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MEDICAL AND AGRICULTURAL IMPORTANCE OF RED IMPORTED FIRE ANT

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The red imported fire ant (RIFA), *Solenopsis invicta* Buren, currently inhabits over 90 million hectares in 9 southern states from Texas to North Carolina. In all of these states, the RIFA has been the target of chemical eradication or wide-area control programs. Attempts to eliminate the RIFA have been controversial because of the nontarget impacts of the pesticides used but also because control programs were initiated before the economic importance of the RIFA was thoroughly evaluated. The economic estimates of losses or damage are often based on surveys or extrapolated from the limited published information that is available. Therefore, we will only review investigations published in scientific journals. The mass of unpublished information that has accumulated has been reviewed by Lofgren et al. (1975) and more recently by Canter (1981).

Medical Impacts

The effects of the RIFA on human health can be conveniently reviewed in the context of several questions posed by Canter (1981).

What are the individual adverse health effects produced by contact with RIFA? Envenomization by the RIFA produces an array of reactions in people. (1) Some people experience irritation and the formation of a pustule at the site of the sting (Lockey 1974, Brown 1972, Caro et al. 1978). The pustule is regarded by Rhoades et al. (1977) as an adequate diagnostic character for RIFA stings. (2) An infection may occur if the pustule is broken open. Triplett (1976) surveyed some physicians in Mississippi, Georgia and Alabama and found that a majority of their patients were treated for secondary infections, but a few required skin grafts and some required amputation of a limb. (3) Some people suffer systemic allergic reactions when stung by the RIFA (Lockley 1974, Rhoades et al. 1977). (4) Mortality of some hypersensitive people has apparently occurred. Lockley (1974) lists 5 deaths that are attributed to RIFA stinging episodes.

What percentage of the population in areas infested by the RIFA is affected? The epidemiology of fire ant stinging episodes is difficult to assess because fire ant stings are not routinely reported to local or state health departments. Rhoades et al. (1977) surveyed allergists in Jacksonville, Florida, and found that the rate of systemic allergic reactions among the population to approximate 3.8 people/100,000 per year. In Louisiana, a telephone survey of 240 families conducted by Clemmer and Serfling (1975) revealed that 28.6% experienced stings in summer months, 17.0% experienced localized reactions while 4.4% sought medical assistance. Yeager (1978) attempted to characterize the impact of the RIFA on human health in a more systematic fashion. A sample of 156 families in Lowndes County, Georgia, was contacted on a regular basis regarding stinging episodes. Of the 483 persons interviewed, 4.5% reported reactions severe enough to require medical assistance and overall, 13.8% reported being stung at least once. Results of a similar survey were reported by Adams and Lofgren (1981) for 62 family units (254 people) in Sumter County, Georgia. Approximately 31% of the participants suffered at least 1 sting. Both Yeager (1978) and Adams and Lofgren (1981) found that the majority of stinging episodes occurred from March-September which coincided with the seasonal activity cycles of the RIFA and people. A greater percentage of rural residents reported being stung versus urban residents.

What is the frequency of stings from the RIFA relative to other venomous arthropods? This is a very difficult question to address because of the failure of health departments and physicians to report singing episodes or to accurately identify the arthropods involved. The survey conducted by Adams and Lofgren (1982) at Ft. Stewart, Georgia appears to be the only investigation available. The relative frequency of stings and bites from venomous anthropods was determined from questionnaires filled out by outpatients at dispensaries and hospital emergency rooms. Of 329 patients, 161 (49%) were treated for RIFA stings, 83 (25%) sought treatment for envenomization from a variety of other arthropods (wasps, bees, ticks, spiders, mosquitoes and chiggers) and 85 (26%) could not identify the arthropod involved.

What is the value of the discomfort and/or inconvenience or the cost of

medical treatment? Triplett (1976) reported the cost of treatment of 12,438 patients stung by the RIFA in Georgia, Alabama and Mississippi to be $352,273. Adams and Lofgren (1982) projected a cost of $5,070 for 161 people who sought treatment for RIFA stings at medical facilities at Ft. Stewart, Georgia. Lockley (1980) estimated the cost of desensitizing hypersensitive people to RIFA venom to be $16/day per individual.

The cost of the inconvenience and the limitation of outdoor activities resulting from contact with the RIFA has apparently not been quantified.

Agricultural Impacts

The literature largely encompasses the impacts of the RIFA on field crops. Lyle and Fortune (1948) observed fire ants eating the germ out of sprouting corn and subsequently, Glancey et al. (1979) reported the loss of a field of corn in Mississippi to depredation of the seedlings by the RIFA. Estimates of the loss based on the projected value of the crop ranged from $4,000-10,000.

Hunt (1976) reported survey results for soybean farmers from several coastal counties in North Carolina. Combine skips over RIFA mounts, resulting in unharvested seeds, was cited as a major problem resulting from RIFA infestations in soybean fields. Adams et al. (1976, 1977) established that in some Georgia and North Carolina soybean fields from 16.6 to 47.6 kg/ha of soybeans remained unharvested because farmers raised the cutter bar on their combines to avoid impacting RIFA mounds. Losses were estimated at $6-12.35/ha. Lofgren and Adams (1981) reported soybean seed yield data for several RIFA-infested farm fields in Georgia and North Carolina. Fields heavily infested (49-176 mounds/ha) were found to yield less soybeans than lightly infested (1.0-19 mounds/ha) fields. Differences in seed yields ranged from 1.7 to 7.2 hl/ha and averaged 5.1 hl/ha or 14.5%. In a more carefully controlled experiment using paired plots, Lofgren and Adams (1981) found a significant difference in number of pods per plant ($P = 0.05$) and weight of seeds per plant ($P = 0.1$) and an overall reduction of ca. 15% in average seed yield per plant in ant-free versus ant-infested plots. Apperson and Powell (1983) reported results of soybean yield experiments conducted over a 2 year period in North Carolina farm fields infested with the RIFA. Agronomic and environmental variables known to influence soybean seed yield were measured. Many parameters were significantly ($P \leq 0.05$) correlated with seed yield, but the RIFA was one of the only parameters for which a significant negative correlation coefficient was found in both years of experimentation. The RIFA was found to contribute significantly to multiple regression models developed to explain observed variations in soybean seed yields. Apperson and Powell (1983) concluded that the RIFA can contribute to declines in soybean seed yields.

Herzog et al. (1976) showed that RIFA infestations increased the nutrient content of soil associated with the ant mound. These results were confirmed by Blust et al. (1982a) with the additional finding that the increased fertility did not significantly increase the overall fertility of the surrounding area. Blust et al. (1982b) investigated the impacts of the RIFA on the yield and quality of pasture grasses in Louisiana and concluded that the RIFA ". . . did not affect ($P < 0.05$) yield or quality of the forage produced."

In experiments conducted by Campbell (1974), the RIFA destroyed 32.8% of germinated long leaf pine seedlings. The significance of these findings cannot be evaluated since the value of the loss was not quantified and corroborative investigations have not been subsequently published. Wilkinson and Chellman (1979) observed the RIFA to attend pine tortoise scale, *Toumeyella parvicornis* (Ckll.), that infested slash pine trees in north Florida. Heavily infested trees were found to be significantly ($P < 0.01$) shorter than uninfested trees. This scale outbreak appears to be an isolated incident because subsequent surveys failed to detect similar scale infestations.

Investigations of the predation of the RIFA on pest arthropods are too numerous to review. Only a few of these investigations have substantiated the implied impact of RIFA predation on crop yields or pest damage. Reagan et al. (1972) used a chemical exclusion technique to investigate the impact of the RIFA and other predators on abundance of sugarcane borer, *Diatraea saccharalis* (F.) and damage to cane stalks. A single treatment with mirex caused infestations and damage to increase by 53% and 69%, respectively. Another notable example of the beneficial impact of the RIFA is the investigation conducted by Jones and Sterling (1979) of predation by the RIFA on boll weevil, *Anthonomus grandis* Boheman, larvae. Damage to cotton squares never exceeded 17% in RIFA infested plots while in RIFA-free plots damage approached 39%.

Conclusions

Medical Impacts. The published investigations reviewed indicate that while a large portion of the rural population in RIFA-infested areas may be stung by the RIFA, only a small percent of the population is at risk in a "life-threatening" sense. Triplett (1976) concluded that additional data on the ". . . frequency of stings, morbidity and mortality produced . . ." is sorely needed before the RIFA can be labeled as a threat to public health in the southern region that the RIFA now infests. Although considerably more information is now available than when Triplett (1976) made this statement, we believe his statement still to be pertinent at this time.

Agricultural Impacts. The agricultural impacts of the RIFA are also difficult to evaluate. In our opinion, the deleterious and beneficial impacts of the RIFA have not been demonstrated adequately to support any conclusions about its significance as an agricultural insect on a regional basis at this time.

Recommendations

Certainly additional investigations must be conducted. Efforts must be made to coordinate research on a regional basis so that some conclusions on the regional significance of this insect can be formulated. Some specific projects come to mind.

1.) Additional investigations of the frequency and consequences of stinging episodes are needed to clarify the significance of the RIFA as a threat to public health.

2.) More comparative surveys on the incidence of stings from the RIFA and other venomous arthropods should be conducted to bring the RIFA into

perspective as a detriment to human health relative to other venomous arthropods.

3.) The costs of treatment of the morbidity, of the mortality and of the desensitization of hyperallergic people should be studied to provide information for economic analyses of the benefits derived from RIFA control efforts.

4.) The beneficial impact on crop yield of RIFA predation on arthropod pests of agricultural crops of regional significance should be researched to determine its role as a beneficial species in the agro-ecosystem.

5.) Likewise, the deleterious impact on crop yield of RIFA depredation of seedlings or damage to the roots or other parts of plants should be investigated so that its importance as a pest species can be ascertained.

There are many more projects that could be mentioned; however, we believe that these will serve to illustrate that future research efforts must be coordinated on a regional basis and that a more holistic and multidisciplinary approach must be taken if we are ever going to "come to grips" with the "fire ant problem."

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THE PHYSIOLOGY OF THE IMPORTED FIRE ANT REVISITED

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Our understanding of the physiology of the IFA has improved since the last review of the subject (Vinson 1978). However, there are still many