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Fertilizer Salt Index: Influence on Seeds and Plants

Wesley Haun, Research Agronomist

Many fertilizer materials are salt based and readily dissolve in water. When these fertilizer materials dissolve in soil moisture, they increase the salt concentration and result in higher soil solution osmotic potential. As the soil solution osmotic potential rises, seeds and/or plants have greater difficulty in taking up sufficient soil water. Osmotic potential is the external pressure applied to cell walls. Turgor pressure is the internal pressure from within the cells. The difference between osmotic potential and turgor pressure is water potential. Water potential is responsible for net water movement into a plant. A positive water potential infers water uptake by plants. When water potential is negative, there is net loss of water from the plants.

FERTILIZER MATERIALS HAVE VARYING SALT CONTENT

Fertilizer materials vary in amounts of salt content. A salt index was established to compare fertilizer products and their potential to increase salt concentration in the soil. The salt index (SI) of a given fertilizer product is expressed as a ratio of the increase in osmotic potential of the salt solution produced by a fertilizer product to the osmotic potential of the same weight of sodium nitrate (NaNO_3). The salt index of NaNO_3 was defined with a relative value of 100. Therefore, fertilizer products with lower SI values have less potential to result in injury to seeds or plants, especially when placed in close proximity to seed row. Higher analysis fertilizers tend to have lower SI as fewer salt ions are released into soil solution per unit of plant nutrient when they dissolve.

Salt injury from fertilizer products generally is not a problem if the fertilizer and seed/plant are separated. However, when the fertilizer is applied in or near the seed row, salt injury may occur. This type of application has several names including "pop-up", "in-furrow", and "seed row". The SI does not predict the amount of fertilizer or type of formulation that could result in injury. Salt injury potential is influenced by several factors including type of crop, soil type, soil moisture content, and proximity to seed or seedling. Seed row application requires fertilizer sources and rates that minimize the chances for injury.

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CONTACT INFORMATION

Corporate Headquarters
4 Armstrong Road, Suite 220
Shelton, CT 06484
203-635-0190 (phone)
203-227-8351 (fax)

TIGER-SUL Products (Canada) Co. P.O. Box
126
275137 Range Road 263
Irricana, AB TOM 1B0, Canada 877-
299-3399
403-935-4197 (direct)

TIGER-SUL Products LLC.
25 Byrne Drive
Atmore, AL 36502, USA
800-239-3647
251-202-3850 (direct)
251-368-4964 (fax)
Mailing Address:
P.O. Box 5; Atmore, AL 36504, USA

info@tigersul.com
www.tigersul.com



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Crops vary in their ability to tolerate salt concentration in the soil. For example: wheat is moderately tolerant, corn is intermediate in tolerance, and soybeans are very sensitive. Including some nitrogen compounds (urea, UAN, ammonium thiosulfate) in a row starter can result in similar injury symptoms as salt because they produce free ammonia which can reduce seed germination or cause seedling death.

SALT INDEX (SI)

FERTILIZER PRODUCT	NUTRIENT CONCENTRATION	SALT INDEX
Magnesium Oxide	Mg 60%	1.7
TIGER® Micronutrients Zn 18%	S 65%, Zn 18%	2.9
TIGER® 90CR	S 90.0%	3.7
Gypsum	Ca 23%, S 17%	8.1
Triple superphosphate	P₂O₅ 45%	10.1
Ammonium Polyphosphate	N 10%, P₂O₅ 34%	20.0
Monoammonium Phosphate	P₂O₅ 52%, N 11%	26.7
Diammonium Phosphate	P₂O₅ 46%, N 18%	29.2
Potassium Sulfate	K₂O 50%, S 18%	42.6
Sulfate of Potash – Magnesia	K₂O 22%, Mg 11%, S 22%	43.4
Magnesium sulfate	Mg 10%, S 14%	44.0
Anhydrous Ammonia	N 82%	47.1
Urea-Ammonium Nitrate Solution	N 28%	63.0
Potassium thiosulfate	K₂O 25%, S 17%	68.0
Urea-Ammonium Nitrate Solution	N 32%	71.1
Potassium Nitrate	K₂O 46.5%, N 13%	73.6
Urea	N 46%	74.4
Ammonium Sulfate	N 21%, S 24%	88.3
Ammonium thiosulfate	N 12%, S 26%	90.4
Sodium Nitrate (NaNO₃)	N 16.5%	100.0
Ammonium Nitrate	N 34%	104.0
Potassium Chloride	K₂O 60%	116.3

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