Nebraska-Wyoming Builder

Lloyd May died on May 23, 1999 at his home outside Pine Bluffs, WY, when it burned down Sunday night. Lloyd was 63, born in Kimball, NE. He began farming wheat and corn with his father in Banner Co., NE, and Laramie Co., WY. In 1970, Lloyd took over the family business, May Farms, Inc., and, in 1975, began growing seed potatoes in Wyoming. In 1984, Lloyd moved to Imperial, NE, formed Frenchman Valley Produce and began growing potatoes for the fresh market.

After an operation in 1991, he moved back to Banner County. Frenchman Valley Produce today is in the able hands of Tim May, his son. Lloyd was a member of the Elks Lodge and Eagles. Funeral services were held at the Albin (WY) community center on Friday, May 28 and internment at the Albin Cemetery.

He is survived by Shirley, his wife of 44 years; his children and their spouses - Tom and Bobbie May (Banner Co.), Tim and Tamy May (Imperial), Randy and Tracy May (Harrisburg), LeAnn and Daryl Skees (Gering), and Lana and Don Gray (Auradale, AZ) -- 16 grandchildren and one great-grand child.

"He cut a large swath and brought a bumper crop."

-- Alexander D. Pavlista

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Herbicides and Injury on Potato

With planting near completion and emergence under way, it is worth reviewing the type of injuries which can be caused by herbicides used on potatoes, or can be carried over from the previous year’s crop, or may be used on the crop across the road. Injury descriptions are organized based on the most likely use of herbicides. Following these descriptions, injuries due to non-potato labeled herbicide are described.

Potato Labeled Herbicides

Most herbicide injury is first observed as a general stunting of the canopy and/or distorted growth of the leaves and stems. Potato plants can be injured even by herbicide to which they are tolerant if they are under stress such as from temperature extremes or damaged by hail. Stress decreases the plant’s ability to reduce uptake or deactivate the herbicide. The herbicides covered, in general order of application, are

ROUNDUP - DUAL - PROWL and TREFLAN - LEXONE/SENCOR - LOROX - MATRIX - EPTAM/GENEP - POAST.

ROUNDUP (glyphosate)

mode of action: amino acid synthesis inhibition

specific mode: inhibits EPSP synthetase (stops production of phenylalanine, tryptophan and tyrosine)

chemical family: amino acid derivative

uptake: foliar only

movement: systemic throughout plant

common application: pre-plant

weed control: non-selective, "TVC" total vegetation control

weed stage: emerged

potato injury: Growing cells (meristems) are affected and plant growth stops due to lack of protein. Injury appears in less than a week after exposure and starts with new, young leaves. Symptoms start with leaf yellowing (chlorosis) and progresses to browning (necrosis) until plants wilt and die. The process takes 10 to 14 days from exposure. There is no recovery. Sub-lethal doses cause parallel veinning on leaves and an over-production of vegetative buds (similar to symptoms caused by phenoxy compounds such as 2,4D).

DUAL (metolachlor)

mode of action: seedling growth inhibition

specific mode: shoot inhibitor

chemical family: chloroacetamide (acetanilide)

uptake: stem primarily and root

movement: systemic throughout plant

common application: pre-emergence

weed control: annual grasses and some annual broadleaves

For Nebraska, grasses as foxtails, sandbur, crabgrass, fall panicum, and...
Herbicides and Injury on Potato (continued)

Broadleaves as Eastern black nightshade and pigweeds, and partial control of hairy nightshade

Weed stage: pre-emerged (germinating seed)

Potato injury: Symptoms at the shoot and root tips (meristem cells) is inhibited resulting in poor growth. The first symptom of severe exposure is no emergence of potato sprouts due to stunting of underground shoots. If severely affected plants emerge, the stem will not recover and new stem growth must occur from below ground. With mild exposure, affected leaves have a shortened mid-vein resulting in a "heart-shaped" appearance from the "draw-string" effect. Leaf "crinkling" is usually associated with the draw-string effect. Leaves are often very small and may be downwardly cupped before forming the heart shape. Injury results from post-emergence application or application at cracking followed by rain or irrigation which pushes Dual down the soil crack to the sprout.

Prowl (pendimethalin) and Treflan (trifluralin)

Mode of action: Seeding growth inhibition

Specific mode: Inhibits root growth chemical family: dinitroaniline (DNA)

Uptake: root primarily and shoot movement: remain at site of absorption

Common application: Pre-emergence

Weed control: annual grasses

For Nebraska, grasses as foxtails, sandbur, crabgrass and fall panicum, and broadleaves as Kochia, lambsquarters and pigweed

Weed stage: pre-emerged (germinating seed)

Potato injury: Dinitroanilines inhibit tubule formation thereby stop cell division at the root tips. With no cell division, cells enlarge. Lateral root development is halted causing short, stubby roots with enlarged tips. Root hairs don't form along affected portions of root. Note that root must grow into soil area containing the dinitroaniline. Short thick underground shoots may be seen if they were in direct contact with herbicide. Plants become stunted. Injury appears within a week of exposure. Injury may result from an early post-emergence application. Mildly injured plants show dark-green areas on leaves with some crinkling. Mature plants with leaf symptoms often have brittle stems which can be snapped by wind. Seldom is injury severe enough to cause death since un-affected roots can make up for loss. Some varieties seem more prone to injury than others.

Lexone and Sencor (metribuzin) and Lorox (linuron)

Mode of action: Photosynthesis inhibition

Specific mode: C4 class (metribuzin), C3 class (linuron)

Chemical family: triazine (metribuzin), phenylurea (linuron)

Uptake: root and foliar

Movement: move from roots to vine, no movement from leaves

Common application: Pre-emergence

Weed control: Annual grasses, annual broadleaves, perennials

For Nebraska, grasses as foxtails, crabgrass, fall panicum, and broadleaves as Kochia, lambsquarters, pigweed, common ragweed and wild mustard, and thistles

Weed stage: Pre-emerged and early post-emerged broadleaves

Potato injury: Photosynthesis inhibitors result in the production of free radicals which disrupt cell membranes. Because of compounds upward movement in plant's xylem, symptoms appear in the leaves. These compounds do not prevent emergence but become effective when the plants are exposed to sunlight, form leaves and begin photosynthesis. Initial symptoms are a yellowing (chlorosis) of leaf margins and tips especially of older leaves. Yellowing first occurs between the veins and moves inward to the mid-vein. As injury progresses, leaves turn brown (necrotic) and die. Younger leaves are more affected as they enlarge. Plant death is not common but loss of yield and quality is. Symptoms are more pronounced in soils with pHs above 7.2 (alkaline). Varieties vary considerably in their sensitivity to injury. As a general rule with many exceptions, white and red-skinned varieties are more sensitive than russet-skinned ones. Russet Norkotah is one of the least sensitive and metribuzin has been successfully used early post-emergence on this variety.

Matrix (imisulfuron)

Mode of action: Amino acid synthesis inhibition

Specific mode: Inhibits ALS-AMAS enzyme (stops production of isoleucine, leucine and valine)

Chemical family: Sulfonamide, uptake: foliar and root

Movement: Systemic throughout plant

Common application: Early post-emergence

Weed control: Grasses and broadleaves

(Major use is control of triazine-resistant weeds as pigweeds)

For Nebraska, grasses as foxtails, volunteer cereals and corn, crabgrass and fall panicum, and broadleaves as Kochia, Mustards, pigweeds, and partial control of hairy nightshade, common ragweed and common lambsquarters

Weed stage: Pre-emerged and early post-emerged

Potato injury: Growing cells (meristem) slowly stop growing as amino acid reservoir depletes and proteins aren't synthesized. This is the newest of the potato herbicides in use, so injury information is scarce. Symptoms should be similar to other sulfonamides such as Accent and imidazolinones such as Pursuit. Plants may become stunted, and both leaves and stems may turn yellow (chlorosis) and/or purple. Severe injury may result in death of terminal growing points. Growth stops shortly after application but discolorations appear gradually, one to two weeks.

Eptam/Genep (EPTC)

Mode of action: Seeding growth inhibition

Specific mode: Lipid synthesis (non-ACCase) inhibitor

Chemical family: Thiocarbamate uptake: Stem and root

Movement: Systemic throughout plant

Common application: Post-emergence and pre-emergence

Weed control: Grasses and broadleaves

For Nebraska, grasses as foxtails, sandbur, crabgrass, fall panicum, cereals and broadleaves as black, hairy and cutleaf nightshades, pigweeds, and common lambsquarters

Weed stage: Pre-emerged and newly emerged

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Herbicides and Injury on Potato (continued)

Potato Injury Due to Carryover
In Nebraska, carryover injury on potatoes has been observed from four major herbicidal families. Carboxylic acids are plant growth regulators, imidazolinones and sulfonylureas are both inhibitors of ALS/AHAS enzyme, and triazines are photosynthesis inhibitors.

Synthetic auxin growth regulator
family: carboxylic acid or pyridine or picolinic acid
e,xample: clopyralid (Stinger) and pictoran (Tordon)
crop use: small grains, corn, sugar beets, grass pastures
movement: downward through plant
potato injury: Potato injury is similar to that from phenoxyacetic acids such as 2,4D. Typical symptoms are curling of young leaves, "fiddle-neck" leaf appearance. Tuber yields are greatly reduced. In addition, exposure may carry over into seed tubers and affect the following year's crop.

Photosynthesis inhibitors
family: triazine
e,xample: atrazine (several product names), cyarazine (Glades), simazine (Princep), hexazinone (Velpar)
crop use: corn and alfalfa
movement: upward from root to vine
potato injury: Carry-over has generally occurred in Nebraska when metribuzin at its high, labeled rates is also used on a field after atrazine-treated corn in Nebraska. Recommendations are to use metribuzin at half rate under this circumstance or to plant a variety that is resistant to triazine injury such as Russet Norkotah. Symptoms are the same as those described for metribuzin (Lexone, Sencor). The most notable early symptom is veinal chlorosis.

Amino acid inhibitors
family: imidazolinone
e,xample: mazethanpr (Pursuit), imazaquin (Scepter) and imazamox (Rapture)
family: sulfonylurea
e,xample: chlorimuron (Classic), chlorsulfuron (Glean), metsulfuron (Ally),nicosulfuron (Accent), and triasulfuron (Amber)
crop use: corn, soybean, small grains, grass pasture, and CRP
movement: throughout plant
potato injury: Foliar symptoms include a light green appearance of leaves especially new ones. Leaves are cupped upward giving a "boat-shaped" appearance. There may be a loss of leaf blade integrity; leaf disintegrates leaving the midrib and about 10% of a normal leaf. Rolling of the leaves may occur resembling drought stress. Severe injury may result in stunting and purpling. Tuber yield and quality are greatly reduced.

TUBER SYMPTOMS ASSOCIATED WITH HERBICIDE INJURY
Tuber mis-shaping include longitudinal cracks, "dumb-bells," curved or folded tubers, indentations, and knobs, bumps or protrusions. Tuber are often under-sized. The skin may develop "alligator on elephant-hide." Severe injury may cause tuber "chaining" and formation of "popcorn" tubers. Aerial tubers have also been observed.

Potato Injury Due to Drift
In Nebraska, three major herbicidal families have caused injury due to drift from nearby fields. Phenoxyacetic and benzoic acids are plant growth regulators, and biopyridines are vine desiccants.

Synthetic auxin growth regulators
family: phenoxyacetic acid
e,xample: 2,4D (many product names)
family: benzoic acid
e,xample: dicamba (Banvel, Clarity)
crop uses: small grains, com, pasture
movement: downward through plant (phloem)
potato injury: As auxins, these promote cell enlargement in the vascular tissue resulting in clogging and inhibition of translocation. Plants exposed to phenoxyacetic acids exhibit twisting stems (epinasty) due to asymmetrical growth. Leaves will malform appearing cup-shaped, crinkled, stripped, and having parallel veins. Leaves of dicamba-exposed plants have a "fiddle-neck" appearance, or a folded or hooded appearance. Curling of some petioles and leaves may occur along with the puckered appearance. Symptoms may occur within a few hours to several days. Yields are reduced. Tuber may have creases and appear with elephant-hide.

Cell membrane disrupters
family: bipyridilium
example: diquat (Diquat) and paraquat (Gramoxone)
crop use: potato vine desiccation
movement: none, contact herbicide
potato injury: By diverting electrons from photosynthesis, these compounds cause the formation of hydrogen peroxide which disrupts cell membranes. Drill injury of these potato vine desiccant appears as leaf speckling or necrotic spots on leaves.

Injury due to PGRs
**Potato Injury Symptoms from Herbicides**

<table>
<thead>
<tr>
<th>Herbicide</th>
<th>Leaves</th>
<th>Stems</th>
<th>Roots</th>
</tr>
</thead>
<tbody>
<tr>
<td>glyphosate</td>
<td>yellow, brown, die</td>
<td>delayed emergence, stunting</td>
<td>—</td>
</tr>
<tr>
<td>metolachlor</td>
<td>heart-shape, crinkle, downward cup</td>
<td>delayed emergence, stunting</td>
<td>—</td>
</tr>
<tr>
<td>pendimethalin</td>
<td>dark-green blotches, some crinkling</td>
<td>short thick sprout, stunting, brittle</td>
<td>—</td>
</tr>
<tr>
<td>trifluralin</td>
<td>—</td>
<td>stunting, purpling, —</td>
<td>—</td>
</tr>
<tr>
<td>metribuzin</td>
<td>yellow margins &amp; tips, interveinal yellowing to browning</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>linuron [triazines]</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>rimsulfuron [imidazolinones]</td>
<td>—</td>
<td>—</td>
<td>—</td>
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<tr>
<td>sulfurylureas</td>
<td>—</td>
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<td>—</td>
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<tr>
<td>EPTC</td>
<td>crinkled, puckered, thicken, dark-green closed leaf buds</td>
<td>delayed emergence, stunting</td>
<td>—</td>
</tr>
<tr>
<td>PGRe</td>
<td>cupped, crinkled, strappled, curled, parallel veining, fiddle-necking</td>
<td>twisted, bent</td>
<td>—</td>
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<tr>
<td>diquat paraquat</td>
<td>—</td>
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</tbody>
</table>

**References**