Pecan Industry: Current Situation and Future Challenges, Third National Pecan Workshop Proceedings

Pecan Industry: Current Situation and Future Challenges, Third National Pecan Workshop Proceedings

Las Cruces and Inn of the Mountain Gods
Ruidoso, New Mexico
June 20–23, 1998

PECAN WEEVIL MANAGEMENT CONSIDERATIONS

Marvin Harris[1]

The keys to pecan weevil management are: 1) to determine if pecan weevil density is sufficient to cause economic damage; 2) if it is, treatment must be timed properly to maximize efficacy, and 3), monitoring must be continued following the first treatment to ensure retreatments, if needed, are also applied in time to prevent newly emerging pecan weevil adults from causing damage.

DETERMINING ACTION LEVELS FOR PECAN WEEVIL

The pecan weevil has primarily a 2 yr life cycle, with a few requiring 3 yrs (Harp and Van Cleave 1976). This means the adults that will attack the 1998 pecan crop come primarily from larvae that fed on the pecan crop in 1996 (and perhaps a few in 1995). A good rule of thumb has been developed to anticipate the damage potential of pecan weevil to the current crop by using field infestation data gathered from the same orchard two and three yrs previously (Harris et al 1981). We know that unmanaged pecan weevil given adequate food will increase about 4.81 (±2.6) times from one generation to the next generation two yrs later, and about 0.48 (± 0.4) times for the three yr portion of the life cycle (Harris et al 1981). This means that a 10% pecan weevil infestation of a 500 lb/acre crop two and three years previously will be capable of increasing about 5 times in the current year so that about 50% of a 500 lb/acre crop could be damaged. Of course, crop loads can vary from year to year and pecan weevil infestations also vary. This is accounted for in the following formula: Expected Damage Capacity of Pecan Weevil in Current Year = (% infestation 2 yrs ago x lbs/acre yield 2 yrs ago x 5) + (% infestation 3 yrs ago x lbs/acre yield 3 yrs ago x 0.5). Note that pecan weevil damage in 1997 is not important to what happens in 1998. Weevil damage in 1997 will provide most weevils in 1999 and some in 2000 to attack those crops.

A simple example for 1998 is suppose 500 lb/acre crops were produced in 1995 and 1996, and each had about 10% infestation from pecan weevil. Larvae from infested nuts emerged in the orchard prior to harvest and entered the soil where they are now adults that will emerge to attack the 1998 crop beginning in late August. Calculation of damage capacity to the 1998 crop is (10% x 500 x 5) + (10% x 500 x 0.5) = 250 + 25 = 275 lbs/acre that pecan weevil can damage in 1998. This damage level is expected whenever you have a crop of 275 lbs/acre or larger in 1998; a shorter crop is expected to be completely infested for all practical purposes. Figure 1 shows expected yield losses in the

current season calculated from various amounts of pecan weevil damage to crops of various sizes two years previously. Generally speaking, pecan weevil in the current year will damage five times as many pecans as were damaged two years previously.

COMPARING RISK FROM PECAN WEEVIL TO MANAGEMENT COSTS

The preceeding method is simple and uses easily obtainable field data to determine the risk from pecan weevil in the current year in lbs/acre of inshell pecan nuts. These data must be converted to $/acre and compared to management costs to determine if control can be economically justified.

Native inshell pecans are smaller and sell for less than improved pecans. Pecan weevil adults however damage an average of 15 nuts/adult regardless of nut size or price so that the damage caused per weevil is a function of nut size and price as shown in Figure 2. Choctaw pecans weighing 40/lb and selling at the modest price of $1.50/lb are damaged at the rate of 56¢/adult weevil. By contrast, small natives weighing 100/lb and selling at the fire sale price of $0.50/lb are damaged at the bargain rate of 7.5¢/adult weevil. Management costs average about $25/acre/treatment and as many as three treatments may be required to control pecan weevil resulting in a total cost for pecan weevil management of $75/acre, regardless of nut size or price.

This means the number of adult pecan weevil needed to justify spraying for them depends on nut size and price. Figure 3 shows the number of weevils per acre needed to cause $75 in damage to pecans varying within the size and price ranges presented in Figure 2. The key point of Figure 3 is that less than 1000 adult weevils per acre are needed to cause economic damage. Under the threshold conditions of Figure 3, treatments may still be undertaken for a number of reasons. Perhaps management can be achieved using just two treatments, or pecan prices may be higher than those shown, or reducing future risk (year 2000) from pecan weevil may be a consideration. This ballpark method allows the producer to consider the risks from pecan weevil and plan a management strategy before the events occur in 1998.

MONITORING PECAN WEEVIL VS. MEASURING DENSITY

Another method to assess risk from pecan weevil is to monitor adult emergence from the soil in the current season using cages or traps of various kinds. This should be a routine tool for every grower expecting to have to spray to protect their crop from pecan weevil because these monitoring aids identify the time when adults are emerging from the soil to enter the pecan canopy and infest pecans there. The drawback to using cages and traps to assess risk or potential damage from pecan weevil is that emergence

[1] Professor of Entomology, Entomology Dept. Texas A&M, College Station, TX 77843

is not complete before treatments to prevent damage must be undertaken and obtaining accurate pecan weevil density estimates requires very intensive trapping (Boethel and Eikenbary 1979, Harris et al 1981).

This becomes clear when one considers the number of pecan weevils/acre that will cause $75 of damage (note this equals maximum expected management costs; see Figure 3). How can you accurately detect a few hundred or even a thousand pecan weevil adults/acre using cages or traps? The short answer is, if you are finding emerging pecan weevils in late August onward you are very very likely to have more than the minimum density to justify treatment and the question is not whether to spray, but when to spray to prevent damage.

But, let us consider this question of density a little more. No ordinary pecan grower I have ever met has used sufficient traps to accurately detect 1,000 or fewer pecan weevils/acre in time to spray. There are 43,560 ft^2 in an acre. Adult weevils will emerge from soil beneath the pecan canopy and well spaced trees will cover about 50% of that area so weevils emerging from about 22,000 ft^2 need to be detected. This means a density of 1,000 weevils/acre will be distributed on average 1 weevil for every 22 square feet that will emerge sometime from August to November. The standard cone emergence cage covers about 7 ft^2 and three are therefore needed to cover about 22 ft^2 (Harris et al 1980). About 30 such emergence cages are needed to detect 10 weevils at a density of 1,000 weevils/acre over the entire season, and if just 10 adult weevils accumulated in those 30 traps by the end of the season, you should have sprayed. But you can't wait until the end of the season to make that decision. The first spray for pecan weevil in Texas is typically needed when only 10% of adults have emerged by late August. With 30 standard cone emergence traps, chances are about even that 1 weevil would be captured at this time given an economically damaging population of 1,000 weevils/acre. One needs more cages than 30 to accurately assess such a density, perhaps as many as 120 (Boethel and Eikenbary 1979). Accurate detection of just 300 weevils/acre in time to spray effectively would require even more cages.

The trapping effectiveness of cone cages can be increased by using Leggett tops (Neel and Shepard 1976, Anon. 1990) that capture adults emerging beneath the trap and those that land on the outside of the trap and walk up it into the top. The problem with using this capture data to measure density is that the trapping area is unknown. The weevils originating outside the cage have come from some unknown distance away. Similar difficulties exist with burlap trunk traps, tygon tubing, tire traps, open bottomed cages suspended in trees (see Neel and Shepard 1976, Knutson and Ree 1998) and the new pyramidal traps (Tedders and Wood 1994). These latter methods often allow more effective detection of pecan weevil activity, but are less accurate in measuring density for reliable

treat/no treat decision making.

My conclusion is that precise detection of pecan weevil density is presently too expensive and time consuming to warrant building, maintaining and monitoring the 120 or more cone cages needed to detect economic threshold numbers of emerging pecan weevils. Traps and cages are best used for deciding when to treat and orchard history combined with current season evaluations should be used to determine if treatment is needed. Generally speaking, if pecan weevils can be detected, economic damage is likely to occur if management action is not undertaken at the right time.

TREATMENT AND RETREATMENT DECISION MAKING FOR PECAN WEEVIL

Pecan weevil adults can emerge from the soil to attack pecans from August to November, as noted above, but typically emerge in greatest numbers from late August to early September in Texas (Figure 4). Females can successfully lay eggs any time after late gel stage of nut development until shuck split. There is a 3-5 day preoviposition period following emergence before the female begins egg laying. Carbaryl typically has a 5-7 day residual activity. A continuously emerging pecan weevil population entering pecan canopies with nuts between late gel and shuck split will require repeated treatments at 8-12 day intervals to prevent damage. The first treatment can be delayed until trees with the earliest maturing nuts enter the late gel stage of development and weevil emergence has begun. Early maturing varieties like Pawnee enter the late gel stage in August, sometimes before any weevils have been detected emerging from the soil. They are very susceptible but safe from attack until weevil emergence begins; then they must be treated within a few days and if weevil emergence continues after 5 days from the treatment date, they must be retreated within 8-12 days from the last treatment date, and this must be continued until emergence ceases. Later maturing varieties like Mahan can accumulate weevils in the canopy until the onset of late gel in late August or early September and then treated to prevent oviposition. Again, if weevil emergence continues after 5 days from the treatment date, retreatment must be made 8-12 days after the initial treatment and this must be continued until emergence ceases. Native trees vary from early to late maturing varieties and typically begin entering gel stage in mid August with a few not doing so until the 3rd week of September. Irregular spacing and distribution of natives usually prevents treating them individually and spraying is usually conducted based on the earliest maturing trees experiencing weevil emergence. These decisions are summarized in Figure 5.

Although the susceptibility period for pecan weevil attack extends from late gel to shuck split, emergence typically occurs in one or two peaks in Texas with the first taking place the last week in August through the first week of September and the second, if a second peak occurs at all, following a soil softening rain or

irrigation that releases the remaining drought-delayed weevils from the soil. The latter can occur as late as November and these late emerging weevils will attack nuts that have not undergone shuck split. This is why monitoring pecan weevil activity in the orchard is essential. Treatments of carbaryl must be applied to prevent susceptible nuts from egg laying by emerging female pecan weevils. Making these decisions when to treat requires monitoring nut development and soil conditions, and detecting weevil emergence before during and after treatment to determine if retreatment is needed (Fig. 5).

CHECKING DROUGHT-DELAY

The first treatment is made when weevils are detected emerging from the soil and nut development is in late gel or dough. Monitoring of soil conditions at this time will help anticipate whether part of the weevil population will be drought delayed. If soil hardness is harder than $60kg/cm^2$, a portion of the population will be delayed in emergence (Schraer et al 1998). This can be crudely measured by taking a 6" section of a ½" dowel rod, embedding it in a handle, and exerting about 130 lbs of pressure on the flat tip of the rod against the soil surface to test soil hardness. If the rod penetrates the soil 5-6" in depth with 130 lbs pressure or less, no drought delay is expected and weevil emergence should occur over a 2-3 week period in a normal manner; if the soil is too hard to allow weevils that can't access soil cracks or root channels to emerge, then they will be delayed until rainfall or irrigation softens the soil surface above their cells to a hardness of 60 kg/cm^2 or less. The moisture required for this softening varies with soil type and preexisting soil conditions (Schraer et al 1998). Several areas within the drip line of representative trees should be checked to determine the likelihood of a drought delay and monitoring traps and cages should be maintained and checked until the danger of delayed emergence is past or harvest has occurred.

RECOMMENDED PROGRAM FOR PECAN WEEVIL

Determine if a harvestable crop worth protecting from pecan weevil is present.

Check the orchard crop and pecan weevil infestation history to determine the risk from pecan weevil. Establish a crop, pecan weevil and soil monitoring system in early August. Monitor for onset of late gel stage in the crop and beginning of pecan weevil emergence at least twice a week. Pyramidal cages (Tedders and Wood 1994) are inexpensive and effective pecan weevil monitoring devices that work best when adjacent trees are whitewashed. These and other devices are discussed by Knutson and Ree (1998). Apply the first treatment of carbaryl when pecan weevils have begun emerging and earliest maturing trees are in late gel (or dough if no weevils were present at late gel). Check soil hardness to determine

likelihood of drought delay. Apply a second treatment 8-12 days after the first if weevils continue to emerge 5 or more days after applying the first treatment. Continue monitoring and treating as needed until harvest. Generally speaking, a maximum of three treatments should be sufficient to protect most pecans in most years when drought delay occurs and two treatments should be sufficient when pecan weevils emerge normally in late August and early September. Take yield and pecan weevil infestation data for use in decision making in future years.

LITERATURE CITED

Anonymous. 1990. The boll weevil trap; an eradication tool. Fact Sheet. USDA, Aphis.

Boethel, D.J. and R.D. Eikenbary. 1979. Status of pest management programs for the pecan weevil. P 87-119. In Pest Management Programs for Deciduous Tree Fruits and Nuts. Plenum Press. N.Y. 256p.

Harp, S.J. and H.W. Van Cleave. 1976. Biology of the Pecan Weevil. Southw. Entomol. 1:21-30.

Harris, M.K., J.A. Jackman and D.R. Ring. 1981.

Harris, M.K., D. R. Ring, B.L. Cutler, C.W. Neeb and J.A. Jackman. 1980. Pecan weevil management in Texas. Pecan Quart. 14:3-14.

Knutson A., and B. Ree. 1998. Managing Insect and Mite Pests of Commercial Pecans in Texas B-1238 (5-98).

Neel, W.W. and M. Shpard. 1976. Sampling and adult pecan weevils. Sout. Coop. Ext. Bull. 208. Misc. Agric. And For. Exp. Sta., Miss. State. 17pp.

Schraer, M., M.K. Harris, J.A. Jackman and M. Biggerstaff. 1998. Drought delay in pecan weevil lonergence in different soil types. J. Econ. Entomol. (in press).

Tedders, W.L. and B.W. Wood. 1994. Update on pecan weevil. Second National Pecan Workshop Proc. Pp 31-37.

PECAN WEEVIL YIELD LOSSES
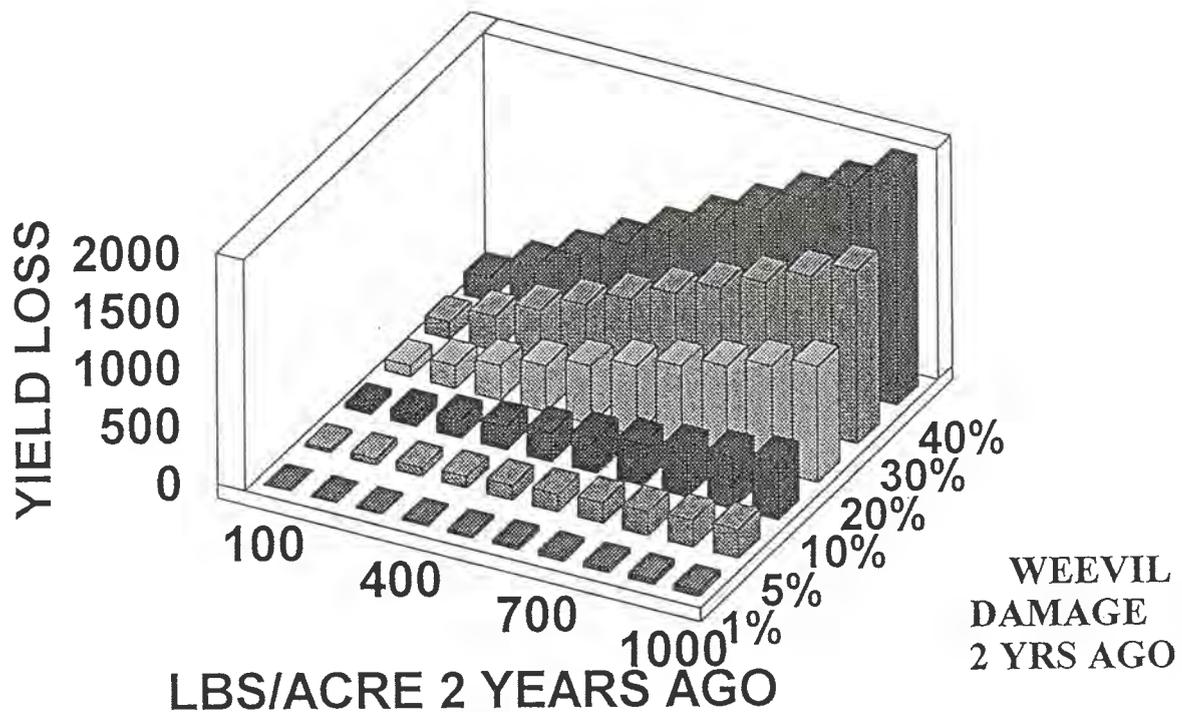## FROM YIELD AND DAMAGE 2 YRS AGO

Figure 1. Expected yield losses from pecan weevil based on yield and damage experienced two years previously. Losses represent the damage capacity of the pecan weevil to the current years crop.

LOSSES CAUSED BY ONE ADULT WEEVIL
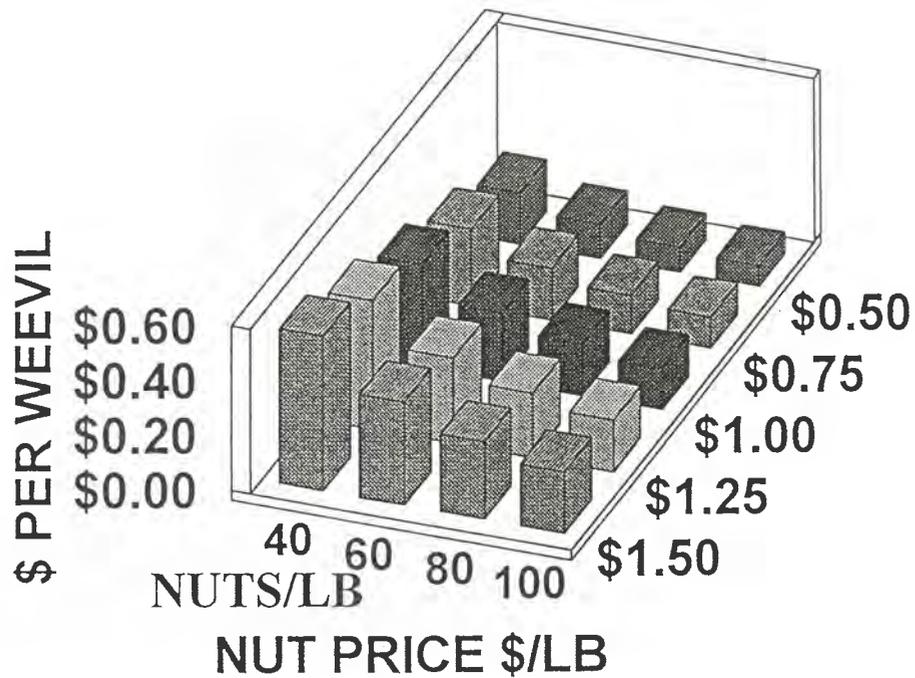## EACH ADULT DAMAGES 15 NUTS

Figure 2. Each adult pecan weevil damages about 15 nuts and $ loss per weevil is shown for various nut sizes and prices.
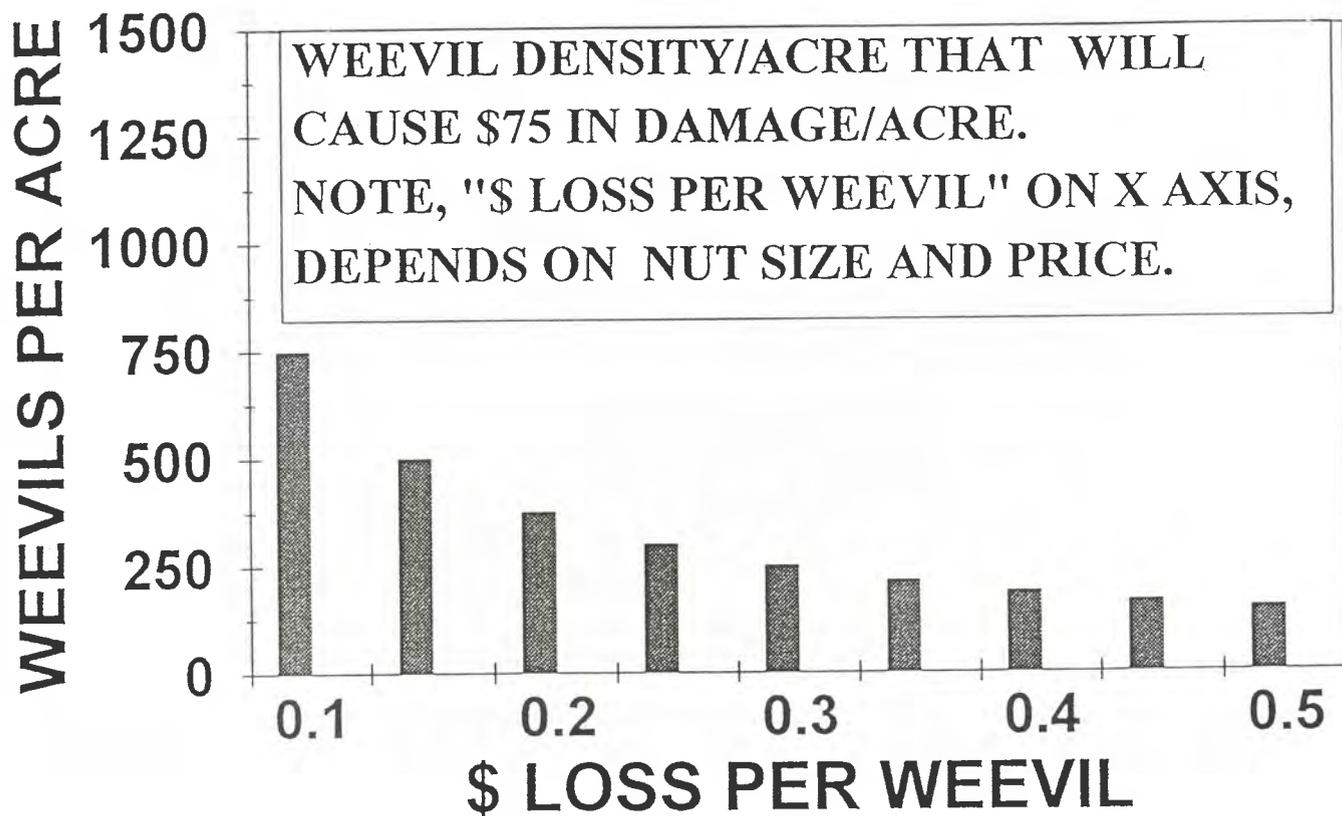
Figure 3. The minimum number of adult pecan weevils per acre required to justify management costs is compared to losses incurred per weevil, which depends on nut size and price (see Fig. 2).
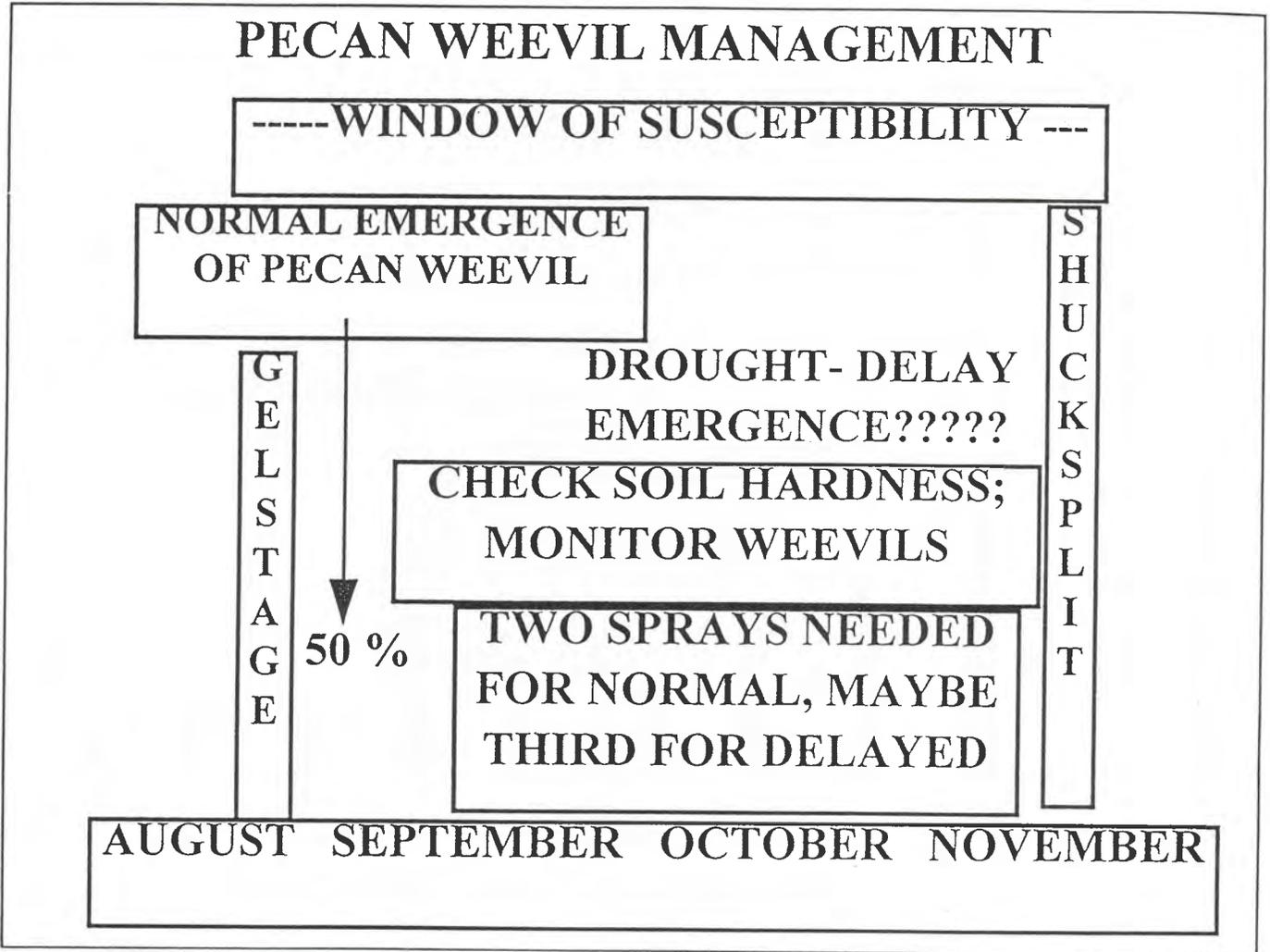
Figure 4. Pecan weevil management considerations during key periods of the season.

PECAN WEEVIL MANAGEMENT

1. MONITOR, BEGINNING EARLY AUGUST, FOR NUT DEVELOPMENT AND WEEVIL EMERGENCE

2. APPLY FIRST CARBARYL SPRAY WHEN NUTS AT GEL STAGE OR LATER AND WEEVILS ARE EMERGING

3. IF WEEVILS CONTINUE TO EMERGE 5+ DAYS AFTER TREATMENT, TREAT AGAIN BY 12TH DAY. REPEAT AS NEEDED (3 SPRAYS USUALLY ENOUGH)

CHECK SOIL HARDNESS;
MONITOR WEEVILS

AUGUST   SEPTEMBER   OCTOBER   NOVEMBER

Figure 5. Pecan weevil monitoring and spray timing factors for treating and retreating.