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Slow-Release and Controlled-Release Fertilizers: An Overview of the Market Today

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INTRODUCTION

Commercially available slow-release fertilizers (SRFs) are different than controlled-release fertilizers (CRFs). They differ in coating materials, characteristics of fertilizer release, longevity as influenced by temperature, hydrolysis and/or microbial activity - and unit cost compared to actual usage/longevity cost in a commercial, production setting (Figure 1). Unit cost is not the only deciding economic factor.

Slow Release Fertilizers (SRF) are Not Controlled Release Fertilizers (CRF)

- One difference is in the coating characteristics.

Slow Release	Controlled Release
Natural Organics	Resin Coated
Synthetic Organics	Polymer Coated
Polymer Coated Sulfur Coated Urea - PCSCU	

Figure 1. Slow release fertilizers (SRF) differ from controlled release fertilizers (CRF) in coating characteristics.

SLOW-RELEASE FERTILIZERS (SRFS)

The different SRFs on the market today are (1) natural organic products, such as Nature Safe and other true organic compounds; (2) synthetic organic products, such as Nitroform Blue-Chip and IBDU-Isobutylidenediurea; these break down through hydrolysis and mineralization (Figures 2 and 3).

Slow Release Fertilizers (SRF)

Slow Release	Product example	Released via
Natural Organics	Milorganite, Nature Safe	Microbial Action
Synthetic Organics	IBDU	Hydrolysis
Synthetic Organics	Nitroform, Nutralene	Mineralization
Polymer Coated Sulfur Coated Urea - PCSCU	Poly-S, XCU®	Catastrophic, rupture

Figure 2. Examples or slow release fertilizer (SRF) products and their release mechanism.

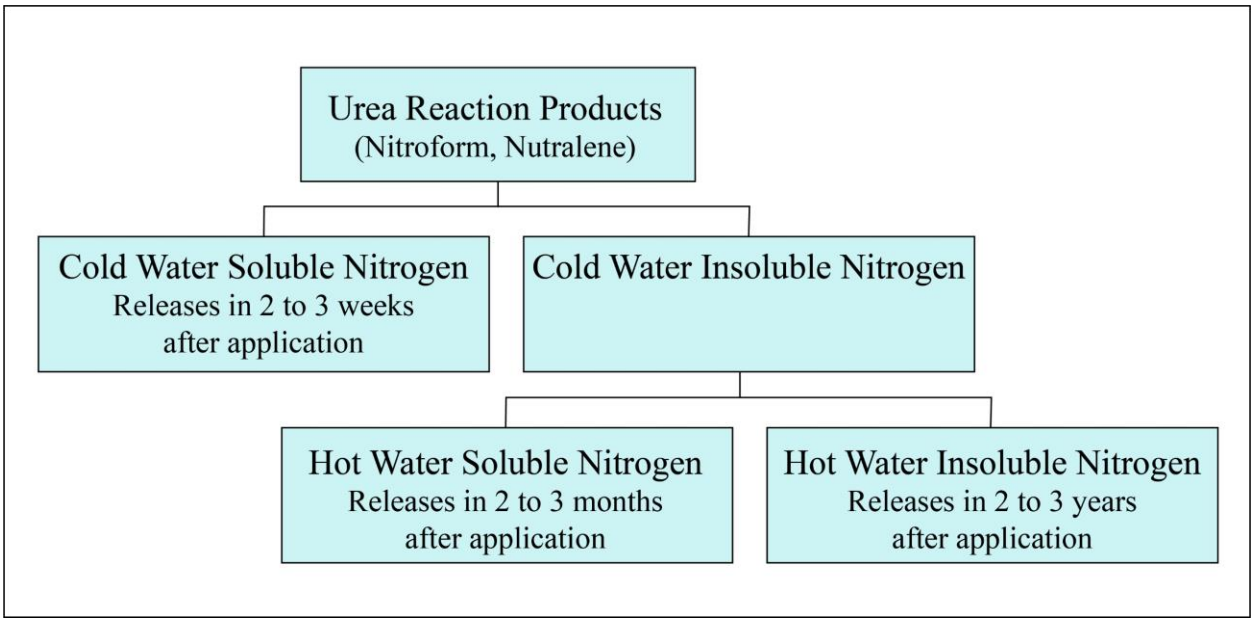
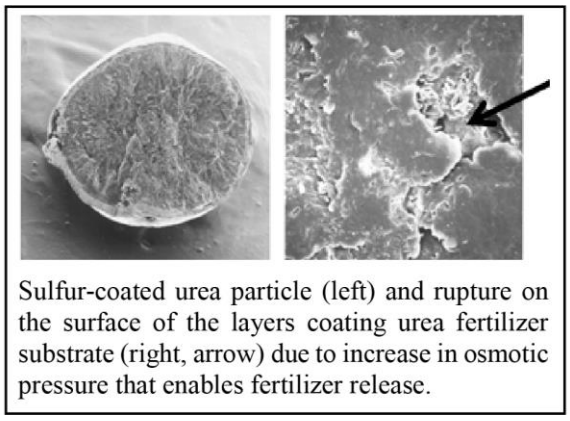


Figure 3. Fertilizer in Nitroform SRF is released through mineralization

There are also polymer coated sulfur coated urea products (PCSCU) such as Poly-S and XCU® - which release via what is known as "catastrophic release" (ruptures, cracks, fractures in the coating) (Figure 4).



Sulfur-coated urea particle (left) and rupture on the surface of the layers coating urea fertilizer substrate (right, arrow) due to increase in osmotic pressure that enables fertilizer release.

Figure 4. Fertilizer in sulfur coated urea is dispensed via catastrophic release via the rupture/ fissure in the polymer coated layers.

In summary, SRF's have no "controlled release" mechanism. They are also less efficient and are not ideal as the sole source of a fertility program. However, they are great additions in a more balanced approach to complement CRF's.

CONTROLLED-RELEASE FERTILIZERS (CRFS)

CRF's are classified into two different groups based on their coating: **resin coated** (coating comes from plant origins) or **polymer coated** (synthetic coating).

Resin coated

Osmocote® is the only true resin coated product on the market today. A resin is "any of numerous clear to translucent yellow or brown solid, or semi-solid substance of plant origin (organic or natural) such as copal, rosin, and amber used principally in lacquers, varnishes, inks, adhesives, synthetic plastics, and pharmaceuticals". It was seen as the "pioneer" of the CRF market. It was developed based on a floor varnish used in the 1940s (Figure 5). It is manufactured by ICL and releases through the process of osmosis (Figure 6). The prills swell when water enters and once it swells - it cannot contract. Fissures form in the coating, and the water/nutrient solution then exits the prills. The longevity of Osmocote® is based on the coating thickness at an average temperature

of 21°C (70°F). Higher temperatures and physical damage to the prills will speed up the fertilizer release.

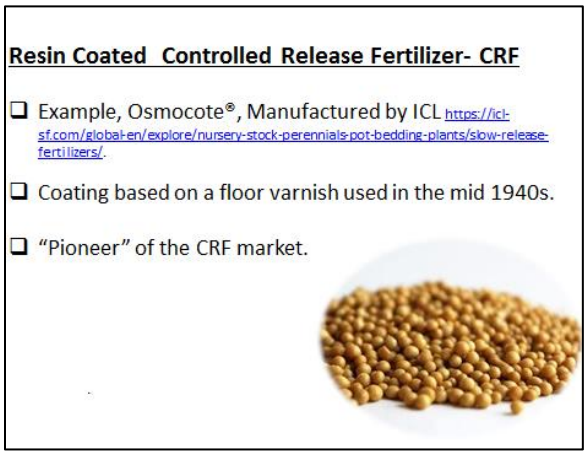


Figure 5. Osmocote® is an example of a resin coated, controlled release fertilizers (CRF).

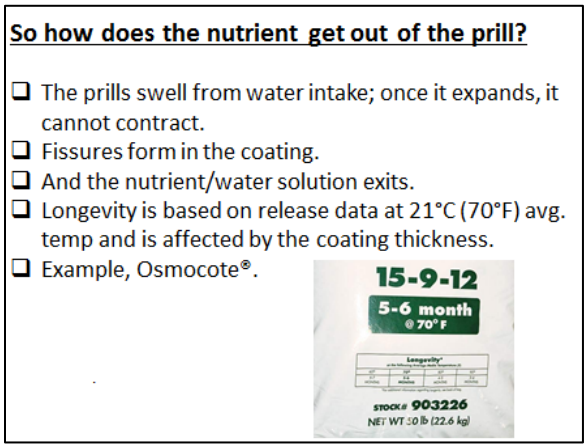


Figure 6. How does the fertilizer get out of an Osmocote® prill?

Polymer coated

Polymer coated includes coating with "any of numerous synthetic compounds of usually high molecular weight , consisting of up to millions of repeated linked units, each a relatively light and simple molecule." An example is Nutricote®, which is manufactured by JCAM in Japan. JCAM creates the raw and finished product in Japan and then ships it to the USA where Florikan® is the exclusive distributor. Nutricote® is unique in that the longevity is not based on the coating thickness; rather, it is the ratio of two polymers (with different release times) that coat the prills. This determines the fertilizer release period. The release pores of the polymers can close in cooler temperatures. The release mechanisms is via the solute concentration gradient of the two polymers coating the prill (Figure 7). The longevity of Nutricote® is based on an average temperature of 25°C (77°F).

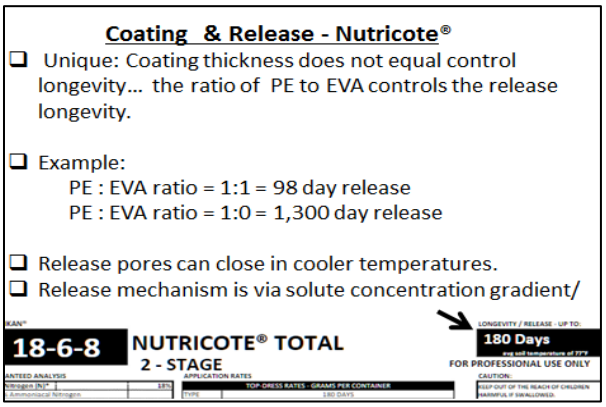


Figure 7. Coating and release characteristics of Nutricote® controlled release fertilizer (CRF).

Polyon® is the other major CRF in the market today. It is manufactured by Koch Agronomic Services in the USA and is exclusively distributed by Harrell's. Polyon® is custom blended and sold directly to the end user. The longevity of Polyon® is related to the coating thickness of the two monomers incorporated with polyurethane (Figure 8). Polyon® also releases via the solute concentration gradient, and its longevity is based on 30°C (86°F).

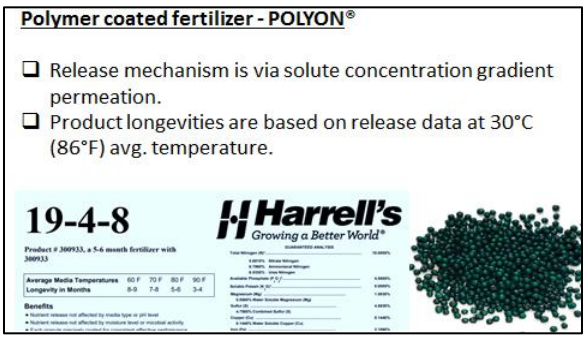


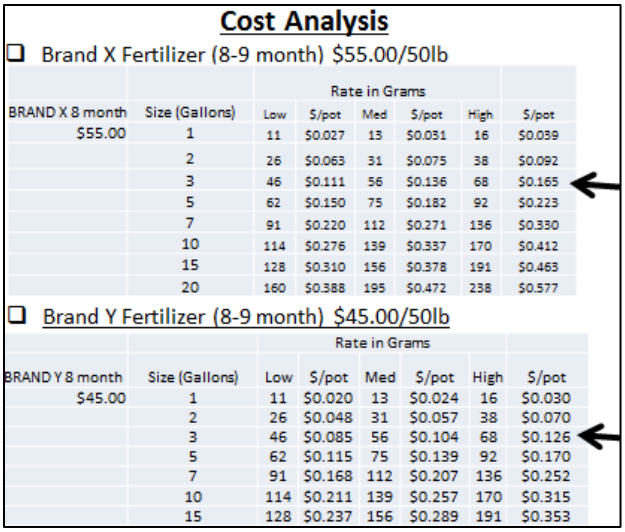
Figure 8. Polymer coated Polyon® controlled release fertilizer (CRF).

Other CRF products mentioned briefly are similar in characteristics to Polyon®. These are, as follows:

- GAL-Xe$^{ONE®}$ —formerly known as "Florikote®" that is owned by Simplot http://simplotgalxeone.com/ and sold nationwide. Release longevities are based on 38°C (100°F)
- Multicote®—Manufactured by Haifa in Israel. Release longevity is based on 21°C (70°F). Its availability is based on temperature and potassium release, not nitrogen.
- Plantacot® —longevity is based on 21°C (70°F).
- Duration®—Former Agrium product, but now is part of Koch Agronomic Sciences technology. Release data is based on 20°C (68°F).
- Purkote® —a new product from Pursell that is still under evaluation. Release data is based on 30°C (86°F).

SUMMARY

I encourage IPPS members to compare more than cost when looking at different CRF products. For instance, a $10 per 50lb bag difference in pricing only equates to $0.04 difference per 3-gal container (assuming the analysis and longevities are the same) (Figs. 9 and 10). Also, be careful to check the temperatures in which the longevities are determined. A "4 month" CRF product based on release data at 21°C (70°F) - is reduced to a "2 month" product at 30°C (86°F).



BRAND X 8 month	Size (Gallons)	Rate in Grams Low	$/pot	Med	$/pot	High	$/pot
$55.00	1	11	$0.027	13	$0.031	16	$0.039
	2	26	$0.063	31	$0.075	38	$0.092
	3	46	$0.111	56	$0.136	68	$0.165
	5	62	$0.150	75	$0.182	92	$0.223
	7	91	$0.220	112	$0.271	136	$0.330
	10	114	$0.276	139	$0.337	170	$0.412
	15	128	$0.310	156	$0.378	191	$0.463
	20	160	$0.388	195	$0.472	238	$0.577

BRAND Y 8 month	Size (Gallons)	Rate in Grams Low	$/pot	Med	$/pot	High	$/pot
$45.00	1	11	$0.020	13	$0.024	16	$0.030
	2	26	$0.048	31	$0.057	38	$0.070
	3	46	$0.085	56	$0.104	68	$0.126
	5	62	$0.115	75	$0.139	92	$0.170
	7	91	$0.168	112	$0.207	136	$0.252
	10	114	$0.211	139	$0.257	170	$0.315
	15	128	$0.237	156	$0.289	191	$0.353

Figure 9. Cost analysis of a CRFs based on unit prices

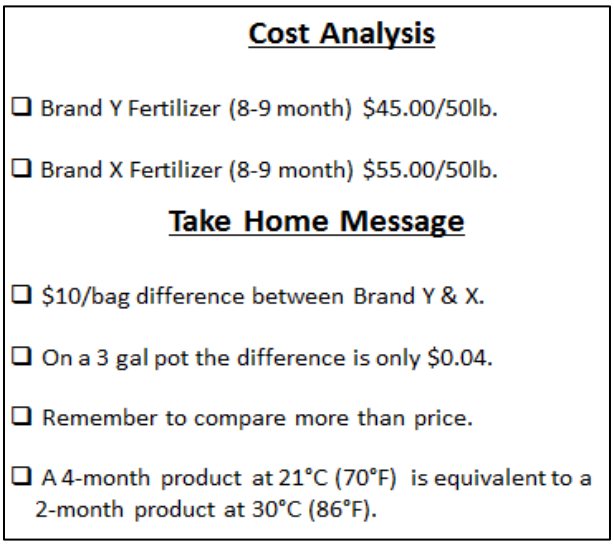


Figure 10. Factors in selecting a CRF should not be based just on the unit price – but rather the usage/ longevity cost under local, commercial production conditions.

Products

Nature Safe https://www.naturesafe.com/

Nitroform Blue-Chip https://kochturf.com/Products/SlowRelease/Nitroform/

Poly-S https://icl-sf.com/uk-en/technologies/poly-s/

XCU® https://www.greenindustrypros.com/lawn-care-renovation/product/10156380/koch-agronomic-services-kas-xcu-slowrelease-fertilizer

Osmocote® https://www.iclfertilizers.com/

Nutricote® http://www.jcam-agri.co.jp/

Florikan® https://www.florikan.com/about

Polyon® https://www.harrells.com/