QUINCLORAC EFFICACY AS AFFECTED BY SURFACTANTS, NITROGEN FERTILIZERS, AND pH. Zenon Woznica, John D. Nalewaja, and Calvin G. Messersmith, Visiting Scientist and Professors, Department of Plant Sciences, North Dakota State University, Fargo, ND 58105.

Quinclorac applied postemergence requires an adjuvant for efficacy. However, adjuvants may differ in effectiveness depending on chemistry, molecular size, hydrophilic/lipophilic properties, and other characteristics. Quinclorac is a quinolinecarboxylic acid and, similar to other acid-type herbicides, may be antagonized by salts present in the spray carrier.

Laboratory and greenhouse experiments (25±5 C, 50±10% RH) were conducted to determine quinclorac efficacy as influenced by nonionic surfactants, methylated seed oil (MSO), spray mixture pH, salts present in spray carrier, spray deposit characteristics, and absorption. Quinclorac at 105 g ai/ha was applied to 3-4 leaf green foxtail in 80 L/ha. Surfactants tested at 0.25% w/v were linear alcohol ethoxylates (LAE) with different chain lengths of 8 to 10, 12 to 14, and 16 to 18 carbons and 40, 60, and 80% ethoxylation. In a separate experiment, quinclorac was applied with a block copolymer nonionic surfactant (Pluronic® P-104) at 0.25% (w/v) and MSO at 1% (v/v) in distilled water, water containing sodium bicarbonate (500 mg Na^+/L) and calcium chloride (250 mg Ca^{2+}/L), and in two natural hard waters. Treatments were applied with and without 0.5% (w/v) ammonium sulfate, 0.5% (w/v) ammonium nitrate, 0.5% (w/v) urea, and 1% (v/v) 28% N (liquid ammonium nitrate/urea fertilizer). Quinclorac was applied in distilled water (unbuffered pH 2.6), distilled water plus 0.16% (v/v) triethanolamine (TEA) (buffered pH 7.3), and with various natural waters. Scanning electron micrographs (SEM) of quinclorac spray deposits with and without selected LAE surfactants were taken at 650X magnification 2-3 h after application. ^{14}C-quinclorac absorption was determined 24 h after application.

Quinclorac efficacy to green foxtail generally increased as alcohol chain length and percentage ethoxylation of LAE surfactants increased. Regardless of LAE surfactants, quinclorac phytotoxicity to green foxtail was nearly doubled from 40% to 76% when the spray mixture pH was increased from 2.6 to 7.3 by inclusion of TEA. Enhanced phytotoxicity and absorption by LAE surfactants related to close contact of the spray deposit to the cuticle and enhanced quinclorac solubility by high pH. Sodium and calcium ions strongly antagonized quinclorac efficacy when applied with a block copolymer surfactant and MSO. Ammonium sulfate or ammonium nitrate adjuvants were more effective than 28% N fertilizer in overcoming sodium and calcium antagonism of quinclorac. However, all nitrogen fertilizers equally overcame the antagonistic effect from ions present in natural well waters. These data demonstrate the potential for optimizing postemergence quinclorac efficacy by carefully selecting surfactant chemistry, surfactant hydrophilic/lipophilic balance, addition of proper nitrogen fertilizer, and by regulating pH of the spray mixture.