The Texas-based research cited below involves primary researchers (J.K. Westbrook, W.W. Wolf, J.D. López, J.R. Coppedge, G.D. Jones, J. F. Esquivel, R.S. Eyster and P.G. Schleider) from the USDA, ARS, Areawide Pest Management Research Unit, College Station, TX 77845 and the following collaborators:
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Entomopalynology

Gretchen Jones

Adults of numerous insect species feed on pollen, nectar, and other plant exudates that are frequently associated with flowers. As a result of this feeding activity, these adults become contaminated with pollen. Identification of this pollen is useful in the study of adult insect feeding and migratory activities for several reasons. First, most pollen grains are very distinctive, easily recognizable, and identifiable to the family, genus, and often species rank. Thus, very specific information can be obtained about the plants that serve as adult host plants. Second, pollen is composed of sporopollenin that is very durable and does not easily decay. Therefore, pollen remains as a durable natural marker on or in an insect. Third, from the identification of this pollen, the geographical origin of the plant from which the pollen came can often be determined, especially when there is temporal and geographical variation in the distribution of the identified plant.

This year several new techniques in preparing corn earworm (CEW) moths and boll weevils (BW) for pollen analyses were developed. From these techniques new natural markers were found. In addition, these techniques have added new data to the foraging resources of these two insect pests. Although initially designed to obtain a better array of natural markers for adult CEW and BW, these new techniques can be applied to other insect species.

Summer and early-fall 1994 populations of CEW adults from Texas, Oklahoma, Iowa, and Minnesota were examined for pollen. Fifty-two percent of the moths from Texas were contaminated with pollen, in Iowa 100%, in Oklahoma 70% and in Minnesota 34%. Most of the pollen found on the moths was from the plant family Asteraceae.

Adult CEW were collected through direct capture in selected blooming citrus groves in the Lower Rio Grande Valley (LRGV) of Texas to evaluate citrus pollen contamination, behavioral activities, and population dynamics. These aspects are fundamental for understanding the migratory activity of corn earworm from a documented source zone. Preliminary electron microscopy observations indicate 71% of direct captured corn earworm possessed citrus pollen. Dissections show that 61% of captured females had been mated. However, only 6% were mating at the time of capture. A transect of pheromone traps through the citrus growing region will yield additional data regarding citrus pollen contamination and population dynamics of corn earworm field populations.

These data can be used to identify peak population activity and citrus pollen contamination of field populations throughout the LRGV. Direct captures resulted in identification of twenty additional noctuid species active in citrus groves.
Studies were initiated to evaluate pollen cross-contamination of corn earworm adults. Placing citrus-contaminated insects with laboratory reared insects showed occurrence of cross-contamination. Likewise, placing laboratory-reared insects in pheromone trap tops at dusk resulted in pollen cross-contamination of laboratory insects by field insects attracted to the trap.
BW from three locations in Texas are being examined for pollen. Also, BW from 17 sites in the state of Tamaulipas, Mexico, are being examined for pollen in a collaborative agreement with J. Raulston (USDA, ARS). Migratory activities between locations will be evaluated from pollen found on these boll weevils.
Early-season Insect Migration
Adult corn earworms (CEW) have been captured north of their overwintering range before local emergence, indicating that migration was required. Adult CEW feed on nectar from citrus and other flowering plants in February and March before migrating. Pollen from the citrus and other plants contaminates the proboscis, eyes and other body parts of the adult CEW. Such pollen provide unique natural markers that can be used to determine the migratory range and host variety of the CEW.

Corn earworm pheromone traps were monitored in and away from the LRGV. Traps were placed throughout northeastern Mexico to evaluate activity in the region. The downwind trapping scheme used during the 1994 campaign was expanded to include 26 additional locations throughout Texas and New Mexico to monitor migratory movement from the LRGV. Combining downwind trapping data with meteorological, radar, and direct capture data will provide a basis for determining implementation of areawide pest management strategies. Pheromone traps were operated daily to determine the distribution of the adult CEW throughout northeastern Tamaulipas, Mexico, and southern Texas from February - March. Captured specimens were frozen and later analyzed for the presence of pollen by scanning electron microscopy.

A vertical-pointing radar and a scanning radar were operated in the LRGV near citrus orchards. A scanning radar and a tracking radar were operated about 100 km north-northwest of the LRGV. Tetroons (i.e., large tetrahedral-shaped balloons made of mylar) were released nightly from the LRGV and tracked to determine the nocturnal wind transport available to migrating CEW.
We attempted to capture migrating CEW in blacklight traps that were attached to tetroons. The 0.5 m x 0.25 m traps were constructed of balsa wood vanes covered with white monocote. An 8-watt blacklight in the center of the trap was powered by 4 alkaline AA batteries. TangleTrap® adhesive was applied to the trap vanes for capturing insects on contact. No CEW were captured in the traps during several hours of aerial deployment. Modifications to the traps will be made, including consideration of other modes of insect attraction, before the traps are deployed next year.

As part of the Unit's cooperative research with S. Johnson, A. Hammond and L. Luo (LSU) on the migration of the true armyworm, sex pheromone and blacklight traps were

operated in an agricultural area close to College Station, Texas, to monitor adult activity and response and to collect moth samples for reproductive, physiological and flight analyses. Field populations were also sampled at night in ergot-infected ryegrass. Large numbers of moths representing several migratory species were observed feeding on the ergot honeydew. It appears that the honeydew from ergot-infected ryegrass may be an important food source for early-season migration and other adult activities. More intensive evaluation or ergot-infected ryegrass as a source of food for migratory insect pest species and of feeding attractants / stimulants for use in developing adult control technology is planned for the Spring of 1996.

Contact John Westbrook for additional information.
Mid-season Insect Migration
A pheromone trap network similar to that used in February and March was deployed in June. Cooperators monitored traps daily. Spatial resolution was emphasized more than identification of the migratory / nonmigratory status of captured specimens.

Tetroons were launched nightly from the LRGV. Blacklight insect traps were attached to some of the tetroons. No adhesive was applied to the trap vanes, but a fabric sock was attached to the bottom of the trap to collect insects in good condition.

Three entomological radars were located along a line north-northwest from the LRGV to detect migratory insect flight along the mean wind trajectory. A vertical-pointing radar was located in the LRGV; a tracking radar was located 100 km north-northwest of the LRGV; and a scanning radar was located 200 km north-northwest of the LRGV. The tracking radar was used to determine insect air speed, heading, and rates of ascent and descent.

Doppler radar data from NEXRAD facilities at Del Rio (Laughlin AFB), New Braunfels, Brownsville and League City were acquired for use in analysis of reflectivity (i.e., concentration of targets) and speed (i.e., wind speed plus target speed). NEXRAD facilities at New Braunfels and Del Rio were recently commissioned for service, and Brownsville began 24-hour operations about one week before the start of the June field study.

During the course of the field project, NEXRAD reflectivity images were reviewed and discussed with Jim Raulston and Dale Spurgeon of the USDA-ARS at Weslaco, TX. An anomalous cluster of high reflectivity originated from Lyford, TX, and moved downwind on the night of 5 June 1995. This cluster of high reflectivity was hypothesized to be beet armyworms which had already devastated the cotton production in the LRGV. Level II data will be analyzed with respect to winds and entomological field survey data to evaluate the hypothesis. In any event, beet armyworms became a new target of interest for migration studies.

A field study of beet armyworm migration was conducted in an area of mature cotton fields from 31 August 1995 - 4 September 1995 near San Angelo, TX. The Ralph Hoelscher farm location was situated within an area where beet armyworm infestations

had devastated cotton production. The study period was during the time of estimated peak emergence of the beet armyworm. A scanning radar was operated throughout the night to monitor insect migratory flight. Tetroons were launched nightly and tracked by the Argos satellite system. Pilot balloons and radiosondes were tracked to measure vertical profiles of wind velocity, air temperature, relative humidity and barometric pressure.

Scientists studying the abundance and behavior of the Mexican free-tailed bat population in central Texas have discussed opportunities for future collaborative research. Dr. McCracken, of the Univ. of Tennessee, conducts physiological analyses of bats to determine dietary patterns. He reports that the bats change their primary food source during the night, with bats consuming a larger proportion of moths in the late-night / early-morning. Coincidentally, noctuids from the LRGV would be arriving in central Texas at this time. Because the Mexican free-tailed bats and the corn earworm migrate during the same time of the year, knowledge of the dietary proportion of particular insect species, particularly marked specimens, would aid in our understanding of long-distance insect migration. Dr. McCracken is also interested in attaching a microphone / radio transmitter to a tetroon, and recording bat audio signals that indicate the bats' feeding behavior along the approximate trajectory of noctuids migrating from the LRGV. Plans are also underway to instrument the U.S. Drug Enforcement Agency Aerostat surveillance radar near Rio Grande City, TX, with insect traps and microphone / radio transmitters.

Contact John Westbrook at for additional information.

Ground-truth of NEXRAD Doppler Radar Measurements

A scanning radar and a tracking radar were operated in an area of mature corn fields about 30 km east of the NEXRAD doppler radar facility at New Braunfels to provide ground truth of target reflectivity and speed. Pilot balloons and radiosondes were tracked to independently measure vertical profiles of wind velocity, air temperature, relative humidity and barometric pressure. Tetroons with attached blacklight insect traps were tracked for two hours per night to capture insects along wind trajectories. NEXRAD Level IV archive data have been examined for preliminary evaluations with respect to the ARS field measurements. NEXRAD Level II data will be analyzed for more precise analyses.

Contact Wayne Wolf for additional information.

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