroot pigweed, sunflower, and volunteer RR canola control and when tank-mixing with POST grass herbicides in small grains.

*Or generic equivalent.

C5. Aim (carfentrazone) controls only small weeds and gives top-growth control of field bindweed. Aim may be tank-mixed with most herbicides registered in wheat. Aim is a contact herbicide, requires application to small weeds, and may produce speckling and spotting on crop leaves receiving spray. New growth should appear normal. Degree of speckling is affected primarily by sunlight intensity, humidity, and moisture. Higher humidity and moisture at application increase risk of leaf burn but usually the crop quickly recovers. Data shows that Aim may be safened when tank-mixed with SU herbicides.

Rage D-Tech (carfentrazone & 2,4-D) is a premix of common tank-mix partners. Inclusion of 2,4-D improves control of several weed species over a broader range of weed sizes at application. MCPA may be a better partner for Aim and has demonstrated similar benefits to 2,4-D.

C6. Ally* (metsulfuron), **Ally Extra*** (metsulfuron & thifensulfuron & tribenuron) controls broadleaf weeds and should be applied with another broadleaf herbicide with a different mode of action to reduce development of resistant weeds. Burndown (speed of weed death) is faster with Ally* and Ally Extra* than other SU herbicides. Do not apply to soils with a pH greater than 7.9. Ally* and Ally Extra* residue may persist in the soil for 3 years or more. Refer to the label or pages 108-110 for crop rotation restriction section.

C7. Amber (triasulfuron), **Glean*** (chlorsulfuron), **Finesse** (chlorsulfuron & metsulfuron) with 2,4-D or 2,4-D + Banvel* will control most annual weeds and suppress Canada thistle. Follow label for application window and tank-mix herbicides. Apply with NIS at 0.125% v/v depending on the tank-mix herbicide and rate. Finesse can be applied only once every 24 months in North Dakota. Speed at which herbicides kills weeds are relatively slow compared to other SU herbicides. Amber and Glean* may persist in soil for 4 years or more. Consult label or pages 108-110 for rotational crop restrictions.

C8. Assert (imazamethabenz) controls wild mustard, wild oat and suppresses small buckwheat. Add MSO adjuvant. Spray solution thickening may develop if Assert is tank-mixed with dicamba or amine formulations of 2,4-D or MCPA. Thickening results from using hard water, or additives that increase spray solution pH. Assert 2.5S is formulated as a sulfate ester, is water soluble only at a low pH, and contains chemicals to maintain low pH. The amount of acidifier in the formulation may be inadequate when rates are low, when highly alkaline waters are used, or in mixture with fertilizers that raise pH. These conditions may cause Assert to precipitate and reduce efficacy as well as plug nozzles. Amine formulations of 2,4-D, MCPA, or Banvel* impart a high pH to the spray solution and can cause Assert to precipitate even when the spray water is neutral. To reverse thickening, lower water pH by adding an acid, preferably muriatic acid (HCl). Muriatic acid is available at most agricultural outlets and comes in different concentrations (10% HCl to 100% HCl). Regardless of concentration add only enough to change the solution to a liquid state (less than 1 gal/100 gal water when using a 10% HCl conc.)

C9. Axial (pinoxaden & safener) is of a different chemical family than other ACCase inhibitors. It controls annual grass weeds and is not antagonized by broadleaf tank-mix partners. It controls several ACCase-resistant biotypes, but is an ACCase inhibitor. Some resistant grass biotypes express resistance to Axial after selection with other ACCase inhibitors, and a few biotypes have become more resistant to Axial following treatment with Axial.

Axial TBC (pinoxaden & florasulam & safener) includes an ALS inhibitor for only partial control of broadleaf weeds. Add a tank-mix partner control most broadleaf weeds.

C10. Banvel* dicamba controls many broadleaf weeds but usually is applied with MCPA, 2,4-D, or others to increase control of broadleaf weeds. Oat is more tolerant than wheat to Banvel*. Apply to wheat and oat at the 2- through 4-leaf stage. Barley can be treated during the 2- through 3-leaf stage but tolerance is marginal. Allow 45 days/pt of Banvel*, excluding days when ground is frozen, to rotate to any broadleaf crop.

Pulsar (dicamba & fluroxypyr) provides more rapid control of kochia and controls a broader weed spectrum than either herbicide alone at higher use rates. Pulsar at the base rate includes the equivalent of 1.5 fl oz/A of Banvel* and 5 fl oz/A of 1.5EC Starane*. This amount of dicamba minimizes crop response but transient injury has been observed. Apply early to avoid measurable crop injury.

C11. Curtail* (cloprialid & 2,4-D) or **Curtail M*** (cloprialid & MCPA) controls Canada thistle and annual broadleaf weeds. Canada thistle is most susceptible at rosette to early bolting stages. Curtail*/M* will not provide long-term control of Canada thistle with one application but will reduce populations with repeated use. Curtail* contains 2,4-D and should be applied to wheat and barley from 4-leaf through jointing only. Do not apply Curtail* on oat. See label for crop rotation restrictions.

WideMatch* (cloprialid & fluroxypyr) controls most broadleaf weeds volunteer flax, and suppresses field bindweed. Apply with MCPA, 2,4-D, or Affinity* to control mustard, pigweed, lambsquarters, and Russian thistle control. Canada thistle is most susceptible at rosette to early bolting stages and repeat applications are required to reduce underground roots. All POST grass herbicides labeled in small grains can be applied with Widematch*. Allow a 40 day PHI. See label for crop rotation restrictions.

Starane* (fluroxypyr) controls some broadleaf weed including kochia, cleavers, common mallow, volunteer flax, and suppresses field bindweed. Starane* is very effective on kochia and has benefits over Banvel* that include excellent crop safety; a wider application window that extends to flag leaf emergence; control of larger kochia; and option to tank-mix with all registered POST grass herbicides. Starane* at 0.5 pt/A controls kochia <4 inches tall and at 0.67 pt/A up to 8 inches tall while Buctril* controls small kochia less than 2 inches tall. Apply Starane* with 2,4-D or MCPA for broad-spectrum broadleaf weed control. Starane* is labeled with most registered POST grass herbicides. Refer to label of tank-mix partner for mixing options. Starane* is available in several commercial premixes.

C12. Discover NG (clodinafop & safener) controls grass weeds including volunteer corn, giant foxtail, Persian dandel, and annual ryegrass. Do not apply to winter wheat in the fall. Discover controls grass weeds over wide environmental conditions and when applied with several broadleaf herbicides. See label for tank-mix options.

C13. Everest 2.0 (flucarbazone + safener) can be applied POST to wheat (including durum) at 0.75 to 1 fl oz/A. Use 0.75 fl oz/A for wild oat and green foxtail control, including ACCase resistant grasses, and control of mustards and pigweed. Use 1 fl oz/A for control of high populations of wild oat, yellow foxtail, Persian dandel, barnyardgrass, and Japanese brome and 0.5 fl oz/A can be used sequentially with Pre-Pare for control of green foxtail. Everest suppresses downy brome. Add a basic blend adjuvant or NIS + AMS. Soil residue of flucarbazone may control flushes of grass and broadleaf weeds. Addition of tribenuron increases grass control. Most crops can be planted the year following application.

*Or generic equivalent.

C14-21 - SMALL GRAINS

PrePare (flucarbazone) can be applied in the fall for fall emerging brome species. Winter, spring (including durum) wheat can be planted the following season. PrePare is more active on higher pH soils with lower organic matter. Do not use on soils with OM less than 2 and pH above 7.8. High clay soils can reduce activity.

Raze (flucarbazone & fluroxypyr & safener) provides additional broadleaf weed control, including Kochia and other broadleaf weeds. Add additional broadleaf herbicide for wide-spectrum weed control and control of large weeds. The use rate of Raze when following PrePare is restricted to 5 fl oz/A.

C14. FirstStep (glyphosate-dma & florasulam) applied preplant control most weeds. If additional glyphosate is added use only DMA salt formulations (i.e. Durango) as inclusion of other salt formulations has resulted in crystalline precipitate in university trials. Florasulam may improve control of certain broadleaf weeds, but the residual benefit of FirstStep has not been confirmed in university trials.

C15. Far-Go (triallate) can vaporize and the liquid formulation must be incorporated immediately after application. Spring-applied liquid formulations have given more consistent wild oat control with less crop thinning than the granular formulation. Far-Go applied before seeding should be incorporated 3 to 4 inches deep. Delay wheat seeding for 3 days. Far-Go applied before seeding may injure certain wheat varieties. Far-Go applied after seeding (PoPI) should be incorporated **less deeply** than the depth of the crop seed. Spring PPI Far-Go has greater potential for injury to wheat than applied at other times. Refer to label for varieties that may be susceptible to PPI Far-Go.

C16. GoldSky (pyroxsulam & florasulam & fluroxypyr & safener) controls grass and broadleaf weeds. The grass component is an ALS inhibitor that is among the best options for control of downy brome in wheat. Wild oat control is best when applied to plants with less than three leaves. ALS inhibitors, including GoldSky, is less effective on foxtail than ACCase products but GoldSky provides better yellow foxtail control than most ALS inhibitors. Although all three components contribute to broadleaf activity, control of mallow, nightshades, prickly lettuce, smartweed, and Canada thistle may be improved with another herbicide.

PowerFlex (pyroxsulam & safener) has different amounts of the active and safener than GoldSky specifically targeted for enhanced control of downy brome in winter wheat. The broadleaf spectrum is greatly reduced compared with GoldSky so an effective broadleaf herbicide should be added.

C17. Huskie (bromoxynil & pyrasulfotole & mefenpyr safener) controls most annual broadleaf weeds including false chamomile, cleavers, cockle species, chickweed, and annual and perennial sowthistle. Huskie does not control grass weeds. No additional adjuvants are required. Huskie can be applied with POST grass herbicides, fungicides, and insecticides but combination with strobilurin fungicides may cause crop injury. Do not plant lentil for 18 months after application. Most crops can be planted the year following application. Refer to label for other information. Both bromoxynil and pyrasulfotole both act at different sites in the photosynthetic pathway and will control broadleaf weeds resistant to other herbicides.

Wolverine (fenoxaprop & bromoxynil & pyrasulfotole & mefenpyr safener) controls most grass and broadleaf weeds in wheat and barley fields. Wolverine at 1.7 pt/ac will control of wild oat, foxtails, millets, barnyardgrass, volunteer corn, wild buckwheat, mustards, pigweeds, common lambsquarters, volunteer soybeans, and other weeds. Wolverine can be mixed with several fungicides and insecticides. Wolverine does not require additional adjuvant. Most crops can be planted the year following application. Do not plant lentil for 18 months after application. Refer to the label for other information and restrictions.

C18. Maverick (sulfosulfuron) applied fall POST controls cheat, downy brome, and Japanese brome at 2- to 3-leaf stage in winter wheat or applied spring POST controls wild oat, cleavers, false chamomile, flixweed, and suppresses annual bromes in the 1- to 4-leaf stage. Apply with a herbicide of different mode of action to delay weed resistance. Do not apply Maverick with organophosphate insecticides. Thoroughly clean sprayer to prevent injury to susceptible crops. See sprayer cleanout section. Maverick may persist in soil for 3 years or more. Refer to label or pages 108-110 for re-cropping restrictions.

C19. Rimfire (mesosulfuron + propoxycarbazine) control some grass and broadleaf weeds including volunteer canola, and suppresses chickweed, catchweed bedstraw, and henbit. Rimfire contains Silverado and a low rate of Olympus. **Rimfire Max** (mesosulfuron + propoxycarbazine) controls several difficult-to-control grass as some broadleaf weeds included volunteer canola and mustards. Rimfire Max contains a full labeled rate of Silverado and a low rate of Olympus to aid in control of difficult grass weeds. Rimfire at 1.75 to 2.25 oz/A + Silverado at 0.5 oz/A and Rimfire Max at 3 oz/ac controls Persian dandelion. Refer to label for tank-mix options. Rimfire/Max will control most ACCase resistant wild oat populations. Most crops can be planted the year following application. See label for tank-mix options, crop rotation restrictions (or pages 108-110), and application information.

C20. Peak (prosulfuron) controls broadleaf weeds in wheat, barley, oat, rye, triticale, proso millet, and sorghum. Burndown (speed of weed death) is relatively average compared with other SU herbicides. Do not apply a foliar or soil organophosphate insecticide within 15 days before or 10 days after Peak. Corn is tolerant to Peak, which is different than other long residue SU herbicides labeled in small grains. Peak may persist in the soil for 3 years or more. Refer to label or herbicide carryover section for rotational cropping restrictions.

C21. Puma (fenoxaprop + mefenpyr safener) controls many grass weeds. Do not apply Puma to jointed barley; to avoid potential injury, terminate application at 4-leaf barley. Low humidity and high temperature reduces foxtail and wild oat control. Puma can be applied with Mancozeb, Stratego, Tilt fungicides; and Peak, Curtail M*, Starane*, Widematch*, or MCPA ester herbicides at all rates of Puma. Other broadleaf herbicides listed for tank-mix applications with Puma may antagonize wild oat and yellow foxtail control. For green foxtail and foxtail millet control, apply Puma at 0.33 pt/A with Affinity*, Ally*, Amber, Banvel*, Bronate*, Buctril*, Curtail M*, Express*, Harmony*, MCPA ester, and Starane*. For yellow foxtail and wild proso millet, apply Puma at 0.4 pt/A with Banvel*, Curtail M*, MCPA ester, Peak, or Starane*.

For barnyardgrass and wild oat control apply Puma at 0.66 pt/A with Affinity*, Bronate*, Buctril*, Curtail*/M*, Harmony*, MCPA ester, Peak, and Starane*. Do not apply Puma to corn, tame oat, or rye. Do not apply Puma within 60 days of wheat harvest or 57 days of barley harvest.

*Or generic equivalent.

C22. Treflan* (trifluralin) should be incorporated by harrowing twice at right angles and depth of herbicide incorporation must be above the wheat seed. Wheat should be seeded 2 to 2.5 inches deep to permit incorporation above the seed. Some wheat varieties, especially semi-dwarfs, emerge poorly from deep seeding so seed should be placed no deeper than 2 to 2.5 inches. A heavy rain or irrigation immediately after trifluralin application has caused wheat injury on light and medium textured soils. Trieflan* applied in this manner does not control wild oat.

Clearfield Resistant Wheat

C23. Beyond (imazamox) or **ClearMax** (imazamox + MCPA) controls many annual grass and broadleaf weeds in Clearfield wheat. Beyond will not control ALS resistant weed populations. Refer to label for tank-mix options, crop rotation restrictions, and other application and use information.

C24. Small grain preharvest herbicides can desiccate weeds and crop and provide perennial weed control. Expectations for preharvest weed control may exceed reality. It is difficult to kill or dry down a 3-foot tall weed in the same manner as a 3-inch tall weed. Lower portions of the weed may not be affected. Plant desiccation requires 7 to 10 days, or more when wet and cool conditions persist after treatment. Preharvest herbicides are slow acting which requires a longer dry down period as compared to contact type herbicides like bromoxynil or paraquat. The intent of a preharvest treatment should be to facilitate harvest and reduce harvest loss. Preharvest treatments do not decrease yield losses due to weed competition or prevent weed seed production. Herbicide drift from preharvest treatments can cause injury to crops nearby sensitive crops, trees, and gardens. **Paraquat* is NOT labeled as a harvest aid in small grains.**

C25. 2,4-D as a Harvest Aid

Apply 2,4-D at 1.5 to 3 pt/A to aid harvest of spring wheat, durum, barley, and rye. Not all 2,4-D formulations are labeled for preharvest applications. Follow label directions as labels vary in crop use instructions. Some 2,4-D labels only allow use on wheat, others allow use on wheat and barley and others allow use on wheat, barley, and rye. Ester formulations will give better control and quicker burndown than an amine formulation. Use at least 2 pt/A of amine formulation for larger weeds. 2,4-D does not control kochia, wild buckwheat, or large pigweed. Weeds with large stems may not desiccate and may stay green. 2,4-D can be tank mixed with glyphosate on spring wheat and durum for additional broadleaf and grass control. Follow the glyphosate label.

C26. Ally* + 2,4-D as a Harvest Aid

Ally is labeled as preharvest aid in wheat, durum, and barley alone or with 2,4-D or on wheat and durum with 2,4-D and/or Banvel*. Ally* has a long residue so use only in a continuous wheat or wheat-fallow rotation. The user must follow crop rotation restrictions. Do not use if crop was treated previously with another SU herbicide. For wheat, Ally* + 2,4-D can be tank-mixed with Banvel* for faster dry down and for weed resistance management. Follow the label for crop rotation restrictions and refer to the 2,4-D and/or Banvel* label for grazing restrictions.

C27. Banvel* + 2,4-D as a Harvest Aid

Banvel* can be applied alone or with 2,4-D in wheat and durum to aid harvest. Banvel* will provide additional control of wild buckwheat, kochia, lambsquarters, pigweeds, sunflower, and Russian thistle as compared to 2,4-D alone. Allow a 7 day PHI for Banvel* but 2,4-D formulations may be more restrictive. Always follow the longest PHI of the herbicide used. Do not feed treated straw to livestock. Caution: Drift to broadleaf crops is especially hazardous at this time.

C28. Roundup* as a Harvest Aid

Roundup* is labeled as a harvest aid only in spring wheat, durum, and feed barley. DO NOT apply to wheat or barley grown for seed, or malting barley as a reduction in germination or vigor may occur. Roundup* drift will injure or kill sensitive plants. See label for adjuvant use. Always add AMS for increased control of annual and perennial weeds, especially control of weeds stressed by dry weather. AMS also eliminates antagonism from ions and carbonates in hard water. DO NOT use AMS in place of a NIS. Refer to label for addition of other adjuvants

Roundup* can be tank mixed with 2,4-D for additional broadleaf weed control. Roundup* at up to 0.75 lb ae/A + Banvel* at 0.25 to 0.5 pt/A can be applied preharvest to wheat and durum at the hard dough stage after green color is gone from nodes. Allow a 14 day PHI. The tank-mix can be applied by ground or air.

*Or generic equivalent.

CORN

D1. A combination of cultural, mechanical and chemical methods is necessary for effective weed control in corn. Control early germinating weeds by cultivation or land preparation before planting if conventional tillage is used. A rotary hoe can be used to control emerging weeds when the corn coleoptile is below the working depth of the rotary hoe or when corn is beyond the spike stage. Cultivate between the rows soon after weeds emerge. Corn is very susceptible to early season competition from weeds. Initial postemergence herbicides must be applied before weeds reach 2 to 4 inches in height to avoid yield loss.

D2. NDSU MICRO-RATE PROGRAMS:

Early application to small weeds minimizes weed competition with corn and gives greater weed control from reduced herbicide rates. NDSU research has shown Accent and Steadfast applied at half to full rates plus atrazine at 0.42 lb DF/A + Banvel* at 4 fl oz/A + MSO type oil or basic pH blend adjuvants or Lumax at 3 pt/A + oil adjuvants control most annual grass and broadleaf weeds. NDSU research has shown that adjuvant enhancement of Accent and Steadfast was greatest with an MSO type oil or basic pH blend adjuvant, followed by petroleum oil, and least with NIS + 28%. Poor yellow foxtail control will result if Accent* and Steadfast are applied at reduced rates, if applied with Banvel*, if yellow foxtail is larger than recommended, or if growing in adverse conditions.

Use the highest labeled rate of Accent* and Steadfast to control yellow foxtail, wild proso millet, volunteer cereals, field sandbur, and quackgrass. Apply before grasses are taller than 2 or 3 inches tall or control will quickly decline. Yellow foxtail has increased in ND. Banvel* and premixes containing dicamba antagonizes yellow foxtail control from Accent and Steadfast. In some cases, MSO adjuvant has overcome yellow foxtail antagonism from Banvel*. Atrazine* at 0.38 lb ai/A will allow all crops to be planted the following year, unless severe drought occurs in the year of application. MSO adjuvants should be used, when allowed by label, to provide maximum enhancement of weed control. Refer to D4 below for additional information. NDSU research has shown enhancement of yellow foxtail control when Accent and Steadfast are applied with Callisto at 3 fl oz/A + atrazine at 0.38 lb ai/A + MSO or Lumax at 3 pt/A + oil adjuvant.

D3. Accent* (nicosulfuron), **Resolve*** (rimsulfuron), and **Steadfast*** (nicosulfuron & rimsulfuron) controls most annual grasses, quackgrass, and some broadleaf weeds. Resolve* as compared to Accent* has greater POST activity on grass weeds, shorter chemical residual in the soil but greater biological and residual soil activity on weeds, and has a greater risk of causing injury to short-season corn varieties. Resolve* may add short-term residual weed control after activation. Use caution when applying Steadfast to corn hybrids of 88 or less days maturity. See label for herbicide tank-mix options. Refer to the label or pages 108-110 for crop rotation restrictions.

D4. Atrazine applied PPI or PRE or at rates greater than 0.75 lb ai/A is not recommended in ND. PPI or PRE atrazine require rates greater than 1 lb/A for consistent weed control but also causes carryover concerns for more than two years. Atrazine is available as a prepackage mix with several herbicides. Most atrazine premixes contains excessive atrazine rates for normal crop rotation in ND. Atrazine is a restricted use herbicide.

*Or generic equivalent.

Atrazine at 0.38 to 0.75 lb ai/A applied POST to corn less than 12 inches tall aids in control of broadleaf weeds less than 4 inches tall and grass weeds less than 1 inch tall. Atrazine controls wild oat, gives partial foxtail control and excellent control of broadleaf weeds including kochia, wild buckwheat, and volunteer sunflower when used in combination with oil adjuvants. NIS is less effective with atrazine than any oil adjuvants. Refer to label or pages 108-110 for crop rotation restrictions. Refer to label for application information and restrictions.

D5. Banvel* (dicamba) is safest when applied to corn at the spike stage. Do not apply broadcast to corn greater than 8 inches tall to reduce injury. **Status** (dicamba & diflufenzopyr & isoxadifen safener) applied to corn at least 4 inches tall controls annual and perennial broadleaf weeds and will suppress foxtail. Diflufenzopyr inhibits auxin transport, is synergistic to dicamba and other growth regulator herbicides, and aids translocation to metabolic sinks and areas of high metabolic activity, such as growing points of shoots and roots.

D6. Balance Flexx (isoxaflutole & isoxadifen safener) will control several grass and broadleaf weeds with excellent safety to corn. Balance will not control yellow foxtail, wild oat, volunteer grain, and large-seeded broadleaf weeds like wild buckwheat, cocklebur, sunflower, giant ragweed. Balance may give 6 to 8 weeks residual weed control after activation. See label or pages 108-110 for crop rotation restrictions. Precipitation and soil moisture are more critical to breakdown than other factors.

D7. Callisto (mesotrione), **Impact** (topramezone), or **Laudis** (tembotrione & isoxadifen safener) plus atrazine at 0.38 lb ai/A - controls most annual broadleaf weeds and suppresses Canada thistle with excellent corn safety. Apply with MSO adjuvant + UAN at 2.5% v/v or AMS at 8.5 lb/100 gallons water. NDSU studies show that broadleaf weed control from Impact is similar to Callisto but Impact gives nearly complete common ragweed and yellow foxtail control. Laudis will also control yellow foxtail, barnyardgrass, and proso millet. All three herbicides will leave a residue in the soil the following year. Refer to label for crop rotation restrictions but soybean, dry bean, canola, flax, safflower, and sugarbeet may not be planted for 8 to 18 months after application, depending on herbicide.

Callisto, Impact, and Laudis are bleaching HPPD inhibitor mode of action herbicides and symptoms are expressed as white plant tissue which quickly desiccates. All three herbicides are enhanced by atrazine and oil adjuvants, have greater activity on yellow foxtail than green foxtail, will injure corn if applied with organophosphate insecticides, and have no known resistant weeds.

Lumax at 3 pt/A contains 3.2 fl oz/A Callisto & 1 pt/A Dual II Magnum* & 0.38 lb ai/A atrazine and can be applied with POST grass herbicides labeled in corn. NDSU research has shown improved weed control, including yellow foxtail control, from Steadfast + Lumax compared to Steadfast + Callisto + atrazine at comparable rates. Dual* has no POST activity but emulsifiers in the formulation may function as adjuvants to improve weed control. Refer to label for crop rotation restrictions and other information.

D8. Harness/Surpass* (acetochlor & safener) applied shallow PPI or PRE control annual grasses and certain broadleaf weeds. Use the higher rate on clay soils high in organic matter. Do not apply Harness* on sands with less than 3% OM, loamy sands with less than 2% OM, or sandy loams with 1% OM if ground water is within 30 feet of soil surface. Shallow incorporation may improve weed control under dry conditions. Harness* may be applied up to 45 days before planting and applied POST to corn up to 11 inches tall. Harness* applied PPI or PRE provides greater and more consistent grass and broadleaf weed control than other similar soil-applied grass herbicides.

D9. Python (flumetsulam) does not control grasses and requires rain for activation. High soil pH increases Python activity and increases rate of herbicide degradation. Some stunting of corn may occur under poor growing conditions on soils with pH greater than 8.0. Use the higher rate on fine textured soils with greater than 3% OM and the lower rates on coarse textured soils with less than 3% OM. Incorporate into the **top 2 inches** for PPI applications. Soil insecticides should be applied in a T-band to avoid corn injury. Refer to label for tank-mix options. See Herbicide Residue section for information on crop rotation restrictions.

D10. 2,4-D amine is not recommended by NDSU on corn because of the high potential for corn injury. Corn stalks may become brittle and break off in windy conditions. The safest application stage is EPP or PRE. Do not apply to corn greater than 8 inches tall. Apply 2,4-D with drop nozzles when corn is 8 to 24 inches tall to reduce corn injury by directing the spray away from the whorl. MCPA is not labeled and will injure corn.

D11. Emergency control of broadleaf and grass weeds in corn can be obtained with paraquat at 0.8 to 1.3 pt/A applied POST directed only. Apply with NIS at 0.25% v/v. Paraquat* applied over the top of corn will cause severe injury and contact with the leaves will cause burning. Do not apply paraquat* before corn is 10 inches high. Weeds should be less than 4 inches tall.

*Or generic equivalent.

HERBICIDE-RESISTANT CROPS

Clearfield Corn

D12. Lightning (imazethapyr & imazapyr) controls nearly all annual grass and broadleaf weeds except ALS resistant weeds and suppresses quackgrass and Canada thistle. Lightning contains Pursuit and Arsenal, both imidazolinone herbicides. The rate of Pursuit in Lightning is approximately 1.08 oz WDG/A and Arsenal is at 1% the rate of Arsenal that is registered on noncropland. Refer to the rotational crop restriction section of this guide. Add products containing the active ingredient of Banvel* or herbicides with a different mode of action or use other weed control strategies to slow development of resistant weeds.

LibertyLink Canola, Corn, and Soybean

D13. Ignite 280 (glufosinate) applied POST to LibertyLink canola, corn, and soybean varieties controls most annual broadleaf weeds, controls or suppresses grasses, and controls top-growth of perennial weeds. Apply to small weeds because of limited translocation. Ignite does not control large or well tillered grasses like yellow foxtail, wild oat, or volunteer cereals. Ignite is non-residual, which may require multiple applications or applying with a residual herbicide to control multiple weed flushes. Always add AMS fertilizer. Apply Ignite in canola and soybean with registered POST grass herbicides. Refer to label for weeds controlled, application information and timing, tank-mix options, application information, and other restrictions. Ignite can be used to control weeds resistant to other herbicides.

Roundup Ready Canola, Corn, and Soybean

D14. Roundup* glyphosate applied in Roundup Ready (RR) and RR 2 Yield crops controls most annual and perennial weeds. Add NIS at 0.25% v/v unless restricted by the label. Add AMS at 4 to 6 lb/100 gal water or at 1 lb/A if applied at more than 12 gpa to all Roundup* formulations. In-crop application timing may not be appropriate for effective perennial weed control because of weed stage of growth is not optimum. Roundup* is a non-selective, non-residual, translocated herbicide. Broadleaf weeds are more difficult to control than grasses. Some broadleaf weeds like kochia, common and giant ragweed, nightshade, wild buckwheat, horseweed (marestalk), dandelion, and lambsquarters may not be controlled by Roundup* applied alone or after one application. Roundup* will control weeds resistant to other herbicides. Refer to Weed Resistance Section (X1) for more information. Refer to label for weeds controlled, application information, timing, and tank-mix options.

D15. Roundup Ready Corn II hybrids have increased resistance to glyphosate compared to RR corn hybrids. Not all Roundup* formulations contain use information on RR Corn II. Generic Roundup* brands can be used on RR Corn II hybrids but application information and restrictions contained on the label must be followed. Use Roundup* according to label directions on the brand used and not according to the label on a different glyphosate product.

D16. Roundup/STS (sulfonylurea tolerant soybean) varieties are resistant to both Roundup* and Harmony*. Harmony* improves wild buckwheat, mustard species, lambsquarters, pigweed species, annual smartweed control, and will suppresses other broadleaf weeds. Apply with NIS at 0.125 to 0.25% v/v to non- and partial-loaded Roundup* formulations. Refer to Roundup* label for application and adjuvant information.

*Or generic equivalent.

SOYBEAN

E1. Soybean is a poor competitor with weeds when cool soil temperatures cause slow germination and growth but does compete effectively in warm soils when germination and growth are rapid. Soybean production requires good cultural practices. Prepare the seedbed prior to planting to kill germinating weeds. Management practices such as thorough seedbed preparation, adequate soil fertility, choice of a well-adapted variety, and use of good quality seed all contribute to conditions of good competition with weeds. A rotary hoe or harrow may be used to control weeds after planting but before the soybean emerge or after emergence when soybean are in the 1 to 2 trifoliate leaf stage. Rotary hoe or harrow help activate PRE herbicides under dry conditions and increase weed control. The rotary hoe is an effective and economical weed control method when ground is not trashy, lumpy or wet, and when weeds are emerging. Cultivation is most effective when soybean are slightly wilted during the warm part of the day, because the crop is less susceptible to breakage and weeds will desiccate quickly.

E2. Poast (sethoxydim) plus petroleum oil adjuvant applied POST controls annual grasses. **Assure II/Targa** (quizalofop), **Select*** (clethodim), **Fusilade DX** (fluzafop-P), **Fusion** (fluzafop-P & fenoxaprop-P) plus petroleum oil adjuvant or **Select Max** (clethodim) applied POST controls annual grasses and quackgrass. MSO oils have performed equal to petroleum-based oil additives. Refer to Select Max label for adjuvant information. See table in the soybean section for rates according to weed and weed size. Retreat quackgrass when regrowth is 4 to 8 inches tall. Poast only suppresses quackgrass. Most broadleaf herbicides tank mixed with POST grass herbicides will often reduce grass control compared to the grass herbicide applied alone. Reduced grass control can be avoided by applying the grass herbicide at least 1 day before or 7 days after application of a broadleaf herbicide.

Assure II/Targa may provide excellent green foxtail control but poor yellow foxtail control. Lower yellow foxtail control may result from applying Assure II/Targa at reduced rates, with broadleaf herbicides, or to large or stressed plants. Addition of fertilizer may enhance control of yellow foxtail control and stressed grasses.

Select* is a ACCase mode of action herbicide, similar to Assure II*, Fusilade, and Poast. However, in NDSU research Select* controls many grasses documented resistant to other ACCase herbicides and is antagonized less by tank-mixes with broadleaf herbicides. It is recommended that Select* be used in rotation with herbicides of different modes of action and in a resistant weed management program. Several generic brands of clethodim are available but not all formulations are identical to the original Select formulation. Select*, Clethodim*, Trigger* and Volunteer* are the same but Arrow*, Section*, and Select Max all have different formulations. Select Max is a 1 lb/gal formulation, contains activating adjuvants in the formulation, and allows use of NIS, PO, or MSO depending on tank-mix partner.

E3. Basagran (bentazon) at 0.5 to 1 qt/A applied POST controls many annual broadleaf weeds and suppresses Canada thistle. NDSU research has shown greater broadleaf weed control, especially kochia, lambsquarters, redroot pigweed and wild buckwheat by applying Basagran as split treatments either twice each at 1 pt/A, 3 times each at 0.67 pt/A, or 4 times each at 0.5 pt/A as compared to one application at 2 pt/A. Make applications 7 to 10 days apart depending on weed growth rate, growing conditions, size of weeds at application, degree of weed control from first application, and sequential flushes. The first application must be made to small weeds (1 inch).

For Canada thistle control, apply Basagran at 1 qt/A when plants are 8 inches tall to bud stage and make a second application at 1 qt/A 7 to 10 days later.

Sequential micro-rate applications will provide greater broadleaf weed control than from a single application at full rates and can be used in all crops where Basagran is labeled. Apply with oil additive at 1 qt/A (1 pt/A by air). Do not reduce the amount of oil adjuvant with the micro-rate. MSO adjuvant has shown greater enhancement of Basagran than petroleum oil (COC) adjuvants but the cost of MSO is higher. Basagran is safe to soybean at all stages. The total maximum seasonal use rate is 4 pt/A so the micro-rate can be increased if weeds are large at application or if sequential applications are delayed due to rain or wind. Refer to paragraph F6 in the dry bean section for more information.

Weed control from Basagran applied one to four times. NDSU data.

Basagran +	Rate	Colq	Koch	Rrpw
	(pt/A)	----- % control -----		
Petroleum oil at 1 qt/A	2 pt x 1 application	8	38	51
	1 pt x 2	31	64	90
	0.67 pt x 3	34	79	95
	0.5 pt x 4	76	98	99
MSO at 1.5 pt/A	2 pt x 1 application	35	86	92
	1 pt x 2	76	98	95
	0.67 pt x 3	79	98	98
	0.5 pt x 4	99	99	99

Basagran is commonly combined with fertilizer micronutrients that may cause incompatibility problems resulting in zinc precipitation. Chelated zinc materials (black in color) have greater incompatibility problems than unchelated material (clear). Recommendations to prevent precipitation are to fill sprayer with water, add Basagran and thoroughly agitate, then add zinc fertilizer material.

Result B and Result G (bentazon & sethoxydim) applied POST at equal product amounts controls some grass and broadleaf weeds. Apply with oil adjuvants at 1 to 2 pt/A. Refer to label or narrative for tank-mix options. Result is priced economically compared to other POST herbicide programs. Result may be more economical than Basagran for grass and broadleaf weed control. If so, use the following chart.

bentazon (lb ai/A)	Basagran (Product/A)	Result (Product/A)
0.25	0.5 pt	0.4 pt
0.33	0.67 pt	0.56 pt
0.5	1 pt	0.8 pt
1	2 pt	1.6 pt

E4. Flexstar (fomesafen + adjuvants) applied POST controls many small broadleaf weeds. Apply with NIS at 0.25 to 0.5% v/v or oil adjuvant at 0.5 to 1% v/v. Oil adjuvant increase weed control but also increase risk of soybean injury. NDSU research has shown good to excellent kochia control when Flexstar is applied at high spray volumes (>17 gpa), with oil adjuvants (especially MSO type), at labeled rates, and to kochia less than 2 inches tall.

Soybean injury may result when Flexstar is tank-mixed with EC formulation herbicides which act as additional oil adjuvant. Activity of Flexstar increases and risk of crop injury increases as temperature and humidity increases. A maximum of 0.75 pt/A is allowed in most of ND while 1 pt/A is allowed through the Midwest. The reduced Flexstar rate reduces carryover and crop rotation restrictions.

Flexstar is labeled on soybean and Reflex is labeled on dry bean. Flexstar contains adjuvants lacking in the Reflex formulation. Reflex may give less consistent weed control than Flexstar and will require better management strategies to achieve equivalent weed control. See label or crop rotation restriction section for additional information.

E5. Harmony* (thifensulfuron) has activity on wild mustard, lambsquarters, pigweed species, annual smartweed, and wild buckwheat. Apply with NIS at 0.125 to 0.25% v/v or oil adjuvants at 0.5% v/v plus liquid fertilizer at 4% v/v. DO NOT apply with oil adjuvants when tank-mixing with any other herbicide or severe crop injury may occur. See label or Pursuit paragraph for precautions when tank-mixing with Pursuit and other herbicides. Harmony* as spray drift or sprayer contamination may cause severe injury to susceptible crops such as sugarbeet and sunflower. Thoroughly clean sprayer to prevent contamination of subsequent spray mixtures and injury to susceptible crops. Follow label for improved cleanout procedure.

E6. Lasso/Intrro* (alachlor), **Dual*** (S/metolachlor), or **Outlook*** (dimethenamid) applied PPI or PRE control annual grass and some broadleaf weeds and does not control wild oat. Apply the higher rate on clay soils high in organic matter. Soybean has good tolerance and incorporation improves consistency of weed control. Dual* products may be surface applied or incorporated in the fall after October 15 but before ground freezes or applied in the spring.

E7. Pursuit (imazethapyr) applied POST controls or suppress many broadleaf weeds, except ALS resistant. Pursuit has controlled marshelder, Russian thistle, common cocklebur, sunflower, smartweed, and lanceleaf sage in NDSU field trials. Pursuit may not control Venice mallow, horseweed, wild buckwheat, lambsquarters and common ragweed. POST application may not provide adequate soil residual to control subsequent flushes of nightshade due to plant foliage intercepting most of the spray. However, even a small amount of Pursuit may give a reduction in number and intensity of flushes of other weeds. Pursuit is enhanced greatest by MSO (1.5 pt/A) and basic pH blend (1% v/v) adjuvants. UAN fertilizer improves weed control, especially lambsquarters.

Crop injury may result if either Pursuit or thifensulfuron is applied sequentially or tank-mixed together. In sequential application, the first herbicide reduces the ability of soybean to metabolize the second herbicide. Weeds not controlled by the first herbicide may not be controlled after the second herbicide is applied. This is particularly important for lambsquarters. Weeds that escape control from the first herbicide may be larger than labeled size by the time soybean can safely be treated with the second herbicide. Delay cultivation for 14 days after application to avoid reduction in weed control.

Tank-mixtures of Pursuit with Assure II*, Fusilade DX, or Select* may result in reduced grass control. Reduced grass control can be avoided by applying the POST grass herbicide either 1 or more days prior to or 7 days after Pursuit.

Pursuit Plus (imazethapyr & pendimethalin) at 1.8 pt/A applied PPI controls most annual grass and broadleaf weeds, including wild buckwheat. ND state labeling allows use in ND only south of State Highway 2 at a reduced rate of 1.8 pt/A which is 75% of the full labeled rate. Pursuit Plus at 1.8 pt/A contains the equivalent of Pursuit at 3 fl oz/A plus 1.75 pt/A of Prowl EC. Add additional pendimethalin at 1.75 pt/A for more consistent weed control. Thoroughly incorporate into the top 1 to 2 inches of soil. Refer to paragraphs on Pursuit and Prowl for additional information on use and restrictions.

E8. Python (flumetsulam) applied PPI or PRE will control many annual small-seeded broadleaf weeds in soybean. Python does not control large-seeded broadleaf weeds like common and giant ragweed and common cocklebur. Python requires soil moisture for optimum weed control. Python is also strongly affected by soil pH. High soil pH increases herbicide activity and increases speed of herbicide degradation, but also increases risk of crop injury.

Excellent broad spectrum weed control may occur when applied on soils with above 7.5 pH, when significant precipitation occurs after application, when rates are based on soil texture and organic matter content, and under light to moderate weed infestations. Some stunting may occur under poor growing conditions on soils with pH greater than 8.0. See label or Python in pages 108-110 for information on crop rotation restrictions.

E9. Raptor (imazamox) applied POST controls nearly all annual grass and broadleaf weeds in soybean except wild buckwheat, lambsquarters, common and giant ragweed, Venice mallow, horseweed, biennial wormwood, and ALS-resistant weeds. In NDSU field trials, Raptor has controlled marshelder, Russian thistle, and lanceleaf sage less than 1 inch tall. Soil residue of Raptor will not control late germinating weeds or weed flushes later in the growing season after rain events. Raptor as compared to Pursuit has greater grass and broadleaf weed control, provides improved lambsquarters control, and has less carryover and crop rotation restrictions.

Apply **Raptor** with basic pH blend adjuvant at 1% v/v or MSO type adjuvants at 1.25 pt/A. Alternatively, apply with NIS at 0.125 to 0.25% v/v or oil concentrate at 0.5% v/v plus 28% UAN liquid fertilizer at 4% v/v. Use of 28% UAN improves control of some weeds like lambsquarters. MSO type oil additives should be used when weeds are large and/or stressed. MSO or basic pH blend adjuvants enhance weed control more than NIS or some petroleum oil additives with or without 28% UAN. However, Raptor applied with MSO + UAN may result in crop injury at temperatures greater than 88 F and greater than 80% relative humidity.

Refer to label and paragraph on Pursuit and Raptor for information and restrictions when applying Raptor before or after Harmony* or tank-mixing with Harmony* or other POST grass herbicides. Crop rotation restrictions are less with Raptor than Pursuit. However, like Pursuit, Raptor carryover is affected by soil pH. As soil pH increases, rate of Raptor degradation increases. At soil pH less than 6.5, rate of breakdown is slow and injury to sugarbeet and other sensitive crops may occur if planted before allowed time interval. See label or Raptor on pages 108-110 for information on crop rotation restrictions.

*Or generic equivalent.

E10-E13 - SOYBEAN

E10. Sencor* (metribuzin) controls some annual broadleaf weeds, including wild mustard. Adjust rate according to soil type, pH, and % organic matter. Some soybean varieties are susceptible to Sencor*; consult label for list of susceptible varieties. Soybean injury can be reduced by using herbicide combinations with lower rates of Sencor*.

E11. Sonalan (ethalfluralin), **Treflan*** (trifluralin), or **Prowl/H20** (pendimethalin) applied PPI controls most annual grasses and some small-seeded broadleaf weeds but no wild mustard, common cocklebur and sunflower control. Requirements for proper timing and depth of incorporation differ for each herbicide. Adjust rate according to soil type. Treflan* must be incorporated in the top 2 to 3 inches of soil within 24 hours of application. Treflan* incorporation may be delayed up to 2 days if applied to a cool, dry soil. Incorporation of Sonalan 10G can be delayed 3 to 5 days after application. Herbicides can be applied with most soil PPI herbicides labeled in soybean. Sonalan has less soil residue than Treflan* or Prowl and may be more active at comparable rates.

E12. Spartan (sulfentrazone) applied shallow PPI or PRE controls most annual small-seeded broadleaf weeds, may partially control wild buckwheat, marshelder, wild mustard, common ragweed, hairy nightshade, Venice mallow, and foxtail, but provides no perennial weed control. Rate must be adjusted for soil texture, soil pH and organic matter content. Apply 3 to 6 fl oz/A for coarse and medium textured soils, and 4 to 8 fl oz/A for fine textured soils. Herbicide solubility, activity, and phytotoxicity increases as soil pH increases. User must read and follow label for rate information to ensure adequate weed control. Spartan provides excellent burndown weed control and may be applied up to 30 days prior to planting but use the higher rate in the appropriate rate range. Spartan can be tank-mixed with most PPI/PRE herbicides registered in soybean.

NDSU research has shown that consistent control of susceptible broadleaf weeds and suppression of foxtail and marginally susceptible broadleaf weeds depends on at least 0.5 to 0.75 inch rainfall shortly after application and before weeds emerge. Spartan will leave a residue in soil for more than one year. Refer to label or pages 108-110 for crop rotation restrictions.

E13. Valor (flumioxazin) applied EPP or PRE controls most small-seeded broadleaf weeds and may suppress foxtail, common and giant ragweed, annual smartweed, Russian thistle, and wild buckwheat. **Gangster** (flumioxazin & cloransulam), a copack of Valor and FirstRate applied EPP or PRE controls most broadleaf weeds. Valor and Gangster does not control perennial weeds. Apply from 14 days prior to seeding to just before soybean emergence. Valor can be applied with glyphosate in early burndown programs in soybean. Valor requires a minimum of 0.25 inch of rain for activation and requires a bioassay prior to planting sensitive crops. Refer to label for weeds controlled, rates, and crop rotation restrictions.

DRY EDIBLE BEAN

F1. Navy bean generally is less tolerance to herbicides than other dry beans types or soybean. Rotary hoe before crook stage or after emergence up to 1 to 2 trifoliates.

F2. Eptam (EPTC) plus Prowl, Sonalan, or Treflan* controls many grass and broadleaf weeds. Incorporate 4 to 6 inches deep immediately after application. Do not use Eptam on soybean.

F3. Lasso/Intrro* (alachlor), **Dual*** (S/metolachlor), **Outlook*** (dimethenamid) applied PPI or PRE controls annual grasses and some broadleaf weeds. PPI may provide more consistent weed control because PRE require rainfall for activation. Outlook* can be applied in sequential treatments for improved nightshade control. Outlook* PPI or PRE provides greater nightshade control than Dual* or Lasso* but may degrade in soil before nightshade emergence ceases. Apply Outlook* EPOST up to third trifoliolate dry beans to reduce late nightshade emergence.

F4. Pursuit (imazethapyr) applied PPI, PRE or POST controls many broadleaf weeds. Pursuit can be applied ONLY PPI within 1 week of planting or PRE up to 3 days following planting to chickpea/garbanzo bean and lentil. DO NOT apply POST to chickpea/ garbanzo bean or lentil, or Domino variety black turtle bean. Do not apply after crop begins to flower or cold and/or wet weather are present or predicted to occur within one week of application. Do not use oil additives or liquid fertilizer. Apply with NIS at 0.25% v/v to dry beans with at least one trifoliolate leaf. Refer to the Raptor paragraph in the soybean section for additional information on application use and restrictions. Refer to label or pages 108-110 for crop rotation restrictions. **User assume all risk of liability for injury.**

F5. Reflex (fomesafen) applied POST with NIS at 0.25 to 0.5% v/v or oil adjuvant at 0.5 to 1% v/v controls many broadleaf weeds. Oil adjuvant may increase weed control but also increases risk of dry bean injury. Refer to the Flexstar paragraph in the soybean section for information on application and adjuvant use and restrictions.

F6. NDSU Dry Bean Micro-rate concept is based on the Sugarbeet Micro-Rate and substitutes additional weed management for reduced herbicide rates. Application to small weeds is essential for success. The micro-rate can be applied more than once in dry beans to control emerging weed flushes but applying a foundation herbicide treatment (DNA or acetanilide) may require only one POST application. MSO adjuvant is required for optimum weed control. The POST grass herbicide can be excluded if grass populations are low. Preliminary data show weed control can be improved by increasing spray volume. The first application can be made at 10 gpa when weeds are small and less than 3 inches tall. Increase spray volume by 10 gpa for every 3 inches in weed height. Addition of AMS at 1 lb/A also increases weed control. Weed control from the micro-rate is best when temperature plus humidity is greater than 140. Increasing spray volume and using AMS may help improve weed control when the value is below 140. Refer to paragraph E3 in the soybean section for additional information. In addition to weeds listed in E3, data from soybean/dry bean micro-rate research has shown excellent control of wild mustard, nightshade, buckwheat, ragweed, and cocklebur.

*Or generic equivalent.

FIELD PEA

G1. Field pea is a poor competitor with weeds in the early seedling stage. Small weeds can be controlled by harrowing before crop emergence and when pea is 3 to 7 inches tall. Apply broadleaf herbicides to small weeds and small pea to reduce risk of pea injury. Do not apply POST herbicides when temperatures are above 85 F or when pea are under heat/drought stress.

G2. Basagran (bentazon) applied in 15 to 20 gpa with MSO oil controls some annual broadleaf weeds and suppresses Canada thistle. Allow a 30 day PHI. See paragraphs E3 and F6 for additional information.

G3. Thistrol (MCPB) applied to 4- to 6-inch pea vines controls some broadleaf weeds including lambsquarters and redroot pigweed and suppresses Canada thistle. Slight pea injury may occur but pea will usually recover. Injury potential increases when pea is taller than 6 inches and when temperatures exceed 85 F or when the pea is under heat/drought stress. Apply prior to flowering.

G4. Roundup* (glyphosate) applied preharvest for annual weed control or as a spot treatment controls many troublesome, perennial weeds including Canada thistle, perennial sowthistle, common milkweed, and quackgrass. The crop in treated areas will be killed. Allow a 7 day PHI for preharvest and 14 day PHI for spot treatment. No more than 10% of the total field area may be spot treated at rates greater than 0.75 lb ae/A. Do not apply to crop grown for seed.

CHICKPEA/GARBANZO BEAN

H1. Chickpea/Garbanzo beans is a poor competitor with weeds in the early seedling stage. Small weeds can be controlled by harrowing after seeding up to 3 to 5 days after chickpea germination and again when chickpea is 2 to 4 inches tall. Apply broadleaf herbicides to small weeds and small chickpea to reduce risk of pea injury. Do not apply POST herbicides above 85 F or when chickpea is under heat / drought stress.

LENTIL

H2. Lentil is a poor competitor with weeds in the early seedling stage. Small weeds can be controlled by harrowing before crop emergence and when lentil is 3 to 7 inches tall.

H3. Treflan* (trifluralin) applied fall or spring controls grass and some broadleaf weeds. Rates should be adjusted based on soil texture and organic matter. Lentil tolerance to Treflan* is marginal, so injury can occur. Cool soil conditions over an extended period of time will delay germination and emergence and increase risk of injury. Treflan* spring-applied is more likely to cause stand reduction than when fall-applied. If seeding into cool, dry soil after a spring application, the seeding rate should be increased by 15% to compensate for injury that may occur. Seed no deeper than 1.5 inches to reduce the potential for lentil injury.

*Or generic equivalent.

SUNFLOWER

J1. Sunflower competes poorly with weeds because of slow early growth and incomplete ground cover. Cultivation with a spike-tooth or coil spring harrow about 1 week after seeding but before sunflower emergence will kill weeds that emerge before sunflower. Harrow or rotary hoe when sunflower has at least 4 leaves. Cultivation will control weeds between the rows.

J2. Assert (imazamethabenz) may cause severe sunflower injury when applied in high temperature and humidity. Sunflower variety, growth stage, weather conditions, humidity, spray volume, and additives may affect sunflower safety. Risk of injury should be considered when deciding if treatment is warranted. Do not apply to sunflower under drought or heat stress. Apply Assert when air temperature plus relative humidity is below 150. Sunflower damage may range from plant stunting to head deformation. Refer to label.

J3. Spartan (sulfentrazone) applied EPP, shallow PPI, or PRE controls most annual small-seeded broadleaf weeds, may partially control wild buckwheat, marshelder, wild mustard, common ragweed, hairy nightshade, and foxtail, but provides no perennial weed control. Adjusted rate for soil texture, soil pH, and organic matter content. Herbicide solubility, activity, and phytotoxicity increases as soil pH increases. Crop injury will be minimized and greater likelihood of activation by rainfall will result if applied up to 30 days prior to planting. Sunflower has good tolerance to Spartan on medium to fine textured soils with OM above 3%. Crop injury may occur on soils with low OM and soil pH greater than 7.5, especially on calcareous outcropping. Poor growing conditions at and following crop emergence, cold temperatures, soil compaction, or rates too high based on soil type and OM may result in crop injury. Spartan requires at least 0.5 to 0.75 inches of water for activation shortly after application. The approximate ranking of crops from most to least tolerant is soybean, flax, chickpea, mint, sunflower, potato, field pea, dry edible beans, safflower, crambe, canola, lentil, and sugarbeet. Refer to label for crop rotation restrictions.

HERBICIDE RESISTANT SUNFLOWER

Clearfield Sunflower

J4. Beyond (imazamox) applied POST to Clearfield sunflower hybrids controls most annual grass and broadleaf weeds, will not control wild buckwheat, ragweed, lambsquarters (> 2 inches), biennial wormwood, Canada thistle, and ALS resistant kochia. NIS and UAN adjuvants are recommended but MSO adjuvants are not restricted, will provide greater herbicide enhancement, and may increase risk of temporary sunflower yellowing and stunting. Refer to label for application information, use restrictions, and crop rotation restrictions.

ExpressSun Sunflower

J5. Express* tribenuron applied POST to ExpressSun sunflower hybrids controls most broadleaf weeds and Canada thistle. Express* does not control grasses or ALS resistant weeds. MSO adjuvants will provide greatest herbicide enhancement. Express* may antagonize POST grass herbicides when applied together. The antagonism can be reduced or avoided by applying a higher rate of the grass herbicide or applying the grass herbicide 1 or more days before or 7 days after Express* application. Do not apply any other ALS herbicide on ExpressSun sunflower varieties or severe sunflower injury or death will result. Refer to label for use directions and other information.

*Or generic equivalent.

FLAX

K1. Flax is less competitive with weeds than small grains and should be grown on relatively weed-free fields. Seed flax on fields with low weed levels by controlling weeds in preceding crops. Flax should be seeded directly or with shallow spring tillage in fields. Deep tillage of fields could bring dormant seeds to the surface and increase weed problems. For weedy fields, moldboard plow the soil to bury weed seeds, thereby reducing the weed infestation the following crop season. Moldboard plowing can reduce infestations of small-seeded weeds like foxtails and kochia, which have short seed survival.

Weed control is needed before flax emerges to reduce yield losses since flax is a poor competitor with weeds. Soil-applied herbicides reduce weed emergence and minimize early weed competition to maximize flax yields. POST herbicides applied soon after weed emergence to small weeds and flax usually give better control and allow more time for flax recovery from possible herbicide injury than treatment to larger weeds and flax.

K2. Treflan* (trifluralin) may be fall-applied on fields to be seeded to flax. Granular formulations may be applied to standing stubble. Use liquid or granular formulations when residue will not interfere with incorporation. Seed flax less than 1.5 inches deep into a moist seedbed. Incorporate shallow and seed deep or seed shallow with deep incorporation to maximize crop safety.

Treflan* is not labeled for spring application in flax because of injury risk but may be spring-applied if user assumes all liability for crop safety. To reduce potential of flax injury, spring-apply no more than 0.5 lb ai/A and incorporate as early as possible to create a firm seed bed through rain and soil compaction. A firm seed bed will promote uniform depth-seeding for uniform emergence. Early application will allow more time for degradation of "hot spots" in soil.

CANOLA AND MUSTARD CROPS

L1. Mustard crops in the early seedling stage are poor competitors with weeds. Control small weeds by harrowing until 3 to 5 days after mustard germination. Harrowing after emergence is not recommended.

L2. Stinger* (clopyralid) applied POST controls several broadleaf weeds and volunteer crops in canola, rapeseed, and crambe. Stinger* is most effective when applied to common cocklebur, giant ragweed, volunteer sunflower, wild sunflower, volunteer alfalfa, and volunteer soybean up to the 6-leaf stage, common ragweed up to the 5-leaf stage, and wild buckwheat in the 3- to 5-leaf stage before vining begins. Stinger* is most effective on Canada thistle in the rosette to pre-bud growth stage but rosette application often gives better control than later application.

HERBICIDE RESISTANT CANOLA

Clearfield Canola

L3. Beyond (imazamox) applied POST to Clearfield canola varieties controls most annual grass and broadleaf weeds. Beyond will not control ALS-resistant weeds. Clearfield canola can be planted on land previously treated with Assert or Pursuit and may reduce or eliminate injury from long residual SU herbicides. See label or information on Raptor in the soybean section for use, weed control, carryover, crop rotation restrictions, and other use information.

*Or generic equivalent.

SUGARBEET

M1. Sugarbeet herbicides may be used to supplement cultural practices. Hand labor, mostly hoeing, may be needed for optimum weed control but can be reduced or eliminated by timely cultivations and herbicide applications.

M2. Herbicide tank-mixtures are commonly used on sugarbeet. Non-labeled herbicide combinations may be tank-mixed legally if all herbicides in the mixture are registered for use on sugarbeet and the mixtures are not prohibited. However, the user must assume liability for any crop injury, inadequate weed control, or illegal and/or harmful residues.

M3. Betanex / Alphanex (desmedipham) and **Betamix / Phen-Des 8+8** (desmedipham & phenmedipham) applied POST occasionally causes sugarbeet injury. Sugarbeet with four true leaves are more tolerant than smaller plants and continue to gain tolerance with increased size. Application rates totaling 3 pt/A or less should be followed by a second application in 5 to 7 days if living weeds are present after 5 days. Split application with reduced rates reduces sugarbeet injury and increases weed control compared to one full-rate application. See Table 1 below. Risk of sugarbeet injury is reduced by starting application in late afternoon so cooler temperatures follow application. Risk of injury increases during recent flooding, high temperature, and especially, a sudden change from cool, cloudy conditions to hot, sunny weather. Allow a 75 day PHI for Betanex* and Betamix*.

Betanex*, Betamix*, Broadcast Rate.

Sugarbeet stage	No soil herbicide			
	Low pressure (<100 psi)		High pressure or aerial	
	(lb/A)	(pt/A)	(lb/A)	(pt/A)
Coty-2-leaf	0.25	1.5	0.16	1
2-leaf	0.33	2	0.25	1.5
4-leaf	0.5	3	0.4	2.5
6-8-leaf	0.75	4.6	0.75	4.6

Sugarbeet stage	With soil herbicide			
	Low pressure (<100 psi)		High pressure or aerial	
	(lb/A)	(pt/A)	(lb/A)	(pt/A)
Coty-2-leaf	0.16	1	0.12	0.75
2-leaf	0.25	1.5	0.16	1
4-leaf	0.33	2	0.25	1.5
6-8-leaf	0.5	3	0.5	3

* Or generic equivalent.

M4. Dual Magnum* (S-metolachlor) applied preplant incorporated or preemergence has caused excessive sugarbeet injury. Growers must sign a liability form that releases Syngenta from all liability for sugarbeet injury before use. Apply PPI or PRE in the spring or fall and adjust rate depending on soil texture and OM content. Make fall applications after October 15 but before ground freezes. Lay-by applications can be done without signing a liability release form. Apply lay-by after sugarbeet has four true leaves. Multiple lay-by applications can be made but the total applied must not exceed 2.6 pt/A per season. Precipitation after application is required for activation.

*Or generic equivalent.

M5. Eptam (EPTC) may cause sugarbeet stand reduction and temporary stunting without yield reduction if adequate sugarbeet population remains after thinning. Injury increases in light soils with low OM. Ro-Neet or Nortron* cause less sugarbeet injury on the low OM soils where Eptam injury may be excessive.

Ro-Neet (cycloate) gives better control than Eptam when spring rainfall is adequate to excessive but Eptam tends to give better weed control than Ro-Neet on fine-textured, high OM soils or under relatively dry conditions. Ro-Neet causes less injury than Eptam and is safer on more coarse-textured, low OM soils. Eptam and Ro-Neet can be applied in the fall.

M6. Eptam (EPTC) plus **Ro-Neet** (cycloate) has less potential for sugarbeet injury and is less expensive than Ro-Neet alone. The rate of the mixture must be adjusted for soil texture and OM. Suggested Eptam + Ro-Neet rates.

Soil type	OM	Eptam + Ro-Neet	
		Rate	
Fall applied	%	----- pt/A -----	
–	<3	--	5.3
Loam or coarser	3	1.1	4
Loam to clay-loam	3-4	1.7	3.3
Clay-loam	3.5-4.5	2.3	2.7
Clay to clay-loam	>4.5	2.9	3.3
Spring applied			
Loam or coarser	<3	--	4
Loam or coarser	3-3.5	1.1	3.3
Loam to clay-loam	3.5-4.5	1.7	3.3
Clay loam or finer	>4	2.3	2.7

Adjust rates on certain fields or with certain incorporation tools based on individual experience. Eptam, Ro-Neet, or Eptam plus Ro-Neet require immediate incorporation for best weed control.

M7. Far-Go (triallate) requires immediate incorporation after application at 3 to 4 inches deep for best wild oat control. Delaying the second incorporation for three days or longer after the first incorporation improves wild oat control. Delaying the second incorporation is especially important for granular formulations. One incorporation in the fall followed by spring seed-bed preparation is sufficient for fall-applied Far-Go. Far-Go should be fall-applied when temperatures are consistently below 50 F. Far-Go may be applied until snow cover or soil freeze up. Far-Go will control wild oat that have developed resistance to ACCase-inhibitor POST herbicides.

M8. Micro-rate or Mid-rate programs use low rates of herbicides in combination applied three or more times at 5 to 7 day intervals starting when weeds are just emerging. The micro-rate treatment is Betanex* / Betamix* / Progress* plus UpBeet plus Stinger* plus a methylated seed oil (MSO) adjuvant at 8 to 12 / 8 to 12 / 5.7 to 8.7 fl oz/A plus 0.125 oz/A plus 1.3 fl oz/A plus 1.5% v/v. The MSO is essential to increase weed control when low herbicide rates are used.

The mid-rate treatment includes Betanex*/Betamix*/Progress* at 12 to 16 / 12 to 16 / 8.7 to 11.6 fl oz/A after sugarbeet has four leaves along with the same rate of UpBeet, Stinger* and MSO. Add Assure II at 4 fl oz/A or Select* at 2 fl oz/A or Poast at 5.3 fl oz/A to the micro-rate to improve grass control. The micro-rate will not control lanceleaf sage or ALS-resistant kochia.

The micro-rate and mid-rates applied a minimum of three times generally gives better weed control than two applications of conventional rates. Three applications of conventional rates may give better weed control than three applications of the micro-rate. Four micro-rate applications may give better weed control than three applications of conventional rates or the micro-rate due to controlling late-emerging weeds.

S8-17 - SUGARBEET

Refer to factors listed below to reduce nozzle plugging from precipitation with ground application of the micro-rate treatment. Several factors may reduce nozzle plugging.

- 1) Start with a clean sprayer, spray out the tank load immediately after mixing, spray until tank is dry, flush sprayer between loads, clean sprayer frequently, and avoid spray solution to set in the tank.
- 2) Allow the sprayer tank water to warm before mixing and increase the pH of water to 8 or 9 by adding ammonia or Quad 7.
- 3) Pre-mix the UpBeet in hot water or water with pH 8 to 9. Put UpBeet in the tank first and be sure it is dissolved before adding, in order, Betanex*/Betamix*/Progress*, Stinger*, and MSO type oil adjuvant. A 2% solution of household ammonia at 1 gal/100 gal of water will give about pH 9. Add ammonia slowly as the tank fills so water pH does not go much over pH 9.
- 4) Add a grass herbicide. Tests using a single nozzle and a small volume of spray solution indicated that Assure II* reduced precipitation more than Poast and Select* but all had an effect.
- 5) Use gentle agitation.

M9. Nortron* (ethofumesate) is the best of the soil-applied herbicides for kochia control providing fair to good control. Nortron* applied PPI improves weed control. Incorporate at 2 to 4 inches than 1 inch for better weed control. Band application of Nortron* reduces cost and soil residue. Nortron* has been relatively safe on sugarbeet but use of with Ro-Neet or Eptam (fall-applied) can cause sugarbeet injury especially on medium to coarse textured soils. Nortron* plus spring-applied Eptam may cause serious injury and should only be used on fine textured soils with over 6% OM. See labels for Nortron* rate adjustment for various soil types.

Use the following recommendations to reduce nozzle plugging or incompatibility issues with Nortron*:

- 1) Fill partially used Nortron* jugs with water to prevent formation of insoluble Nortron* residue. Mark the level of remaining Nortron* in the jug before adding water.
- 2) Flush lines and clean nozzles and screens daily.
- 3) Use warm water.
- 4) Addition of liquid nitrogen may help.
- 5) Use 50 mesh or larger screens.
- 6) Use spray volumes of 40 to 60 gpa.

M10. Outlook* (dimethenamid) on medium to fine-textured soils may be used as a lay-by treatment when sugarbeet has 4 to 8 leaves. Apply once or sequentially but the total must not exceed 21 fl oz/A. Precipitation after application is required for activation. Weeds that emerge prior to activation will not be controlled.

M11. Progress / BNB Plus (desmedipham & phenmedipham & ethofumesate) applied POST gives increased control of some weeds and greater risk of sugarbeet injury than Betamix* alone. The active ingredients are in a 1:1:1 ratio. Adjust the rate of Progress* so the total lb/A of the active ingredients is equal to the lb/A of Betamix* if the Betamix* were applied alone. For example, if the normal rate of Betamix* was 0.3 lb/A then Progress* also should be applied at 0.3 lb/A. Risk factors are the same as for Betamix* alone.

M12. UpBeet (triflurosulfuron) improves weed control applied in combination with other herbicides. Add adjuvant when applied with Stinger* but no adjuvant when applied with Betanex*, Betamix*, or Progress* except in the micro-rate. UpBeet will antagonize grass control from POST grass herbicides. Research in eastern ND and MN has shown that Betamix* + UpBeet applied once at 1.5 pt + 0.5 oz/A followed 7 days later by 2 pt + 0.5 oz/A generally gave less control than Betamix* + UpBeet applied three times at 7 day intervals using 1 pt + 0.25 to 0.3 oz/A in each treatment.

M13. Stinger* (clopyralid) applied with MSO adjuvant controls small weeds in the Composite, Polygonum, Legume, and Nightshade families. Apply to wild buckwheat in the 3- to 5-leaf stage before vining begins. Apply Stinger* at 0.5 to 0.66 pt/A to Canada thistle in the rosette to pre-bud growth stage. Rosette application will give better control than later application.

M14. Treflan* (trifluralin) will provide residual weed control. Broadcast and incorporate immediately with cultivators or tillage tools adjusted to mix the herbicides in the soil without excessive sugarbeet stand loss. The crop should be clean cultivated before application since established weeds are not controlled. Treflan* with good moisture conditions will control late germinating weeds that may become a problem late into the season.

M15. Combinations of postemergence herbicides give more broad spectrum and greater total weed control compared to individual treatments. Stinger* + Betanex* or Stinger* + Betamix* have controlled wild buckwheat, eastern black nightshade, lambsquarters, buffalobur, giant ragweed, ladythumb, lanceleaf sage, and Russian thistle superior to Stinger* alone and superior to Betanex* or Betamix* alone.

UpBeet* plus Betanex*, Betamix* or Progress* has provided improved control of redroot pigweed, prostrate pigweed, kochia, common mallow, nightshade, ladythumb, Venice mallow, nightflowering catchfly, wild mustard and velvetleaf compared to Betanex*, Betamix*, or Progress* alone.

UpBeet generally has little effect on sugarbeet injury. A three-way combination of Betanex* + UpBeet + Stinger* has given good to excellent control of all common broadleaf weeds in sugarbeet in research conducted in ND and MN except ALS-resistant kochia.

HERBICIDE-RESISTANT SUGARBEET

Roundup Ready Sugarbeet (Only USDA/ APHIS approved seed)

M16. Roundup* (glyphosate) may be applied from emergence to 30 days before harvest to Roundup Ready sugarbeet. Refer to labels for adjuvant use. Roundup* is formulated from 3 to 5 lbs acid equivalent (ae) per gallon. Use registered formulations and rates in Roundup Ready sugarbeet. The total amount of Roundup* that can be applied to sugarbeet at various times is listed in the tables. Roundup* may be applied up to four times POST to sugarbeet with at least 10 days between applications. Apply Roundup* in the least amount of spray volume allowed but avoid drift of spray droplets. Apply with AMS at 4 lbs/100 gallons of water, or more for hard water.

The initial Roundup* application should be applied to 1 to 2 inch weeds or 2 to 4-leaf stage sugarbeet at 1.125 lb ae/A. Sequential applications should be applied 14 to 21 days after the previous application.

M17. Sequence (glyphosate-K & S-metolachlor) may be applied only to Roundup Ready sugarbeet from 2-leaf to canopy closure. Sequence may be applied from 2 to 8-leaf sugarbeet at the maximum rate of 2.5 pt/A on course soils and 3.0 pt/A on medium and fine soils in a single application. The maximum rate of Sequence that may be applied from 8-leaf to canopy closure is 2.5 pt/A for a single application. Sequential applications must be separated by 10 days. Additional Roundup* may be included but do not exceed single and multiple Roundup* application rates within each growth stage according to the label. Add AMS at the minimum rate of 8.5 lbs/100 gallon of water. The PHI for Sequence is 60 days. Do not exceed 7.0 pt/A of Sequence and 4 POST applications per season. Reduced weed control was observed with Sequence compared to a tank-mixture of glyphosate and S-metolachlor in 2010 research.

*Or generic equivalent.

POTATO

N1. Tillage through hilling and cultivation and herbicides are the two primary means of controlling weeds in potato. The first tillage operation after planting is usually a "blind" cultivation or harrowing before the crop emerges. The number of tillage operations will vary, but three cultivations and two hilling operations are common. After emergence, inter-row cultivation is used to control weeds and to form a ridge or hill over the seed piece and developing tubers. Besides controlling weeds, the ridge or hill helps protect tuber from sunburn (tuber greening), late season frosts, excessive rainfall or irrigation and reduces the amount of soil to be moved at harvest. Deep cultivation may cause root and tuber pruning.

N2. Matrix* (rimsulfuron) applied PRE or POST alone or with Sencor* controls annual grass and some broadleaf weeds. Use the low rate of Sencor* for PRE applications to coarse textured soil. Soil residual of Matrix* and Sencor* may injure susceptible crops the following year.

Matrix* controls eastern black nightshade and may control or suppress hairy nightshade but gives no black nightshade and lambsquarters control. Apply PRE to potato and weeds after hilling or drag-off but before potato emerge or POST before potato is 14 inches tall and annual weeds are less than 1 inch tall and quackgrass 4 to 6 inches tall. Best results occur when 0.75 inches of water occur soon after application. Apply with petroleum or MSO adjuvants at 1.25 pt/A to emerged weeds. Matrix* can be applied in a sequential program of 1 oz 25DF/A PRE followed by 1 oz 25DF/A POST. Matrix* may be tank-mixed with Eptam, Dual*, Sencor*, or Prowl. Follow label directions when tank-mixing Matrix* plus Sencor*. See Sencor paragraph for additional information.

N3. Sencor* (metribuzin) applied PRE or POST controls many broadleaf weeds and suppresses some grasses. Use lower rate on coarse textured soils and for weeds under 1 inch tall. Do not apply to red-skinned, early maturing, white-skinned varieties; or within 3 days after cool, wet, cloudy weather. Follow varietal restrictions according to Sencor* label. Injury may occur to russet type or white skin potato varieties; therefore, use only the low rate of Sencor* and consider the risk of weed control vs potato injury prior to application to "at risk" varieties. Refer to label for application information and restrictions.

*Or generic equivalent.

FORAGE LEGUMES

P1. Seedling legumes are poor competitors with weeds. Use good management practices in preceding crops, such as clean cultivation in row crops and post-harvest tillage to reduce weed seeds in soil. Weed control for establishment of legumes sown alone can be aided by mowing (except sweetclover), herbicides, or by seeding a companion crop. Strong alfalfa competition may improve control of weeds that escape herbicide activity. Except for use of Roundup* in Roundup Ready alfalfa, there is no chemical control for absinth wormwood.

CRP BREAKOUT

R1. CRP breakout or vegetation management when breaking land out of CRP is difficult. Heavy vegetation produced from many years of growth without grazing or haying will make cultivation difficult. For most situations, haying in the summer will help remove much of the vegetation found in CRP. Burning may destroy standing plant residues but will not kill underground roots and is not recommended. Removing vegetation by burning may increase weed seed germination. Methods to control vegetation without destroying residues should be used to enhance soil quality and control erosion.

Cultivation alone will not give satisfactory control of CRP vegetation. A herbicide treatment applied several weeks prior to tillage will reduce the amount of vegetation. Fall-applied herbicides are needed if conventional tillage methods will be used to prepare a seedbed the following year. Fall application allows breakdown of foliage and root plant biomass. Cultivators and some tillage equipment tend to plug during spring tillage when a fall-applied herbicide is not used. Mechanical and cultural vegetation control methods should be followed by a vigorous weed control program the following spring. CRP grasses and forbs may become a problem in the planted crop. Seeding a broadleaf crop after CRP breakout will provide chemical control options not available in grass crops.

NDSU research found that Roundup* at 0.75 lb ae/A applied fall or spring gave less than 70% alfalfa and smooth brome control. Roundup* at 1.5 lb ae/A applied in fall gave 98% early season alfalfa and smooth brome control but regrowth occurred by mid-summer. A fall application followed by a spring application of Roundup* each at 0.75 lb ae/A or a spring application of Roundup* at 1.5 lb ae/A was required for greater than 90% control of smooth brome. A spring application of Roundup* at 1.5 lb ae/A also provided over 90% alfalfa and smooth brome control. Tillage improved control of perennial regrowth (15 to 20% increase) from fall applications of Roundup* but did not improve control from spring applications.

*Or generic equivalent.