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Let's Be Careful When Defining Salt Index

Original data and definition of salt-index predate many current fertilizers.

***Summary:** The original data and definition of salt index come from a time before many of the current fertilizer products, especially fluids after the 1940s, were developed. In recent years, some have adopted a method that measures electrical conductivity (EC) and not the original osmotic pressure approach. A few products may have widely different salt index values, depending on methodology used. Salt index, by itself, does not tell us how much of a given product is safe when applied with the seed. It only provides relative differences among products. Many other factors such as soil temperature, soil moisture, and potential free ammonia formation may all impact germination and/or seedling root development.*

In the 1940s, dry fertilizer materials available at that time were evaluated for changes that occurred in the soil solution osmotic pressure upon application. In 1943, Rader et al. reported salt index values for 45 dry fertilizer materials based on the osmotic pressure of the soil solution when applied to Norfolk sand. This method involved mixing fertilizer materials with air-dried soil and then spraying with water to bring the moisture content to 75 percent of its moisture equivalent. After five days, the soil solution was removed and evaluated for conductivity and freezing point. The resulting freezing point values were then converted to osmotic pressure by tables developed for vegetable saps. A salt index value was then expressed relative to the increase in osmotic pressure as compared with that obtained with the same weight of sodium nitrate. During this time, three nitrogen (N) containing solutions were evaluated, but they could not be urea-ammonium nitrate solution (UAN) since the N content ranged from 37 to 40.8 percent. A laboratory method was later published by W.L. Jackson in 1958 where salt index of a fertilizer was measured by electrical conductance, rather than by osmotic pressure, relative to sodium nitrate. However, this method generally results in significantly higher salt index readings than the original method and data derived from this laboratory method did not correlate well with earlier soil-applied applications. Fluid fertilizers such as UAN, ammonium polyphosphate (APP), ammonium thiosulfate (ATS), potassium thiosulfate (KTS), calcium nitrate (CN9) and others were not available until after the original study. Data from these materials have been added to data from the original study in the fertilizer salt index reference tables being used today.

Recent studies

Method comparison. In 2004, Murray and Clapp compared several potassium (K) sources for salt index values, as determined by the Jackson method, with the original data published by Rader.

As noted in Table 1, salt index values from the two methods do not directly correlate. Some minor differences are noted as a result of differences in the K_2O concentration because Rader used chemically pure material for K_2SO_4 and KNO_3. In this study, a

Table 1. Salt Index values for K sources from Jackson and Rader methods and those reported in the Crop Protection Handbook (CPH) and Western Fertilizer Handbook (WFH)				
K Source	Rader	Jackson*	CPH	WFH
KCl	116.3	149.6	116.2	116.3
K_2SO_4	46.1	111.2	42.6	46.1
KNO_3	73.6	97.6	69.5	73.6
S of potash-magnesia	43.2	64.8	43.4	43.4
KTS	-	63.2	68.0	64.0
*Determined by Southern Enviromental Testing, Florence, Alabama.				

Table. 2 Influence of a starter NPKS fertilizer on corn stands and yield.				
	$N-P_2O_5-K_2O-S$	2004	2005	2005
	lbs/A			
Soil Temperature °F		56	48	60
Days to emerge		8	15	-
Plant population-10^3/A	0-0-0-0	33.6	33.5	34.1
	6-20-6-4	33.3	22.6	32.9
Yield - bu/A	0-0-0-0	181.7	166.5	209.2
	6-20-6-4	198.9	145.1	215.4

soluble grade of KCl (62% K_2O) was used, whereas Rader evaluated a 60 percent K_2O grade. Values from the Jackson method are higher than those from the Rader study. These values range from 28.6 percent higher for KCl to 141.2 percent higher for K_2SO_4. Potassium thiosulfate was not available when the Rader study was conducted.

Seedling safety. Some references have been made using the salt index value of a fertilizer to indicate seedling safety, especially for direct placement with the seed. However, factors other than salt index values have a large influence on seedling safety in addition to the salt index value. For example, data from a recent three-year study in Minnesota by Randall and Vetsch illustrate that soil temperature has a major influence on seedling survival and yield in a starter fertilizer placement study for corn. Placement of a starter NPKS fertilizer in the seed zone produced no significant reduction in plant populations for two years of the three-year study when soil temperature was in the 56 to 60°F range, but reduced the population by 32.5 percent when the temperature was 48°F (Table 2).

Soil temperature, soil moisture, soil type and the potential for free ammonia formation from urea-containing materials all influence the safety of fertilizer products placed in direct seed contact.

For additional information, see the 2001 Fluid Journal article "Calculating Salt Index" at the Fluid Journal website. http://www.fluidfertilizer.com/fertilizer_article_archive.html

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