Florida Beef Cattle and Pasture Pest Management Profile

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Production Facts

- In 2006, Florida ranked 12th nationally in beef cattle with approximately 926,000 head. In 2005, 880,000 calves were born in the state (1)

- Nearly all calves are shipped at weaning to the Plains areas (Texas, Oklahoma, Kansas) for backgrounding and/or finishing. Florida ranchers shipped 652,000 feeder calves to markets outside the state in 2005 (1).

- Calf prices were $130 per hundred weight in 2005, an increase of $9 from the year before. Cow prices averaged $50 per hundred weight, $1 more than in 2004. Florida's cattle numbers continue to steadily decline from the peak in 1976 (1).

- Calves are produced by about 20,000 cattlemen in Florida. An average herd size is approximately 50 head per producer. However, 82 percent of these cattle producers have fewer than 50 beef cows (2).

- Nearly 99 percent of Florida's cattle producing operations find it necessary to use some sort of pesticide to protect their cattle, facilities, and/or pastures from pests (3).

Production Regions

Beef cattle are raised in every county in the state. The rolling grassland of central and south Florida is the heart of the beef cattle country. Osceola is the state's leading beef cattle county with approximately 73,000 head of beef cows. Highlands (57,000), Hendry (49,000), Okeechobee (69,000), and Polk Counties (62,000) each inventory significant numbers of beef cattle annually. Smaller operations are found in the northern and panhandle areas (1).

Production Practices

Beef cattle production, an important part of Florida's agriculture, converts an abundant but otherwise low value product - forage grown on land not suited for crop production - into feeder cattle. Beef producers generally have three important reasons for raising beef cattle on their farms: 1) beef cattle subsist on otherwise unused land or roughage resources; 2) production of beef cattle requires less labor than other livestock enterprises, which means the cow-calf enterprise is complementary to off-farm employment; and, 3) lifestyle, or enjoyment in raising cattle.

Before purchasing the first cow, cattlemen must focus on establishing pastures, building adequate facilities, and selecting a breed-type. When these necessities are established, cattlemen/ranchers set goals to ensure continued improvement within the beef herd. A reasonable set of production goals for a typical beef herd might consist of: 1) achieving a 90 percent or higher calf crop, born within a 75-day calving period; 2) getting a calf from each cow, every 12 months; 3) achieving heavy weaning weights (more than 500 pounds); 4) providing adequate nutrition at reasonable costs; and 5) receiving a good selling price (2).

One problem for the typical cow-calf program in Florida that does not affect other states is most calves are sold at weaning time (late summer and fall in Florida), when prices are historically low. Smaller operations, as a whole, are often at a disadvantage because their size frequently prohibits large, bulk purchases. Purchasing feed, fertilizer, and other supplies in smaller quantities results in higher per-unit costs. Similarly, equipment costs, on a per-cow basis, are higher for the small operation. Low land and equipment costs afford the greatest profit potential (2).

Calving season is primarily dependent on the season that best suits the pasture program. Usually, fall-calving (October-December) cows are in good body condition at calving. Fall calves offer some flexibility in marketing since they can either be sold at weaning, or grazed for a period of time. The market price for fall-born calves is usually better than for spring-born calves (2).

Winter-born calves (January-March) are one to three months of age by the time warm season pastures start growing in north and central Florida. Calf weight gains are good in the spring, because high quality forage increases the cows' milk production. These calves have heavier weaning weights for fall marketing than spring-born calves. Winter-calving cows, however, require an ample supply of good quality feed in February and March if they are expected to rebreed on time (2).

Spring-calving cows (March-May) can be wintered on residual pasture and lower quality hay because they are "dry" during winter. Calves are born when pasture quality is good; but three to four months after calving, just when milk production is peaking, forage quality declines. Consequently, calf weights are usually lower at weaning because calves are younger and have lower gains. Spring calving may be justified for some beef operations using native and woods pastures, but it is not recommended for most operations (2).

Summer-calving (June-September) is not recommended, because calves will have the lightest weaning weights of all. Heat, insects, and poor quality pasture make this a last option (2).

The number of acres needed for each cow depends on the level of forage production, as well as the cattle and their management. The level of forage production varies with species, soil fertility, moisture, temperature, season, and other related factors. Cattle stocking rates are usually defined by the months during which forage production is

limiting. In north and central Florida, warm season forages are usually the primary feed source for the herd from April through November (with hay or winter pasture providing feed from December through March). April and May are usually the stocking-rate-limiting months for warm season pasture, which means pastures must provide adequate forage growth during these months. During the summer, excess forage can be harvested for hay. In south Florida, most producers use neither hay nor winter annual pastures. The stocking-rate-limiting months for warm season pasture in south Florida range from December to May (2).

Forages

Florida has considerable variability in soils and climate. In north Florida there are clay-loam soils with good moisture holding capacity that are quite productive. Further south there are the upland sandy ridges and flatwoods. In general, the flatwoods soils with their greater moisture holding capacity are more productive than the deep upland sands. The warm growing season is longer in south Florida than in north Florida, and longer along the coast compared to the center of the peninsula. Winter temperatures (below freezing) reach lower levels in north Florida than in south Florida. Certain tropical forages can be grown in south Florida (south of Orlando) that cannot survive in north Florida because they "freeze out." Spring droughts are usually more severe in peninsular Florida than in north and west Florida.

These differences in climate, soils, and length of growing season affect not only the types of forage that can be grown on a particular ranch, but the overall management system as well. Florida's relatively mild climate, together with its 50-plus inches of annual rainfall, affords a better opportunity for nearly 12 months of grazing than in any other state except Hawaii. Yet, most years, some supplemental feed or forage is required during the cool season (or winter months), especially in north Florida.

Selecting suitable forage(s) for a ranch and determining proper management is a complex undertaking. The types of forage from which to choose include: grasses, legumes, and other plants. Some forages are perennials and live for many years (permanent pasture). Others are annuals and live only one year (temporary pasture). Most are warm season plants; but some are cool season, and many of these can be interseeded into perennial warm season pastures to furnish cool season grazing, especially in north Florida. Some forages can also be grown for hay, while others are suitable only for grazing. Several forages that grow in south Florida cannot be grown in north Florida because they lack sufficient cold tolerance. Some forages can only be grown on well-drained soils while others are adapted to very moist soils. Some are established from seed and others can only be established by vegetative means (stem, stolon or rhizomes).

The success of a beef cattle operation is tied directly to the amount and quality of forage, whether pasture or hay, available to the beef animals. As a general rule, readily available pasture of high quality is the cheapest source of feed nutrients. In Florida,

native pastures, as well as planted or improved pastures, furnish viable grazing. Most producers working with small acreage are interested in planted or improved pastures.

Selection of pasture species for beef cattle depends on three major factors: temperature, soil moisture, and soil fertility. Selection of pasture species in Florida must focus primarily on temperature, due to the wide-ranging climate. South Florida has a climate similar to subtropical regions, while north Florida has subtropical summers but temperate winters.

Perennial grasses are the basis for permanent pastures. Perennial grasses for north Florida include bahiagrasses, improved hybrid Bermudagrasses, limpograss, and tall fescue; for central Florida, the bahiagrasses, the improved hybrid Bermudagrasses, and limpograss. Perennial grasses for south Florida include bahiagrasses and stargrasses, as well as some of the improved hybrid Bermudagrasses; along with limpograss and Rhodesgrass (plus St. Augustinegrass and paragrass, to a lesser extent).

Annual species provide grazing for temporary pastures. Certain annual grasses are used throughout the state in both cool and warm seasons. Rye, oats, wheat, and ryegrass can all be used for winter grazing, while pearl millet and sorghum X sudangrass hybrids can provide summer grazing on cultivated land.

Warm season perennial grasses, however, are the foundation of pastures in Florida. Bahiagrass is predominantly used. It can be established from seed and is widely adapted, very dependable, persistent, and easy to manage. Bahiagrass can endure considerable mistreatment (overgrazing, no fertilizer, etc.) and still maintain a stand. Only three pests adversely affect bahiagrass: the mole cricket and the weeds, tropical soda apple and smutgrass. Both have, at times, seriously damaged bahiagrass pastures in some areas of the state (2).

External Insect Pests of Beef Cattle

External arthropod parasites of beef cattle are a constant menace. These pests: 1) lower the quality of animal products (hides, hair, meat) by physical feeding damage; 2) reduce meat and milk production by sucking blood from animals; 3) transmit diseases; and, 4) cause energy loss. Several species of fly, louse and tick are important pests of cattle. As herd sizes increase on modern farms, pest pressures often are aggravated by large quantities of animal waste that must be handled and by conditions that promote the spread of external parasites. Flies and lice are considered to be the insect pest/parasite problems that cause the greatest economic loss in Florida cattle operations (3,4).

Flies.

Horn flies are generally the most noticeable, serious, and abundant flies on pastured cattle. They cause pain, annoyance and interference with feeding, resting and other normal activities. Horn fly larvae live only in fresh cattle manure while the adults feed

only on blood, primarily from cattle. These blood-sucking pests are persistent biters and remain on their host continuously, relocating only when disturbed or when moving to fresh manure to deposit their eggs. Horn flies are abundant much of the year, and adults are usually found on the shoulders and backs of cattle. A swarm of 500 horn flies can draw one-half pound of blood from an animal in one day, reducing grazing and weight gain, leaving an anemic, poorly performing cow. Horn fly numbers of 50 or more per animal are considered to be of economic importance, although 10,000-20,000 per animal have been reported. Adults feed up to 20 times per day (5). Horn flies have been evaluated to determine insecticide resistance levels in south and south coastal Florida. Resistance levels for pirimiphos-methyl were above 3X. Cyhalothrin resistance levels were seen as high as 225X. No pyrethroid ear tag works with resistance levels this high (6).

Stable flies, normally a pest around animal premises, have become a problem on pastured cattle in recent years. Unlike other biting flies, both sexes of the stable fly are vicious biters. They are strong fliers and range as far as 70 miles from the breeding sites. Stable flies cause irritation and weakness in animals and account for much blood loss in severe cases. These flies are mechanical transmitters of anthrax, equine infectious anemia, and anaplasmosis. The peak population in Florida occur from August through December (7).

Cattle Grubs (Heel Flies) cause economic losses because they reduce weight gain, feeding efficiency, milk production, and hide value (from larval exit holes). Heel fly activity causes cattle to run wildly with tails in the air (gadding), or to stand in water to protect themselves. Loss of weight resulting from the wild efforts of the animals trying to escape from the adult flies may be considerable. Further damage may result from the cattle running into fences and other objects. Losses also are suffered with carcass trim and lower meat quality. Cattle grubs are the larval stage of heel flies. Adult heel flies emerge in late winter, spring or summer. Female flies lay eggs on the legs and lower body regions of cattle. Eggs attached to the hairs hatch into tiny larvae that penetrate the skin and begin to migrate through the body of the animal. Larvae congregate in the tissues of the esophagus, but eventually move to the back in later summer, fall or winter. Additional damage may occur from secondary infections in initial grub entrance wound. Grubs develop within a “cyst” or “warble” just under the skin on the back. After feeding on the animal’s internal tissues for approximately 9 months, grubs leave the animal’s body through holes cut in the hide, fall to the soil and pupate (8).

Horse flies can be severe-blood sucking pests, and are usually a problem for cattle during late summer. Female horse flies feed on cattle, causing extreme irritation from their bites. Their attacks often account for lowered weight gains. Because of their painful bites and frequent attacks, horse flies produce frenzied behavior on their hosts, sometimes causing them to run long distances in an effort to escape. These flies also introduce an anticoagulant into the wound when they bite that keeps blood from clotting. The wound become excellent sites for secondary infections. Being intermittent feeders,

the flies also can be important mechanical transmitters of diseases such as anthrax, tularemia, and anaplasmosis (4).

Face flies are non-biting flies that feed on the mucus secreted from the eyes of cattle. Face flies are also responsible for spreading the bacterium that causes pinkeye in cattle (4).

Female *black flies* suck blood mainly during daylight hours. The black fly is a potential disease vector in Florida. It hovers about the eyes, ears and nostrils of animals, often alighting and puncturing the skin with an irritating bite. Large numbers of bites cause weakness from blood loss, anaphylactic shock or death. Adult black flies are strong fliers and may fly 7-10 miles from their breeding sites (4).

Female *mosquitoes* suck blood but do not always need blood to lay their first batch of eggs. Mosquitoes attack livestock causing painful bites, unthriftiness, weight loss, and occasionally death by suffocation or heavy blood loss.

Financial loss due to flies is not easily measured, but a rough estimate is between 50 and 100 million dollars per year (5). Persistent flies cause cows to resort to “shaking off” motions, which reduces time spent feeding. A study at Hanover Veterinary College’s Institute of Parasitology observed cows making 20 “shake off” motions per minute, or a total of 14,400 motions per 12-hour day, in their attempts to avoid the painful bite of the stable fly. This results in an increase in heart and respiration rates, as well as higher body temperature. Because this affects the cow’s ability to eat and drink, the animal’s weight can drop (6).

Lice. Lice cause the cattle industry annual losses of several million dollars. These losses result from anemia, unthriftiness, reduced rates of growth, inefficient feed utilization, secondary diseases resulting from lowered resistance of the animals and even mortality. Four species of louse suck blood from cattle; one feeds on hair and scales. Lice are more abundant during winter and spring when the hair is long and animals are in close proximity. Lice are permanent ectoparasites, spending their entire life on the host. Both immature and adult stages are parasitic, therefore, they must remain on the host to survive. Lice are generally transmitted from one animal to another by contact. Transmission from herd to herd is usually accomplished by transportation of carrier animals, although some lice may move from place to place by clinging to flies. Feeding lice irritate host animals, and infestations may be recognized by animal behavior. Sucking lice pierce the animal’s skin and draw blood. Biting lice have chewing mouthparts and feed on particles of hair, scab, and skin exudations. Weight loss may occur as a result of nervousness and improper nutrition (4,9).

Ticks. Several species of hard and soft tick attack livestock. Tick problems occur in wooded or brushy areas during spring and summer. Adults attack cattle mainly around the ears, eyes and poll of the head. Ticks have recurved teeth that allow them to hold on strongly once they have bitten the host. A fully engorged female usually deposits as many as 18,000 eggs on the ground. Larval or seed ticks emerge from the eggs and

usually climb up grasses or other low vegetation to contact passing animals. Effects from ticks on the host include inflammation, itching and swelling at the bite site, blood loss, production of wounds that can serve as sites for secondary invasion, obstruction of body openings, and paralysis from the injection of toxic fluids. Ticks also transmit many diseases, and they have the ability to transmit these diseases to their offspring without feeding on a diseased animal (4).

Insect Pests of Pastures

Mole crickets, caterpillar-type pests-such as armyworms, and spittlebugs are the most important pests of pasture grasses in Florida. Other insects may become important at certain times in localized areas. Between 1996 and 1999, about 300,000 acres of bahiagrass pasture have been destroyed by mole crickets in south-central Florida. The value of hay lost through this damage is estimated at $6 million annually. The combination of mole crickets and spittlebugs cause large patches of certain pastures to die back. Armyworms consume forage and cause extensive damage through widespread stripping of leaf blades from their veins. Aphids, armyworms, mole crickets and fire ants are considered to be the insects that cause the greatest economic loss in Florida pasture operations (3,10,11).

Aphids. The yellow sugarcane aphid is a major pest of pangolagrass. It is a potential threat in all areas where pangolagrass is grown, but it is of greatest importance in central and southern Florida. The greenbug (also an aphid) is found in most areas, but unlike the yellow sugarcane aphid, it is highly parasitized and frequently controlled by natural enemies (11).

Armyworms (fall, southern, striped and others). These caterpillars or “worms” are the immature stages of grayish-brown moths. Females lay their eggs on the lower leaves of grasses and the larvae begin to feed as soon as they hatch. They are called armyworms because they often move in large numbers from one area to another in search of food. Treatment must be made when the worms are small to prevent extensive damage. The almost mature larvae (1-1.5 inches in length) are difficult to control (11).

Grassworms or Striped Grass Loopers. These caterpillars, when full grown, are longer and more slender than the armyworms. They move in a looping manner by humping their bodies (inch worm). Striped grass loopers are especially fond of pangola-, para- and Bermudagrasses. Their color varies from cream to blue-gray to brown, black or orange. Large black and white spots appear when the body of the larva is fully extended. In addition to this coloration, grassworms have a light narrow stripe along the middle of the back the full length of the body. Smaller larvae are often overlooked when scouting (11).

Spittlebugs. Spittlebugs have caused damage to pastures in some areas of Florida. Adults, as well as nymphs, damage plants by sucking plant sap. The adult spittlebug is

about 3/8-inch long, and is dark brown to black, with two orange-red lines across its wings. The presence of immatures or nymphs is easily determined because they are covered with a mass of froth or spittle-like material. Tests for control have been limited. Insecticides have not given effective spittlebug management where the grass was allowed to grow tall and become densely matted. Burning off the dense mat of dry grass in late February or early March has been suggested for control of spittlebugs in coast pastures in the central and northern areas of the state. If the pasture contains clover, it can be burned late in the fall. Frequent mowing or grazing to keep down the dense mat will reduce the spittlebug problem (11).

Mole Crickets. Three species of these odd looking crickets, the tawny, the short-winged and the Southern mole cricket, are present in Florida. Only the tawny and Southern species are destructive to pastures. These brown crickets are covered with very fine hair and have flattened, shovel-like front legs. They usually grow to 1.5-inches in length. Mole crickets make burrows resembling tiny mole tunnels in the soil. The burrowing loosens the soil and the crickets disturb and cut off the grass roots. In the spring the adult female places 30 or more eggs in each of three or four underground cells. Eggs hatch in one or two weeks during warm weather. The crickets become adults by fall. There is one generation per year. Bait applications from mid-July through August are recommended for best control of mole crickets (11).

Chinch Bugs. Chinch bugs occasionally cause yield losses in pasture grass. They are common in dry years and prefer thin stands of grass. The adult chinch bug is 1/5-inch long with a black body. It has white wing covers, each with a black triangle at the middle of its outer margin. Newly hatched chinch bugs are reddish with a white band across their backs. As the nymphs mature, their reddish color becomes darker. Chinch bug feeding causes grass to have areas of dead and dying plants early in the spring, summer and fall. Generally these areas are limited to those spots where plant growth is poorest (11).

Management of Pasture Insects

Insect infestations in pastures usually start in small, isolated areas. Frequent inspections and spot treatments are recommended before infestations become widespread. This practice not only saves insecticide, but also prevents extensive injury to the grass and reduces environmental or residue problems. Granular, wettable powder (WP), and emulsifiable concentrate (EC) formulation insecticides may be used to control pasture insects. The granular formulations come “ready to apply,” while WP and EC formulations are diluted in enough water for sufficient coverage, usually a minimum of 3 gallons per acre by air and 10 gallons per acre by ground.

Management of Cattle-Attacking Insects

Most cattlemen/ranchers (about 93 percent) consider herd and pasture pest management to be an important part of the cattle operation. Cattlemen/ranchers report they determine when to treat the animals or pastures for pests on the following criteria:

- 65 percent administer a pest management treatment upon observing the pest;
- 51 percent treat when processing cattle;
- 45 percent treat based on the appearance of the animal or pasture (hair loss, scratching, etc.);
- 45 percent follow scheduled treatments;
- 18 percent treat when a pest threshold is reached; and
- 11 percent treat at their convenience (3).

Non-chemical Control

Biological Control of Mole Crickets

The mole cricket nematode (*Steinernema scapterisci*) can provide effective control of late instar and adult tawny, Southern, and short-winged mole crickets. For best results, the nematode is typically applied when most of the mole crickets are in the late instar and adult stages, which is normally June, July, and early August in north Florida. All stages may occur earlier in south Florida. The only stage of the nematode capable of infecting a mole cricket is the third stage (infective juvenile) which is the stage marketed by industry. After a mole cricket is infected by as few as two infective juveniles, the nematode reproduces inside the mole cricket body, undergoes two complete life cycles, and produces about 50,000 infective juveniles that emerge to seek out additional mole cricket hosts. The nematode is a living organism, and must be kept alive and in good condition before, during, and after application. It is stored under refrigeration until used and applied either late in the afternoon, at night, or on overcast days to avoid drying and the harmful effects of ultraviolet radiation. The nematode is usually applied to pastures suspended in water by equipment that injects the nematode into the soil. The application rate is approximately one billion per acre (12,13).

The Brazilian fly (*Ormia depleta*) was released in Florida for the first time in 1988 and is now established in at least 30 counties in the central and southern part of the Florida peninsula. Adult flies, which are active at night, require plant nectars as an energy source. Adult females give birth to living larvae which are deposited on and near adult mole crickets. The larvae burrow into the mole crickets, feeding on their internal organs. The larvae are fully-developed within about 7 days and emerge from the dying mole crickets to pupate in the ground. Adult flies emerge from the pupae after about 11 days, and push their way to the soil surface. Adult female files, when ready to deposit their larvae, are attracted to the song of mole cricket males. Males of both tawny and Southern mole crickets (found all over the state) produce songs attractive to these flies, but short-winged mole crickets (found primarily only in extreme south Florida) do not sing. The flies are capable of finding adult male tawny and Southern mole crickets by their song and will attack them and female mole crickets positioned near the singing males. The specificity of attraction to the song of tawny and Southern mole crickets means that these flies are harmless to non-target organisms. The flies are not sold as commercial products since they are classical biological control agents that have established populations in Florida. Instead of making further releases of flies in counties where populations are established, emphasis is placed on maintaining nectar-

producing plants in landscaping. The flies thrive and build up large populations only when they have access to adult mole crickets and nectar throughout the year (12).

Digger wasps (*Larra* spp.) have been collected from the Caribbean and South America and released several times in Florida beginning in the 1940s. Several nodes of establishment of *Larra bicolor* have been monitored in both the Fort Lauderdale area and the Gainesville area. It is important to have the appropriate nectar sources for the adult wasps for proper colonization, and efforts are being made to promote the planting of a buttonweed (*Spermacoce verticillata*) to feed the wasps during the adult stage (14).

Biological control agents imported from South America against *Scapteriscus* mole crickets are now well-established in parts of peninsular Florida. They seem to be producing area-wide control of mole crickets with no recurrent cost; this is the most economical means of mole cricket management. The level of mole cricket control probably will be improved by the continued spread of these established biological control agents (12).

Other Non-chemical Insect Pest Management Tactics

Florida ranchers report the practice of a variety of nonchemical pest management practices to manage insect pests (3). These practices include (percent refers to number reporting they follow the practice):

- scout for pests in their herds and pastures [94 percent]
    - conduct general observations while performing routine tasks [83 percent]
    - scout for pests more than once a week [44 percent]
    - conduct scouting one time per week [32 percent]
    - perform deliberate scouting activities on a scheduled basis [29 percent]
    - scout one time every two weeks [11 percent]
    - one time every month [10 percent]
    - one time every three weeks [3 percent]
- mow pastures [78 percent]
- rotate pastures [68 percent]
- practice manure management by dragging, etc. [60 percent]
- keep feeders and waterers clean [42 percent]
- alternate pesticides for resistance management [40 percent]
- burn pastures [35 percent]
- move cattle to open pastures to avoid flies [20 percent]
- separate infected animals from the rest of the herd [17 percent]
- isolating new animals from the herd [17 percent]
- incorporate fly traps to aid in management [3 percent]

Chemical Control

Nearly 99 percent of Florida's cattle producing operations report using pesticides to protect their cattle, facilities, and/or pastures from pests. Insecticides are applied by nearly all cattlemen to their animals, and most apply insecticides to their pastures.

Insecticides commonly applied to animals to manage external insect pests include coumaphos, diazinon, tetrachlorvinphos, tetrachlorvinphos + dichlorvos, permethrin, lambda-cyhalothrin, cyfluthrin, phosmet and pirimiphos-methyl. The animal drug products, moxidectin, ivermectin and doramectin (which have insecticide activity but are regulated by FDA rather than EPA) were also reported as being used. Insecticides commonly used to manage insect pests of pastures include compounds such as carbaryl, malathion, *Bacillus thuringiensis*, hydramethylnon, and methomyl (3). Other animal treatment compounds available in Florida in 2007 were beta-cyfluthrin, diazinon + chlorpyrifos, methoprene, and zeta-cypermethrin. Spinosad is available for pasture use and diflubenzuron is registered for pasture and animal, but the animal product is not registered for sale in Florida as of 2007 (4,11).

Chemical of Management of Animal Parasites

Coumaphos. Coumaphos is an organophosphate insecticide that has been used for management of cattle pests such as (ranked in order of importance): horn flies, lice, face flies, ticks, cattle grubs, stable flies, horse flies, and mange. Coumaphos is considered a selective insecticide because it kills specific insect species while sparing other non-target organisms. Coumaphos was reported as being used by 24 percent of the Florida cattlemen/ranchers. They reported its use on approximately 95 percent of their herd an average of 2.4 times in some manner (either as an animal spray, a pour-on, or an ear tag). The average coumaphos treatment rate for animals in the South is 2.2 grams per head (3,15).

Permethrin. Permethrin is a broad-spectrum, synthetic pyrethroid insecticide. Cattle producers in Florida report using permethrin during most years, primarily for the management of cattle pests such as (ranked in order of importance): lice, horn flies, face flies, ticks, cattle grubs, stable flies, horse flies, and mange. One product, (DeLice®) was applied by 41 percent of surveyed cattlemen/ranchers and it was applied to approximately 94 percent of their herd an average of 2.3 times as a pour-on, an animal spray, or an ear tag. Other permethrin-containing products were applied by 11 percent of surveyed cattlemen/ranchers. Of those reporting use of permethrin products other than DeLice®, approximately 95 percent of their herds were treated an average of 2.8 times in some manner. The average permethrin treatment rate for animals in the South is 2.0 grams per head (3,15).

Tetrachlorvinphos. Tetrachlorvinphos is another organophosphate insecticide, used for management of cattle pests such as (ranked in order of importance): horn flies, face flies, horse flies, stable flies, ticks, lice, cattle grubs, and mange. Tetrachlorvinphos was applied by 2 percent of surveyed cattlemen/ranchers. Of those reporting use of tetrachlorvinphos, it was applied to approximately 90 percent of their herd an average of 3.6 times as an animal spray. The average tetrachlorvinphos treatment rate for animals in the South is 12.2 grams per head (3,15).

Tetrachlorvinphos + dichlorvos. This combination product, generally marketed as RaVap® is an insecticide comprised of two organophosphate active ingredients.

Tetrachlorvinphos is sometimes called stirofos. Dichlorvos is also known as DDVP. RaVap® is primarily used for management of cattle pests such as (ranked in order of importance): face flies, lice, horse flies, horn flies, stable flies, mange, cattle grubs, and ticks. RaVap® was applied by 2 percent of surveyed cattlemen/ranchers. Those reporting use of the product applied it to 100 percent of their herd an average of 2 times as an animal spray. The average dichlorvos treatment rate for animals in the South is 2.6 grams per head (3,15).

Phosmet. Phosmet is an organophosphate insecticide, primarily used for management of cattle pests such as (ranked in order of importance): horn flies, lice, face flies, ticks, stable flies, horse flies, mange, and cattle grubs. Phosmet was applied by 3 percent of surveyed cattlemen/ranchers. Of those reporting phosmet use, it was applied to approximately 99 percent of their herd an average of 1.6 times, as an animal spray, as a pour-on, or as a backrubber. The average phosmet treatment rate for animals in the South is 5.4 grams per head (3,15).

Diazinon. Diazinon is an organophospate insecticide used to manage cattle pests such as (ranked in order of importance): horn flies, face flies, lice, stable flies, ticks, horse flies, cattle grubs, and mange. Diazinon was applied by 10 percent of surveyed cattlemen/ranchers. Of those reporting diazinon use, it was applied to approximately 95 percent of their herd an average of 1.4 times, as ear tags, dust bags, as a pour-on, or as an animal spray. The average diazinon treatment rate for animals in the South is 11.5 grams per head (3,15).

Cyfluthrin. Cyfluthrin is a synthetic pyrethroid insecticide that has both contact and stomach poison action, used to manage cattle pests such as (ranked in order of importance): horn flies, lice, face flies, stable flies, cattle grubs, ticks, horse flies, and mange. Cyfluthrin was applied by 4 percent of surveyed cattlemen/ranchers. Of those reporting cyfluthrin use, it was applied to approximately 91 percent of their herd an average of 2.1 times as a pour-on or as an animal spray. The average cyfluthrin treatment rate for animals in the South is 0.7 grams per head (3,15).

Lambda-cyhalothrin. Lambda-cyhalothrin is a synthetic pyrethroid insecticide used for management of cattle pests such as (ranked in order of importance): horn flies, lice, face flies, ticks, cattle grubs, stable flies, and horse flies. Lambda-cyhalothrin was applied by 9 percent of surveyed cattlemen/ranchers. Of those reporting lambda-cyhalothrin use, it was applied to approximately 97 percent of their herd an average of 2.0 times as a pour-on or as an animal spray. The average lambda-cyhalothrin treatment rate for animals in the South is 0.6 grams per head (3,15).

Malathion - Malathion is a broad-spectrum organophosphate insecticide used for management of cattle pests such as (ranked in order of importance): face flies, horn flies, horse flies, lice, stable flies, ticks, and cattle grubs. Malathion was applied by 3 percent of surveyed cattlemen/ranchers. Of those reporting malathion use, it was applied to approximately 95 percent of their herd an average of 3.3 times as a

backrubber, or as an animal spray or pour-on. The average malathion treatment rate for animals in the South is 33.5 grams per head (3,15).

Ivermectin. Ivermectin, regulated by FDA as an animal drug, is a fermentation product derived from the soil bacterium *Streptomyces avermitilis*. It is primarily used for management of internal parasites of cattle and external pests such as (ranked in order of importance): horn flies, lice, face flies, cattle grubs, ticks, stable flies, horse flies, and mange. Ivermectin was applied by 27 percent of surveyed cattlemen/ranchers. Of those reporting ivermectin use, it was applied to approximately 91 percent of their herd an average of 1.9 times as a pour-on or as an injection. The average ivermectin treatment rate for animals in the South is 0.1 grams per head (3,15).

Doramectrin. Doramectrin is also regulated by FDA as an animal drug. Doramectin is used for management of internal parasites of cattle and external pests such as (ranked in order of importance): lice, horn flies, face flies, ticks, stable flies, cattle grubs, and ticks. Doramectrin was applied by 4 percent of surveyed cattlemen/ranchers. Of those reporting doramectrin use, it was applied to approximately 92 percent of their herd an average of 1.9 times as a pour-on. The average doramectin treatment rate for animals in the South is 0.1 grams per head (3,15).

Chemical Management of Pasture Insect

Carbaryl. Carbaryl is a carbamate insecticide used to manage armyworms, fire ants, mole crickets, spittlebugs and, to a lesser degree, mosquitoes. It is applied as a ground spray (88 percent), by bait application (16 percent), or by an aerial spray (7 percent). More than 32 percent of Florida cattlemen/ranchers apply carbaryl to their pastures at a rate of approximately 1.24 pounds of active ingredient (ai) per acre an average of 2 times annually. There is a 14-day grazing and haying restriction after application (3,11).

Methomyl. Methomyl is another carbamate insecticide used to manage armyworms and other lepidopteran larvae. It is applied as a ground spray (by 85 percent), or as an aerial spray (14 percent). More than 6 percent of Florida cattlemen/ranchers apply methomyl to their pastures, at a rate of approximately 0.43 lb ai/acre an average of 2.1 times annually. Methomyl is effective in two ways: (a) as a “contact insecticide,” because it kills target insects upon direct contact, and (b) as a “systemic insecticide” because of its capability to cause overall “systemic” poisoning in target insects, after it is absorbed and transported throughout the pests that feed on treated plants. There is a 7-day grazing restriction and a 3-day Bermudagrass haying restriction after application (3,11).

Hydramethylnon. Hydramethylnon is a trifluoromethyl amidinohydrazone insecticide used to manage fire ants by inhibiting mitochondrial electron flow. It is only applied as a bait. More than 8 percent of cattlemen/ranchers apply the bait to their pastures, at a rate of approximately 0.18 pounds ai/acre an average of 3 times annually. There is a 7-day grazing and haying restriction after bait placement (3,11).

Malathion. Malathion is an organophosphate insecticide used to manage armyworms, mole crickets and fire ants, and mosquitoes to a lesser degree. Malathion is a nonsystemic, broad-spectrum organophosphate insecticide. For pasture uses, it is applied as a ground spray. More than 4 percent of Florida cattlemen/ranchers apply malathion to their pastures, at a rate of approximately 2.1 lb ai/acre an average of 1.25 times annually (3,11).

***Bacillus thuringiensis*.** B.t. is a lepidopteran-specific insecticide considered ideal for pest management because of its specificity to pests and because of its lack of toxicity to humans or natural enemies of many crop pests. To be effective, B.t. must be eaten by insects during the early stages of the larvae. B.t. is ineffective against adult insects. Cattlemen/ranchers in Florida use B.t. mainly for the management of pasture pests such as armyworms. B.t. was applied by nearly 2 percent of Florida cattlemen/ranchers as a ground spray, a total of 2.0 times annually (3,11).

Weed Management in Pastures and Rangeland

Effective weed control begins with good pasture or rangeland management. Good weed management begins with proper choice of the forage species and variety, adequate fertility/soil pH, proper grazing management, and management of pests. If the grass dies or is not growing well, there is usually some weed that will tolerate the condition that caused the grass not to grow and that weed will become established. Once a weed is established, mechanical or chemical methods are usually employed to control the weeds; however, unless the basic management problem is corrected, the grass will not regrow in the area and weeds will continue to reinfest the area. Florida cattlemen consider dogfennel, smutgrass, and tropical soda apple (in that order) to be the weeds that cause the greatest economic loss in Florida pasture operations (3,16-20). However, tropical soda apple has the greatest potential for creating economic barriers to trade and transport.

Tropical Soda Apple. Tropical soda apple (TSA) is a serious broadleaf perennial weed problem in many grass pastures and rangelands in Florida. This noxious weed has foliage unpalatable to livestock and highly viable seed. It can seriously infest pasture or native land within 1-2 years, resulting in lower stocking rates. In addition to Florida, TSA occurs in Georgia, Alabama, Mississippi, South Carolina, Tennessee, Louisiana, and Pennsylvania; however, its incidence has been highest in Florida (covering more than one million acres since 1991, or about 40 percent of improved pastureland in the state). Populations are highest in south Florida, although it is observed throughout the state. TSA is found in pastures, ditch banks, citrus groves, sugarcane fields, vegetable fields, and rangeland. It appears to be restricted to semi-disturbed sites.

At maturity TSA is 3-6 feet tall and the entire plant (stems, leaves) has prickles (like thorns) that are about 0.5 - 1.0 inch long. The leaves are pubescent (hairy), 6-8 inches long and 3-6 inches wide, and lobed. The flowers are white with cream-colored stamens. The fruit is globular, about 1 inch in diameter, and yellow when mature

(immature fruit look like a small watermelon). Each mature fruit contains about 400 light red-brown seeds that are about 0.1 inch in diameter. Seeds are moderately flattened and contained in a mucilaginous layer that contains a glyco-alkaloid called solasodine. Flowering and fruit production occurs throughout the year, but it is concentrated from September through May when large numbers (40,000 to 50,000 per plant) of viable seeds (75 percent germination) are provided for dispersal. Livestock and wildlife (feral hogs, deer, raccoons) eat the fruit and disperse the seed via their feces spreading the plant to other land areas.

The viability of TSA seeds that pass through the gastrointestinal tract of cattle is as high as 88 percent. Tropical soda apple seedlings have been observed germinating from dung piles which means cattle can spread the seed from pasture to pasture and state to state. Research indicates that tropical soda apple seed can remain in the gastrointestinal tract for at least 18 days, but the seed is non-viable after approximately 6 days in the tract. This suggests that cattle should be held in a TSA free area for at least 1 week before shipping cattle from a tropical soda apple infested area.

New TSA plants emerge from seed or roots of existing plants. The root system is extensive with feeder roots (0.25-1.0 inch diameter) located a few inches below ground, extending 3-6 feet horizontally from the crown of the plant. Research indicates that neither temperature nor photoperiod are likely to limit the spread of TSA in southern and southeastern United States.

The invasion of tropical soda apple has several impacts. It causes lower stocking rates (due to displacement of desirable forage species and its unpalatable leaves) and increased management costs. TSA is a host to three viruses that cause disease in pepper, tomato, and tobacco and it supports the Colorado potato beetle, tobacco hornworm and budworm, tomato pinworm, green peach aphid, and sweet-potato whitefly. Hence, TSA serves as a reservoir for viruses and other pests of economically important crops (16-18).

Dogfennel. Dogfennel is particularly a problem on unimproved or overgrazed pastures where it adds to the decline of forage yield and quality. It is considered by Florida cattlemen to be the number one pasture weed problem. While it may be grazed for lack of other suitable forage, it contains low levels of the toxin tremitol, which causes dehydration in cattle (19).

Smutgrass. Smutgrass is a serious weed problem in many Florida pastures. Giant smutgrass is found primarily in south Florida while small smutgrass is found throughout the state. These are perennial bunch plants named for the dark-colored fungus that is often found in the seed heads. Seeds of smutgrass plants often remain attached to the seed head for sometime after maturing and are spread by adhering to livestock, by water or wind and may remain viable for two or more years. Smutgrass produces in excess of 45,000 seeds per plant with over 1,400 seeds per head. Seed production takes place continuously throughout the growing season (20).

Non-chemical Weed Management
Tropical soda apple must not be allowed to produce fruit. Mowing plants to a 3 inch stubble height as soon as possible keeps them from producing fruit and seed. Pastures should be checked monthly for new TSA seedlings. Mowing may slow TSA spread; however, mowing alone will not provide complete control (16).

For other weeds, mowing is one of the most used methods for general weed control in pastures. Mowing improves the appearance of a pasture and, if properly timed, prevents weeds from producing seed. Its effectiveness in controlling weeds depends on the type of weeds present. Mowing is generally more effective on broadleaf and annual weeds than grass and perennial weeds. Mowing aids in the spread of smutgrass seeds rather than controlling it. With continuous close mowing, the diameter of the smutgrass plant decreases, but the number of plants increases. Mowing or fire alone provides only a short term solution for briars. Cattlemen/ranchers must consider the amount of energy required and effectiveness before mowing. Other methods of weed management may be more energy efficient (19-21).

Burning
Fire plays an important role in preventing woody plant invasion. Burning is limited to controlling brush and weeds and improving grazing distribution. The presence and abundance of plant species, forage yields, and range condition are affected by burning and the timing of burning. Burning must occur when the plant is actively growing or has buds above the soil surface to effectively control undesirable species. Perennial plant food reserves should be near their lowest point to make regrowth difficult. Timing of the burn affects forage yield. The earlier the burning date, the lower the forage yield. Changes in forage yield associated with burning date are due to moisture and temperature change. Properly timed burns result in little change in soil moisture condition, soil structure and soil erosion due to runoff. Prescribed burning is a management tool for pastures and rangeland, practiced by more than a third of Florida cattlemen/ranchers. Properly used, it can be a cost effective method for increasing the productivity of pastures/rangeland as well as controlling many undesirable plants (3,20).

Chemical Control
Proper choice of herbicide and the rate applied are extremely important considerations. Rates that are too low will not give adequate weed control, and rates that are too high may injure the forage and kill only the top of perennial weeds. Timing the application is important. Preemergence herbicides are applied before the weeds germinate and emerge; therefore, knowledge of the life cycle of the weed is important. The vast majority of herbicide applications made to pastures are made postemergence. To be effective, applications need to be made when the weeds have recently germinated and are small. It is advisable to allow perennial weeds regrowing from storage organs to grow for a short period of time before spraying to allow sufficient leaf surface for coverage and to insure that the perennial is manufacturing food (through photosynthesis) and translocating it and the herbicide back to the roots. Herbicides may be applied to the entire pasture or as spot treatments for localized infestations of weeds. Spot treatments reduce costs and save energy. Herbicides used in pastures

and rangelands present minimal hazard to animals when used according to label directions (22).

Care must be exercised in selecting herbicides based on grass species. Different species have different sensitivities to these compounds. However, the vast amount of acreage is planted in bahiagrass and Bermudagrass (23). Herbicides registered for use in Florida for pasture in 2007 include: aminopyralid, 2,4-D, carfentrazone, chlorsulfuron, diuron, dicamba, fluroxypyr, glyphosate, hexazinone, imazapic, metsulfuron, paraquat, and triclopyr (22).

Dicamba + 2,4-D. This combination is popular for control of mainly dogfennel, but also controls weeds such as pigweed, horseweed, ragweed, wild mustard, myrtle and thistle. Dicamba is a benzoic acid herbicide and 2,4-D is a phenoxy herbicide. The combination is applied by about a quarter of cattlemen/ranchers in the state by either ground (80 percent), spot application (18 percent), or aerial application (5 percent). At a rate of 45 fluid ounces of formulated material per acre, approximately 0.35 lb ai of dicamba and 1.0 lb ai of 2,4-D are applied per acre an average of 1.3 times annually. For beef cattle, there is no grazing restriction, but there is a 30-day slaughter restriction. There is also a 37-day haying restriction (3,22,24).

Glyphosate. Glyphosate is a non-selective systemic post-emergent herbicide applied by more than 15 percent of Florida cattlemen/ranchers to manage any actively-growing plants in the area of treatment. It is a broad-spectrum herbicide used for control of annual and perennial plants including grasses, sedges, broad-leaved weeds, and woody plants. Cattlemen/ranchers apply it as a spot application to areas such as fence rows. At a rate of 53 fluid ounces of formulated material per acre, approximately 1.6 lbs ai/A are applied an average of 1.5 times annually. There are no restrictions when used during the dormant season, but there are one- or two-month restrictions when used between cuttings or for pasture renovation, respectively (3,22,25).

Triclopyr. Triclopyr, a picolinic acid, is a selective systemic herbicide applied by nearly 15 percent of Florida cattlemen/ranchers to manage weeds such as tropical soda apple, Brazilian pepper, briars and blackberry, dogfennel, ragweed, persimmon, nightshade, myrtle, thistle, morningglory, cactus, and goldenrod. It is applied as a spot application (76 percent), but also as ground applications (22 percent) or, to a lesser degree, by aerial application (2 percent). At a rate of 44 fluid ounces of formulated material per acre, approximately 2 lbs ai/A are applied an average of 1.7 times annually. For beef cattle, there is no grazing restriction, but there is a 3-day slaughter restriction. There is also a 14-day haying restriction (3,22,26).

2,4-D. 2,4-D is a broadleaf systemic post-emergent herbicide applied by nearly 13 percent of all cattlemen/ranchers to manage weeds such as dogfennel, pigweed, wild radish, ragweed, dandelion, spiny amaranth, and teaweed. It is applied via ground (81 percent) and spot application (22 percent). At a rate of 45 fluid ounces of formulated material per acre, approximately 1.4 lb ai/A are applied an average of 1.3 times

annually. For beef cattle, there is no grazing restriction, but there is a 3-day slaughter restriction. There is also a 30-day haying restriction (3,22).

Metsulfuron. Metsulfuron is a residual sulfonylurea compound used as a selective pre- and postemergence herbicide for broadleaf weeds and some annual grasses. It is a systemic compound with foliar and soil activity. It is applied by nearly 3 percent of Florida cattlemen/ranchers to manage bahiagrass in Bermudagrass pastures. It is applied by ground (100 percent) sometimes with follow-up spot applications (17 percent). Metsulfuron is applied at a rate of approximately 0.24 ounces of ai per acre an average of 1.0 time (3,22).

Hexazinone. Hexazinone is a systemic post-emergent broadleaf and grassy weed triazine herbicide applied by more than 2 percent of Florida cattlemen/ranchers to manage smutgrass. Hexazinone is applied by ground (67 percent) and spot application (33 percent). At a rate of 56 fluid ounces of formulated material per acre, approximately 0.9 lb ai/A is applied once annually. There is a 60-day grazing restriction and a 60-day haying restriction (3,22,27).

Paraquat. Paraquat is a non-selective systemic post-emergent herbicide applied by nearly 1 percent of all cattlemen/ranchers. It is a quick-acting compound that destroys green plant tissue on contact. It is applied to manage growing plants in the area of treatment. Paraquat is applied by cattlemen/ranchers as a spot application to areas such as fence rows. At a rate of 16 fluid ounces of formulated material per acre, approximately 0.4 lb ai/A is applied an average of once annually (3,22,28).

Key Contacts

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