Effects of Insecticidal Placement on Non-Target Arthropods in the Peanut Ecosystem[1]

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ABSTRACT

Three methods of applying insecticides to irrigated peanuts for soil insect suppression were compared to evaluate their impact on non-target arthropods. Insecticides were applied as basal directed sprays, broadcast sprays and granules. D-vac suction samples were utilized to compare population densities of non-target arthropods at regular intervals after insecticide application. All application methods showed immediate reductions in most non-target arthropod populations. Granular insecticide applications had the least detrimental impact on non-target arthropods and broadcast sprays the greatest.

Peanuts in the Southwest are attacked by numerous injurious and potentially injurious insects and mites. Those most commonly encountered include: lesser cornstalk borer, *Elasmopalpus lignosellus* (Zeller); tobacco thrips, *Frankliniella fusca* (Hinds); western flower thrips, *F. occidentalis* (Pergande); corn earworm, *Heliothis zea* (Boddie); tobacco budworm, *H. virescens* (Fabricius); granulate cutworm, *Feltia subterranea* (Fabricius); yellowstriped armyworm, *Spodoptera ornithogalli* (Guenee); beet armyworm, *S. exigua* (Hubner); fall armyworm, *S. frugiperda* (J. E. Smith); rednecked peanutworm, *Stegasta bosqueella* (Chambers); threecornered alfalfa hop per, *Spissistilus festinus* (Say); southern corn rootworm, *Diabrotica undecimpunctata howardi* Barber; saltmarsh caterpillar, *Estigmene acrea* (Drury); velvetbean caterpillar, *Anticarsia gemmatalis* Hubner; green cloverworm, *Plathypena scabra* (Fabricius); cabbage looper, *Trichoplusia ni* (Hubner); potato leafhopper, *Empoasca fabae* (Harris); cotton square borer, *Strymon melinus* (Hubner); 3 burrowing stink bugs, *Pangaeus bilineatus* (Say), *P. congruus* (Uhler), *Cyrtomenus ciliatus* (Palisot de Beauvois); carmine spider mite, *Tetranychus cinnabarinus* (Boisduval; desert spider mite, *T. desertorum* Banks; twospotted spider mite, *T. urticae* Koch; and several unidentified aphids, webworms, wireworms, leafminers, grasshoppers, flea beetles, stink bugs, white grubs, armyworms and loopers.

These phytophagous arthropods and their associated natural enemies occupy 2 distinct ecological habitats in the peanut agroecosystem; soil and vegetation. Eighty percent of the injurious or potentially injurious arthropods reside on the plant vegetation with the remaining balance residing in the soil. The major insect pest, the lesser cornstalk borer, (King *et al.* 1961, Smith *et al.* 1975, Walton *et al.* 1964) is soil inhabitating. *P. bilineatus* a regional major pest restricted to the southern area of Texas (Smith and Pitts 1974) also resides in the soil. The remaining arthropod species are economically classified as occasional or potential pests because they usually exist at population densities below economic injury levels.

Natural biological control is usually sufficent in maintaining the foliage consuming pests below economically damaging levels. The egg and early larval stages of the foliage feeding lepidopterous complex oftentimes occur at high densities. However, predation, parasitism and microbial infection drastically reduce such populations prior to development of the more voracious feeding latter instars (Sears and Smith 1975; Sears unpublished data).

Heavy use of non-selective, broad spectrum insecticides can create ecological imbalances which destroy effective natural control. This condition was exemplified in Texas when peanut producers practiced a lesser cornstalk borer moth control program based on prophylactic aerial application of insecticides on 5, 7, and 10 day intervals during 1969-1970. Plant defoliation by lepidopterous larvae became an economic problem. Spider mites, previously innocuous (King *et al.* 1961), caused widespread damage and often completely killed large areas within fields or entire fields as large as ca. 200 acres. These new acarine pests identified as carmine and twospotted spider mites were previously unreported from peanuts in the Southwest. Both spider mite species were found to be resistant to all insecticides labeled for use on peanuts when prophylactic use of organophosphorous insecticides preceded mite infestation. Thus within one year several new target pests emerged and the insecticide load on the peanut ecosystem increased.

These developments dictated an approach to soil insect control on peanuts that would be selective for the target organisms and conserve natural enemies for suppression of foliage feeders. Smith and Pitts 1974, Smith et al. 1975, developed a successful technique for soil insect control by applying granular insecticides to irrigated peanuts and a basal directed insectidical spray to non-irrigated peanuts. These techniques apply the insecticide in the soil habitat of the target pest and minimize direct insecticidal exposure to the non-target foliage arthropods. Such application techniques were postulated to conserve natural enemies of foliage feeding pests. Investigations were undertaken in 1972 and 1973 to ascertain the effects of these insecticidal application techniques on non-target foliage residents on peanuts.

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Materials and Methods

Insecticidal Application Techniques — Insecticides were applied as basal directed sprays placing one, 80° flat fan nozzle on each side of the row directing the spray at the soil surface and lower stems and leaves of the plant. The nozzles were tilted 45° from the horizontal plane to further control the basal spray. Only non-irrigated peanuts received basal directed spray applications. Broadcast applications were applied similar to conventional foliar applications using 2 nozzles per row applied over the top of the foliage. All spray applications were applied at 40 psi and 20 gallons total spray per acre. Granules were applied over the row and sifted through the foliage and formed a 25-30 cm band on the soil surface. For irrigated fields the granules were incorporated with a 2-acre-in irrigation within 24 hrs. Insecticides applied included parathion, Sevimol^R, carbaryl, Dyfonate^R (O-ethyl S-phenyl ethyl phosphorothioate), and Dasanit^R (O, O-Diethyl O- P-(methylsulfinyl) phosphorothioate). Dasanit formulations were spray concentrates or 15% granules applied at rates of 1.0 and 2.0 lbs. actual insecticide per acre (AI/A) respectively. Dyfonate was applied as a 10% granular and an emulsifiable concentrate at 1.5 and 1.0 lb AI/A respectively. Parathion and Sevimol were liquid formulations applied at 0.5 and 1.0 lb AI/A respectively.

All irrigated treatments were 49m x 24m in 1972 and 1973 while non-irrigated treatments were 27.5m x 7m in 1972 and 49m x 30.5m in 1973. Insecticides were applied on August 21, 1972 and August 8, 1973. Samples obtained on treatment dates were taken just prior to application.

Non-target arthropod assessment. — One hundred, 365cm2, D-vac^R suction samples were taken per treatment for each sampling date. Samples were taken systematically by walking a figure 8 in each treatment. The composite sample from each treatment was placed in 70% ethyl alcohol. Arthropods were later removed, categorized and counted.

Sampling in 1972 began on the day of insecticide application, August 21, and continued at 2 day intervals for 8 days. In 1973, sampling began on June 20, continued at 7 day intervals until insecticides were applied. After insecticide application, the sampling interval was shortened to 3-4 days for a 23 day period then returned to the 7 day interval.

Results and Discussion

Figure 1 compares the impact of Dyfonate granules and parathion broadcast spray on non-target arthropods in an irrigated peanut ecosystem. The rate of increase in non-target arthropod density in the granular and untreated areas after day 2 was greater than the broadcast treatment (Fig 1A). Figure 1B shows the effects of these two methods of application on selected arthropod groups.

Comparison of parathion basal directed sprays and broadcast sprays (Fig. 2A, B) on non-irrigated peanuts revealed no differences in non-target arthropod conservation. Smith *et al.* 1975 postulated that basal directed sprays should be selective and conserve natural enemies residing on the peanut foliage. The data presented in Figs. 2A, B do not support this hypothesis. No explanation was available for the dramatic decrease in non-target arthropod density that occurred on day 6 in the untreated area.

Data presented in Figs. 1A, B and 2A, B reveal only short term effects of insecticide application

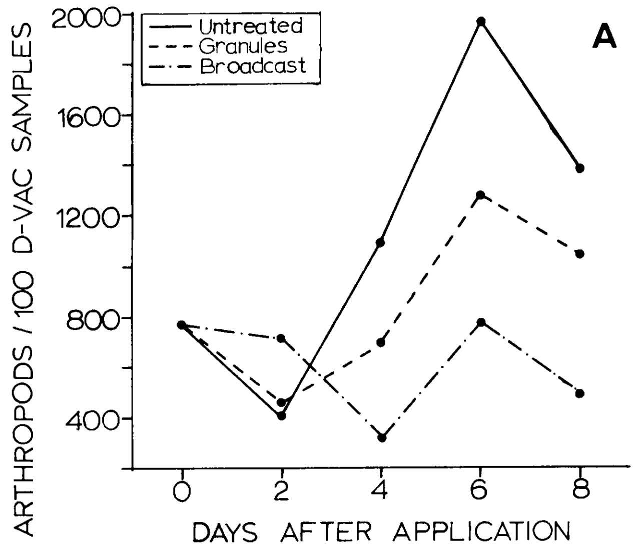

Figure 1A

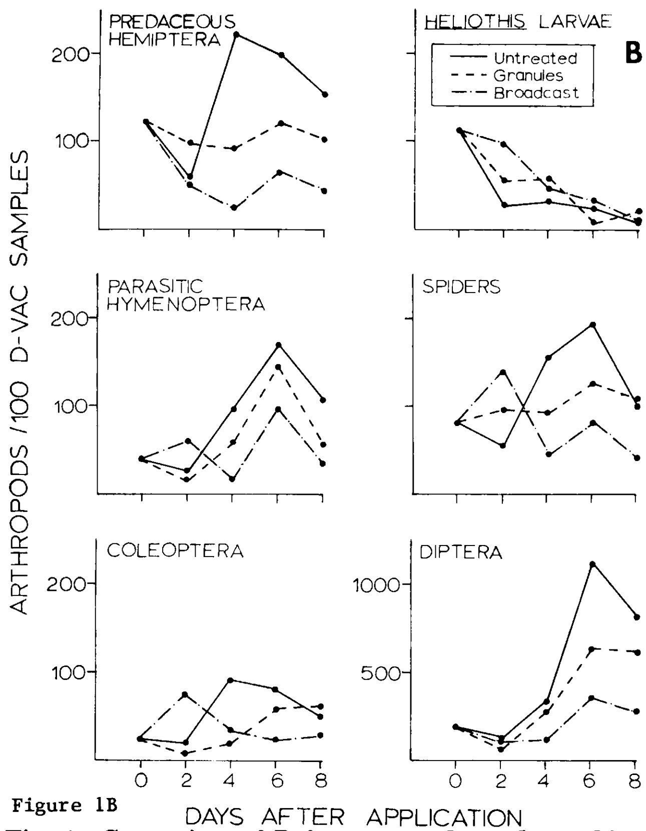

Figure 1B

Fig. 1. Comparison of Dyfonate granules and parathion broadcast spray on non-target arthropod density for irrigated spanish peanuts; (A) total fauna, (B) selected groups.

techniques on non-target arthropods. For irrigated peanuts differences may be attributed to the toxicity of 2 different insecticides. These data represented the insecticides and the different methods of application used by Texas peanut producers in 1970-1972 for control of lesser cornstalk borer. The data shown in Figures 3, 4A, B were collected in 1973 to gain an insight into long-term effects of selective application techniques on non-target arthropods.

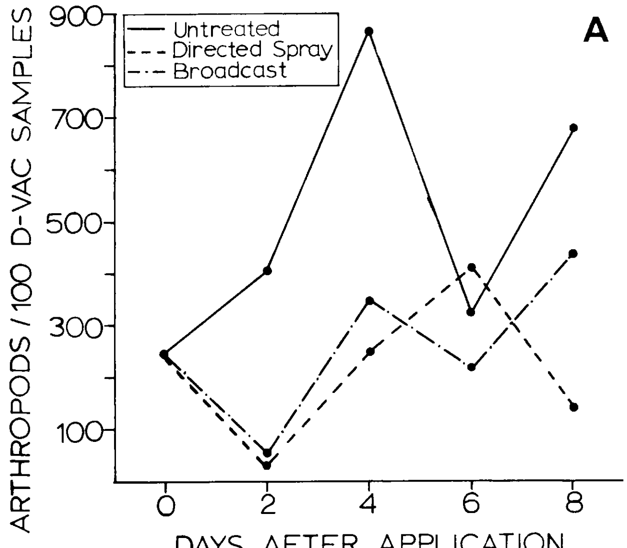

Figure 2A

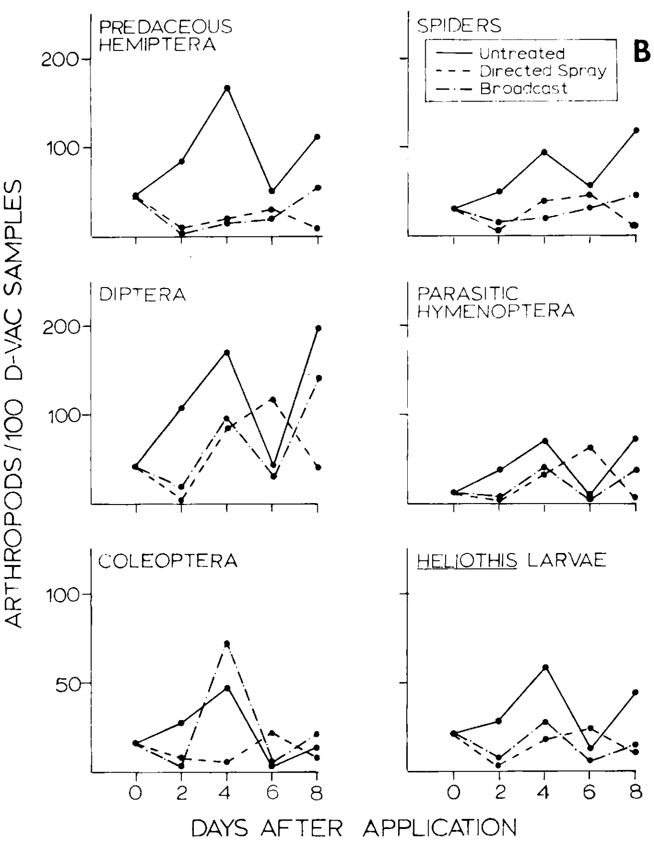

Figure 2B

Fig. 2. Comparison of parathion applied as a basal directed spray and broadcast spray on non-target arthropod density for non-irrigated spanish peanuts; (A) total fauna, (B) selected groups.

Non-target arthropod densities monitored from irrigated peanuts treated with Dasanit as granules and broadcast sprays on August 8 (Fig. 3) revealed the same trends observed in 1972 when the 2 methods were compared using 2 different insec-

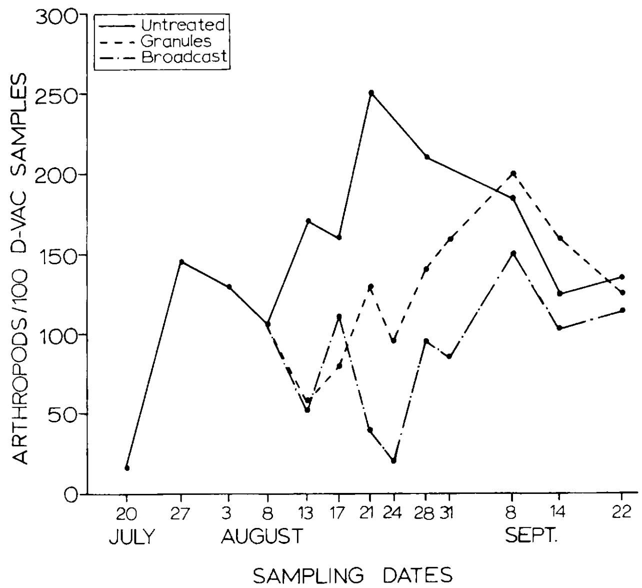

Figure 3

Fig. 3. Comparison of Dasanit applied as granules and broadcast spray on non-target arthropod density for irrigated spanish peanuts.

ticides (Fig. 1). Samples for September 8 show that the non-target arthropod density in the treated areas had regained the density in the untreated area. The area receiving the granules retained a higher arthropod density than the area of broadcast treatment throughout the experimental period.

Data shown in Fig. 4A, B for non-irrigated peanuts again revealed no definite trends in non-target arthropod conservation when comparing broadcast and basal directed sprays. Dasanit treated areas (Fig. 4A) showed short term differences between granules and sprays with all treated areas eventually reaching a common arthropod density less than the untreated area. Non-target arthropods in the Dyfonate treatments (Fig. 4B) had a faster rate of recovery compared to untreated levels than Dasanit (Fig. 4A). In both the Dasanit and Dyfonate evaluations the granules were least destructive to non-target arthropods with the broadcast spray being the most destructive (Fig. 4A, B).

Granular formulations of insecticides for soil insect control conserved non-target arthropods residing on the plant foliage. Although no distinct trends in non-target arthropod conservation were shown when comparing the basal directed spray and broadcast spray application methods in small plots, differences in natural enemy conservation as depicted in Fig. 4A, B should be greatly magnified when the basal directed spray technique is utilized over large areas. Considering the reports of Cunningham *et al.* 1959 and Smith *et al.* 1975 where basal directed sprays greatly enhanced lesser cornstalk borer control as compared to broadcast sprays, the basal directed spray would decrease the number of insecticide applications

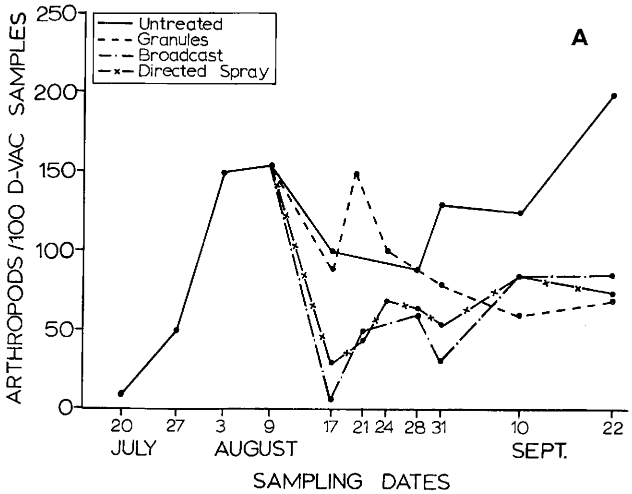

Figure 4A

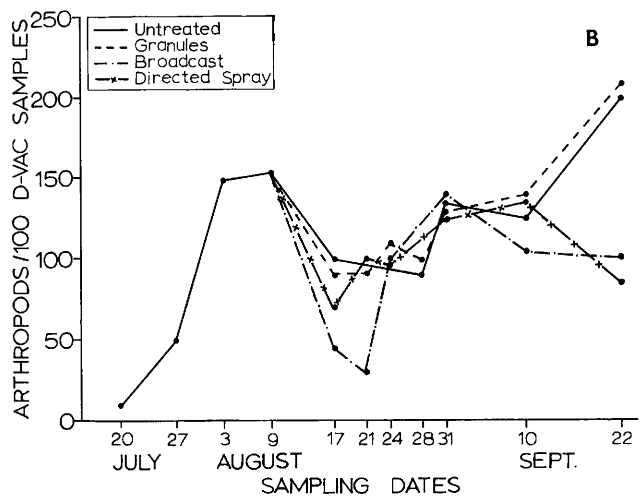

Figure 4B

Fig. 4. Comparison of granules, basal directed spray and broadcast spray on non-target arthropod density for non-irrigated peanuts; (A) Dasanit treatment, (B) Dyfonate treatment.

necessary for lesser cornstalk borer control during a growing season and thus conserve natural enemies.

Evidence presented by Smith and Hoelscher 1975, substantiates a decrease in insecticide use when peanut growers adopted selective insecticidal application methods for soil insect control.

The use of granular insecticides and basal directed sprays for soil insect suppression demonstrates ecological selectivity (Ripper *et al.* 1951). Ecologically selective application techniques do not solve the delemma of target pest resurgence, but a more formidable problem exists in the peanut ecosystem; the creation of many new target pests. This situation is especially prominent since many pests that historically have shown an affinity to become resistant to insecticides e. g. tobacco budworm (Nemec and Adkisson 1969), spider mites (Gunther and Jeppson 1960), beet armyworm, saltmarsh caterpillar (Brown 1961), cabbage looper and corn earworm (Brown 1968) are currently occasional pests of peanuts but could become target pests in the absence of selective insecticide use.

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