CHAPTER FIVE

SUMMARY AND CONCLUSIONS

The results of these studies showed that quinclorac herbicide has some very unique properties. It has not as yet been classified into a current, particular herbicide action or structural group. It is considered to belong to a new class of highly specific auxin-like herbicides (4). Quinclorac causes auxin-like symptomology in susceptible broadleaf species, but also causes chlorosis and necrosis in sensitive grass species (4). The findings of this research project reconfirmed these effects on sensitive broadleaf species such as cleavers and sensitive grasses such as large crabgrass.

Results of the adjuvant studies showed that species differed in their sensitivity to the herbicide and the use of quinclorac required the use of an effective adjuvant. As far as ranking of sensitivity to quinclorac the findings suggested that cleavers > annual sowthistle > large crabgrass > goosegrass. Across evaluated species, little difference was observed on the effectiveness of the evaluated adjuvants. The only noted exception where an adjuvant failed to provide comparable control with other materials tested, was in the case of Sylgard 309 applied to large crabgrass.
Goosegrass was found to be very tolerant to quinclorac regardless of adjuvant or stage of growth treated. The stage of growth studies did show that the one to two-leaf stage was the most sensitive stage to quinclorac. However, even at the one to two-leaf stage, the GR50 value was well above the labeled rates. The goosegrass studies also suggested that root uptake was a key component in the performance of quinclorac.

The 14C absorption studies showed that after 80 hr of exposure, both large crabgrass and goosegrass absorbed over 20% of the applied herbicide. These data suggested that the quantity of quinclorac absorbed was not a causal factor in the difference observed in sensitivity. The translocation results showed that in both weed species, most of the applied 14C-quinclorac remained in the treated leaf; however, the amount translocated out of the leaf was greater with goosegrass than large crabgrass. The translocation of 14C-quinclorac was primarily into the meristematic regions of tillers and the crown and new leaf tissue. Dilution of herbicides by plants has been suggested as a mechanism used by plants to avoid or reduce phytotoxic effects from herbicides (3). Results also showed that goosegrass did not exudate any appreciable amount of 14C-quinclorac which had been found to be a key tolerance mechanism in species such as rice (1) and Kentucky bluegrass (3).

Spray retention results showed that goosegrass actually retained more herbicide than large crabgrass.
These results ruled out the role of retention as a possible mechanism of differential tolerance of the two species.

The detached shoot study results suggested that some modifications in the leading proposed models of the mode of action of quinclorac may be necessary. In these tests, we were able to induce the phytotoxic effects of quinclorac to both large crabgrass and goosegrass. Grossmann's model suggested that quinclorac stimulates ACC synthase in root tissue and the subsequent ACC is then transported to the shoot (4,5,6,7). Since the roots were excised immediately after application, how then were the phytotoxic effects induced? Another question posed was why were we able to induce an effect to the shoots of a sensitive species (large crabgrass) and Grossmann was unable in his evaluations with sensitive barnyardgrass? Our results with detached large crabgrass plants suggested that ACC synthase may also be stimulated in leaf tissue as well.

The results observed with applied ACC suggested that one could mimic the effects of quinclorac to large crabgrass. This observation supported the proposed model put forth by Grossmann on the mode of action (4). However, the lack of observable response in goosegrass suggested that tolerant species may employ other physiological pathways to avoid the phytotoxic effects of quinclorac. Also, the endogenous concentration of ACC may have to be much higher in goosegrass for the reaction sequence to ethylene and HCN to be triggered.
In goosegrass, one could also speculate that if ACC synthase is stimulated and subsequent ACC produced, the plant employs other metabolic pathways for ACC, other than to ethylene and HCN. Conversion to MACC as described by Peiser et al. (8) may be a main alternate pathway.

The results of this research suggested that further work needs to be conducted to ascertain the specific mechanisms that goosegrass employs to avoid the phytotoxic effects of quinclorac. Suggested areas of investigation include: 1) Evaluate the effects of applied KCN to see as with Grossmann's work on large crabgrass (4), if one can induce symptomology? It is possible that goosegrass can tolerate higher free levels of HCN or has a very efficient $\beta$-cyanalanine synthase to detoxify HCN, 2) Evaluate the effects of inhibitors of $\beta$-cyanalanine synthase that are discussed in the literature and observe the effects of applied quinclorac to goosegrass (8,9) and 3) As an indirect effect, one should evaluate the endogenous concentrations and species capacity to synthesize the amino acid cysteine, which is the main substrate to which $\beta$-cyanalanine synthase acts to capture free HCN (2).


