University of Idaho
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Kentucky Bluegrass Production

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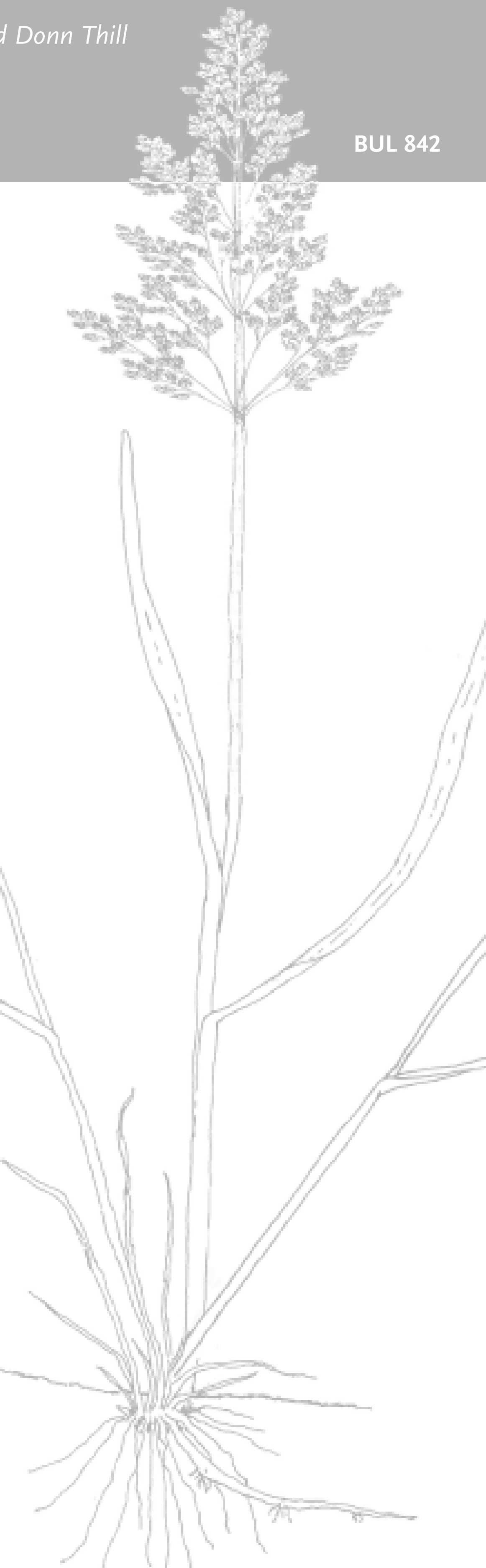
BUL 842



INTRODUCTION

The production of Kentucky bluegrass in northern Idaho began during the 1950's with approximately 10,000 acres and has since grown to 70,000 acres. Idaho produces 50 percent, and the tri-state region (Idaho, Washington, and Oregon) produces 90 percent of the total U.S. Kentucky bluegrass seed (Canode, 1978; Census of Agriculture, 1997). Bluegrass is used in turf grass applications, erosion control practices, and pastures. Acreage in the region has increased due to greater demand, an environment ideally suited for bluegrass production, and the ability of established stands to reduce soil erosion and nutrient runoff, which helps protect the area's soil and water quality.

Producers have historically burned bluegrass post-harvest residue to maintain stand productivity and profitability. Burning reduces thatch accumulation, viable weed seed, and disease, insect, and rodent incidence. In addition, burning returns nitrogen (N), potassium (K), phosphorus (P), and other nutrients to the soil. Unfortunately, burning has also been associated with significant air quality and public health impacts. Due to these concerns the state of Washington issued a moratorium on burning bluegrass residue in 1996, and restrictions on field burning were implemented in Idaho. Researchers at the University of Idaho (UI) are evaluating no-burn and reduced-burn residue management systems for their sustainability.

STAND ESTABLISHMENT—$230 TO $400 PER ACRE

Bluegrass stand establishment poses a significant cost and risk to producers. Stand establishment costs approximately $400 per acre for irrigated and $230 per acre for dryland production (Smathers, 2003b; Smathers, 2003d). In addition, about 7 percent of the time a stand is unsuccessfully established and must be replanted. Annual production costs average $600 per acre for irrigated and $350 per acre for dryland production (Smathers,

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NOTE: This publication is the first in a series evaluating the effects of residue management on bluegrass production, growth, and seed production. Please refer to other UI Extension publications for the effect of residue management on Kentucky bluegrass profitability (BUL 161 by Van Tassel, 2002), or growth, development and seed production (BUL 843, Holman and Thill, 2005). Also find resources at the UI bluegrass website, *www.ag.uidaho.edu/bluegrass/*.

2003a; Smathers, 2003c). Stand life is shortened in no-burn systems, which increases the frequency and risk of stand establishment.

Stands can either be spring or fall planted. Stands fall-seeded in areas with long growing seasons and irrigation (i.e., the Columbia Basin of Washington) can produce seed the following year. In regions with short growing seasons, fall plantings will likely not produce seed the following year, but will take advantage of early spring moisture and produce seed the next year.

In both burn and no-burn production, seed should be planted on 12-inch row spacings, at a soil depth of ¼-inch, and at a rate of 3 to 9 lb per acre, depending on seed size and viability. Varieties with a large seed size and low germination seed lots need to be seeded at higher rates. Phosphorus (P) and potassium (K) have limited soil mobility. A 3-year supply of P and K can be applied at seeding to ensure nutrient levels are adequate for the first couple of years (Mahler, 2001). A bluegrass stand will produce seed for three to ten years in a burn system, and three years in current no-burn systems.

Swathing too soon can reduce seed germination and yield, while swathing too late can result in seed shattering.

HARVEST— CRITICAL FOR HIGH SEED YIELD, QUALITY

Bluegrass is swathed at maturity, which typically occurs in early July for early maturing varieties. It is best to consult with a field representative when determining the best time to swath and harvest your bluegrass. Maturity can be estimated by striking seed heads into your hand; the plant can be swathed when a couple of seeds are dislodged from the head. After swathing, the bluegrass is dried in the field for a minimum of 10 days before harvest.

High humidity, cool temperatures, rain, and cloudy days can lengthen the time required for bluegrass to dry. Time of swathing and harvesting are critical for obtaining high seed yield and quality. Swathing too soon can reduce seed germination and yield, while swathing too late can result in seed shattering. Harvesting high moisture seed can reduce seed quality and require supplemental drying, while harvesting late increases the chances of seed shattering and loss.

PEST MANAGEMENT

Weeds—Control Them During Stand Establishment

Weeds, and particularly noxious weeds, are a major problem in grass seed production. If left uncontrolled, weed injury can reduce seed production 50 to 80 percent and contaminate the harvested seed crop. There is zero tolerance for noxious weeds in a grass seed crop, and contamination of a seed lot with noxious weeds can result in the entire seed lot being rejected. Therefore, it is critical that fields are scouted for weed infestations and managed accordingly. For information on herbicides available for use in Kentucky bluegrass, refer to the Pacific Northwest Weed Management Handbook available at *http://weeds.ippc.orst.edu/pnw/weeds*. Weeds should be controlled during stand establishment, since the cost of weed management is recuperated by higher seed yield and lower weed densities in subsequent years (Canode and Robocker, 1966).

Burn. Weed populations are lower in burn systems due to 1) reduced weed seedling establishment in the absence of soil disturbance; 2) decline in the weed seed bank; and 3) crop competition of an established stand.

Reduced-burn. It is unknown what the long-term effect will be on weed populations in reduced-burn systems. Due to higher residue levels in reduced-burn systems, applying foliar-active rather than soil-active herbicides may increase weed control cost, but also efficacy. As always, it is important to follow proper herbicide selection and mode of action rotation standards to prevent crop injury and the development of herbicide resistance. For more information on herbicide selection and rotation, refer to the Pacific Northwest Extension Publication No. 437 (Mallory-Smith et al., 2002).

No-burn. Weed populations tend to increase in no-burn production systems during the third year of production. In contrast, weed populations tend to remain fairly consistent in burn production systems (Chastain et al., 1997; Chilcote and Young, 1991; Thill, unpublished data).

Higher weed populations in no-burn systems are caused by 1) an increase in the weed seed bank due to lower post-harvest seed mortality; 2) decreased efficacy of soil active herbicides due to herbicide binding to the plant residue; and 3) lower crop competition due to more frequent stand establishment, decreased fertilizer efficiency, and higher insect, disease, and rodent incidence (Chilcote and Young, 1991; Young et al., 1984).

Proposed methods of increasing bluegrass stand life in no-burn production systems have been to widen the row spacing and harrow the residue post-harvest. Widening the row spacing greater than 12" may help delay sodding in of the stand, but it also reduces crop competition with weeds and lowers yield (Gossen et al., 2002). Harrowing enhances residue decomposition and may increase stand life, but it also can cause stand injury and increase weed seed incorporation into the soil, resulting in increased weed seedling establishment.

Diseases—Uncontrolled, Can Greatly Reduce Yields

Burning grass seed residue originated during the late 1940's to control several plant diseases and insects (Hardison, 1976). Uncontrolled disease infestations have been known to reduce bluegrass seed yield 20 to 100 percent. Disease incidence is more common under cool, humid, cloudy conditions. Diseases common in bluegrass include silvertop (*Fusarium poae*), leaf spot (*Helminthosporium*), stem rust (*Puccinia graminis* subsp. *graminicola*), powdery mildew (*Peronospora parasitica*), and ergot (*Claviceps purpurea*). Of these diseases, silvertop and leaf spot are two of the most common and yield-limiting diseases in bluegrass. For information on fungicides available for use in Kentucky bluegrass, refer to the Pacific Northwest Disease Management Handbook online at *http://plant-disease.ippc.orst.edu*.

Silvertop causes seed heads to become silvery-white in color and necrotic (dead) prior to setting seed. Silvertop has been known to affect up to 80 percent of a field (Peterson and Vea, 1969). It is uncertain what causes silvertop, since it develops under many different situations. Silvertop may be caused by a fungus (*Fusarium poae*), and vectored by several insects that vary by region and environmental condition (Peterson and Vea, 1969). Insect vectors include cutworms, thrips, capsus bugs, wheat stem maggots, weevils, and lepidoperous borers.

Or, silvertop may simply be a plant stress response syndrome caused by insect or mechanical damage. Regardless, insects are likely a major component in the development of silvertop, since an insecticide application can reduce silvertop incidence (Bragg et al., 2002).

Leaf spot causes leaf spotting (development of small brown spots on the leaves) and melting out (rotting out of basal tissue near the soil surface) of susceptible bluegrass varieties, and can cause an infected plant to die during hot, windy weather (Ensign et al., 1974). Incidence is favored by warm temperatures (70 °F or 21 °C) and high humidity.

Although burning reduces the inoculua level of leaf spot, burn production fields can still become infected (Ensign et al., 1975). In the absence of burning, bluegrass emerging in the fall becomes infected with leaf spot when the plant comes into contact with infected crop residue. In addition to providing a host for the pathogen, the post-harvest residue promotes disease development by maintaining a higher humidity for leaf lesion development and fungal spore germination.

The occurrence of leaf spot in burn production systems is believed to be caused by high background levels of inoculua that can cause a secondary infestation of Kentucky bluegrass after burning. Therefore, only varieties resistant to leaf spot are effectively protected from leaf spot (Ensign et al., 1975). Many "elite" or proprietary varieties are resistant to leaf spot. However, "elite" has also been used as a marketing tool, so it is important to verify with a seed provider if the variety is resistant to leaf spot. See Table 1 for a partial listing of bluegrass varieties and their disease resistance.

Stem rust infects susceptible cultivars and causes moderate to severe damage if left uncontrolled. Infection is favored under moderately warm, moist weather. Dew for 10 to 12 hours is sufficient for the spores to infect grass plants. Fungi survive from season to season on infected foliage of bluegrass and other host plants.

Powdery mildew overwinters on infected plants and plant debris. Spores are dislodged easily and spread by wind. Severely infected grass stands can be destroyed by powdery mildew if left uncontrolled.

Ergot overwinters on or near the soil surface and germinates in the spring. Infection occurs within the floret (flower within a spikelet) as a dark purple to black sclerotia (ergot bodies) in place of the seed. The ergot bodies

TABLE 1. Kentucky bluegrass varietal characteristics for 65 varieties.

Variety[a]	Aggressiveness[b]	Genetic Color	Spring Greenup	Leaf Width	Leaf Spot	Patch Disease	Stem Rust	Dollar Spot	Powdery Mildew
Princeton - 104	9	7	6	5	9	7	5	8	6
Mystic	9	3	6	9	4	7	3	2	9
A-34	9	4	6	4	7	6	8	6	—
Sydsport	8	5	4	5	7	7	8	5	5
Touchdown	8	6	5	6	8	5	4	4	2
Blacksburg	7	8	3	7	8	7	3	6	5
Glade	7	8	5	7	5	8	7	6	5
Eclipse	7	7	6	6	8	8	4	8	5
Amazon	7	7	2	7	6	3	4	5	3
Merion	7	6	5	5	7	6	2	6	4
Chateau	7	6	4	5	7	6	8	5	3
Plush	7	5	6	5	5	4	6	8	4
Ram 1	6	7	7	7	5	3	6	4	8
Midnight	6	9	2	7	8	8	5	6	2
Enmundi	6	8	5	6	8	—	—	7	8
Able 1	6	8	3	7	7	7	8	7	4
Challenger	6	7	7	6	7	8	7	7	5
Adelphi	6	7	7	6	7	8	7	8	3
Nugget	6	7	1	7	8	2	4	3	9
America	6	7	3	7	6	8	6	7	7
Aspen	6	7	6	6	7	8	7	7	7
Julia	6	6	5	6	7	4	6	5	4
Abby	6	6	4	6	6	6	5	7	2
Majestic	6	6	7	6	7	8	7	7	3
Tendos	6	6	6	7	5	8	6	6	—
Classic	6	6	7	6	6	7	8	7	5
Aquila	6	6	4	6	3	8	6	4	8
Ikone	6	6	5	7	7	3	7	5	7
Welcome	6	6	3	7	4	7	—	6	7
Wabash	6	3	7	8	2	4	7	6	6
1757	5	7	6	5	7	8	9	8	9
Baron	5	7	4	6	6	8	7	6	3
Georgetown	5	6	7	6	6	8	8	6	5
Bristol	5	8	6	5	8	8	7	7	8
Columbia	5	6	7	5	7	7	8	6	2

TABLE 1. continued

Variety[a]	Aggressiveness[b]	Genetic Color	Spring Greenup	Leaf Width	Leaf Spot	Patch Disease	Stem Rust	Dollar Spot	Powdery Mildew
Victa	5	6	4	5	6	7	6	6	3
Liberty	5	6	7	7	6	8	7	7	6
Gnome	5	6	4	5	6	6	6	6	2
Birka	5	6	4	6	7	5	6	3	5
Merit	5	6	4	6	6	8	5	5	3
Cynthia	5	6	5	9	4	8	8	8	6
Haga	5	6	7	6	6	7	8	6	5
Parade	5	6	7	6	6	7	8	6	5
Rugby	5	6	7	6	6	7	8	6	5
Trenton	5	6	7	6	6	7	8	6	5
Coventry	5	6	4	5	6	6	7	5	5
Cheri	5	6	4	5	6	6	8	6	3
Estate	5	6	4	5	3	6	8	6	6
Fylking	5	6	5	5	6	2	6	5	2
Banf	5	6	7	6	6	7	7	6	2
Vantage	5	5	8	4	4	7	6	2	—
Monopoly	5	4	6	6	6	3	8	5	8
Harmony	5	3	3	5	4	8	—	6	2
Nassau	4	7	7	5	7	6	7	7	4
Dawn	4	7	6	6	7	4	7	7	5
Suffolk	4	6	6	6	7	8	8	8	8
Huntsville	4	6	7	8	3	8	8	6	8
Freedom	4	5	7	7	6	7	—	7	6
Destiny	3	7	6	5	6	6	7	7	6
Newport	3	5	7	5	2	5	6	—	7
Park	3	5	8	8	1	1	6	6	6
Garfield	3	4	8	8	1	1	6	—	—
Argyle	3	4	8	6	1	1	6	1	—
Kenblue	3	4	8	8	1	1	8	4	8
South Dakota	2	3	7	8	1	1	6	5	5

[a] Varieties listed in descending order by aggressiveness.

[b] Rating is on a scale of 1 to 9, with 9 being the most aggressive, darkest color, earliest greenup, finest leaf width, and best disease resistance.

consist of a mass of vegetative strands of the fungus. The interior of the sclerotum is white or tannish-white. Infected florets secrete plant sap called honeydew. It is high in sugar content and attracts insects, which help spread the disease. The degree of infection and damage caused by ergot depends on the variety and amount of inoculua present. Infection increases seed cleaning costs, and reduces yield by causing sterility of neighboring spikelets and reducing seed weight.

Seed certification standards allow up to one percent inert matter. Since ergot is a component of inert matter, ergot levels greater than one percent do not meet seed certification standards. Many grass species are hosts for ergot. Wild bluegrass plants are highly susceptible to ergot. Their presence near seed fields is a primary source of inoculua.

The long-term effect of not burning on the insect population is unknown, and insect populations might change with time and increased no-burn production acreage.

Tillage, aggressive harrowing, and irrigation increase the potential for disease development (Ensign et al., 1974). Tillage and harrowing stress the bluegrass plant and injure the plant's rhizomes, creating a pathway for pathogens to infect the plant. Irrigation increases humidity near the soil surface, which promotes fungal spore germination. Irrigation also causes disease infection by carrying fungal spores from the soil surface to the plant leaves with splashing drops of water.

Early fall burning is more effective at controlling diseases than late fall burning (Ensign et al., 1974). Surprisingly, disease incidence has not increased in recent years, when changing from a burn to no-burn production system, as it did during the 1940's (Chilcote and Young, 1991; Ensign et al., 1974; Ensign et al., 1975; Young et al., 1984).

The lower disease incidence observed today in no-burn systems might be the result of newer, more disease resistant varieties, lower disease inocula from years of burning, a recent switch from burn to no-burn production, and more frequent crop rotation due to shorter stand lives associated with no-burn production. As the amount of no-burn acreage increases, the probability of disease incidence will likely increase due to higher inocula levels within a production field and from neighboring production fields (Chilcote and Young, 1991).

Insects—When to Apply Insecticide

Insect damage to Kentucky bluegrass is highly variable across year, location, and variety. Varieties vary in phenological development, and their susceptible growth stages may or may not coincide with damaging levels of insects. Fields should be monitored for insect incidence and crop injury. An insecticide should be applied when insect densities approach the economic injury level (point at which insect damage exceeds the cost to apply an insecticide). For information on insect identification and insecticides available for use in Kentucky bluegrass, refer to the Pacific Northwest Insect Management Handbook, available at *http://insects.ippc.orst.edu/pnw/insects,* or Washington State University Extension Bulletin 681, Insect and Mite Pests of Bluegrass Seed Fields.

Sod webworms (*Crambus* spp.), commonly called lawn moths, can severely damage bluegrass and spread to adjacent fields. Damage is highest in dry years. Adults emerge during the summer as moths. They reside in burrows during the day. At night, they fly, feed on plant crowns, and scatter their eggs in the grass crop. Eggs hatch after about one week. The first instar larvae (stage in the life cycle of the insect between two successive molts) feed on the crown the remainder of the growing season. They overwinter as a second instar and resume feeding during the spring until they emerge as adults (moths) during the summer months. Generations may overlap, with all stages present by late summer. Damage to susceptible grass crops is most obvious in spring and fall. Fields should be scouted and treated as necessary each fall.

Meadow plant bug (*Leptoperna dolabrata*) damage can exceed 50 percent if not controlled. Most damage occurs to the older, common varieties of bluegrass. Many newer varieties such as South Dakota, Palouse, and Newport appear to have an effective level of resistance, and currently do not require treatment. Adult plant bugs damage the seed crop by feeding on florets and preventing seed development. The bug also feeds on and can kill newly planted grass seedlings.

Cutworms and **armyworms** frequently damage grass seed crops below and above ground. Cutworms tend to feed on crowns and leaves of developing plants during fall, winter and spring months. Armyworms generally feed on foliage in mid to late summer. Cutworms and armyworms are more effectively controlled when they are small and immature. Control of cutworms and armyworms is typically achieved by insecticides applied for sod webworm control.

Winter grain mites (*Penthaleus major*) occasionally reach densities that reduce yield 20 to 40 percent. Winter grain mites are active throughout the year but are particularly numerous during warm winter months.

Burn vs. No-Burn. The impact of burning on insect populations is unknown. One study found no difference in insect density between burn and no-burn systems after three years of production (Chilcote and Young, 1991). A second study found that burning did not impact moth larval pests, but reduced the density of Miridae (meadow plant bug and other species), thrips, and grass mites (Adams et al., 1976). In the second study, the reduction in insect density was caused by less ground cover, which facilitated increased bird predation. However, the increase in bird predation did not eliminate pest damage to bluegrass, since bird predation occurred after the crop was harvested (Adams et al., 1976). The long-term effect of not burning on the insect population is unknown, and insect populations might change with time and increased no-burn production acreage.

Rodents—Monitor Fields for Crop Injury

Rodents can cause significant bluegrass yield reductions, and burning can reduce the impact of rodents on seed production by lowering their population levels (Chilcote and Young, 1991). It is unknown what the rodent population or its impact on seed production will be in a no-burn or reduced-burn production system. Monitoring fields for damage and pest levels can help minimize crop yield loss.

SOIL FERTILITY—
APPLY FERTILIZER IN THE FALL

Fertilizer needs to be applied in the fall for fall regrowth, which is necessary for seed production the following year (for more information on plant growth and seed production see BUL 843; Lamb and Murray, 1999). For specific fertilizer recommendations on bluegrass production in a burn system, refer to the UI Extension Publication No. 788 (Mahler, 2001).

Burn. In a burn system, fertilizer should be applied in October since applying earlier can result in too much fall regrowth, and applying later can result in too little regrowth, both resulting in decreased seed production (Lamb and Murray, 1999).

No-burn/less-burn. Current fertilizer research is investigating time and rate of application in no-burn and reduced-burn systems, since nutrient management may need to be amended in these systems. In these systems, preliminary results indicate fertilizer rate may need to be increased and time of fertilizer application modified (Holman, unpublished data).

Burning bluegrass residue releases N, K, P, calcium (Ca), and other minerals into the soil (Hardison, 1976). Some N and sulfur (S) are volatilized (lost to the atmosphere) when the residue is burned (Mahler, 2001). Increasing N fertilizer rate alone does not compensate for the reduced seed production and shorter stand life in no-burn production systems (Adams et al., 1976; Pumphrey, 1965; Thompson and Clark, 1989).

Baling the residue as part of a reduced-burn or no-burn production system removes N, P, K, S, Ca, magnesium (Mg), boron (B), iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), and aluminum (Al) with the baled residue (Oregon State University, 2003) (Table 2). It is uncertain but likely that the fertilizer rate will need to be increased to replace the nutrients removed with the baled residue. The residue analyzed by OSU was 1.7 percent N or 10.92 percent crude protein (%N * 6.25 = crude protein) (Table 2). In comparison, test results from the UI have commonly found bluegrass residue contains 0.64 to 0.96 percent N or 4 to 6 percent crude protein (Holman, unpublished data).

TABLE 2. Nutrients removed with baled Kentucky bluegrass post-harvest residue (Oregon State University, unpublished data). It is uncertain if baling will require a higher fertilizer rate to replace the nurtients removed by baling. Preliminary research indicates that fertilizer rate may need to be increased and time of application modified in no-burn and reduced-burn production systems.

Element	Symbol	lb of element/ton of residue	lb of element/2.5 tons of residue[a]
Nitrogen	N	34.95	87.38
Phosporus	P	6.47	16.19
Potassium	K	37.64	94.11
Sulfur	S	3.84	9.61
Calcium	Ca	9.28	23.20
Magnesium	Mg	4.37	10.93
Boron	B	0.04	0.11
Iron	Fe	4.10	10.24
Manganese	Mn	0.18	0.45
Copper	Cu	0.03	0.07
Zinc	Zn	0.08	0.19
Aluminum	Al	2.17	5.43

[a] One acre of dryland common type Kentucky bluegrass will commonly produce 2 to 2.5 tons of residue.

SOIL EROSION AND NUTRIENT RUNOFF—DOWNSIDE OF NO-BURN

Compared to annual cropping systems, Kentucky bluegrass reduces soil and nutrient runoff in all years except the establishment and plow-out years (Adams et al., 1976; McCool and Papendick, 1980). It is unknown if differences in soil and nutrient runoff will occur between no-burn and burn production systems. However, if stands are more frequently established in no-burn production systems due to shorter stand lives, than an increase in soil erosion will likely occur.

SUMMARY

Burning post-harvest residue has been an integral component of Kentucky bluegrass seed production. Burning helps control weed, disease, insect, and rodent populations, produce high quality seed, manage post-harvest residue, cycle nutrients, and maintain stand productivity. Eliminating burning will greatly impact Kentucky bluegrass seed production. Identifying the specific agronomic benefits of burning will help identify those practices that will need to be implemented for a reduced-burn or no-burn production system to be viable.

Additionally, the environmental impacts of not burning need to be evaluated. Reducing or eliminating burning will reduce smoke emissions, but might increase soil erosion and lower water quality. The agronomic and environmental factors of reduced-burn and no-burn Kentucky bluegrass production systems will have significant implications on how and where bluegrass seed is produced.

PRODUCER TIPS

While much research is needed to document best practices in reduced-burn and no-burn production systems, the following key points presented in this paper are summarized.

Stand establishment

1. In both burn and no-burn production, seed should be planted on 12-inch row spacing, at a soil depth of ¼-inch, and at a rate of 3 to 9 lb per acre. Varieties with large seed size and low germination seed lots need to be seeded at higher rates.
2. Phosphorus (P) and potassium (K) have limited soil mobility. To help insure adequate nurtrient levels, apply a 3-year supply of P and K at seeding (Mahler, 2001).

Harvest

3. Consult with a field representative to determine the best time to swath and harvest your bluegrass.

Pest Management—weeds

4. Scout fields for weed infestations.
5. No noxious weeds are allowed in grass seed crops.
6. Manage weeds during stand establishment.
7. Row spacings wider than 12'' will reduce yield and crop competition with weeds.
8. Use a foliar-active rather than a soil-active herbicide in no-burn production systems.
9. Minimize harrowing to prevent weed seed incorporation into the soil.
10. Post-harvest burning kills some weed seed lying on the soil surface.

Pest Management—diseases

11. Monitor fields for disease incidence.
12. Post-harvest burning reduces disease inoculua.
13. Early fall burning is more effective at controlling diseases than late fall burning.
14. Insecticide applications can reduce silvertop incidence.
15. Consult your seed supplier for disease resistant varieties.
16. Control grassy weeds and wild bluegrass adjacent to production fields to prevent the spread of disease.
17. Tillage, aggressive harrowing, and irrigation increase the potential for disease development.

Pest Management—insects

18. Monitor fields for insect incidence and crop damage.
19. Apply an insecticide when insect densities approach the economic injury level (point at which insect damage exceeds the cost of applying an insecticide).

Pest Management—rodents

20. Monitor fields for rodent incidence and crop damage to determine if and when to apply a rodenticide.

Soil Fertility

21. For specific fertilizer recommendations on bluegrass production in a burn system, refer to the UI Extension Publication No. 788 (Mahler, 2001).
22. Fertilizer should be applied in October in a burn system.
23. No-burn and reduced-burn production systems will likely require increased fertilizer rates and modifying the time of application. Current research is evaluating best fertilizer management practices in reduced-burn and no-burn production systems.
24. Baling post-harvest residue removes nutrients, which will likely require increased fertilizer rates for seed production to be maintained.
25. Baled bluegrass contains 4 to 10 percent crude protein.
26. Increasing fertilizer rate alone does not compensate for the reduced seed production and shorter stand life in no-burn production systems.
27. Compared to annual cropping systems, Kentucky bluegrass reduces soil and nutrient runoff in all years except the establishment and plow-out years.
28. More frequent stand establishment in no-burn production systems, due to shorter stand life, will likely increase soil erosion and nutrient runoff.

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