

# Tall Fescue

## History, Application, Establishment and Management

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### History

Tall fescue [*Lolium arundinaceum* (Schreb.) Darbysh = *Festuca arundinacea*] is an introduced, cool-season, perennial grass that is native from Europe to Siberia and into North Africa. The date of the actual introduction into North America is unknown, but it began to appear in seed catalogs in 1870. By 1892, tall fescue began appearing in variety trials from Utah to Kentucky. In 1943, the cultivar Kentucky 31 was released by the University of Kentucky, based on selections taken from a pasture on the William Suiter Farm in Manifee County, Ken. From this selection, the popularity of tall fescue rapidly expanded in the United States from 39,500 acres in 1940 to approximately 37.1 million acres today, making tall fescue the most common introduced grass in the country. In areas where it is highly adapted, the rise in its popularity can be attributed to a number of favorable agronomic factors: it remains green through winter; it grows in a wide range of climatic conditions; it tolerates a wide soil pH range, and is easily established; it is tolerant of close grazing, provides soil erosion control; and it provides sufficient forage quantity and quality for a number of classes of grazing livestock.

### Summer-active and summer-dormant tall fescue

Tall fescue is considered either summer-active (Continental) or summer-dormant (Mediterranean), based upon whether it originated in the northern European continent or the Mediterranean Basin region (Malinowski, 2005). Most of the recommended tall fescue varieties in the United States have European origins and are considered summer-active and referred to as 'Continental'. This means that during

the summer they will grow with good soil moisture and moderate temperatures, but will stop growth in response to low soil moisture and high temperatures.

By contrast, tall fescue varieties that originate from the Mediterranean Basin are summer-dormant and remain dormant through the summer regardless of growing conditions. This gives summer-dormant tall fescue varieties the potential to persist in areas with hot, dry summers. These tall fescue types are commonly referred to as 'Mediterranean' tall fescues.

### 'Toxic' Endophyte, Endophyte-'free' and 'Novel'-endophyte-infected Tall Fescue

#### Toxic-endophyte-infected tall fescue

Despite the popularity of tall fescue, it developed a reputation for causing production and performance issues with grazing livestock. In the

late 1970s, it was discovered that tall fescue is often infected with a fungal endophyte [*Neotyphodium coenophialum* (Morgan-Jones and Gams) Glenn, Bacon and Hanlin]. Tall fescue plants infected with the endophyte are commonly referred to as being 'endophyte-infected' or E+. As this endophyte fungus resides between plant cells, there is no way to determine that a plant is endophyte-infected from its outward appearance. Presence of the endophyte is detected by laboratory analysis of plant tissue. The endophyte is only transmitted through the seeds of an E+ tall fescue plant and cannot be passed from plant to plant; therefore, a plant that is endophyte-free cannot become endophyte-infected. A mutually symbiotic relationship exists between the endophyte and tall fescue. A tall fescue plant serves as a host for the endophyte fungus, providing it a place to live between the cells of the plant and a means of ►



transmission through the plant's seeds. In return, the endophyte produces alkaloids that are beneficial for plant persistence. The endophyte-produced alkaloids, peramine and loline, provide tall fescue with deterrents to insect predation. Ergot alkaloids produced by the endophyte are toxic to grazing animals and cause fescue toxicosis. Endophyte-infected tall fescue that produces ergot alkaloids causes fescue toxicosis.

There are three main syndromes associated with fescue toxicosis (Ball et al., 2003). These can occur in beef and dairy cattle, horses, sheep, and deer. Nationwide, losses in beef cattle revenue to fescue toxicosis is estimated to cost producers between \$500 million and \$1 billion annually (Browning, 2003). These syndromes include:

fescue that has been highly fertilized with nitrogen or poultry litter. It is characterized by deposits of hard masses of fat in the abdominal cavities, tail head and around reproductive organs. These masses have been known to interfere with reproductive function and calving.

- **Fescue toxicity** – Fescue toxicity is the most common of the tall fescue disorders with the greatest economic impact. Symptoms can include reduced feed intake; decreased gain; lower milk production; increased respiration rate; elevated body temperature; rough hair coat; reduced grazing time with more time being spent under shade or in water in an attempt to reduce body temperature; reduced reproductive performance; low blood serum prolactin levels; and

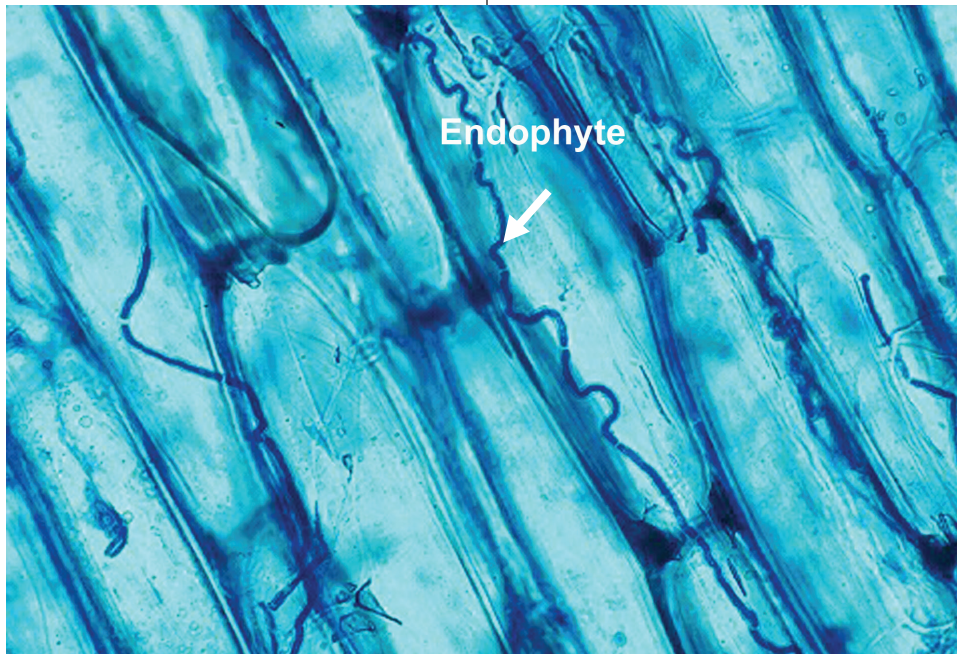
in endophyte-free (E-) tall fescue plants when planted. Performance of grazing animals on E- tall fescue is superior to that of animals grazing toxic E+ tall fescue. However, by eliminating the endophyte from tall fescue, plant persistence suffered. E-tall fescue typically does not have the drought, grazing or insect tolerance of toxic E+ tall fescue. Because of these reasons, stand persistence of E- tall fescue is typically shorter compared to toxic E+ tall fescue. Often, complete stand losses of E- tall fescue can occur within three to four years after establishment, due to drought intolerance and overgrazing. Consequently, E-, summer-active varieties are not recommended for establishment in the Southern Plains.

### Novel-endophyte-infected tall fescue

Naturally occurring endophyte strains have been identified that do not produce the ergot alkaloids. These non-ergot-alkaloid-producing endophytes can be manually inoculated into tall fescue selections, creating 'selected' endophyte/grass associations that are now commercially available. **These novel E+ tall fescue varieties do not cause fescue toxicosis.** Stocker cattle performance on novel E+ tall fescue has been comparable to wheat or rye pasture. In a three-year study at the Noble Foundation, spring average daily gain of steers was 2.2 pounds (Islam et al., 2011). Other studies have reported a range in average daily gains of stocker cattle grazing novel E+ tall fescue of 0.96-2.8 pounds (Gunter and Beck, 2004). Plant persistence of novel E+ tall fescue is similar to toxic E+ tall fescue. In a three-year grazing study at the Noble Foundation, percent stands of both novel E+ and toxic E+ tall fescues averaged 99% (Hopkins and Alison, 2006).

### Adaptation

Summer-active tall fescue is best adapted to clay or loam soils with a pH range of 5.5-7.5 in rainfall zones of 35 inches or more per year. It will not



- **Fescue foot** – Causes lameness of the grazing animal and in extreme cases sloughing of hooves or feet. It can also cause loss of the tail switch and ear tips. Fescue foot generally occurs during cold weather with animals grazing toxic E+ tall fescue. Animal performance will be reduced in animals suffering from fescue foot.
- **Bovine fat necrosis** – This condition occurs in cattle grazing toxic E+ tall

excessive salivation.

### Endophyte-free tall fescue

Once the link was made between ergot alkaloid production of toxic E+ tall fescue and fescue toxicosis, researchers began searching for a solution to the fescue toxicosis problem. It was soon discovered that the endophyte could easily be eliminated from tall fescue seed, which resulted

persist on sandy or sandy loam soils. If soil moisture is adequate, leaf growth can occur from 39-95° F, but optimal growth temperatures are 68-77° F. Figure 1 shows areas of major and minor tall fescue use. The summer-dormant-type tall fescues that do not actively grow during summer may have the potential to increase the area of adaptation westward.

## Case studies for tall fescue production

The seasonal growth curve for tall fescue in central Oklahoma can be represented by a bimodal curve (Fig. 2). Spring growth of tall fescue will begin in February and continue through May. Tall fescue will flower in May and set seed in May and June. Fall production of tall fescue will normally peak in November or December.

Fall production of tall fescue at the Noble Foundation has been inconsistent and rainfall-dependent. Table 1 is a summary of fall tall fescue production from studies done at the Noble Foundation.

In contrast to fall production, tall fescue spring production has been consistent. A Noble Foundation stockpile study (36-inch annual rainfall) conducted from 2008-2011 with both summer-dormant and -active tall fescues had an average April-May production of 4,139 pounds of dry matter per acre with a September application of 120 pounds N per acre (Rogers, unpublished data). In two of the three study years, annual rainfall was below normal. Following the study's termination in May 2011, drought followed with annual rainfall 16 inches below normal. The result was complete stand loss of summer-active varieties. Summer-dormant tall fescue survived with a 66% stand.

A Noble Foundation grazing study (36-inch annual rainfall) compared agronomic and economic performance of novel E+ summer-active tall fescue to a cereal rye-annual ryegrass system. Tall fescue did not produce enough forage for fall grazing three of the five years of the study due to lack of rain-

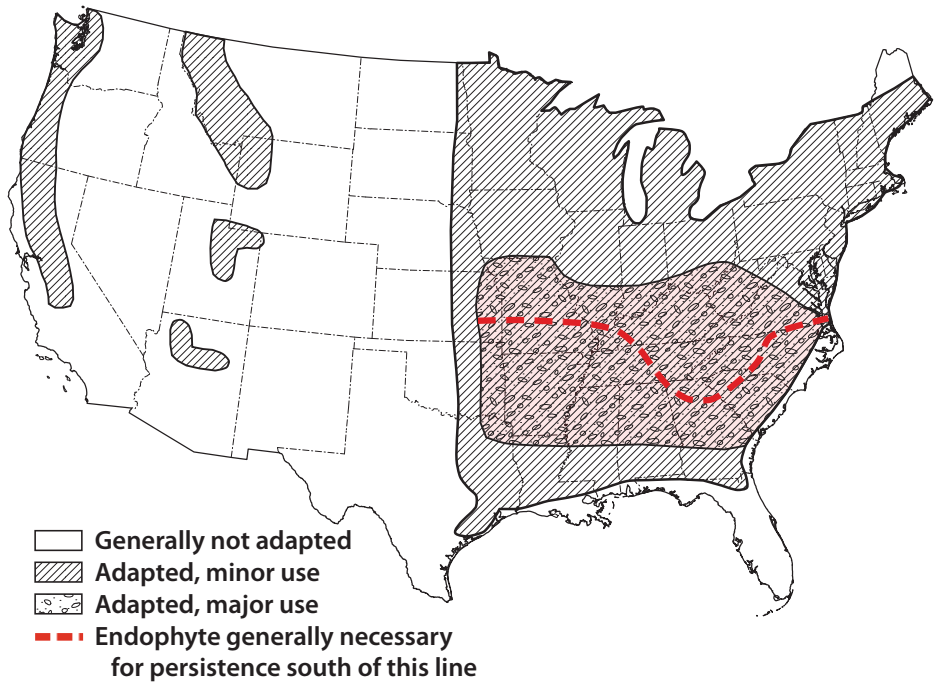


Figure 1. Major and minor areas of tall fescue use in the U.S. (West, 1998)

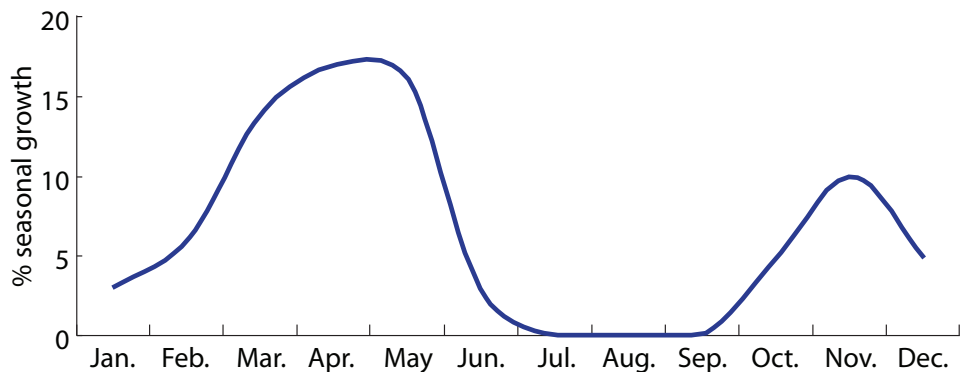


Figure 2. Typical seasonal growth of tall fescue in south-central Oklahoma

Table 1. November dry matter yields of tall fescue

Year	Aug.-Nov. precipitation	Departure from normal precipitation	N lbs/ac	DM yield lbs/ac
2001*	12.76"	-1.06"	75	846
2002*	10.62"	-3.20"	75	2,628
2003*	5.57"	-8.25"	75	1,381
2008**	8.99"	-4.66"	60	1,463
2009**	17.09"	+3.44"	60	1,626
2010**	14.00"	+0.35"	60	630

\*2001-2003 – Burneyville, Okla., bottomland silt loam soil (Hopkins and Alison, 2006)

\*\*2008-2010 – Ardmore, Okla., upland silt loam soil (Rogers, unpublished data)

fall. However, spring grazing did occur in all five study years from March-June with average daily gains on tall fescue similar to that of the cereal rye-annual ryegrass system. Because of the lack of fall grazing in the tall fescue system, gross revenue was greater for the cereal rye-annual ryegrass system (\$298 per acre) compared to the tall fescue system (\$224 per acre). However, there was no statistical difference in net returns to land, labor and management between the two systems (\$116 per acre cereal rye-annual ryegrass versus \$90 per acre tall fescue). It was estimated that the tall fescue stand would need to persist 12 years for average net returns of both systems to equal (Islam et al., 2011).

A similar Arkansas study (48-inch annual rainfall) compared a novel E+ summer-active tall fescue system to an annual ryegrass or small grains system. Tall fescue was consistently grazed both fall and spring each year of the three-year study. Grazing days averaged 85 in the fall and 89 in the spring. The tall fescue system realized \$91 per acre compared to \$57 per acre for annual ryegrass and a loss of \$28/acre for the small grains system (Beck et al., 2008).

Texas A&M researchers in east Texas (45-inch annual rainfall) conducted a three-year rotational grazing study with a novel E+ summer-active tall fescue grown in a well-drained creek bottom soil. At the end of the three-year study of grazing from fall through winter, % stands of the novel E+ entries averaged 86%. No summer grazing of the tall fescue occurred during the study (Rouquette et al., 2004).

Current research data in areas receiving 36 inches of annual rainfall or less indicate that long-term persistence of summer-active tall fescue may be limited to stand persistence ranging from three to six years. East of Interstate-35, tall fescue persistence and opportunities for fall production increase as annual rainfall increases.

## Tall fescue establishment

Producers considering summer-active tall fescue establishment should consider their annual rainfall and pay careful attention to site selection. Summer-active tall fescue is best adapted to clay to clay loam soils in areas with good water-holding capacity; it is not suited to sandy soils with low water-holding capacity.

Tall fescue should be established in the fall; spring planting of tall fescue is not recommended because plants have little time to establish prior to the heat and lower rainfall typically experienced in summer. Tall fescue can be easy to establish with good quality seed and by following proper planting procedures. Successful stands have been achieved using either no-till or conventional tillage practices.

### **Clean tillage establishment:**

1. Soil-test (0-6 inch) to determine phosphorus, potassium and lime needs. Apply lime immediately if required.
2. If ryegrass or other cool-season annuals are present, then prevention/elimination of any seed production the spring before a fall planting is crucial to successful fall establishment. Cool-season annuals usually go to seed from early May to the middle of June. Seed production can be prevented with either a burn-down herbicide application or late spring tillage.
3. Prepare a clean, firm, weed-free planting bed. If necessary, graze down, hay or apply herbicide to reduce vegetation volume prior to beginning preparatory tillage in August. Preparatory tillage usually consists of disking and cultivating to reduce clod size and the incorporation of residue and fertilizers, followed by a weighted roller or "cultipacker" to firm the planting bed. It will often require several cultivation or disking passes to prepare the soil. Apply phosphorus and potassium prior to the final cultivation or disking. The

soil should be free of clods and firm, but not fluffy, before planting.

4. If ryegrass or other cool-season annuals were present, irrigate or allow rainfall to stimulate a fall growth flush. Eliminate this fall growth flush with a burn-down herbicide application. Do not eliminate the growth flush with tillage, or it will stimulate another fall growth flush.
5. Plant 15 pounds of tall fescue pure live seed (PLS) of tall fescue seed per acre between Sept. 15 and Nov. 1. Plant the tall fescue seed  $\frac{1}{4}$  to  $\frac{1}{2}$  inches deep with a calibrated grain drill. Use caution not to plant deeper than  $\frac{1}{2}$  inch, or emergence will be poor. Good seed-to-soil contact is critical for establishment.
6. Once tall fescue is established, apply 60 pounds actual nitrogen per acre to aid in greater coverage. After this stage, monitor for broadleaf weeds and, if needed, apply 1 pound 2,4-D amine per acre (1 quart of a 3.8-pound-per-gallon formulation) to keep weeds suppressed.
7. The stand should not be fully utilized in the early spring following planting as the plants are not fully established, and overgrazing prior to summer can severely affect future stand persistence. However, if the stand is full, it can be hayed or lightly grazed, leaving at least a 4-inch stubble height prior to June 1. Full grazing can begin the fall following establishment.

### **No-till establishment:**

1. Soil-test (0-6 inch) to determine phosphorus, potassium and lime needs. Apply lime immediately if required.
2. If ryegrass or other cool-season annuals are present, prevent any seed production the spring before a fall planting. Cool-season annuals usually go to seed from early May to the middle of June. Seed production is most effectively prevented with a burn-down herbicide application.
3. Graze short or hay to reduce exist-

ing vegetation volume by late August or early September. Depending upon type of vegetation present, apply 1-4 pounds glyphosate per acre (1-4 quarts of a 4 pound-per-gallon formulation per acre) to burn down existing vegetation prior to planting.

4. If ryegrass or other cool-season annuals were present in the spring, then allow rainfall (or irrigation) to stimulate a fall growth flush. Eliminate this fall growth flush with a burn-down herbicide application.
5. Apply phosphorus and potassium according to soil test.
6. Plant 15 pounds of tall fescue PLS per acre between Sept. 15 and Nov.
  1. Plant the tall fescue seed  $\frac{1}{4}$  to  $\frac{1}{2}$  inches deep with a calibrated no-till drill. Use caution not to plant deeper than  $\frac{1}{2}$  inch, or emergence will be poor. Good seed-to-soil contact is critical for establishment.
7. Once the tall fescue is established, apply 60 pounds actual nitrogen per acre to aid in greater coverage. After this stage, monitor for broadleaf weeds, and, if needed, apply 1 pound 2,4-D amine per acre (1 quart of a 3.8-pound-per-gallon formulation) to keep weeds suppressed.
8. The stand should not be fully utilized in the early spring following planting as the plants are not fully established, and overgrazing prior to summer can severely affect stand persistence. However, if the stand is full, it can be hayed or lightly grazed, leaving at least a 4-inch stubble height prior to June 1. Full grazing can begin the fall following establishment.

## Tall fescue management

Care should be taken to avoid grazing or haying during the first spring following the fall establishment to allow tall fescue time for root system development to aid long-term stand persistence. If weather conditions have been favorable during establishment and spring top growth develops rap-



idly, a light grazing or haying can be performed. Do not graze or hay short. Terminate grazing or haying prior to the first of June and leave at least 4 inches of residual top growth.

Tall fescue is typically ready to be fully utilized in the fall following establishment. Expect  $\frac{1}{4}$  to  $\frac{1}{3}$  of total yearly production in fall and the remainder in the spring. N fertilizer can be applied at rates of up to 120 pounds actual N per acre in a year with split applications. Tall fescue is very compatible with legumes such as clovers, and these are often grown together in higher rainfall zones.

Tall fescue can be strip, continuous or rotationally grazed as long as it is not overgrazed. Care should be taken that tall fescue stands enter the summer with no less than 4 inches of residual height. Less residual height could result in stand thinning over time.

Tall fescue quality will be highest in the fall and spring, and declines to a seasonal low in the summer when

the plants produce seed. In a Noble Foundation stockpile study, crude protein ranged from 18% in November to 12% in May. Total digestible nutrient content ranged from 68% in November to 64% in May.

## Management of 'toxic' E+ tall fescue

For producers who currently utilize toxic E+ tall fescue for grazing, there are ways to manage it to minimize the toxic effects:

1. Dilute the effect by interseeding the stand with legumes.
2. Dilute the effect by feeding hay that is not toxic E+ tall fescue or by feeding a grain supplement.
3. Avoid excessive nitrogen applications as this tends to increase alkaloid levels.
4. Avoid grazing toxic E+ tall fescue during the summer.
5. Try to keep tall fescue vegetative, and avoid grazing seed heads. Endophyte concentrations are highest in the seed heads. ■

## A glossary of tall fescue terminology

**cool-season plant** – Plant species that grow best during cool, moist periods of the year. They commonly have temperature optimums of 59° to 77° F.

**crude protein (CP)** – An estimate of protein concentration in a feed or forage that is based on total nitrogen (N) concentration; generally calculated as total N X 6.25 because N concentration of plant proteins averages 16%.

**dormancy** – A period of arrested growth and development due to physical or physiological factors.

**drought avoidance** – Ability of a plant to avoid exposure to water-deficit stress.

**endophyte-free tall fescue** – Tall fescue that is not infected with the endophyte fungus *Neotyphodium coenophialum*.

**novel-endophyte-infected tall fescue** – Tall fescue that is infected with a selected strain of *Neotyphodium coenophialum* that does not produce ergot alkaloids. Novel-endophyte-infected tall fescues do not cause fescue toxicosis. The novel endophyte/grass association is beneficial to plant persistence. Example varieties: Jesup MaxQ, Texoma MaxQ II, Estancia with ArkShield®.

**overgrazing** – The long-term overutilization of a forage resource. It occurs when the carrying capacity of the forage resource is repeatedly exceeded.

**perennial** – Plant that lives for more than one year through persisting organs, such as rhizomes, stolons or crowns, that contain tiller buds.

**persistence, plant** – The ability of perennial plants to remain alive and productive over long periods of time.

**persistence, stand** – Trait that allows a forage stand to be productive for several years. Stand persistence occurs due to plant persistence.

**stockpiling** – To allow forage to accumulate for grazing at a later period.

**strip grazing** – A stocking method where animals are confined to a small area of pasture for a relatively short period of time. Usually accomplished with a temporary fence that is moved in increments across the pasture as available forage is consumed.

**summer-dormant tall fescue** – Tall fescue that has originated from the Mediterranean Basin that becomes dormant during the summer. Example varieties in Prosper, Grasslands Flecha

**summer-active tall fescue** – Tall fescue that has originated from the European Continent; sometimes referred to as ‘Continental’ tall fescue. Example varieties: Texoma MaxQ II, Kentucky 31, Fawn.

**symbiotic** – Having a mutually beneficial relationship between two organisms, such as legumes and rhizobia bacteria or *Neotyphodium coenophialum* and tall fescue.

**total digestible nutrients (TDN)** – Sum total of the digestibility of the organic components of plant material and/or seed; e.g., crude protein + nitrogen-free extract + crude fiber + fat.

**toxic** – Causing injury or impairment.

**toxic or wild endophyte-infected tall fescue** – Tall fescue that is infected with a common strain of *Neotyphodium coenophialum*, an endophyte (fungus) that lives within the plant in a symbiotic relationship. The endophyte produces alkaloids that are beneficial to the plant’s persistence. Some of the alkaloids produced, namely ergovaline, can harm grazing animals by causing fescue toxicosis. The outward appearance of the plant is not altered by the endophyte. The endophyte can only be transferred through the seeds of the plant. Example variety in Kentucky 31.

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