CCS Pipeline™

Salt Index

SALT INDEX

Most all fertilizer materials are salts. When dissolved in water the salt concentration of the solution is increased. As the salt concentration of a solution increases the osmotic potential of the solution increases. The osmotic potential increase could result in; seed germination failure, root growth reduction or cell membrane damage.

Salt index is defined as, "a measure of the extent to which various fertilizer materials increase the osmotic pressure of the solution in which they are dissolved compared to the osmotic pressure of an equal amount of sodium nitrate where sodium nitrate is adjusted to 100".

Salt index of a soil is measured by adding an amount of fertilizer to soil and incubating for five days. The osmotic pressure of the displaced soil solution is then measured. Sodium Nitrate is the standard used as the reference point at 100. Similarly solution salt index is measured by adding one gram of pure fertilizer salt to 100 ml of distilled water connected to another chamber with an equal water volume. The chambers are separated by a semi-permeable membrane. This membrane will allow water to move through but not salts. The osmotic potential in the half of the solution with the salt will be greater than the osmotic potential in the pure water half. Water will move through the membrane toward the higher osmotic potential side. The fertilizer salt water displacement is compared to water displacement relative to one gram of pure sodium nitrate water displacement. Depending upon material, the salt index may be smaller or higher than 100.

As the ionic concentration of a solution (foliar mix or soil solution) increases, the osmotic pressure increases. If the osmotic pressure increases, the water potential will decrease. Decreases in water potential are associated with decreases in the rate at which plant roots and seeds absorb water. When foliar materials containing higher osmotic pressure than the pressure in cells are placed on the cell surface, water will move out of the cell. If the movement is great enough, the cell membrane may be disrupted and the cell destroyed.

This destruction on a large scale resembles a burn or browning of the affected tissue.

Placing too much fertilizer or fertilizer with a high salt index too close to plant roots or seeds could result in injury or death of the roots or inhibition of seed germination. Solutions too high in salts or containing materials with high salt index could also result in injury or death of the plant or tissue where foliar nutrients are applied.

In 1943 a research paper was published by C.W. Whittaker discussing methodology to measure salt index. Various fertilizer materials were compared using sodium nitrate as the standard (sodium nitrate = 100).

The salt index of a mixture is the sum of the partial salt index of the ingredients. Salt index does not predict the amount of material that will produce injury to crops. It classifies fertilizer material relative to each other using sodium nitrate as a standard.

Salt index can be used to predict relative to each other the potential for damage to plant tissue from foliar application of fertilizer materials. A general rule of thumb to consider is, "if the salt index of a particular material or mix of materials is less than 40, the damage potential is minimal for most crops." If the salt index is greater than 40 only apply the material if experience has demonstrated it can be safely done.

Charts have been prepared showing the relative salt index value of different materials in solution. Soil solution electric conductivity ECe and irrigation water conductivity ECw (measured in dS/m* or an equivalent unit) tables have been prepared predicting crop injury or loss if the conductivity is too high. Fertilizer materials based on their individual salt index contribute to the overall conductivity of the soil solution. Fertilizer rates, application timing, irrigation methods/amounts and placement affect the overall soil salt level and damage potential. *(dS/m X 640 = ppm)

If any doubts exist as to damage potential when using a foliar or soil applied fertilizer material, then do not apply the material.

For more information on this topic or other crop fertility topics please contact
Creech Crop Services, LLC. - Buford Creech, CCA – 941-737-2719
Or email - creechcrop@aol.com

CREECH CROP SERVICES, LLC

TECHNICAL INFORMATION FILE ON SALT INDEX AND SOLUBILITY OF COMMON FERTILIZER MATERIALS

#	MATERIAL	FORMULA	ANALYSIS	Salt Index	Sol. oz/gal.	Sol. g/100ml
1	Ammonium Chloride	NH_4Cl	26%N - 66%Cl	52	39	29.4
2	Anhydrous Ammonia	Gas Material	82%N	47		
3	Ammonium nitrate	NH_4NO_3	34%N	105	157	118.2
4	Ammonium sulfate	$(NH_2)_2SO_4$	21%N - 24%S	69	93	70.0
5	Ammonium Thiosulfate	Liquid Material	12%N, 26%S	90		
6	Ammonium Polysulfide	Material	20%N, 40%S	59		
7	Borax	$Na_2B_4O_7 \cdot 10H_2O$	11% B	4	3	2.3
8	Calcium carbonate	$CaCO_3$	40%Ca	5	0.003	0.002
9	Dolomitic Limestone	Ca & Mg CO_3	21.5% Ca, 11%Mg	1	0.003	0.002
10	Calcium nitrate	$Ca(NO_3)_2 . 4H_2O$	15%N - 17%Ca	53	178	134.0
11	Calcium sulfate	$CaSO_4 . 2H_2O$	23%Ca - 19%S	8	0.3	0.2
12	Copper sulfate	$CuSO_4$	26%Cu - 13%S	42	32	24.1
13	Diammonium phosphate	$(NH_4)_2HPO_4$	21%N - 23%P	29	33	24.8
14	TSP	Material	46% P2O5	10		
15	MAP	Material	11%N - 52%P2O5	27		
16	MAP	Material	10%N - 50%P2O5	24		
17	APP	Liquid Material	10%N - 34%P2O4	20		
18	APP	Liquid Material	11%N - 37%P2O5	23		
19	Normal Superphosphate	Material	20%P2O5	8		
20	Phosphoric Acid	Liquid Material	54% P2O5	1.6133 per 100 lbs H_3PO_4/Ton		
21	Phosphoric Acid	Liquid Material	72% P2O5	1.7540 per 100 lbs H_3PO_4/Ton		
22	Iron sulfate	$FeSO_4 . 7H_2O$	20%Fe - 12%S	20	15	11.3
23	Magnesium nitrate	$Mg(NO_3)_2 . 6H_20$	10%Mg - 11%N	56	42	31.6
24	Magnesium sulfate	$MgSO_4 . 7H_2O$	10%Mg - 12%S	53	113	85.1
25	Magnesium Oxide	Material	60%Mg	1.7		
26	Manganese Sulfate	$MnSO_4 . 4H_2O$	25%Mn - 14%S	140	105	79.0
27	Monoammonium phosphate	$NH_4H_2PO_4$	12%N - 27%P	30	57	42.9
28	Manure Salts	Slurry	20% Solids	113		
29	Manure Salts	Slurry	30%	92		
30	Potassium chloride	KCl	52%K - 47%Cl	116	37	27.9
31	Potassium Hydroxide	KOH	83.6%K2O	1.015 per 20 lbs in a ton		
32	Potassium diphosphate	K_2HPO_4	45%K - 18%P	22	167	125.7
33	Potassium monophosphate	KH_2PO_4 (MKP)	29%K - 23%P	8	44	33.1
34	Potassium nitrate	KNO_3	14%N - 39%K	70	17	12.8
35	Potassium sulfate	K_2SO_4	45%K - 18%S	43	10	7.5
36	SPM	Material	22%K2O, 22%S, 11% Mg	43		
37	Potassium ThioSulfate	Liquid Material	25%K2O, 17%S	68		
38	Sodium molybdate	$Na_2MoO_4 . 2H_2O$	40%Mo	74	56	42.2
39	Sodium nitrate	$NaNO_3$	17%N	STD 100	97	73.0
40	Sodium Chloride	$NaCl_2$	Table Salt	154		
41	Urea	$CO(NH_2)_2$	47%N	75	89	67.0
42	UAN Solution	Solution	32%N	71		
43	UAN Solution	Solution	28%N	63		
44	Methylene Urea	Polymer of Urea	41% N	24		
45	Tri-Potassium Phosphate	K_3PO_4	14.6%P & 55.1%K	78		
46	Zinc sulfate	$ZnSO_4 . 6H_2O$	24%Zn - 12%S	93	70	52.7

Solubility varies with temperature and ionic composition of water, Data taken from Berg. (1980), Bunt (1976) and Hanan et al. (1978)
A salt index of less than 30 means the product has an undetectable level of soluble salts.
Between 30 and 40 the potential for plant damage is very low. Under 50 is considered low.
From 50 - 70 the damage is moderate. 70-80 the damage is moderately high.
Above 80 and certainly above 100 damage will probably occur.