ABSTRACT SUMMARY
Coating technologies have been applied in numerous capacities in agriculture and aquaculture systems. Applications include controlled or improved seed germination, controlled delivery of pesticides, fungicides, and the like, improved seed handling capabilities, controlled fertilizer release, and cleanup operations. This presentation takes a look back at selected applications of controlled release in these areas ~30+ years ago to give a sense of the application scope and problems that were solved. This information coupled with knowledge of current problems and technology can help address current concerns.

INTRODUCTION
Agriculture and aquaculture systems are vital to human survival. Mankind has learned to cultivate and optimize production from these systems to help meet needs of a growing populace. Optimization includes many factors including nutrient availability, pest and disease control, germination factors, and seed conservation. Coating and controlled release technology is involved in many optimization strategies. Selected historical applications are presented in this presentation.

EXPERIMENTAL METHODS
The applications summarized in this presentation involve pan and fluid bed film coating technologies. Film coating allows tremendous flexibility to optimize coating formulations to achieve a desired property. Some applications involve older non-vented pan technology that may still be viable in today’s cost structures. Others involve more efficient vented-pan coating. Fluid bed technology may involve Wurster (bottom spray), top spray, or tangential spray coating systems. Product evaluation procedures commonly involve lab characterization, lab performance tests, and field trials.

DISCUSSION
Sulfur coated urea fertilizer resulted from 15 years of development work on controlled release nitrogen fertilizers at the Tennessee Valley Authority (TVA). Early work involved study of potential materials with naturally controlled release properties including oxamide, glycouril, cyanuric acid, ammeline, and ammelide. None of these proved to be commercially viable, which led to work with elemental sulfur coatings on urea. Application strategies included dipping in molten sulfur and spray from carbon disulfide or ammonia vehicles. Eventually a continuous process consisting of rotating drums and sprayed on molten sulfur followed by a top coat sealant and dusting proved most viable. A final product composed of a large, spherical urea particle with 14% sulfur coating, 2% wax sealant, and 2% diatomaceous earth dusting was reported. Sulfur coated urea initially proved to have greatest advantage in rice, sugarcane, pineapples, forage, turf, and some fruit and vegetable crops.
Warfarin® blood anticoagulant was identified and studied at the University of Wisconsin in the 1930s and -40s. Its high toxicity to rodents was quickly recognized, but administration as a rodenticide was a challenge due to the natural taste aversion. As the Wurster fluid bed process became available through the 1950s and -60s, application of a “taste mask” coating that could hide the taste, but also release contents in the gut became viable. The keys to success included masking of odor and taste, small particle size to avoid rupture in the mouth, stability under processing temperatures and pressures of bait manufacturing, and release in the stomach.

Fast release Fintrol® products were developed to selectively control fish populations. Antimycin was incorporated into these products to release at required water depths. Fintrol 5 was designed to kill within the top five feet of water depth.

Baylucide® lampracide was developed to control sea lamprey in the Great Lakes. The pesticide is based on lampracide broadcasting over larval beds where it drops to the sediments and releases toxin. The targeted concentration at the sediment surface is adequate to kill larvae, but as it dilutes in the surrounding water, it is harmless to other organisms.

The Baylucide® product concept was also applied to purging snails from spent commercial fish ponds. Its efficacy was so superior to current non-controlled release applications that clients were convinced another undisclosed chemical entity was being used and canceled further interest.

Polyvinyl chloride, polyvinylidene chloride, and other resins were coated on cotton seeds with a systemic insecticide (Di-Syston) to control aphids in maturing plants. Presence of the insecticide extended protection by up to ~1.5 weeks compared to uncoated seeds.

Onion seeds were coated with a Benomyl coat formulation to control the white rot pathogen, Sclerotium cepivorum, on onion. Excessive amounts of coating reduced germination, but effective control was evident.

REFERENCES
Internal records, Coating Place, Inc.