

Monsanto Medical Management Protocol

PRODUCT NAME

Roundup Klasik Pro

PHYSICAL PROPERTIES

Form: liquid
Colour: yellow - amber
pH: 4.8

COMPOSITION

NOTE: COMPANY CONFIDENTIAL

Composition details are Company Confidential information and are provided only for use by health care professionals for purposes of the assessment and treatment of exposed individuals.

Components	CAS No.	% by weight (approx.)
glyphosate, potassium salt	70901-12-1	35 %
water	7732-18-5	59 %
anionic surfactant	--	6 %

GENERAL

HUMAN INGESTION EXPERIENCE WITH THIS PRODUCT IS EXTREMELY LIMITED. This management plan is largely based upon experience with glyphosate products having a closely related surfactant system (ethoxylated tallowamine) and upon animal data regarding the formulation components. **While Monsanto expects the toxicity of this product to be similar to the ethoxylated tallowamine product, the actual clinical presentation may possibly differ from that presented below.**

WARNING: This product contains the POTASSIUM SALT of glyphosate.

POTASSIUM CONTENT: 185 mEq PER 100 CC OF PRODUCT.

While the toxicology literature suggests that large ingestions of potassium are generally well tolerated, hyperkalemia and serious cardiac rhythm disturbances may arise in the event of a large ingestion or in patients with renal failure, underlying cardiac disease, or other factors predisposing to potassium toxicity.

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THIS PROTOCOL DOES NOT APPLY TO ALL MONSANTO GLYPHOSATE PRODUCTS. Certain specialty products or formulations contain higher surfactant loads or other ingredients which may alter medical management. Recommendations for these other products should be available on this website. For products not listed on this website, please contact Monsanto for additional information.

THIS PROTOCOL MAY NOT BE APPROPRIATE FOR PRODUCTS SUPPLIED BY OTHER MANUFACTURERS. Other manufacturers may utilize different glyphosate salts and/or formulation components which may substantially alter the toxicity of the product.

Due to local differences in treatment practices, medications, equipment, and standards of care, **THESE GUIDELINES DO NOT ATTEMPT TO PROVIDE DETAILED MANAGEMENT RECOMMENDATIONS FOR COMMON MEDICAL CONDITIONS** such as seizures, hypotension, etc. This document is intended to provide supplemental medical information and guidance which is useful in regard to the specific Monsanto product requested. Please contact your local Poison Control Center or physician, if necessary, for more detailed information regarding treatment of specific medical conditions.

GLYPHOSATE DOES NOT INHIBIT CHOLINESTERASE. ATROPINE AND OXIME THERAPY IS NOT INDICATED. Symptoms consistent with cholinergic poisoning (as would be seen with organophosphate or carbamate poisoning) strongly suggest exposure to another agent instead of, or in addition to, glyphosate.

FIRST AID MEASURES

Eye contact

Rinse immediately with plenty of water. Continue for at least 15 minutes. If easy to do, remove contact lenses. If irritation persists, obtain medical attention from an eye specialist.

Skin contact

Immediately take off all contaminated clothing, wristwatch, and jewellery. Wash contaminated skin promptly. Continue for at least 15 minutes. If spilled into boots, remove immediately. Seek medical treatment if symptoms persist following contact with skin.

Inhalation

Remove to fresh air. If breathing is difficult, give oxygen. If not breathing, give artificial respiration. Obtain medical advice.

Ingestion

Do NOT induce vomiting. If symptoms occur, get medical attention.

SIGNS AND SYMPTOMS OF TOXICITY

General

Fever, malaise, and dehydration may occur in serious ingestions.

Skin contact

Irritation may occur following skin contact. Irritation is generally mild unless exposure is prolonged and the exposed area is occluded or abraded.

Eye contact

Irritation may occur following eye contact.

Neurologic

Glyphosate does NOT inhibit cholinesterase. Cholinergic crisis does not occur as a result of glyphosate/surfactant ingestion. Neurologic dysfunction, including stupor, coma, and seizures has occurred in severe poisoning. This is most likely the result of haemodynamic and biochemical disturbances rather than the direct result of central nervous system toxicity.

Respiratory

Irritation of the respiratory tract with cough, bronchospasm, dyspnoea, tachypnea, and cyanosis may occur, especially if aspiration occurs. Aspiration pneumonitis may occur. Pulmonary oedema is reported in severely intoxicated cases, probably as a result of haemodynamic dysfunction. Individual clinicians have suggested that late airway compromise due to laryngeal oedema, occurring 48 to 72 hours after ingestion, may possibly contribute to the deterioration of severely intoxicated cases, but this has not been systematically investigated.

Cardiovascular

Death in severely intoxicated cases is generally due to intractable hypotension. Animal studies of tallowamine surfactant indicate that this is due to both a loss of contractility and a loss of systemic vascular resistance. In the case of human intoxication, this may be aggravated by systemic volume depletion and electrolyte abnormalities. Abnormalities of heart rhythm are NOT common except in severely ill cases with concomitant fluid and electrolyte abnormalities.

This product contains the POTASSIUM SALT of glyphosate. While generally well tolerated, large ingestions of potassium may result in electrocardiographic disturbances (peaked t-waves, U-waves) and serious cardiac rhythm disturbances.

Gastrointestinal

Irritation of the mouth and throat, epigastric pain, nausea, and vomiting are common. In severe cases one may see gastrointestinal haemorrhage, paralytic ileus, diarrhoea, and injury or necrosis of the intestinal wall. Diarrhoea and intestinal injury may cause dehydration and electrolyte disturbances. Endoscopic studies and clinical reports have NOT demonstrated severe injury, corrosive perforation, stricture, or other complications involving the oesophagus. In fatal cases, autopsy has revealed intestinal mucosal injury with transmural oedema and mucosal necrosis. The degree to which gut injury contributes to metabolic disturbances and/or fatal complications following large ingestions is not clear. Elevations of serum amylase are reported. Isoenzyme analysis suggests that this may be primarily of salivary origin.

Hepatic

Abnormalities of liver function tests are reported in severe intoxications. These abnormalities are generally not clinically significant, although serious liver injury and hepatic failure may be seen as a complication of severe systemic illness.

Renal-Genitourinary

Abnormal renal function is reported in severe overdose. These abnormalities probably are the result of fluid loss and haemodynamic instability rather than direct toxicity to the kidney itself. Overt renal failure may occur in the severely ill patient.

Metabolic (acid/base, fluid/electrolyte disturbances)

Metabolic acidosis and hyperkalemia may occur. Other disturbances of electrolytes may occur as a complication of systemic illness in severely intoxicated patients.

Haematologic

Leucocytosis may occur.

ADVANCED MEDICAL MANAGEMENT INFORMATION

General Information

GLYPHOSATE DOES NOT INHIBIT CHOLINESTERASE. ATROPINE AND OXIME THERAPY IS NOT INDICATED. Symptoms consistent with cholinergic poisoning (as would be seen with organophosphate or carbamate poisoning) strongly suggest exposure to another agent instead of, or in addition to, glyphosate.

WARNING: This product contains the POTASSIUM SALT of glyphosate.

POTASSIUM CONTENT: 185 mEq PER 100 CC OF PRODUCT.

Glyphosate itself has a low degree of mammalian toxicity. Severe illness and death has been reported following ingestion of glyphosate formulations, most likely due to the surfactant component. Almost all serious illness has followed ingestion of the 41% glyphosate concentrate product. Once this product has been diluted for application (glyphosate concentration usually less than 2%), serious illness following ingestion appears to be highly unlikely.

Clinical response to ingestion of these products is highly variable. Although many individuals in the moderate- to high-risk ingestion categories (see below) will develop only symptoms of gastrointestinal irritation, others may develop serious or fatal illness.

Assessment of Exposure

NOTE: Assessment and management are based upon exposure to this product as purchased (i.e.- not diluted for use). Contact with or ingestion of the fully diluted spray solution is not expected to produce toxicity other than mild irritant effects to the eyes, skin, respiratory mucosa, or gastrointestinal tract.

Skin contact

Systemic poisoning is not expected to occur via this route of exposure.

Eye contact

Systemic poisoning is not expected to occur via this route of exposure.

Inhalation

Systemic poisoning is not expected to occur via this route of exposure.

Ingestion

The following is based upon experience with glyphosate-surfactant ingestions (See below for assessment of potassium intake):

Low risk (moderate or serious illness is highly unlikely):

ADULT (weight over 50 kg): ingestion < 50 mL

CHILD (or small adult, less than 50 kg): ingestion < 0.7 mL per kg body weight

Moderate risk (moderate to serious illness may occur, death is unlikely):

ADULT (weight over 50 kg): ingestion 50-100 mL

CHILD (or small adult, less than 50 kg): ingestion 0.7–1.4 mL per kg body weight

High risk (serious illness or death may occur):

ADULT (weight over 50 kg): ingestion > 100 mL

CHILD (or small adult, less than 50 kg): ingestion > 1.4 mL per kg body weight

Assessment of potassium intake:

While potentially toxic ingestions of all glyphosate products may result in fluid and electrolyte disturbances, particular attention to potassium may be important following ingestion of the potassium salt products.

- Pending further experience with these products, **Monsanto recommends close monitoring of serum potassium levels and/or electrocardiographic monitoring** (for peaked T-waves or rhythm disturbances) following significant ingestion of potassium salt products, particularly for high risk individuals.

- **Individuals with the following may be at elevated risk following acute potassium exposure:**

- **Known hyperkalemia.**
- **Renal failure / renal dysfunction.**
- **Use of potassium sparing diuretics.**
- **Hypoaldosteronism.**
- **Co-ingestion of other K⁺ containing materials.**
- **Underlying heart disease.**
- **Use of digoxin, digitoxin, ouabain, or exposure to other cardiac glycosides.**

Medical Management

Skin contact

Mild to moderate skin irritation generally does not require additional treatment. Low potency steroids may be useful for symptomatic relief. In the event of open skin injury or hypersensitivity contact dermatitis, high potency topical corticosteroids, systemic corticosteroids, and/or antibiotic treatment may be indicated. Monsanto glyphosate/surfactant formulations (unless otherwise labelled) are not expected to produce skin sensitization. Standard skin test antigens do not exist for most glyphosate formulation ingredients. Consideration should be given to plants or other dermal sensitizer exposures which may produce ongoing symptoms if not recognized and eliminated.

Eye contact

Following initial first aid, individuals with persistent foreign-body sensation, pain, or photophobia should undergo fluorescein evaluation for possible corneal abrasion. Any irritated eye may become secondarily infected, particularly in young children. Topical steroids, topical antimicrobials (or combined corticosteroid/ antibiotic ointments) and eye patching should be utilized as indicated by the condition of the eye and the presence of (or potential for development of) secondary infection.

Inhalation

Irritation of the nose and throat is possible after inhalation of aerosols. Medical treatment is generally not necessary, but symptoms can possibly be reduced or relieved using inhaled corticosteroids and topical measures such as a steam vaporizer, hot beverages, etc. Inhalation injury to the lower respiratory tract and lungs is not expected to occur

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with glyphosate/surfactant products (unless aspirated - see Ingestion below.) Although the possibility of lower respiratory tract illness related to these products cannot be absolutely excluded, other aetiologies should be considered for any observed lower respiratory illness and management appropriate for other likely aetiologies (infections, other chemical agents) should be instituted when appropriate.

Ingestion

- **Gastric Emptying:** Gastric emptying using lavage is indicated for individuals in the moderate- or high-risk ingestion category if less than three hours have elapsed since ingestion and if vomiting has not already occurred. Care should be exercised in cases with corrosive co-ingestants, clinical evidence of severe oesophageal or gastric injury, possible perforated viscus, paralytic ileus, altered mental status, seizures (or high risk of seizures), and individuals with head trauma. Gastric emptying is not indicated for individuals in the low-risk ingestion category.
- **Endoscopy:** Available studies do not support the need for routine endoscopic evaluation of patients following glyphosate/surfactant ingestions. Endoscopy should be reserved for individuals with clinical evidence of severe mucosal injury (most likely due to a corrosive co-ingestant) or in situations when endoscopy is necessary to facilitate gastric lavage (head injury).
- **Observation:** Individuals in the low risk category can be observed in the emergency room and discharged if stable, with instructions to return if more severe symptoms arise. Prolonged observation may be indicated for suicidal individuals. Individuals in the moderate risk category should be observed in-hospital for 48 hours. Observation should include vital signs and fluid/electrolyte status. Individuals in the high risk category should be observed for 48 hours in an intensive care or similar environment, with monitoring of vital signs, fluid and electrolyte status.
- **Fluid/Electrolytes:** **Due to the potassium content of this product (185 mEq/100cc), individuals with moderate to high risk ingestions, or individuals at risk for potassium toxicity (see list, above) should be monitored carefully for alterations in serum potassium or for electrocardiographic manifestations of hyperkalemia.** In seriously ill cases, attention should be paid to magnesium and phosphate concentrations. Although not known to occur as a result of glyphosate/surfactant ingestions, abnormalities of these parameters may contribute to cardiovascular dysfunction and hypotension.

For moderate hyperkalemia (K^+ of 6.0-7.0 mEq/L), administer sodium polystyrene sulfonate (Kayexelate™) 1-2 gm/kg with 3 gm sorbitol/gm PO, or with 5 ml sorbitol/gm as enema. For more severe hyperkalemia ($K^+ > 7$ mEq/L) or serious complications of hyperkalemia, correct metabolic or respiratory acidosis if present to allow potassium to enter the intracellular space. Additional management may include: 1) Administer insulin 0.1 units/gram glucose + glucose 0.5 gm/kg IV over 30 min and repeat if necessary, OR drip D25 at 1-2 ml/kg/hr + regular insulin at 0.1u/kg/hr; (2) administer Sodium Bicarbonate 1-2 gm/kg IV or (3) administer intravenous Calcium, and (4) consider dialysis to remove excess potassium.

Care should be used in the treatment of patients with combined acidosis and hyperkalemia, as correction of the acid-base disturbance following removal of potassium by dialysis may result in acutely low serum potassium concentrations.

- **Respiratory:** Monitor respiratory status clinically. Obtain blood gas determinations and chest X-ray as clinically indicated. Respiratory compromise (hypoxia or acidosis) may contribute to haemodynamic instability and metabolic disturbances and should be corrected if feasible.
- **Aspiration Pneumonitis:** Aspiration in the context of a glyphosate/surfactant ingestion is not believed to be unique in any way and should be managed in accordance with local practices and standards. The use of positive-end-expiratory-pressure and other pulmonary support techniques may result in diminished cardiac return and/or cardiac function and may worsen haemodynamic instability caused by glyphosate/surfactant ingestion.

- **Pulmonary Oedema:** Pulmonary oedema (in the absence of aspiration pneumonitis) is believed to be due to haemodynamic factors (volume overload and poor cardiac contractility). The surfactant component of the product may also result in alterations in pulmonary vascular function and/or induce pulmonary endothelial injury, but this has not been investigated. Management should include the correction of cardiovascular/haemodynamic abnormalities and the judicious use of diuretics. The use of opiate agents in pulmonary oedema is controversial, and in this case is probably not appropriate as it may further decrease both cardiac function and systemic vascular resistance. The use of positive-end-expiratory-pressure and other pulmonary support techniques may result in diminished cardiac return and/or cardiac function and may worsen haemodynamic instability caused by glyphosate/surfactant ingestion.
- **Cardiovascular:** Hypotension may be life threatening in severe cases and is often reported as being unresponsive to therapy in fatal intoxications. Hypotension may be due to systemic volume depletion, loss of cardiac contractility, or loss of systemic vascular resistance. In seriously poisoned cases, all three factors may play a role. Therapeutic interventions should include careful monitoring of fluid status and electrolyte status (pH, potassium, magnesium, phosphate). Consider monitoring of central venous pressure to enhance assessment of volume status. Although no outcome data exist to support its use, Swan-Ganz catheterization with independent measurement of fluid status, cardiac function, and vascular resistance, may be helpful in managing severely ill individuals. Correct pH and electrolyte abnormalities to the extent feasible. Consider the use of pressor agents to enhance cardiac contractility, systemic vascular resistance, or both.

In the event of cardiac rhythm disturbances or electrocardiographic abnormalities, consider possible hyperkalemia (for management see Fluid and Electrolytes above).

- **Seizures:** Seizures in the context of glyphosate/surfactant ingestions are NOT believed to be due to a specific neurotoxic mechanism. Glyphosate does NOT inhibit cholinesterase. Management should include correction of metabolic abnormalities such as hypoxia or acidosis as well as the use of standard anticonvulsant medications.
 - **Enhanced Elimination:** Enhanced elimination is NOT routinely indicated for glyphosate/surfactant ingestions. Although the low molecular weight of glyphosate suggests that it is dialyzable, toxicity is most likely due to the high molecular weight surfactant component. Dialysis may be indicated for the correction of severe fluid and electrolyte abnormalities, including hyperkalemia, in severely affected individuals.
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