Status of Control-Release Fertilizer and Propagation in the Pacific Northwest©

George Bear
Apex Professional Products, 16777 Howland Rd., Lathrop, California 95330
Email: george.bear@simplot.com

FOREWORD

This presentation will briefly detail the findings of numerous production nursery visits in Oregon, Washington and the lower mainland of British Columbia. The distance traveled focused on trials, tribulations, successes, and shortcomings of control-release fertilizers (CRFs). The thought here is to present a brief picture of the role of CRFs in nursery production in the Pacific Northwest.

INTRODUCTION

What is contained between the margins of this manuscript is clearly not a research paper. It contains neither new earth-shaking nor evolutionary ideas. What is briefly detailed is a refresher for those who treat knowledge of nutrition needs, horticultural production practices, and specific crop tolerances as a foregone conclusion. What is needed is an open discussion of what has changed in the way some production nurseries are using CRFs. There are more aspects to a controlled-release nutrient than just getting plants to market. Focusing on what cannot be seen may play a more prominent role in the near future than just plant nutrition. These "new" uses have come not from deep within the manufacturer's sterile laboratories, or the brain-child of some white-coated laboratory chemist, but rather by the "trial-and-kill" method of the true innovators in horticultural research, the humble grower.

We start with an excerpt from what I like to call "the propagators bible," by Hartmann and Kester (1983), Chapter One Verse One: "Controlled-release fertilizers may be incorporated in the medium during mixing and applied to the surface after cuttings have been stuck or seedlings have been transplanted. Whatever fertilization program is chosen, the routine monitoring of soluble salts and pH is essential. The propagator should be cautious when selecting and managing a fertilization system and should fertilize with moderation during propagation." Enough said?

The times have changed from the days of uncoated granular fertilizers being delivered in bulk trailers for acres of agricultural crops and the occasional container-grown "oddity." Now we grow a thousand different ornamental genera, species, and cultivars with advanced nutrition technology that can be pre-determined to deliver nutrients from several months to multiple growing seasons. The current group of controlled-release technologies has developed in a relatively short period of time considering that sulfur first coated urea in the mid 1900s. This one revolutionary development changed how our industry refers to fertilizer. The nutrient delivery system is now a technology that has been developing over the past half century, with variations on a theme coming in the last 10 or so years. More CRFs are coming to our shores in the next few years and, by some estimates, up to five new CRFs will be in production the next 60 months of this presentation.

These manufacturers have numerous choices when creating a product for the ornamental market. They can coat urea, phosphates, potassium, iron, and trace elements to extend the release and save nutrients inside the casing. The coating process generally starts when the particles are first coated to meet a specific longevity from 8 weeks to 24 months and more. Blenders utilizing the many combinations of ingredients and multiple longevities make up your CRF formulations.

On a side note: Although articles exist from some of the leading authorities on CRFs stating there are fertilizers that are released by time or "time released," in my limited understanding, I can't name a true "time release" fertilizer, unless they all are. I have yet to peer into the microscope and witness a molecule of nitrogen with a wrist watch! By the way, a true controlled release is when a plant can extract a specific nutrient from a micron-sized chip, when and where needed. That's a ways off. In reality there are numerous agents that affect the release of nutrients from a coated granule, time isn't one of them.

AGENTS OF CHANGE: A REVIEW

Although time is not a release agent, the following four factors can affect the release of a CRF. Which one or combination of these agents affect the release is where you get "the-devil-is-in-the-details" scenarios. The four agents of change simply stated are: (1) pH, (2) microbes, (3) water, and (4) temperature. These four are the factors that growers deal with every day, whether they acknowledge them daily or not. The "control" of a CRF comes from the management of these agents. For instance, measuring critical elements of the media, including pH and electrical conductivity (EC), is the first and foremost tool in managing an efficient production system. Healthy plant life lives in a very narrow balance between acid and base. Establishing an initial pH in a soilless media is the easy part. Keeping the pH within an optimum growing range is sometimes a never-ending battle. Most of the current technologies do not rely on pH as a release agent. However, the over or under availability of any one nutrient can greatly affect the complex mineral web. Microbial activity is affected by pH, water, and temperature. We tend to think of microbes as being more heavily influenced by temperature. Microbial activity increases as temperature warms and visa versa. As you know the conversion of urea to a usable from of nitrogen (ammonium and nitrate) is converted based mainly on temperature. Growers understand this relationship when planning a total fertilization program that includes a planting date and a ready date. For CRF planning, be sure to include after production values, such as shelf life plus box-store guarantees, when establishing total nitrogen needed in the spring, summer, fall, and winter production cycles.

Third and probably the greatest "affector" of nutrient efficacy is water. Water as "the new oil" is the new mantra. Water and CRF are integral in the need to: (1) be absorbed by the mineral element inside the coating, (2) move the nutrient out of the casing, (3) carry the nutrients as plant uptake only takes place in a soil solution, and (4) flush high level of salts from the root zone when the release of the CRF is greater that the capacity of plant uptake. Couple this variable with the next factor and you have a three dimensional chess game.

Temperature is the great divider of CRFs, all other things equal. Control-release fertilizer technologies vary in this aspect and are affected differently by temperatures under 40 °F, when plant activity is slower. However, as of this writing there is no technology that "shuts down" when the plant respiration goes into survival mode and "shuts down" at high temperatures (over 95 °F).

What affects the release of a CRF and why should I care?

Understanding the control mechanism(s) that influences the release of a CRF is as important as any of the chemistries in a grower's production regimen. Growers that educate themselves and their irrigation crews about the numerous active ingredients of numerous chemistries will also understand that "not all CRFs are created equal" either. The following four physical properties contain the key to understanding the release of a CRF and how that release affects plant growth, your irrigation practices, and most importantly, your ability to affect production turns hereby saving production costs.

THE FOUR CONTROLS OF CR FERTILIZERS

The four controls are: (1) coating thickness, (2) moisture, (3) mineral solubility, and (4) temperature. The coating or the layers that insulate the substrate (basic fertilizer pellet) from immediately dissolving is where the technology is most evident. What to coat and "how much" to coat is the science. The blending of these components, both coated and uncoated, is where the art resides. The trouble starts with an imbalance of any one of these four factors.

The reason is that salts are hydroscopic. The pellets attract water molecules across the coating membrane and inside the coating. Normally the time taken for a water molecule to travel twice the coating thickness will, in most cases, indicate the time of the first detectable controlled release of the coated pellet. The fragility of the coating, however, is a variable that will change this axiom. Rough-handled CRFs can produce higher than needed up-front salt levels. Product handling and the mechanics used to blend the CRF with the media will give some indication of what to expect from the first several watering cycles. The fact that the initial EC can set a crop back by root injury and root necrosis should warrant special attention in the first 14 days after application. The need to regenerate roots is "lost time" and lost dollars as well.

TIPS FOR "NEW" USERS OF CONTROLLED-RELEASE FERTILIZERS

Trial Small to Fail Small. This is an obvious rule that most of us forget about because of a million other reasons. Overlook this and put a million units at risk. Small and well-controlled trial plots give the same results. Start with lower label rates and look for leaf and root tip-burn as a sign of "an over-eager early release" of ammonium and/or total salts. This can occur in warm temperatures when urea is rapidly converted to ammonium and a larger than normal amount of broken or uncoated pellets in the mix. Also remember that the media you are using has a natural charge of nutrients that may have variable levels of P, K, and micronutrients, especially manganese in Douglas-fir bark.

When Less Is More. There has been research that concludes that beyond a certain level there is an inverse relationship between root generation and increased nitrogen levels in the soil solution. In other words more nitrogen does not necessarily grow more roots. Be careful to monitor leaching after the first few irrigation cycles to ensure a "low" level of nitrogen is present in the soil solution in the first days before and after root initiation.

Technology and Ecology. There are now numerous CRF manufacturers and each manufactured CRF has its own unique limitations, release patterns, and properties. Do your homework with your supplier's input and work through the process of matching a CRF for your specific propagation and production needs. If leaching fractions are over 50% (some have stated that leaching fractions in the valley can hit highs in the 100%–200% range) you are losing nutrients and money is flowing out the bottom of every pot. The grower who has a handle on when and how much to leach will pollute less, grow a better looking plant, and save money while doing so. Note that technologies for monitoring the EC combined with evapotranspiration coeffients, plant weight, and heat units are the up-and-coming focus of the average grower interested in saving dollars on their CRF applications.

Think "Outside the Bag." How do you compare one coated fertilizer to all the others? Ask your supplier to assist in reading and understanding how the individual ingredients named in the "derived from" portion of the bag will affect your production schedules and secure a firm understanding of how the coating reacts to temperature (both high and low). This basic information will go hand-in-hand with temperature forecasts for high temperatures or an "unseasonable" cool spell. Regulate the ppm of your fertigation program accordingly to save even more on plant inputs.

Think "Inside the Bag." The grower should ask "What is really inside the bag?" and "How do I know how much is needed to promote controlled plant growth?" The term "longevity" was added to our fertilizer vocabulary after sulfur-coated urea was introduced. With that one revolutionary product came the need to rethink what the numbers on a bag of fertilizer really mean when the bag contains "technology." The percentage of NPK included on the front of the bag says nothing about the longevity of individual components. The grower needs to make fact-based decisions using a working knowledge of how a particular CRF will impact production.

CONCLUDING COMMENTS

The three numbers represent total nitrogen (N), phosphorus (P), potassium (K), and the percent of each macronutrient in the bag. When fertilizers do not have a coating and the average duration is measured in days and weeks then that information is all that is needed. With the advancement of coating technologies available to nursery growers and propagators the dialogue has changed. When "how long will it last?" is added to the fertilizer equation, the numbers on the bag lose something in translation. This is when longevity becomes a concern. Manufacturers coat many combinations of minerals and each blended combination will result in different release patterns of the nitrogen, phosphorus, and potassium. Inquire about the release of each of the individual components.

When incorporating a CRF into your overall nutrient program remember your end customer in answering the question "just how long do I want my CRF to last?" A little longer won't hurt your reputation when that petunia or arborvitae has a little "extra kick" at out-planting into that "just perfect" garden spot.

Finally, pH, microbial activity, irrigation, and temperature combine with coating thickness, moisture, substrate solubility, and temperature to give a complex equation for understanding CRF and crop production. The grower can improve the probability of plant uptake and increased efficacy of plant nutrients by monitoring the release of CRFs. Therefore, vigilance combined with a mean sense of regularity is the key to understanding how to affect healthy plant growth and capture CRF in the plant and avoid cost overruns. As water flows from a ubiquitous commodity to priceless as liquid gold, be an advocate for leachate monitoring and watering less to save more water and keep potential groundwater "pollutants" in the pot where they do the most good.

Thank you once again to the I.P.P.S. Western Region committee for inviting me to share my travels. Special thanks to the following nurseries and their managers who shared their experiences with control release fertilizers: Briggs Nursery, Ball Nursery, Fisher Farms, Monrovia, Zelenka West, Kraemer's Nursery, and Woodburn Nursery and Azaleas.

LITERATURE CITED

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