

## LIVESTOCK PRODUCTION



# PASTURE-WEED IDENTIFICATION AND MANAGEMENT

# WORKSHOP PROCEEDINGS

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## **Table of Contents**

IMPORTANCE OF PASTURE-WEED MANAGEMENT .....	3
Introduction .....	3
Steps to Manage Pasture Weeds.....	3
Methods of Weed Management .....	4
Conclusions .....	6
References .....	6
HERBICIDE RESISTANCE AND THE NEED FOR INTEGRATED.....	8
WEED MANAGEMENT .....	8
What is Herbicide Resistance? .....	8
Mechanisms of Herbicide Resistance .....	8
What are the Indications of Herbicide Resistance?.....	9
Confirmed Herbicide-Resistant Weeds in Alabama .....	9
Herbicide Modes of Action.....	10
Ways to Prevent or Delay Herbicide Resistance.....	11
Managing Herbicide Resistance with Integrated Weed Management (IWM).....	12
References .....	13
USING GOATS TO CONTROL WEEDS .....	14
Introduction .....	14
Weed Control Strategies.....	15
Why are Goats Suitable for Weed Control?.....	16
Simple Guidelines .....	17
Potential Constraints .....	18
Conclusions .....	18
References .....	19
COMMON NASTY WEEDS IN SOUTHERN PASTURES AND THEIR SUSTAINABLE MANAGEMENT .....	20
Why Control Weeds in Forages? .....	20
What is a Weed?.....	20
Characteristics of Weeds.....	20
Proper Weed Identification .....	21

Weed Terminology.....	22
Broadleaf Weeds Affecting Forage Crops .....	23
Grassy Weeds Affecting Forage Crops.....	23
Pasture Weed Control Strategies.....	23
References .....	24
<b>CHEMICAL USE TO CONTROL PASTURE WEED – HERBICIDE SELECTION, PREPARATION, TIMING, AND APPLICATION.....</b>	<b>25</b>
Introduction .....	25
Good Pasture Management is the Foundation for Weed Control .....	25
Understanding the Growth Patterns of the Target Weeds.....	26
Weed Control Tools of the Trade.....	27
Herbicides Commonly Used in Pastures.....	33
Conclusions .....	36
References .....	37
<b>THE INFLUENCE OF SOIL pH, NUTRIENTS, AND GRAZING MANAGEMENT ON WEED PREVALENCE IN PASTURES .....</b>	<b>38</b>
Background .....	38
Soil Fertility.....	39
Soil pH.....	39
Nitrogen.....	40
Phosphorus .....	41
Potassium .....	41
Grazing Management .....	42
References .....	44

# IMPORTANCE OF PASTURE-WEED MANAGEMENT

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## Introduction

Weed management is one of the important aspects for maintaining healthy, productive pastures. Any unwanted plant is called weed. Whether a plant is considered weed may differ from one to another production system. For example, a weed in cattle grazing system may not necessarily be a weed in goat grazing system, such as briars being present in the latter. Weeds emerge and develop voluntarily whenever and wherever they find suitable environment. Weeds compete with forage plants for nutrients, moisture, sunlight, and space, and lower pasture productivity. Weeds are generally not eaten by grazing animals, but forages surrounding the weeds are utilized. This situation provides weeds with better growing conditions with no or minimum competition from the useful forage plants. When weeds are left on pastures, they get well established by developing strong roots and stems as well as food storage structures like rhizomes, tubers, stolons, and crowns. Moreover, weeds propagate very fast with a huge quantity of seed production if not removed before their reproductive phase (flowering, seed development, and maturation). Rhodes et al. (2005) have highlighted that a single plant of musk thistle, curly dock, and pigweed, respectively, can produce as many as 10,000, 40,000, and 120,000 seeds in one growing season. So, one can imagine that if weeds are not managed properly, pasture can be badly infested with weeds in a matter of a year or couple of years.

## Steps to Manage Pasture Weeds

1. **Identify weeds:** Identification is the first step in weed management. One must be able to identify weeds and useful forages present in pastures so that weeds can be removed without harming the useful plants.
2. **Be watchful on your pastures:** Take a walk on your pasture from time to time and inspect whether any weeds are emerging. You will notice weed growth if there are any. By noticing weeds early, you have the opportunity to control them before it is too late, that is, before they

are mature, seeds are produced, and spread to infest larger area. Early control of weeds also saves time, money, and the environment in the long run.

3. **Minimize human or animal mediated weed spread:** Avoid spreading manure infested with weed seeds. Manure from weed infested area should not be used in weed free area. Grazing animals should be quarantined after they are removed from weed-infested areas and before moving them to weed-free areas. Also, choppers and mowers should be thoroughly cleaned after using them in weed-infested areas to avoid the weed seeds spreading to new areas.
4. **Manage weeds on time:** When you notice weed infestation in your pastures, you need to act in time to manage them appropriately. There are different methods of weed management. One can use any one method or a combination of different methods that is most appropriate depending on weed species, available resources, associated cost, and farm conditions. Common methods of weed management are briefly presented below.

### **Methods of Weed Management**

**Cultural practices:** Pasture soils need to be tested for pH and nutrient contents while establishing new pastures or maintaining existing pastures. Based on soil test recommendations, necessary lime and fertilizers need to be added to the pasture soils to provide appropriate pH and nutrient requirements for forage growth. Also, suitable forage species should be planted for the given soil types and climatic conditions so that forages grow well and remain competitive.

Appropriate quantity of seed should be planted to obtain a good forage sod. Use of lower seed rates leaves spaces for weeds to grow and overseeding results into much competition among the desirable species, so they cannot perform well and weeds may invade. This method is covered in detail under a different topic ‘Influence of soil pH, nutrients, and grazing management on weed prevalence in pasture’ later in these proceedings.

**Crop rotation:** Weed problems can be minimized by crop rotation as weeds are removed with the removal of existing crops and weed roots are weakened or damaged by all the tilling operations involved in planting new crops. However, it may not be a practical option for permanent pastures.

**Grazing management:** Weeds can be managed better with rotational grazing than continuous grazing system. This is because animals are left in pastures for a whole grazing season and managers do not have any control on animals where they go and how long they graze in a continuous grazing system. Also, animals overgraze palatable species and undergraze less palatable species in a continuous grazing system. Overgrazing depletes the sod and expose soil/bare ground. This allows sunlight reaching the ground, which facilitates weed emergence and development. Undergrazing leaves plants to grow tall and mature; this shades the short growing forages and deplete their growth resulting in depletion of sward thickness and promotion of weed emergence and development.

In a rotational grazing system, pastures are divided into different sections and animals are allowed to graze one section at a time until the desirable stubble height of forages is reached, then moved to next section sequentially based on available forages. In this system, there are few days of grazing period when animals are allowed to graze any section and several days of resting period when animals are taken completely off that section. Confinement of animals in a smaller portion results in uniform utilization of all forages present in that portion, so the chances of overgrazing or undergrazing is minimized. With the provision of resting period after each grazing, forages have chance to recover and maintain a good sod. Consequently, there is less suitable environment for weed emergence and development in rotational grazing system compared to continuous grazing system. More detail about the continuous and rotational grazing systems can be found in ‘Year-round Pasture Production and Management’ (Karki and Gurung 2009).

Another useful grazing strategy for weed management is to practice mixed-species grazing. This involves including different species of grazing animals with different forage preferences. For example, most weeds can be managed well when cattle and goats are grazed in the same pastures. This is because cattle prefer grass, while goats prefer browsing on brush, shrub, and grazing broad leaf plants including weeds and briers (Coffey 2001; Luginbuhl et al. 2000).

**Mechanical:** This method involves removing weeds by cutting, uprooting, or mowing. Weeds should be removed when they are still in vegetative stage. Cosgrove and Doll (1996) mentioned that one mowing in a growing season should be enough for managing annual weeds. For

managing perennial weeds, multiple mowing in an interval that allows weeds to grow 8-12 inches tall is required until these are killed completely.

**Chemical:** This method involves the application of appropriate herbicides at suitable stage of weed growth. Details on this method will be covered under a separate heading ‘Chemical use to control pasture weed – herbicide selection, preparation, timing, and application’ later in these proceedings.

**Integrated management:** This involves the application of more than one method mentioned above.

### Conclusions

Weed management is very important for maintaining pasture productivity and lower production cost. One needs to be very watchful to identify the emerging weeds in pastures and apply an appropriate method to avoid weed infestation. Whichever method is used, weeds should be controlled when they are young and still in vegetative stage. Once seeds are dropped, more weeds will come up in the next season resulting in wastage of money and time spent for weed control. If weeds are not controlled, they gradually take over pasture since the grazer selects against them.

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# HERBICIDE RESISTANCE AND THE NEED FOR INTEGRATED WEED MANAGEMENT

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## What is Herbicide Resistance?

Herbicide resistance is the inherited ability of a plant to survive and reproduce despite an exposure to a dose of herbicide that would normally be lethal to it. It is a naturally occurring evolutionary process in response to a selection pressure, i.e. herbicides. The occurrence of herbicide resistant weeds is not a new phenomenon. The first report was from Hawaii in 1957 when spreading dayflower (*Commelina diffusa*) showed resistance to 2,4-D (Heap 2011). However, the first confirmed case of a resistant weed in the U.S. was that of common groundsel (*Senecio vulgaris*) against triazine in 1968 (Ryan 1970). Since then, 352 biotypes of weeds belonging to 192 species have evolved resistance to various herbicides worldwide (Heap 2011). Herbicide resistance is not confined to agronomic or horticultural crops. It can also occur in pastures; and it is a big problem in pastures in countries like Australia.

## Mechanisms of Herbicide Resistance

Four main mechanisms have been identified by which weeds are able to resist herbicides. These include:

- a) Altered site of action: Within a plant, an herbicide has to act on a specific site to disrupt a particular vital plant function. Some plants have been able to make alterations in this target site so that the herbicide molecule is no longer able to bind to this site.
- b) Enhanced metabolism of the herbicide: Some plants have evolved resistance by developing the ability to metabolize or break down the chemical to nonactive compounds.
- c) Reduced translocation: Herbicides can be translocated in the xylem, phloem, or both. Some plants have been able to show resistance by reducing the translocation of herbicides within their system.

- d) Herbicide compartmentalization/sequestration: Some plants have evolved resistance by compartmentalizing or sequestering herbicides into physiologically inactive regions (e.g. vacuoles) in the plant.

### **What are the Indications of Herbicide Resistance?**

A case for herbicide resistance can be suspected when:

- A select number of plants show significant re-growth following treatment at the recommended label dose and weed growth stage.
- A select number of plants completely escape a treatment, even though they were treated at the recommended label dose and time.
- Higher than label rates are needed for control.
- A shift in weed species occur after years of treating with the same herbicide(s), even though they were controlled previously at the same recommended labeled rates.

#### ***Do not confuse herbicide resistance with herbicide failure***

Herbicide failure should not be confused with herbicide resistance. Sometimes when herbicides are not applied according to label directions they may not work effectively, this is herbicide failure and not necessarily herbicide resistance. Often people spray herbicides when the weeds are too big or at a mature stage. The spray may not work but this may be because of the wrong application time and not because of herbicide resistance. The environmental conditions (temperature, humidity, time of day etc.) during herbicide application are important to get the best weed control out of the herbicides. Even the pH of the water and quality of the water can affect herbicide performance. In some cases, if a weed is not mentioned on the herbicide label, probably the herbicide will not have an effect on that weed. This again is not a case of herbicide resistance. It is recommended that producers consult Extension agents or scientific authorities to confirm herbicide resistance.

### **Confirmed Herbicide-Resistant Weeds in Alabama**

According to an online report (Heap 2011), there are four weed species that have been confirmed as resistant to certain herbicide groups in Alabama (Table 2.1). The website

([www.weedscience.org](http://www.weedscience.org)) provides up-to-date information on cases of herbicide resistance worldwide.

Table 2.1. Herbicide Resistant Weeds in Alabama (Adapted from Heap 2011)

<b>Name of Weed</b>	<b>Situation</b>	<b>Herbicide Group*</b>	<b>Year</b>
Annual bluegrass ( <i>Poa annua</i> )	Pastures	5	1980
Goosegrass ( <i>Eleusine indica</i> )	Cotton	3	1987
Common cocklebur ( <i>Xanthium strumarium</i> )	Cotton	17	1988
Palmer amaranth ( <i>Amaranthus palmeri</i> )	Soybean	9	2008

\*Please see Table 2.2 for the mode of action of these herbicide groups.

There are several other weeds in adjoining states that have been reported to be resistant to some herbicides. This information has to be taken into consideration because the chances are very high that these weeds could become herbicide resistant in Alabama too.

### **Herbicide Modes of Action**

Herbicide use is an important tool for vegetation management. The judicious use of herbicides, however, has always been advocated to prevent or delay herbicide resistance. To address this issue, the Weed Science Society of America (WSSA) developed a classification system for herbicides based on their site of action (Table 2.2). Herbicides with the similar site of actions were assigned to the same group in this Table. A major reason for the evolution of herbicide resistance in weeds is the repeated use of herbicides from the same group. Therefore, it is important to know the mode of action of the herbicides and their grouping and rotate herbicides from different groups accordingly to prevent or delay resistance.

Table 2.2. Herbicide Groups and Their Mechanism of Action (Adapted from WSSA 2011).

Group	Mode of Action	Examples of common names*
1	Acetyl CoA Carboxylase (ACCase) Inhibitors	Fluazifop-P, Clethodim, Sethoxydim
2	Acetolactate Synthase (ALS) or Acetohydroxy Acid Synthase (AHAS) Inhibitors	Imazamox, Imazapyr, Bensulfuron, Chlorsulfuron, Metsulfuron, Nicosulfuron, Rimsulfuron, Flumetsulam
3, 15, 23	Mitosis inhibitor	Pendimethalin, Trifluralin, Thiazopyr, DCPA
4	Synthetic auxins	2,4-D, Dicamba, MCPA, Picloram, Triclopyr
5, 6, 7	Photosystem II inhibitors	Atrazine, Metribuzin, Bentazon, Diuron
8, 16	Fatty Acid and Lipid Biosynthesis Inhibitors	EPTC, Bensulide,
9	Enolpyruvyl Shikimate-3-Phosphate (EPSP) Synthase Inhibitors	Glyphosate
10	Glutamine Synthetase Inhibitors	Glufonisate
11, 12, 13, 27	Carotenoid Biosynthesis Inhibitors	Amitrole, Isoxaflutole, Norflurazon,
14	Protoporphyrinogen Oxidase (PPG oxidase or Protox) Inhibitors	Acifluorfen, Flumioxazin, Oxadiazon
17, 25, 26, 28	Potential Nucleic Acid Inhibitors or Non-descript mode of action	MSMA, Dazomet, Difenzoquat
18	Dihydropteroate Synthetase Inhibitors	Asulam
19	Auxin Transport Inhibitors	Diflufenzopyr
20, 21, 28	Cellulose Inhibitors	Dichlobenil, Isoxaben
22	Photosystem I Inhibitors	Diquat, Paraquat
24	Oxidative Phosphorylation Uncouplers	Dinoterb
NC	Not classified	

\*This is not a complete list. Please contact your local Extension office for more details and registration status.

### Ways to Prevent or Delay Herbicide Resistance

Herbicide resistance can be prevented or delayed by using appropriate management practices.

Some of these practices include:

- a) Herbicide rotation: Repeated application of the same herbicide or herbicides with the same mode of action every year should be avoided.
- b) Crop rotation: Generally different crop types require different herbicides so rotating crops will also mean a rotation of herbicides. However, caution should be taken to avoid herbicides with the same mode of action. Crop rotation may not always be an option in pastures.

- c) Residual herbicides: Herbicide resistance can also be generally prevented or delayed by avoiding the use of herbicides that persist in the soil for long periods.
- d) Clean seed: Certified clean crop seeds should be planted to avoid contamination by herbicide-resistant weed seeds.
- e) Monitoring: Fields should be regularly monitored to watch for weed escapes that may be herbicide resistant.
- f) Record keeping: Accurate records of herbicides applied should be kept to maintain a field history.
- g) Prevent seed return: Weeds should not be allowed to set seeds because if they are herbicide resistant it is very likely that they will produce herbicide resistant plants in the future. In Australia, controlled burning in pastures is practiced to kill weed seeds.
- h) Heavy grazing/mowing to reduce weed seed set.
- i) Care should be taken in moving equipment or animals from one field to another. If one field is infested with resistant weeds, seeds or plant parts can easily move to other fields with the equipment or animals.
- j) Integrated weed management: An integrated program should be practiced by combining all available tools (cultural, mechanical, biological, chemical) of weed management to prevent herbicide resistance.

### **Managing Herbicide Resistance with Integrated Weed Management (IWM)**

#### **What is integrated weed management?**

Integrated weed management (IWM) is a systems approach to weed management that advocates the use of several tactics to manage weeds. IWM combines direct and indirect weed control strategies. Direct weed control strategies include cultural and chemical means. Indirect control implies weed suppressive agronomic practices which may include choice of crop variety, crop rotation, time of sowing, seeding rate, row spacing, cover crops, and nutrient management designed to promote crop competitive ability (Gill et al. 1997; Liebman et al. 2001). Several IWM options are also available for pastures such as mowing, burning, heavy grazing, etc. An IWM system may also have the potential to reduce herbicide use, which in turn reduces the cost of inputs and provides more robust and long-term management of weeds (Swanton and Weise 1991). IWM thus, reduces the reliance on the repeated use of herbicides as it advocates the

combination of several tactics to manage weeds. When several tactics are used to manage weeds, the weeds will have difficulty adapting to the management system and in the process herbicide resistance will be prevented and the utility of herbicides can be prolonged.

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## USING GOATS TO CONTROL WEEDS

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### Introduction

Weeds can be defined as plants without any values, and that compete with desirable forages for sunlight, water, nutrients, and space, thereby reducing yield (LaPrade et al. 2001). However, some weeds can be toxic to animals or create feeding problems. The abundance of weeds in any pasture can lower the desirability of forages available to livestock. This could result in the need for more acreage for the pasture due to reduced yields or the purchase of supplementary feeds. In addition, some weeds may be poisonous or toxic to livestock. Majority of weeds infesting Alabama pastures and hayfields are shown in Table 3.1 (LaPrade et al. 2001). It is important to note that more than one weed can infest the same field.

Forages form the basis of Alabama's cow-calf operations. There are more than 60 forage species routinely planted, often in mixtures, throughout the state (LaPrade et al. 2001). The most dominant forages are perennials in Alabama. Besides, many other plants volunteer within pasture and hayfields providing nutrition for forage-consuming animals. Several hundred million dollars are spent each year by Alabama cattle producers on weed control. Majority of costs include purchasing herbicides, and hiring equipments and operators to clear brush and reclaim lands that have become unable to support cattle at an acceptable production level. Unless sustainable management practices are followed, weeds can compete with the forage growth and reduce the productivity of pastures.

Table 3.1. Weeds of Perennial Grass Pastures and Hayfields in Alabama.

Weeds	% Acres Infested	Frequency of Occurrence	Life cycle	Timing of control	Damage done
Bitter sneezeweed	15	Statewide/sporadic	Annual	Postemergence	Milk loss/reduced forage
Blackberry, dewberry	20	Statewide/yearly	Perennial	Postemergence	Animal injury/reduced quality
Curley dock	15	Statewide/yearly	Perennial	Postemergence	Reduced forage/reduced quality
Dogfennel	55	Statewide/yearly	Perennial	Postemergence	Animal injury/reduced quality
Horsenettle	15	Statewide/yearly	Perennial	Postemergence	Animal injury/reduced quality
Musk thistle	35	Statewide/yearly	Biennial	Postemergence	Animal injury/reduced quality
Pigweed	25	Statewide/yearly	Annual	Postemergence	Animal injury/reduced quality
Common ragweed	20	Statewide/sporadic	Annual	Postemergence	Reduced quality
Wild buttercup	30	Statewide/yearly	Annual/perennial	Postemergence	Animal injury/reduced forage
Yellow thistle	35	Statewide/yearly	Biennial	Postemergence	Animal injury/reduced forage

### Weed Control Strategies

The traditional methods of weed control in pastures include cultural, biological, chemical, mechanical, or grazing. Not all are necessarily effective or desirable and the most of them are expensive. Moreover, due to environmental and food safety concerns, chemical control methods are perceived as less favorable by the public. However, if used according to label directions in grazing or hay harvesting situations, these herbicides are safe for humans and animals. In the recent years, goats have been promoted as alternative means of weed control. The use of goats can save the costs of chemicals, time, labor, and machinery, and also the method is environmentally sustainable. Besides, goats can also provide a return of \$10 to \$25 per acre



while controlling vegetation (Hart 2001). Already, goats have been used as an alternative to control burning to reduce fire hazards in the urban wild-land interface, and to control understory vegetation on public and other lands that are socially or environmentally sensitive to conventional methods (Peischel 2010). They do not disturb the existing grass and soil and, they do not leave synthetic chemicals that could run off into lakes and streams or be ingested by cows or other animals. Goats also eat non-native invasive species such as multiflora rose, Chinese privet, and kudzu. These invasives are typically not native to the U. S. and were accidentally or intentionally introduced decades or centuries ago. These are listed as most noxious weeds in the U.S. According to Hart (2001), some of the weed species highly preferred by goats are blackberry, greenbrier or smilax, sumac and winged sumac, winged elm, poison ivy, ironweed, sericea lespedeza, mimosa, and kudzu. Some moderately preferred species include post oak, blackjack oak, multiflora rose, sunflower, and thistles. Lesser preferred species include Osage orange (bodock), hackberry, and common and giant ragweeds. Moreover, goats can be combined with cattle and horses as co-grazing species because their diet selection preferences are different. They also do not share internal parasites with cattle and horses.

### **Why are Goats Suitable for Weed Control?**

The unique anatomical and behavioral features make goats ideal for use in the vegetation management. Goats possess a unique characteristic that separates them from almost all other types of livestock. Browse makes up approximately 60 percent of a goat's diet given the choice. Higher intake of browse by goats is their adoption of a bipedal stance. The mean and the maximum foraging heights recorded for goats are, respectively, 1.65 and 2.10 m whereas the corresponding values for cattle were 1.47 and 1.90 m and sheep were 0.87 and 1.17 m (Dove 2010). Goats can digest higher amounts of tannins in their diets compared with cattle because they produce proline-rich protein saliva which has a greater tannin-binding capacity (Hoffman 1989). Goats have special ecological adaptations for browsing such as a split upper lip, narrower muzzle, longer legs for climbing, different tolerance to plant chemicals, and the documented ability to travel farther each day than sheep in search of feed (NRC 2007). While browsing, goats eat from the tip of the plant toward the base selecting the highest quality plant and plant part the first time. They eat the seed heads from grasses and forbs and select flowers of thistles and some brush species. Mobile lips and bipedal capabilities afford them the ability to select young buds,

create a 6 to 8 foot browse line and knock down larger diameter vegetation high in cellulose and lignin (Provenza et al. 1996). Goats are known to be able to distinguish between bitter, salt, sweet, and sour tastes. The fact that they have a higher tolerance for bitter tasting feeds than most other ruminants can be attributed to the browsing propensity for bark, leaves, shoots, shrubs, and branches which may have a more bitter taste than grasses, forbs, and general pasture.

### **Simple Guidelines**

The use of goats for vegetation management/weed control requires several management tips to be followed and the success depends on how well these considerations are taken into account. One should remember that goats being employed to control vegetation are managed differently than those raised for meat production. For vegetation management, goats are managed intensively using very high stocking rates and time management in a site-specific area (Peischel 2010). The number of goats required to control brush depends on several factors such as types of brush to control, time-frame, and the growth rates of weeds and plants. Goats with previous experience working on vegetation management should be used. Usually wethers (castrated male goats) are better for this purpose and should be trained at a very young age. Among suitability of goat breed for this purpose, the author is personally in favor of using Kikos. Results from a study at Tennessee State University indicated that they are more parasite-resistant than other breeds and more adaptable to semi-intensively managed humid and subtropical pastures (Browning et al. 2011). Effective livestock guardians, especially domestic dogs, are of utmost value when working in an extensive, isolated, or predator infested habitat. If the area for weed control is large, there must be at least one or two guard/herd dogs that are allowed to run with the goats. This will minimize the threat of potential predators such as coyotes and other packs of dogs (Peischel 2010). Feeding and management of livestock guardian dogs is very crucial and should be fed a high energy, high protein food daily. It is advisable to provide fresh water at all times in smaller troughs to both goats and dogs with a high rate of recharge. Monitoring body condition score (BCS) of goats before going into a browsing project and throughout the project duration is very crucial (Peischel 2010). The BCS is an indicator of body fat reserves. The BCS chart ranges from 1 to 5, with 1 being very thin and 5 being obese. However, when goats are used for vegetation management, the BCS chart should be 1 to 9 because the wide range provides better

indication of sensitivity of body condition (Peischel 2010). The BCS should be 6 out of possible 9 or never below 2.5 out of 5 during the entire grazing period.

### **Potential Constraints**

It is a well known fact that goats are difficult to contain in a confined area. If you want to force them to eat in a confined area or certain type of brush, it is advisable to have suitable cattle panels which will usually keep goats in place. For larger areas, electric fence or a hybrid of electric hot wires, barbed wire, and neutral wires are suitable. The electric fence is often the most effective and least expensive option. Cattle fences are inadequate for goats and sheep and therefore electric or power fencing provides the most effective method of containing goats on the pasture. The goats have to be trained to adjust to the electric fence. After being trained to an electric fence, two strands of electric wire as a cross-fence is enough to control goats. Fences that will prevent coyotes coming in will also keep goats in. That being said, producers should consult reputed companies and compare costs and quality before making the final decision.

One of the major concerns with using higher number of goats to eliminate unwanted vegetation is infestation of internal parasites. Goats are very susceptible to internal parasites especially barber pole worm. This parasite is very prevalent in the hot and humid climate of the Southeast. Its life cycle is very short. The concentration of goats in a small area may magnify the infestation especially when goats are forced to graze at ground level. It is recommended that proper health care and parasite control protocols are in place.

### **Conclusions**

The use of goats has increased in recent years because of the need for biological control agents in environmentally sensitive areas. However, this requires different sets of management skills. Goats should be managed intensively with higher stocking rates. Fencing must be carefully managed. Parasites control should be managed properly. In other words, animal welfare and health related issues should be given a top priority. The body condition scores of grazing animals must be carefully monitored. In addition, guardian dogs need to be kept and maintained because predators are real threats in many areas when goats are used in extensive and isolated areas. The health and welfare of animals should comply with the USDA guidelines. For more information,

producers should contact land-grant university Cooperative Extension Programs and USDA/NRCS personnel in their area.

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# **COMMON NASTY WEEDS IN SOUTHERN PASTURES AND THEIR SUSTAINABLE MANAGEMENT**

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## **Why Control Weeds in Forages?**

Weeds compete with forages for light, moisture and nutrients, which reduces total production and may result in stand loss. Typically for every pound of weeds produced, a pound of forage is lost in native pastures and two to three pounds of forage is lost in improved pastures. Many weeds are lower in protein content and are less digestible than most forage species; consequently, weed infestation lowers the overall quality of the forage produced per acre. Some weed species are also toxic to animals. Perilla mint, buttercup, and bitterweed are just a few of the common weeds that are potentially toxic (Bryson and DeFelice 2009).

## **What is a Weed?**

What is the definition of a weed? The most commonly used definition is that it is a plant that is growing out of place. An example would be a corn plant in a soybean field. Relatively few plants have the characteristics that make them true weeds. Of the total number of plants in the world (about 250,000 species), only about 3% are thought to behave as weeds in agriculture (Murphy 1996).

## **Characteristics of Weeds**

A major characteristic of a weed is its competitive ability. Where forage crops and weeds are growing together, both compete for the same limited supplies of essential resources needed for growth and development. Weeds can produce a large number of seeds per plant, whereas most agronomic plants produce only several hundred seeds per plant. A large number of these seeds can fall to the ground, and the buildup of weed seeds in the upper soil layers can be substantial. Successful weeds can produce viable seeds even under conditions of poor fertility, drought stress, and freezing temperatures.

Seed dormancy is a condition in which seeds fail to germinate even when appropriate environmental conditions persist. Weed control would be greatly simplified if all the seeds of a

weed species were to germinate at one time. Seed dormancy is an important component of weed persistence because seeds are prevented from germinating during periods of adverse conditions. Weed seeds can also be buried in the soil for many years, and have the ability to germinate when environmental conditions are favorable. The seed coats of many weed seeds protect the seed from destruction, so these seeds are able to resist freezing, drought, fire, passage through animal digestive tracts, submersion in water, and ensiling. In addition, weed seeds are excellent travelers. Hooks and spines adhere to feathers, fur, hair, and clothing. Even weed seeds without special adaptations can be moved easily by farm machinery, automobiles, airplanes, ships, and contaminated farm products.

Many of the most troublesome and persistent weeds such as Johnsongrass and yellow nutsedge are perennials that reproduce vegetatively (Murphy 1996). Vegetative reproductive structures serve as major food storage organs and possess numerous buds capable of generating new plants. These structures include rhizomes, stolons, tubers, bulbs, and creeping roots. These vegetative reproductive structures allow the plant to have another form of an overwintering structure in addition to seeds. The movement and storage of food materials into these organs during the late-summer and early-fall permits the production of vigorous new shoots the following spring. These structures also permit the plant to have another means of propagation in addition to seeds. These structures contain buds, which can develop into new plants. This occurs when the parent plant is partially destroyed through tillage, clipping, or grazing.

### **Proper Weed Identification**

A crucial aspect of controlling a weed is properly identifying it. However, there are many weed species and it is difficult to know them all. Fortunately, weeds can be classified and managed by their life cycle and growth habit. The first step is to determine if the weed is an annual or perennial. The second step is to determine if the weed is a grass, broadleaf, or sedge. The final step is to determine if the weed is cool-season (germinating in the fall) or warm-season (germinating in spring, growing throughout the summer).

With the advent of the Internet, searches can be made with various search engines to aid in identifying various weed species. A very good resource book is titled “Weeds of the South” (Bryson and DeFelice 2009). It is available for about \$30-35.

## Weed Terminology

Listed below are some common terms that are essential to know and understand when attempting to identify and classify various weed species.

1. **Annuals:** Plants that live for one growing season only. Summer annuals germinate in the spring, flower and produce seed in mid-to-late summer and die in the fall. Winter annuals germinate from late-summer to early-spring, flower and produce seed in mid-to-late spring, and die in the summer.
2. **Biennials:** Plants that live for two growing seasons. Seeds germinate in the spring, summer or fall of the first year and plants overwinter as a basal rosette of leaves with a thick storage root. After the shoot tips are exposed to cold, the plants flower and produce seed in the summer of the second year and die in the fall.
3. **Perennials:** Plants that produce vegetative structures which allow them to live for more than two years. Simple perennials are plants that overwinter by means of a vegetative structure such as a perennial root with a crown, but they reproduce almost entirely by seed. Creeping perennials can both overwinter and produce new independent plants from vegetative reproductive structures. Most also can reproduce from seeds. Vegetative reproductive structures include:
  - Rhizomes: elongated horizontal underground stems.
  - Stolons: horizontal aboveground stems.
  - Tubers: thickened underground stems borne on the ends of rhizomes.
  - Creeping roots: roots modified for food storage and vegetative reproduction.
4. **Monocots:** Plants whose seedlings bear only one cotyledon. This includes grasses and sedges.
5. **Dicots:** Plants whose seedlings produce two cotyledons. This includes broadleaves and legumes.
6. **C<sub>3</sub> plants:** Normally referred to plants that grow during the cool-season. The first stable product of photosynthesis has three carbon atoms. These include annual ryegrass, wheat, oats, curly dock and white clover.
7. **C<sub>4</sub> plants:** Normally referred to plants that grow during the warm-season. The first stable product of photosynthesis has four carbon atoms. These include corn, Johnsongrass, yellow nutsedge, crabgrass and bermudagrass.

### **Broadleaf Weeds Affecting Forage Crops**

Listed below are a number of broadleaf weed species that are commonly found in forage crops.

Bitterweed	Dogfennel	Prickly Sida
Blackberry	Henbit	Privet
Blue Vervain	Horsenettle	Smartweed
Buttercup	Horseweed	Spiny Amaranth
Chinese tallow tree	Ironweed	Tropical Soda Apple
Curly Dock	Perilla Mint	Wooly Croton
Dewberry	Pigweed	

### **Grassy Weeds Affecting Forage Crops**

Listed below are a number of grassy weed species that are commonly found in forage crops.

Annual Foxtails	Dallisgrass	Smutgrass
Annual Ryegrass	Fall Panicum	Vaseygrass
Bahiagrass	Goosegrass	Yellow + Purple Nutsedge
Barnyardgrass	Johnsongrass	
Crabgrass	Little Barley	

### **Pasture Weed Control Strategies**

Listed below are some of the key approaches that producers have utilized to control weeds in forage crops in an effective manner.

- Maintain healthy forage plants through proper fertilization and grazing management;
- Clipping pastures can be an effective tool by reducing competition;
- Some weed species (i.e., Johnsongrass and crabgrass) have good quality and palatability when they are small;
- Apply herbicides when weeds are relatively small;
- For summer weed control, apply herbicides around June 1 and then clip pastures throughout the rest of the summer or apply a second application in late summer;
- Be patient when trying to control perennial weeds; it may take several years to achieve adequate control, and



- Use a calibrated sprayer.

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# **CHEMICAL USE TO CONTROL PASTURE WEED – HERBICIDE SELECTION, PREPARATION, TIMING, AND APPLICATION**

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## **Introduction**

Weed control is an important component for forage production in Alabama. Whether one is growing bermudagrass, bahiagrass, tall fescue, dallisgrass, or Johnsongrass, weeds may cause numerous problems. These problems include serious losses in forage yields and forage quality, livestock poisoning and animal mechanical injury, and wear and tear on fencing and equipment such as tractors, mowers, and sprayers. Despite these issues, weed control is often neglected in pastures. Weeds are often “out of sight, out of mind” until they begin to overtake pastures, at which point control is generally more difficult. The objective of this paper is to broadly discuss methods useful for controlling weeds in Alabama pastures, but in particular discuss chemical control methods.

## **Good Pasture Management is the Foundation for Weed Control**

Many producers often respond to weed problems with aggressive herbicide measures without fully considering the problem. There may be underlying issues with the production system that weed control will not solve. Effective weed control is best accomplished by first knowing about the pasture production system in place, how it functions, and what is needed to keep it functioning properly. A good parallel to this is a mechanic who works on automobiles. When doing a job, an auto mechanic will have extensive knowledge about the automobile to be fixed. The mechanic will understand how each component of the engine works and how they function together for optimal performance. The mechanic does not reach for tools without first diagnosing the problem. This may require initial diagnostic testing, but this is often critical to identifying the problem. The mechanic will then select the appropriate tools that will be needed to do the job correctly and efficiently. The mechanic has been trained on the use of those tools and knows how each one works, their limitations, and any safety issues associated with using

them. The mechanic then takes the tools and uses them to fix the problem and gets the engine running.

Before implementing weed control, farmers should likewise be knowledgeable regarding the pasture system being utilized. They should have knowledge of the entire system from the soil to the forage species being grown to the climate and weather patterns that impact production. They should understand these things before spending considerable time and money on weed control. They should then understand the tools available for pasture weed management, how they work, their limitations, and safety issues associated with using them. Finally, they can select the proper tools and use them to get weeds under control and get the pasture “running” properly.

Weeds are often a symptom of pasture problems such as poor or excessive fertility, low soil pH, compaction, and poor grazing management where the forage base is overutilized or underutilized. Diagnostic soil tests can be taken to assess fertility, pH, and compaction problems. These can be done during the winter dormant season to prepare for the upcoming growing season. Improving pasture utilization can be accomplished with rotational grazing and areas of compaction may require rest or tillage depending on the severity of the situation.

### **Understanding the Growth Patterns of the Target Weeds**

Weeds come in many forms and have very different germination and growth patterns. Winter annual weeds germinate in the late fall or early spring, grow rapidly with the onset of warmer spring temperatures, flower, set seed, and die by late spring. Examples of winter annual weeds include henbit, purple deadnettle, and common chickweed. Summer annual weeds germinate in the spring or throughout the summer after soil temperatures begin to warm up, grow rapidly, flower from mid-summer through fall, and then die. Examples of summer annual weeds include spiny pigweed, bitterweed, and marehail. Biennials germinate in one growing season, overwinter as low growing rosettes, elongate flower stalks the next year, flower, set seed, and die. Examples of biennials include musk thistle. Perennials live for more than two years and reproduce from root crowns, creeping lateral roots, or underground creeping stems called rhizomes. Examples of perennials include dogfennel, horsenettle, buckhorn plantain, blackberry, woody shrubs, trees, and many vines such as English ivy and honeysuckle. This basic biology can help tremendously in selecting the proper timing for weed control. For example, many farmers want to spray winter annual weeds in the late spring. This is a waste because they have already produced seed. Winter

annuals will die on their own by late spring, so control strategies should be employed much earlier for useful control.

**Beware of Poisonous Plants.** Not all weeds are safe to leave in your pasture. There are several poisonous plant species that when ingested can result in the death of cattle, sheep, and even goats. Three serious offenders in Alabama are showy croton, perilla mint, and mountain laurel. Additionally, certain weeds such as Johnsongrass may become poisonous during severe drought stress or after an early frost. A complete list with species descriptions can be found on the Alabama cooperative Extension website at <http://www.aces.edu/pubs/docs/A/ANR-0975/ANR-0975.pdf> (Everest et al. year unknown).

### **Weed Control Tools of the Trade**

Weed control tools include cultural, physical, biological, and chemical methods. These methods are often more effective when utilized in an integrated fashion than when used alone.

Additionally, developing integrated management plans are important to prevent herbicide weed resistance, which can occur when the same herbicide is used over and over with no changes.

**Cultural control** is the application of strategies that are normally employed within pasture management and may include weed prevention and competition. Weed prevention has many opportunities to reduce future weed problems. Weed prevention strategies include feeding weed free hay in the winter, monitoring winter hay feeding areas for new weeds in the spring and summer, cleaning equipment, especially after mowing or hay cutting, and using only certified seed when overseeding pastures. While weed free hay is difficult to find and not often feasible, monitoring winter hay feeding areas is easy to do and can prevent the establishment of new weeds through early detection and rapid response efforts. Cleaning equipment can help prevent the spread of weed seed which commonly occurs on tractors, mowers, ATVs, and trucks.

**Physical control** is any technique that does physical damage to the weeds such as mowing, cutting, pulling, digging, or burning. In pastures, mowing is often the most widely used method of weed control. Mowing can be effective in suppressing many weed species but does not typically provide excellent weed control. Most weeds are capable of regrowth following cutting,

due to the presence of growing points called buds, in the leaf axils below the cutting height. These buds are released to grow and make new shoots when the plant tops are removed by cutting. This type of regrowth can be affected by several things but available moisture is one of the most important factors. When adequate moisture is available, regrowth from axillary buds can result in almost complete recovery and very poor control. However, when conditions are very dry following cutting, regrowth is typically greatly reduced, resulting in better control. In general, the optimal time to mow a given weed is when shoots have elongated but just before flowering. This timing works best because after elongation, there will be fewer growing points below the cutting height and no seed have yet been produced. Mowing earlier than this generally results in considerable regrowth and mowing later, such as after flowering, does not prevent seed production and only serves to spread the problem by increasing seed dispersal. Repeated mowing during the summer may also increase control of certain species. However, this may also reduce forage availability and may not be effective on later emerging weeds which are too small to be controlled.

**Hand pulling** is also sometimes used, but its effectiveness is limited on species that resprout from buds on the roots. A good contrast of this issue is Carolina horsenettle (*Solanum carolinense*) which resprouts from the roots and is poorly controlled by hand pulling, and musk thistle, which does not resprout from the roots and is readily controlled by hand pulling. Hand pulling is often difficult and labor intensive, and is not recommend for large infestations.

**Burning** of pastures is not commonly used but can be effective for winter annual broadleaf weed control in the late winter before warm season forages break dormancy. To be effective, there must be enough residual forage to carry the fire across the pasture and the fire must be hot enough to girdle the stems of broadleaf weeds. Burning can often stimulate new forage growth by removing the thatch layer which delays the warm up of soil in the spring and releases nutrients tied up in the thatch layer. However, burning can also release a new flush of weeds from the seed bank which also respond positively to nutrients and warmer soil conditions. Burning does result in a period of zero forage availability before regrowth occurs so other pastures or hay should be available for animals just after the burn.

**Grazing** is also a form of physical weed control as certain classes of livestock can selectively remove weeds from pastures. Although cattle do not readily graze most broadleaf weeds, sheep and goats actually prefer many broadleaf weeds over grasses. Sheep typically prefer forbs (broadleaf herbaceous plants) over grasses and goats prefer woody browse (trees, shrubs and some vines and brambles) and forbs over grasses. Goats and sheep are not silver bullets, however, and grazing must be carefully managed to prevent them from overgrazing and removing grasses too. Goats are also very effective at controlling spiny plants such as thistles and blackberries and even some poisonous plants such as poison ivy. Goats can consume extremely thorny plants that would cause severe mechanical injury to cattle because they are often less sensitive to poisonous plants than cattle. However, it is critical to understand poisonous plants before using goats to control them.

**Biological control** is the use of living organisms to suppress or kill target pests. Biological controls are often insects or pathogens that only damage specific individual target weed species. They are often found within the native range of the weed which may be Europe, Asia, Africa, or South America. They are then screened for host specificity to ensure they do not attack crops or native plants in the United States. There are a limited number of biological controls that have been used for pasture weed control in Alabama. Two that have been used with varying degrees of success are the musk thistle head weevil and the musk thistle rosette weevil. These biocontrols target the flower heads and the rosettes as their names imply. They will frequently decrease musk thistle seed production but will not provide complete control as biocontrols do not eradicate their host plants. An excellent publication which describes these biocontrols can be found at <http://www.aces.edu/pubs/docs/A/ANR-1034/> (Flanders et al. 2001). Additionally, in Florida and Alabama, research is ongoing on biological control of tropical soda apple, which is a serious threat to pastures across the Southeast. However, there are few other pasture weeds that have effective biocontrols available. Technically, goats and sheep may also fit in this biocontrol category but were previously discussed in the mechanical section.

**Chemical control** is generally the most effective method for weed control. There are a wide range of herbicides available for many pasture weed problems which will provide excellent weed control and will be safe on forage grasses. However, it must be stated that herbicides are not a

“silver bullet” and a single herbicide treatment will not solve all weed problems permanently. This is an unrealistic expectation that many people have and they are quickly disappointed when weeds return. A good parallel is a comparison of herbicides to antibiotics versus vaccinations. Herbicides are more similar to antibiotics used to treat a sick patient for an infection rather than to a vaccination given to a person against a disease. The vaccination is often a one-time injection that provides a lifetime of protection against the disease. However, the antibiotic is administered to eliminate an infection but does not prevent getting that infection again. Herbicides can clear up weed “infections” and prevent reinfection for a short length of time but do not prevent new infections forever. Herbicides issues that must be understood include the herbicide label, safety, efficacy, selectivity, persistence, rate, timing of application, and method of application.

The herbicide label is the legally binding document that contains the EPA requirements for use. The label contains critical information including the formulation, the amount of active ingredient as a percentage or in pounds per gallon, applicator safety issues, environmental restrictions, sites appropriate for use, product rates, required additives, weeds controlled, plantback restrictions, and if the product is restricted use. Herbicide labels are provided with each container and many are also available free of charge online at [www.cdms.net](http://www.cdms.net) (Anonymous 2011b). Although not required in Alabama for most pasture herbicides, pesticide safety training is highly recommended for ALL pesticide applicators. It is recommended that producers contact their local county Extension office for information on pesticide applicator training.

Herbicide efficacy refers to how well the product controls the target weed. Typically, excellent efficacy refers to greater than 90 percent control of the target weed. Commercially acceptable efficacy is generally greater than 80 percent control of the target weed. Sixty to eighty percent control is often referred to as suppression but a failure in efficacy may often range from 0 to 70 percent control depending on the product.

Herbicide selectivity encompasses two general categories of herbicides, selective and nonselective. Selective herbicides control certain types of plants but do not control others. The best example of this is 2,4-D, which control broadleaf plants but does not control grasses. Selective herbicides are widely used in pastures where farmers want to control broadleaf weeds and not injure forage grasses. Non-selective herbicides generally control or injure all types of vegetation. A good example of a non-selective herbicide is glyphosate which will injure or kill broadleaf and grass species. Selectivity is not an absolute for many herbicides, meaning that

selectivity is rate dependent. The higher the rate, the less selective they become. The selectivity of imazapic is highly rate dependent. At low rates, imazapic is relatively safe on bermudagrass but at high rates it will severely injure bermudagrass.

Herbicide persistence refers to the length of time a herbicide can persist in the environment before it is broken down into its base chemical constituents. Herbicide persistence is often very desirable in pastures and is referred to as soil residual activity, where it remains active in the soil and controls germinating weed seedlings. A good example of this is the active ingredient aminopyralid which can be applied in the late winter and provide soil residual control of thistles for the entire summer. In general, almost all pasture herbicides that have soil residual activity do not persist at high enough levels to provide more than one year of weed control. Herbicide persistence can also be problematic in some cases, especially where non target vegetation such as trees is close by. Picloram is a good example of an herbicide that should not be applied under trees due to its soil persistence and high degree of efficacy on many trees species.

Herbicide rate is one of the most critical elements of effective herbicide application. Herbicide rates can be expressed in several ways including percent solution, rate of product per acre, or in rate of active ingredient per acre. The simplest way to express herbicide rate is a percent solution also called percent volume to volume or % v/v. Herbicide rates expressed as a percent solution are commonly given for spot treatments of individual plants or for cut stump or basal bark treatment. For percent volume to volume herbicide calculations, the correct amount of herbicide to add to the spray tank is calculated by multiplying the desired percent solution by the total spray volume (which is the number of gallons to be made). For example, if I want to make a 1 percent solution of RoundupPro and I want to make a total of 3 gallons of spray solution. To calculate how much RoundupPro to add to the three gallon tank, I multiply the following:  $(1/100) \times 3 \text{ gallons} = 0.03 \text{ gallons}$ . This is the amount of Roundup Pro to add to the tank. However, it is always useful to keep several conversion factors handy because measuring 0.03 gallons would not be an easy task. Since 1 gallon equals 128 fluid ounces, we can multiply 0.03 gallons  $\times$  128 fluid ounces/gallon to get our answer: 3.84 fluid ounces which is approximately 4 fluid ounces of herbicide to add to the three gallon tank.

The second most common method of expressing herbicide rate is the amount of product to be applied on an area basis. Most herbicide labels express herbicide rates on a product per acre



basis. This is assuming a uniform broadcast application of the herbicide across the entire acre of land. Liquid formulations are normally expressed in gallons, quarts, pints, or fluid ounces of product per acre. Dry formulations may be expressed in either pounds or ounces of product per acre. To be accurately applied at the correct rate, the sprayer used must be properly calibrated. However, sprayer calibration is beyond the scope of this discussion. An excellent guide to sprayer calibration can be found at: <http://www.aces.edu/crd/publications/ANR-570.pdf> (Ogburn 1992).

Timing of herbicide application is also a critical element for effective herbicide application. In general annual pasture weeds should be targeted when they are small for effective control. For winter annual weed control, make applications in the fall through late winter when weeds are small and before they flower. For summer annual weeds, make applications when summer annuals are less than six inches tall which may occur from late spring to early summer. Treatment of larger annual weeds is often much more difficult and treatment of annual weeds that have already flowered is not recommended. Treatment of perennial weeds does not follow the same timing. For pastures, most troublesome perennials are warm season weeds such as dogfennel or horsenettle. Perennial weed control is often less effective when they are just emerging and should be delayed until they have put on some vegetative growth or are closer to flowering. For example, dogfennel should be treated when there are 12-18 inches of growth while horsenettle should be treated during flowering. For woody plant control, allow plants to leaf out in the spring and treat when new growth is 3-4 feet tall. Blackberries and wild roses should be treated at flowering. If they have been previously mowed, wait at least nine months after mowing before herbicide treatment.

Herbicide application technique is also important as herbicides are expensive and misapplication is costly and may cause environmental problems. Spot treatment is a common method for many woody pasture weeds that are less than six to eight feet tall. Spot treatment is typically done with a single nozzle hand-held backpack sprayer or an ATV single nozzle hand gun sprayer. The key to spot treatment is good coverage. Use low pressure and spray to wet the foliage, being sure to cover all growing points but not too wet to the point of dripping. This is excessive herbicide use and is very wasteful. Broadcast application requires a good boom sprayer, although there are single nozzle boomless systems that are used for broadcast treatment.

The elements of broadcast application include proper pressure, nozzle selection, and boom height but these are beyond the scope of this discussion.

### **Herbicides Commonly Used in Pastures**

There are several herbicides commonly used in pastures for weed control which are listed in Table 5.1. Table 5.1 includes a wide range of information such as recommended rates, grass safety, restricted use status, whether generics are available, and if they have soil residual activity. One of the biggest issues that arises with essentially all of these pasture herbicides is that they are effective clover killers too. With the exception of very low rates of 2,4-D applied when clovers are dormant, every other commonly used pasture herbicide will severely injure or kill clovers. Waiting until after clovers seed before spraying is possible, but if weed problems are severe, there will be little clover seeding anyway.

Grass weed control is less utilized in pastures but is common in high quality hay production. Table 5.2 lists herbicides useful for weedy grass control primarily in bermudagrass hay. More information on pasture herbicides is available in the 2011 Alabama Pest Management Handbook, Volume 1, which is at <http://www.aces.edu/pubs/docs/A/ANR-0500-A/ANR-0500-A.pdf> (Anonymous 2011a). Additionally specific fact sheets on thistle control, Pastora and Prowl H<sub>2</sub>O are available at <http://www.aces.edu/anr/crops/haypastweedcontrol.php> (Enloe 20110).

Table 5.1. General Herbicide Recommendations for Broadleaf Weed Control in Pastures.

Herbicide	Active ingredient(s)	Product rate	Restricted use	Controls these weeds:	Generics available	Product safe for:	Soil residual
Chaparral	Aminopyralid + metsulfuron	2 oz/A	No	General broadleaf, blackberry, some woody	No	Bermuda only <sup>1</sup>	Yes
Cimarron Plus	Metsulfuron + chlorsulfuron	0.25 oz/A	No	Certain broadleaf, blackberry	No	Bermuda only <sup>1</sup>	Yes
GrazonNext	Aminopyralid + 2,4-D	2 pt/A	No	General broadleaf	No	All grasses	Yes
Grazon P+D	Picloram + 2,4-D	2 pt/A	Yes	General broadleaf	Yes	All grasses	Yes
Milestone	Aminopyralid	3 oz/A	No	Certain broadleaf	No	All grasses	Yes
PastureGard	Triclopyr + fluroxypyr	2-8 pt/A	No	Certain broadleaf, Woody, vines blackberry	No	All grasses	No
Remedy	triclopyr	1 qt/a	No	Certain broadleaf, Woody, vines blackberries,	Yes	All grasses	No
Surmount	Picloram + fluroxypyr	1.5-2 pt/A	Yes	General broadleaf, certain woody, vines,	No	All grasses	Yes
Weedmaster	Dicamba + 2,4-D	2 pt/A	No	Dogfennel, general broadleaf	Yes	All grasses	No
2,4-D	2,4-D	2 pt/A	No	Winter annual broadleaf	Yes	All grasses	No

<sup>1</sup>Both Chaparral and Cimarron Plus are also labeled for use in tall fescue. However, temporary yellowing and stunting can occur and may cause distress to the landowner.

Table 5.2. General Herbicide Recommendations for Weedy Grass Control in Pastures.

Herbicide	Active ingredient(s)	Product rate	Restricted use	Controls these grasses:	Generics available	Product safe for:	Soil residual
Chaparral	Aminopyralid + metsulfuron	2.5 oz/A	No	Bahiagrass	No	Bermuda only <sup>1</sup>	Yes
Cimarron Plus	Metsulfuron + chlorsulfuron	0.3 oz/A	No	Bahiagrass	No	Bermuda only <sup>1</sup>	Yes
Pastora	Nicosulfuron + metsulfuron	1-1.5 oz/A	No	Bahiagrass, Johnsongrass, vaseygrass, several annual grasses	No	Dormant Bermuda and within 7 days after hay harvest	No
Plateau	Imazapic	4 fl oz/A	No	Several annual grasses	Yes	Bermuda only <sup>2</sup>	Yes
Prowl H <sub>2</sub> O	Pendimethalin	2-4 qt/A	No	Annual grasses and some broadleaves	No	Dormant Bermuda ONLY	Yes
Roundup Powermax	Glyphosate	10 fl oz/A	No	Annual grasses and broadleaves	Yes	Dormant Bermuda and within 7 days after hay harvest	No

<sup>1</sup>Both Chaparral and Cimarron Plus are also labeled for use in tall fescue. However, temporary yellowing and stunting can occur and may cause distress to the landowner.

<sup>2</sup>Plateau has been shown to cause injury to bermudagrass that may result in the loss of one hay cutting.

## Conclusions

Effective weed control is readily achievable in pastures. Here are the summary points to follow to get started on weed control.

- 1. There are no silver bullets.** Weed seed persist in the soil for several years and new seed are also dispersed each year by wind, water, animals, and birds. These seed factors translate into a requirement for annual weed management, so no single treatment will knock it out forever.
- 2. Weed control will not solve all your pasture problems.** Weed control is effective for weeds but it will not solve soil fertility, pH, or compaction problems. It cannot fix poor grazing management either. These are separate issues that must be dealt with alongside weed control.
- 3. Plan ahead for weed control.** If the pasture had a weed problem last year, it will be there again this year. If upwind neighbors had a weed problem last year, it will likely be the downwind neighbors' problem this year. Producers should get out early and look for small weeds hiding in the grass. They should not wait for the weeds to grow and flower before doing anything about them. If the producer plans to have a custom spray business treat his/her pasture then he/she should get on the business calendar early.
- 4. Treat annuals when they are small for better forage production.** While some of the newer herbicides are effective on larger weeds that have already bolted, treating early when weeds are small will eliminate weed competition and free up resources for forage growth. The bigger the weeds get before treatment, the less forage will be produced.
- 5. Effective herbicide choices have greatly increased in the last few years.** There are several newer herbicides that are extremely effective on thistles and are just as good as picloram + 2,4-D (Grazon P+D and generics). These include GrazonNext, Milestone, Chaparral, and Surmount. All of these will provide excellent thistle control and have enough soil residual activity to keep pastures in good shape for much of the growing season.
- 6. All of the newer herbicides are still lethal to clovers.** There is no herbicide that is safe on clovers. The only redeeming thing is that clovers tend to recover from the soil seedbank for many years.
- 7. There is an optimal mowing timing.** If the producer decides to mow for thistle control, he/she should do it after bolting (when the flower stalks elongate) but before thistle flowers

open. This timing will reduce thistle seed production as much as is possible with mowing. However, expect some regrowth and flowering later in the summer.

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## **THE INFLUENCE OF SOIL pH, NUTRIENTS, AND GRAZING MANAGEMENT ON WEED PREVALENCE IN PASTURES**

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### **Background**

While visiting farms in recent years, the lack of forage production is the most common issue presented to me. Many farmers boast of times when fescue pastures were belly-deep to cattle and bermudagrass hayfields were pure and lush. Now, the waning fescue pastures have been invaded by foxtail, crabgrass, and common bermudagrass. Bermudagrass hayfields also in decline are falling victim to a number of less palatable and inferior grasses in addition to noxious and invasive weeds.

These once thriving landscapes have fallen prey to environmental and economic circumstances. Severe droughts in 2006 and 2007, and the continued drought conditions since then have contributed to the recent deterioration of forage stands. However, the economy, especially fuel and fertilizer prices, has dealt a far greater blow to forage health and vigor. In the time of relatively cheap fertilizer, producers were quick to order plenty of 17-17-17 every spring and a couple hundred pounds of ammonium nitrate or N-Sol after every cutting of hay to apply to their hay fields. When the price of nitrogen spiked due to high oil prices, many livestock producers were no longer able to afford the extra nitrogen. Even worse, phosphorus and potassium prices escalated due to high demand in China and India, forcing some producers to eliminate fertilizer from their management routine. The price of lime has also increased considerably over the past few years placing farmers in a position to choose between lime and fertilizer. Most choose to apply a little fertilizer.

In general, the cost of doing business on a livestock farm has far outpaced the returns leading to a vicious cycle with respect to forages. With less capital to invest in fertilizer and lime, forage production has been impaired. Less forage to graze leads to overgrazing and an increased need for stored feed. However, hay yields are lowered with poor soil fertility and drought. Less available grazing and hay leads producers into the dilemma of purchasing feed or adjusting their stocking rate. In the long run, the cost of the operation increases which leads to a

decision not to lime and fertilize to soil test recommendations. The end result is forages take the fall and noxious weeds take their place.

### **Soil Fertility**

Soil is the foundation of every livestock operation and like the foundation of a building, it must be maintained or everything above will fail. Soil fertility must be a priority and a soil test is the first step. Obtaining a soil sample for analysis is a simple task. Collect 15 to 20 random samples of soil (about a handful) from the top 4 - 6 inches and blend them together to form a composite representing an average of the fertility for the field. Soil sample boxes, information sheets, and other resources can be obtained from the county Extension office. After a sample is submitted to the lab for analysis a report will be generated detailing the fertility of the soil based on the crop (type of forage) described in the pastures and hayfields. The report will provide soil pH, the status of various nutrients including phosphorus and potassium, and recommendations for lime and fertilizer to optimize forage production. The county Extension agent can assist the producer with an interpretation of this report.

### **Soil pH**

Soil pH is a measure of soil acidity. Soil pH affects the growth of plant roots and their ability to take-up nutrients from the soil. In addition, it affects the availability of nutrients to the plants. When soil pH is too low, or very acidic, the major nutrients required by forages become less available to the plants (Figure 1). If recommended in a soil test report, the addition of lime will raise soil pH to a level that optimizes nutrient availability. Most soils in Alabama are naturally acidic and need amending to raise the pH to a level that optimizes nutrient availability to the plants; about 6.0 to 6.5. Legumes such as clover and alfalfa need a soil pH nearer to 7.0.



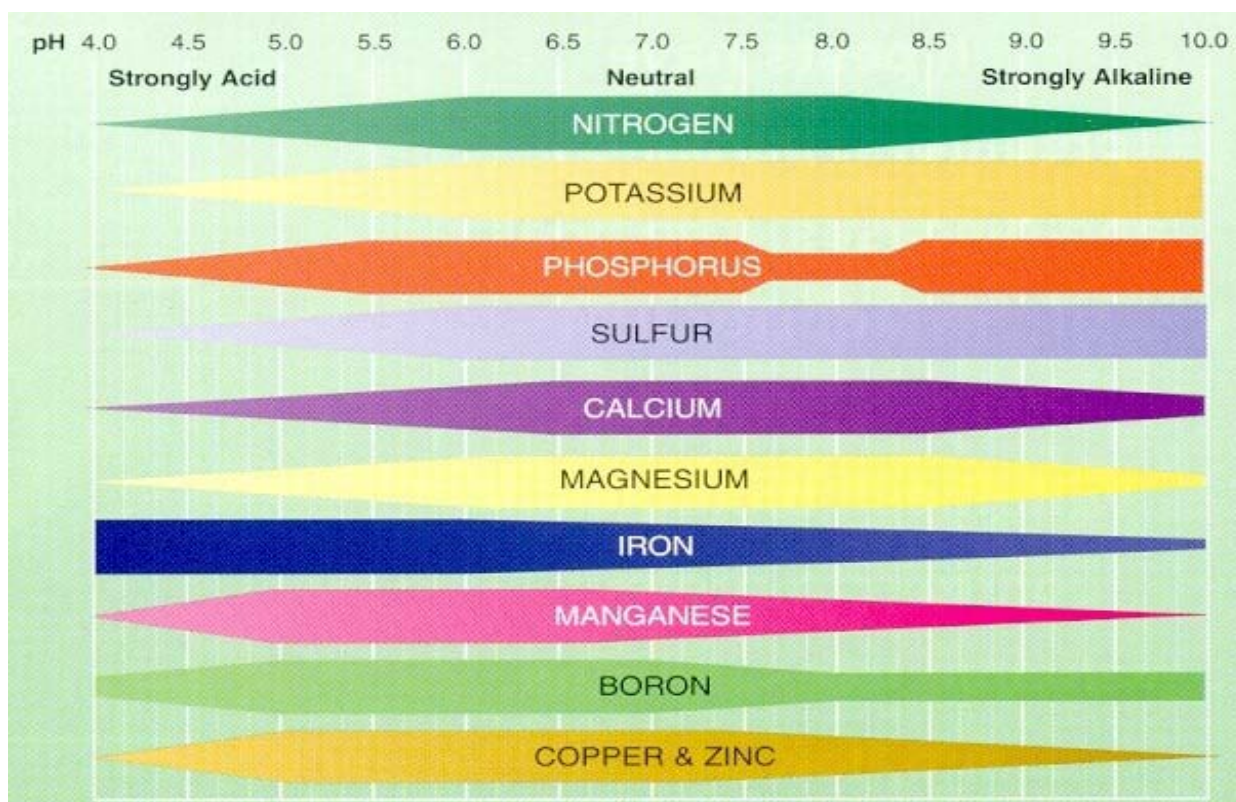


Figure 1. Illustration of the effect of soil pH on the availability of various nutrients. As soil pH decreases, the availability of most major and minor nutrients also decreases. A pH of 6.0 to 6.5 is desirable for most Alabama forages. Graphic Illustration courtesy of Dr. Don Ball, Extension Forage Agronomist, Alabama Cooperative Extension System, Auburn University.

## Nitrogen

Nitrogen (N) is vital to the formation of all plant proteins and many of the compounds in plants must have nitrogen. Nitrogen is a critical component of protein, amino acids, and many other critical plant compounds (Barker 2011). If soil pH is adequate, the addition of N will result in greener and faster growing grasses. Pastures do not require a tremendous amount of N because most of it is recycled through the animals and deposited back on the pasture in the form of urine and feces. Plants deficient in N will be stunted and may appear yellowed or less green in color.

In most cases, soil test N recommendations for pasture grasses will be 60 pounds per acre. That is 60 pounds of N, not fertilizer. Different fertilizers contain different amounts of N, so you need to ensure that enough fertilizer is applied to meet the N recommendation. For example, ammonium sulfate contains 21% N. Every 100 pounds of ammonium sulfate contains 21 pounds of N, so it takes 300 pounds of ammonium sulfate to get the needed 60 pounds of N.

Liquid nitrogen, or N-Sol, typically contains 32% N, so only 200 pounds of N-Sol is needed to get 60 pounds of N.

### Phosphorus

Phosphorus (P) is a major player in forage grasses and legumes and is utilized by plants in the form of phosphate or  $P_2O_5$ . It is an important component for plant proteins and in the process of photosynthesis. It helps make stiff stems that hold foliage up to the sunlight for plants to grow more vigorously. Plants in  $P_2O_5$  deficient soils will exhibit stunted growth, fewer flowers and may have a purple tint (Watson 2011).

### Potassium

Potassium (K) serves many important roles in plants and the form used by plants is more commonly known as potash or  $K_2O$ . Although  $K_2O$  is not a part of the structural components of plants, it is very essential in plant systems. It is a water soluble nutrient and moves throughout the plant to where it is needed most (Benson 2011), often the growing portions of the plant above and below ground.  $K_2O$  assists the plant with its efficient use of water (Benson 2011), promotes sturdy stems, deep roots and aids in the plant's preparation for winter survival. Plants deficient in  $K_2O$  will appear stunted, have a weak root system and become more susceptible to disease and heat stress.

Soil fertility is relatively easy to maintain in pastures where 300 pounds of beef removes only 9 pounds of N, 7 pounds of  $P_2O_5$ , and 1 pound of  $K_2O$ . Fertilizing once in the spring at green-up is usually all that is required. Once soil test  $P_2O_5$  and  $K_2O$  are adequate there is no need to apply more until a soil test recommends it. Hayfields, especially bermudagrass, require a little more attention. Each ton of bermudagrass hay removes about 50 pounds of N, 10 pounds of  $P_2O_5$ , and 40 pounds of  $K_2O$ , and hay yield is easily related to the amount of nitrogen applied for each cutting. But equally, if not more important is the application of  $K_2O$  which must be replaced every year to avoid stand loss. It is suspected that a potassium deficiency had many bermudagrass hayfields in decline prior to the drought, which only sped up the process allowing weeds to intrude at an accelerated rate. Weed tolerance of low soil fertility starve desirable plants for sunlight, water and nutrition, further compounding the situation.

## Grazing Management

Overgrazing is a serious problem for many farms, especially those with soil fertility problems. While grazing, livestock remove the green leafy portion of forages, where most of the sunlight is captured for the production of food that forages store in the roots. Healthy forages have abundant and healthy roots, however, forages suffering from nutrient deficiencies and overgrazing, especially overgrazing, have fewer roots. In addition to the uptake of water and nutrients to grow forage above ground, plant roots serve as a place to store excess food to regrow the plant after the leaves are removed, either by natural causes or by grazing. An analogy is to think of the leaves as a manufacturing plant and the roots as a warehouse to store materials for the manufacturing process. When forages are grazed, the manufacturing plant is being removed. To counter the effect, the plant draws from the warehouse, the roots, to rebuild the manufacturing plant. When more leaf is removed by grazing, more root storage is required to rebuild the plant and consequently, root mass is reduced in the process. Forages that are continuously grazed tend to have smaller and fewer roots than plants that are rotationally grazed and they are more susceptible to stress and disease. Figure 2 illustrates the effect of continuous grazing on the root system of forages.



Figure 2. Potted plants were clipped to mimic continuous grazing and various levels of rotational grazing. The plant on the left, representing continuous grazing remained much shorter due to the constant removal of leaf and the impact on the root system was very detrimental. The Plants grazed less often maintained more leaf area and a larger and denser root mass. Photographs courtesy of Dr. Don Ball, Extension Forage Agronomist, Alabama Cooperative Extension System, Auburn University.

Forages with deeper roots are able to withstand drought for a longer period of time as the roots are able to draw water found deeper in the soil. Conversely, overgrazed forages with fewer roots that are shallow in the soil will exhibit drought stress in a relatively short period of time when compared to the deeper rooted, healthier forages. When coupled with poor soil fertility, overgrazing already stunted and weakened plants increases the opportunity for weeds to encroach and replace desirable forages. Most weeds native to Alabama are very tolerant of a wide range of soil fertility and as a result will replace desirable forages as they become weak. Livestock prefer not to eat many of these same weeds allowing them to grow larger and stronger and further complicate the problem.

What is the solution? The producer has no control over the weather, but can always influence soil fertility, livestock grazing, and weed prevalence. First things first, SOIL TEST! When a soil test report calls for lime and fertilizer but limited capital will not allow both to be applied, it is better to lime. Residual fertility will increase forage production if soil pH is corrected. That is not to say lime is all that is needed to grow forages. If the money is limited, then it is recommended to lime the year in question and fertilize the next year. Fertilizing cannot be overlooked but it can wait until soil pH is adequate.

Producers should research the various sources of nitrogen from commercial fertilizers, or possibly animal manures and make sure to apply  $P_2O_5$  and  $K_2O$  to soil test recommendations. After that, they should save the money on  $P_2O_5$  and  $K_2O$  until a soil test recommends otherwise. Soil testing every other year will more than pay for itself with fertilizer savings alone. As for the weeds, modern chemistry makes broadleaf weed control relatively cheap and easy in grass forages. New and emerging products have some promise for controlling grass weeds in grass pastures and hayfields but that chore is still difficult and complex.

When drought and other uncontrollable circumstances limit available forage, the producer should be quick and decisive in adjusting stocking rates. Culling less productive animals will not only benefit cash flow, but also reduce the added stress of overgrazing forages. Surveying the landscape and developing a written plan will make the process easier to manage.

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**Workshop Coordinating Team**

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