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The competitive response of Panicum virgatum cultivars to non-native invasive species in southern Illinois

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THE COMPETITIVE RESPONSE OF *PANICUM VIRGATUM* CULTIVARS TO NON-NATIVE INVASIVE SPECIES IN SOUTHERN ILLINOIS

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Historically, the tallgrass prairie (TGP) was the largest ecosystem in North America, but today only about 10-15% of the original extent exists today. Some areas have experienced more extreme loss, for example in the state of Illinois less than 0.01% of high-quality native tallgrass prairie remains. Non-native invasive species are a recent phenomenon that threatens the integrity of surviving TGP communities. Ecotypes of dominant C_4 grasses are the basis of numerous cultivars, many of which are utilized in prairie restorations. In this study, the effects of three invasive species (*Bromus inermis, Schedonorus phoenix,* and *Poa pratensis*) on two lowland ('Alamo' and 'Kanlow') and three upland ('Blackwell', 'Cave in Rock', and 'Trailblazer') cultivars of the dominant C_4 grass *Panicum virgatum* were tested. Two simple pair-wise greenhouse experiments were established in which cultivars were sown as a monoculture or as a mixture of the cultivars with one of three invasive species. Pots were subjected to one of two water treatments with three replicates of each treatment combination. Response variables (height, number of leaves, tiller density, and biomass) and resources (soil moisture, soil pH, soil electrical conductivity, and light intensity) were measured.

The greenhouse studies showed that response variables were affected by the presence of invasive species and that the time of growth affected resource levels. Resources

are allocated to different areas (i.e growth and reproduction) when competition and stress are implemented on the dominant species. This study was the first to experimentally test for the presence of the physiological stress marker, trigonelline, in a prairie grass. Trigonelline was highest in upland cultivars under low moisture and highest in lowland cultivars under low moisture treatments. The results of these greenhouse studies suggest that invasive species may differentially affect cultivars of *Panicum virgatum* that may be sown in a prairie restoration. Performance of the *P. virgatum* cultivars was dependent on the timing of growth, the pot size, the invasive species, as well as soil moisture level. Therefore, when choosing a cultivar source for restoration, resources (i.e. soil moisture) should be looked into to maximize the output of the cultivar.

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CHAPTER 1: INTRODUCTION

The North American Tallgrass Prairie

Grasslands, historically, were the largest ecosystem found in North America (Samson and Knopf 1994). The tallgrass prairie used to have a range from Canada and Minnesota, south to Texas and is the eastern part of the more extensive Great Plains, which extends south to Mexico and west to the Rocky Mountains (Figure 1) (Samson and Knopf 1994). Since European settlement, however, there has been a decline in the natural range as high as 99% (Howe 1994, Samson and Knopf 2004). The tallgrass prairie has undergone a larger decline in area than any other ecosystem. Even within the Great Plains region, the tallgrass prairie has suffered the largest reduction in area than any other grassland type (i.e. mixed-grass, short grass, etc.) because the soil is very fertile and easily transferable to agricultural uses (Howe 1994).

Ecological restoration can be defined as “the process of assisting the recovery of an ecosystem that has been degraded, damaged or destroyed” (Society for Ecological Restoration 2004). There are two main factors in tallgrass prairie ecology that affect diversity: fire and ungulate grazing (Howe 1994). These factors are important in the restoration of tallgrass prairies. Tallgrass prairie restorations generally exhibit lower species diversity and richness when compared to remnant sites (Camill et al. 2005). The relatively easy establishment and ensuing dominance of perennial C_4 grasses is the principal cause of this lower diversity in restorations (Camill et al. 2005, Howe 1994, McCain et al. 2010).

Tallgrass prairies are naturally dominated by few perennial C_4 grasses, such as *Andropogon gerardii, Panicum virgatum* and *Sorghastrum nutans* (Lederman 1999). The high diversity of this system comes from the large number of low abundance forbs. These C_4 grasses are the foundation matrix species for the tallgrass prairie. They are commonly found across the prairie in a variety of habitats. The subordinate forbs fill in the interstices in the matrix. There is extensive ecotypic and genotypic intraspecific variation in the dominant grasses (McMillan 1959). These variations among the dominant grasses likely have a large effect on the subordinate species but the effects are poorly understood (Gibson et al., 2011).

Resource Allocation

The balance between competition and stress tolerance may lead to differences in resource allocation among cultivars of *P. virgatum* originating from habitats varying in resource availability and may be altered depending on their response to non-native species invasion. Different cultivars may vary in their competitive response and stress tolerance (Gibson 2009). It is likely that cultivars from resource-poor, stressful habitats will minimize their competitive response at the expense of stress tolerance (Goldberg and Novoplansky 1997 and Grime 1979). Under low resource conditions the cultivars best suited for stress tolerance will do best against invasive species, whereas under higher resource conditions, the most competitive cultivars will do best (Newman 1973).

An understanding of the competition-stress response of *P. virgatum* cultivars arises from Grime's CSR model that illustrates the relationship between competition (C), stress tolerance (S) and disturbance (R) (Gibson 2009). Competition is defined as "the tendency

of neighboring plants to utilize the same quantum of light, ion of a mineral nutrient, molecule of water, or volume of space" (Grime 1979). Stress is the "phenomena which restricts photosynthetic production" (Grime 1979). Disturbance, for ruderals, can be defined as "partial or total destruction of biomass" (Grime 1979). Competitors are species with adaptations allowing them to maximize their relative growth rate (RGR) (Gibson 2009). Competitors quickly will make use of both the above and below-ground resources. Stress tolerators are organisms with low RGR that can withstand low levels of disturbance and low resource levels. Ruderals exploit low-stress and highly or frequently disturbed areas.

Competition can be compared between species in two ways: first, in their competitive effect or their ability to suppress other individuals, and second in their competitive response or their ability to avoid being suppressed (Goldberg and Landa 1991). Grime (1979) has hypothesized that competition is relatively unimportant for plants in unproductive or stressful environments because resource allocation is low (Goldberg and Novoplansky 1997). Unproductive environments are dominated by species that are poor competitors, but are highly stress tolerant (Goldberg and Novoplansky 1997). Facilitation rather than competitive interactions are postulated to predominate in unproductive, high-stress environments (Maron and Marlon 2007).

Switchgrass

Switchgrass (*Panicum virgatum* L.) is a perennial, warm season C_4 grass that can dominate mesic tallgrass prairie (Parrish and Fike 2005). *Panicum virgatum* is photoperiod sensitive, and flowering is related to latitude, where northern ecotypes flower earlier than southern

ecotypes (Lemus et al. 2002). *Panicum virgatum* is a coarse-grained grass that can grow up to 3 m tall (Parrish and Fike 2005). Soil type has little effect on the development or morphology of *P. virgatum* (Parrish and Fike 2005, Porter 1966). Mutualism with mycorrhizal fungi is very important in the adaptation of *P. virgatum* (Porter 1966). This species exhibits extensive ecotypic variation that has allowed the development of numerous cultivars. *Panicum virgatum*, when used for forage, is usually grazed, but can be used for hay. Prevention of soil erosion is also an important use for *P. virgatum* (Parrish and Fike 2005). Its dense canopy and extensive root system helps reduce rain runoff and improve erosion control.

Within the last decade, the U.S. Department of Energy along with the USDA has identified *P. virgatum* as an important biofuel crop (Vogel 1996, Berdahl et al. 2005, Wang et al. 2010). *Panicum virgatum* grown for biofuel can be used either to generate power by co-firing with coal or indirectly as a fuel by fermentation to ethanol (Lemus et al. 2002). *Panicum virgatum* cultivars have been improved to have high biomass potential. Biomass potential for energy crops need to produce high yields of biomass with low concentrations of water, nitrogen, and ash, and high concentrations of lignin and cellulose (Wang et al 2010 and Lemus et al. 2002). This improvement is largely the result of selecting genotypes originating at lower latitudes and moving them north where the cultivar flowers later due to photoperiod response to day length (Vogel et al. 1985). In the Great Plains region, *P. virgatum* would economically challenge other crop species as a biofuel crop (Berdahl et al. 2005). A minimum biomass yield of 9.0 Mg ha^{-1} is achievable for *P. virgatum* (Berdahl et al. 2005).

There is a consistent genetic difference found between upland and lowland ecotypes of *P. virgatum*. This genetic difference has been located in the genomes of the chloroplasts (Parrish and Fike 2005). Upland ecotypes are associated with higher, mesic sites and lowland ecotypes are associated with lower, wetter locations (Porter 1966). Morphologically, upland ecotypes are typically shorter, rhizotamous and have finer, thinner stems than lowland ecotypes (Lemus et al. 2002). Upland ecotypes tend to favor drier soils and are more susceptible to disease than lowland ecotypes (Lemus et al. 2002). Lowland ecotypes are vigorous, thick-stemmed, coarser, and can grow up to one meter taller than upland ecotypes (Lemus et al. 2002). Compared with upland ecotypes, lowland ecotypes tend to grow better in wetter and denser soil (Porter 1966). Upland ecotypes grew best in more moderate moisture conditions (Porter 1966). Upland and lowland ecotypes vary in their nitrogen requirements with lowland ecotypes requiring less nitrogen than upland ecotypes (Porter 1966). There are multiple ploidy levels among *P. virgatum* cultivars and ecotypes. Upland ecotypes are hexaploids or octoploids and lowland ecotypes are tetraploids (Parrish and Fike 2005, Porter 1966).

Switchgrass Cultivars

A large number of cultivars of *Panicum virgatum* have been developed primarily for forage quality and wildlife habitat (Parrish and Fike 2005). In this study, three upland cultivars ('Blackwell', 'Cave in Rock' and 'Trailblazer') and two lowland cultivars ('Alamo' and 'Kanlow') were tested. The three upland cultivars are octoploid and the two lowland cultivars are tetraploid (Elbersen et al. 2001). 'Blackwell' originated from Northern Oklahoma and is a disease resistant variety that produces vigorous stems and roots

(Elbersen et al. 2001). 'Cave in Rock', originally from Southern Illinois, is palatable and disease resistant. It grows best in years of average rainfall and temperature and can reach an average of three meters in height. 'Trailblazer' is an upland cultivar from Nebraska (Elbersen et al. 2001) that is winter hardy, late maturing and has a high seed production (Elbersen et al. 2001).

'Alamo' was developed in Texas and is a coarse-grained cultivar that matures late allowing for production into early fall (Parrish and Fike 2005). 'Kanlow', originally from Kansas, is suitable for growth in the southern 2/3rds of the United States and is especially well suited for poorly drained soils (Elbersen et al. 2001). 'Alamo' and 'Kanlow' produced more biomass than 'Blackwell', 'Cave in Rock', and 'Trailblazer' in a 2000-2001 study (Lemus et al. 2002). 'Alamo' and 'Kanlow' were the highest yielding cultivars in this study and had low ash, low fiber concentrations, and moderate levels of important minerals. This suggests that excellent germplasm is available for biofuel production (Lemus et al. 2002).

Invasive Species in Tallgrass Prairies

An invasive species can be defined as a species that is not native to the ecosystem under consideration and is harmful to the environment. Non-native species, or exotic species, are defined as species from other "continents arriving in North America after the time of Columbus" (Great Plains Flora Association 1986). Not all invasive species are exotic, and not all exotic species are invasive. Invasive species in tallgrass prairies have large ecological impacts. These species can quickly evolve in areas of disturbance through founder effects and hybridization by responding to selection pressures in the environment (Mealor and Hild 2006). Variables that can influence a rapid invasion include life history,

latitude, climate, interactions with new species, and release from competitive species and pathogens in the original habitat (Cully et al. 2003, Mealor and Hild 2006). Resource availability is also important to the location of an invasive species (Seabloom et al. 2003). Research has suggested that after resource availability has been accounted for, there is no "meaningful" relationship between the native species and the invasive species (Maron and Marler 2007).

Tallgrass prairies are vulnerable to invasive species because 90% of invaders are C_3 grasses (Culley et al. 2003). This is in contrast with the dominant prairie biomass that is predominantly C_4 grass. C_3 species can use available resources before C_4 species establish (Culley et al. 2003). Invasive species in tallgrass prairies can alter soil chemistry, increase soil erosion, reduce forage quality and wildlife populations, and fragment plant populations (Mealor and Hild 2006). These species may spread with global climate change and in return this will cause a decrease in native species diversity (Maron and Marler 2007).

Invasive species richness in tallgrass prairies is not related to the region in which a site is located except at the regional scale. Communities with high species richness may be more resistant to invasive species than species-poor communities (Culley et al. 2003). The top ten most abundant invasive species (from largest percent occurrence to least percent occurrence) in tallgrass prairies were reported as *Poa pratensis, Bromus inermis, Trifolium campestre, Schedonorus phoenix, Tragopogon dubius, Bromus tectorum, Bromus japonicus, Poa compressa, Daucus carota* and a *Bromus* sp. (Culley et al. 2003). These species all have C_3 photosynthetic pathways and exhibit similar phenological traits. An example of one of these traits would be that these species all are capable of beginning their reproductive cycles early in the growing season (Culley et al. 2003).

Non-native Species in this Study

Three invasive species will be tested in this study, i.e., Kentucky bluegrass (*Poa pratensis* L.), Smooth bromegrass (*Bromus inermis* L.) and Tall fescue (*Schedonorus phoenix* L., syn: *Festuca arundinacea* Schreb.). These three species are all on a top ten list of prairie invaders (Culley et al. 2003) and are all cool season, C_3 perennial, rhizomatous grasses (Kaufman and Kaufman 2007).

Poa pratensis is native to Europe and northern Asia (Duble 2000) and is used for erosion control, forage, recreation, wildlife cover, and as an ornamental (Bush 2002, Huff 2001). *Poa pratensis* is found throughout the North America except for in the southwest (Duble 2000). This species has an apomictic reproductive system (Huff 2001). Apomixis is the replacement of sexual reproduction with asexual reproduction, without fertilization in the production of seed (Huff 2003). *Poa pratensis* has its optimum growth on slightly dry, sandy soils (Peeters 2004). Naturally occurring ecotypes of *Poa pratensis* are becoming increasingly difficult to find (Huff 2001).

Bromus inermis is native to Europe and Asia and was introduced to North America in 1884 (Peeters 2004, Roberts and Kallenbackh 2000). It is used for erosion control, wildlife cover, hay, silage and forage (Bush 2002). *Bromus inermis* can be grown on a variety of soils and is found all over the United States and southern Canada (Hall 2008, Kaufman and Kaufman 2007). *Bromus inermis* is found in both lawns and pastures, and in meadows and native grasslands (Kaufman and Kaufman 2007). For example, Gibson et al. (1993) reported *B. inermis* as a component of otherwise native tallgrass prairie in Kansas. *Bromus inermis* can lower the overall quality of wildlife habitat. *Bromus inermis* is best adapted to cool climates and on slightly acidic soils. *Bromus inermis* is most commonly found in sunny,

moist, nutrient rich soils (Kaufman and Kaufman 2007). However, with enough moisture it will grow on a variety of soil types. *Bromus inermis* is also drought resistant (Bush 2002). This is an aggressive species that can displace other dominant grass species (Marks et al. 1991).

Schedonorus phoenix is native to Europe and North Africa and was introduced to North America in the late 1800s (Hannaway et al. 1999). There are many cultivars of *S. phoenix* with KY-3 being the most widely planted. Many of these cultivars and native sources (Spyreas et al. 2001a) of *S. phoenix* are infected with an endophytic fungus, *Neotyphodium coenophialum* (Kaufman and Kaufman 2007). Endophyte infected plants are competitively superior compared with uninfected plants and native plants, which can cause a decrease in species diversity (Marks et al. 1991). The fungal infected plants germinate more quickly and have a higher seed set than uninfected plants. The infected plants also produce alkaloids that can cause some ungulates to become sick, causing them to avoid eating the plant (Kaufman and Kaufman 2007). *Schedonorus phoenix* is well adapted to humid, temperate areas (Hannaway et al. 1999) and can be found in all of the United States, except Florida, Georgia and Alabama, as well as Canada and Europe (Kaufman and Kaufman 2007, U.S. Department of Agriculture 1948). It is especially adapted to rough ground and a variety of soil types (Gibson and Newman 2001). The preferred habitat is along open riverbanks, roadsides, edges of fields, prairies, and pastures (Kaufman and Kaufman 2007). *Schedonorus phoenix* is used primarily for forage, silage and hay (Gibson and Newman 2001). It is the most widely planted forage grass in the eastern United States.

Drought Stress

Stress is defined as "any factor that decreases plant growth and reproduction below the genotype's potential" (Osmond et al. 1987). Stress can bring on changes and changes to responses at all functional levels of a plant. These changes and changes to responses can be temporary or permanent (Larcher 2001). Overall, stress can reduce a harvested forage yield, alter nutritional value, and change species composition (Sanderson et al. 1997).

Drought is an abiotic factor that can cause stress to a plant if too little water is available. Drought can occur for many reasons, such as dry soil, frozen soil, high water evaporation, inadequate root systems that are not allowing for an adequate uptake of water due to shallow soils, and osmotic binding in saline soils (Larcher 2001). Plants resist water stress with a combination of avoidance and tolerance mechanisms. Avoidance mechanisms include deeper roots, leaf surface modifications, leaf orientation, and leaf senescence (Chaves 1991 and Hsiao 1973). Tolerance mechanisms, however, enables the plant to maintain the water level of its tissues (Bray 1993). C_4 photosynthetic pathway grasses will roll or fold their leaves to reduce the transpiring leaf surface exposed to the sun (Hardy et al 1995).

Understanding complex traits such as drought stress has been a challenge for scientists; determining the basis of their genetic control, the complex interrelationships of metabolic pathways (Humphreys et al. 1998). One solution involves a comparison of putative traits in species known to have contrasting drought stress. A disadvantage is determining which of the many measurable differences are relevant. Another approach is to produce lines homozygous except for the putative genes predicted to be involved in the particular trait (Humphreys et al. 1998). A disadvantage is that a response may be specific

to one genetic background and that molecular markers could be responsive in specific plants and not in other plants.

Trigonelline

Trigonelline (TRG) is a physiological marker that may be used to map drought stress in plants. TRG is a conjugate of nicotinic acid and acts as a cell cycle regulator and as a compatible solute in response to salinity and water stress (Chen and Wood 2004, Cho et al. 2003). The ability to synthesize and accumulate TRG is widely distributed in plants such as soybeans, *Glycine max*, and has not been reported in prarie grasses (Chen and Wood 2004, Blunden et al. 2005). TRG can be highly concentrated in leaves and dry seeds.

This molecular marker is considered to be a storage form of nicotinic acid. It can re-enter the nicotinamide metabolic pathway by demethylation (Cho et al. 2002). TRG can affect the plant cell cycle (Mazzuca et al. 2000) and mediate leaf movement (Ueda et al. 1999). Trigonelline has also been used as a biochemical marker for water stress resulting from interspecific weed competition (Pfeiffer et al. 2001, Cho et al. 2003, Cho et al. 2002).

RESEARCH OBJECTIVES AND HYPOTHESIS

The overall research objective was to determine whether native Switchgrass (*Panicum virgatum*) cultivars would grow and establish differently in the presence of non-native invasive species and how the upland and lowland cultivars differ ecologically. Two local greenhouse experiments were conducted to test for intraspecific variation.

The first research objective was to determine what the competitive response of *P. virgatum* cultivars to non-native invasive species were and to determine whether the

cultivars responded differently to the presence of non-native invasive species. The first hypothesis was that lowland cultivars would be more susceptible than upland cultivars to invasive species because the lowland cultivars are adapted to a moister soil than upland cultivars and thus will be allocating more resources to stress tolerance than competitive response. The second hypothesis was that there would be resource competition between *P. virgatum* cultivars and invasive species.

The second research objective was to determine whether a mixture of the cultivars would respond better to non-native invasive species rather than to cultivars on their own. The third hypothesis was that a cultivar mixture would be less affected by invasive species than by the individual cultivars because the cultivar mixture will be more adaptable and have more resources available than the individual cultivars.

The third research objective was to determine whether a signal of soil moisture stress could be identified using a molecular marker, and, if so, how that might differ among lowland and upland *Panicum virgatum* cultivars subject to interspecific competition. The fourth hypothesis was that trigonelline would be found in the upland cultivars because they required more moisture than the lowland cultivars, and a drought treatment would have a greater effect on those cultivars as opposed to the lowland cultivars that require less moisture to survive.

Two greenhouse experiments were conducted to look at the consistency of the outcome of competition over short and long time periods. A long-term effect of competition was observed in the first greenhouse experiment. Larger pots were used over a long period of time. Eventually, the plants became root bound. A short-term effect of competition was observed in the second greenhouse experiment. Smaller cone-tainers were used over a

short period of time. The density of sown plants was smaller in the second greenhouse experiment than the first greenhouse experiment.

CHAPTER 2: PRELIMINARY EXPERIMENT

A preliminary experiment was conducted on the germination rates of eight *P. virgatum* cultivars: 'Alamo', 'Blackwell', 'Cave in Rock', 'Kanlow', Nebraska 28, Pathfinder, Shelter, and 'Trailblazer' (Appendix 1). The purpose of this preliminary work was to determine the germination rate for *P. virgatum* cultivars and for the invasive species and to determine the seed viability for the *P. virgatum* cultivars. The results from this preliminary experiment helped me to select which cultivars to use and to establish the seeding rate of each cultivar. The study was conducted 27 August 2009 - 14 October 2009 on the Southern Illinois University at Carbondale's campus in the Life Science II building, room 405. One hundred and fifty seed of each cultivar were placed in groups of 50 seed on moist filter paper in one of three (12.5cm diameter) Petri dishes assigned to each cultivar. The Petri dishes were sealed with Parafilm "M" Laboratory Film, Peching Plastic Packaging to retain moisture. The Petri dishes were placed underneath a light bank (24 hour continuous illumination) where temperature and seed germination was recorded daily. Average photosynthetically active radiation (PAR) under the light bank was 89.135 $\mu mol\ s^{-1}m^{-2}$ (Li Cor LI-250 light meter, LiCor, Inc., Lincoln, Nebraska). Temperature ranged from 28.9°C to 29.8°C. Germinated seeds were determined by when the radicle emerged. Once germinated, the seed was removed.

After 49 days, 'Cave in Rock' had the highest number of seeds germinate (79 of 150 seeds, 53%) (Figure 2). 'Blackwell' had a 41% germination rate. Pathfinder's seed germination rate was 39%. 'Trailblazer' had a cumulative seed germination rate of 15%. 'Alamo' had a germination rate of 11% and 'Kanlow' had a rate of 5%. The lowest seed

germination rate was Nebraska 28 with a rate of 1%. The highest peaks of seed germination were found on days 4-6 for 'Blackwell', 'Cave in Rock' and Pathfinder.

A follow-up study was done to test the viability of the seed of the eight cultivars using the tetrazolium test (Grabe 1970). Eight hundred seeds for each of the five cultivars were tested using this method. Eighty seeds from each cultivar were tested each day for ten days using 1% 2,3,5-Triphenyl-2H-Tetrazolium Chloride from MP Biomedicals. The seeds were dampened in a wet paper towel over night. The next day, I used a dissecting pin to puncture the seed coat under a dissecting microscope. The seeds were held with forceps while being punctured. The seeds were soaked in the tetrazolium solution over night in a Petri dish placed in the dark. The following day, the seeds were observed under the dissecting scope to see if they were viable or not (Figure 3). The seed viability was based on the amount of the seed stained. Black areas on the seed indicated stained, living tissue and white areas represent unstained, dead tissue (Grabe 1970). The number of seeds that will need to be sown for 'Alamo' and 'Kanlow' will be increased accordingly based on these data and on the tetrazolium test (below).

After the ten-day experiment, 'Trailblazer' and 'Cave in Rock' had the highest percentage of viable seed at 85%. Nebraska 28 had the lowest percent seed viability of 43%. The lowland ecotypes 'Alamo' and 'Kanlow' had a viability of 46% and 50%, respectively.

A germination test was undertaken on the three invasive species (Figure 4). The procedure was the same as for the germination test of the *Panicum virgatum* cultivars testing 150 seeds per species, except that this experiment was run for a longer period. *Poa pratensis* had a low total germinated seeds; thirteen seed germinated out of 150 tested.

Schedonorus phoenix, however, had the highest germinated seeds with a total of 93% seeds germinated. One *Bromus inermis* seed germinated and so an additional test of seed that had been scarified was undertaken seven days later. Again, only one seed germinated.

CHAPTER 3: MATERIALS AND METHODS

Greenhouse Experiment 1

The greenhouse experiment utilized a simple pair-wise (SP) design. SP designs usually maintain a 1:1 ratio of the two species of interest. The SP design is used to examine the roles of plant interactions allowing a range of treatments to be tested on competition between two species under controlled environmental conditions (Gibson et al. 1999). The SP design was used here to challenge each *P. virgatum* cultivar separately against the three invasive grasses individually.

Plants were grown from seed in the horticulture greenhouse (HRC) at Southern Illinois University Carbondale (SIUC) beginning in the summer of 2010. The average greenhouse conditions included a photoperiod of about 8-12 hours per day, a maximum temperature of about 37.2°C and a minimum temperature of about -1°C (photoperiod and temperature ranged over the 213 day experiment). Seeds were planted in plastic pots filled with a silt-clay loam soil that was collected from the Southern Illinois University Carbondale Agronomy Center. The field soil had a topsoil of silt loam (0-0.25 m) and subsoil (0.25-1.30 m) of silt clay loam (Herman et al. 1976). The regional climate has an average annual temperature of 14.7°C and an average minimum and maximum temperature of 7.4°C and 20.1°C, respectively. The average yearly rainfall estimate is 1300 mm, according a 25-year record from the Dixon Springs Agricultural Center National Atmospheric Deposition Program site (Pope County, IL, USA). The soil was sieved before use to remove rocks and other debris. A 1:1 ratio of soil and sand was used. Twenty seeds of a cultivar and twenty seeds of one of the invasive species were sown together in a grid

system for a total of forty seeds in a 15.24 cm diameter, 15.24 cm deep plastic pot. The pots were sterilized before use. Pots were placed under a mister for two weeks. The pots were misted for 8-10 seconds every 12 minutes for 13 hours a day. Once seedlings had established, the pots were moved to a different wing of the same greenhouse. Upon emergence the twenty seedlings was thinned down to ten cultivar seedlings and ten invasive species seedlings per pot. Each of the five cultivars and a mixture of the five cultivars (n=6 for cultivar treatment) were either planted as a monoculture (control) or with one of the three invasive species individually (n=4 for invasive species treatment). The cultivar mixture was planted in a grid so that each cultivar can be tracked. Control pots were sown with twenty seeds that were thinned down to ten seeds.

The experiment also tested the competiveness between the five cultivars under differing resource conditions: i.e., high moisture and low moisture. These conditions were chosen because these cultivars vary among sites of origin in precipitation. The two treatments, high and low moisture levels provided a test of the response of the five *P. virgatum* cultivars to the 3 invasive species and their interaction with soil moisture status. The low moisture treatment was watered to field capacity twice every week and the high moisture treatment was watered to field capacity every five days using potable water out of the hose. Water treatments began August 3, 2010. Pots were fertilized twice (July 20, 2010 at 400 ppm N and February 2, 2011 at 200 ppm N) with a 20-10-20 (NPK) Peters Walter Soluble Fertilizer.

The experimental design of the greenhouse experiment was a randomized complete block design with repeated measures. The treatment design was a fully factorial combination of *P. virgatum* cultivars (‘Alamo’, ‘Kanlow’, ‘Blackwell’, ‘Cave in Rock’,

‘Trailblazer’, and a mixture of the cultivars), invasive species (control, *Poa pratensis* (local variety unknown, Bellville Seed House, Inc.), ‘Lincoln’ *Bromus inermis* and ‘KY 31’ *Schedonorus phoenix*), moisture treatment (high and low), and with three blocks (Table 1a). There were three replications of each treatment combination for a total of 6 x 4 x 2 x 3 = 144 pots.

To provide the data necessary to test the hypotheses, vegetative tiller density, number of leaves, and height of the *P. virgatum* cultivars was taken on the plants in each pot. Measurements were taken on three separate occasions (days 39, 166 and 213 of the experiment). Vegetative tiller density, number of leaves, and height of the three non-native invasive species was taken on day 224 of the experiment. Soil moisture was recorded for in each pot eleven times with an ECH_20 Decagon Soil Moisture meter (days 3, 19, 30, 43, 58, 70, 84, 98, 118, 136 and 157 of the experiment). Light intensity at the soil surface was also recorded using a LI-COR Light Meter (Model LI-250) eleven times (days 3, 19, 30, 43, 58, 70, 84, 98, 118, 136 and 157 of the experiment). Biomass of both the cultivars and of the non-native invasive species was measured at the end of the experiment after 213 days (collected March 4-5, 2011; days 214-215 of the experiment). Above and below biomass were taken. Aboveground tissues of the cultivars and invasive species were separated, cut at the soil level and placed into separate labeled, paper bags. It was not possible to separate the roots of the cultivars and invasive species, hence, belowground biomass was determined after washing the roots and placing them into another separate labeled, paper bag. Soil from each pot was placed into another paper bag. Bags contained the above and belowground biomass were placed into a VWR Scientific constant temperature, forced air 1390FM oven and dried for 48 hours at 55°C (days 216-217 of the experiment). The dried

matter was then weighed on an OHAUS Corporation precision standard scale (day 218 of the experiment).

Data were analyzed using a repeated measures mixed model in SAS (PROC MIXED, SAS Institute, 2003) to determine if there were significant differences in the performance (tiller density, leaf number, plant height) of *P. virgatum*, soil moisture and light intensity between cultivar (6 treatment levels), invasive species (4 treatment levels) and soil moisture (2 treatment levels) treatments or their interaction. The three groups in which the pots were placed on the greenhouse bench were included as random effects (blocks) in the model. Biomass, soil pH and soil electrical conductivity was analyzed using a three-way mixed model. Significance was assed at $P < 0.05$. A Tukey's test was used to determine significant differences among means.

After 208 days, cultivars 'Alamo' (lowland) and 'Trailblazer' (upland) had been completely displaced by invasive species. Therefore, data from only the first two days (days 39 and 166) were used in the analysis for vegetative tiller density, number of leaves, and height of the *P. virgatum* cultivars. Also, only the last six measurements for soil moisture (days 70, 84, 98, 118, 136 and 157) and only the last three measurements for light intensity (days 118, 136 and 157) were used for analysis. The last three days for light intensity were used, because this is when the pots were in a continuous place; before, the pots had been moved to another part of the greenhouse and then rearranged.

The soil that was collected from biomass was used to analyze soil pH and conductivity on April 28-29, 2011. A 1:2 (15 grams of soil: 30 mL of deionized wter) ratio of soil to deionized water was placed into 125 mL Pyrex Erlenmeyer flasks. Then the flasks were hand shaken and allowed to stand for 30 minutes. After 30 minutes, the flasks were

covered with one square of Parafilm and placed on a New Brunswick Scientific Innova 2000 platform shaker for 30 minutes at 250 rpms (Robertson et al. 1999). Once a slurry was reached, conductivity was tested with an EcoSense, EC 300 conductivity meter. Soil pH was tested on the same samples after conductivity was tested with a Fisher Scientific Accument, AP62 pH meter. The pH meter was buffered before use with three Fisher Scientific buffer solutions (pH 4.00, pH 7.00 and pH 10.00). In between each test, the conductivity or pH meter probe was dipped into deionized water and wiped with a Kimberly Clark Professional kimwipe. Samples were not allowed to settle. A two-way ANOVA was used to analyze these data.

Greenhouse Experiment 2

A follow up greenhouse experiment was started on April 14, 2011 in Life Science II at Southern Illinois University Carbondale. The average greenhouse conditions for photoperiod was about 12-14 hours per day and the average maximum temperature was 42.8°C, whereas the average minimum temperature was 27.3°C. Seeds of two lowland cultivars ('Alamo' and 'Kanlow'), the three upland cultivars ('Blackwell', 'Cave in Rock' and 'Trailblazer'), and the three invasive species (*P. pratensis*, *I. bromus*, and *S. phoenix*) were sown into two flats and placed under a light bank (24 hour continuous illumination) until April 26, 2011. The flats were lined with vermiculite, followed by Miracle Grow™ potting soil. The seeds were watered with tap water every other day, unless the soil was dry in which case more frequent watering was applied. After the seed germinated and seedlings were established, seedlings of the cultivars and invasive species were transplanted into 2.5cm radius x 16cm deep cone-tainers (Stuewe and Sons, Ray Leach, Tangent, Oregon) on

April 26, 2011. The cone-tainers were placed in 98-celled trays. Seeds were planted in silt-clay loam rich soil that was collected from the Southern Illinois University Carbondale Agronomy Center. The soil was sieved before use to remove rocks and other debris. A 1:1 ratio of soil and sand was used. Cultivars were sown as a monoculture (control) or with one invasive species. One cultivar and one invasive plant were sown together. *P. virgatum* cultivar mixtures as in Experiment 1were not tested due to the limited size of the cone-tainers. The cone-tainers were placed in the fern house of the Plant Biology greenhouse at Southern Illinois University on April 28, 2011 and moved to the North greenhouse May 3, 2011. The plants were watched carefully and watered regularly after being transplanted. Any plants that died from transplant shock were replaced quickly. Once well established, low and high water treatments began on May 15, 2011. High moisture treatments were watered to field capacity every day and the low moisture treatment was watered to field capacity every Monday, Tuesday, Thursday and Saturday until June 6, 2011. Both water treatments were watered with potable water from the hose.

The experimental design of the greenhouse experiment was a randomized complete block design with repeated measures. The treatment design was a fully factorial combination of *P. virgatum* cultivars (‘Alamo’, ‘Kanlow’, ‘Blackwell’, ‘Cave in Rock’, and ‘Trailblazer’), invasive species (control, *Poa pratensis* (local variety unknown, Bellville Seed House, Inc.), ‘Lincoln’ *Bromus inermis* and ‘KY 31’ *Schedonorus phoenix*), moisture treatment (high and low), and with three blocks (Table 1b). There were three replications of each treatment combination for a total of 5 x 4 x 2 x 3 = 120 pots.

To provide the data necessary to test the hypotheses, number of leaves, and height of the *P. virgatum* cultivars and of the invasive species was measured on the plants in each

pot. Soil moisture was recorded for in each pot weekly with an ECH_20 Decagon Soil Moisture meter. Soil conductivity and soil pH analyses were conducted on June 9, 2011 the same way as in the previous greenhouse experiment.

Data were analyzed using a repeated measures mixed model in SAS (PROC MIXED, SAS Institute, 2003) to determine if there were significant differences in the performance (tiller density, leaf number, plant height) of *P. virgatum* and soil moisture between cultivar (5 treatment levels), invasive species (4 treatment levels) and soil moisture (2 treatment levels) treatments or their interaction. The three groups in which the cone-tainers were placed on the greenhouse bench were included as random effects (blocks) in the model. Significance was assessed at $P < 0.05$. A Tukey's test was used to determine significant differences among means.

Trigonelline levels were measured using an ion exchange chromatography method (Plapp and Casida 1958). The second leaf (5-10 cm) from the bottom of the stem for each *P. virgatum* was collected and placed in a glass vial containing 10mL of methanol. The vial was weighed before and after the leaves were harvested to obtain leaf fresh weight. The vials were sealed with a plastic cap and placed in the refrigerator for one month. The leaves were removed by pressing the leaf against the vial to remove the extract. Five ml of chloroform and 6 ml of water were added into each vial and inverted about twenty times. The vials sat at room temperature for at least 2.5 hours. The aqueous layer was removed and placed into a separate vial. A dried extract was obtained by placing the aqueous vials under an air spout and allowed to dry overnight.

The amino acids were then separated from sugars and quaternary ammonium compounds (QACs). The Dowex-1 was activated by adding 1 ml of the solution to the

column, then by adding 2 ml of 1 M sodium hydroxide (NaOH), which was allowed to drip through the column. Finally, 2 ml of autoclaved water was added and allowed to drip through the column twice. Dowex-1 columns were placed on top of clean, marked vials. The dried extracts were redissolved in 2 ml of autoclaved water. Then, 2 ml of the resolved extract was applied to the Dowex-1 columns. The washing was allowed to drip into the new vials. This solution contained the sugar and QACs fraction.

The sugar and QACs fraction were quantified by dissolving the dried extracts in 1 ml of autoclaved water. Then 20 microliters (μl) of the resuspended extract was placed into 980 μl of autoclaved water (50 times diluted). Then 1 ml of the solution was placed into a 1 ml quartz cuvette (SCC) and put into a Carly 50 Bio UV-Visible Spectrophotometer set to an absorbance of 264 nm for trigonelline. It should be noted that what is measured at 264 nm is not conclusively trigonelline and that theoretically something else could be detectable at this level.

CHAPTER 4: RESULTS

Greenhouse Experiment 1

There was a marginal effect of soil moisture and invasive species on performance of the *P. virgatum* cultivars (Appendix 2, Table 2). Under low moisture, *P. virgatum* had more leaves when growing with *Bromus inermis* than when growing alone (Figure 5). There was no response of *P. virgatum* to the other invasive species under low or high moisture. There was a main effect of soil moisture over time on the number of leaves (Figure 6). On day 166, the number of leaves in the low moisture treatment level was higher when compared to the high moisture, and compared to either moisture level on day 39.

There was a three-way interaction between cultivar, moisture, and day affecting the height of *P. virgatum* (Table 3). There was a highly significant difference in height ($F_{5,79}$ = 6.46, P < 0.0001) among cultivars, especially 'Kanlow', 'Cave in Rock', 'Trailblazer', and the cultivar mixture over days 39 and 166 (Figure 7). There was also a three-way interaction between day, cultivar, and invasive species (Table 3) affecting the mean height of *P. virgatum* between cultivars and invasive species that showed two main patterns (Figure 8). 'Kanlow' on day 39 was shorter than the upland cultivars in the presence of invasive species, but was taller with the presence of *P. pratensis* on day 166. 'Blackwell', however, showed the opposite pattern to 'Kanlow'; on day 39, the cultivar grew taller with *S. phoenix* than with the other two invasive species, but by day 166 this difference was lost. 'Cave in Rock', on day 39, was tallest with *S. phoenix* and remained the same on day 166. The cultivar mix showed similar results as 'Kanlow', i.e., there was a reduced height in the presence of an invasive species.

There was an interaction between the *P. virgatum* cultivars and time affecting light intensity (Table 4, Figure 9). Different cultivars affected the light intensity at the soil level differently, for example, light intensity under the upland cultivar ‘Trailblazer’ decreased between day 136 and day 157 whereas light intensity under other cultivars did not change. There was no significant difference between the *P. virgatum* cultivars and time on light intensity.

Soil moisture in the high moisture treatment was always higher than in the low moisture treatment corroborating the efficacy of the treatments (Table 5, Figure 11). There was a significant interaction between cultivar and soil moisture treatment affecting soil moisture (Table 5, Figure 10). In both low and high moisture treatment levels, lowland cultivars (‘Alamo’ and ‘Kanlow’) had low soil moisture levels; whereas the upland cultivars (‘Blackwell’, ‘Cave in Rock’, and ‘Trailblazer’) and the cultivar mixture had significantly higher levels of soil moisture. There was a significant difference in soil moisture among the cultivars ($F_{25,49}$ = 1.66, P = 0.02, Table 4). Over the six different sampling days, ‘Cave in Rock’ (upland) consistently had the highest soil moisture level, with the lowland cultivars (‘Alamo’ and ‘Kanlow’) having the lowest soil moisture levels among the cultivars and the cultivar mixture (Figure12).

Leaf number of *P. pratensis* and *S. phoenix* were individually affected by the moisture treatment (Table 6 & 7). *Schendonorus phoenix* showed a significant difference in performance among moisture treatments; whereas *P. pratensis* did not (Figure 13). The height of *P. pratensis* was not significantly different among *P. virgatum* cultivars; however, the height of *S. phoenix* was shorter in the presence of a cultivar compared with when grown in the cultivar mix (Table 8, Figure 14).

The vegetative tiller density per plant of the *P. virgatum* cultivars showed a highly significant interaction between cultivar and day (Table 9, Figure 15). Tiller density decreased drastically in both the lowland cultivars and the upland cultivars from day 166 to day 213. The highest tiller density was found in 'Cave in Rock' on day 39. The mixture of cultivars had the highest number of tillers per plant on day 213. There was a statistically significant interaction between moisture and day affecting tiller number of the *P. virgatum* cultivars (Figure 16) reflecting a high density of tillers under the high moisture treatment on day 39 compared with lower tiller density under the low moisture treatment on days 39 and 166. By day 213, tiller density was substantially lower regardless of moisture treatment. There was a marginally significant interaction between invasive species and day (Figure 17). In the comparison of tiller numbers of *P. virgatum* with respect to invasive species (Table 9), the *B. inermis* pots had the lowest number of tillers on day 39 and 166; however, on day 213, *S. phoenix* had the highest amount of tillers. On day 39, there were fewer tillers of *P. virgatum* associated with *B. inermis* than compared with in the controls or with *S. phoenix* and with *P. pratensis* on day 166. *Bromus inermis* had no tillers present on day 213. There were no data for reproductive tiller density because *P. virgatum* did not flower over the course of the experiment.

Vegetative tiller density for the invasive species had a marginally significant interaction between moisture and invasive species (Table 10, Figure 18)*. Bromus inermis* had the lowest amount of tillers in both high and low moisture treatments. *Schedonorus phoenix* and *P. pratensis* had the highest amount of tillers in both high and low moisture treatments, but tiller density of *P. pratensis* was lower in the low moisture treatment when compared with the high moisture treatment. There was a highly significant interaction

between invasive species and day (Figure 19). *Bromus inermis* had the lowest amount of tillers on all three days. Over all three collection dates, *S. phoenix* and *P. pratensis* had equivalent numbers of tillers per plant. There were no reproductive tiller density data because the invasive species did not flower over the course of the experiment.

Total biomass and biomass of the individual plant components did not show an interaction between cultivar and invasive species (Tables 11-14; Figures 20-24). There was a significant difference in root biomass, aboveground biomass of *P. virgatum* cultivars, and the total aboveground biomass only among *P. virgatum* cultivars. The highest aboveground biomass of *P. virgatum* was in the cultivar mixture (Figure 20). Analysis of aboveground biomass of the invasive species and the total pooled aboveground biomass of *P. virgatum* and invasive species was highly significant with the highest biomass in pots containing *S. phoenix* (Figure 24). Soil electrical conductivity (EC) showed no interaction among treatments, but did show highly significant separate effects of both the *P. virgatum* cultivars and for invasive species (Tables 15). Among the *P. virgatum* cultivars, 'Trailblazer' (upland) had the highest mean EC (83.23 mS/m); whereas, both lowland species ('Alamo'=81.23 mS/m and 'Kanlow'=82.05 mS/m) had the lowest mean EC (Figure 25). *Schedonorus phoenix* had the highest mean EC for the invasive species (83.93 mS/m); with *B. inermis* having the lowest mean EC (82.25 mS/m) (Figure 26), but in neither case was EC under an invasive species significantly different to it in the control pots.

Soil pH showed a highly significant interaction between *P. virgatum* cultivars and invasive species (Table 16). Among the lowland cultivars, the controls had a lower mean pH than the invasive species. *Poa pratensis* had the highest mean pH for both lowland

cultivars. The upland cultivars and the cultivar mixture consistently had the highest mean soil pH when growing in the presence of *S. phoenix* (Figure 27).

Greenhouse Experiment 2

There were several treatment affects on the height of *P. virgatum* cultivars (Appendix 3, Table 17). A two-way interaction between cultivar and moisture reflected a difference in height between high and low moisture treatments of the 'Alamo' and 'Blackwell' cultivars (Figure 28). Height of *P. virgatum* cultivars increased (by about 8-17%) between days 6-11 and day 22 (Figure 29) or between invasive species or control (Figure 30). The number of leaves on *Panicum virgatum* plants showed a significant interaction between invasive species and day. There was a continuous increase in the number of leaves over time independent of which invasive species *P. virgatum* was growing with (Table 18, Figure 31).

The height of the invasive species showed a significant response to moisture level and day (Table 19, Figure 32). There was an increase in height of the invasive species over the course of the experiment irrespective of soil moisture level (Figure 32, 33). There was a highly significant interaction between cultivar, moisture and day (Table 20, Figure 34) and between invasive species and day (Figure 35) on the number of leaves on the invasive species. On day 6, the number of leaves on the invasive species was highest under high soil moisture when in the presence of all of the cultivars except 'Alamo' where there was no difference with respect to soil moisture (Figure 34). On day 11, however, the number of leaves had increased in number on the invasive species under the low moisture treatment but was still greater under high compared with low soil moisture in the presence of 'Kanlow', 'Blackwell', and 'Trailblazer' cultivars, but lower in the high soil moisture

treatment in the presence of 'Alamo' and Cave-in-Rock cultivars. By day 22, there were more leaves on the invasive species under high compared with low soil moisture in the presence 'Alamo' and 'Cave in Rock' cultivars, but this relationship was reversed in the presence of the 'Blackwell' cultivar. The invasive species by day interaction reflected an increase in leaf number on the invasive species through time that differed among the invasive species. *Bromus inermis* plants had approximately double the number of leaves than *P. pratensis* and *S. phoenix* by the end of the experiment (Figure 35).

Light intensity showed a significant response to cultivar, moisture and day (Table 21, Figure 36) and to cultivar, invasive species and day (Figure 37). The three-way interaction between cultivar, moisture and day showed only a decreased light intensity in the low moisture treatment in 'Trailblazer' on day 22; otherwise, the cultivars in both moisture treatments showed similar light intensities. The three-way interaction between cultivar, invasive species and day showed that on day 22, the lowland cultivars ('Alamo' and 'Kanlow') had the highest light intensity when no invasive species was present. However, two of the three upland cultivars ('Blackwell' and 'Trailblazer') showed the highest light intensity with the presence of *S. phoenix*.

Soil moisture showed a highly significant four-way interaction between cultivar, moisture, invasive species and day (Table 22, Figures 38a-e). All of the *P. virgatum* cultivars showed the highest amount of soil moisture to be on day 22 of the experiment regardless of the invasive species; the lowest amount of soil moisture was found on day 6 for all of the cultivars except for 'Alamo', which was found on day 11. 'Alamo' showed the highest soil moisture when grown with *S. phoenix* whereas 'Kanlow' had the highest soil moisture with *P. pratensis*. Both lowland cultivars had the lowest soil moisture when grown in the

presence of *B. inermis* or when grown alone (control) in either high or low moisture. The upland cultivars had the highest soil moisture when grown alone (control) or in the presence of *P. pratensis* in either high or low moisture and had the lowest soil moisture when grown in the presence of *S. phoenix* in either moisture level.

Aboveground biomass of *P. virgatum* was significantly different among cultivars regardless of invasive species (Table 23, Figure 39). The lowland cultivars, ‘Alamo’ and ‘Kanlow’, had higher biomass than the upland cultivars. Aboveground biomass of the cultivars, invasive species, pooled belowground biomass and pooled aboveground biomass were affected only by the identity of the invasive species (Table 23-26, Figures 40-43). Aboveground biomass of the *P. virgatum* cultivars were > 50% less in the presence *B. inermis* compared with in the presence of *S. phoenix* or *P. pratensis*, and 200% less that that when grown in the absence of an invasive species (Figure 40). Aboveground biomass of the invasive species was highest for *S.phoenix* and lowest for *P. pratensis* with *B. inermis* being intermediate regardless of *P. virgatum* cultivars or soil moisture treatment (Figure 41). Pooled aboveground biomass (*P. virgatum* plus invasive species) was highest in the absence of an invasive species or in the presence of *B. inermis*. The presence of *P. pratensis* and *S. phoenix* significantly reduced pooled aboveground biomass (Figure 42). Pooled belowground biomass was 4-5 times higher in the presence of *B. inermis* than in the presence of *P. pratensis*, *S. phoenix*, or in the absence of an invasive species.

Soil pH did not show any significant response to cultivar or invasive species, but did show a trend in response to soil moisture (Table 27, Figure 44). Soil electrical conductivity (EC) showed no response to the experimental factors (Table 28).

Trigonelline (TRG) showed a highly significant response to the *P. virgatum* cultivar and moisture level interaction regardless of invasive species (Table 29, Figure 45). ‘Cave in Rock’ (upland cultivar) had the highest mean TRG level under low moisture conditions (0.995 $OD_{264}gFW^{-1}$); whereas ‘Trailblazer’ under high moisture conditions had the lowest mean TRG (0.085 $OD_{264}gFW^{-1}$). Under low moisture conditions, the lowland cultivars had the lowest mean TRG compared to the upland cultivars. The lowland cultivars also had the highest mean TRG under low moisture conditions with the exception of ‘Cave in Rock’. There was also a marginally significant interaction between *P. virgatum* cultivars and invasive species. The lowland cultivars had smaller amounts of TRG present than the upland cultivars (Table 29, Figure 46). The invasive species did not seem to have an affect on the lowland cultivars; whereas the invasive species affected the amount of TRG present in the upland cultivars. ‘Blackwell’’s TRG level was greatly increased (from 0.09 $OD_{264}gFW^{-1}$ to 0.62 $OD_{264}gFW^{-1}$) in the presence of *S. phoenix*; whereas ‘Cave in Rock’ showed the lowest amount of TRG when sown with this invasive species. ‘Cave in Rock’ had the highest amount of TRG when sown with *P. pratensis* and ‘Trailblazer’ had the highest amount of TRG when sown with *B. inermis*.

CHAPTER 5: DISCUSSION

Results of this study are interpreted in light of the four hypothesis proposed at the start of this study (Chapter 1); i.e.,

Hypothesis 1: Lowland cultivars would be more susceptible than upland cultivars to invasive species because the lowland cultivars are adapted to a moister soil than upland cultivars and thus will be allocating more resources to stress tolerance than competitive response.

Hypothesis 2: There would be resource competition between *P. virgatum* cultivars and invasive species.

Hypothesis 3: A cultivar mixture would be less affected by invasive species than by the individual cultivars because the cultivar mixture will be more adaptable and have more resources available than the individual cultivars.

Hypothesis 4: Trigonelline would be found in the upland cultivars because they required more moisture than the lowland cultivars, and a drought treatment would have a greater effect on those cultivars as opposed to the lowland cultivars that require less moisture to survive.

Competitive Response of *Panicum virgatum* Cultivars to Invasive Species

The first objective to this study was to determine the competitive response of *Panicum virgatum* cultivars to the presence of non-native invasive species. Previous studies have suggested that competition among plants is relatively unimportant in unproductive, or "stressful," environments because resource levels are low (Goldberg and Novoplansky

1997, Grime 1979). Consequently, it has been suggested (Newman 1973, Tilman 1987) that unproductive environments are dominated by species that are poor competitors but are highly stress tolerant because they survive better during periods of severe resource shortage. Therefore, it was predicted that cultivars from unproductive environments would minimize their competitive response at the expense of stress tolerance in the presence of neighboring non-native invasive species.

Performance of the *P. virgatum* cultivars in two greenhouse experiments was measured in terms of several response variables. The poor performance of the lowland cultivars compared to the upland cultivars indicates that the lowland cultivars were allocating resources to stress tolerance rather than to competition when sown with non-native invasive species supporting the first hypothesis tested. Both greenhouse experiments showed that the height, number of leaves, and tiller density of the lowland cultivars were affected by the presence of the invasive species. In the first greenhouse experiment, 'Alamo' and 'Kanlow' cultivars had lower average heights and lower average number of leaves in both low and high moisture levels than the upland cultivars. Height of the 'Kanlow' cultivar was affected more by the presence of the invasive species than 'Alamo', especially by *Bromus inermis*. The lowland cultivars had fewer tillers than the upland cultivars, in contrast to a study by Porter (1966). However, lowland cultivars tend to grow more slowly than upland cultivars in the first year (Hartman et al. 2011) and grow better under the highest moisture conditions (Berdahl et al. 2005 and Lemus et al. 2002).

Total biomass and biomass of the individual plant parts showed no interactions between *P. virgatum* cultivar and the invasive species in either greenhouse experiment. This lack of relationship could be a real effect or be due to the length of time that the

experiments were conducted (i.e. a Type II experimental error falsely interpreting a lack of an effect as a real effect); either the experiment ran too long (greenhouse experiment 1) or not long enough (greenhouse experiment 2) for an interaction to be present. However, the lowland cultivars had higher aboveground biomass compared to the upland cultivars (supported by Lemus et al. 2002). A limitation of interpreting these biomass measurements could have been the plants were root-bound in the first experiment, which ran for 213 days in 15.24 cm x 15.24 cm pots that had a volume of 2,781.12 cm^3. The environment, especially photoperiod, with the specific cultivar has a significant effect on biomass (Vogel el at. 1985 and Wang et al. 2010). A greater investment in belowground biomass may reflect the importance of over wintering in perennial plants, and the survival through unproductive environments as dormant underground roots (Raven et al. 1999).

In addition to the low value of the response variables measured, the soil in which the lowland cultivars were growing exhibited low resource (soil moisture, soil pH, and soil electrical conductivity) availability when compared to the upland cultivars. In both greenhouse experiments, the soil in which the lowland cultivars were growing had the lowest soil moisture when compared to the soil with upland cultivars. This observation supports earlier work indicating that lowland cultivars require more moisture than the upland cultivars (Barney et al.2009). Light intensity at the soil surface was lowest with the 'Alamo' and 'Kanlow' cultivars in the first greenhouse experiment. This could be due to the fact that lowland cultivars have wider stems then upland cultivars allowing less light to penetrate to the soil surface compared with under upland cultivars (Barney et al. 2009 and Porter 1966).

In the first greenhouse experiment the lowland cultivars had the lowest soil electrical conductivity (EC) and that the upland cultivars had the highest EC. Soil pH was highest under both lowland cultivars in the first greenhouse experiment. Both EC and pH showed no interaction in the second greenhouse experiment, which could be due to the shorter length of the experiment compared with the first experiment. EC varies with temperature and with the nature and concentration of H^+ ions in the solution (Allen et al. 1974). The soil pH in the two greenhouse experiments averaged from 5.97-6.89. Soil pH values in this range indicate that exchangeable Al^{3+} is no longer present (Thomas 1996). A complex mixture of hydroxy-Aluminum ions is present instead (Rich 1964). These may be involved in the suppression of root growth (Alva et al. 1986). The average pH values in this study could be directly correlated to the root growth of the cultivars and invasive species. All of the native study species were warm season perennial grasses. The greater allocation to above and belowground response variables (i.e. biomass) in the *P. virgatum* cultivar sources may be indicative of a greater ability to survive over time and provide advantages to each cultivar source (Bhandari et al. 2011).

"Classical competition theory predicts intraspecific competition should be greater than interspecific competition because individuals of the same species share similar resource requirements (Mangla et al. 2011)." In this study the fast growing non-native invasive species were more competitive when compared to the slow growing native *P. virgatum* cultivars in terms of response variables (i.e. height, number of leaves, tiller density, and biomass) and resources (soil moisture, soil pH, soil electrical conductivity, and light intensity) supporting the second hypothesis. In the first greenhouse experiment, *B. inermis* affected the performance of the *P. virgatum* cultivars irrespective of cultivar source.

This effect could be due to a competitively unique trait such as a fibrous root system (Seabloom et al. 2003). *Poa pratensis* and *Schedonorus phoenix* affected biomass of the *P. virgatum* cultivars differently. *Poa pratensis* had the lowest biomass when grown with the *P. virgatum* cultivars and *S. phoenix* had the largest biomass. Among the upland cultivars, the soil in which *S. phoenix* grew had the highest mean pH; whereas, soil associated with *P. pratensis* had the highest mean pH when grown with the lowland cultivars. Bennett et al. (2011) showed that invasive species strongly affects the soil microbial communities, thus altering the native species around them. This effect of the soil microbial community could be an explanation for the response of the *P. virgatum* cultivars to the non-native invasive species. In the second greenhouse experiment, *B. inermis* grew taller and had more leaves than the other two invasive species. This could be that the roots did not become root bound as in the first greenhouse experiment. The upland cultivars had the highest soil moisture when grown with *P. pratensis*; whereas the lowland cultivars had the highest soil moisture when grown with *S. phoenix*. Competition is partially driven by the available resources in the community. Non-native invasive species have been shown to decline in abundance when there are fewer resources available (Barney and DiTomaso 2010 and Maron and Marler 2007). The amount of available resources and the fact that the invasive species grew faster and larger in this experiment, compared with the previous experiment, could be a reason why they competed so well with the *P. virgatum* cultivars.

Cultivar Mixture vs. Monoculture in the Presence of Invasive Species

The second objective of this study was to determine whether the mixture of cultivars responded better to non-native invasive species rather that to cultivars on their own. The

response of *P. virgatum* and the measurements of environmental resources (light, soil moisture, soil pH and EC) indicated that the cultivar mixture was less affected by the invasive species than the cultivar monocultures were. The cultivar mixture appeared to be more adaptable and had more resources available than the lowland cultivars supporting the third hypothesis.

The mixture of cultivars were generally taller with a higher biomass than the cultivars grown as monocultures (with the exception of 'Trailblazer', which was the tallest) in both moisture levels. Goldberg at al. (2001) determined that competition between native and invasive species would be observed in the final plant biomass measurements, which was seen in this experiment when the cultivar mixture was grown with the three invasive species. Soil EC and pH were also highest in the cultivar mixture with the invasive *S. phoenix* having the greatest affect on the mixture. The cultivar mixture had the highest available soil pH and EC, with the exception of the 'Cave in Rock' cultivar, which had the highest mean soil moisture in the high moisture level treatment. The intraspecific interaction could be a factor because the cultivars have similar resource requirements (Mangla et al. 2011). Initially the cultivar mixture responded best to the invasive species (Wassmuth et al. 2009); however, the resources in the cultivar mixture became depleted in the first greenhouse study (Brown et al. 2008). The resource depletion could be due to the germination, emergence and initial root and shoot development, which may be very sensitive to competition for resources (Foster 1999).

Trigonelline

The third research objective was to determine whether a signal of soil moisture could be identified using a molecular marker, and, if so, how that might differ among lowland and upland *Panicum virgatum* cultivars. There was a detectable amount of trigonelline (TRG) in all of the *P. virgatum* cultivars, especially in the upland cultivars, supporting the fourth hypothesis.

Detectable amounts of TRG range from about 200-800 $\mu g\ g^{-1}$ (d.m.) in *Glycine max* cultivars in a drought tolerance treatment (Cho et al. 2002) and from about 2-10 $\mu g\ g^{-1}$ (d.m.) in *Glycine max* under interspecific competitive stress (Pfeiffer et al. 2001); whereas *P. virgatum* cultivars, in this study, ranged from about 0.2-1.2 $OD_{264}gFW^{-1}$. The units differ between the two experiments because the Cho et al. (2002) experiment used a pure sample to determine TRG availability; whereas, in this experiment, a pure sample was not used to determine the availability of TRG. The upland *P. virgatum* cultivars ('Blackwell', 'Cave in Rock' and 'Trailblazer') exhibited higher amounts of TRG than the lowland cultivars ('Alamo' and 'Kanlow') when grown in the low moisture treatment. TRG accumulates in plant tissues under moisture stress (Millas et al. 2011, Pfeiffer et al. 2010) and the concentrations observed in this experiment could be due to moisture stress in the upland cultivars compared with the lowland cultivars under the experimental conditions and a higher moisture requirement of the upland cultivars compared with the lowland cultivars (Barney et al. 2010, Lemus et al. 2002, and Wang et al. 2010). When grown in the high moisture treatment, however, the lowland cultivars had higher TRG than the upland cultivars. This result could be because the higher moisture level would be most suitable for growth of the upland cultivars while stressing the lowland cultivars (Bhandari et al. 2011

and Porter et al. 1966). TRG concentrations could also reflect adaptation to the precipitation regime in the original source location of a cultivar. *Panicum virgatum* cultivars grown in moister conditions (upland) as opposed to more mesic conditions (lowland) which allocate resources differently and should be chosen for restoration accordingly to allow for the maximum production of the cultivar (Parrish and Fike 2005) and TRG tissue concentrations could be a useful marker of moisture stressing in these situations (Millar et al. 2011).

The non-native invasive species did not have an effect on the lowland cultivars, but did when sown with the upland cultivars. TRG levels in upland cultivars depended on the identity of the competing invasive species. This effect of invasive species could be due in part to the source of the cultivar and by the presence of the invasive species (Parrish and Fike 2005). The competitive environment, particularly moisture stress, differed depending on which invasive species was present.

Synthesis

A few general trends in performance of *P. virgatum* cultivars can be deduced from this study. Growth time (i.e., days since the start of the experiment) was an important factor when considering the response variables and environmental resource levels. The performance of the *P. virgatum* cultivars, especially 'Kanlow' and 'Blackwell', was differentially affected by the three invasive species in the first greenhouse experiment. Total biomass and biomass of the individual plant parts did not show an interaction with the invasive species in either greenhouse experiment. Overall, of the three invasive species tested, *B. inermis* affected performance of the *P. virgatum* cultivars the most.

Resource allocation among the *P. virgatum* cultivars was positively correlated in both greenhouse experiments. Soil moisture was lower in the lowland cultivars than in the upland cultivars throughout both experiments. The upland cultivars had the highest soil moisture under the high moisture level when grown with *P. pratensis*. The lowland cultivars, however, had the highest soil moisture when grown with *S. phoenix* under the high moisture treatment. Light intensity was affected by the cultivars and changed as the experiment progressed. In the second greenhouse experiment, however, the invasive species were also a factor for light intensity. Soil EC and pH differed between greenhouse experiments. In the first greenhouse experiment, there were significant main effects, but no interactions between *P. virgatum* cultivars and invasive species on soil EC. The lowland cultivars had the lowest EC whereas 'Trailblazer' (upland) had the highest EC. Soil pH was highest under both lowland cultivars. Mean pH was highest under the upland cultivars and under the invasive *S. phoenix* in the mixture. In the second greenhouse experiment, however, there was no interaction between cultivar or invasive species on either soil EC or pH. Time was a factor for the differences in soil EC and pH in the two greenhouse experiments. The growth period showed that soil EC and pH are not resources, but are measurements that may reflect availability of soil resources such as nutrients, that the *P. virgatum* cultivars were focused on. The cultivars, in the first greenhouse experiment, were allocating resources to deal with competition and not growth or reproduction; whereas in the second greenhouse experiment, the cultivar resources could be allocated towards growth and reproduction. Resource allocation is an important factor to different cultivar sources because a cultivar sown in the wrong precipitation regime or time of year could yield a much lower performance than when sown in the correct resource conditions.

The conditions in which the invasive species can invade are dependent somewhat on the neighboring species and the abiotic conditions. In this study, the invasive species were aggressive compeititors, especially *S. phoenix* in the first greenhouse experiment and *B. inermis* in the second greenhouse experiment. The invasive species did not seem to compete more or less with specific cultivars. The length of the experiment did have an effect on the resource uptake in the plants.

This study was the first to experimentally test for trigonelline in a dominant prairie grass. Detectable levels of trigonelline were found in both lowland and upland cultivars. Soil moisture and cultivar interacted affecting trigonelline levels. The upland cultivars showed higher detectable amounts of trigonelline when grown in a low moisture environment (drought stressed). The lowland cultivars however, showed higher amounts of trigonelline in the high moisture treatment. This suggests that source location of a cultivar may reflect response to local stress levels.

Implications for Restoration

This study indicates that competition with non-native invasive species can affect the performance of cultivars of *Panicum virgatum*, a dominant prairie species in terms of response variables and resource allocation. Cultivars showed early signs of allocating their resources to growth and not to competition. However, once the cultivars were established resource allocation shifted towards competition. The non-native invasive species, especially *B. inermis*, affected the growth of *P. virgatum* cultivars. There was a positive relationship between the response variable and the resources showing that the upland and lowland cultivars respond differently to soil moisture level. There was little competitive

advantage of the cultivar mixture when compared to the *P. virgatum* monocultures. Therefore, cultivar selection may act as a potential filter on community and ecosystem assembly if due to intraspecific variation in the dominant species and how they are able to compete with interspecific neighbors.

The implications for ecosystem restoration are particularly relevant for the tallgrass prairie due to the extreme loss and degradation it has experienced (Samson and Knopf 1994). Only about 10-15% of the original extent of the tallgrass prairie remains (Camill et al. 2004 and Samson et al. 2004), and in states such as Illinois less than 0.01% of the tallgrass prairie remains (Illinois Department of Energy and Natural Resources 1994). Prairie restoration projects are imperative to restore this highly degraded ecosystem and their success may depend on factors such as cultivar source. Therefore, cultivar selection and knowledge of the dominant grasses should be considered as a potential filter in tallgrass prairie restorations.

TABLES

Table 1a. A fully factorial combination treatment design for the first greenhouse experiment; including *P. virgatum* cultivars ('Alamo', 'Kanlow', 'Blackwell', 'Cave in Rock', 'Trailblazer', and a mixture), invasive species (control, *Poa pratensis* (local variety unknown, Bellville Seed House, Inc.), 'Lincoln' *Bromus inermis* and 'KY 31' *Schedonorus phoenix*), moisture treatment (high (H) and low (L)), and with three block replications.

Block 1-3	***Panicum virgatum*** **Cultivars**					
Invasive Species	Alamo	Kanlow	Blackwell	Cave in Rock	Trailblazer	Mix
Control	H/L	H/L	H/L	H/L	H/L	H/L
Poa pratensis	H/L	H/L	H/L	H/L	H/L	H/L
Bromus inermis	H/L	H/L	H/L	H/L	H/L	H/L
Schedonorus phoenix	H/L	H/L	H/L	H/L	H/L	H/L

Table 1b. A fully factorial combination treatment design for the second greenhouse experiment; including *P. virgatum* cultivars (‘Alamo’, ‘Kanlow’, ‘Blackwell’, ‘Cave in Rock’, and ‘Trailblazer’), invasive species (control, *Poa pratensis* (local variety unknown, Bellville Seed House, Inc.), ‘Lincoln’ *Bromus inermis* and ‘KY 31’ *Schedonorus phoenix*), moisture treatment (high (H) and low (L)), and with three block replications.

Block 1-3	***Panicum virgatum* Cultivars**				
Invasive Species	Alamo	Kanlow	Blackwell	Cave in Rock	Trailblazer
Control	H/L	H/L	H/L	H/L	H/L
Poa pratensis	H/L	H/L	H/L	H/L	H/L
Bromus inermis	H/L	H/L	H/L	H/L	H/L
Schedonorus phoenix	H/L	H/L	H/L	H/L	H/L

Table 2. Greenhouse Experiment 1: Results of mixed model analysis of mean number of leaves per pot (n=263) of *P. virgatum* cultivars grown either alone (control) or in the presence of one of three invasive species under low and high soil moisture conditions over time.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	5	83.2	0.44	0.8228
Moisture (Moist)	1	83.5	1.14	0.2894
CV*Moist	5	83.2	0.32	0.8992
Invasive (INV)	3	83.5	0.49	0.6901
CV*INV	15	83.2	1.01	0.4505
Moist*INV	3	83.5	2.54	0.0617
CV*Moist*INV	15	83.2	1.17	0.3129
DAY	1	79.6	7.24	0.0089
CV*DAY	5	79.2	0.98	0.4338
Moist*DAY	1	79.6	7.99	0.0059
CV*Moist*DAY	5	79.2	0.57	0.7229
INV*DAY	3	79.5	0.23	0.8771
CV*INV*DAY	15	79	0.85	0.6208
Moist*INV*DAY	3	79.5	0.63	0.5974
CV*Moist*INV*DAY	15	79	0.73	0.7462

Table 3. Greenhouse Experiment 1: Results of mixed model analysis of mean height per pot (n=263) of *P. virgatum* cultivars grown either alone (control) or in the presence of one of three invasive species under low and high soil moisture conditions over three sampling dates (day).

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	5	83.5	95.41	0.0001
Moisture (Moist)	1	83.5	63.84	0.0001
CV*Moist	5	83.6	7.21	0.0001
Invasive (INV)	3	83.6	1.56	0.2064
CV*INV	15	83.5	1.55	0.1053
Moist*INV	3	83.5	1.99	0.1224
CV*Moist*INV	15	83.4	0.99	0.4772
DAY	1	79.2	10.01	0.0022
CV*DAY	5	79	16.76	0.0001
Moist*DAY	1	79.2	0.76	0.3864
CV*Moist*DAY	5	79	6.46	0.0001
INV*DAY	3	79.2	3.41	0.0214
CV*INV*DAY	15	78.9	2.16	0.0150
Moist*INV*DAY	3	79.2	0.36	0.7837
CV*Moist*INV*DAY	15	78.9	0.88	0.5876

Table 4. Greenhouse Experiment 1: Results of mixed model analysis of light intensity (n=432) of *P. virgatum* cultivars over three sampling dates (day).

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	5	117	2.03	0.0790
Moisture (Moist)	1	117	0.30	0.5822
CV*Moist	5	117	0.65	0.6601
Invasive (INV)	3	117	0.86	0.4663
CV*INV	15	117	0.98	0.4754
Moist*INV	3	117	0.34	0.7995
CV*Moist*INV	15	117	0.93	0.5372
DAY	2	192	5.19	0.0064
CV*DAY	10	204	1.75	0.0724
Moist*DAY	2	192	7.57	0.0007
CV*Moist*DAY	10	204	0.38	0.9559
INV*DAY	6	201	0.88	0.5081
CV*INV*DAY	30	202	1.20	0.2297
Moist*INV*DAY	6	201	0.62	0.7111
CV*Moist*INV*DAY	30	202	1.19	0.2427

Table 5. Greenhouse Experiment 1: Results of mixed model analysis of mean soil moisture per pot (n=864) of *P. virgatum* cultivars grown either alone (control) or in the presence of one of three invasive species under low and high soil moisture conditions over three sampling dates (day).

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	5	103	129.74	0.0001
Moisture (Moist)	1	103	356.39	0.0001
CV*Moist	5	103	2.64	0.0272
Invasive (INV)	3	103	3.16	0.0279
CV*INV	15	103	1.01	0.4543
Moist*INV	3	103	0.23	0.8774
CV*Moist*INV	15	103	0.96	0.5004
DAY	5	477	18.73	0.0001
CV*DAY	25	479	1.66	0.0246
Moist*DAY	5	477	11.06	0.0001
CV*Moist*DAY	25	479	0.73	0.8328
INV*DAY	15	479	0.73	0.7541
CV*INV*DAY	75	475	0.91	0.6972
Moist*INV*DAY	15	479	0.54	0.9209
CV*Moist*INV*DAY	75	475	1.15	0.2047

Table 6. Greenhouse Experiment 1: Results of mixed model analysis of mean number of leaves per pot (n=28) of *Poa pratensis* grown in the presence of one of five *P. virgatum* cultivars under high and low soil moisture treatments.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	5	16	0.08	0.9938
Moisture (Moist)	1	16	3.14	0.0953
CV*Moist	5	16	0.52	0.7607

Table 7. Greenhouse Experiment 1: Results of mixed model analysis of mean number of leaves per pot (n=31) of *Schedonorus phoenix* grown in the presence of one of five *P. virgatum* cultivars under high and low soil moisture treatments.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	5	17	0.74	0.6070
Moisture (Moist)	1	17.1	7.83	0.0123
CV*Moist	5	17	1.34	0.2959

Table 8. Greenhouse Experiment 1: Results of mixed model analysis of mean height per pot (n=31) of *Schedonorus phoenix* grown in the presence of one of five *P. virgatum* cultivars under high and low soil moisture treatments.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	5	19	4.19	0.0098
Moisture (Moist)	1	19	2.41	0.1372
CV*Moist	5	19	1.90	0.1416

Table 9. Greenhouse Experiment 1: Results of mixed model analysis of mean tiller density per pot (n=432) of *P. virgatum* cultivars grown either alone (control) or in the presence of one of three invasive species under low and high soil moisture conditions over three sampling dates (day).

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	5	94	26.79	0.0001
Moisture (Moist)	1	94	14.41	0.0003
CV*Moist	5	94	0.77	0.5712
Invasive (INV)	3	94	3.99	0.0101
CV*INV	15	94	0.48	0.9431
Moist*INV	3	94	0.75	0.5233
CV*Moist*INV	15	94	0.86	0.6048
DAY	2	192	506.24	0.0001
CV*DAY	10	192	14.61	0.0001
Moist*DAY	2	192	8.27	0.0004
CV*Moist*DAY	10	192	1.35	0.2079
INV*DAY	6	192	1.93	0.0773
CV*INV*DAY	30	192	0.70	0.8786
Moist*INV*DAY	6	192	0.42	0.8655
CV*Moist*INV*DAY	30	192	0.79	0.7733

Table 10. Greenhouse Experiment 1: Results of mixed model analysis of mean tiller density per pot (n=432) of the invasive species grown in the presence of one of five *P. virgatum* cultivars under low and high soil moisture conditions over three sampling dates (day).

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	5	68.6	1.36	0.2487
Moisture (Moist)	1	68.6	6.83	0.0110
CV*Moist	5	68.6	1.50	0.2021
Invasive (INV)	3	686	59.42	0.0001
CV*INV	10	68.6	0.86	0.5732
Moist*INV	2	68.6	2.72	0.0727
CV*Moist*INV	10	68.6	0.41	0.9384
DAY	2	142	13.72	0.0001
CV*DAY	10	142	0.70	0.7223
Moist*DAY	2	142	0.53	0.5883
CV*Moist*DAY	10	142	0.49	0.8953
INV*DAY	4	142	6.90	0.0001
CV*INV*DAY	20	142	0.81	0.6947
Moist*INV*DAY	4	142	1.23	0.3023
CV*Moist*INV*DAY	20	142	0.71	0.8124

Table 11. Greenhouse Experiment 1: Results of mixed model analysis of belowground biomass (n=144) of *P. virgatum* cultivars grown either alone (control) or in the presence of one of three invasive species under low and high soil moisture conditions.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	5	94	3.39	0.0073
Moisture (Moist)	1	94	0.11	0.7419
CV*Moist	5	94	0.97	0.4383
Invasive (INV)	3	94	1.34	0.2648
CV*INV	15	94	1.33	0.2030
Moist*INV	3	94	1.42	0.2428
CV*Moist*INV	15	94	1.06	0.4076

Table 12. Greenhouse Experiment 1: Results of mixed model analysis of aboveground biomass (n=144) of *P. virgatum* cultivars grown either alone (control) or in the presence of one of three invasive species under low and high soil moisture conditions.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	5	94.1	3.05	0.0135
Moisture (Moist)	1	94.1	0.25	0.6156
CV*Moist	5	94.1	0.93	0.4668
Invasive (INV)	3	94.1	0.14	0.9345
CV*INV	15	94.1	1.24	0.2592
Moist*INV	3	94.1	0.29	0.8338
CV*Moist*INV	15	94.1	1.19	0.2936

Table 13. Greenhouse Experiment 1: Results of mixed model analysis of aboveground biomass (n=108) of invasive species grown in the presence of one of five *P. virgatum* cultivars under low and high soil moisture conditions.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	5	70	0.43	0.8252
Moisture (Moist)	1	70	1.11	0.2965
CV*Moist	5	70	1.85	0.1149
Invasive (INV)	2	70	76.67	0.0001
CV*INV	10	70	1.26	0.2672
Moist*INV	2	70	0.64	0.5298
CV*Moist*INV	10	70	0.53	0.8629

Table 14. Greenhouse Experiment 1: Results of mixed model analysis of the total aboveground biomass (n=144) of *P. virgatum* cultivars and invasive species under low and high soil moisture conditions.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	5	96	2.65	0.0272
Moisture (Moist)	1	96	0.04	0.8466
CV*Moist	5	96	0.88	0.4957
Invasive (INV)	3	96	16.18	0.0001
CV*INV	15	96	1.04	0.4182
Moist*INV	3	96	0.08	0.9697
CV*Moist*INV	15	96	1.46	0.1352

Table 15. Greenhouse Experiment 1: Results of mixed model analysis of mean soil electrical conductivity (EC) (N=144) of *P. virgatum* cultivars and invasive species under low and high moisture.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	5	94	9.02	0.0001
Moisture (Moist)	1	94	5.31	0.0234
CV*Moist	5	94	1.12	0.3527
Invasive (INV)	3	94	16.39	0.0001
CV*INV	15	94	1.63	0.0808
Moist*INV	3	94	0.93	0.4277
CV*Moist*INV	15	94	1.50	0.1198

Table 16. Greenhouse Experiment 1: Results of mixed model analysis of soil pH (N=144) in response to *P. virgatum* cultivars and invasive species under high and low soil moisture treatments.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	5	96	8.03	0.0001
Moisture (Moist)	1	96	0.36	0.5475
CV*Moist	5	96	0.66	0.6558
Invasive (INV)	3	96	11.99	0.0001
CV*INV	15	96	2.78	0.0013
Moist*INV	3	96	0.96	0.4143
CV*Moist*INV	15	96	0.62	0.8521

Table 17.Greenhouse Experiment 2: Results of mixed model analysis of mean height per pot (n=360) of *P. virgatum* cultivars grown either alone (control) or in the presence of one of three invasive species under low and high soil moisture conditions over three sampling dates (day).

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	4	79	59.64	0.0001
Moisture (Moist)	1	79	6.24	0.0146
CV*Moist	4	79	3.55	0.0102
Invasive (INV)	3	79	9.70	0.0001
CV*INV	12	79	0.26	0.9940
Moist*INV	3	79	0.59	0.6213
CV*Moist*INV	12	79	0.54	0.8826
DAY	2	158	280.79	0.0001
CV*DAY	8	158	9.18	0.0001
Moist*DAY	2	158	0.13	0.8788
CV*Moist*DAY	8	158	0.99	0.4431
INV*DAY	6	158	8.72	0.0001
CV*INV*DAY	24	158	0.32	0.9991
Moist*INV*DAY	6	158	0.44	0.8508
CV*Moist*INV*DAY	24	158	0.39	0.9954

Table 18. Greenhouse Experiment 2: Results of mixed model analysis of mean number of leaves per pot (n=360) of *P. virgatum* cultivars grown either alone (control) or in the presence of one of three invasive species under low and high soil moisture conditions over three sampling dates (day).

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	4	79	1.61	0.1792
Moisture (Moist)	1	79	0.78	0.3797
CV*Moist	4	79	1.38	0.2481
Invasive (INV)	3	79	23.85	0.0001
CV*INV	12	79	1.24	0.2719
Moist*INV	3	79	0.83	0.4804
CV*Moist*INV	12	79	1.17	0.3208
DAY	2	158	284.15	0.0001
CV*DAY	8	158	1.21	0.2959
Moist*DAY	2	158	1.22	0.2974
CV*Moist*DAY	8	158	1.11	0.3582
INV*DAY	6	158	3.75	0.0016
CV*INV*DAY	24	158	0.73	0.8196
Moist*INV*DAY	6	158	0.91	0.4927
CV*Moist*INV*DAY	24	158	0.50	0.9760

Table 19. Greenhouse Experiment 2: Results of mixed model analysis of mean height per pot (n=360) of the invasive species grown in the presence of one of five *P. virgatum* cultivars over three sampling dates (day).

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	4	57	2.40	0.0604
Moisture (Moist)	1	57	0.20	0.6578
CV*Moist	4	57	1.00	0.4139
Invasive (INV)	2	57	377.54	0.0001
CV*INV	8	57	1.29	0.2652
Moist*INV	2	57	0.16	0.8555
CV*Moist*INV	8	57	1.04	0.4201
DAY	2	118	303.55	0.0001
CV*DAY	8	118	0.55	0.8139
Moist*DAY	2	118	3.54	0.0321
CV*Moist*DAY	8	118	1.36	0.2223
INV*DAY	4	118	21.37	0.0001
CV*INV*DAY	16	118	0.55	0.9158
Moist*INV*DAY	4	118	0.11	0.9790
CV*Moist*INV*DAY	16	118	0.58	0.8927

Table 20. Greenhouse Experiment 2: Results of mixed model analysis of mean number of leaves per pot (n=360) of the invasive species grown in the presence of one of five *P. virgatum* over three sampling dates (day).

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	4	57	2.18	0.0833
Moisture (Moist)	1	57	13.71	0.0005
CV*Moist	4	57	0.19	0.9407
Invasive (INV)	2	57	102.32	0.0001
CV*INV	8	57	0.57	0.8003
Moist*INV	2	57	3.24	0.0465
CV*Moist*INV	8	57	1.04	0.4164
DAY	2	118	165.92	0.0001
CV*DAY	8	118	1.46	0.1808
Moist*DAY	2	118	6.04	0.0032
CV*Moist*DAY	8	118	4.82	0.0001
INV*DAY	4	118	39.99	0.0001
CV*INV*DAY	16	118	0.82	0.6562
Moist*INV*DAY	4	118	1.97	0.1036
CV*Moist*INV*DAY	16	118	1.62	0.0731

Table 21. Greenhouse Experiment 2: Results of mixed model analysis of mean light intensity (n=360) at the soil surface over three sampling dates (day).

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	4	116	0.29	0.8815
Moisture (Moist)	1	116	0.48	0.4901
CV*Moist	4	116	1.33	0.2614
Invasive (INV)	3	116	0.38	0.7682
CV*INV	12	116	0.69	0.7585
Moist*INV	3	116	0.50	0.6820
CV*Moist*INV	12	116	0.71	0.7348
DAY	2	158	1.40	0.2505
CV*DAY	8	176	1.55	0.1429
Moist*DAY	2	158	0.30	0.7425
CV*Moist*DAY	8	176	2.46	0.0152
INV*DAY	6	173	1.38	0.2248
CV*INV*DAY	24	178	1.60	0.0448
Moist*INV*DAY	6	173	1.01	0.4229
CV*Moist*INV*DAY	24	178	1.24	0.2172

Table 22. Greenhouse Experiment 2: Results of mixed model analysis of mean soil moisture (n=360) of *P. virgatum* cultivars grown either alone (control) or in the presence of one of three invasive species under low and high soil moisture conditions over three sampling dates (day).

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	4	78	7.07	0.0001
Moisture (Moist)	1	78	11.02	0.0014
CV*Moist	4	78	1.64	0.1733
Invasive (INV)	3	78	94.85	0.0001
CV*INV	12	78	4.87	0.0001
Moist*INV	3	78	0.03	0.9925
CV*Moist*INV	12	78	6.18	0.0001
DAY	2	160	328.47	0.0001
CV*DAY	8	160	2.65	0.0093
Moist*DAY	2	160	7.17	0.0010
CV*Moist*DAY	8	160	0.97	0.4644
INV*DAY	6	160	4.85	0.0001
CV*INV*DAY	24	160	3.43	0.0001
Moist*INV*DAY	6	160	1.67	0.1304
CV*Moist*INV*DAY	24	160	4.87	0.0001

Table 23. Greenhouse Experiment 2: Results of mixed model analysis of aboveground biomass at the final harvest (n=120) of *P. virgatum* cultivars grown either alone (control) or in the presence of one of three invasive species under low and high soil moisture conditions.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	4	80	2.54	0.0460
Moisture (Moist)	1	80	2.15	0.1469
CV*Moist	4	80	1.03	0.3995
Invasive (INV)	3	80	7.88	0.0001
CV*INV	12	80	0.55	0.8755
Moist*INV	3	80	1.31	0.2756
CV*Moist*INV	12	80	0.89	0.5589

Table 24. Greenhouse Experiment 2: Results of mixed model analysis of aboveground biomass at the final harvest (n=90) of invasive species grown in the presence of one of five *P. virgatum* cultivars under low and high soil moisture conditions.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	4	58	0.03	0.9986
Moisture (Moist)	1	58	0.00	0.9965
CV*Moist	4	58	0.67	0.6150
Invasive (INV)	2	58	38.52	0.0001
CV*INV	8	58	0.09	0.9994
Moist*INV	2	58	0.45	0.6403
CV*Moist*INV	8	58	1.06	0.4053

Table 25. Greenhouse Experiment 2: Results of mixed model analysis of the total aboveground biomass at the final harvest (n=120) of *P. virgatum* cultivars and invasive species under low and high soil moisture conditions.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	4	78	0.05	0.9961
Moisture (Moist)	1	78	0.08	0.7775
CV*Moist	4	78	0.50	0.7333
Invasive (INV)	3	78	34.39	0.0001
CV*INV	12	78	0.13	0.9998
Moist*INV	3	78	0.62	0.6045
CV*Moist*INV	12	78	1.06	0.4030

Table 26. Greenhouse Experiment 2: Results of mixed model analysis of belowground biomass at the final harvest (n=120) of *P. virgatum* cultivars grown either alone (control) or in the presence of one of three invasive species under low and high soil moisture conditions.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	4	78	0.82	0.5190
Moisture (Moist)	1	78	0.31	0.5788
CV*Moist	4	78	0.72	0.5801
Invasive (INV)	3	78	51.57	0.0001
CV*INV	12	78	0.76	0.6915
Moist*INV	3	78	1.10	0.3558
CV*Moist*INV	12	78	1.16	0.3281

Table 27. Greenhouse Experiment 2: Results of mixed model analysis of soil pH (N=120) of the *P. virgatum* cultivars and of the invasive species under high and low moisture.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	4	80	0.76	0.5562
Moisture (Moist)	1	80	2.91	0.0918
CV*Moist	4	80	1.53	0.2003
Invasive (INV)	3	80	0.90	0.4458
CV*INV	12	80	1.22	0.2848
Moist*INV	3	80	0.72	0.5444
CV*Moist*INV	12	80	0.93	0.5198

Table 28. Greenhouse Experiment 2: Results of mixed model analysis of soil electrical conductivity (EC) (N=120) of *P. virgatum* cultivars and invasive species under low and high moisture.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	4	78	0.37	0.8276
Moisture (Moist)	1	78	1.65	0.2021
CV*Moist	4	78	1.10	0.3631
Invasive (INV)	3	78	0.35	0.7885
CV*INV	12	78	0.92	0.5269
Moist*INV	3	78	1.80	0.1547
CV*Moist*INV	12	78	1.11	0.3668

Table 29. Greenhouse Experiment 2: Results of mixed model analysis of trigonelline (N=120) of *P. virgatum* cultivars under low and high moisture.

Effect	Num. DF	Denom. DF	F-value	P
Cultivar (CV)	4	80	7.68	0.0001
Moisture (Moist)	1	80	22.57	0.0001
CV*Moist	4	80	12.50	0.0001
Invasive (INV)	3	80	1.20	0.3145
CV*INV	12	80	1.68	0.0857
Moist*INV	3	80	0.50	0.6866
CV*Moist*INV	12	80	0.73	0.7198

FIGURES

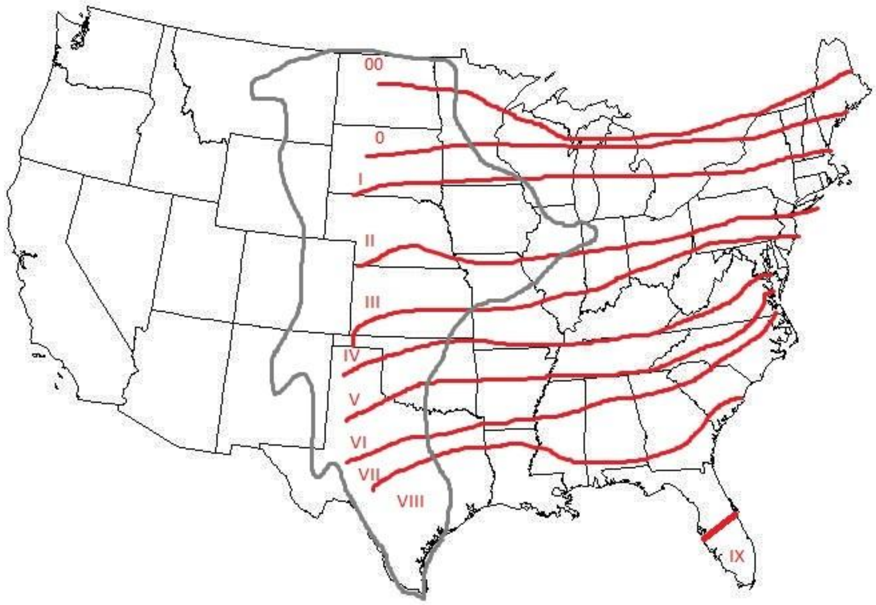


Figure 1. The adapted maturity zone for commercially developed *Panicum virgatum* cultivars in the United States of America. The red lines indicate the 'zones' suggested for cultivating specific cultivars. The grey lines indicate the boundaries of the original range of the North American prairie, which includes the shortgrass prairie to the east, the tallgrass prairie to the west and mixed-grass prairie in between. The suggested cultivation zones per cultivar include: 'Dacotah': 00, 0, I, 'Pathfinder': 00, 0, I, 'Trailblazer': 0, I, II, 'Nebraska-28': I, II, III, 'Shelter': I, II, III, IV, 'Cave in Rock': I, II, III, IV, V, 'Blackwell': II, III, IV, V, 'Kanlow': IV, V, VI, VII, and 'Alamo': V, VI, VII, VIII, IX. Adapted from Elbersen et al. (2001) and Samson et al. (2004).

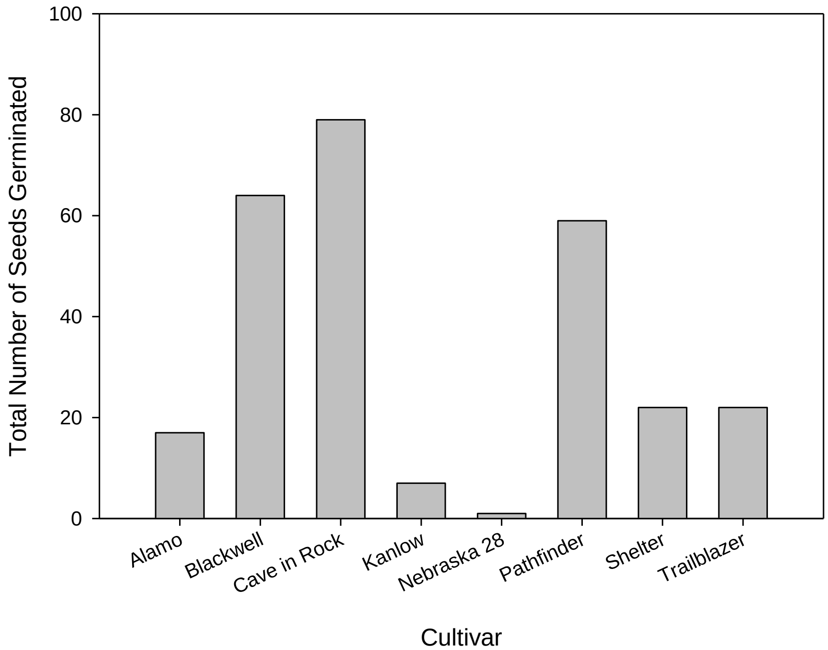


Figure 2. Preliminary Experiment: Cumulative number of seed germinated out of 150 for each of eight *P. virgatum* cultivars over 49 days.

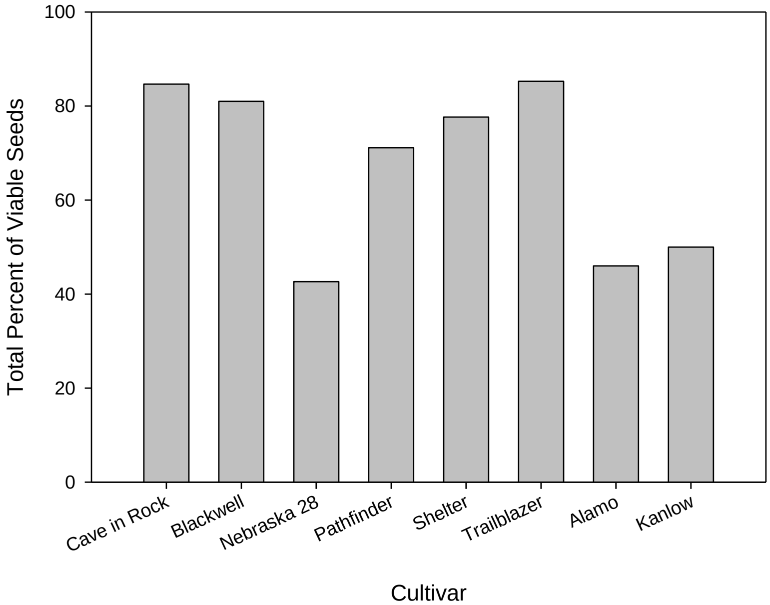


Figure 3. Preliminary Experiment: Seed viability (percent viability based upon tetrazolium test) for eight *Panicum virgatum* cultivars (n=150 seeds tested per cultivar).

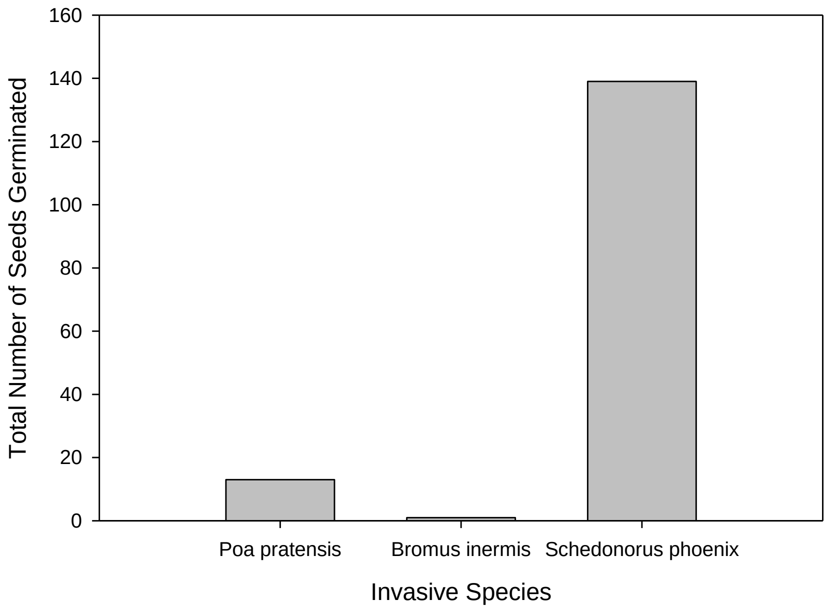


Figure 4. Preliminary Experiment: Cumulative number of seed germinated out of 150 for the three invasive species over a thirty-day period.

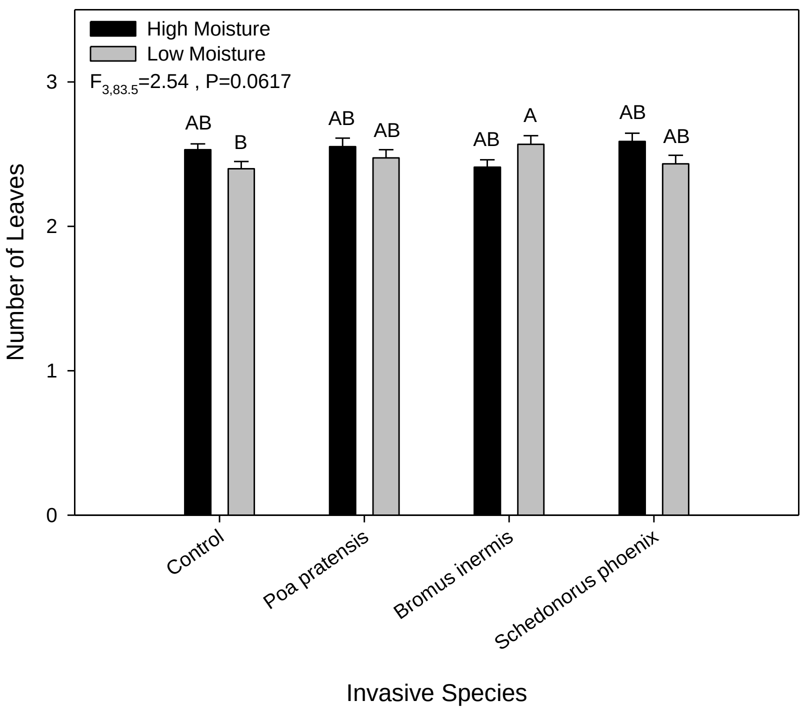


Figure 5. Greenhouse Experiment 1: Mean number of leaves of *P. virgatum* per plant grown in the presence of invasive species or alone (control) in low and high moisture. Mean values with the same letters within an invasive species are not significantly different at α = 0.05.

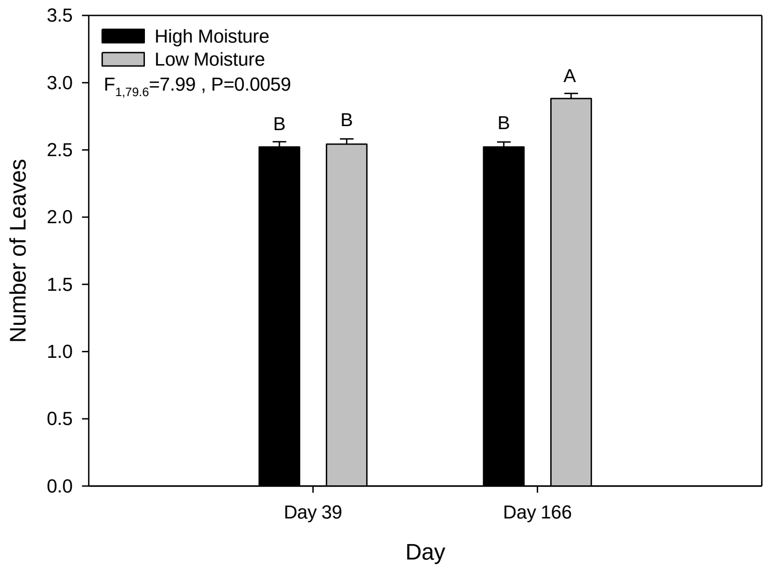


Figure 6. Greenhouse Experiment 1: Mean number of leaves of *P. virgatum* plants at days 39 and 166 under high and low soil moisture treatment. Mean values with the same letters within a day are not significantly different at α = 0.05.

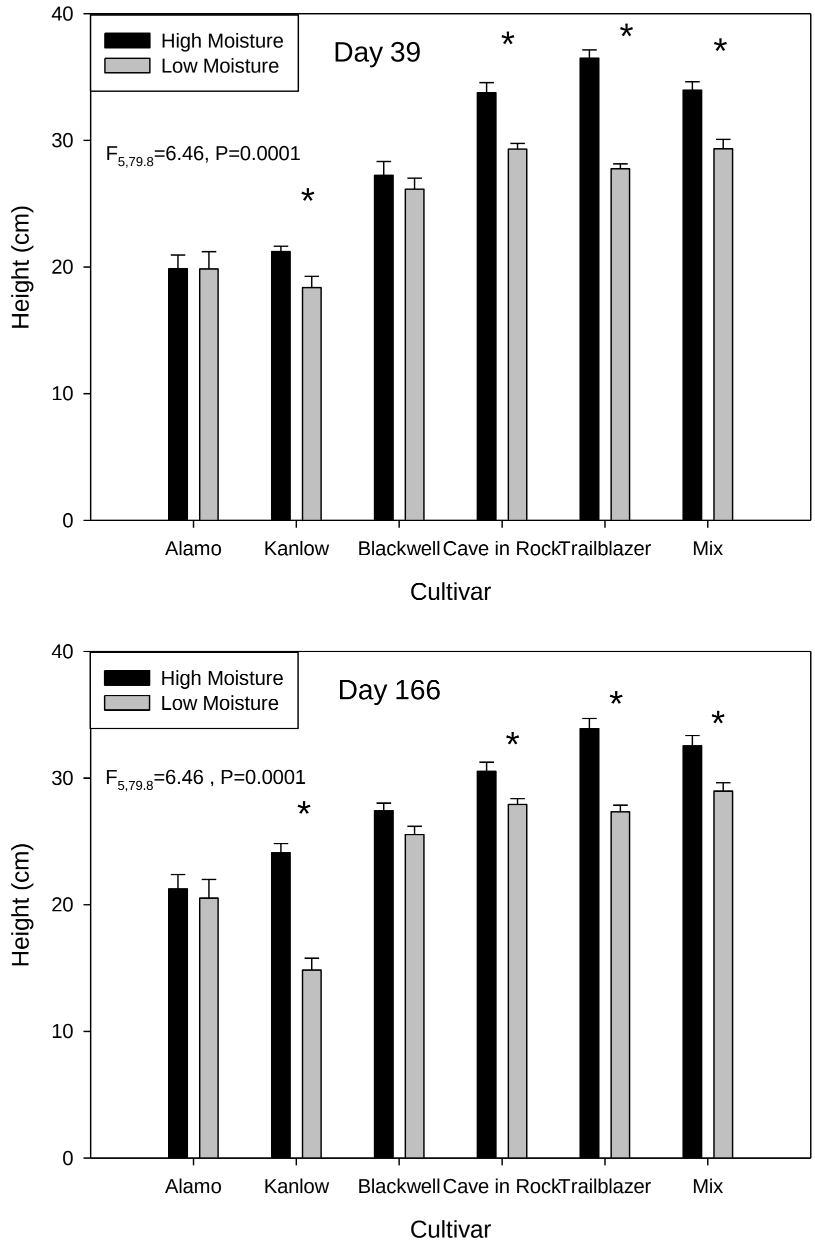
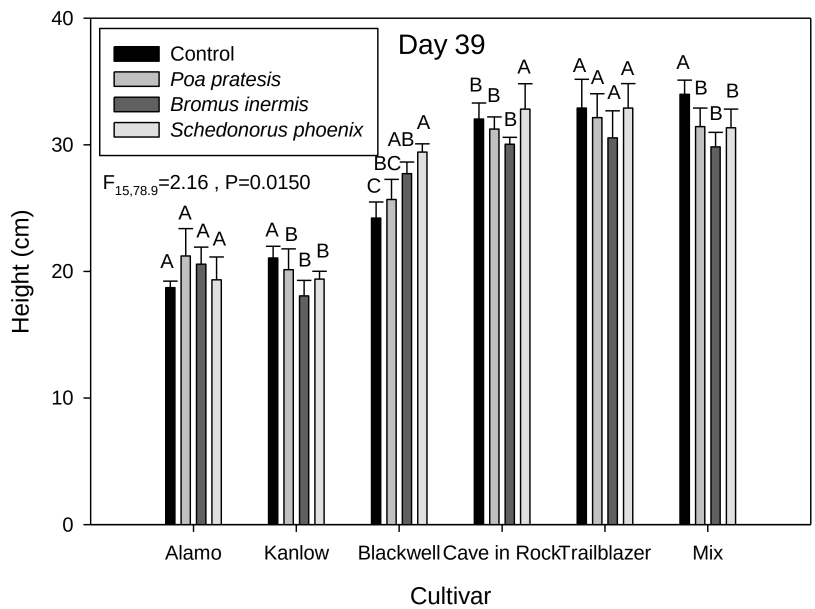


Figure 7. Greenhouse Experiment 1: Mean height of *P. virgatum* cultivars in a three-way interaction between cultivar, moisture and day. * represents a significant difference in the mean height between high and low moisture.



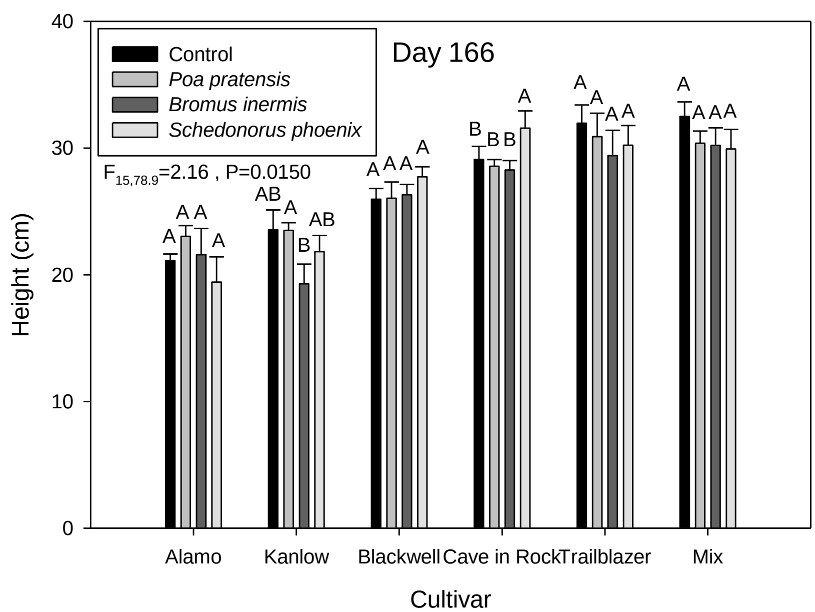


Figure 8. Greenhouse Experiment 1: Mean height of *P. virgatum* cultivars in a three-way interaction between cultivar, invasive species, and day. Mean values on bars within a cultivar with the same letters are not significantly different at $\alpha = 0.05$.

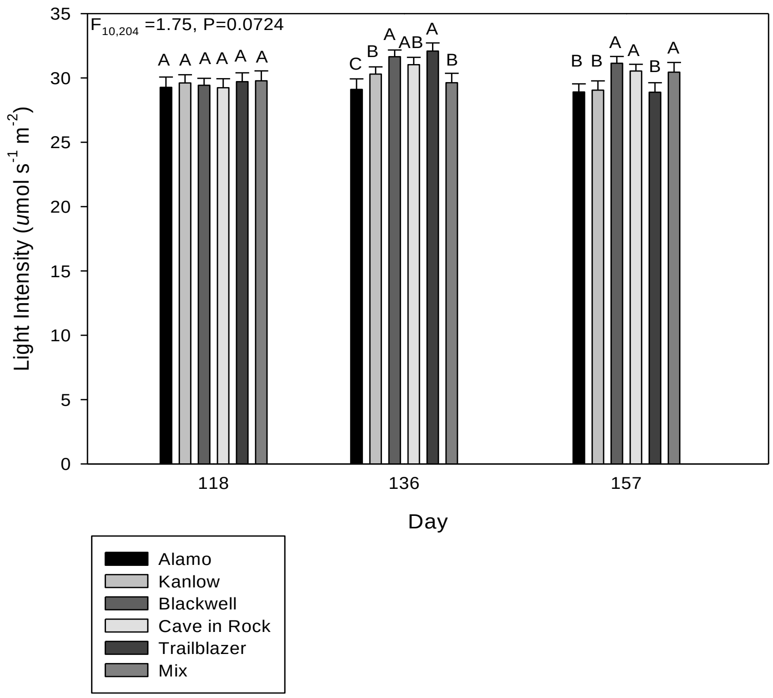


Figure 9. Greenhouse Experiment 1: Mean soil surface light intensity in response to *P. virgatum* cultivars over three sample dates. Mean values with the same letters are not significantly different at $\alpha = 0.05$ within a sample day.

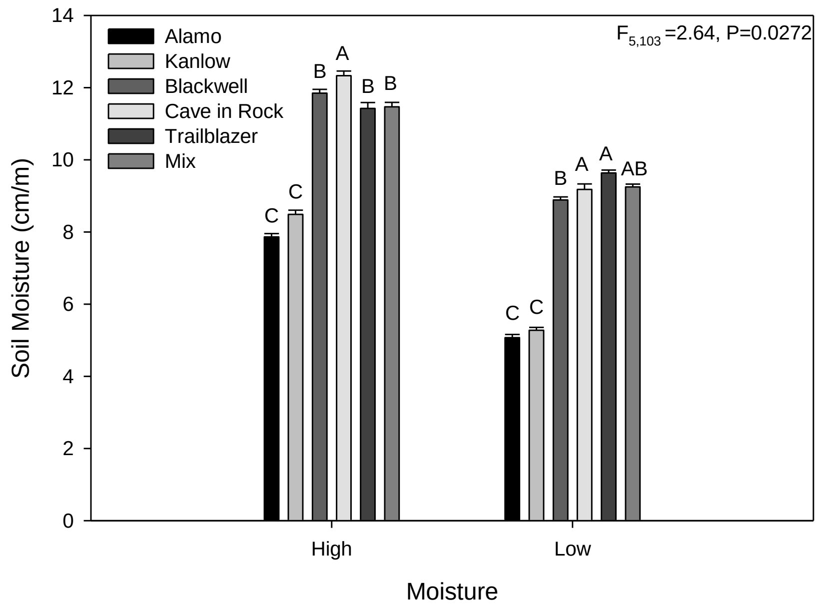


Figure 10. Greenhouse Experiment 1: Mean soil moisture in response to cultivar under high and low moisture treatments. Mean values with the same letters are not significantly different at α = 0.05 within a soil moisture treatment.

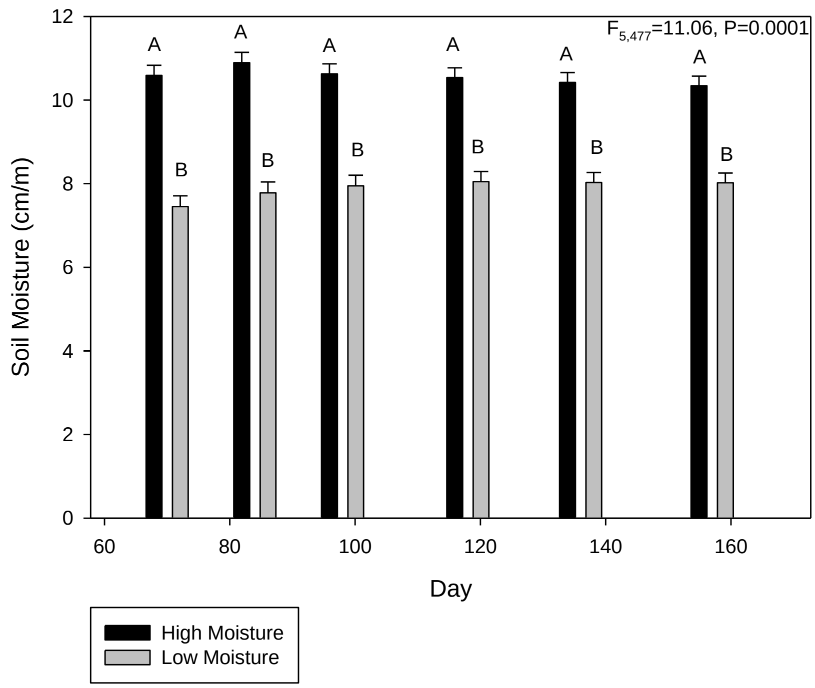


Figure 11. Greenhouse Experiment 1: Mean soil moisture in response to high and low moisture treatments over a six-day period. Mean values with the same letters are not significantly different at α = 0.05 within a sample day.

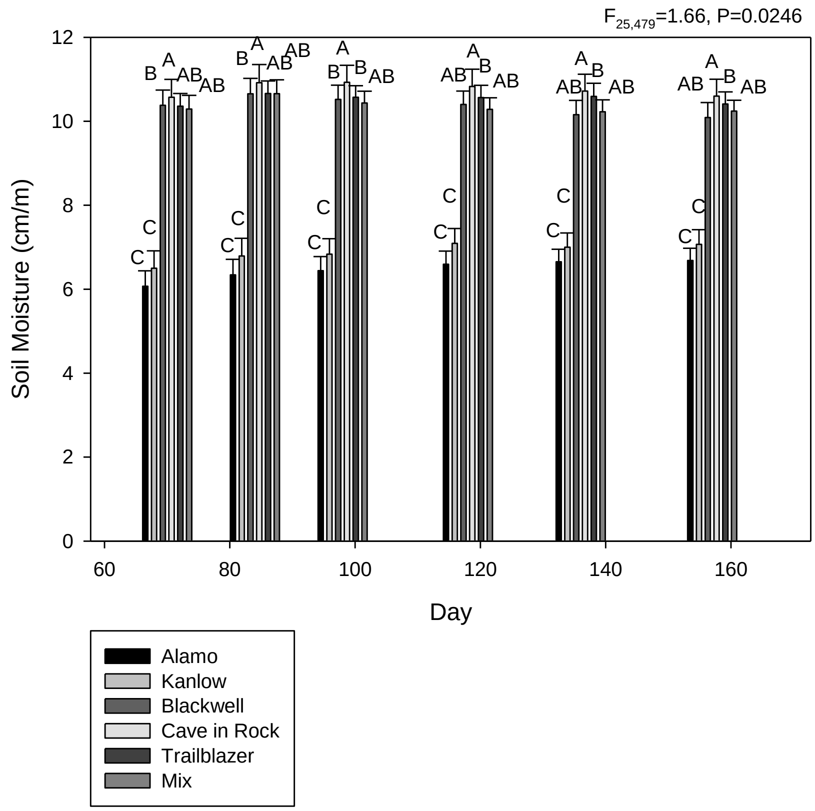
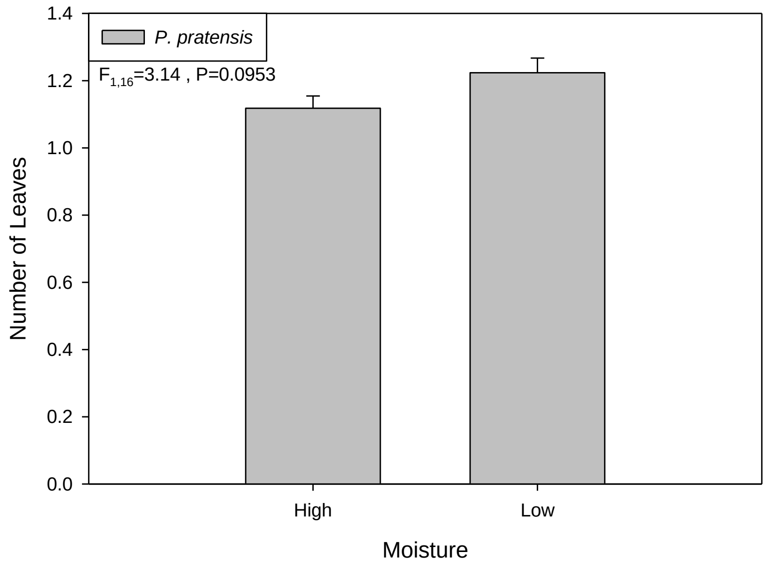


Figure 12. Greenhouse Experiment 1: Mean soil moisture in response to cultivar over six days. Mean values with the same letters are not significantly different at α = 0.05 within a sample day.



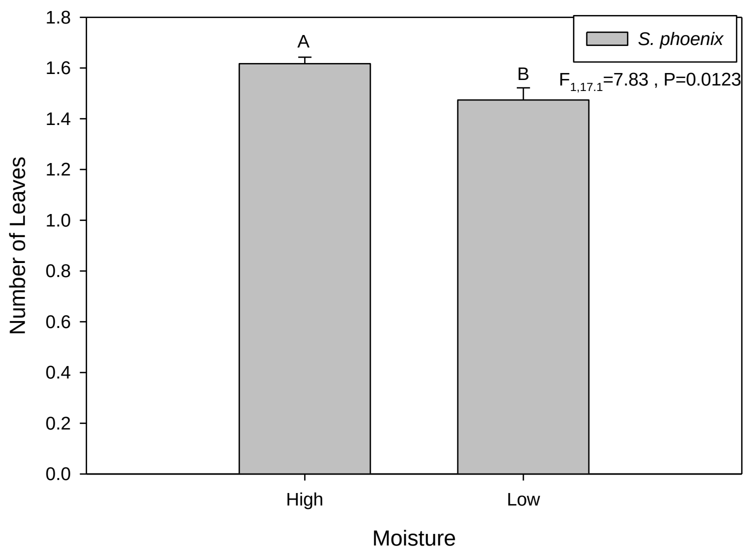


Figure 13. Greenhouse Experiment 1: Mean number of leaves of *P. virgatum* in response to *P. pratensis* and *S. phoenix* under low and high moisture conditions. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

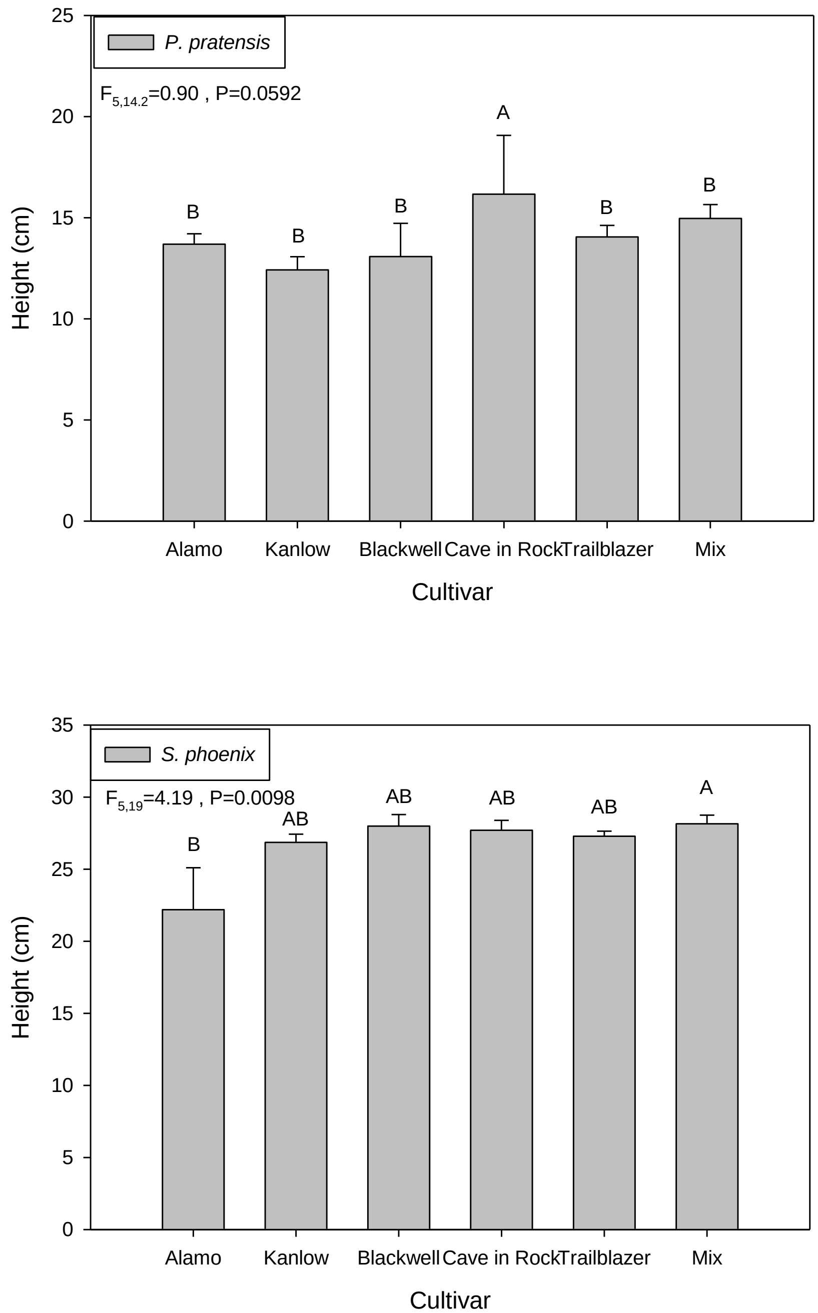


Figure 14. Greenhouse Experiment 1: Mean height of *P. pratensis* and *S. phoenix* in response to *P. pratensis* and *S. phoenix* under the presence of *P. virgatum* cultivars. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

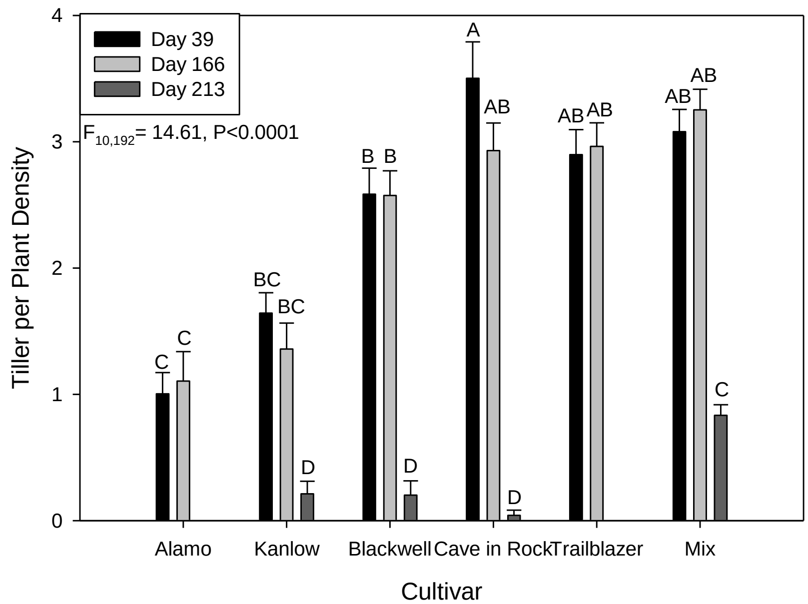


Figure 15. Greenhouse Experiment 1: Mean total tiller density per plant of the *P. virgatum* cultivars in response to *P. virgatum* cultivars over three sampling dates. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

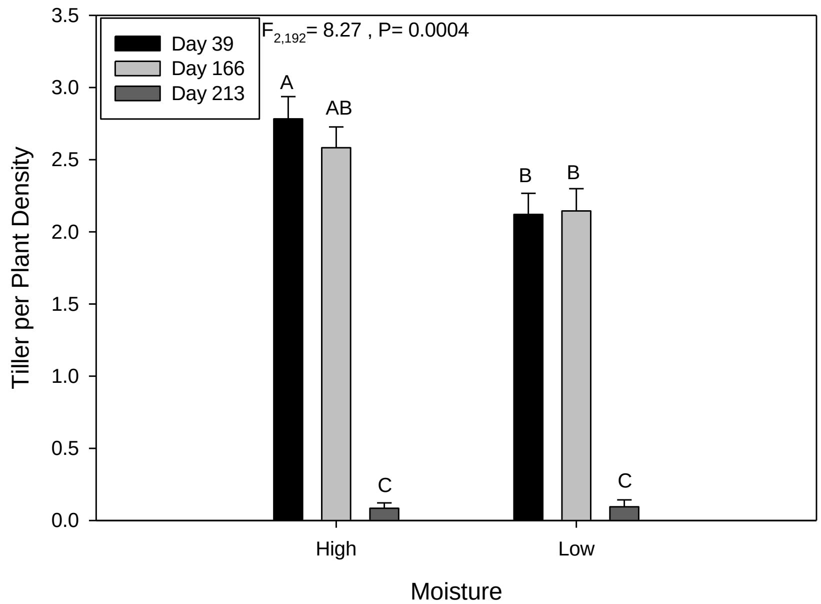


Figure 16. Greenhouse Experiment 1: Mean total tiller density per plant of the *P. virgatum* cultivars in response to moisture level over three sampling dates. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

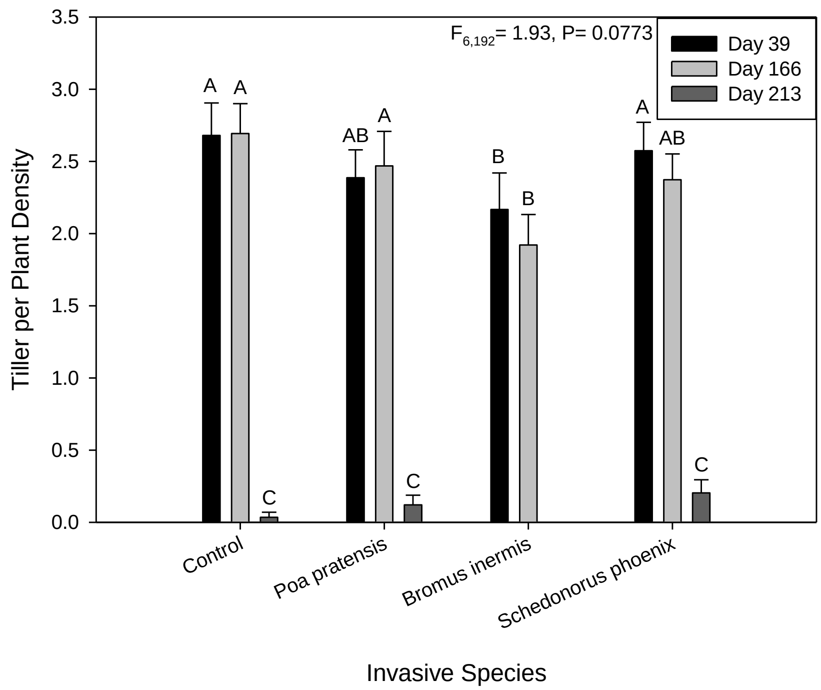


Figure 17. Greenhouse Experiment 1: Mean total tiller density per plant of the *P. virgatum* cultivars in response to the three invasive species over three sampling dates. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

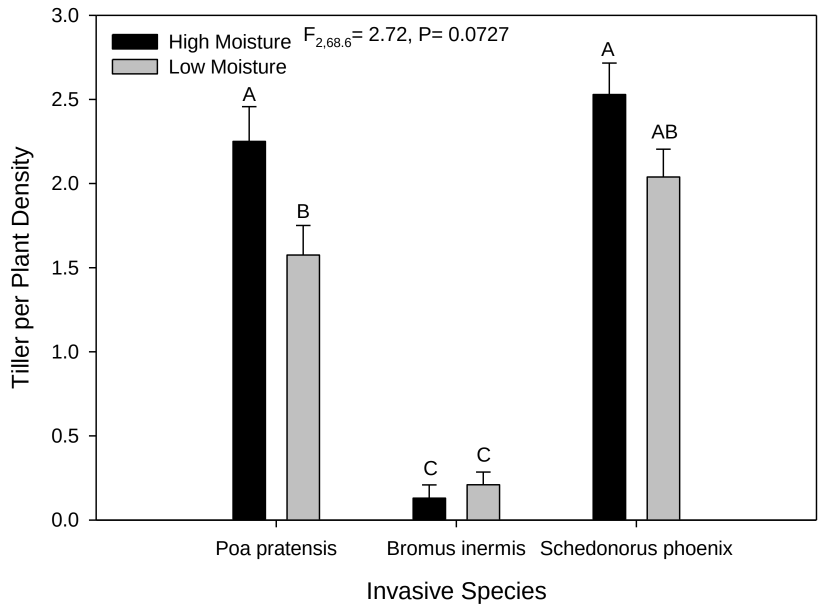


Figure 18. Greenhouse Experiment 1: Mean total tiller density per plant of the invasive species in response to the invasive species over low and high moisture treatments. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

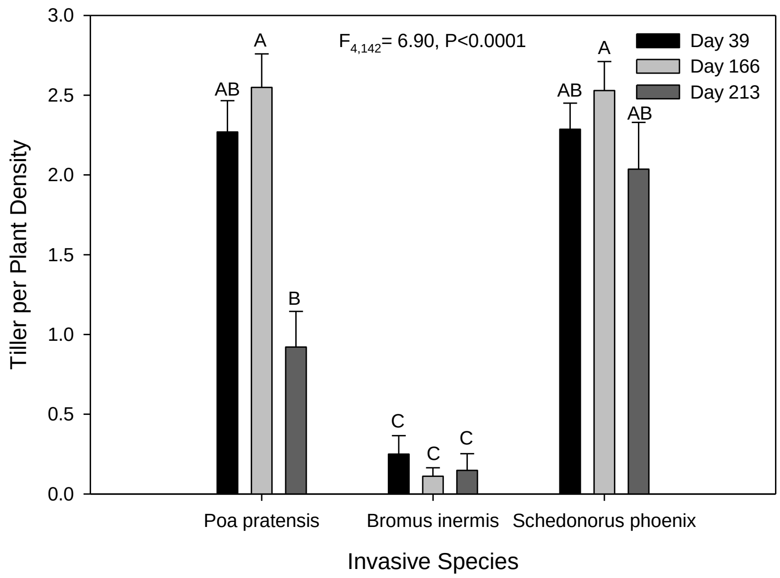


Figure 19. Greenhouse Experiment 1: Mean total tiller density per plant of the invasive species in response to the invasive species three sampling dates. Mean values with the same letters are not significantly different at α = 0.05.

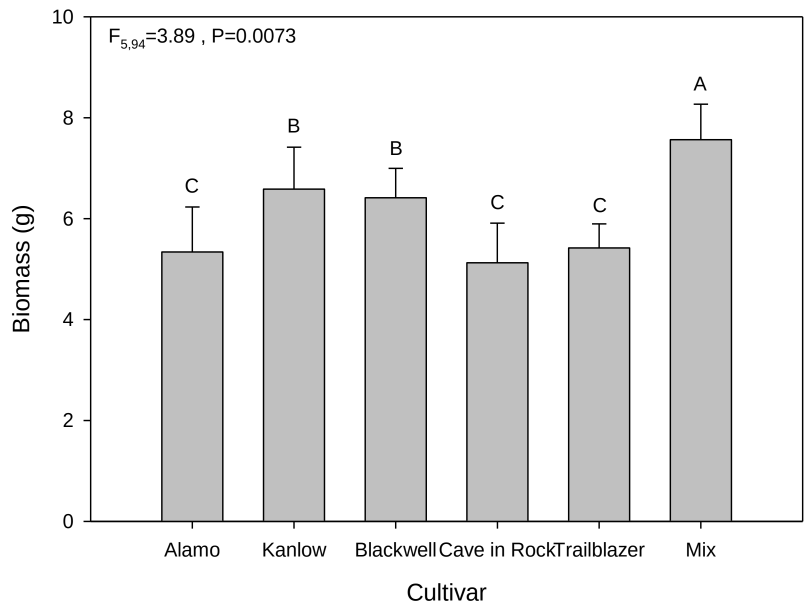


Figure 20. Greenhouse Experiment 1: Mean total belowground biomass of *P. virgatum* and invasive species in response to planted cultivar. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

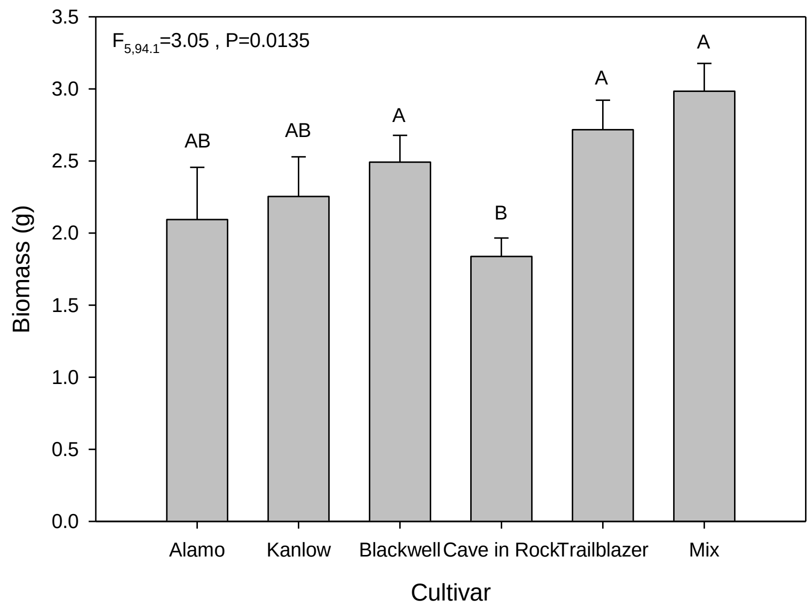


Figure 21. Greenhouse Experiment 1: Mean aboveground biomass in response to *P. virgatum* cultivars. Mean values with the same letters are not significantly different at α = 0.05.

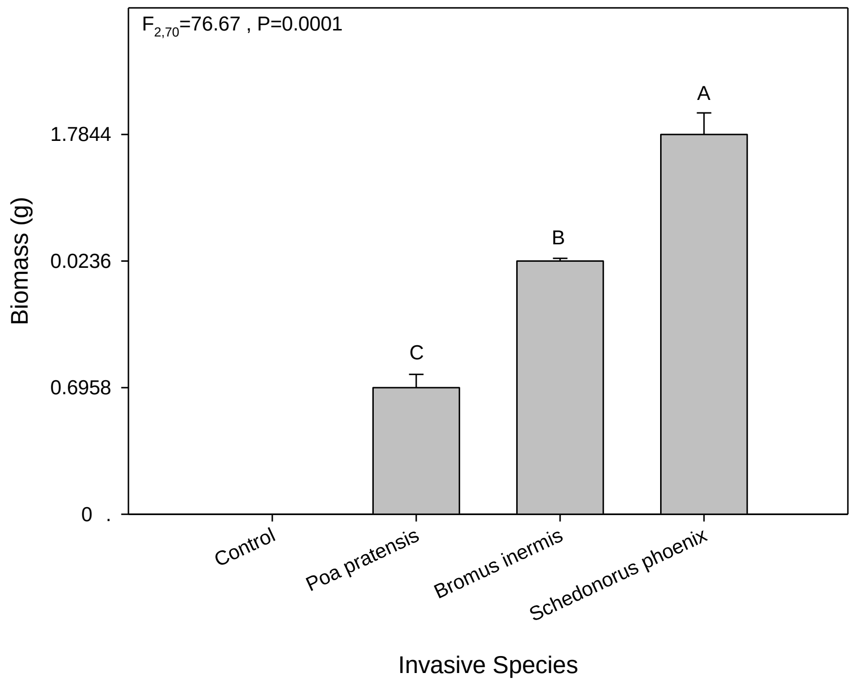


Figure 22. Greenhouse Experiment 1: Mean aboveground biomass of the invasive species in response to the planted invasive species.

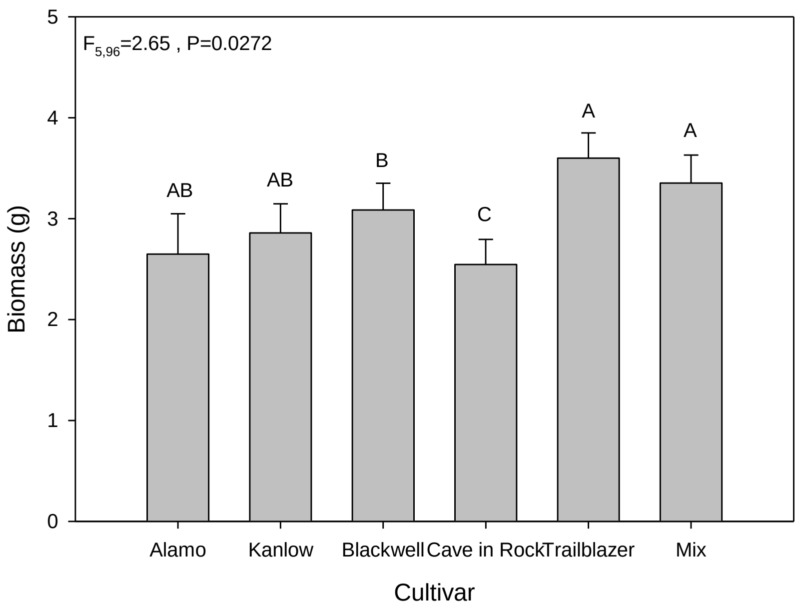


Figure 23. Greenhouse Experiment 1: Mean total aboveground biomass of the cultivars and the invasive species in response to *P. virgatum* cultivars. Mean values with the same letters are not significantly different at α = 0.05.

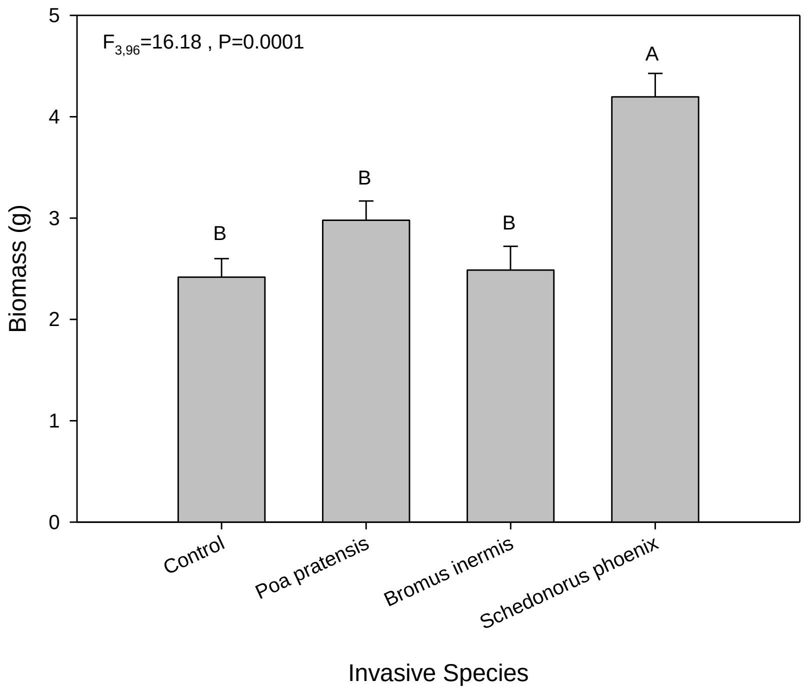


Figure 24. Greenhouse Experiment 1: Mean total aboveground biomass of the cultivars and the invasive species in response to invasive species. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

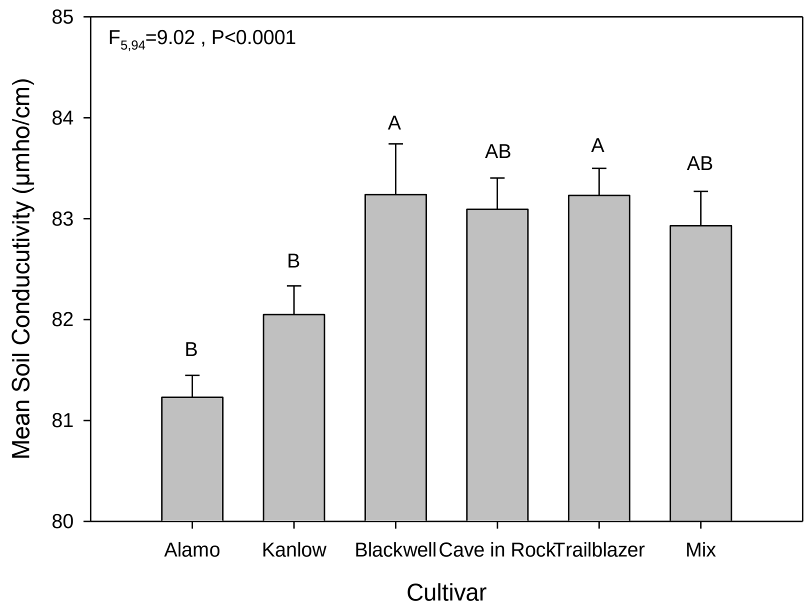


Figure 25. Greenhouse Experiment 1: Mean soil electrical conductivity (EC) in response to the *P. virgatum* cultivars. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

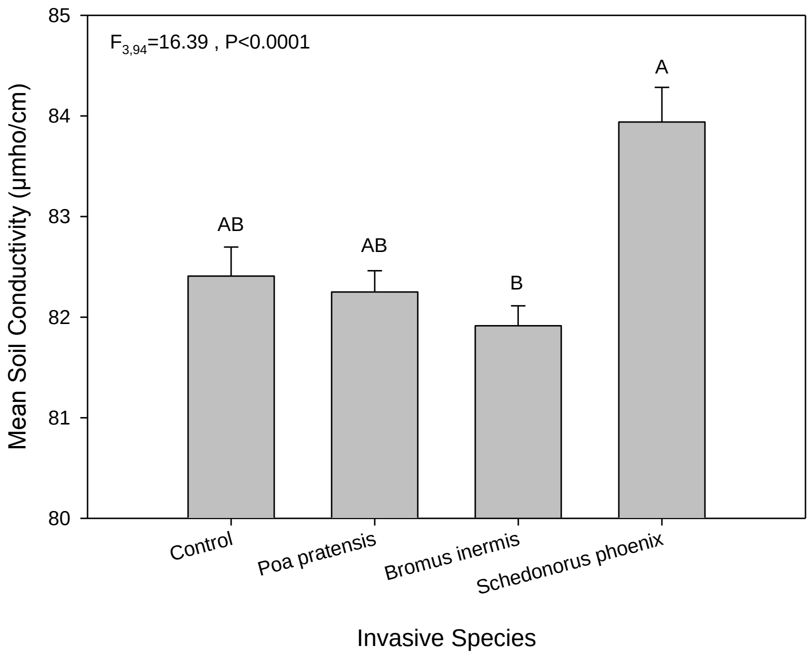


Figure 26. Greenhouse Experiment 1: Mean soil electrical conductivity (EC) in response to soil planted with *P. virgatum* alone (control) or with one of three invasive species. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

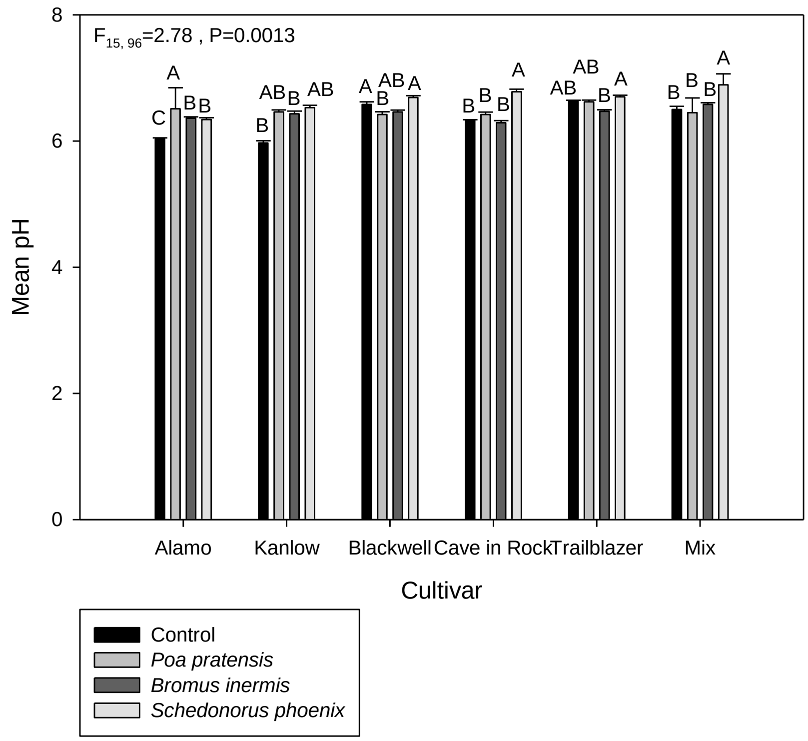


Figure 27. Greenhouse Experiment 1: Mean soil pH in response to *P. virgatum* cultivars grown with one of the three invasive species or alone (control). Mean values with the same letters within a cultivar are not significantly different at $\alpha = 0.05$.

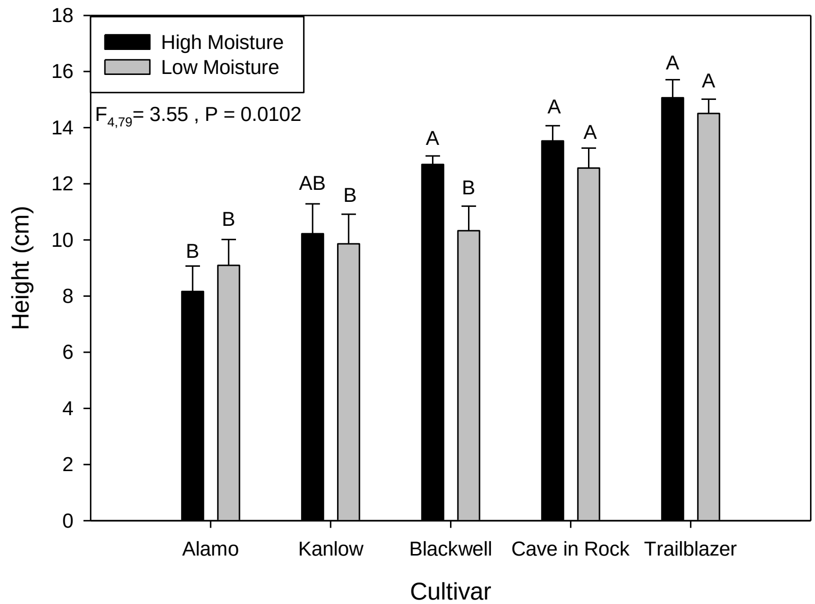


Figure 28. Greenhouse Experiment 2: Mean height of *P. virgatum* cultivars in response to moisture treatment. Letters are within a cultivar. Mean values with the same letters within a cultivar are not significantly different at $\alpha = 0.05$.

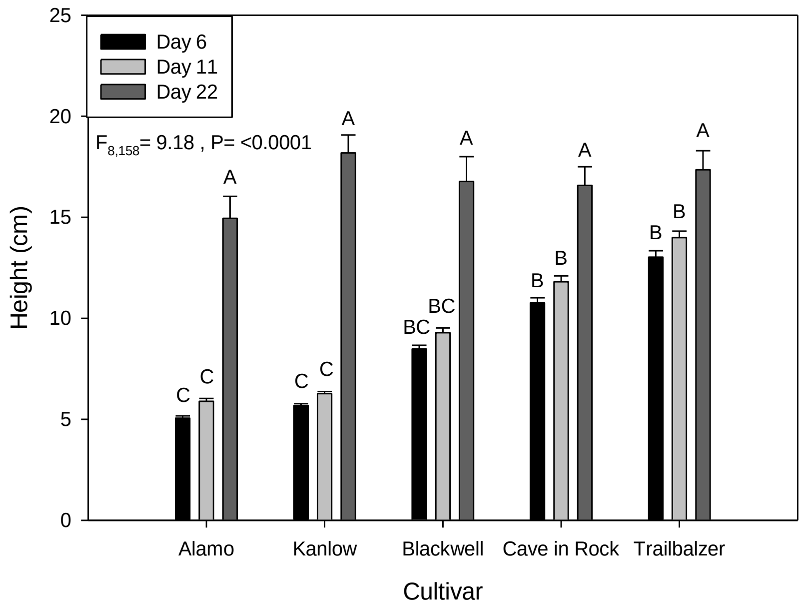


Figure 29. Greenhouse Experiment 2: Mean height of *P. virgatum* cultivars on days 6, 11, and 22. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

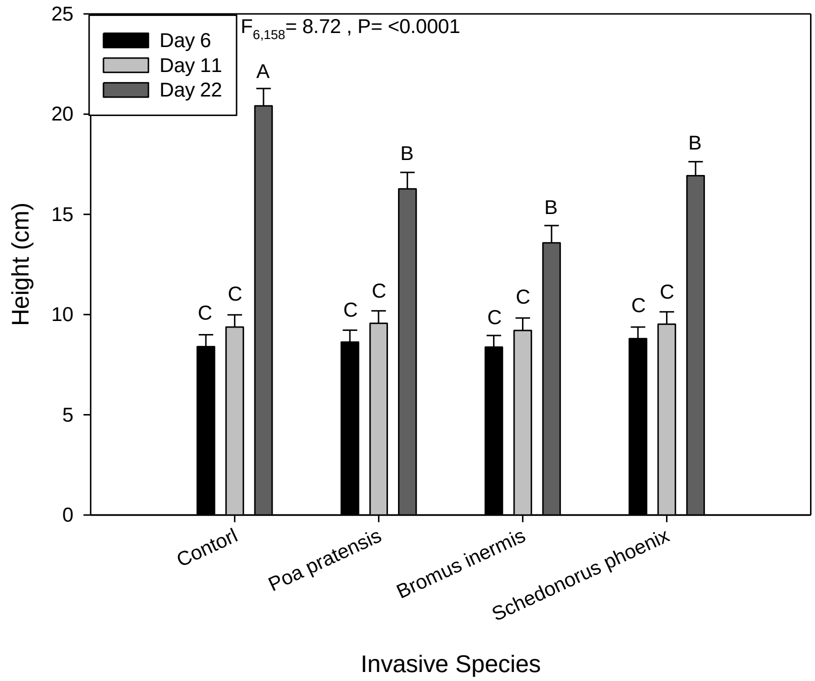


Figure 30. Greenhouse Experiment 2: Mean height of *P. virgatum* cultivars on days 6, 11, and 22 growing either alone (control) or in the presence of one of three invasive species. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

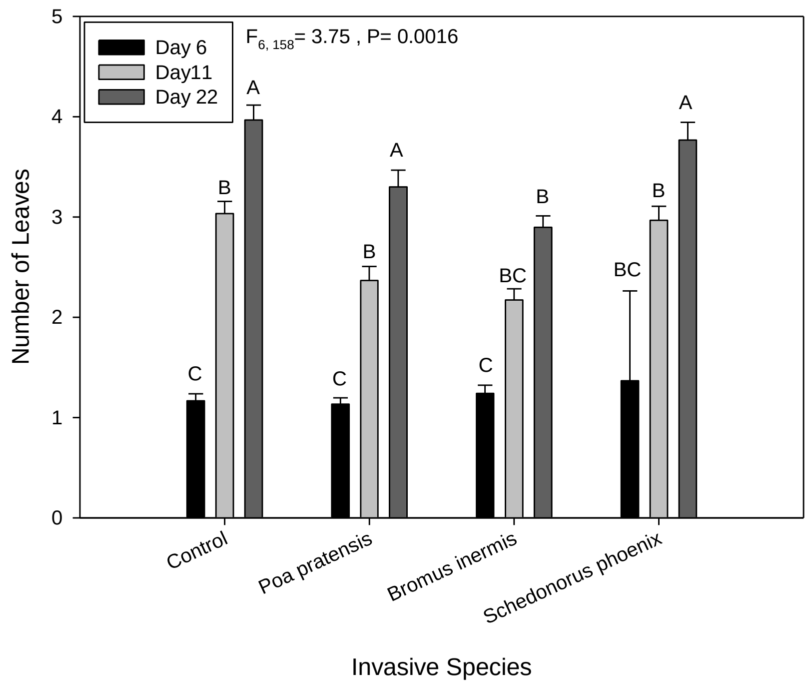


Figure 31. Greenhouse Experiment 2: Mean number of leaves of *P. virgatum* in response to the presence of invasive species over three days. Mean values with the same letters within a cultivar are not significantly different at $\alpha = 0.05$.

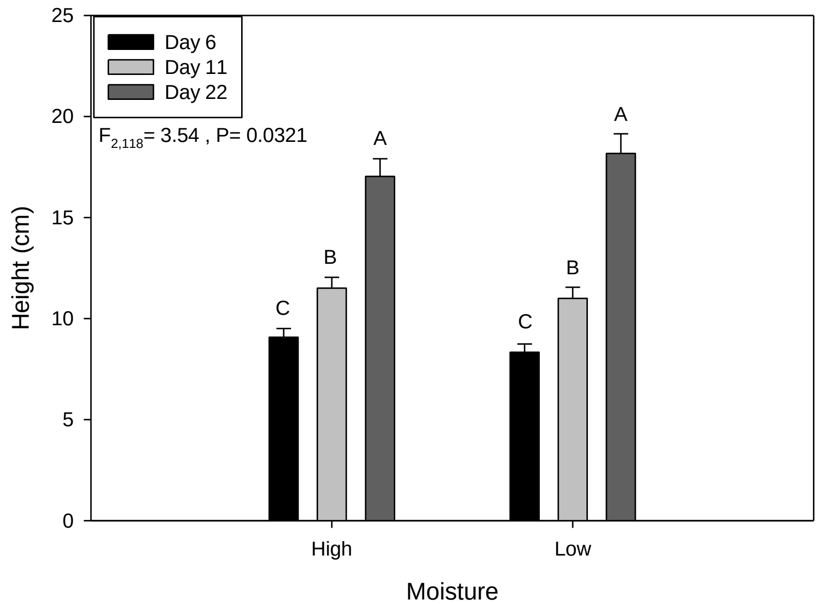


Figure 32. Greenhouse Experiment 2: Mean height soil moisture in response to day. Mean values with the same letters within a cultivar are not significantly different at $\alpha = 0.05$.

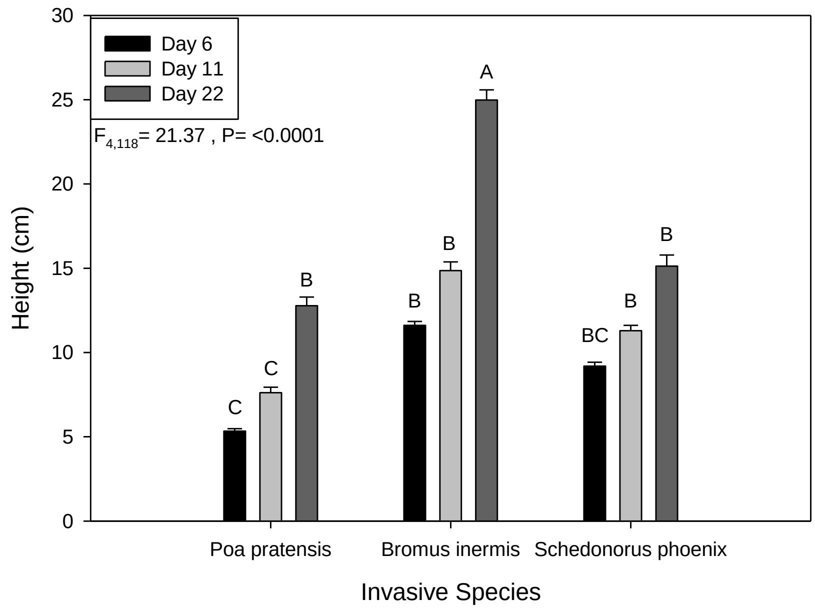


Figure 33. Greenhouse Experiment 2: Mean height of the invasive species over three days. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

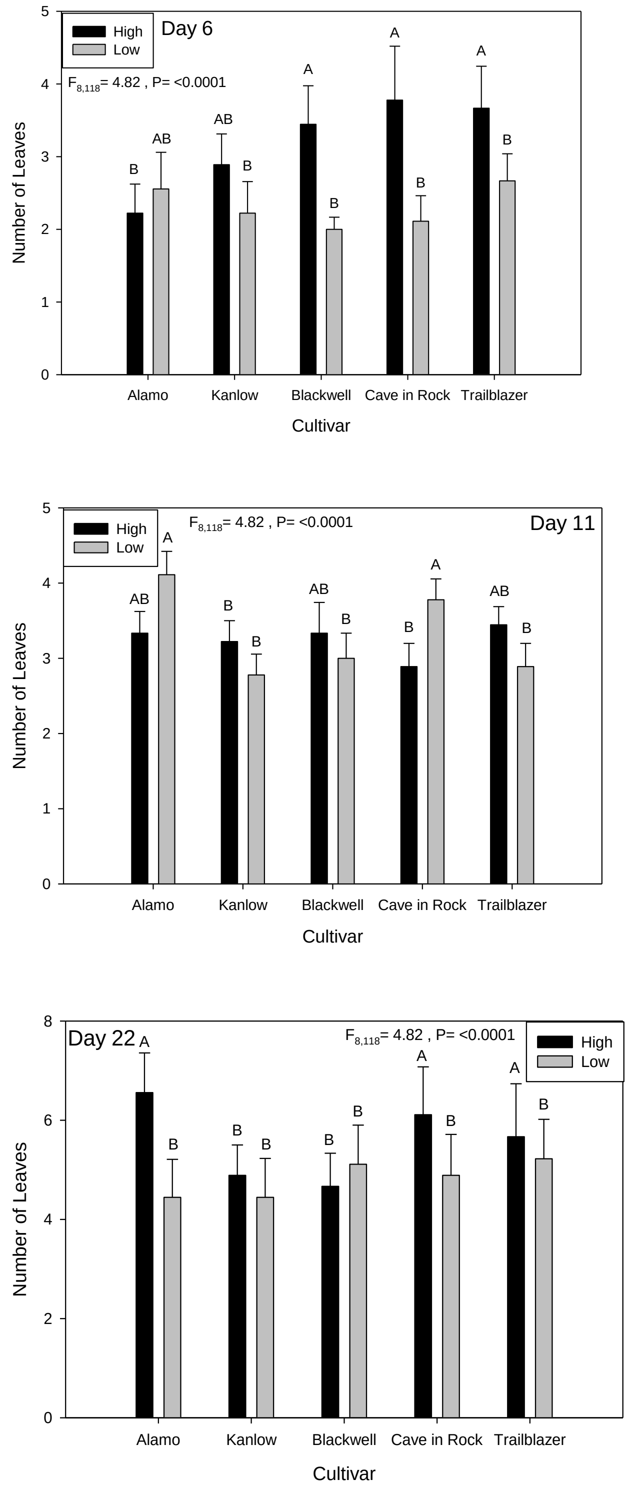


Figure 34. Greenhouse Experiment 2: Mean number of leaves for invasive species in a three-way interaction between cultivar, moisture and day. Mean values with the same letters within a cultivar are not significantly different at α = 0.05.

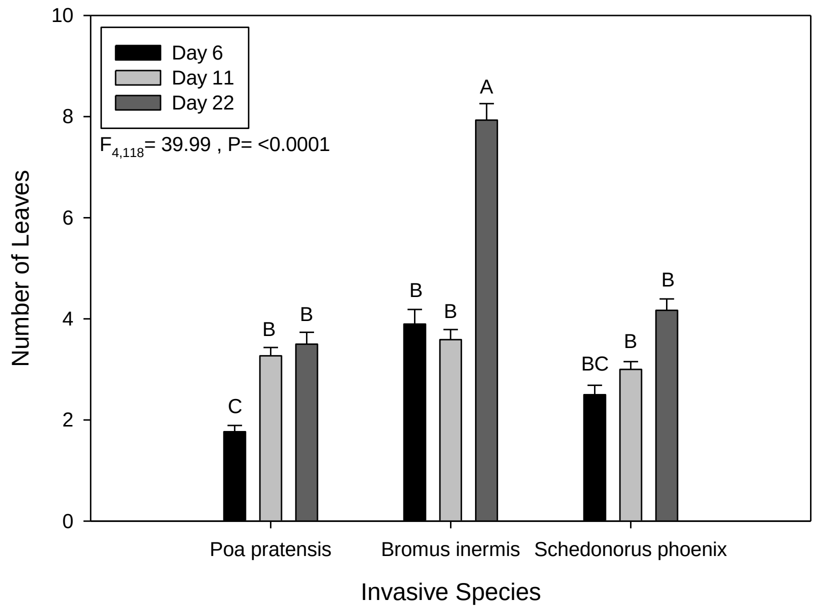


Figure 35. Greenhouse Experiment 2: Mean number of leaves in response to the invasive species over three days. Mean values with the same letters within a cultivar are not significantly different at $\alpha = 0.05$.

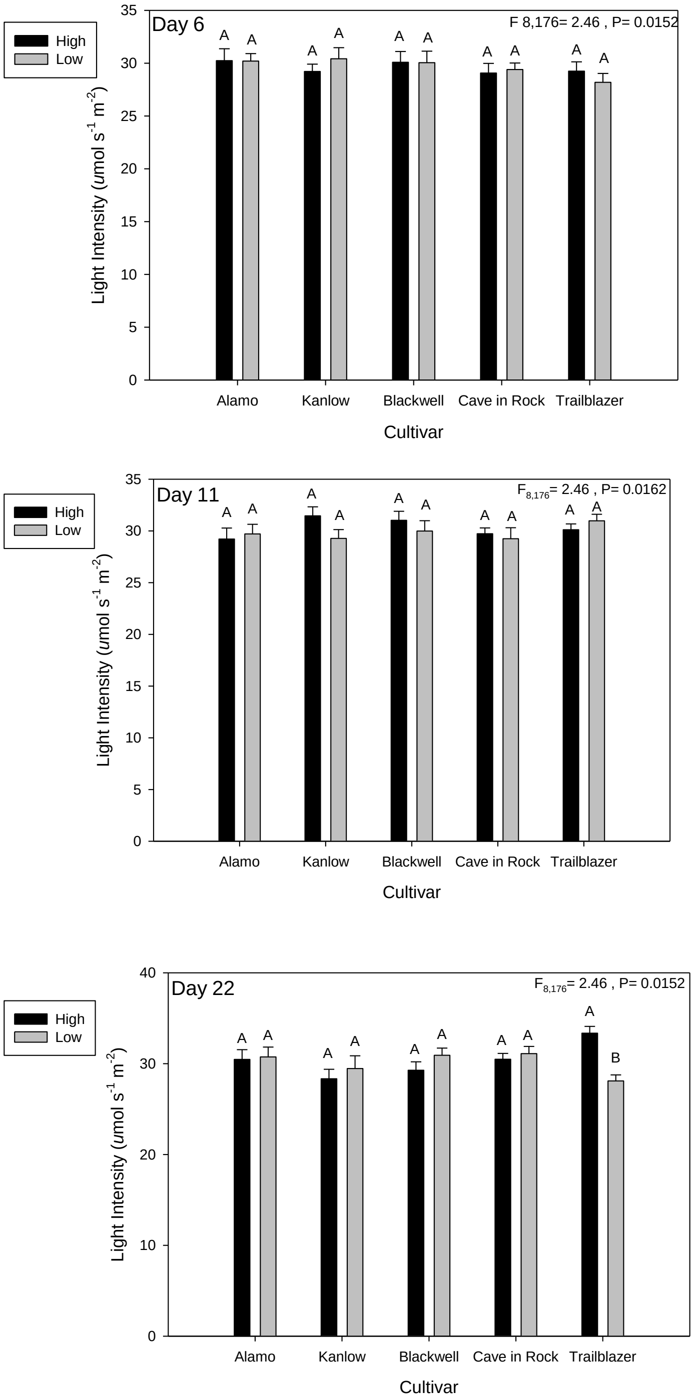
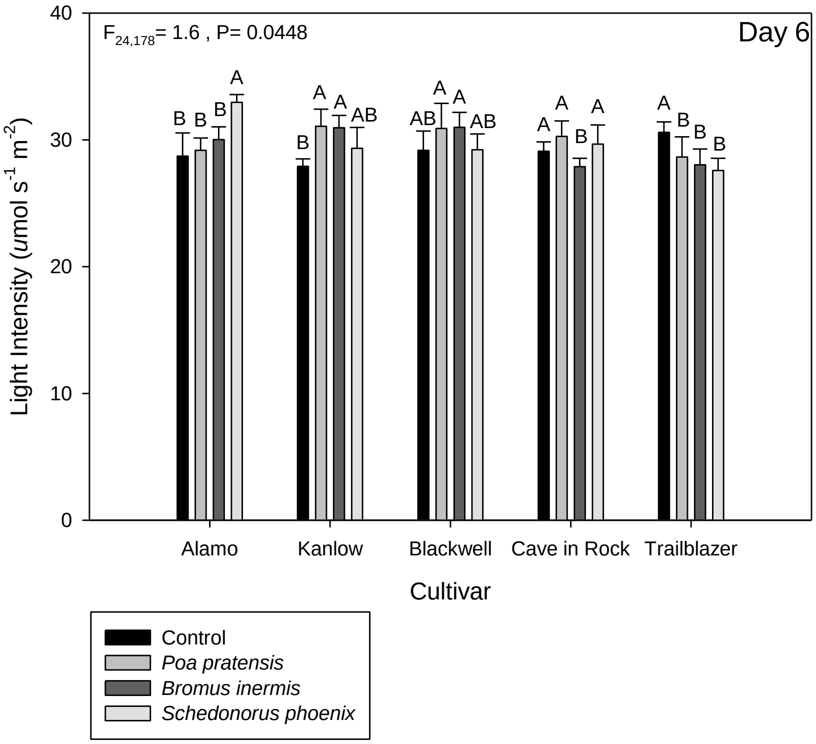
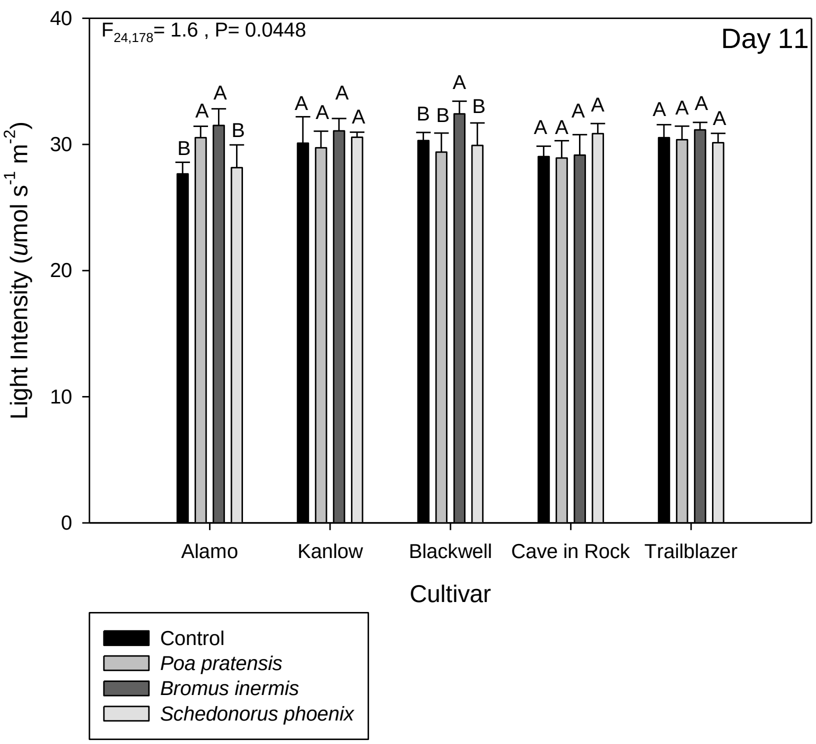


Figure 36. Greenhouse Experiment 2: Mean light intensity in response to cultivar, moisture and day. Mean values with the same letters within a cultivar are not significantly different at $\alpha = 0.05$.



$F_{24,178}$= 1.6 , P= 0.0448
Day 6
Light Intensity ($u$mol s^{-1} m^{-2})
Alamo
Kanlow
Blackwell
Cave in Rock
Trailblazer
Cultivar
Control
Poa pratensis
Bromus inermis
Schedonorus phoenix



$F_{24,178}$= 1.6 , P= 0.0448
Day 11
Light Intensity ($u$mol s^{-1} m^{-2})
Alamo
Kanlow
Blackwell
Cave in Rock
Trailblazer
Cultivar
Control
Poa pratensis
Bromus inermis
Schedonorus phoenix

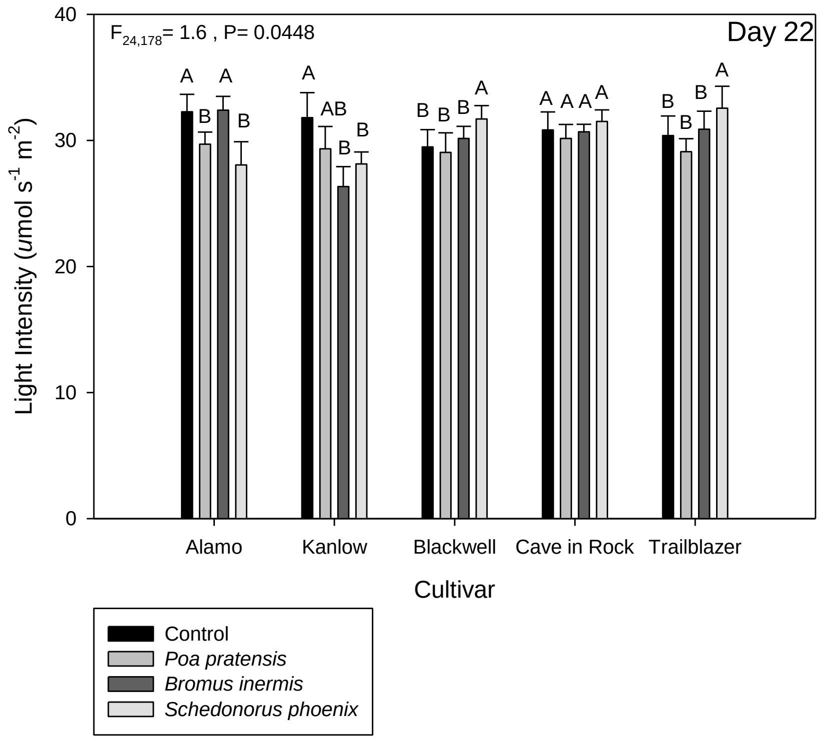


Figure 37. Greenhouse Experiment 2: Mean light intensity in response to cultivar, invasive species and day. Mean values with the same letters within a cultivar are not significantly different at $\alpha = 0.05$.

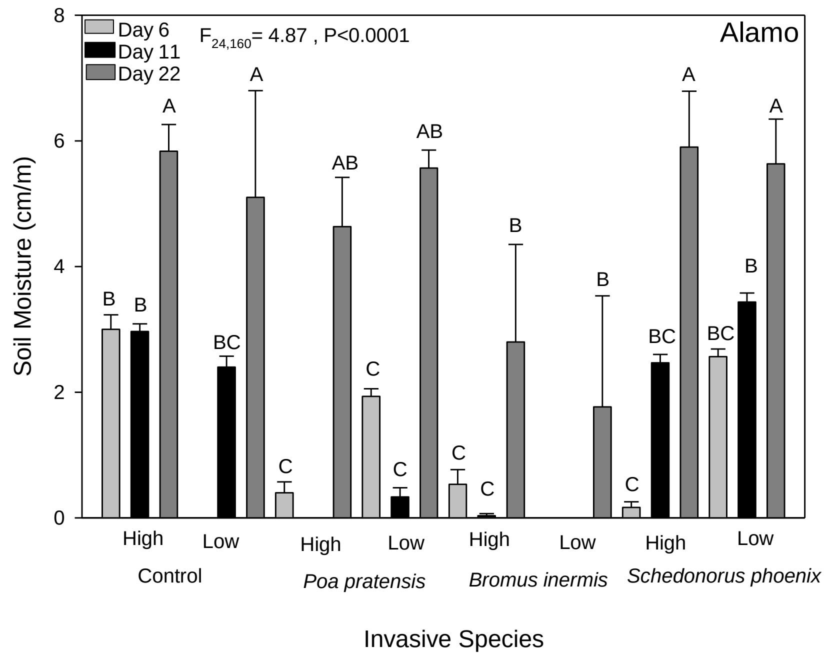


Figure 38a. Greenhouse Experiment 2: 'Alamo' mean soil moisture over days 6, 11 and 22 in response to soil moisture and invasive species. Mean values with the same letters within an invasive species are not significantly different at α = 0.05.

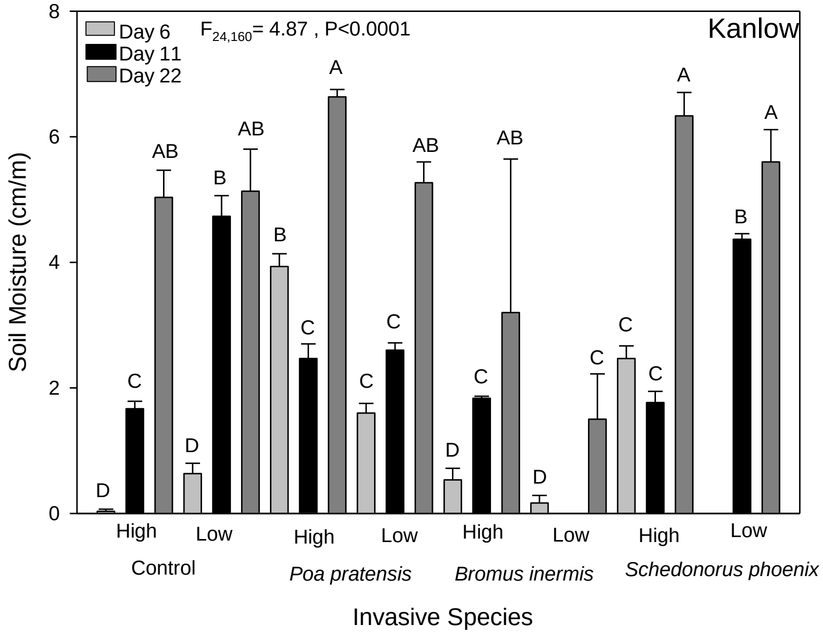


Figure 38b. Greenhouse Experiment 2: 'Kanlow' mean soil moisture over days 6, 11 and 22 in response to soil moisture and invasive species. Mean values with the same letters within an invasive species are not significantly different at $\alpha = 0.05$.

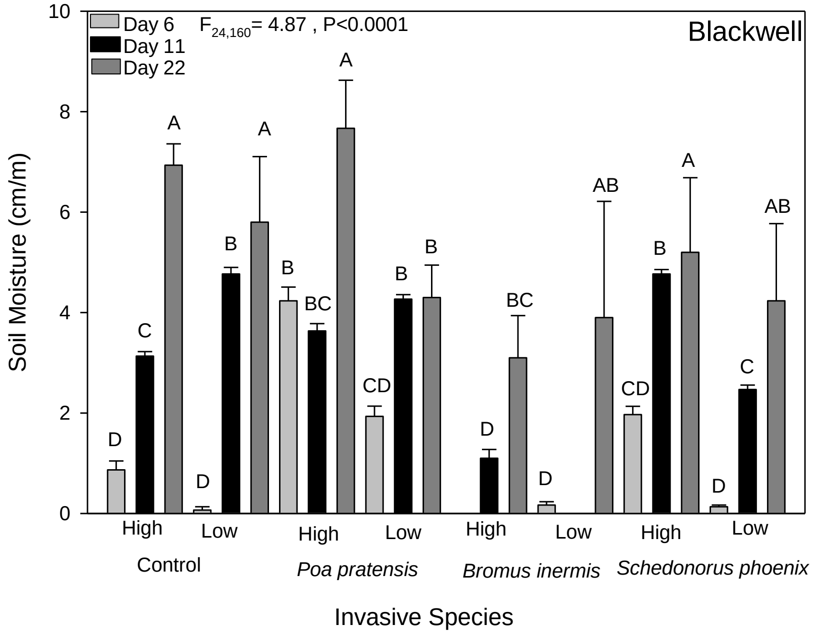


Figure 38c. Greenhouse Experiment 2: 'Blackwell' mean soil moisture over days 6, 11 and 22 in response to soil moisture and invasive species. Mean values with the same letters within an invasive species are not significantly different at $\alpha = 0.05$.

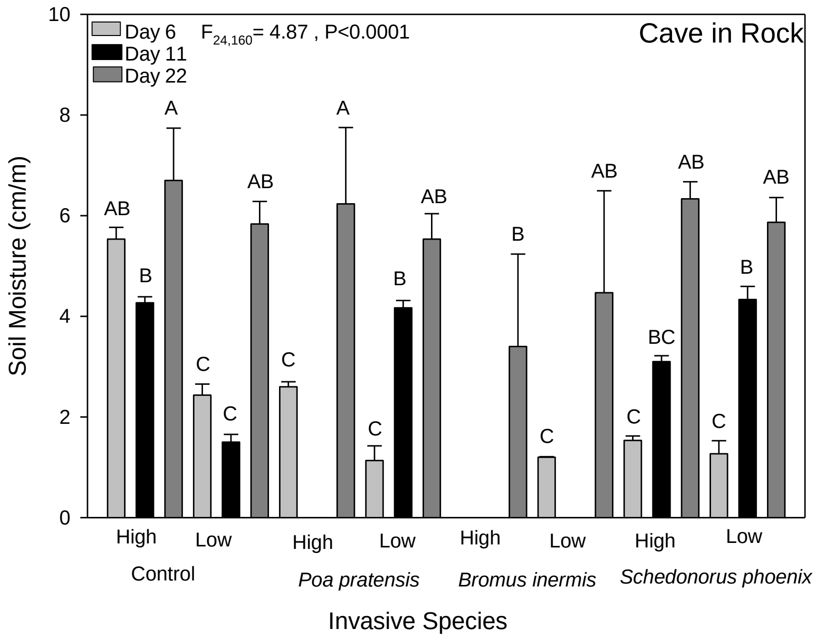


Figure 38d. Greenhouse Experiment 2: 'Cave in Rock' mean soil moisture over days 6, 11 and 22 in response to soil moisture and invasive species. Mean values with the same letters within an invasive species are not significantly different at $\alpha = 0.05$.

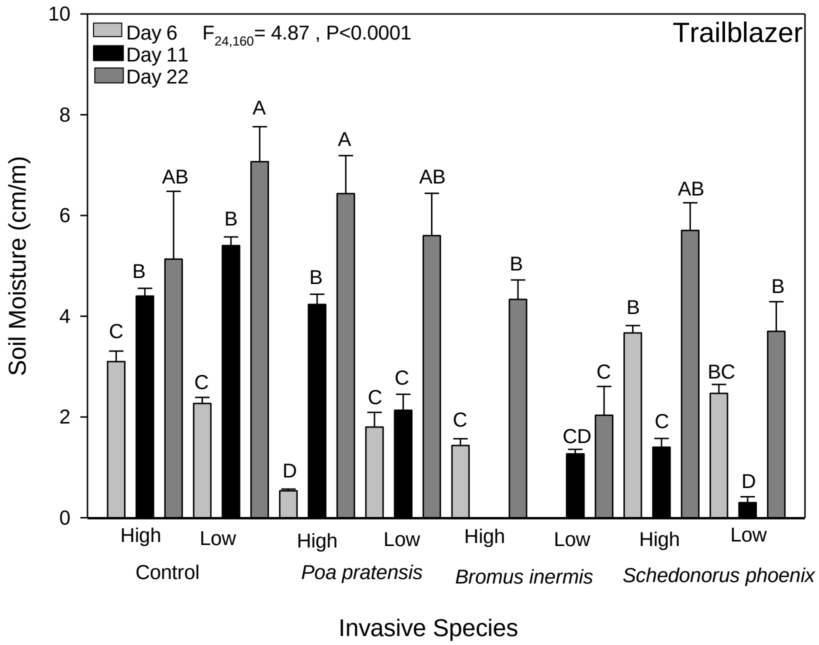


Figure 38e. Greenhouse Experiment 2: 'Trailblazer' mean soil moisture over days 6, 11 and 22 in response to soil moisture and invasive species. Mean values with the same letters within an invasive species are not significantly different at $\alpha = 0.05$.

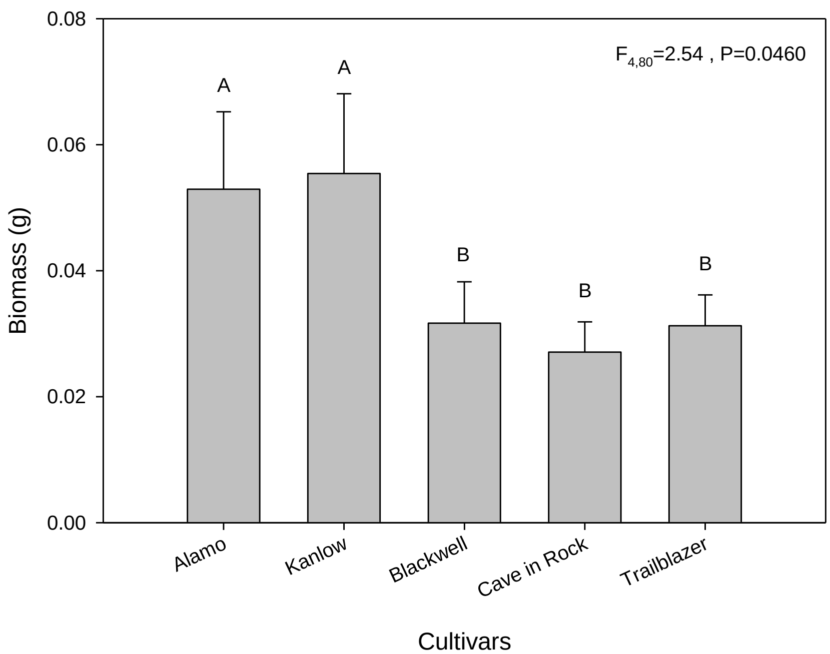


Figure 39. Greenhouse Experiment 2: Mean total aboveground biomass of the cultivars and the invasive species in response to *P. virgatum* cultivars. Mean values with the same letters within a cultivar are not significantly different at $\alpha = 0.05$.

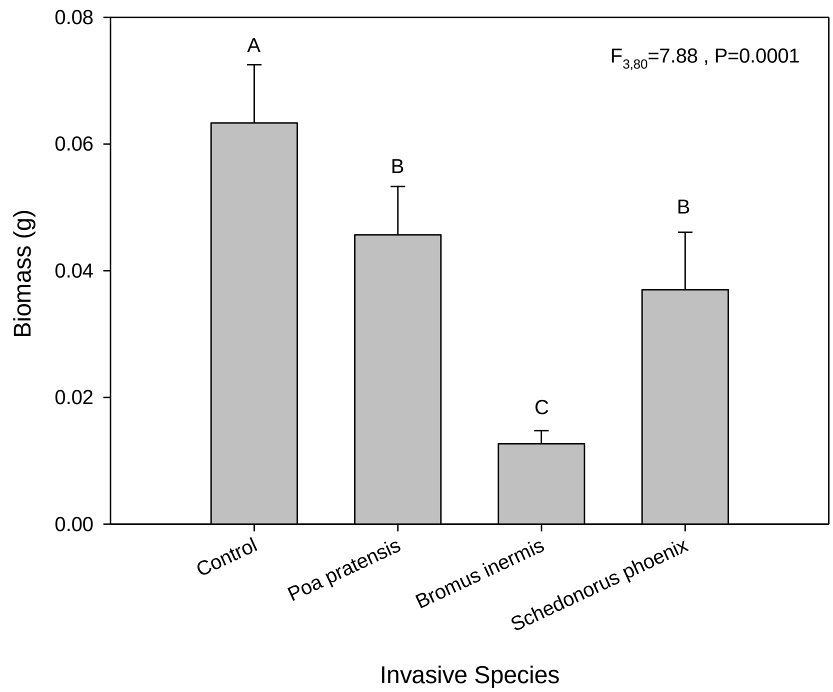


Figure 40. Greenhouse Experiment 2: Mean total aboveground biomass of the cultivars and the invasive species in response to *P. virgatum* cultivars. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

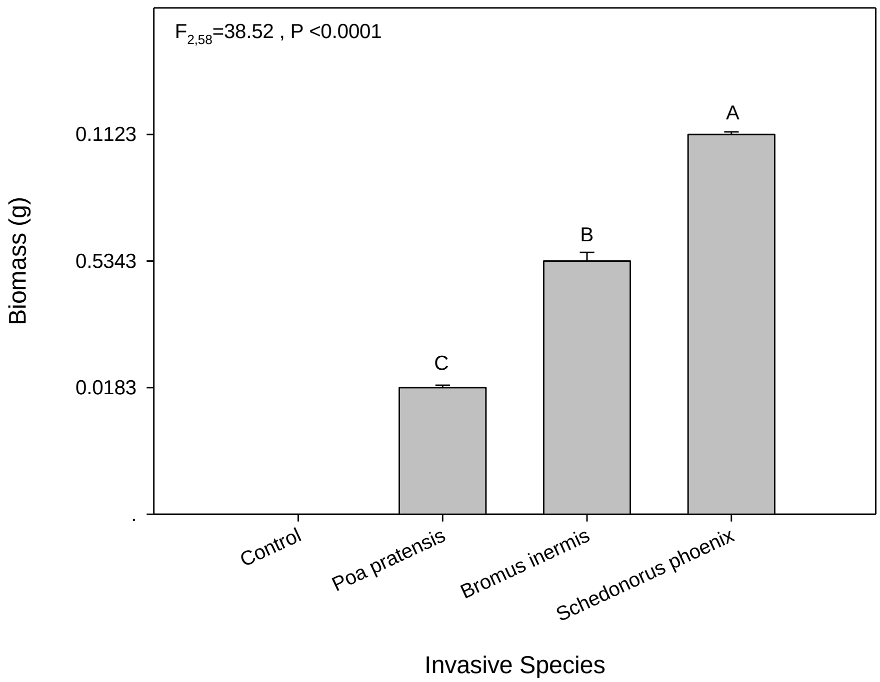


Figure 41. Greenhouse Experiment 2: Mean total aboveground biomass of the cultivars and the invasive species in response to the invasive species. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

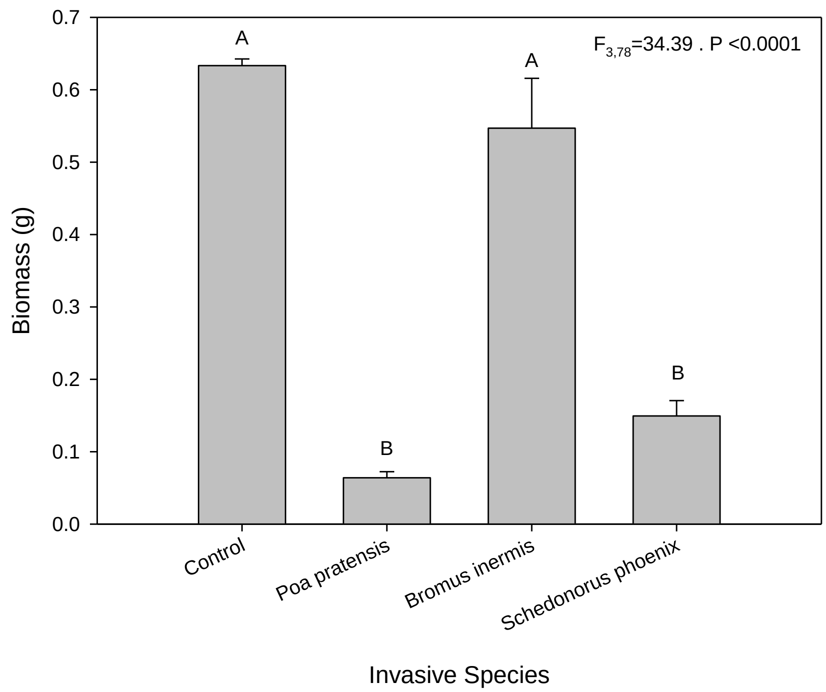


Figure 42. Greenhouse Experiment 2: Mean total aboveground biomass of the cultivars and the invasive species in response to both the *P. virgatum* cultivars and the invasive species. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

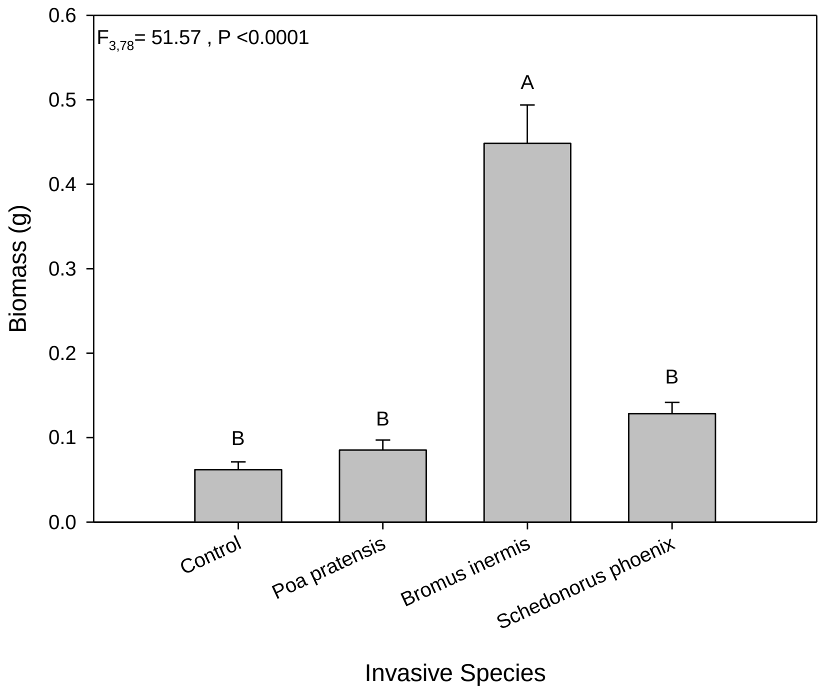


Figure 43. Greenhouse Experiment 2: Mean total belowground biomass of the cultivars and the invasive species in response to the invasive species. Mean values with the same letters are not significantly different at $\alpha = 0.05$.

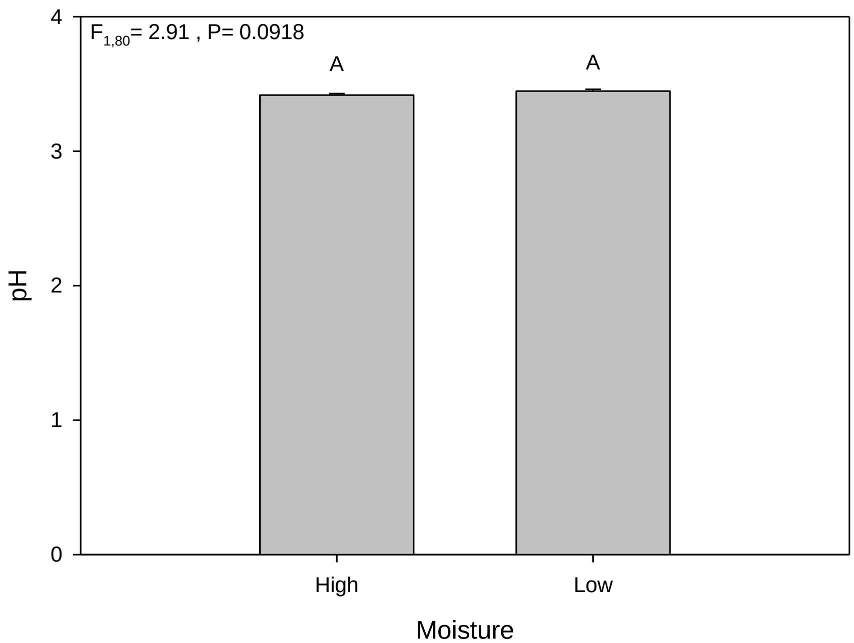


Figure 44. Greenhouse Experiment 2: Mean pH in response to high and low moisture levels. Mean values with the same letters are not significantly different at α = 0.05.

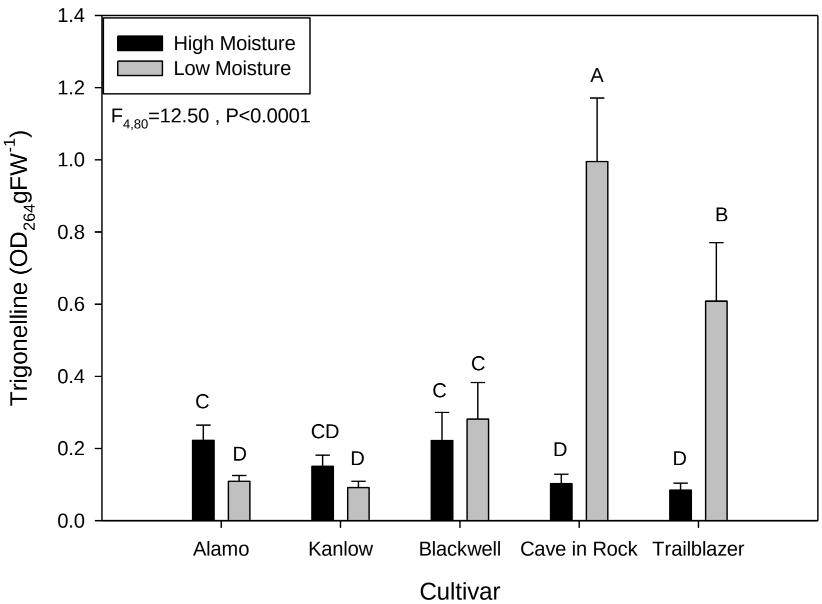


Figure 45. Greenhouse Experiment 2: Mean leaf trigonelline values in *P. virgatum* cultivars grown under high and low soil moisture levels. Mean values with the same letters are not significantly different at α = 0.05.

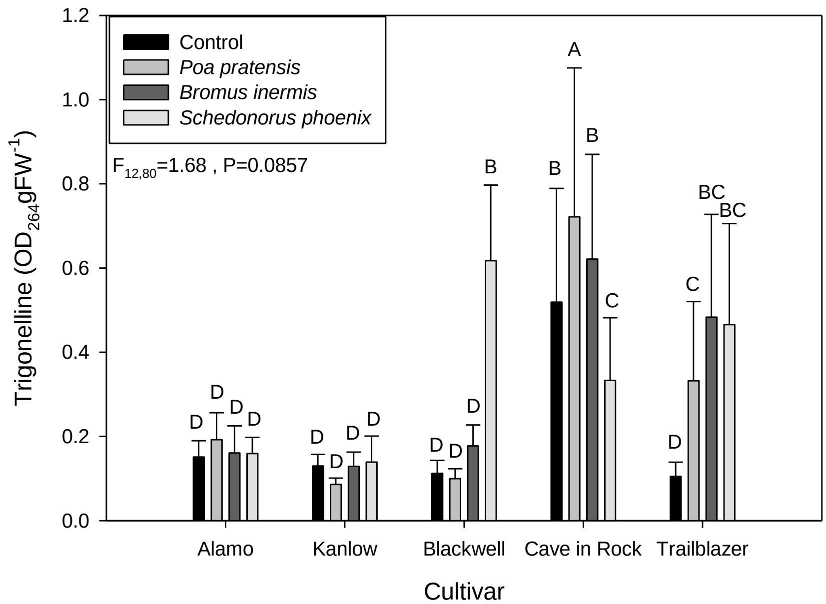


Figure 46. Mean leaf trigonelline values in response to *P. virgatum* cultivars when grown with an invasive species. Mean values with the same letters across the cultivars are not significantly different at $\alpha = 0.05$.

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APPENDICIES

Appendix 1. Preliminary Experiment

Appendix 1a. The number of seeds germinated for the *Panicum virgatum* cultivars over 49 days.

Cultivar	27-Aug	28-Aug	29-Aug	30-Aug	31-Aug	1-Sep	2-Sep	3-Sep	4-Sep	5-Sep	6-Sep	7-Sep	8-Sep	9-Sep	10-Sep	11-Sep	12-Sep	13-Sep	14-Sep	15-Sep	16-Sep	17-Sep	18-Sep	19-Sep	20-Sep
Alamo A	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	1	0	0	1	0	0	0	0
Alamo B	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
Alamo C	0	0	0	0	0	0	0	1	0	0	0	0	0	1	1	0	1	1	1	0	0	0	0	0	0
Blackwell A	0	0	1	10	6	2	2	1	1	1	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0
Blackwell B	0	0	0	6	9	3	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1
Blackwell C	0	0	0	1	3	5	4	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cave in Rock A	0	0	0	4	9	6	0	2	0	0	1	0	0	1	0	0	0	0	0	1	0	0	0	0	0
Cave in Rock B	0	0	1	10	5	3	4	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cave in Rock C	0	0	0	5	12	7	1	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanlow A	0	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanlow B	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Kanlow C	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nebraska 28 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nebraska 28 B	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nebraska 28 C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pathfinder A	0	0	1	7	11	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pathfinder B	0	0	0	4	8	0	1	1	1	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Pethfinder C	0	0	3	5	7	3	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
Shelter A	0	0	0	0	1	3	2	2	0	0	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0
Shelter B	0	0	0	0	0	2	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shelter C	0	0	0	0	2	2	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trailblazer A	0	0	0	0	0	0	0	2	0	0	3	0	0	1	0	0	0	0	0	1	0	0	0	0	0
Trailblazer B	0	0	1	0	0	1	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trailblazer C	0	0	0	0	1	3	1	0	0	0	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0

Cultivar	21-Sep	22-Sep	23-Sep	24-Sep	25-Sep	26-Sep	27-Sep	28-Sep	29-Sep	30-Sep	1-Oct	2-Oct	3-Oct	4-Oct	5-Oct	6-Oct	7-Oct	8-Oct	9-Oct	10-Oct	11-Oct	12-Oct	13-Oct	14-Oct
Alamo A	0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alamo B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Alamo C	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blackwell A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blackwell B	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Blackwell C	1	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cave in Rock A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cave in Rock B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cave in Rock C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanlow A	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanlow B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kanlow C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nebraska 28 A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nebraska 28 B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Nebraska 28 C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pathfinder A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pathfinder B	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pethfinder C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shelter A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
Shelter B	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Shelter C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trailblazer A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trailblazer B	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trailblazer C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 1b. The number of seeds germinated for the three invasive species over 30 days.

Germination	19-Jan	20-Jan	21-Jan	22-Jan	23-Jan	24-Jan	25-Jan	26-Jan	27-Jan	28-Jan	29-Jan	30-Jan	31-Jan	1-Feb	2-Feb	3-Feb	4-Feb	5-Feb	6-Feb	7-Feb	8-Feb	9-Feb	10-Feb	11-Feb	12-Feb	13-Feb	14-Feb	15-Feb	16-Feb	17-Feb
Kentucky Bluegrass A	0	0	0	0	0	0	2	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Kentucky Bluegrass B	0	0	0	0	0	0	0	2	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0
Kentucky Bluegrass C	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
Smooth Brome A	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smooth Brome B	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Smooth Brome C	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Tall Fescue A	0	0	0	12	10	7	2	0	1	0	1	3	5	3	0	0	0	0	2	1	0	0	0	0	1	1	0	0	0	0
Tall Fescue B	0	0	0	12	10	5	0	2	2	0	0	3	4	2	0	0	0	0	0	0	2	1	0	0	2	0	0	0	0	0
Tall Fescue C	0	0	3	19	9	6	1	1	0	0	0	2	0	0	0	0	0	1	1	1	1	0	0	0	0	0	0	0	0	0

Appendix 1c. The number of viable and unviable seed determined by a Tetrazloium test for the *Panicum virgatum* cultivars.

Viable Seed	27-Jan	28-Jan	29-Jan	30-Jan	31-Jan	1-Feb	2-Feb	3-Feb
Cave in Rock	57	58	66	73	69	76	67	72
Pathfinder	46	36	52	61	53	71	58	61
Shelter	61	52	54	59	67	64	62	68
Trailblazer	78	67	47	70	74	72	71	76
Nebraska 28	13	42	18	34	42	20	26	49
Alamo	18	38	29	33	38	41	33	53
Blackwell	62	61	67	61	62	75	66	73
Kanlow	24	40	21	37	53	43	39	57
Unviable Seed	**27-Jan**	**28-Jan**	**29-Jan**	**30-Jan**	**31-Jan**	**1-Feb**	**2-Feb**	**3-Feb**
Cave in Rock	23	22	14	7	11	4	13	8
Pathfinder	34	44	28	19	27	9	22	19
Shelter	19	28	26	21	13	16	18	12
Trailblazer	2	13	33	10	6	8	9	4
Nebraska 28	67	38	62	46	38	60	54	31
Alamo	62	42	51	47	42	39	47	27
Blackwell	18	19	13	19	18	5	34	7
Kanlow	56	40	59	31	27	37	41	23

Appendix 2. Greenhouse Experiment 1

Appendix 2a. *Panicum virgatum* height and number of leaves data over three collection dates. CV = Cultivar (A=‘Alamo’, K=‘Kanlow’, BW=‘Blackwell’, CR=‘Cave in Rock’, TB=‘Trailblazer’), MOIST = Moisture Level, BLK = Block, INV = Invasive Species (C=Control, KB=Kentucky Bluegrass, SB=Smooth Brome, TF=Tall Fescue), NO.SG = Number of Switchgrass, NO.INV = Number of Invasive Species, HT = Height (cm), NO.LVS = Number of Leaves, .= Missing Values.

POT ID	CV	MOIST.	BLK	INV	NO.SG	NO.INVS	PLANT	HT	NO. LVS	DAY
1	A	Low	1	C	0	.	.	.	.	1
2	A	Low	1	KB	2	5	1	22	3	1
2	A	Low	1	KB	2	5	2	17.3	3	1
3	A	Low	1	SB	0	0	.	.	.	1
4	A	Low	1	TF	4	3	1	18.5	2	1
4	A	Low	1	TF	4	3	2	14.2	3	1
4	A	Low	1	TF	4	3	3	20.5	2	1
4	A	Low	1	TF	4	3	4	17.8	2	1
5	K	Low	1	C	8	.	1	25.1	2	1
5	K	Low	1	C	8	.	2	21.3	2	1
5	K	Low	1	C	8	.	3	19.7	2	1
5	K	Low	1	C	8	.	4	23.4	3	1
5	K	Low	1	C	8	.	5	25.1	2	1
6	K	Low	1	KB	4	2	1	26	3	1
6	K	Low	1	KB	4	2	2	22.5	3	1
6	K	Low	1	KB	4	2	3	29.4	3	1
6	K	Low	1	KB	4	2	4	20.1	2	1
7	K	Low	1	SB	5	0	1	15.3	2	1
7	K	Low	1	SB	5	0	2	18.6	2	1
7	K	Low	1	SB	5	0	3	19.2	3	1
7	K	Low	1	SB	5	0	4	22.4	3	1
7	K	Low	1	SB	5	0	5	20.7	3	1
8	K	Low	1	TF	1	28	1	17.1	3	1
9	BW	Low	1	C	13	.	1	24.1	2	1
9	BW	Low	1	C	13	.	2	28	2	1
9	BW	Low	1	C	13	.	3	23.5	2	1
9	BW	Low	1	C	13	.	4	24.8	2	1
9	BW	Low	1	C	13	.	5	30.2	3	1
10	BW	Low	1	KB	8	9	1	26.5	2	1
10	BW	Low	1	KB	8	9	2	24.7	2	1
10	BW	Low	1	KB	8	9	3	28.3	2	1
10	BW	Low	1	KB	8	9	4	31	3	1
10	BW	Low	1	KB	8	9	5	30.4	3	1
11	BW	Low	1	SB	8	0	1	30.6	2	1
11	BW	Low	1	SB	8	0	2	26.4	2	1
11	BW	Low	1	SB	8	0	3	22.9	2	1
11	BW	Low	1	SB	8	0	4	27.5	2	1
11	BW	Low	1	SB	8	0	5	24.5	3	1
12	BW	Low	1	TF	10	4	1	23	2	1
12	BW	Low	1	TF	10	4	2	27.5	2	1
12	BW	Low	1	TF	10	4	3	33.1	3	1
12	BW	Low	1	TF	10	4	4	28.2	3	1
12	BW	Low	1	TF	10	4	5	25	3	1
13	CR	Low	1	C	52	.	1	24.5	2	1
13	CR	Low	1	C	52	.	2	30.5	2	1
13	CR	Low	1	C	52	.	3	40.1	3	1
13	CR	Low	1	C	52	.	4	28.3	3	1
13	CR	Low	1	C	52	.	5	30.5	4	1

14	CR	Low	1	KB	15	17	1	27.4	2	1
14	CR	Low	1	KB	15	17	2	26.1	2	1
14	CR	Low	1	KB	15	17	3	29.6	2	1
14	CR	Low	1	KB	15	17	4	30	2	1
14	CR	Low	1	KB	15	17	5	30.3	2	1
15	CR	Low	1	SB	12	2	1	29.3	2	1
15	CR	Low	1	SB	12	2	2	30.2	2	1
15	CR	Low	1	SB	12	2	3	31.5	2	1
15	CR	Low	1	SB	12	2	4	28	3	1
15	CR	Low	1	SB	12	2	5	26.5	3	1
16	CR	Low	1	TF	30	2	1	33.1	2	1
16	CR	Low	1	TF	30	2	2	26.5	3	1
16	CR	Low	1	TF	30	2	3	30.4	3	1
16	CR	Low	1	TF	30	2	4	28.2	3	1
16	CR	Low	1	TF	30	2	5	35	3	1
17	TB	Low	1	C	21	.	1	32.6	2	1
17	TB	Low	1	C	21	.	2	30.5	2	1
17	TB	Low	1	C	21	.	3	23.7	2	1
17	TB	Low	1	C	21	.	4	26.2	3	1
17	TB	Low	1	C	21	.	5	25	3	1
18	TB	Low	1	KB	15	0	1	30.5	2	1
18	TB	Low	1	KB	15	0	2	31.5	2	1
18	TB	Low	1	KB	15	0	3	32	2	1
18	TB	Low	1	KB	15	0	4	21.4	2	1
18	TB	Low	1	KB	15	0	5	29.9	3	1
19	TB	Low	1	SB	9	1	1	28	2	1
19	TB	Low	1	SB	9	1	2	24.5	3	1
19	TB	Low	1	SB	9	1	3	26	3	1
19	TB	Low	1	SB	9	1	4	27.2	3	1
19	TB	Low	1	SB	9	1	5	28.1	3	1
20	TB	Low	1	TF	14	3	1	20.7	3	1
20	TB	Low	1	TF	14	3	2	29.6	3	1
20	TB	Low	1	TF	14	3	3	33.4	3	1
20	TB	Low	1	TF	14	3	4	30.1	3	1
20	TB	Low	1	TF	14	3	5	27.1	3	1
21	MIX	Low	1	C	22	.	1	26.5	2	1
21	MIX	Low	1	C	22	.	2	40	2	1
21	MIX	Low	1	C	22	.	3	23.1	2	1
21	MIX	Low	1	C	22	.	4	40.5	2	1
21	MIX	Low	1	C	22	.	5	32.3	3	1
22	MIX	Low	1	KB	47	3	1	37.2	2	1
22	MIX	Low	1	KB	47	3	2	25.5	2	1
22	MIX	Low	1	KB	47	3	3	28.6	3	1
22	MIX	Low	1	KB	47	3	4	31.5	3	1
22	MIX	Low	1	KB	47	3	5	34	4	1
23	MIX	Low	1	SB	24	0	1	28.5	2	1
23	MIX	Low	1	SB	24	0	2	30.7	2	1
23	MIX	Low	1	SB	24	0	3	26.9	2	1
23	MIX	Low	1	SB	24	0	4	35.1	2	1
23	MIX	Low	1	SB	24	0	5	32.1	3	1
24	MIX	Low	1	TF	37	3	1	25.2	2	1
24	MIX	Low	1	TF	37	3	2	28.7	2	1
24	MIX	Low	1	TF	37	3	3	30.6	2	1
24	MIX	Low	1	TF	37	3	4	28.9	3	1
24	MIX	Low	1	TF	37	3	5	24.1	3	1

25	A	High	1	C	4	.	1	15	2	1
25	A	High	1	C	4	.	2	23.5	2	1
25	A	High	1	C	4	.	3	18.2	3	1
25	A	High	1	C	4	.	4	20.3	3	1
26	A	High	1	KB	10	0	1	24.7	3	1
26	A	High	1	KB	10	0	2	19.2	2	1
26	A	High	1	KB	10	0	3	25.1	3	1
26	A	High	1	KB	10	0	4	27.6	3	1
26	A	High	1	KB	10	0	5	22.7	3	1
27	A	High	1	SB	0	3	.	.	.	1
28	A	High	1	TF	2	10	1	14.5	3	1
28	A	High	1	TF	2	10	2	17.2	3	1
29	K	High	1	C	13	.	1	23.8	2	1
29	K	High	1	C	13	.	2	19.2	3	1
29	K	High	1	C	13	.	3	23.1	3	1
29	K	High	1	C	13	.	4	20.4	3	1
29	K	High	1	C	13	.	5	17.6	3	1
30	K	High	1	KB	9	7	1	21.3	2	1
30	K	High	1	KB	9	7	2	22.5	3	1
30	K	High	1	KB	9	7	3	23.7	3	1
30	K	High	1	KB	9	7	4	22.5	3	1
30	K	High	1	KB	9	7	5	24.7	4	1
31	K	High	1	SB	3	0	1	20.5	2	1
31	K	High	1	SB	3	0	2	17.3	2	1
31	K	High	1	SB	3	0	3	18.8	2	1
32	K	High	1	TF	8	5	1	19.2	3	1
32	K	High	1	TF	8	5	2	22.1	3	1
32	K	High	1	TF	8	5	3	19.8	3	1
32	K	High	1	TF	8	5	4	20.6	3	1
32	K	High	1	TF	8	5	5	24.1	3	1
33	BW	High	1	C	26	.	1	27.6	2	1
33	BW	High	1	C	26	.	2	20.9	2	1
33	BW	High	1	C	26	.	3	25	2	1
33	BW	High	1	C	26	.	4	27.8	2	1
33	BW	High	1	C	26	.	5	26.5	3	1
34	BW	High	1	KB	13	23	1	25.7	2	1
34	BW	High	1	KB	13	23	2	28.9	2	1
34	BW	High	1	KB	13	23	3	33.1	3	1
34	BW	High	1	KB	13	23	4	32.6	3	1
34	BW	High	1	KB	13	23	5	32.1	3	1
35	BW	High	1	SB	11	0	1	28.3	2	1
35	BW	High	1	SB	11	0	2	21.5	2	1
35	BW	High	1	SB	11	0	3	26.9	2	1
35	BW	High	1	SB	11	0	4	27.9	2	1
35	BW	High	1	SB	11	0	5	24.7	3	1
36	BW	High	1	TF	33	2	1	31.5	1	1
36	BW	High	1	TF	33	2	2	33.8	2	1
36	BW	High	1	TF	33	2	3	30.2	2	1
36	BW	High	1	TF	33	2	4	29.7	2	1
36	BW	High	1	TF	33	2	5	28.5	3	1
37	CR	High	1	C	22	.	1	29.1	2	1
37	CR	High	1	C	22	.	2	35.8	2	1
37	CR	High	1	C	22	.	3	41.6	3	1
37	CR	High	1	C	22	.	4	40.5	3	1
37	CR	High	1	C	22	.	5	37.3	3	1
38	CR	High	1	KB	18	4	1	37.8	2	1
38	CR	High	1	KB	18	4	2	30.2	3	1
38	CR	High	1	KB	18	4	3	37.5	3	1
38	CR	High	1	KB	18	4	4	33.8	3	1
38	CR	High	1	KB	18	4	5	34.6	3	1

39	CR	High	1	SB	43	0	1	31	2	1
39	CR	High	1	SB	43	0	2	30.5	2	1
39	CR	High	1	SB	43	0	3	29.7	2	1
39	CR	High	1	SB	43	0	4	32.3	2	1
39	CR	High	1	SB	43	0	5	30.8	3	1
40	CR	High	1	TF	28	1	1	32.1	2	1
40	CR	High	1	TF	28	1	2	29.9	2	1
40	CR	High	1	TF	28	1	3	34.7	3	1
40	CR	High	1	TF	28	1	4	38.5	3	1
40	CR	High	1	TF	28	1	5	42.1	3	1
41	TB	High	1	C	24	.	1	43.5	2	1
41	TB	High	1	C	24	.	2	39.8	2	1
41	TB	High	1	C	24	.	3	41.7	2	1
41	TB	High	1	C	24	.	4	40.5	2	1
41	TB	High	1	C	24	.	5	38.5	3	1
42	TB	High	1	KB	21	30	1	39.1	3	1
42	TB	High	1	KB	21	30	2	41.2	3	1
42	TB	High	1	KB	21	30	3	37.4	3	1
42	TB	High	1	KB	21	30	4	39.6	3	1
42	TB	High	1	KB	21	30	5	37.2	3	1
43	TB	High	1	SB	2	0	1	37.5	2	1
43	TB	High	1	SB	2	0	2	38.1	2	1
44	TB	High	1	TF	16	1	1	37.6	3	1
44	TB	High	1	TF	16	1	2	35.5	3	1
44	TB	High	1	TF	16	1	3	37.1	3	1
44	TB	High	1	TF	16	1	4	36.2	3	1
44	TB	High	1	TF	16	1	5	34.8	4	1
45	MIX	High	1	C	12	.	1	35.7	2	1
45	MIX	High	1	C	12	.	2	33.9	2	1
45	MIX	High	1	C	12	.	3	38.2	2	1
45	MIX	High	1	C	12	.	4	37.1	3	1
45	MIX	High	1	C	12	.	5	36	3	1
46	MIX	High	1	KB	13	15	1	32.5	2	1
46	MIX	High	1	KB	13	15	2	35.4	2	1
46	MIX	High	1	KB	13	15	3	31.3	2	1
46	MIX	High	1	KB	13	15	4	34.7	2	1
46	MIX	High	1	KB	13	15	5	33.5	3	1
47	MIX	High	1	SB	18	0	1	30.8	2	1
47	MIX	High	1	SB	18	0	2	31.3	3	1
47	MIX	High	1	SB	18	0	3	29.7	3	1
47	MIX	High	1	SB	18	0	4	30.5	3	1
47	MIX	High	1	SB	18	0	5	27.9	3	1
48	MIX	High	1	TF	7	4	1	29.7	2	1
48	MIX	High	1	TF	7	4	2	32.5	2	1
48	MIX	High	1	TF	7	4	3	30.6	2	1
48	MIX	High	1	TF	7	4	4	29.4	3	1
48	MIX	High	1	TF	7	4	5	31.1	3	1
49	A	Low	2	C	2	.	1	20.1	2	1
49	A	Low	2	C	2	.	2	19.7	2	1
50	A	Low	2	KB	3	5	1	24.6	2	1
50	A	Low	2	KB	3	5	2	25.1	3	1
50	A	Low	2	KB	3	5	3	26.7	3	1
51	A	Low	2	SB	4	0	1	23.5	3	1
51	A	Low	2	SB	4	0	2	29.4	3	1
51	A	Low	2	SB	4	0	3	22.1	3	1
51	A	Low	2	SB	4	0	4	17.2	3	1
52	A	Low	2	TF	3	1	1	15.3	2	1
52	A	Low	2	TF	3	1	2	18.6	3	1
52	A	Low	2	TF	3	1	3	22.4	3	1
53	K	Low	2	C	4	.	1	16.9	2	1
53	K	Low	2	C	4	.	2	21.3	2	1
53	K	Low	2	C	4	.	3	19.1	3	1
53	K	Low	2	C	4	.	4	21.5	3	1

54	K	Low	2	KB	1	7	1	15.3	3	1
55	K	Low	2	SB	2	0	1	16.8	3	1
55	K	Low	2	SB	2	0	2	17.4	3	1
56	K	Low	2	TF	5	9	1	20.5	2	1
56	K	Low	2	TF	5	9	2	21.8	2	1
56	K	Low	2	TF	5	9	3	18.6	2	1
56	K	Low	2	TF	5	9	4	15.9	3	1
56	K	Low	2	TF	5	9	5	23.1	3	1
57	BW	Low	2	C	12	.	1	24.7	2	1
57	BW	Low	2	C	12	.	2	21.5	3	1
57	BW	Low	2	C	12	.	3	20.3	3	1
57	BW	Low	2	C	12	.	4	20.7	3	1
57	BW	Low	2	C	12	.	5	19.4	4	1
58	BW	Low	2	KB	7	13	1	22.3	2	1
58	BW	Low	2	KB	7	13	2	17.8	2	1
58	BW	Low	2	KB	7	13	3	19.2	2	1
58	BW	Low	2	KB	7	13	4	20.5	3	1
58	BW	Low	2	KB	7	13	5	20.9	3	1
59	BW	Low	2	SB	0	2	.	.	.	1
60	BW	Low	2	TF	9	4	1	27.4	2	1
60	BW	Low	2	TF	9	4	2	23.1	2	1
60	BW	Low	2	TF	9	4	3	30.1	2	1
60	BW	Low	2	TF	9	4	4	30.7	3	1
60	BW	Low	2	TF	9	4	5	28.4	3	1
61	CR	Low	2	C	31	.	1	30	2	1
61	CR	Low	2	C	31	.	2	29.5	2	1
61	CR	Low	2	C	31	.	3	31.5	2	1
61	CR	Low	2	C	31	.	4	28.6	2	1
61	CR	Low	2	C	31	.	5	26.5	2	1
62	CR	Low	2	KB	24	17	1	33.4	2	1
62	CR	Low	2	KB	24	17	2	27.6	3	1
62	CR	Low	2	KB	24	17	3	30.4	3	1
62	CR	Low	2	KB	24	17	4	28.2	3	1
62	CR	Low	2	KB	24	17	5	34.7	3	1
63	CR	Low	2	SB	21	0	1	32.6	3	1
63	CR	Low	2	SB	21	0	2	31	3	1
63	CR	Low	2	SB	21	0	3	24.5	3	1
63	CR	Low	2	SB	21	0	4	26.2	3	1
63	CR	Low	2	SB	21	0	5	25.4	3	1
64	CR	Low	2	TF	26	6	1	30.5	2	1
64	CR	Low	2	TF	26	6	2	31	2	1
64	CR	Low	2	TF	26	6	3	32.8	2	1
64	CR	Low	2	TF	26	6	4	24.8	3	1
64	CR	Low	2	TF	26	6	5	33.7	3	1
65	TB	Low	2	C	17	.	1	30.5	2	1
65	TB	Low	2	C	17	.	2	22.6	2	1
65	TB	Low	2	C	17	.	3	26.1	3	1
65	TB	Low	2	C	17	.	4	26.6	3	1
65	TB	Low	2	C	17	.	5	30.5	3	1
66	TB	Low	2	KB	17	11	1	31.5	2	1
66	TB	Low	2	KB	17	11	2	32.9	2	1
66	TB	Low	2	KB	17	11	3	23.7	2	1
66	TB	Low	2	KB	17	11	4	25.9	2	1
66	TB	Low	2	KB	17	11	5	28.1	3	1
67	TB	Low	2	SB	12	0	1	25	2	1
67	TB	Low	2	SB	12	0	2	26.2	2	1
67	TB	Low	2	SB	12	0	3	24.8	2	1
67	TB	Low	2	SB	12	0	4	27.6	3	1
67	TB	Low	2	SB	12	0	5	23.7	3	1
68	TB	Low	2	TF	14	4	1	27.1	2	1
68	TB	Low	2	TF	14	4	2	30.3	3	1
68	TB	Low	2	TF	14	4	3	30.5	3	1
68	TB	Low	2	TF	14	4	4	28.9	3	1
68	TB	Low	2	TF	14	4	5	26.1	3	1

69	MIX	Low	2	C	25	.	1	38.5	3	1
69	MIX	Low	2	C	25	.	2	27.4	3	1
69	MIX	Low	2	C	25	.	3	37.8	3	1
69	MIX	Low	2	C	25	.	4	33.7	3	1
69	MIX	Low	2	C	25	.	5	34.9	3	1
70	MIX	Low	2	KB	19	21	1	28.3	2	1
70	MIX	Low	2	KB	19	21	2	29.1	2	1
70	MIX	Low	2	KB	19	21	3	30.5	2	1
70	MIX	Low	2	KB	19	21	4	27.4	2	1
70	MIX	Low	2	KB	19	21	5	25.3	3	1
71	MIX	Low	2	SB	16	0	1	28.3	2	1
71	MIX	Low	2	SB	16	0	2	24.1	2	1
71	MIX	Low	2	SB	16	0	3	25.8	2	1
71	MIX	Low	2	SB	16	0	4	26.6	3	1
71	MIX	Low	2	SB	16	0	5	23.9	3	1
72	MIX	Low	2	TF	27	4	1	28.5	2	1
72	MIX	Low	2	TF	27	4	2	26.9	2	1
72	MIX	Low	2	TF	27	4	3	31.3	2	1
72	MIX	Low	2	TF	27	4	4	30.4	3	1
72	MIX	Low	2	TF	27	4	5	28.1	3	1
73	A	High	2	C	3	.	1	18.3	2	1
73	A	High	2	C	3	.	2	16.5	3	1
73	A	High	2	C	3	.	3	19.3	3	1
74	A	High	2	KB	0	25	.	.	.	1
75	A	High	2	SB	2	0	1	23.1	3	1
75	A	High	2	SB	2	0	2	17.4	3	1
76	A	High	2	TF	5	1	1	19.5	2	1
76	A	High	2	TF	5	1	2	23.8	3	1
76	A	High	2	TF	5	1	3	27.2	3	1
76	A	High	2	TF	5	1	4	26.8	3	1
76	A	High	2	TF	5	1	5	23.7	3	1
77	A	High	2	C	7	.	1	20.6	2	1
77	A	High	2	C	7	.	2	22.2	2	1
77	A	High	2	C	7	.	3	23.1	3	1
77	A	High	2	C	7	.	4	23.7	3	1
77	A	High	2	C	7	.	5	24.6	3	1
78	K	High	2	KB	9	18	1	19.7	3	1
78	K	High	2	KB	9	18	2	22.4	3	1
78	K	High	2	KB	9	18	3	20.4	3	1
78	K	High	2	KB	9	18	4	18.3	3	1
78	K	High	2	KB	9	18	5	20.9	3	1
79	K	High	2	SB	5	0	1	22.7	2	1
79	K	High	2	SB	5	0	2	20.6	2	1
79	K	High	2	SB	5	0	3	19.5	2	1
79	K	High	2	SB	5	0	4	20.8	3	1
79	K	High	2	SB	5	0	5	22.3	3	1
80	K	High	2	TF	2	7	1	18.9	2	1
80	K	High	2	TF	2	7	2	20.3	2	1
81	BW	High	2	C	24	.	1	21.4	2	1
81	BW	High	2	C	24	.	2	25.2	3	1
81	BW	High	2	C	24	.	3	26.3	3	1
81	BW	High	2	C	24	.	4	23.8	3	1
81	BW	High	2	C	24	.	5	24.5	3	1

82	BW	High	2	KB	27	21	1	28.2	3	1
82	BW	High	2	KB	27	21	2	25.9	3	1
82	BW	High	2	KB	27	21	3	26.4	3	1
82	BW	High	2	KB	27	21	4	28.1	3	1
82	BW	High	2	KB	27	21	5	28.7	4	1
83	BW	High	2	SB	19	0	1	30.2	2	1
83	BW	High	2	SB	19	0	2	29.5	2	1
83	BW	High	2	SB	19	0	3	27.4	3	1
83	BW	High	2	SB	19	0	4	24.6	3	1
83	BW	High	2	SB	19	0	5	26.8	3	1
84	BW	High	2	TF	22	9	1	31.3	2	1
84	BW	High	2	TF	22	9	2	27.5	3	1
84	BW	High	2	TF	22	9	3	30	3	1
84	BW	High	2	TF	22	9	4	32.7	3	1
84	BW	High	2	TF	22	9	5	31.5	3	1
85	CR	High	2	C	14	.	1	30.4	2	1
85	CR	High	2	C	14	.	2	28.7	2	1
85	CR	High	2	C	14	.	3	30.1	2	1
85	CR	High	2	C	14	.	4	33.7	3	1
85	CR	High	2	C	14	.	5	32.8	3	1
86	CR	High	2	KB	10	26	1	35.2	2	1
86	CR	High	2	KB	10	26	2	31.7	2	1
86	CR	High	2	KB	10	26	3	34.6	2	1
86	CR	High	2	KB	10	26	4	31.4	2	1
86	CR	High	2	KB	10	26	5	33.5	3	1
87	CR	High	2	SB	8	0	1	31.4	2	1
87	CR	High	2	SB	8	0	2	29.8	3	1
87	CR	High	2	SB	8	0	3	30.6	3	1
87	CR	High	2	SB	8	0	4	34.1	3	1
87	CR	High	2	SB	8	0	5	31.8	3	1
88	CR	High	2	TF	25	11	1	32.6	2	1
88	CR	High	2	TF	25	11	2	37.5	2	1
88	CR	High	2	TF	25	11	3	36.9	3	1
88	CR	High	2	TF	25	11	4	35.3	3	1
88	CR	High	2	TF	25	11	5	38.2	3	1
89	TB	High	2	C	23	.	1	37.6	2	1
89	TB	High	2	C	23	.	2	35.5	2	1
89	TB	High	2	C	23	.	3	38.7	3	1
89	TB	High	2	C	23	.	4	35.1	3	1
89	TB	High	2	C	23	.	5	37.2	3	1
90	TB	High	2	KB	27	13	1	38.1	2	1
90	TB	High	2	KB	27	13	2	34.5	2	1
90	TB	High	2	KB	27	13	3	35.1	2	1
90	TB	High	2	KB	27	13	4	36.9	3	1
90	TB	High	2	KB	27	13	5	31.8	3	1
91	TB	High	2	SB	24	0	1	29.7	2	1
91	TB	High	2	SB	24	0	2	33.2	2	1
91	TB	High	2	SB	24	0	3	34.7	2	1
91	TB	High	2	SB	24	0	4	36.4	3	1
91	TB	High	2	SB	24	0	5	33.8	3	1
92	TB	High	2	TF	31	3	1	37.3	2	1
92	TB	High	2	TF	31	3	2	38.1	2	1
92	TB	High	2	TF	31	3	3	35.4	2	1
92	TB	High	2	TF	31	3	4	33.9	2	1
92	TB	High	2	TF	31	3	5	35.9	3	1

93	MIX	High	2	C	32	.	1	33.5	2	1
93	MIX	High	2	C	32	.	2	37.8	3	1
93	MIX	High	2	C	32	.	3	38.4	3	1
93	MIX	High	2	C	32	.	4	36.5	3	1
93	MIX	High	2	C	32	.	5	33.2	3	1
94	MIX	High	2	KB	29	20	1	33.7	2	1
94	MIX	High	2	KB	29	20	2	34.3	2	1
94	MIX	High	2	KB	29	20	3	31.8	3	1
94	MIX	High	2	KB	29	20	4	36.4	3	1
94	MIX	High	2	KB	29	20	5	32.5	3	1
95	MIX	High	2	SB	34	0	1	33.6	2	1
95	MIX	High	2	SB	34	0	2	31.5	2	1
95	MIX	High	2	SB	34	0	3	29.8	2	1
95	MIX	High	2	SB	34	0	4	30.1	2	1
95	MIX	High	2	SB	34	0	5	31.7	3	1
96	MIX	High	2	TF	31	8	1	32.1	2	1
96	MIX	High	2	TF	31	8	2	30.5	2	1
96	MIX	High	2	TF	31	8	3	33.6	2	1
96	MIX	High	2	TF	31	8	4	38.2	3	1
96	MIX	High	2	TF	31	8	5	35.9	3	1
97	A	Low	3	C	0	.	.	.	.	1
98	A	Low	3	KB	0	0	.	.	.	1
99	A	Low	3	SB	0	0	.	.	.	1
100	A	Low	3	TF	1	2	1	14.3	3	1
101	K	Low	3	C	3	.	1	15.7	2	1
101	K	Low	3	C	3	.	2	17.2	2	1
101	K	Low	3	C	3	.	3	19.1	2	1
102	K	Low	3	KB	1	4	1	15.2	3	1
103	K	Low	3	SB	1	0	1	13.9	3	1
104	K	Low	3	TF	4	1	1	18.5	2	1
104	K	Low	3	TF	4	1	2	19	2	1
104	K	Low	3	TF	4	1	3	17.6	2	1
104	K	Low	3	TF	4	1	4	17.4	2	1
105	BW	Low	3	C	7	.	1	32	2	1
105	BW	Low	3	C	7	.	2	26.5	2	1
105	BW	Low	3	C	7	.	3	24.8	3	1
105	BW	Low	3	C	7	.	4	30.5	3	1
105	BW	Low	3	C	7	.	5	27.1	3	1
106	BW	Low	3	KB	9	7	1	21.9	2	1
106	BW	Low	3	KB	9	7	2	28.1	3	1
106	BW	Low	3	KB	9	7	3	24.5	3	1
106	BW	Low	3	KB	9	7	4	26.4	3	1
106	BW	Low	3	KB	9	7	5	27.2	3	1
107	BW	Low	3	SB	4	1	1	25	2	1
107	BW	Low	3	SB	4	1	2	27.5	3	1
107	BW	Low	3	SB	4	1	3	29.1	3	1
107	BW	Low	3	SB	4	1	4	28.6	3	1
108	BW	Low	3	TF	5	3	1	30.1	2	1
108	BW	Low	3	TF	5	3	2	28.1	2	1
108	BW	Low	3	TF	5	3	3	30.3	2	1
108	BW	Low	3	TF	5	3	4	27.4	3	1
108	BW	Low	3	TF	5	3	5	28.2	3	1
109	CR	Low	3	C	8	.	1	27.5	2	1
109	CR	Low	3	C	8	.	2	30	2	1
109	CR	Low	3	C	8	.	3	30.3	2	1
109	CR	Low	3	C	8	.	4	27.8	3	1
109	CR	Low	3	C	8	.	5	31.2	3	1
110	CR	Low	3	KB	6	13	1	31.5	2	1
110	CR	Low	3	KB	6	13	2	27.9	2	1
110	CR	Low	3	KB	6	13	3	27.3	2	1
110	CR	Low	3	KB	6	13	4	31.8	2	1
110	CR	Low	3	KB	6	13	5	27.4	3	1
111	CR	Low	3	SB	11	0	1	29.8	2	1
111	CR	Low	3	SB	11	0	2	26.8	2	1
111	CR	Low	3	SB	11	0	3	30.4	3	1
111	CR	Low	3	SB	11	0	4	32.6	3	1
111	CR	Low	3	SB	11	0	5	30.5	3	1
112	CR	Low	3	TF	2	17	1	25.7	2	1
112	CR	Low	3	TF	2	17	2	24.9	2	1

113	TB	Low	3	C	10	.	1	25.1	2	1
113	TB	Low	3	C	10	.	2	32.9	2	1
113	TB	Low	3	C	10	.	3	30.1	3	1
113	TB	Low	3	C	10	.	4	33.7	3	1
113	TB	Low	3	C	10	.	5	25.8	3	1
114	TB	Low	3	KB	7	5	1	29.9	2	1
114	TB	Low	3	KB	7	5	2	26	2	1
114	TB	Low	3	KB	7	5	3	25.5	2	1
114	TB	Low	3	KB	7	5	4	26.2	3	1
114	TB	Low	3	KB	7	5	5	28.3	3	1
115	TB	Low	3	SB	7	0	1	25.4	2	1
115	TB	Low	3	SB	7	0	2	22.3	3	1
115	TB	Low	3	SB	7	0	3	27.3	3	1
115	TB	Low	3	SB	7	0	4	23.7	3	1
115	TB	Low	3	SB	7	0	5	29.8	4	1
116	TB	Low	3	TF	5	9	1	30.2	2	1
116	TB	Low	3	TF	5	9	2	27.8	2	1
116	TB	Low	3	TF	5	9	3	32.5	2	1
116	TB	Low	3	TF	5	9	4	27.6	2	1
116	TB	Low	3	TF	5	9	5	28.5	3	1
117	MIX	Low	3	C	14	.	1	30.4	2	1
117	MIX	Low	3	C	14	.	2	31.5	2	1
117	MIX	Low	3	C	14	.	3	28.6	3	1
117	MIX	Low	3	C	14	.	4	29.5	3	1
117	MIX	Low	3	C	14	.	5	25.8	3	1
118	MIX	Low	3	KB	9	0	1	27.3	2	1
118	MIX	Low	3	KB	9	0	2	28.1	2	1
118	MIX	Low	3	KB	9	0	3	25.3	3	1
118	MIX	Low	3	KB	9	0	4	27.1	3	1
118	MIX	Low	3	KB	9	0	5	23.5	3	1
119	MIX	Low	3	SB	5	0	1	26.2	2	1
119	MIX	Low	3	SB	5	0	2	28.3	3	1
119	MIX	Low	3	SB	5	0	3	27.5	3	1
119	MIX	Low	3	SB	5	0	4	30	3	1
119	MIX	Low	3	SB	5	0	5	26.1	3	1
120	MIX	Low	3	TF	7	10	1	29.1	2	1
120	MIX	Low	3	TF	7	10	2	31	2	1
120	MIX	Low	3	TF	7	10	3	29.2	2	1
120	MIX	Low	3	TF	7	10	4	28.5	3	1
120	MIX	Low	3	TF	7	10	5	30.4	3	1
121	A	High	3	C	3	.	1	16.7	2	1
121	A	High	3	C	3	.	2	17.2	2	1
121	A	High	3	C	3	.	3	19.1	3	1
122	A	High	3	KB	1	3	1	15.9	2	1
123	A	High	3	SB	4	0	1	20.2	2	1
123	A	High	3	SB	4	0	2	15.8	2	1
123	A	High	3	SB	4	0	3	18.4	2	1
123	A	High	3	SB	4	0	4	19.2	2	1
124	A	High	3	TF	2	3	1	22.4	2	1
124	A	High	3	TF	2	3	2	27.9	3	1
125	K	High	3	C	2	.	1	22.1	3	1
125	K	High	3	C	2	.	2	23.4	3	1
126	K	High	3	KB	5	5	1	21.5	2	1
126	K	High	3	KB	5	5	2	24.3	2	1
126	K	High	3	KB	5	5	3	23.9	3	1
126	K	High	3	KB	5	5	4	22.7	3	1
126	K	High	3	KB	5	5	5	20.3	3	1
127	K	High	3	SB	0	0	.	.	.	1
128	K	High	3	TF	7	11	1	21.2	2	1
128	K	High	3	TF	7	11	2	18.6	3	1
128	K	High	3	TF	7	11	3	20.5	3	1
128	K	High	3	TF	7	11	4	21.7	3	1
128	K	High	3	TF	7	11	5	19.8	3	1
129	BW	High	3	C	9	.	1	17.3	2	1
129	BW	High	3	C	9	.	2	21.6	2	1
129	BW	High	3	C	9	.	3	20.2	3	1
129	BW	High	3	C	9	.	4	20.7	3	1
129	BW	High	3	C	9	.	5	19.4	3	1
130	BW	High	3	KB	3	17	1	23.5	2	1
130	BW	High	3	KB	3	17	2	22.8	2	1
130	BW	High	3	KB	3	17	3	20.1	2	1

131	BW	High	3	SB	12	0	1	34.1	2	1
131	BW	High	3	SB	12	0	2	31.5	2	1
131	BW	High	3	SB	12	0	3	27.9	2	1
131	BW	High	3	SB	12	0	4	32.3	2	1
131	BW	High	3	SB	12	0	5	29.8	3	1
132	BW	High	3	TF	9	6	1	33.5	2	1
132	BW	High	3	TF	9	6	2	29	2	1
132	BW	High	3	TF	9	6	3	30.8	3	1
132	BW	High	3	TF	9	6	4	29.7	3	1
132	BW	High	3	TF	9	6	5	32.4	3	1
133	CR	High	3	C	21	.	1	35.7	2	1
133	CR	High	3	C	21	.	2	33.9	2	1
133	CR	High	3	C	21	.	3	38.2	2	1
133	CR	High	3	C	21	.	4	33.5	3	1
133	CR	High	3	C	21	.	5	32.6	3	1
134	CR	High	3	KB	16	11	1	31.3	2	1
134	CR	High	3	KB	16	11	2	31.8	2	1
134	CR	High	3	KB	16	11	3	30.2	2	1
134	CR	High	3	KB	16	11	4	29.6	2	1
134	CR	High	3	KB	16	11	5	30.3	3	1
135	CR	High	3	SB	8	0	1	31.8	2	1
135	CR	High	3	SB	8	0	2	29.4	2	1
135	CR	High	3	SB	8	0	3	29.5	2	1
135	CR	High	3	SB	8	0	4	30.8	3	1
135	CR	High	3	SB	8	0	5	32.5	3	1
136	CR	High	3	TF	19	8	1	38.1	2	1
136	CR	High	3	TF	19	8	2	37	2	1
136	CR	High	3	TF	19	8	3	40.4	2	1
136	CR	High	3	TF	19	8	4	39.5	3	1
136	CR	High	3	TF	19	8	5	39.1	3	1
137	TB	High	3	C	17	.	1	36.2	2	1
137	TB	High	3	C	17	.	2	33.6	2	1
137	TB	High	3	C	17	.	3	37.2	2	1
137	TB	High	3	C	17	.	4	35.3	2	1
137	TB	High	3	C	17	.	5	34.7	2	1
138	TB	High	3	KB	22	23	1	33.8	2	1
138	TB	High	3	KB	22	23	2	32.9	2	1
138	TB	High	3	KB	22	23	3	36.2	3	1
138	TB	High	3	KB	22	23	4	34.5	3	1
138	TB	High	3	KB	22	23	5	32.7	3	1
139	TB	High	3	SB	12	0	1	31.8	2	1
139	TB	High	3	SB	12	0	2	35.2	2	1
139	TB	High	3	SB	12	0	3	34.6	3	1
139	TB	High	3	SB	12	0	4	33.9	3	1
139	TB	High	3	SB	12	0	5	34.4	3	1
140	TB	High	3	TF	27	10	1	40.2	2	1
140	TB	High	3	TF	27	10	2	38.5	3	1
140	TB	High	3	TF	27	10	3	37.4	3	1
140	TB	High	3	TF	27	10	4	40.8	3	1
140	TB	High	3	TF	27	10	5	37.8	3	1
141	MIX	High	3	C	31	.	1	33.9	2	1
141	MIX	High	3	C	31	.	2	35.2	2	1
141	MIX	High	3	C	31	.	3	36.1	3	1
141	MIX	High	3	C	31	.	4	35.9	3	1
141	MIX	High	3	C	31	.	5	37.6	3	1
142	MIX	High	3	KB	25	2	1	34.5	2	1
142	MIX	High	3	KB	25	2	2	37.2	2	1
142	MIX	High	3	KB	25	2	3	33	2	1
142	MIX	High	3	KB	25	2	4	38.5	3	1
142	MIX	High	3	KB	25	2	5	34.9	3	1

143	MIX	High	3	SB	21	0	1	35.2	2	1
143	MIX	High	3	SB	21	0	2	30.7	2	1
143	MIX	High	3	SB	21	0	3	31.2	2	1
143	MIX	High	3	SB	21	0	4	34.9	3	1
143	MIX	High	3	SB	21	0	5	36.1	3	1
144	MIX	High	3	TF	27	5	1	35.4	2	1
144	MIX	High	3	TF	27	5	2	38.5	2	1
144	MIX	High	3	TF	27	5	3	33.9	3	1
144	MIX	High	3	TF	27	5	4	37.9	3	1
144	MIX	High	3	TF	27	5	5	40.2	3	1
1	A	Low	1	C	0	.	.	.	.	2
2	A	Low	1	KB	2	5	1	24.5	3	2
2	A	Low	1	KB	2	5	2	18.2	3	2
3	A	Low	1	SB	0	0	.	.	.	2
4	A	Low	1	TF	4	5	1	17.3	2	2
4	A	Low	1	TF	4	5	2	14.6	2	2
4	A	Low	1	TF	4	5	3	20.1	2	2
5	K	Low	1	C	8	.	1	23.2	2	2
5	K	Low	1	C	8	.	2	24.6	2	2
5	K	Low	1	C	8	.	3	15.2	2	2
5	K	Low	1	C	8	.	4	19.5	2	2
5	K	Low	1	C	8	.	5	23.8	3	2
6	K	Low	1	KB	4	3	1	24.7	3	2
6	K	Low	1	KB	4	3	2	20.3	2	2
6	K	Low	1	KB	4	3	3	26.9	2	2
6	K	Low	1	KB	4	3	4	18.4	3	2
7	K	Low	1	SB	5	1	1	17.2	2	2
7	K	Low	1	SB	5	1	2	15.8	2	2
7	K	Low	1	SB	5	1	3	20.1	2	2
8	K	Low	1	TF	.	33	.	.	.	2
9	BW	Low	1	C	13	.	1	23	2	2
9	BW	Low	1	C	13	.	2	22.5	2	2
9	BW	Low	1	C	13	.	3	27.1	2	2
9	BW	Low	1	C	13	.	4	26.2	3	2
9	BW	Low	1	C	13	.	5	28.3	3	2
10	BW	Low	1	KB	6	9	1	25.3	2	2
10	BW	Low	1	KB	6	9	2	21.9	2	2
10	BW	Low	1	KB	6	9	3	28.4	2	2
10	BW	Low	1	KB	6	9	4	32.3	3	2
10	BW	Low	1	KB	6	9	5	28.6	3	2
11	BW	Low	1	SB	8	0	1	31.2	2	2
11	BW	Low	1	SB	8	0	2	24.2	2	2
11	BW	Low	1	SB	8	0	3	20.5	2	2
11	BW	Low	1	SB	8	0	4	23.9	3	2
11	BW	Low	1	SB	8	0	5	27.7	3	2
12	BW	Low	1	TF	7	7	1	22.8	2	2
12	BW	Low	1	TF	7	7	2	26.1	2	2
12	BW	Low	1	TF	7	7	3	29.6	3	2
12	BW	Low	1	TF	7	7	4	27	3	2
12	BW	Low	1	TF	7	7	5	25.5	3	2
13	CR	Low	1	C	52	.	1	22.6	3	2
13	CR	Low	1	C	52	.	2	28.4	2	2
13	CR	Low	1	C	52	.	3	31.1	3	2
13	CR	Low	1	C	52	.	4	24.9	3	2
13	CR	Low	1	C	52	.	5	28.1	3	2

14	CR	Low	1	KB	15	17	1	23.9	2	2
14	CR	Low	1	KB	15	17	2	24.7	2	2
14	CR	Low	1	KB	15	17	3	29.6	2	2
14	CR	Low	1	KB	15	17	4	28.4	2	2
14	CR	Low	1	KB	15	17	5	30.3	2	2
15	CR	Low	1	SB	12	2	1	29.3	2	2
15	CR	Low	1	SB	12	2	2	31.2	2	2
15	CR	Low	1	SB	12	2	3	27.6	2	2
15	CR	Low	1	SB	12	2	4	27.3	3	2
15	CR	Low	1	SB	12	2	5	26.5	2	2
16	CR	Low	1	TF	30	2	1	29.3	3	2
16	CR	Low	1	TF	30	2	2	28.4	2	2
16	CR	Low	1	TF	30	2	3	27.1	2	2
16	CR	Low	1	TF	30	2	4	28.2	3	2
16	CR	Low	1	TF	30	2	5	33.6	3	2
17	TB	Low	1	C	21	.	1	29.1	2	2
17	TB	Low	1	C	21	.	2	26.4	2	2
17	TB	Low	1	C	21	.	3	28.5	2	2
17	TB	Low	1	C	21	.	4	30	3	2
17	TB	Low	1	C	21	.	5	29.5	3	2
18	TB	Low	1	KB	13	0	1	26.9	2	2
18	TB	Low	1	KB	13	0	2	28.7	2	2
18	TB	Low	1	KB	13	0	3	29.5	3	2
18	TB	Low	1	KB	13	0	4	23	2	2
18	TB	Low	1	KB	13	0	5	27.5	2	2
19	TB	Low	1	SB	9	0	1	29.4	4	2
19	TB	Low	1	SB	9	0	2	23.7	2	2
19	TB	Low	1	SB	9	0	3	28.1	3	2
19	TB	Low	1	SB	9	0	4	30.2	2	2
19	TB	Low	1	SB	9	0	5	29.3	3	2
20	TB	Low	1	TF	10	5	1	17.4	3	2
20	TB	Low	1	TF	10	5	2	26.3	3	2
20	TB	Low	1	TF	10	5	3	28.8	3	2
20	TB	Low	1	TF	10	5	4	33.1	3	2
20	TB	Low	1	TF	10	5	5	27	3	2
21	MIX	Low	1	C	22	.	1	27.3	2	2
21	MIX	Low	1	C	22	.	2	29.7	2	2
21	MIX	Low	1	C	22	.	3	31.8	2	2
21	MIX	Low	1	C	22	.	4	33.4	2	2
21	MIX	Low	1	C	22	.	5	35.1	3	2
22	MIX	Low	1	KB	47	3	1	37.2	2	2
22	MIX	Low	1	KB	47	3	2	25.5	2	2
22	MIX	Low	1	KB	47	3	3	28.6	3	2
22	MIX	Low	1	KB	47	3	4	31.5	3	2
22	MIX	Low	1	KB	47	3	5	34	4	2
23	MIX	Low	1	SB	24	0	1	28.5	2	2
23	MIX	Low	1	SB	24	0	2	30.7	2	2
23	MIX	Low	1	SB	24	0	3	26.9	2	2
23	MIX	Low	1	SB	24	0	4	35.1	2	2
23	MIX	Low	1	SB	24	0	5	32.1	2	2

24	MIX	Low	1	TF	33	6	1	27.4	2	2
24	MIX	Low	1	TF	33	6	2	23.4	3	2
24	MIX	Low	1	TF	33	6	3	28.4	2	2
24	MIX	Low	1	TF	33	6	4	26	2	2
24	MIX	Low	1	TF	33	6	5	23.1	3	2
25	A	High	1	C	4	.	1	18.2	2	2
25	A	High	1	C	4	.	2	25.7	2	2
25	A	High	1	C	4	.	3	23.3	3	2
25	A	High	1	C	4	.	4	26.2	3	2
26	A	High	1	KB	10	0	1	24.7	3	2
26	A	High	1	KB	10	0	2	19.2	2	2
26	A	High	1	KB	10	0	3	25.1	3	2
26	A	High	1	KB	10	0	4	27.6	3	2
26	A	High	1	KB	10	0	5	22.7	3	2
27	A	High	1	SB	0	3	.	.	.	2
28	A	High	1	TF	1	10	1	14.2	2	2
28	A	High	1	TF	1	10	2	16.3	2	2
29	K	High	1	C	14	.	1	25.8	2	2
29	K	High	1	C	14	.	2	22.4	3	2
29	K	High	1	C	14	.	3	26.7	3	2
29	K	High	1	C	14	.	4	29.4	3	2
29	K	High	1	C	14	.	5	23.5	3	2
30	K	High	1	KB	9	7	1	23.5	2	2
30	K	High	1	KB	9	7	2	23.6	3	2
30	K	High	1	KB	9	7	3	25.7	2	2
30	K	High	1	KB	9	7	4	27.2	2	2
30	K	High	1	KB	9	7	5	26.4	3	2
31	K	High	1	SB	3	0	1	20.5	2	2
31	K	High	1	SB	3	0	2	17.3	2	2
31	K	High	1	SB	3	0	3	18.8	2	2
32	K	High	1	TF	8	4	1	27.3	3	2
32	K	High	1	TF	8	4	2	24.1	3	2
32	K	High	1	TF	8	4	3	20	3	2
32	K	High	1	TF	8	4	4	22.5	3	2
32	K	High	1	TF	8	4	5	26.6	3	2
33	BW	High	1	C	22	.	1	25.9	2	2
33	BW	High	1	C	22	.	2	30	2	2
33	BW	High	1	C	22	.	3	28.1	2	2
33	BW	High	1	C	22	.	4	25.7	2	2
33	BW	High	1	C	22	.	5	29.5	2	2
34	BW	High	1	KB	12	23	1	24.9	2	2
34	BW	High	1	KB	12	23	2	27.6	2	2
34	BW	High	1	KB	12	23	3	29.8	3	2
34	BW	High	1	KB	12	23	4	30.2	2	2
34	BW	High	1	KB	12	23	5	32.1	2	2
35	BW	High	1	SB	11	0	1	28.3	2	2
35	BW	High	1	SB	11	0	2	21.5	2	2
35	BW	High	1	SB	11	0	3	26.9	2	2
35	BW	High	1	SB	11	0	4	27.9	2	2
35	BW	High	1	SB	11	0	5	24.7	3	2
36	BW	High	1	TF	33	1	1	29.5	1	2
36	BW	High	1	TF	33	1	2	34.1	2	2
36	BW	High	1	TF	33	1	3	30	2	2
36	BW	High	1	TF	33	1	4	28.7	2	2
36	BW	High	1	TF	33	1	5	30.1	3	2
37	CR	High	1	C	24	.	1	24.1	2	2
37	CR	High	1	C	24	.	2	33	2	2
37	CR	High	1	C	24	.	3	32.6	4	2
37	CR	High	1	C	24	.	4	35.5	3	2
37	CR	High	1	C	24	.	5	33.1	3	2

38	CR	High	1	KB	18	4	1	22.7	2	2
38	CR	High	1	KB	18	4	2	30.2	3	2
38	CR	High	1	KB	18	4	3	31.8	3	2
38	CR	High	1	KB	18	4	4	27.2	3	2
38	CR	High	1	KB	18	4	5	29.3	3	2
39	CR	High	1	SB	43	0	1	31	2	2
39	CR	High	1	SB	43	0	2	30.5	3	2
39	CR	High	1	SB	43	0	3	29.7	3	2
39	CR	High	1	SB	43	0	4	32.3	2	2
39	CR	High	1	SB	43	0	5	30.8	3	2
40	CR	High	1	TF	28	0	1	30.5	2	2
40	CR	High	1	TF	25	0	2	29.3	2	2
40	CR	High	1	TF	25	0	3	32.1	3	2
40	CR	High	1	TF	25	0	4	30.8	2	2
40	CR	High	1	TF	25	0	5	32.6	2	2
41	TB	High	1	C	27	.	1	38.2	2	2
41	TB	High	1	C	27	.	2	35.6	2	2
41	TB	High	1	C	27	.	3	37.1	2	2
41	TB	High	1	C	27	.	4	34.3	2	2
41	TB	High	1	C	27	.	5	36.2	3	2
42	TB	High	1	KB	21	30	1	39.1	3	2
42	TB	High	1	KB	21	30	2	41.2	3	2
42	TB	High	1	KB	21	30	3	37.4	3	2
42	TB	High	1	KB	21	30	4	39.6	3	2
42	TB	High	1	KB	21	30	5	37.2	3	2
43	TB	High	1	SB	2	0	1	37.6	2	2
43	TB	High	1	SB	2	0	2	36.4	2	2
44	TB	High	1	TF	15	1	1	34.8	3	2
44	TB	High	1	TF	15	1	2	33	3	2
44	TB	High	1	TF	15	1	3	33.1	3	2
44	TB	High	1	TF	15	1	4	24.7	3	2
44	TB	High	1	TF	15	1	5	33.2	4	2
45	MIX	High	1	C	12	.	1	33.8	2	2
45	MIX	High	1	C	12	.	2	31.7	2	2
45	MIX	High	1	C	12	.	3	36.8	2	2
45	MIX	High	1	C	12	.	4	39.4	3	2
45	MIX	High	1	C	12	.	5	33.2	3	2
46	MIX	High	1	KB	13	15	1	31.6	3	2
46	MIX	High	1	KB	13	15	2	30.8	3	2
46	MIX	High	1	KB	13	15	3	27.5	3	2
46	MIX	High	1	KB	13	15	4	29.1	3	2
46	MIX	High	1	KB	13	15	5	28.9	2	2
47	MIX	High	1	SB	18	0	1	30.8	2	2
47	MIX	High	1	SB	18	0	2	31.3	3	2
47	MIX	High	1	SB	18	0	3	29.7	3	2
47	MIX	High	1	SB	18	0	4	30.5	2	2
47	MIX	High	1	SB	18	0	5	27.9	2	2
48	MIX	High	1	TF	6	4	1	29	2	2
48	MIX	High	1	TF	6	4	2	28.1	2	2
48	MIX	High	1	TF	6	4	3	26.7	3	2
48	MIX	High	1	TF	6	4	4	29.4	2	2
48	MIX	High	1	TF	6	4	5	27.3	3	2
49	A	Low	2	C	2	.	1	23.6	2	2
49	A	Low	2	C	2	.	2	20.5	2	2
50	A	Low	2	KB	2	5	1	23.5	2	2
50	A	Low	2	KB	2	5	2	24.3	3	2
51	A	Low	2	SB	2	0	1	24.4	2	2
51	A	Low	2	SB	2	0	2	26.9	3	2
52	A	Low	2	TF	3	1	1	20.2	2	2
52	A	Low	2	TF	3	1	2	17.4	2	2
52	A	Low	2	TF	3	1	3	19.6	3	2
53	K	Low	2	C	5	.	1	21.8	2	2
53	K	Low	2	C	5	.	2	25.7	2	2
53	K	Low	2	C	5	.	3	23.6	3	2
53	K	LOW	2	C	5		4	24.1	2	2
53	K	Low	2	C	5	.	5	25.3	3	2
54	K	Low	2	KB	.	5	.	.	.	2
55	K	Low	2	SB	1	0	1	16.8	3	2

56	K	Low	2	TF	3	9	1	17.8	2	2
56	K	Low	2	TF	3	9	2	19.4	2	2
56	K	Low	2	TF	3	9	3	20.6	2	2
57	BW	Low	2	C	13	.	1	26.2	2	2
57	BW	Low	2	C	13	.	2	24.9	3	2
57	BW	Low	2	C	13	.	3	24.1	2	2
57	BW	Low	2	C	13	.	4	27.1	2	2
57	BW	Low	2	C	13	.	5	25.4	3	2
58	BW	Low	2	KB	7	13	1	22.3	2	2
58	BW	Low	2	KB	7	13	2	17.8	2	2
58	BW	Low	2	KB	7	13	3	19.2	2	2
58	BW	Low	2	KB	7	13	4	20.5	3	2
58	BW	Low	2	KB	7	13	5	20.9	3	2
59	BW	Low	2	SB	0	2	.	.	.	2
60	BW	Low	2	TF	5	4	1	23.6	2	2
60	BW	Low	2	TF	5	4	2	22.1	2	2
60	BW	Low	2	TF	5	4	3	27.1	2	2
60	BW	Low	2	TF	5	4	4	25.3	1	2
60	BW	Low	2	TF	5	4	5	26.9	2	2
61	CR	Low	2	C	27	.	1	29.3	2	2
61	CR	Low	2	C	27	.	2	24.8	2	2
61	CR	Low	2	C	27	.	3	27	2	2
61	CR	Low	2	C	27	.	4	26.4	2	2
61	CR	Low	2	C	27	.	5	27.5	2	2
62	CR	Low	2	KB	22	17	1	33.4	2	2
62	CR	Low	2	KB	22	17	2	27.6	3	2
62	CR	Low	2	KB	22	17	3	30.4	2	2
62	CR	Low	2	KB	22	17	4	28.2	2	2
62	CR	Low	2	KB	22	17	5	34.7	2	2
63	CR	Low	2	SB	21	0	1	27.4	3	2
63	CR	Low	2	SB	21	0	2	27.7	2	2
63	CR	Low	2	SB	21	0	3	22.3	3	2
63	CR	Low	2	SB	21	0	4	23.8	3	2
63	CR	Low	2	SB	21	0	5	25.4	2	2
64	CR	Low	2	TF	24	6	1	24.2	2	2
64	CR	Low	2	TF	24	6	2	30.5	2	2
64	CR	Low	2	TF	24	6	3	29.3	2	2
64	CR	Low	2	TF	24	6	4	26.1	2	2
64	CR	Low	2	TF	24	6	5	30.8	3	2
65	TB	Low	2	C	19	.	1	32.2	2	2
65	TB	Low	2	C	19	.	2	28.4	2	2
65	TB	Low	2	C	19	.	3	29.3	3	2
65	TB	Low	2	C	19	.	4	30.1	2	2
65	TB	Low	2	C	19	.	5	30.2	3	2
66	TB	Low	2	KB	13	11	1	24.9	2	2
66	TB	Low	2	KB	13	11	2	28.4	2	2
66	TB	Low	2	KB	13	11	3	29.8	2	2
66	TB	Low	2	KB	13	11	4	30.1	2	2
66	TB	Low	2	KB	13	11	5	31.8	3	2
67	TB	Low	2	SB	9	0	1	27.6	2	2
67	TB	Low	2	SB	9	0	2	23.7	2	2
67	TB	Low	2	SB	9	0	3	24.5	2	2
67	TB	Low	2	SB	9	0	4	29.7	3	2
67	TB	Low	2	SB	9	0	5	22.4	3	2

68	TB	Low	2	TF	11	5	1	28.5	2	2
68	TB	Low	2	TF	11	5	2	30	3	2
68	TB	Low	2	TF	11	5	3	29.3	2	2
68	TB	Low	2	TF	11	5	4	24.7	2	2
68	TB	Low	2	TF	11	5	5	28.8	3	2
69	MIX	Low	2	C	21	.	1	33.6	2	2
69	MIX	Low	2	C	21	.	2	31.7	3	2
69	MIX	Low	2	C	21	.	3	34.1	2	2
69	MIX	Low	2	C	21	.	4	29.8	2	2
69	MIX	Low	2	C	21	.	5	31.4	3	2
70	MIX	Low	2	KB	19	17	1	27.4	2	2
70	MIX	Low	2	KB	19	17	2	31.3	2	2
70	MIX	Low	2	KB	19	17	3	29.6	2	2
70	MIX	Low	2	KB	19	17	4	29.1	2	2
70	MIX	Low	2	KB	19	17	5	30.2	3	2
71	MIX	Low	2	SB	16	0	1	28.3	3	2
71	MIX	Low	2	SB	16	0	2	24.1	2	2
71	MIX	Low	2	SB	16	0	3	25.8	3	2
71	MIX	Low	2	SB	16	0	4	26.6	3	2
71	MIX	Low	2	SB	16	0	5	23.9	3	2
72	MIX	Low	2	TF	24	2	1	25.7	2	2
72	MIX	Low	2	TF	24	2	2	27.2	2	2
72	MIX	Low	2	TF	24	2	3	28.1	2	2
72	MIX	Low	2	TF	24	2	4	26.5	3	2
72	MIX	Low	2	TF	24	2	5	28	3	2
73	A	High	2	C	2	.	1	19.7	2	2
73	A	High	2	C	2	.	2	19.2	3	2
74	A	High	2	KB	0	23	.	.	.	2
75	A	High	2	SB	2	0	1	23.1	3	2
75	A	High	2	SB	2	0	2	17.4	3	2
76	A	High	2	TF	5	.	1	22.8	2	2
76	A	High	2	TF	5	.	2	25.9	3	2
76	A	High	2	TF	5	.	3	29.1	3	2
76	A	High	2	TF	5	.	4	26.8	3	2
76	A	High	2	TF	5	.	5	24.4	3	2
77	A	High	2	C	7	.	1	28.5	2	2
77	A	High	2	C	7	.	2	26.7	2	2
77	A	High	2	C	7	.	3	24.9	3	2
77	A	High	2	C	7	.	4	25.3	3	2
77	A	High	2	C	7	.	5	29.4	3	2
78	K	High	2	KB	8	16	1	23	3	2
78	K	High	2	KB	8	16	2	25.2	2	2
78	K	High	2	KB	8	16	3	22.6	2	2
78	K	High	2	KB	8	16	4	24.1	3	2
78	K	High	2	KB	8	16	5	20.3	3	2
79	K	High	2	SB	3	0	1	25.5	2	2
79	K	High	2	SB	3	0	2	22	3	2
79	K	High	2	SB	3	0	3	23.8	2	2
80	K	High	2	TF	.	7	.	.	.	2
81	BW	High	2	C	27	.	1	23.5	3	2
81	BW	High	2	C	27	.	2	27.1	3	2
81	BW	High	2	C	27	.	3	24.6	3	2
81	BW	High	2	C	27	.	4	29.3	2	2
81	BW	High	2	C	27	.	5	27.8	2	2
82	BW	High	2	KB	23	21	1	25.4	2	2
82	BW	High	2	KB	23	21	2	28.6	3	2
82	BW	High	2	KB	23	21	3	29.5	3	2
82	BW	High	2	KB	23	21	4	27.2	2	2
82	BW	High	2	KB	23	21	5	29.7	3	2
83	BW	High	2	SB	19	0	1	30.1	2	2
83	BW	High	2	SB	19	0	2	27.8	2	2
83	BW	High	2	SB	19	0	3	26.4	3	2
83	BW	High	2	SB	19	0	4	23.1	2	2
83	BW	High	2	SB	19	0	5	26.3	3	2
84	BW	High	2	TF	20	4	1	23.6	2	2
84	BW	High	2	TF	20	4	2	30.5	3	2
84	BW	High	2	TF	20	4	3	32.8	2	2
84	BW	High	2	TF	20	4	4	27.4	2	2
84	BW	High	2	TF	20	4	5	28.8	2	2

85	CR	High	2	C	14	.	1	23.5	2	2
85	CR	High	2	C	14	.	2	29	3	2
85	CR	High	2	C	14	.	3	31.2	2	2
85	CR	High	2	C	14	.	4	31.7	3	2
85	CR	High	2	C	14	.	5	29.7	3	2
86	CR	High	2	KB	7	26	1	29.7	2	2
86	CR	High	2	KB	7	26	2	26.7	2	2
86	CR	High	2	KB	7	26	3	30.1	2	2
86	CR	High	2	KB	7	26	4	30.3	2	2
86	CR	High	2	KB	7	26	5	27.8	3	2
87	CR	High	2	SB	8	0	1	26.9	2	2
87	CR	High	2	SB	8	0	2	28.5	3	2
88	CR	High	2	TF	25	11	1	34.2	2	2
88	CR	High	2	TF	25	11	2	33.7	2	2
88	CR	High	2	TF	25	11	3	36.3	3	2
88	CR	High	2	TF	25	11	4	35.8	3	2
88	CR	High	2	TF	25	11	5	29.7	3	2
89	TB	High	2	C	21	.	1	35.1	2	2
89	TB	High	2	C	21	.	2	33.5	2	2
89	TB	High	2	C	21	.	3	34.2	3	2
89	TB	High	2	C	21	.	4	31.6	3	2
89	TB	High	2	C	21	.	5	31.4	3	2
90	TB	High	2	KB	27	13	1	33.5	2	2
90	TB	High	2	KB	27	13	2	30	3	2
90	TB	High	2	KB	27	13	3	32.6	2	2
90	TB	High	2	KB	27	13	4	35.2	2	2
90	TB	High	2	KB	27	13	5	31.8	3	2
91	TB	High	2	SB	24	0	1	32.6	3	2
91	TB	High	2	SB	24	0	2	28.7	2	2
91	TB	High	2	SB	24	0	3	31.5	2	2
91	TB	High	2	SB	24	0	4	32	2	2
91	TB	High	2	SB	24	0	5	34.2	3	2
92	TB	High	2	TF	31	4	1	32.5	2	2
92	TB	High	2	TF	31	4	2	33.1	2	2
92	TB	High	2	TF	31	4	3	28.6	3	2
92	TB	High	2	TF	31	4	4	32.4	3	2
92	TB	High	2	TF	31	4	5	31.7	3	2
93	MIX	High	2	C	36	.	1	31.7	2	2
93	MIX	High	2	C	36	.	2	34.3	4	2
93	MIX	High	2	C	36	.	3	36.2	3	2
93	MIX	High	2	C	36	.	4	31	2	2
93	MIX	High	2	C	36	.	5	30.8	2	2
94	MIX	High	2	KB	23	20	1	28.6	2	2
94	MIX	High	2	KB	23	20	2	25.8	2	2
94	MIX	High	2	KB	23	20	3	30.4	3	2
94	MIX	High	2	KB	23	20	4	32.9	3	2
94	MIX	High	2	KB	23	20	5	32.3	3	2
95	MIX	High	2	SB	31	0	1	34.1	2	2
95	MIX	High	2	SB	31	0	2	30.8	2	2
95	MIX	High	2	SB	31	0	3	29.9	2	2
95	MIX	High	2	SB	31	0	4	27.6	2	2
95	MIX	High	2	SB	31	0	5	32.5	3	2
96	MIX	High	2	TF	28	7	1	33.1	2	2
96	MIX	High	2	TF	28	7	2	31	2	2
96	MIX	High	2	TF	28	7	3	30.8	2	2
96	MIX	High	2	TF	28	7	4	33.6	3	2
96	MIX	High	2	TF	28	7	5	31.7	3	2
97	A	Low	3	C	0	.	.	.	.	2
98	A	Low	3	KB	0	0	.	.	.	2
99	A	Low	3	SB	0	0	.	.	.	2

100	A	Low	3	TF	1	2	1	14.3	3	2
101	K	Low	3	C	2	.	1	14.8	2	2
101	K	Low	3	C	2	.	2	19.2	2	2
102	K	Low	3	KB	.	4	.	.	.	2
103	K	Low	3	SB	.	0	.	.	.	2
104	K	Low	3	TF	2	1	1	22.7	2	2
104	K	Low	3	TF	2	1	2	17.3	2	2
105	BW	Low	3	C	11	.	1	28.6	2	2
105	BW	Low	3	C	11	.	2	25.7	2	2
105	BW	Low	3	C	11	.	3	29.5	3	2
105	BW	Low	3	C	11	.	4	29.3	3	2
105	BW	Low	3	C	11	.	5	27.4	3	2
106	BW	Low	3	KB	4	7	1	25.3	2	2
106	BW	Low	3	KB	4	7	2	23.9	3	2
106	BW	Low	3	KB	4	7	3	25.8	3	2
106	BW	Low	3	KB	4	7	4	27.4	3	2
107	BW	Low	3	SB	2	.	1	25.1	2	2
107	BW	Low	3	SB	2	.	2	23.6	3	2
108	BW	Low	3	TF	3	7	1	26.5	2	2
108	BW	Low	3	TF	3	7	2	29.3	2	2
108	BW	Low	3	TF	3	7	3	27.6	2	2
109	CR	Low	3	C	4	.	1	26.5	2	2
109	CR	Low	3	C	4	.	2	27.8	2	2
109	CR	Low	3	C	4	.	3	29.1	2	2
109	CR	Low	3	C	4	.	4	25.4	3	2
110	CR	Low	3	KB	7	13	1	28.6	2	2
110	CR	Low	3	KB	7	13	2	24.8	2	2
110	CR	Low	3	KB	7	13	3	29.7	2	2
110	CR	Low	3	KB	7	13	4	27.2	2	2
110	CR	Low	3	KB	7	13	5	26.3	3	2
111	CR	Low	3	SB	6	0	1	31	2	2
111	CR	Low	3	SB	6	0	2	29.1	2	2
111	CR	Low	3	SB	6	0	3	26.3	3	2
111	CR	Low	3	SB	6	0	4	29.8	3	2
111	CR	Low	3	SB	6	0	5	29.5	3	2
112	CR	Low	3	TF	.	13	.	.	.	2
113	TB	Low	3	C	10	.	1	28.8	2	2
113	TB	Low	3	C	10	.	2	26.3	2	2
113	TB	Low	3	C	10	.	3	29.4	3	2
113	TB	Low	3	C	10	.	4	26.1	3	2
113	TB	Low	3	C	10	.	5	29.7	3	2
114	TB	Low	3	KB	7	3	1	24.5	2	2
114	TB	Low	3	KB	7	3	2	28.4	2	2
114	TB	Low	3	KB	7	3	3	29.6	2	2
114	TB	Low	3	KB	7	3	4	23.7	2	2
114	TB	Low	3	KB	7	3	5	27.4	2	2
115	TB	Low	3	SB	2	0	1	23.5	2	2
115	TB	Low	3	SB	2	0	2	22.9	2	2
116	TB	Low	3	TF	3	9	1	24.7	3	2
116	TB	Low	3	TF	3	11	2	29.6	3	2
116	TB	Low	3	TF	3	11	3	25.8	2	2
117	MIX	Low	3	C	15	.	1	28.6	3	2
117	MIX	Low	3	C	15	.	2	26.5	2	2
117	MIX	Low	3	C	15	.	3	29	3	2
117	MIX	Low	3	C	15	.	4	30.2	2	2
117	MIX	Low	3	C	15	.	5	24.9	3	2
118	MIX	Low	3	KB	9	0	1	27.1	2	2
118	MIX	Low	3	KB	9	0	2	27.5	2	2
118	MIX	Low	3	KB	9	0	3	29.4	3	2
118	MIX	Low	3	KB	9	0	4	26.8	2	2
118	MIX	Low	3	KB	9	0	5	26.3	3	2
119	MIX	Low	3	SB	5	0	1	27.9	2	2
119	MIX	Low	3	SB	5	0	2	28	3	2

120	MIX	Low	3	TF	8	3	1	30.2	2	2
120	MIX	Low	3	TF	8	3	2	29.8	2	2
120	MIX	Low	3	TF	8	3	3	31.7	2	2
120	MIX	Low	3	TF	8	3	4	30.8	3	2
120	MIX	Low	3	TF	8	3	5	31.2	2	2
121	A	High	3	C	5	.	1	17.8	2	2
121	A	High	3	C	5	.	2	20.3	2	2
121	A	High	3	C	5	.	3	22	2	2
121	A	High	3	C	5	.	4	16.8	2	2
121	A	High	3	C	5	.	5	21.3	3	2
122	A	High	3	KB	.	3	.	.	.	2
123	A	High	3	SB	3	0	1	20.2	3	2
123	A	High	3	SB	3	0	2	16.3	2	2
123	A	High	3	SB	3	0	3	20	3	2
124	A	High	3	TF	2	3	1	23.2	3	2
124	A	High	3	TF	2	3	2	26.4	3	2
125	K	High	3	C	2	.	1	25.1	3	2
125	K	High	3	C	2	.	2	27.8	3	2
126	K	High	3	KB	2	6	1	23.7	2	2
126	K	High	3	KB	2	6	2	22.5	2	2
127	K	High	3	SB	0	0	.	.	.	2
128	K	High	3	TF	7	14	1	23.6	2	2
128	K	High	3	TF	7	14	2	22.9	3	2
128	K	High	3	TF	7	14	3	24.8	3	2
128	K	High	3	TF	7	14	4	23.1	3	2
128	K	High	3	TF	7	14	5	25.3	3	2
129	BW	High	3	C	13	.	1	22.5	2	2
129	BW	High	3	C	13	.	2	25.1	2	2
129	BW	High	3	C	13	.	3	20.4	3	2
129	BW	High	3	C	13	.	4	21.3	3	2
129	BW	High	3	C	13	.	5	22.8	3	2
130	BW	High	3	KB	1	15	1	26.2	2	2
131	BW	High	3	SB	9	0	1	26.8	2	2
131	BW	High	3	SB	9	0	2	30.3	3	2
131	BW	High	3	SB	9	0	3	28.4	3	2
131	BW	High	3	SB	9	0	4	30	3	2
131	BW	High	3	SB	9	0	5	30.2	3	2
132	BW	High	3	TF	3	9	1	27.5	2	2
132	BW	High	3	TF	3	9	2	27.8	3	2
132	BW	High	3	TF	3	9	3	29.6	3	2
133	CR	High	3	C	24	.	1	33.1	2	2
133	CR	High	3	C	24	.	2	30.4	3	2
133	CR	High	3	C	24	.	3	33.6	3	2
133	CR	High	3	C	24	.	4	30.8	2	2
133	CR	High	3	C	24	.	5	35.7	3	2
134	CR	High	3	KB	12	10	1	29.5	2	2
134	CR	High	3	KB	12	10	2	26.8	3	2
134	CR	High	3	KB	12	10	3	30.3	3	2
134	CR	High	3	KB	12	10	4	27.3	4	2
134	CR	High	3	KB	12	10	5	29.4	3	2
135	CR	High	3	SB	6	0	1	30.1	2	2
135	CR	High	3	SB	6	0	2	27	3	2
135	CR	High	3	SB	6	0	3	28.3	3	2
135	CR	High	3	SB	6	0	4	25.9	3	2
135	CR	High	3	SB	6	0	5	29.9	2	2
136	CR	High	3	TF	12	8	1	33.4	3	2
136	CR	High	3	TF	12	8	2	37.1	3	2
136	CR	High	3	TF	12	8	3	35.2	3	2
136	CR	High	3	TF	12	8	4	37.6	2	2
136	CR	High	3	TF	12	8	5	33.5	3	2

137	TB	High	3	C	23	.	1	33.5	2	2
137	TB	High	3	C	23	.	2	37.8	2	2
137	TB	High	3	C	23	.	3	36.9	3	2
137	TB	High	3	C	23	.	4	36.1	3	2
137	TB	High	3	C	23	.	5	33.2	2	2
138	TB	High	3	KB	19	21	1	30.7	3	2
138	TB	High	3	KB	19	21	2	28.7	3	2
138	TB	High	3	KB	19	21	3	30.2	3	2
138	TB	High	3	KB	19	21	4	32.5	2	2
138	TB	High	3	KB	19	21	5	33.1	2	2
139	TB	High	3	SB	7	0	1	29.4	3	2
139	TB	High	3	SB	7	0	2	31.6	2	2
139	TB	High	3	SB	7	0	3	30.5	2	2
139	TB	High	3	SB	7	0	4	31.7	2	2
139	TB	High	3	SB	7	0	5	30.1	2	2
140	TB	High	3	TF	27	4	1	38.4	2	2
140	TB	High	3	TF	27	4	2	32.8	2	2
140	TB	High	3	TF	27	4	3	35.7	2	2
140	TB	High	3	TF	27	4	4	39.6	3	2
140	TB	High	3	TF	27	4	5	35.6	3	2
141	MIX	High	3	C	27	.	1	29.9	3	2
141	MIX	High	3	C	27	.	2	34.6	3	2
141	MIX	High	3	C	27	.	3	38.2	3	2
141	MIX	High	3	C	27	.	4	37	2	2
141	MIX	High	3	C	27	.	5	39.1	2	2
142	MIX	High	3	KB	25	0	1	31.6	2	2
142	MIX	High	3	KB	25	0	2	34	3	2
142	MIX	High	3	KB	25	0	3	38.2	3	2
142	MIX	High	3	KB	25	0	4	31.9	3	2
142	MIX	High	3	KB	25	0	5	36.4	2	2
143	MIX	High	3	SB	23	0	1	38.5	3	2
143	MIX	High	3	SB	23	0	2	32.7	2	2
143	MIX	High	3	SB	23	0	3	36.1	3	2
143	MIX	High	3	SB	23	0	4	34.9	3	2
143	MIX	High	3	SB	23	0	5	37.2	2	2
144	MIX	High	3	TF	24	3	1	33.7	3	2
144	MIX	High	3	TF	24	3	2	34.8	3	2
144	MIX	High	3	TF	24	3	3	35.9	3	2
144	MIX	High	3	TF	24	3	4	37.2	2	2
1	A	Low	1	C	0	.	.	.	.	3
2	A	Low	1	KB	0	0	.	.	.	3
3	A	Low	1	SB	0	0	.	.	.	3
4	A	Low	1	TF	0	0	.	.	.	3
5	K	Low	1	C	0	.	.	.	.	3
6	K	Low	1	KB	0	3	.	.	.	3
7	K	Low	1	SB	0	0	.	.	.	3
8	K	Low	1	TF	0	0	.	.	.	3
9	BW	Low	1	C	0	.	.	.	.	3
10	BW	Low	1	KB	0	0	.	.	.	3
11	BW	Low	1	SB	0	0	.	.	.	3
12	BW	Low	1	TF	0	0	.	.	.	3
13	CR	Low	1	C	0	.	.	.	.	3
14	CR	Low	1	KB	0	0	.	.	.	3
15	CR	Low	1	SB	0	0	.	.	.	3
16	CR	Low	1	TF	0	4	.	.	.	3
17	TB	Low	1	C	0	.	.	.	.	3
18	TB	Low	1	KB	0	0	.	.	.	3
19	TB	Low	1	SB	0	0	.	.	.	3
20	TB	Low	1	TF	0	0	.	.	.	3

21	MIX	Low	1	C	0	.	.	.	.	3
22	MIX	Low	1	KB	0	0	.	.	.	3
23	MIX	Low	1	SB	0	0	.	.	.	3
24	MIX	Low	1	TF	0	5	.	.	.	3
25	A	High	1	C	0	.	.	.	.	3
26	A	High	1	KB	0	0	.	.	.	3
27	A	High	1	SB	0	0	.	.	.	3
28	A	High	1	TF	0	0	.	.	.	3
29	K	High	1	C	0	.	.	.	.	3
30	K	High	1	KB	0	0	.	.	.	3
31	K	High	1	SB	0	0	.	.	.	3
32	K	High	1	TF	0	0	.	.	.	3
33	BW	High	1	C	0	.	.	.	.	3
34	BW	High	1	KB	0	0	.	.	.	3
35	BW	High	1	SB	0	0	.	.	.	3
36	BW	High	1	TF	0	3	.	.	.	3
37	CR	High	1	C	0	.	.	.	.	3
38	CR	High	1	KB	0	0	.	.	.	3
39	CR	High	1	SB	0	0	.	.	.	3
40	CR	High	1	TF	0	4	.	.	.	3
41	TB	High	1	C	0	.	.	.	.	3
42	TB	High	1	KB	0	5	.	.	.	3
43	TB	High	1	SB	0	0	.	.	.	3
44	TB	High	1	TF	0	5	.	.	.	3
45	MIX	High	1	C	0	.	.	.	.	3
46	MIX	High	1	KB	0	8	.	.	.	3
47	MIX	High	1	SB	0	0	.	.	.	3
48	MIX	High	1	TF	0	0	.	.	.	3
49	A	Low	2	C	0	.	.	.	.	3
50	A	Low	2	KB	0	5	.	.	.	3
51	A	Low	2	SB	0	7	.	.	.	3
52	A	Low	2	TF	0	0	.	.	.	3
53	K	Low	2	C	0	.	.	.	.	3
54	K	Low	2	KB	0	0	.	.	.	3
55	K	Low	2	SB	0	0	.	.	.	3
56	K	Low	2	TF	0	9	.	.	.	3
57	BW	Low	2	C	0	.	.	.	.	3
58	BW	Low	2	KB	0	0	.	.	.	3
59	BW	Low	2	SB	0	0	.	.	.	3
60	BW	Low	2	TF	0	0	.	.	.	3
61	CR	Low	2	C	0	.	.	.	.	3
62	CR	Low	2	KB	0	0	.	.	.	3
63	CR	Low	2	SB	0	0	.	.	.	3
64	CR	Low	2	TF	0	6	.	.	.	3
65	TB	Low	2	C	0	.	.	.	.	3
66	TB	Low	2	KB	0	9	.	.	.	3
67	TB	Low	2	SB	0	0	.	.	.	3
68	TB	Low	2	TF	0	6	.	.	.	3
69	MIX	Low	2	C	0	.	.	.	.	3
70	MIX	Low	2	KB	0	0	.	.	.	3
71	MIX	Low	2	SB	0	0	.	.	.	3
72	MIX	Low	2	TF	4	2	1	23.4	2	3
72	MIX	Low	2	TF	4	2	2	22.1	2	3
72	MIX	Low	2	TF	4	2	3	24.6	2	3
72	MIX	Low	2	TF	4	2	4	24.3	3	3
73	A	High	2	C	0	.	.	.	.	3
74	A	High	2	KB	0	10	.	.	.	3
75	A	High	2	SB	0	0	.	.	.	3

76	A	High	2	TF	0	3	.	.	.	3
77	A	High	2	C	5	.	1	19.5	3	3
77	A	High	2	C	5	.	2	21.3	3	3
77	A	High	2	C	5	.	3	24.4	2	3
77	A	High	2	C	5	.	4	22.7	3	3
77	A	High	2	C	5	.	5	23.5	3	3
78	K	High	2	KB	0	0	.	.	.	3
79	K	High	2	SB	0	0	.	.	.	3
80	K	High	2	TF	2	2	1	25.3	3	3
80	K	High	2	TF	2	2	2	23.6	3	3
81	BW	High	2	C	0	.	.	.	.	3
82	BW	High	2	KB	3	9	1	25.7	3	3
82	BW	High	2	KB	3	9	2	24.8	3	3
82	BW	High	2	KB	3	9	3	22.4	3	3
83	BW	High	2	SB	0	0	.	.	.	3
84	BW	High	2	TF	0	3	.	.	.	3
85	CR	High	2	C	0	.	.	.	.	3
86	CR	High	2	KB	0	0	.	.	.	3
87	CR	High	2	SB	0	0	.	.	.	3
88	CR	High	2	TF	5	8	1	25.6	2	3
88	CR	High	2	TF	5	8	2	25.2	3	3
88	CR	High	2	TF	5	8	3	26.8	3	3
88	CR	High	2	TF	5	8	4	24.7	3	3
88	CR	High	2	TF	5	8	5	24.9	3	3
89	TB	High	2	C	0	.	.	.	.	3
90	TB	High	2	KB	0	7	.	.	.	3
91	TB	High	2	SB	0	0	.	.	.	3
92	TB	High	2	TF	0	4	.	.	.	3
93	MIX	High	2	C	0	.	.	.	.	3
94	MIX	High	2	KB	0	0	.	.	.	3
95	MIX	High	2	SB	0	0	.	.	.	3
96	MIX	High	2	TF	0	5	.	.	.	3
97	A	Low	3	C	0	.	.	.	.	3
98	A	Low	3	KB	0	0	.	.	.	3
99	A	Low	3	SB	0	0	.	.	.	3
100	A	Low	3	TF	0	0	.	.	.	3
101	K	Low	3	C	0	.	.	.	.	3
102	K	Low	3	KB	3	6	1	19.6	2	3
102	K	Low	3	KB	3	6	2	21.2	2	3
102	K	Low	3	KB	3	6	3	20.8	3	3
103	K	Low	3	SB	0	0	.	.	.	3
104	K	Low	3	TF	0	0	.	.	.	3
105	BW	Low	3	C	0	.	.	.	.	3
106	BW	Low	3	KB	4	4	1	23.4	3	3
106	BW	Low	3	KB	4	4	2	24.1	3	3
106	BW	Low	3	KB	4	4	3	25.3	3	3
106	BW	Low	3	KB	4	4	4	22.8	2	3
107	BW	Low	3	SB	0	.	.	.	.	3
108	BW	Low	3	TF	4	5	1	26.5	3	3
108	BW	Low	3	TF	4	5	2	27.1	3	3
108	BW	Low	3	TF	4	5	3	25.8	3	3
108	BW	Low	3	TF	4	5	4	25.3	3	3
109	CR	Low	3	C	0	.	.	.	.	3
110	CR	Low	3	KB	0	0	.	.	.	3

111	CR	Low	3	SB	0	0	.	.	.	3
112	CR	Low	3	TF	0	9	.	.	.	3
113	TB	Low	3	C	0	.	.	.	.	3
114	TB	Low	3	KB	0	0	.	.	.	3
115	TB	Low	3	SB	0	0	.	.	.	3
116	TB	Low	3	TF	0	6	.	.	.	3
117	MIX	Low	3	C	0	.	.	.	.	3
118	MIX	Low	3	KB	0	0	.	.	.	3
119	MIX	Low	3	SB	0	0	.	.	.	3
120	MIX	Low	3	TF	0	0	.	.	.	3
121	A	High	3	C	0	.	.	.	.	3
122	A	High	3	KB	0	5	.	.	.	3
123	A	High	3	SB	0	0	.	.	.	3
124	A	High	3	TF	0	3	.	.	.	3
125	K	High	3	C	0	.	.	.	.	3
126	K	High	3	KB	0	0	.	.	.	3
127	K	High	3	SB	0	0	.	.	.	3
128	K	High	3	TF	4	9	1	24.6	3	3
128	K	High	3	TF	4	9	2	27.3	3	3
128	K	High	3	TF	4	9	3	26.5	3	3
128	K	High	3	TF	4	9	4	24.9	3	3
129	BW	High	3	C	0	.	.	.	.	3
130	BW	High	3	KB	0	0	.	.	.	3
131	BW	High	3	SB	0	0	.	.	.	3
132	BW	High	3	TF	0	7	.	.	.	3
133	CR	High	3	C	0	.	.	.	.	3
134	CR	High	3	KB	0	0	.	.	.	3
135	CR	High	3	SB	0	0	.	.	.	3
136	CR	High	3	TF	0	0	.	.	.	3
137	TB	High	3	C	0	.	.	.	.	3
138	TB	High	3	KB	0	0	.	.	.	3
139	TB	High	3	SB	0	3	.	.	.	3
140	TB	High	3	TF	0	0	.	.	.	3
141	MIX	High	3	C	0	.	.	.	.	3
142	MIX	High	3	KB	0	6	.	.	.	3
143	MIX	High	3	SB	0	0	.	.	.	3
144	MIX	High	3	TF	0	4	.	.	.	3

Appendix 2b. Invasive species height and number of leaves data over one collection date. CV = Cultivar (A='Alamo', K='Kanlow', BW='Blackwell', CR='Cave in Rock', TB='Trailblazer'), MOIST = Moisture Level, BLK = Block, INV = Invasive Species (C=Control, KB=Kentucky Bluegrass, SB=Smooth Brome, TF=Tall Fescue), NO.INV = Number of Invasive Species, HT = Height (cm), NO.LVS = Number of Leaves, .= Missing Values.

POT ID	CV	MOIST.	BLK	INV	NO.INV	PLANT	HT	NO.LVS	DAY
1	A	Low	1	C	.	.	.	.	1
2	A	Low	1	KB	2	1	13.2	4	1
2	A	Low	1	KB	2	2	15.6	3	1
3	A	Low	1	SB	0	.	.	.	1
4	A	Low	1	TF	2	1	23.3	4	1
4	A	Low	1	TF	3	2	26.1	4	1
4	A	Low	1	TF	3	3	20.5	2	1
5	K	Low	1	C	.	.	.	.	1
6	K	Low	1	KB	8	1	12.3	2	1
6	K	Low	1	KB	8	2	9.7	3	1
6	K	Low	1	KB	8	3	11.7	4	1
6	K	Low	1	KB	8	4	10.8	2	1
6	K	Low	1	KB	8	5	9.9	3	1
7	K	Low	1	SB	0	.	.	.	1
8	K	Low	1	TF	4	1	24.5	3	1
8	K	Low	1	TF	4	2	27.1	3	1
8	K	Low	1	TF	4	3	22.8	2	1
8	K	Low	1	TF	4	4	24.6	3	1
9	BW	Low	1	C	.	.	.	.	1
10	BW	Low	1	KB	3	1	13.2	2	1
10	BW	Low	1	KB	3	2	8.3	3	1
10	BW	Low	1	KB	3	3	7.2	3	1
11	BW	Low	1	SB	0	.	.	.	1
12	BW	Low	1	TF	4	1	23.8	2	1
12	BW	Low	1	TF	4	2	26.4	2	1
12	BW	Low	1	TF	4	3	24.1	3	1
12	BW	Low	1	TF	4	4	26.9	3	1
13	CR	Low	1	C	.	.	.	.	1
14	CR	Low	1	KB	15	1	25.7	4	1
14	CR	Low	1	KB	15	2	29.2	3	1
14	CR	Low	1	KB	15	3	24.8	4	1
14	CR	Low	1	KB	15	4	26.1	3	1
14	CR	Low	1	KB	15	5	28.3	3	1
15	CR	Low	1	SB	3	1	10.2	2	1
15	CR	Low	1	SB	3	2	13.1	2	1
15	CR	Low	1	SB	3	3	7.6	2	1
16	CR	Low	1	TF	7	1	22.5	3	1
16	CR	Low	1	TF	7	2	23.1	3	1
16	CR	Low	1	TF	7	3	25.4	3	1
16	CR	Low	1	TF	7	4	26.1	3	1
16	CR	Low	1	TF	7	5	28.4	3	1
17	TB	Low	1	C	.	.	.	.	1
18	TB	Low	1	KB	0	.	.	.	1
19	TB	Low	1	SB	0	.	.	.	1
20	TB	Low	1	TF	0	.	.	.	1
21	MIX	Low	1	C	.	.	.	.	1
22	MIX	Low	1	KB	6	1	15.6	2	1
22	MIX	Low	1	KB	6	2	18.2	2	1

22	MIX	Low	1	KB	6	3	19.3	1	1
22	MIX	Low	1	KB	6	4	15.4	2	1
22	MIX	Low	1	KB	6	5	17.4	2	1
23	MIX	Low	1	SB	0	.	.	.	1
24	MIX	Low	1	TF	2	1	26.9	3	1
24	MIX	Low	1	TF	2	2	27.1	4	1
25	A	High	1	C	.	.	.	.	1
26	A	High	1	KB	0	.	.	.	1
27	A	High	1	SB	0	.	.	.	1
28	A	High	1	TF	8	1	22.1	5	1
28	A	High	1	TF	8	2	19.3	3	1
28	A	High	1	TF	8	3	20.6	3	1
28	A	High	1	TF	8	4	23.7	4	1
28	A	High	1	TF	8	5	18.9	3	1
29	K	High	1	C	.	.	.	.	1
30	K	High	1	KB	0	.	.	.	1
31	K	High	1	SB	0	.	.	.	1
32	K	High	1	TF	0	.	.	.	1
33	BW	High	1	C	.	.	.	.	1
34	BW	High	1	KB	6	1	24.3	3	1
34	BW	High	1	KB	6	2	22.1	3	1
34	BW	High	1	KB	6	3	17.6	3	1
34	BW	High	1	KB	6	4	19.8	3	1
34	BW	High	1	KB	6	5	21.4	3	1
35	BW	High	1	SB	0	.	.	.	1
36	BW	High	1	TF	5	1	26.2	6	1
36	BW	High	1	TF	5	2	27.3	4	1
36	BW	High	1	TF	5	3	27.5	5	1
36	BW	High	1	TF	5	4	25.8	6	1
36	BW	High	1	TF	5	5	24.4	5	1
37	CR	High	1	C	.	.	.	.	1
38	CR	High	1	KB	7	1	12.7	2	1
38	CR	High	1	KB	7	2	15.9	3	1
38	CR	High	1	KB	7	3	20.3	3	1
38	CR	High	1	KB	7	4	19.8	3	1
38	CR	High	1	KB	7	5	21.1	3	1
39	CR	High	1	SB	0	.	.	.	1
40	CR	High	1	TF	10	1	29.5	3	1
40	CR	High	1	TF	10	2	27.3	4	1
40	CR	High	1	TF	10	3	27.8	5	1
40	CR	High	1	TF	10	4	30	3	1
40	CR	High	1	TF	10	5	26.4	4	1
41	TB	High	1	C	.	.	.	.	1
42	TB	High	1	KB	8	1	14.6	3	1
42	TB	High	1	KB	8	2	17.9	3	1
42	TB	High	1	KB	8	3	22.3	5	1
42	TB	High	1	KB	8	4	13.5	3	1
42	TB	High	1	KB	8	5	11.9	4	1
43	TB	High	1	SB	0	.	.	.	1
44	TB	High	1	TF	6	1	28.7	5	1
44	TB	High	1	TF	6	2	30.2	4	1
44	TB	High	1	TF	6	3	21.7	5	1
44	TB	High	1	TF	6	4	26.5	4	1
44	TB	High	1	TF	6	5	28.8	4	1
45	MIX	High	1	C	.	.	.	.	1

46	MIX	High	1	KB	11	1	11.4	2	1
46	MIX	High	1	KB	11	2	14.2	2	1
46	MIX	High	1	KB	11	3	17.1	2	1
46	MIX	High	1	KB	11	4	16.2	2	1
46	MIX	High	1	KB	11	5	14.9	3	1
47	MIX	High	1	SB	0	.	.	.	1
48	MIX	High	1	TF	0	.	.	.	1
49	A	Low	2	C	.	.	.	.	1
50	A	Low	2	KB	0	.	.	.	1
51	A	Low	2	SB	0	.	.	.	1
52	A	Low	2	TF	0	.	.	.	1
53	K	Low	2	C	.	.	.	.	1
54	K	Low	2	KB	6	1	15.3	3	1
54	K	Low	2	KB	6	2	12.6	3	1
54	K	Low	2	KB	6	3	13.4	3	1
54	K	Low	2	KB	6	4	18.2	4	1
54	K	Low	2	KB	6	5	10.7	3	1
55	K	Low	2	SB	0	.	.	.	1
56	K	Low	2	TF	6	1	24.7	4	1
56	K	Low	2	TF	6	2	28.6	6	1
56	K	Low	2	TF	6	3	31.2	5	1
56	K	Low	2	TF	6	4	29.6	4	1
56	K	Low	2	TF	6	5	25.3	5	1
57	BW	Low	2	C	.	.	.	.	1
58	BW	Low	2	KB	5	1	10.1	3	1
58	BW	Low	2	KB	5	2	14.2	3	1
58	BW	Low	2	KB	5	3	15.7	3	1
58	BW	Low	2	KB	5	4	10.4	3	1
58	BW	Low	2	KB	5	5	8.8	3	1
59	BW	Low	2	SB	0	.	.	.	1
60	BW	Low	2	TF	8	1	27.4	5	1
60	BW	Low	2	TF	8	2	23.1	4	1
60	BW	Low	2	TF	8	3	30.1	3	1
60	BW	Low	2	TF	8	4	30.7	4	1
60	BW	Low	2	TF	8	5	28.4	4	1
61	CR	Low	2	C	.	.	.	.	1
62	CR	Low	2	KB	0	.	.	.	1
63	CR	Low	2	SB	5	1	20.7	3	1
63	CR	Low	2	SB	5	2	22.8	3	1
63	CR	Low	2	SB	5	3	25.6	3	1
63	CR	Low	2	SB	5	4	23.1	3	1
63	CR	Low	2	SB	5	5	22.5	3	1
64	CR	Low	2	TF	12	1	30.5	4	1
64	CR	Low	2	TF	12	2	31	4	1
64	CR	Low	2	TF	12	3	33.1	5	1
64	CR	Low	2	TF	12	4	27.6	4	1
64	CR	Low	2	TF	12	5	29.2	3	1
65	TB	Low	2	C	.	.	.	.	1
66	TB	Low	2	KB	9	1	13.6	3	1
66	TB	Low	2	KB	9	2	17.3	3	1
66	TB	Low	2	KB	9	3	9.9	3	1
66	TB	Low	2	KB	9	4	11.8	3	1
66	TB	Low	2	KB	9	5	14.1	4	1
67	TB	Low	2	SB	0	.	.	.	1
68	TB	Low	2	TF	5	1	25.8	5	1
68	TB	Low	2	TF	5	2	27.5	4	1
68	TB	Low	2	TF	5	3	30.6	3	1
68	TB	Low	2	TF	5	4	24.7	4	1
68	TB	Low	2	TF	5	5	26.1	4	1
69	MIX	Low	2	C	.	.	.	.	1

70	MIX	Low	2	KB	21	1	12.9	4	1
70	MIX	Low	2	KB	21	2	13.5	4	1
70	MIX	Low	2	KB	21	3	19.2	4	1
70	MIX	Low	2	KB	21	4	15.1	4	1
70	MIX	Low	2	KB	21	5	17.7	3	1
71	MIX	Low	2	SB	0	.	.	.	1
72	MIX	Low	2	TF	0	.	.	.	1
73	A	High	2	C	.	.	.	.	1
74	A	High	2	KB	13	1	13.1	2	1
74	A	High	2	KB	13	2	17	2	1
74	A	High	2	KB	13	3	12.5	2	1
74	A	High	2	KB	13	4	16.8	2	1
74	A	High	2	KB	13	5	10.5	2	1
75	A	High	2	SB	0	.	.	.	1
76	A	High	2	TF	14	1	25.1	4	1
76	A	High	2	TF	14	2	27.7	5	1
76	A	High	2	TF	14	3	27.2	5	1
76	A	High	2	TF	14	4	26.8	5	1
76	A	High	2	TF	14	5	29.6	4	1
77	A	High	2	C	.	.	.	.	1
78	K	High	2	KB	0	.	.	.	1
79	K	High	2	SB	0	.	.	.	1
80	K	High	2	TF	7	1	22.8	4	1
80	K	High	2	TF	7	2	27.4	4	1
80	K	High	2	TF	7	3	31.3	4	1
80	K	High	2	TF	7	4	30	3	1
80	K	High	2	TF	7	5	27.6	5	1
81	BW	High	2	C	.	.	.	.	1
82	BW	High	2	KB	21	1	8.3	3	1
82	BW	High	2	KB	21	2	10.7	3	1
82	BW	High	2	KB	21	3	13.6	3	1
82	BW	High	2	KB	21	4	15.4	3	1
82	BW	High	2	KB	21	5	12.4	3	1
83	BW	High	2	SB	0	.	.	.	1
84	BW	High	2	TF	17	1	31.3	5	1
84	BW	High	2	TF	17	2	27.5	3	1
84	BW	High	2	TF	17	3	30	4	1
84	BW	High	2	TF	17	4	32.7	6	1
84	BW	High	2	TF	17	5	31.5	5	1
85	CR	High	2	C	.	.	.	.	1
86	CR	High	2	KB	26	1	12.5	3	1
86	CR	High	2	KB	26	2	17.2	3	1
86	CR	High	2	KB	26	3	7.6	2	1
86	CR	High	2	KB	26	4	9.4	2	1
86	CR	High	2	KB	26	5	11.7	3	1
87	CR	High	2	SB	0	.	.	.	1
88	CR	High	2	TF	11	1	28.5	4	1
88	CR	High	2	TF	11	2	25.9	5	1
88	CR	High	2	TF	11	3	24.9	6	1
88	CR	High	2	TF	11	4	30.3	4	1
88	CR	High	2	TF	11	5	27.6	4	1
89	TB	High	2	C	.	.	.	.	1

90	TB	High	2	KB	13	1	12.8	2	1
90	TB	High	2	KB	13	2	14.5	2	1
90	TB	High	2	KB	13	3	15.1	2	1
90	TB	High	2	KB	13	4	16.9	3	1
90	TB	High	2	KB	13	5	13.8	2	1
91	TB	High	2	SB	3	1	5.9	2	1
91	TB	High	2	SB	3	2	8.3	2	
91	TB	High	2	SB	3	3	7.6	2	
92	TB	High	2	TF	7	1	27.5	6	1
92	TB	High	2	TF	7	2	28.9	5	1
92	TB	High	2	TF	7	3	25.4	5	1
92	TB	High	2	TF	7	4	23.9	4	1
92	TB	High	2	TF	7	5	25.4	4	1
93	MIX	High	2	C	.	.	.	.	1
94	MIX	High	2	KB	20	1	13.7	2	1
94	MIX	High	2	KB	20	2	14.3	2	1
94	MIX	High	2	KB	20	3	11.8	3	1
94	MIX	High	2	KB	20	4	14.6	3	1
94	MIX	High	2	KB	20	5	12.2	3	1
95	MIX	High	2	SB	0	.	.	.	1
96	MIX	High	2	TF	10	1	25.9	6	1
96	MIX	High	2	TF	10	2	28.6	5	1
96	MIX	High	2	TF	10	3	25.7	4	1
96	MIX	High	2	TF	10	4	28.5	5	1
96	MIX	High	2	TF	10	5	28.3	5	1
97	A	Low	3	C	.	.	.	.	1
98	A	Low	3	KB	0	.	.	.	1
99	A	Low	3	SB	0	.	.	.	1
100	A	Low	3	TF	4	1	14.3	4	1
100	A	Low	3	TF	4	2	9.5	4	1
100	A	Low	3	TF	4	3	7.8	6	1
100	A	Low	3	TF	4	4	15.2	4	1
101	K	Low	3	C	.	.	.	.	1
102	K	Low	3	KB	8	1	15.2	3	1
102	K	Low	3	KB	8	2	14.2	3	1
102	K	Low	3	KB	8	3	10.7	3	1
102	K	Low	3	KB	8	4	8.8	3	1
103	K	Low	3	SB	0	.	.	.	1
104	K	Low	3	TF	4	1	28.1	4	1
104	K	Low	3	TF	4	2	24.3	3	1
104	K	Low	3	TF	4	3	27.4	6	1
104	K	Low	3	TF	4	4	27.2	4	1
105	BW	Low	3	C	.	.	.	.	1
106	BW	Low	3	KB	13	1	11.2	2	1
106	BW	Low	3	KB	13	2	15.1	3	1
106	BW	Low	3	KB	13	3	14.8	3	1
106	BW	Low	3	KB	13	4	9.3	2	1
106	BW	Low	3	KB	13	5	7.2	3	1
107	BW	Low	3	SB	0	.	.	.	1
108	BW	Low	3	TF	11	1	30.2	4	1
108	BW	Low	3	TF	11	2	27.8	3	1
108	BW	Low	3	TF	11	3	32.5	4	1
108	BW	Low	3	TF	11	4	27.6	5	1
108	BW	Low	3	TF	11	5	28.5	5	1
109	CR	Low	3	C	.	.	.	.	1

110	CR	Low	3	KB	13	1	13.1	2	1
110	CR	Low	3	KB	13	2	14.7	3	1
110	CR	Low	3	KB	13	3	12	3	1
110	CR	Low	3	KB	13	4	10.2	2	1
110	CR	Low	3	KB	13	5	10.6	3	1
111	CR	Low	3	SB	0	.	.	.	1
112	CR	Low	3	TF	17	1	25.7	4	1
112	CR	Low	3	TF	17	2	24.9	5	1
112	CR	Low	3	TF	17	3	28.5	5	1
112	CR	Low	3	TF	17	4	29.2	5	1
112	CR	Low	3	TF	17	5	31.4	4	1
113	TB	Low	3	C	.	.	.	.	1
114	TB	Low	3	KB	14	1	10.6	2	1
114	TB	Low	3	KB	14	2	15.6	3	1
114	TB	Low	3	KB	14	3	11.4	3	1
114	TB	Low	3	KB	14	4	12.8	3	1
114	TB	Low	3	KB	14	5	14.6	2	1
115	TB	Low	3	SB	0	.	.	.	1
116	TB	Low	3	TF	9	1	31.5	4	1
116	TB	Low	3	TF	9	2	25.7	6	1
116	TB	Low	3	TF	9	3	29.6	6	1
116	TB	Low	3	TF	9	4	25.1	5	1
116	TB	Low	3	TF	9	5	28.9	5	1
117	MIX	Low	3	C	.	.	.	.	1
118	MIX	Low	3	KB	0	.	.	.	1
119	MIX	Low	3	SB	0	.	.	.	1
120	MIX	Low	3	TF	10	1	29.1	5	1
120	MIX	Low	3	TF	10	2	31	4	1
120	MIX	Low	3	TF	10	3	29.2	5	1
120	MIX	Low	3	TF	10	4	28.5	5	1
120	MIX	Low	3	TF	10	5	30.4	3	1
121	A	High	3	C	.	.	.	.	1
122	A	High	3	KB	3	1	15.9	2	1
122	A	High	3	KB	3	2	13.7	2	1
122	A	High	3	KB	3	3	12.5	2	1
122	A	High	3	KB	3	4	9.6	4	1
122	A	High	3	KB	3	5	11.7	2	1
123	A	High	3	SB	0	.	.	.	1
124	A	High	3	TF	3	1	29.5	4	1
124	A	High	3	TF	3	2	27.9	4	1
124	A	High	3	TF	3	3	25.8	4	1
125	K	High	3	C	.	.	.	.	1
126	K	High	3	KB	5	1	11.5	2	1
126	K	High	3	KB	5	2	14.3	2	1
126	K	High	3	KB	5	3	13.9	3	1
126	K	High	3	KB	5	4	12.7	3	1
126	K	High	3	KB	5	5	10.3	3	1
127	K	High	3	SB	0	.	.	.	1
128	K	High	3	TF	13	1	21.2	4	1
128	K	High	3	TF	13	2	28.4	3	1
128	K	High	3	TF	13	3	27.1	4	1
128	K	High	3	TF	13	4	28.8	7	1
128	K	High	3	TF	13	5	29.8	5	1
129	BW	High	3	C	.	.	.	.	1
130	BW	High	3	KB	17	1	13.5	2	1
130	BW	High	3	KB	17	2	12.8	2	1
130	BW	High	3	KB	17	3	10.1	2	1
130	BW	High	3	KB	17	4	14.1	2	1
130	BW	High	3	KB	17	5	11.5	2	1

131	BW	High	3	SB	0	.	.	.	1
132	BW	High	3	TF	6	1	27.2	6	1
132	BW	High	3	TF	6	2	28.5	6	1
132	BW	High	3	TF	6	3	30.8	4	1
132	BW	High	3	TF	6	4	29.7	4	1
132	BW	High	3	TF	6	5	26.5	5	1
133	CR	High	3	C	.	.	.	.	1
134	CR	High	3	KB	11	1	11.3	2	1
134	CR	High	3	KB	11	2	11.8	2	1
134	CR	High	3	KB	11	3	10.2	2	1
134	CR	High	3	KB	11	4	13.6	2	1
134	CR	High	3	KB	11	5	14.3	3	1
135	CR	High	3	SB	0	1	.	.	1
136	CR	High	3	TF	8	1	28.7	7	1
136	CR	High	3	TF	8	2	27.1	5	1
136	CR	High	3	TF	8	3	26.5	4	1
136	CR	High	3	TF	8	4	24.8	4	1
136	CR	High	3	TF	8	5	29.1	6	1
137	TB	High	3	C	.	.	.	.	1
138	TB	High	3	KB	23	1	13.8	2	1
138	TB	High	3	KB	23	2	12.9	2	1
138	TB	High	3	KB	23	3	14.2	3	1
138	TB	High	3	KB	23	4	14.5	3	1
138	TB	High	3	KB	23	5	10.7	3	1
139	TB	High	3	SB	9	1	17.4	2	1
139	TB	High	3	SB	9	2	15.8	2	1
139	TB	High	3	SB	9	3	14	3	1
139	TB	High	3	SB	9	4	16.1	3	1
139	TB	High	3	SB	9	5	15.7	3	1
140	TB	High	3	TF	10	1	30.1	5	1
140	TB	High	3	TF	10	2	28.6	5	1
140	TB	High	3	TF	10	3	27.2	5	1
140	TB	High	3	TF	10	4	25.9	5	1
140	TB	High	3	TF	10	5	27.8	6	1
141	MIX	High	3	C	.	.	.	.	1
142	MIX	High	3	KB	14	1	14.5	3	1
142	MIX	High	3	KB	14	2	16.2	3	1
142	MIX	High	3	KB	14	3	13.1	3	1
142	MIX	High	3	KB	14	4	10.6	3	1
142	MIX	High	3	KB	14	5	14.9	3	1
143	MIX	High	3	SB	0	.	.	.	1
144	MIX	High	3	TF	5	1	29.9	5	1
144	MIX	High	3	TF	5	2	28.7	5	1
144	MIX	High	3	TF	5	3	26.1	3	1
144	MIX	High	3	TF	5	4	27.8	4	1
144	MIX	High	3	TF	5	5	30.2	5	1

Appendix 2c. Vegetative tiller density for the *Panicum virgatum* cultivars and for the invasive species over three collection dates. . CV = Cultivar (A='Alamo', K='Kanlow', BW='Blackwell', CR='Cave in Rock', TB='Trailblazer'), MOIST = Moisture Level, BLK = Block, INV = Invasive Species (C=Control, KB=Kentucky Bluegrass, SB=Smooth Brome, TF=Tall Fescue), TSG = Total Number of Tillers for *P. virgatum*, and TINV = Total Number of Tillers for the Invasive Species.

POT ID	CV	MOIST	BLK	INV	DAY	TSG	TINV	POT ID	CV	MOIST	BLK	INV	DAY	TSG	TINV
1	A	Low	1	C	1	0	.	48	MIX	High	1	TF	1	7	4
2	A	Low	1	KB	1	2	5	49	A	Low	2	C	1	2	.
3	A	Low	1	SB	1	0	0	50	A	Low	2	KB	1	3	5
4	A	Low	1	TF	1	4	3	51	A	Low	2	SB	1	4	0
5	K	Low	1	C	1	8	.	52	A	Low	2	TF	1	3	1
6	K	Low	1	KB	1	4	2	53	K	Low	2	C	1	4	.
7	K	Low	1	SB	1	5	0	54	K	Low	2	KB	1	1	7
8	K	Low	1	TF	1	1	28	55	K	Low	2	SB	1	2	0
9	BW	Low	1	C	1	13	.	56	K	Low	2	TF	1	5	9
10	BW	Low	1	KB	1	8	9	57	BW	Low	2	C	1	12	.
11	BW	Low	1	SB	1	8	0	58	BW	Low	2	KB	1	7	13
12	BW	Low	1	TF	1	10	4	59	BW	Low	2	SB	1	0	2
13	CR	Low	1	C	1	52	.	60	BW	Low	2	TF	1	9	4
14	CR	Low	1	KB	1	15	17	61	CR	Low	2	C	1	31	.
15	CR	Low	1	SB	1	12	2	62	CR	Low	2	KB	1	24	17
16	CR	Low	1	TF	1	30	2	63	CR	Low	2	SB	1	21	0
17	TB	Low	1	C	1	21	.	64	CR	Low	2	TF	1	26	6
18	TB	Low	1	KB	1	15	0	65	TB	Low	2	C	1	17	.
19	TB	Low	1	SB	1	9	1	66	TB	Low	2	KB	1	17	11
20	TB	Low	1	TF	1	14	3	67	TB	Low	2	SB	1	12	0
21	MIX	Low	1	C	1	22	.	68	TB	Low	2	TF	1	14	4
22	MIX	Low	1	KB	1	47	3	69	MIX	Low	2	C	1	25	.
23	MIX	Low	1	SB	1	24	0	70	MIX	Low	2	KB	1	19	21
24	MIX	Low	1	TF	1	37	3	71	MIX	Low	2	SB	1	16	0
25	A	High	1	C	1	4	.	72	MIX	Low	2	TF	1	27	4
26	A	High	1	KB	1	10	0	73	A	High	2	C	1	3	.
27	A	High	1	SB	1	0	3	74	A	High	2	KB	1	0	25
28	A	High	1	TF	1	2	10	75	A	High	2	SB	1	2	0
29	K	High	1	C	1	13	.	76	A	High	2	TF	1	5	1
30	K	High	1	KB	1	9	7	77	K	High	2	C	1	7	.
31	K	High	1	SB	1	3	0	78	K	High	2	KB	1	9	18
32	K	High	1	TF	1	8	5	79	K	High	2	SB	1	5	0
33	BW	High	1	C	1	26	.	80	K	High	2	TF	1	2	7
34	BW	High	1	KB	1	13	23	81	BW	High	2	C	1	24	.
35	BW	High	1	SB	1	11	0	82	BW	High	2	KB	1	27	21
36	BW	High	1	TF	1	33	2	83	BW	High	2	SB	1	19	0
37	CR	High	1	C	1	22	.	84	BW	High	2	TF	1	22	9
38	CR	High	1	KB	1	18	4	85	CR	High	2	C	1	14	.
39	CR	High	1	SB	1	43	0	86	CR	High	2	KB	1	10	26
40	CR	High	1	TF	1	28	1	87	CR	High	2	SB	1	8	0
41	TB	High	1	C	1	24	.	88	CR	High	2	TF	1	25	11
42	TB	High	1	KB	1	21	30	89	TB	High	2	C	1	23	.
43	TB	High	1	SB	1	2	0	90	TB	High	2	KB	1	27	13
44	TB	High	1	TF	1	16	1	91	TB	High	2	SB	1	24	0
45	MIX	High	1	C	1	12	.	92	TB	High	2	TF	1	31	3
46	MIX	High	1	KB	1	13	15	93	MIX	High	2	C	1	32	.
47	MIX	High	1	SB	1	18	0	94	MIX	High	2	KB	1	29	20

95	MIX	High	2	SB	1	34	0	143	MIX	High	3	SB	1	21	0
96	MIX	High	2	TF	1	31	8	144	MIX	High	3	TF	1	27	5
97	A	Low	3	C	1	0	.	1	A	Low	1	C	2	0	.
98	A	Low	3	KB	1	0	0	2	A	Low	1	KB	2	2	5
99	A	Low	3	SB	1	0	0	3	A	Low	1	SB	2	0	0
100	A	Low	3	TF	1	1	2	4	A	Low	1	TF	2	4	5
101	K	Low	3	C	1	3	.	5	K	Low	1	C	2	8	.
102	K	Low	3	KB	1	1	4	6	K	Low	1	KB	2	4	3
103	K	Low	3	SB	1	1	0	7	K	Low	1	SB	2	5	1
104	K	Low	3	TF	1	4	1	8	K	Low	1	TF	2	0	33
105	BW	Low	3	C	1	7	.	9	BW	Low	1	C	2	13	.
106	BW	Low	3	KB	1	9	7	10	BW	Low	1	KB	2	6	9
107	BW	Low	3	SB	1	4	1	11	BW	Low	1	SB	2	8	0
108	BW	Low	3	TF	1	5	3	12	BW	Low	1	TF	2	7	7
109	CR	Low	3	C	1	8	.	13	CR	Low	1	C	2	52	.
110	CR	Low	3	KB	1	6	13	14	CR	Low	1	KB	2	15	17
111	CR	Low	3	SB	1	11	0	15	CR	Low	1	SB	2	12	2
112	CR	Low	3	TF	1	2	17	16	CR	Low	1	TF	2	30	2
113	TB	Low	3	C	1	10	.	17	TB	Low	1	C	2	21	.
114	TB	Low	3	KB	1	7	5	18	TB	Low	1	KB	2	13	0
115	TB	Low	3	SB	1	7	0	19	TB	Low	1	SB	2	9	0
116	TB	Low	3	TF	1	5	9	20	TB	Low	1	TF	2	10	5
117	MIX	Low	3	C	1	14	.	21	MIX	Low	1	C	2	22	.
118	MIX	Low	3	KB	1	9	0	22	MIX	Low	1	KB	2	47	3
119	MIX	Low	3	SB	1	5	0	23	MIX	Low	1	SB	2	24	0
120	MIX	Low	3	TF	1	7	10	24	MIX	Low	1	TF	2	33	6
121	A	High	3	C	1	3	.	25	A	High	1	C	2	4	.
122	A	High	3	KB	1	1	3	26	A	High	1	KB	2	10	0
123	A	High	3	SB	1	4	0	27	A	High	1	SB	2	0	3
124	A	High	3	TF	1	2	3	28	A	High	1	TF	2	1	10
125	K	High	3	C	1	2	.	29	K	High	1	C	2	14	.
126	K	High	3	KB	1	5	5	30	K	High	1	KB	2	9	7
127	K	High	3	SB	1	0	0	31	K	High	1	SB	2	3	0
128	K	High	3	TF	1	7	11	32	K	High	1	TF	2	8	4
129	BW	High	3	C	1	9	.	33	BW	High	1	C	2	22	.
130	BW	High	3	KB	1	3	17	34	BW	High	1	KB	2	12	23
131	BW	High	3	SB	1	12	0	35	BW	High	1	SB	2	11	0
132	BW	High	3	TF	1	9	6	36	BW	High	1	TF	2	33	1
133	CR	High	3	C	1	21	.	37	CR	High	1	C	2	24	.
134	CR	High	3	KB	1	16	11	38	CR	High	1	KB	2	18	4
135	CR	High	3	SB	1	8	0	39	CR	High	1	SB	2	43	0
136	CR	High	3	TF	1	19	8	40	CR	High	1	TF	2	28	0
137	TB	High	3	C	1	17	.	41	TB	High	1	C	2	27	.
138	TB	High	3	KB	1	22	23	42	TB	High	1	KB	2	21	30
139	TB	High	3	SB	1	12	0	43	TB	High	1	SB	2	2	0
140	TB	High	3	TF	1	27	10	44	TB	High	1	TF	2	15	1
141	MIX	High	3	C	1	31	.	45	MIX	High	1	C	2	12	.
142	MIX	High	3	KB	1	25	2	46	MIX	High	1	KB	2	13	15

47	MIX	High	1	SB	2	18	0	95	MIX	High	2	SB	2	31	0
48	MIX	High	1	TF	2	6	4	96	MIX	High	2	TF	2	28	7
49	A	Low	2	C	2	2	.	97	A	Low	3	C	2	0	.
50	A	Low	2	KB	2	2	5	98	A	Low	3	KB	2	0	0
51	A	Low	2	SB	2	2	0	99	A	Low	3	SB	2	0	0
52	A	Low	2	TF	2	3	1	100	A	Low	3	TF	2	1	2
53	K	Low	2	C	2	5	.	101	K	Low	3	C	2	2	.
54	K	Low	2	KB	2	0	5	102	K	Low	3	KB	2	0	4
55	K	Low	2	SB	2	1	0	103	K	Low	3	SB	2	0	0
56	K	Low	2	TF	2	3	9	104	K	Low	3	TF	2	2	1
57	BW	Low	2	C	2	13	.	105	BW	Low	3	C	2	11	.
58	BW	Low	2	KB	2	7	13	106	BW	Low	3	KB	2	4	7
59	BW	Low	2	SB	2	0	2	107	BW	Low	3	SB	2	2	0
60	BW	Low	2	TF	2	5	4	108	BW	Low	3	TF	2	3	7
61	CR	Low	2	C	2	27	.	109	CR	Low	3	C	2	4	.
62	CR	Low	2	KB	2	22	17	110	CR	Low	3	KB	2	7	13
63	CR	Low	2	SB	2	21	0	111	CR	Low	3	SB	2	6	0
64	CR	Low	2	TF	2	24	6	112	CR	Low	3	TF	2	0	13
65	TB	Low	2	C	2	19	.	113	TB	Low	3	C	2	10	.
66	TB	Low	2	KB	2	13	11	114	TB	Low	3	KB	2	7	3
67	TB	Low	2	SB	2	9	0	115	TB	Low	3	SB	2	2	0
68	TB	Low	2	TF	2	11	5	116	TB	Low	3	TF	2	3	11
69	MIX	Low	2	C	2	21	.	117	MIX	Low	3	C	2	15	.
70	MIX	Low	2	KB	2	19	17	118	MIX	Low	3	KB	2	9	0
71	MIX	Low	2	SB	2	16	0	119	MIX	Low	3	SB	2	5	0
72	MIX	Low	2	TF	2	24	2	120	MIX	Low	3	TF	2	8	3
73	A	High	2	C	2	2	.	121	A	High	3	C	2	5	.
74	A	High	2	KB	2	0	23	122	A	High	3	KB	2	0	3
75	A	High	2	SB	2	2	0	123	A	High	3	SB	2	3	0
76	A	High	2	TF	2	5	0	124	A	High	3	TF	2	2	3
77	K	High	2	C	2	7	.	125	K	High	3	C	2	2	.
78	K	High	2	KB	2	8	16	126	K	High	3	KB	2	2	6
79	K	High	2	SB	2	3	0	127	K	High	3	SB	2	0	0
80	K	High	2	TF	2	0	7	128	K	High	3	TF	2	7	14
81	BW	High	2	C	2	27	.	129	BW	High	3	C	2	13	.
82	BW	High	2	KB	2	23	21	130	BW	High	3	KB	2	1	15
83	BW	High	2	SB	2	19	0	131	BW	High	3	SB	2	9	0
84	BW	High	2	TF	2	20	4	132	BW	High	3	TF	2	3	9
85	CR	High	2	C	2	14	.	133	CR	High	3	C	2	24	.
86	CR	High	2	KB	2	7	26	134	CR	High	3	KB	2	12	10
87	CR	High	2	SB	2	8	0	135	CR	High	3	SB	2	6	0
88	CR	High	2	TF	2	25	11	136	CR	High	3	TF	2	12	8
89	TB	High	2	C	2	21	.	137	TB	High	3	C	2	23	.
90	TB	High	2	KB	2	27	13	138	TB	High	3	KB	2	19	21
91	TB	High	2	SB	2	24	0	139	TB	High	3	SB	2	7	0
92	TB	High	2	TF	2	31	4	140	TB	High	3	TF	2	27	4
93	MIX	High	2	C	2	36	.	141	MIX	High	3	C	2	27	.
94	MIX	High	2	KB	2	23	20	142	MIX	High	3	KB	2	25	0

143	MIX	High	3	SB	2	23	0	47	MIX	High	1	SB	3	0	0
144	MIX	High	3	TF	2	24	3	48	MIX	High	1	TF	3	0	0
1	A	Low	1	C	3	0	.	49	A	Low	2	C	3	0	.
2	A	Low	1	KB	3	0	0	50	A	Low	2	KB	3	0	5
3	A	Low	1	SB	3	0	0	51	A	Low	2	SB	3	0	7
4	A	Low	1	TF	3	0	0	52	A	Low	2	TF	3	0	0
5	K	Low	1	C	3	0	.	53	K	Low	2	C	3	0	.
6	K	Low	1	KB	3	0	3	54	K	Low	2	KB	3	0	0
7	K	Low	1	SB	3	0	0	55	K	Low	2	SB	3	0	0
8	K	Low	1	TF	3	0	0	56	K	Low	2	TF	3	0	9
9	BW	Low	1	C	3	0	.	57	BW	Low	2	C	3	0	.
10	BW	Low	1	KB	3	0	0	58	BW	Low	2	KB	3	0	0
11	BW	Low	1	SB	3	0	0	59	BW	Low	2	SB	3	0	0
12	BW	Low	1	TF	3	0	0	60	BW	Low	2	TF	3	0	0
13	CR	Low	1	C	3	0	.	61	CR	Low	2	C	3	0	.
14	CR	Low	1	KB	3	0	0	62	CR	Low	2	KB	3	0	0
15	CR	Low	1	SB	3	0	0	63	CR	Low	2	SB	3	0	0
16	CR	Low	1	TF	3	0	4	64	CR	Low	2	TF	3	0	6
17	TB	Low	1	C	3	0	.	65	TB	Low	2	C	3	0	.
18	TB	Low	1	KB	3	0	0	66	TB	Low	2	KB	3	0	9
19	TB	Low	1	SB	3	0	0	67	TB	Low	2	SB	3	0	0
20	TB	Low	1	TF	3	0	0	68	TB	Low	2	TF	3	0	6
21	MIX	Low	1	C	3	0	.	69	MIX	Low	2	C	3	0	.
22	MIX	Low	1	KB	3	0	0	70	MIX	Low	2	KB	3	0	0
23	MIX	Low	1	SB	3	0	0	71	MIX	Low	2	SB	3	0	0
24	MIX	Low	1	TF	3	0	5	72	MIX	Low	2	TF	3	4	2
25	A	High	1	C	3	0	.	73	A	High	2	C	3	0	.
26	A	High	1	KB	3	0	0	74	A	High	2	KB	3	0	10
27	A	High	1	SB	3	0	0	75	A	High	2	SB	3	0	0
28	A	High	1	TF	3	0	0	76	A	High	2	TF	3	0	3
29	K	High	1	C	3	0	.	77	K	High	2	C	3	5	.
30	K	High	1	KB	3	0	0	78	K	High	2	KB	3	0	0
31	K	High	1	SB	3	0	0	79	K	High	2	SB	3	0	0
32	K	High	1	TF	3	0	0	80	K	High	2	TF	3	2	2
33	BW	High	1	C	3	0	.	81	BW	High	2	C	3	0	.
34	BW	High	1	KB	3	0	0	82	BW	High	2	KB	3	3	9
35	BW	High	1	SB	3	0	0	83	BW	High	2	SB	3	0	0
36	BW	High	1	TF	3	0	3	84	BW	High	2	TF	3	0	3
37	CR	High	1	C	3	0	.	85	CR	High	2	C	3	0	.
38	CR	High	1	KB	3	0	0	86	CR	High	2	KB	3	0	0
39	CR	High	1	SB	3	0	0	87	CR	High	2	SB	3	0	0
40	CR	High	1	TF	3	0	4	88	CR	High	2	TF	3	5	8
41	TB	High	1	C	3	0	.	89	TB	High	2	C	3	0	.
42	TB	High	1	KB	3	0	5	90	TB	High	2	KB	3	0	7
43	TB	High	1	SB	3	0	0	91	TB	High	2	SB	3	0	0
44	TB	High	1	TF	3	0	5	92	TB	High	2	TF	3	0	4
45	MIX	High	1	C	3	0	.	93	MIX	High	2	C	3	0	.
46	MIX	High	1	KB	3	0	8	94	MIX	High	2	KB	3	0	0

95	MIX	High	2	SB	3	0	0	120	MIX	Low	3	TF	3	0	0
96	MIX	High	2	TF	3	0	5	121	A	High	3	C	3	0	.
97	A	Low	3	C	3	0	.	122	A	High	3	KB	3	0	5
98	A	Low	3	KB	3	0	0	123	A	High	3	SB	3	0	0
99	A	Low	3	SB	3	0	0	124	A	High	3	TF	3	0	3
100	A	Low	3	TF	3	0	0	125	K	High	3	C	3	0	.
101	K	Low	3	C	3	0	.	126	K	High	3	KB	3	0	0
102	K	Low	3	KB	3	3	6	127	K	High	3	SB	3	0	0
103	K	Low	3	SB	3	0	0	128	K	High	3	TF	3	4	9
104	K	Low	3	TF	3	0	0	129	BW	High	3	C	3	0	.
105	BW	Low	3	C	3	0	.	130	BW	High	3	KB	3	0	0
106	BW	Low	3	KB	3	4	4	131	BW	High	3	SB	3	0	0
107	BW	Low	3	SB	3	0	.	132	BW	High	3	TF	3	0	7
108	BW	Low	3	TF	3	4	5	133	CR	High	3	C	3	0	.
109	CR	Low	3	C	3	0	.	134	CR	High	3	KB	3	0	0
110	CR	Low	3	KB	3	0	0	135	CR	High	3	SB	3	0	0
111	CR	Low	3	SB	3	0	0	136	CR	High	3	TF	3	0	0
112	CR	Low	3	TF	3	0	9	137	TB	High	3	C	3	0	.
113	TB	Low	3	C	3	0	.	138	TB	High	3	KB	3	0	0
114	TB	Low	3	KB	3	0	0	139	TB	High	3	SB	3	0	3
115	TB	Low	3	SB	3	0	0	140	TB	High	3	TF	3	0	0
116	TB	Low	3	TF	3	0	6	141	MIX	High	3	C	3	0	.
117	MIX	Low	3	C	3	0	.	142	MIX	High	3	KB	3	0	6
118	MIX	Low	3	KB	3	0	0	143	MIX	High	3	SB	3	0	0
119	MIX	Low	3	SB	3	0	0	144	MIX	High	3	TF	3	0	4

Appendix 2d. Soil moisture data for the *Panicum virgatum* cultivars over eleven collection dates. CV = Cultivar (A=‘Alamo’, K=‘Kanlow’, BW=‘Blackwell’, CR=‘Cave in Rock’, TB=‘Trailblazer’), MOIST = Moisture Level, BLK = Block, INV = Invasive Species (C=Control, KB=Kentucky Bluegrass, SB=Smooth Brome, TF=Tall Fescue), and SM=Soil Moisture (cm/m).

POT ID	CV	MOIST.	BLK	INV	DAY	SM	POT ID	CV	MOIST.	BLK	INV	DAY	SM
1	A	Low	1	C	1	2.7	49	A	Low	2	C	1	3
2	A	Low	1	KB	1	3.2	50	A	Low	2	KB	1	3
3	A	Low	1	SB	1	2.3	51	A	Low	2	SB	1	2
4	A	Low	1	TF	1	1.8	52	A	Low	2	TF	1	3
5	K	Low	1	C	1	2.6	53	K	Low	2	C	1	4
6	K	Low	1	KB	1	2.9	54	K	Low	2	KB	1	3
7	K	Low	1	SB	1	2.5	55	K	Low	2	SB	1	3
8	K	Low	1	TF	1	2.4	56	K	Low	2	TF	1	3
9	BW	Low	1	C	1	5.6	57	BW	Low	2	C	1	7
10	BW	Low	1	KB	1	5.9	58	BW	Low	2	KB	1	8
11	BW	Low	1	SB	1	5.4	59	BW	Low	2	SB	1	7
12	BW	Low	1	TF	1	5.7	60	BW	Low	2	TF	1	7
13	CR	Low	1	C	1	8.1	61	CR	Low	2	C	1	7
14	CR	Low	1	KB	1	7.6	62	CR	Low	2	KB	1	6
15	CR	Low	1	SB	1	8.2	63	CR	Low	2	SB	1	6
16	CR	Low	1	TF	1	7.7	64	CR	Low	2	TF	1	5
17	TB	Low	1	C	1	7.4	65	TB	Low	2	C	1	7
18	TB	Low	1	KB	1	7.3	66	TB	Low	2	KB	1	8
19	TB	Low	1	SB	1	6.5	67	TB	Low	2	SB	1	7
20	TB	Low	1	TF	1	6.9	68	TB	Low	2	TF	1	7
21	MIX	Low	1	C	1	7.8	69	MIX	Low	2	C	1	8
22	MIX	Low	1	KB	1	6.2	70	MIX	Low	2	KB	1	7
23	MIX	Low	1	SB	1	6.8	71	MIX	Low	2	SB	1	7
24	MIX	Low	1	TF	1	6.4	72	MIX	Low	2	TF	1	7
25	A	High	1	C	1	7.2	73	A	High	2	C	1	6
26	A	High	1	KB	1	5.8	74	A	High	2	KB	1	6
27	A	High	1	SB	1	5.2	75	A	High	2	SB	1	5
28	A	High	1	TF	1	6.1	76	A	High	2	TF	1	6
29	K	High	1	C	1	7.3	77	K	High	2	C	1	6
30	K	High	1	KB	1	4.3	78	K	High	2	KB	1	6
31	K	High	1	SB	1	5.9	79	K	High	2	SB	1	6
32	K	High	1	TF	1	6.4	80	K	High	2	TF	1	6
33	BW	High	1	C	1	11.4	81	BW	High	2	C	1	10
34	BW	High	1	KB	1	9.6	82	BW	High	2	KB	1	10
35	BW	High	1	SB	1	10.5	83	BW	High	2	SB	1	10
36	BW	High	1	TF	1	8.9	84	BW	High	2	TF	1	11
37	CR	High	1	C	1	11.7	85	CR	High	2	C	1	11
38	CR	High	1	KB	1	11.3	86	CR	High	2	KB	1	11
39	CR	High	1	SB	1	10.6	87	CR	High	2	SB	1	11
40	CR	High	1	TF	1	11.4	88	CR	High	2	TF	1	10
41	TB	High	1	C	1	9.8	89	TB	High	2	C	1	11
42	TB	High	1	KB	1	9.2	90	TB	High	2	KB	1	11
43	TB	High	1	SB	1	8.9	91	TB	High	2	SB	1	10
44	TB	High	1	TF	1	9.3	92	TB	High	2	TF	1	9
45	MIX	High	1	C	1	10.2	93	MIX	High	2	C	1	9
46	MIX	High	1	KB	1	10.6	94	MIX	High	2	KB	1	9
47	MIX	High	1	SB	1	10.3	95	MIX	High	2	SB	1	10
48	MIX	High	1	TF	1	9.9	96	MIX	High	2	TF	1	9

97	A	Low	3	C	1	3.7	2	A	Low	1	KB	2	4
98	A	Low	3	KB	1	3.9	3	A	Low	1	SB	2	3
99	A	Low	3	SB	1	3.7	4	A	Low	1	TF	2	2
100	A	Low	3	TF	1	3.3	5	K	Low	1	C	2	3
101	K	Low	3	C	1	3.5	6	K	Low	1	KB	2	3
102	K	Low	3	KB	1	3.1	7	K	Low	1	SB	2	3
103	K	Low	3	SB	1	2.9	8	K	Low	1	TF	2	3
104	K	Low	3	TF	1	3	9	BW	Low	1	C	2	6
105	BW	Low	3	C	1	6.5	10	BW	Low	1	KB	2	6
106	BW	Low	3	KB	1	7.1	11	BW	Low	1	SB	2	6
107	BW	Low	3	SB	1	6.8	12	BW	Low	1	TF	2	6
108	BW	Low	3	TF	1	6.5	13	CR	Low	1	C	2	9
109	CR	Low	3	C	1	6.2	14	CR	Low	1	KB	2	8
110	CR	Low	3	KB	1	8.5	15	CR	Low	1	SB	2	9
111	CR	Low	3	SB	1	8.3	16	CR	Low	1	TF	2	8
112	CR	Low	3	TF	1	8.6	17	TB	Low	1	C	2	8
113	TB	Low	3	C	1	8	18	TB	Low	1	KB	2	8
114	TB	Low	3	KB	1	7.7	19	TB	Low	1	SB	2	7
115	TB	Low	3	SB	1	7.9	20	TB	Low	1	TF	2	7
116	TB	Low	3	TF	1	7.2	21	MIX	Low	1	C	2	8
117	MIX	Low	3	C	1	7	22	MIX	Low	1	KB	2	7
118	MIX	Low	3	KB	1	7.8	23	MIX	Low	1	SB	2	7
119	MIX	Low	3	SB	1	7.4	24	MIX	Low	1	TF	2	7
120	MIX	Low	3	TF	1	7.5	25	A	High	1	C	2	7
121	A	High	3	C	1	5.6	26	A	High	1	KB	2	6
122	A	High	3	KB	1	6	27	A	High	1	SB	2	6
123	A	High	3	SB	1	5.9	28	A	High	1	TF	2	6
124	A	High	3	TF	1	5.7	29	K	High	1	C	2	7
125	K	High	3	C	1	6.5	30	K	High	1	KB	2	5
126	K	High	3	KB	1	6.2	31	K	High	1	SB	2	7
127	K	High	3	SB	1	6.5	32	K	High	1	TF	2	6
128	K	High	3	TF	1	6.1	33	BW	High	1	C	2	11
129	BW	High	3	C	1	10.6	34	BW	High	1	KB	2	10
130	BW	High	3	KB	1	11.4	35	BW	High	1	SB	2	10
131	BW	High	3	SB	1	9.8	36	BW	High	1	TF	2	9
132	BW	High	3	TF	1	9.2	37	CR	High	1	C	2	12
133	CR	High	3	C	1	8.9	38	CR	High	1	KB	2	12
134	CR	High	3	KB	1	10.3	39	CR	High	1	SB	2	10
135	CR	High	3	SB	1	9.5	40	CR	High	1	TF	2	11
136	CR	High	3	TF	1	9.8	41	TB	High	1	C	2	10
137	TB	High	3	C	1	9.2	42	TB	High	1	KB	2	10
138	TB	High	3	KB	1	8.9	43	TB	High	1	SB	2	10
139	TB	High	3	SB	1	9.3	44	TB	High	1	TF	2	10
140	TB	High	3	TF	1	8.7	45	MIX	High	1	C	2	11
141	MIX	High	3	C	1	9.2	46	MIX	High	1	KB	2	11
142	MIX	High	3	KB	1	9.5	47	MIX	High	1	SB	2	11
143	MIX	High	3	SB	1	9.4	48	MIX	High	1	TF	2	11
144	MIX	High	3	TF	1	9.4	49	A	Low	2	C	2	3
1	A	Low	1	C	2	2.2	50	A	Low	2	KB	2	3

51	A	Low	2	SB	2	2.5	100	A	Low	3	TF	2	4
52	A	Low	2	TF	2	3.7	101	K	Low	3	C	2	4
53	K	Low	2	C	2	3.9	102	K	Low	3	KB	2	3
54	K	Low	2	KB	2	3.7	103	K	Low	3	SB	2	3
55	K	Low	2	SB	2	3.3	104	K	Low	3	TF	2	3
56	K	Low	2	TF	2	3.4	105	BW	Low	3	C	2	7
57	BW	Low	2	C	2	7.6	106	BW	Low	3	KB	2	8
58	BW	Low	2	KB	2	8.5	107	BW	Low	3	SB	2	7
59	BW	Low	2	SB	2	6.8	108	BW	Low	3	TF	2	7
60	BW	Low	2	TF	2	7.7	109	CR	Low	3	C	2	7
61	CR	Low	2	C	2	7.1	110	CR	Low	3	KB	2	8
62	CR	Low	2	KB	2	6.2	111	CR	Low	3	SB	2	9
63	CR	Low	2	SB	2	5.9	112	CR	Low	3	TF	2	9
64	CR	Low	2	TF	2	5.8	113	TB	Low	3	C	2	8
65	TB	Low	2	C	2	8.1	114	TB	Low	3	KB	2	8
66	TB	Low	2	KB	2	8.1	115	TB	Low	3	SB	2	8
67	TB	Low	2	SB	2	7.6	116	TB	Low	3	TF	2	8
68	TB	Low	2	TF	2	7.2	117	MIX	Low	3	C	2	7
69	MIX	Low	2	C	2	7.7	118	MIX	Low	3	KB	2	8
70	MIX	Low	2	KB	2	7.4	119	MIX	Low	3	SB	2	8
71	MIX	Low	2	SB	2	7.3	120	MIX	Low	3	TF	2	8
72	MIX	Low	2	TF	2	6.9	121	A	High	3	C	2	6
73	A	High	2	C	2	6.2	122	A	High	3	KB	2	6
74	A	High	2	KB	2	5.9	123	A	High	3	SB	2	6
75	A	High	2	SB	2	5.7	124	A	High	3	TF	2	6
76	A	High	2	TF	2	5.8	125	K	High	3	C	2	7
77	K	High	2	C	2	6.2	126	K	High	3	KB	2	7
78	K	High	2	KB	2	6.5	127	K	High	3	SB	2	7
79	K	High	2	SB	2	6.3	128	K	High	3	TF	2	6
80	K	High	2	TF	2	6.6	129	BW	High	3	C	2	11
81	BW	High	2	C	2	10.5	130	BW	High	3	KB	2	12
82	BW	High	2	KB	2	10.3	131	BW	High	3	SB	2	10
83	BW	High	2	SB	2	10.7	132	BW	High	3	TF	2	10
84	BW	High	2	TF	2	11.1	133	CR	High	3	C	2	9
85	CR	High	2	C	2	10.9	134	CR	High	3	KB	2	11
86	CR	High	2	KB	2	11.7	135	CR	High	3	SB	2	10
87	CR	High	2	SB	2	11.5	136	CR	High	3	TF	2	10
88	CR	High	2	TF	2	10.7	137	TB	High	3	C	2	10
89	TB	High	2	C	2	11.5	138	TB	High	3	KB	2	9
90	TB	High	2	KB	2	11.3	139	TB	High	3	SB	2	10
91	TB	High	2	SB	2	10.3	140	TB	High	3	TF	2	9
92	TB	High	2	TF	2	9.6	141	MIX	High	3	C	2	10
93	MIX	High	2	C	2	9.3	142	MIX	High	3	KB	2	10
94	MIX	High	2	KB	2	9.7	143	MIX	High	3	SB	2	10
95	MIX	High	2	SB	2	10.2	144	MIX	High	3	TF	2	10
96	MIX	High	2	TF	2	10.3	1	A	Low	1	C	3	3
97	A	Low	3	C	2	4	2	A	Low	1	KB	3	4
98	A	Low	3	KB	2	4.3	3	A	Low	1	SB	3	3
99	A	Low	3	SB	2	4.1	4	A	Low	1	TF	3	3

5	K	Low	1	C	3	2.9	54	K	Low	2	KB	3	4
6	K	Low	1	KB	3	3.4	55	K	Low	2	SB	3	4
7	K	Low	1	SB	3	3.7	56	K	Low	2	TF	3	4
8	K	Low	1	TF	3	3.3	57	BW	Low	2	C	3	8
9	BW	Low	1	C	3	6.8	58	BW	Low	2	KB	3	9
10	BW	Low	1	KB	3	6.9	59	BW	Low	2	SB	3	7
11	BW	Low	1	SB	3	6.5	60	BW	Low	2	TF	3	8
12	BW	Low	1	TF	3	6.8	61	CR	Low	2	C	3	7
13	CR	Low	1	C	3	8.8	62	CR	Low	2	KB	3	7
14	CR	Low	1	KB	3	8.9	63	CR	Low	2	SB	3	6
15	CR	Low	1	SB	3	9.1	64	CR	Low	2	TF	3	6
16	CR	Low	1	TF	3	8.5	65	TB	Low	2	C	3	9
17	TB	Low	1	C	3	8.3	66	TB	Low	2	KB	3	8
18	TB	Low	1	KB	3	8.3	67	TB	Low	2	SB	3	8
19	TB	Low	1	SB	3	7.5	68	TB	Low	2	TF	3	8
20	TB	Low	1	TF	3	7.7	69	MIX	Low	2	C	3	8
21	MIX	Low	1	C	3	8.5	70	MIX	Low	2	KB	3	8
22	MIX	Low	1	KB	3	6.9	71	MIX	Low	2	SB	3	8
23	MIX	Low	1	SB	3	7.9	72	MIX	Low	2	TF	3	7
24	MIX	Low	1	TF	3	7.4	73	A	High	2	C	3	7
25	A	High	1	C	3	7.5	74	A	High	2	KB	3	6
26	A	High	1	KB	3	6.4	75	A	High	2	SB	3	6
27	A	High	1	SB	3	5.9	76	A	High	2	TF	3	6
28	A	High	1	TF	3	5.7	77	K	High	2	C	3	7
29	K	High	1	C	3	8.2	78	K	High	2	KB	3	7
30	K	High	1	KB	3	5.8	79	K	High	2	SB	3	7
31	K	High	1	SB	3	7.1	80	K	High	2	TF	3	7
32	K	High	1	TF	3	6.8	81	BW	High	2	C	3	11
33	BW	High	1	C	3	11.7	82	BW	High	2	KB	3	11
34	BW	High	1	KB	3	10.3	83	BW	High	2	SB	3	11
35	BW	High	1	SB	3	10.4	84	BW	High	2	TF	3	11
36	BW	High	1	TF	3	9.7	85	CR	High	2	C	3	11
37	CR	High	1	C	3	12.3	86	CR	High	2	KB	3	12
38	CR	High	1	KB	3	11.6	87	CR	High	2	SB	3	12
39	CR	High	1	SB	3	10	88	CR	High	2	TF	3	12
40	CR	High	1	TF	3	10.8	89	TB	High	2	C	3	12
41	TB	High	1	C	3	10.9	90	TB	High	2	KB	3	12
42	TB	High	1	KB	3	10.2	91	TB	High	2	SB	3	11
43	TB	High	1	SB	3	10.1	92	TB	High	2	TF	3	10
44	TB	High	1	TF	3	9.8	93	MIX	High	2	C	3	10
45	MIX	High	1	C	3	10.9	94	MIX	High	2	KB	3	10
46	MIX	High	1	KB	3	11.9	95	MIX	High	2	SB	3	11
47	MIX	High	1	SB	3	11.1	96	MIX	High	2	TF	3	11
48	MIX	High	1	TF	3	11.6	97	A	Low	3	C	3	4
49	A	Low	2	C	3	3.4	98	A	Low	3	KB	3	5
50	A	Low	2	KB	3	3	99	A	Low	3	SB	3	4
51	A	Low	2	SB	3	2.9	100	A	Low	3	TF	3	4
52	A	Low	2	TF	3	4.2	101	K	Low	3	C	3	4
53	K	Low	2	C	3	4.4	102	K	Low	3	KB	3	4

103	K	Low	3	SB	3	3.7	8	K	Low	1	TF	4	4
104	K	Low	3	TF	3	3.5	9	BW	Low	1	C	4	7
105	BW	Low	3	C	3	7.3	10	BW	Low	1	KB	4	8
106	BW	Low	3	KB	3	7.8	11	BW	Low	1	SB	4	7
107	BW	Low	3	SB	3	7.2	12	BW	Low	1	TF	4	7
108	BW	Low	3	TF	3	7.1	13	CR	Low	1	C	4	9
109	CR	Low	3	C	3	6.8	14	CR	Low	1	KB	4	9
110	CR	Low	3	KB	3	8.4	15	CR	Low	1	SB	4	10
111	CR	Low	3	SB	3	8.9	16	CR	Low	1	TF	4	9
112	CR	Low	3	TF	3	9	17	TB	Low	1	C	4	9
113	TB	Low	3	C	3	8.6	18	TB	Low	1	KB	4	9
114	TB	Low	3	KB	3	8.3	19	TB	Low	1	SB	4	8
115	TB	Low	3	SB	3	8.8	20	TB	Low	1	TF	4	8
116	TB	Low	3	TF	3	7.7	21	MIX	Low	1	C	4	9
117	MIX	Low	3	C	3	7.5	22	MIX	Low	1	KB	4	7
118	MIX	Low	3	KB	3	8.3	23	MIX	Low	1	SB	4	8
119	MIX	Low	3	SB	3	7.8	24	MIX	Low	1	TF	4	8
120	MIX	Low	3	TF	3	8.1	25	A	High	1	C	4	8
121	A	High	3	C	3	6.2	26	A	High	1	KB	4	7
122	A	High	3	KB	3	6.5	27	A	High	1	SB	4	7
123	A	High	3	SB	3	6.4	28	A	High	1	TF	4	7
124	A	High	3	TF	3	6.3	29	K	High	1	C	4	10
125	K	High	3	C	3	7.1	30	K	High	1	KB	4	6
126	K	High	3	KB	3	6.9	31	K	High	1	SB	4	8
127	K	High	3	SB	3	7.2	32	K	High	1	TF	4	7
128	K	High	3	TF	3	6.9	33	BW	High	1	C	4	12
129	BW	High	3	C	3	11.1	34	BW	High	1	KB	4	11
130	BW	High	3	KB	3	11.8	35	BW	High	1	SB	4	11
131	BW	High	3	SB	3	10.6	36	BW	High	1	TF	4	10
132	BW	High	3	TF	3	10.2	37	CR	High	1	C	4	13
133	CR	High	3	C	3	9.4	38	CR	High	1	KB	4	12
134	CR	High	3	KB	3	10.9	39	CR	High	1	SB	4	10
135	CR	High	3	SB	3	10.1	40	CR	High	1	TF	4	12
136	CR	High	3	TF	3	10.7	41	TB	High	1	C	4	11
137	TB	High	3	C	3	10.2	42	TB	High	1	KB	4	11
138	TB	High	3	KB	3	9.7	43	TB	High	1	SB	4	11
139	TB	High	3	SB	3	10	44	TB	High	1	TF	4	10
140	TB	High	3	TF	3	9.5	45	MIX	High	1	C	4	12
141	MIX	High	3	C	3	9.9	46	MIX	High	1	KB	4	12
142	MIX	High	3	KB	3	10.3	47	MIX	High	1	SB	4	12
143	MIX	High	3	SB	3	10.1	48	MIX	High	1	TF	4	12
144	MIX	High	3	TF	3	9.8	49	A	Low	2	C	4	4
1	A	Low	1	C	4	2.9	50	A	Low	2	KB	4	3
2	A	Low	1	KB	4	4.5	51	A	Low	2	SB	4	3
3	A	Low	1	SB	4	3.3	52	A	Low	2	TF	4	5
4	A	Low	1	TF	4	2.1	53	K	Low	2	C	4	5
5	K	Low	1	C	4	3.2	54	K	Low	2	KB	4	5
6	K	Low	1	KB	4	3.8	55	K	Low	2	SB	4	4
7	K	Low	1	SB	4	3.5	56	K	Low	2	TF	4	4

57	BW	Low	2	C	4	8.2	106	BW	Low	3	KB	4	8
58	BW	Low	2	KB	4	9.3	107	BW	Low	3	SB	4	8
59	BW	Low	2	SB	4	7.5	108	BW	Low	3	TF	4	7
60	BW	Low	2	TF	4	8.6	109	CR	Low	3	C	4	7
61	CR	Low	2	C	4	7.8	110	CR	Low	3	KB	4	9
62	CR	Low	2	KB	4	6.7	111	CR	Low	3	SB	4	10
63	CR	Low	2	SB	4	6.1	112	CR	Low	3	TF	4	9
64	CR	Low	2	TF	4	6.6	113	TB	Low	3	C	4	9
65	TB	Low	2	C	4	8.9	114	TB	Low	3	KB	4	8
66	TB	Low	2	KB	4	8.6	115	TB	Low	3	SB	4	9
67	TB	Low	2	SB	4	8.4	116	TB	Low	3	TF	4	8
68	TB	Low	2	TF	4	8	117	MIX	Low	3	C	4	8
69	MIX	Low	2	C	4	8.4	118	MIX	Low	3	KB	4	9
70	MIX	Low	2	KB	4	8.1	119	MIX	Low	3	SB	4	8
71	MIX	Low	2	SB	4	7.9	120	MIX	Low	3	TF	4	9
72	MIX	Low	2	TF	4	7.7	121	A	High	3	C	4	7
73	A	High	2	C	4	6.8	122	A	High	3	KB	4	7
74	A	High	2	KB	4	6.7	123	A	High	3	SB	4	7
75	A	High	2	SB	4	6.4	124	A	High	3	TF	4	7
76	A	High	2	TF	4	6.5	125	K	High	3	C	4	7
77	K	High	2	C	4	7.4	126	K	High	3	KB	4	7
78	K	High	2	KB	4	7.2	127	K	High	3	SB	4	8
79	K	High	2	SB	4	6.9	128	K	High	3	TF	4	7
80	K	High	2	TF	4	7.4	129	BW	High	3	C	4	12
81	BW	High	2	C	4	11.6	130	BW	High	3	KB	4	12
82	BW	High	2	KB	4	11.3	131	BW	High	3	SB	4	11
83	BW	High	2	SB	4	11.5	132	BW	High	3	TF	4	11
84	BW	High	2	TF	4	11.7	133	CR	High	3	C	4	10
85	CR	High	2	C	4	11.5	134	CR	High	3	KB	4	11
86	CR	High	2	KB	4	12.4	135	CR	High	3	SB	4	11
87	CR	High	2	SB	4	12.2	136	CR	High	3	TF	4	11
88	CR	High	2	TF	4	11.9	137	TB	High	3	C	4	10
89	TB	High	2	C	4	12.7	138	TB	High	3	KB	4	10
90	TB	High	2	KB	4	12.3	139	TB	High	3	SB	4	10
91	TB	High	2	SB	4	11.4	140	TB	High	3	TF	4	10
92	TB	High	2	TF	4	10.2	141	MIX	High	3	C	4	10
93	MIX	High	2	C	4	10.5	142	MIX	High	3	KB	4	10
94	MIX	High	2	KB	4	10.8	143	MIX	High	3	SB	4	10
95	MIX	High	2	SB	4	10.9	144	MIX	High	3	TF	4	10
96	MIX	High	2	TF	4	11.1	1	A	Low	1	C	5	3
97	A	Low	3	C	4	4.5	2	A	Low	1	KB	5	5
98	A	Low	3	KB	4	4.8	3	A	Low	1	SB	5	4
99	A	Low	3	SB	4	4.7	4	A	Low	1	TF	5	2
100	A	Low	3	TF	4	4.5	5	K	Low	1	C	5	4
101	K	Low	3	C	4	4.6	6	K	Low	1	KB	5	4
102	K	Low	3	KB	4	4.1	7	K	Low	1	SB	5	4
103	K	Low	3	SB	4	4.5	8	K	Low	1	TF	5	4
104	K	Low	3	TF	4	3.8	9	BW	Low	1	C	5	8
105	BW	Low	3	C	4	7.7	10	BW	Low	1	KB	5	8

11	BW	Low	1	SB	5	7.8	60	BW	Low	2	TF	5	9
12	BW	Low	1	TF	5	7.6	61	CR	Low	2	C	5	8
13	CR	Low	1	C	5	9.7	62	CR	Low	2	KB	5	7
14	CR	Low	1	KB	5	9.9	63	CR	Low	2	SB	5	7
15	CR	Low	1	SB	5	10.1	64	CR	Low	2	TF	5	7
16	CR	Low	1	TF	5	9.1	65	TB	Low	2	C	5	9
17	TB	Low	1	C	5	9.1	66	TB	Low	2	KB	5	9
18	TB	Low	1	KB	5	9.4	67	TB	Low	2	SB	5	9
19	TB	Low	1	SB	5	8.5	68	TB	Low	2	TF	5	8
20	TB	Low	1	TF	5	8.6	69	MIX	Low	2	C	5	9
21	MIX	Low	1	C	5	9.4	70	MIX	Low	2	KB	5	9
22	MIX	Low	1	KB	5	7.9	71	MIX	Low	2	SB	5	8
23	MIX	Low	1	SB	5	8.8	72	MIX	Low	2	TF	5	8
24	MIX	Low	1	TF	5	7.7	73	A	High	2	C	5	7
25	A	High	1	C	5	9.4	74	A	High	2	KB	5	7
26	A	High	1	KB	5	7.9	75	A	High	2	SB	5	7
27	A	High	1	SB	5	7	76	A	High	2	TF	5	6
28	A	High	1	TF	5	7.8	77	K	High	2	C	5	8
29	K	High	1	C	5	10.4	78	K	High	2	KB	5	8
30	K	High	1	KB	5	7.1	79	K	High	2	SB	5	8
31	K	High	1	SB	5	9.2	80	K	High	2	TF	5	8
32	K	High	1	TF	5	7.7	81	BW	High	2	C	5	12
33	BW	High	1	C	5	12.3	82	BW	High	2	KB	5	12
34	BW	High	1	KB	5	11.4	83	BW	High	2	SB	5	12
35	BW	High	1	SB	5	11.8	84	BW	High	2	TF	5	12
36	BW	High	1	TF	5	10.7	85	CR	High	2	C	5	12
37	CR	High	1	C	5	12.9	86	CR	High	2	KB	5	13
38	CR	High	1	KB	5	13.1	87	CR	High	2	SB	5	13
39	CR	High	1	SB	5	10.8	88	CR	High	2	TF	5	12
40	CR	High	1	TF	5	12.2	89	TB	High	2	C	5	13
41	TB	High	1	C	5	11.7	90	TB	High	2	KB	5	13
42	TB	High	1	KB	5	11.5	91	TB	High	2	SB	5	12
43	TB	High	1	SB	5	10.1	92	TB	High	2	TF	5	11
44	TB	High	1	TF	5	10	93	MIX	High	2	C	5	11
45	MIX	High	1	C	5	12.1	94	MIX	High	2	KB	5	12
46	MIX	High	1	KB	5	12.6	95	MIX	High	2	SB	5	11
47	MIX	High	1	SB	5	12.2	96	MIX	High	2	TF	5	11
48	MIX	High	1	TF	5	12.7	97	A	Low	3	C	5	5
49	A	Low	2	C	5	4.2	98	A	Low	3	KB	5	5
50	A	Low	2	KB	5	3.8	99	A	Low	3	SB	5	5
51	A	Low	2	SB	5	3.7	100	A	Low	3	TF	5	5
52	A	Low	2	TF	5	4.9	101	K	Low	3	C	5	5
53	K	Low	2	C	5	4.8	102	K	Low	3	KB	5	5
54	K	Low	2	KB	5	4.7	103	K	Low	3	SB	5	4
55	K	Low	2	SB	5	4.3	104	K	Low	3	TF	5	4
56	K	Low	2	TF	5	3.7	105	BW	Low	3	C	5	8
57	BW	Low	2	C	5	8.5	106	BW	Low	3	KB	5	8
58	BW	Low	2	KB	5	9.7	107	BW	Low	3	SB	5	8
59	BW	Low	2	SB	5	7.8	108	BW	Low	3	TF	5	8

109	CR	Low	3	C	5	7.5	14	CR	Low	1	KB	6	10
110	CR	Low	3	KB	5	9.1	15	CR	Low	1	SB	6	10
111	CR	Low	3	SB	5	9.7	16	CR	Low	1	TF	6	9
112	CR	Low	3	TF	5	9.5	17	TB	Low	1	C	6	10
113	TB	Low	3	C	5	9.4	18	TB	Low	1	KB	6	10
114	TB	Low	3	KB	5	8.1	19	TB	Low	1	SB	6	8
115	TB	Low	3	SB	5	9.3	20	TB	Low	1	TF	6	9
116	TB	Low	3	TF	5	8.4	21	MIX	Low	1	C	6	10
117	MIX	Low	3	C	5	8.3	22	MIX	Low	1	KB	6	9
118	MIX	Low	3	KB	5	9.2	23	MIX	Low	1	SB	6	9
119	MIX	Low	3	SB	5	8.5	24	MIX	Low	1	TF	6	8
120	MIX	Low	3	TF	5	8.9	25	A	High	1	C	6	10
121	A	High	3	C	5	6.8	26	A	High	1	KB	6	8
122	A	High	3	KB	5	7.3	27	A	High	1	SB	6	7
123	A	High	3	SB	5	6.8	28	A	High	1	TF	6	8
124	A	High	3	TF	5	6.9	29	K	High	1	C	6	11
125	K	High	3	C	5	7.8	30	K	High	1	KB	6	8
126	K	High	3	KB	5	7.5	31	K	High	1	SB	6	10
127	K	High	3	SB	5	8	32	K	High	1	TF	6	8
128	K	High	3	TF	5	7.7	33	BW	High	1	C	6	13
129	BW	High	3	C	5	11.8	34	BW	High	1	KB	6	12
130	BW	High	3	KB	5	12.3	35	BW	High	1	SB	6	12
131	BW	High	3	SB	5	11.1	36	BW	High	1	TF	6	11
132	BW	High	3	TF	5	10.9	37	CR	High	1	C	6	13
133	CR	High	3	C	5	10.3	38	CR	High	1	KB	6	14
134	CR	High	3	KB	5	11.5	39	CR	High	1	SB	6	12
135	CR	High	3	SB	5	10.3	40	CR	High	1	TF	6	13
136	CR	High	3	TF	5	11.5	41	TB	High	1	C	6	13
137	TB	High	3	C	5	10.7	42	TB	High	1	KB	6	12
138	TB	High	3	KB	5	10.1	43	TB	High	1	SB	6	10
139	TB	High	3	SB	5	10.6	44	TB	High	1	TF	6	11
140	TB	High	3	TF	5	10	45	MIX	High	1	C	6	13
141	MIX	High	3	C	5	10.5	46	MIX	High	1	KB	6	13
142	MIX	High	3	KB	5	10.5	47	MIX	High	1	SB	6	13
143	MIX	High	3	SB	5	10.8	48	MIX	High	1	TF	6	12
144	MIX	High	3	TF	5	10.6	49	A	Low	2	C	6	4
1	A	Low	1	C	6	3.7	50	A	Low	2	KB	6	4
2	A	Low	1	KB	6	5	51	A	Low	2	SB	6	4
3	A	Low	1	SB	6	4.1	52	A	Low	2	TF	6	5
4	A	Low	1	TF	6	2.7	53	K	Low	2	C	6	5
5	K	Low	1	C	6	4.2	54	K	Low	2	KB	6	5
6	K	Low	1	KB	6	4.9	55	K	Low	2	SB	6	5
7	K	Low	1	SB	6	4.4	56	K	Low	2	TF	6	4
8	K	Low	1	TF	6	4.5	57	BW	Low	2	C	6	9
9	BW	Low	1	C	6	8.4	58	BW	Low	2	KB	6	10
10	BW	Low	1	KB	6	8.6	59	BW	Low	2	SB	6	8
11	BW	Low	1	SB	6	8.5	60	BW	Low	2	TF	6	9
12	BW	Low	1	TF	6	8.2	61	CR	Low	2	C	6	8
13	CR	Low	1	C	6	9.9	62	CR	Low	2	KB	6	8

63	CR	Low	2	SB	6	6.7	112	CR	Low	3	TF	6	10
64	CR	Low	2	TF	6	7.4	113	TB	Low	3	C	6	10
65	TB	Low	2	C	6	9.9	114	TB	Low	3	KB	6	9
66	TB	Low	2	KB	6	9.5	115	TB	Low	3	SB	6	9
67	TB	Low	2	SB	6	9.2	116	TB	Low	3	TF	6	9
68	TB	Low	2	TF	6	8.7	117	MIX	Low	3	C	6	9
69	MIX	Low	2	C	6	9.1	118	MIX	Low	3	KB	6	10
70	MIX	Low	2	KB	6	8.8	119	MIX	Low	3	SB	6	9
71	MIX	Low	2	SB	6	8.5	120	MIX	Low	3	TF	6	9
72	MIX	Low	2	TF	6	7.9	121	A	High	3	C	6	7
73	A	High	2	C	6	7.4	122	A	High	3	KB	6	8
74	A	High	2	KB	6	7.5	123	A	High	3	SB	6	7
75	A	High	2	SB	6	7.1	124	A	High	3	TF	6	7
76	A	High	2	TF	6	6.3	125	K	High	3	C	6	8
77	K	High	2	C	6	7.9	126	K	High	3	KB	6	8
78	K	High	2	KB	6	8.1	127	K	High	3	SB	6	8
79	K	High	2	SB	6	7.9	128	K	High	3	TF	6	8
80	K	High	2	TF	6	8.2	129	BW	High	3	C	6	12
81	BW	High	2	C	6	12.5	130	BW	High	3	KB	6	13
82	BW	High	2	KB	6	11.9	131	BW	High	3	SB	6	11
83	BW	High	2	SB	6	12.3	132	BW	High	3	TF	6	11
84	BW	High	2	TF	6	12.6	133	CR	High	3	C	6	10
85	CR	High	2	C	6	12	134	CR	High	3	KB	6	12
86	CR	High	2	KB	6	13.1	135	CR	High	3	SB	6	11
87	CR	High	2	SB	6	12.8	136	CR	High	3	TF	6	12
88	CR	High	2	TF	6	12.9	137	TB	High	3	C	6	11
89	TB	High	2	C	6	13.6	138	TB	High	3	KB	6	11
90	TB	High	2	KB	6	13.1	139	TB	High	3	SB	6	11
91	TB	High	2	SB	6	12.4	140	TB	High	3	TF	6	11
92	TB	High	2	TF	6	10.8	141	MIX	High	3	C	6	11
93	MIX	High	2	C	6	11.3	142	MIX	High	3	KB	6	11
94	MIX	High	2	KB	6	12.1	143	MIX	High	3	SB	6	11
95	MIX	High	2	SB	6	11.3	144	MIX	High	3	TF	6	11
96	MIX	High	2	TF	6	11.8	1	A	Low	1	C	7	4
97	A	Low	3	C	6	5.2	2	A	Low	1	KB	7	5
98	A	Low	3	KB	6	5.6	3	A	Low	1	SB	7	4
99	A	Low	3	SB	6	5.3	4	A	Low	1	TF	7	3
100	A	Low	3	TF	6	5.1	5	K	Low	1	C	7	5
101	K	Low	3	C	6	5.1	6	K	Low	1	KB	7	5
102	K	Low	3	KB	6	4.6	7	K	Low	1	SB	7	5
103	K	Low	3	SB	6	4.2	8	K	Low	1	TF	7	4
104	K	Low	3	TF	6	4.4	9	BW	Low	1	C	7	9
105	BW	Low	3	C	6	8.6	10	BW	Low	1	KB	7	9
106	BW	Low	3	KB	6	8.9	11	BW	Low	1	SB	7	9
107	BW	Low	3	SB	6	8.3	12	BW	Low	1	TF	7	9
108	BW	Low	3	TF	6	8.4	13	CR	Low	1	C	7	10
109	CR	Low	3	C	6	7.7	14	CR	Low	1	KB	7	11
110	CR	Low	3	KB	6	9.4	15	CR	Low	1	SB	7	11
111	CR	Low	3	SB	6	9.4	16	CR	Low	1	TF	7	10

17	TB	Low	1	C	7	10.1	66	TB	Low	2	KB	7	10
18	TB	Low	1	KB	7	9.5	67	TB	Low	2	SB	7	10
19	TB	Low	1	SB	7	8.4	68	TB	Low	2	TF	7	9
20	TB	Low	1	TF	7	9.2	69	MIX	Low	2	C	7	9
21	MIX	Low	1	C	7	10.3	70	MIX	Low	2	KB	7	9
22	MIX	Low	1	KB	7	9.1	71	MIX	Low	2	SB	7	9
23	MIX	Low	1	SB	7	9.7	72	MIX	Low	2	TF	7	8
24	MIX	Low	1	TF	7	8.4	73	A	High	2	C	7	8
25	A	High	1	C	7	10.4	74	A	High	2	KB	7	8
26	A	High	1	KB	7	8.8	75	A	High	2	SB	7	7
27	A	High	1	SB	7	7.6	76	A	High	2	TF	7	7
28	A	High	1	TF	7	8.5	77	K	High	2	C	7	8
29	K	High	1	C	7	10.9	78	K	High	2	KB	7	8
30	K	High	1	KB	7	7.6	79	K	High	2	SB	7	8
31	K	High	1	SB	7	10.2	80	K	High	2	TF	7	9
32	K	High	1	TF	7	8.6	81	BW	High	2	C	7	13
33	BW	High	1	C	7	13	82	BW	High	2	KB	7	12
34	BW	High	1	KB	7	11.9	83	BW	High	2	SB	7	13
35	BW	High	1	SB	7	12.7	84	BW	High	2	TF	7	13
36	BW	High	1	TF	7	11.5	85	CR	High	2	C	7	12
37	CR	High	1	C	7	13.9	86	CR	High	2	KB	7	14
38	CR	High	1	KB	7	14.4	87	CR	High	2	SB	7	13
39	CR	High	1	SB	7	11.7	88	CR	High	2	TF	7	13
40	CR	High	1	TF	7	13.2	89	TB	High	2	C	7	14
41	TB	High	1	C	7	12.5	90	TB	High	2	KB	7	14
42	TB	High	1	KB	7	12.1	91	TB	High	2	SB	7	13
43	TB	High	1	SB	7	10.4	92	TB	High	2	TF	7	11
44	TB	High	1	TF	7	10.8	93	MIX	High	2	C	7	12
45	MIX	High	1	C	7	12.9	94	MIX	High	2	KB	7	13
46	MIX	High	1	KB	7	13.5	95	MIX	High	2	SB	7	11
47	MIX	High	1	SB	7	12.7	96	MIX	High	2	TF	7	12
48	MIX	High	1	TF	7	12.8	97	A	Low	3	C	7	6
49	A	Low	2	C	7	4.9	98	A	Low	3	KB	7	5
50	A	Low	2	KB	7	4.3	99	A	Low	3	SB	7	6
51	A	Low	2	SB	7	4	100	A	Low	3	TF	7	5
52	A	Low	2	TF	7	5.5	101	K	Low	3	C	7	5
53	K	Low	2	C	7	5.4	102	K	Low	3	KB	7	5
54	K	Low	2	KB	7	5.3	103	K	Low	3	SB	7	5
55	K	Low	2	SB	7	5.1	104	K	Low	3	TF	7	5
56	K	Low	2	TF	7	4.3	105	BW	Low	3	C	7	9
57	BW	Low	2	C	7	9.3	106	BW	Low	3	KB	7	9
58	BW	Low	2	KB	7	10.2	107	BW	Low	3	SB	7	9
59	BW	Low	2	SB	7	8.7	108	BW	Low	3	TF	7	9
60	BW	Low	2	TF	7	9.7	109	CR	Low	3	C	7	8
61	CR	Low	2	C	7	8.5	110	CR	Low	3	KB	7	10
62	CR	Low	2	KB	7	7.8	111	CR	Low	3	SB	7	10
63	CR	Low	2	SB	7	7.1	112	CR	Low	3	TF	7	10
64	CR	Low	2	TF	7	7.7	113	TB	Low	3	C	7	10
65	TB	Low	2	C	7	10.5	114	TB	Low	3	KB	7	9

115	TB	Low	3	SB	7	9.7	20	TB	Low	1	TF	8	9
116	TB	Low	3	TF	7	9.5	21	MIX	Low	1	C	8	10
117	MIX	Low	3	C	7	9.1	22	MIX	Low	1	KB	8	9
118	MIX	Low	3	KB	7	9.8	23	MIX	Low	1	SB	8	9
119	MIX	Low	3	SB	7	9	24	MIX	Low	1	TF	8	9
120	MIX	Low	3	TF	7	9.9	25	A	High	1	C	8	8
121	A	High	3	C	7	7.4	26	A	High	1	KB	8	9
122	A	High	3	KB	7	7.8	27	A	High	1	SB	8	7
123	A	High	3	SB	7	7.2	28	A	High	1	TF	8	8
124	A	High	3	TF	7	7.7	29	K	High	1	C	8	8
125	K	High	3	C	7	8.5	30	K	High	1	KB	8	7
126	K	High	3	KB	7	8.1	31	K	High	1	SB	8	11
127	K	High	3	SB	7	8.6	32	K	High	1	TF	8	9
128	K	High	3	TF	7	8.4	33	BW	High	1	C	8	11
129	BW	High	3	C	7	12.5	34	BW	High	1	KB	8	11
130	BW	High	3	KB	7	12.4	35	BW	High	1	SB	8	12
131	BW	High	3	SB	7	11.6	36	BW	High	1	TF	8	11
132	BW	High	3	TF	7	11.6	37	CR	High	1	C	8	12
133	CR	High	3	C	7	10.4	38	CR	High	1	KB	8	13
134	CR	High	3	KB	7	12	39	CR	High	1	SB	8	11
135	CR	High	3	SB	7	10.9	40	CR	High	1	TF	8	14
136	CR	High	3	TF	7	12.2	41	TB	High	1	C	8	12
137	TB	High	3	C	7	11.4	42	TB	High	1	KB	8	9
138	TB	High	3	KB	7	10.2	43	TB	High	1	SB	8	10
139	TB	High	3	SB	7	11.7	44	TB	High	1	TF	8	10
140	TB	High	3	TF	7	10.8	45	MIX	High	1	C	8	13
141	MIX	High	3	C	7	11	46	MIX	High	1	KB	8	13
142	MIX	High	3	KB	7	11.3	47	MIX	High	1	SB	8	10
143	MIX	High	3	SB	7	11.6	48	MIX	High	1	TF	8	10
144	MIX	High	3	TF	7	11.2	49	A	Low	2	C	8	5
1	A	Low	1	C	8	4.4	50	A	Low	2	KB	8	4
2	A	Low	1	KB	8	5.5	51	A	Low	2	SB	8	4
3	A	Low	1	SB	8	4.7	52	A	Low	2	TF	8	5
4	A	Low	1	TF	8	3.7	53	K	Low	2	C	8	6
5	K	Low	1	C	8	5.6	54	K	Low	2	KB	8	6
6	K	Low	1	KB	8	5.5	55	K	Low	2	SB	8	5
7	K	Low	1	SB	8	5.4	56	K	Low	2	TF	8	5
8	K	Low	1	TF	8	4.4	57	BW	Low	2	C	8	10
9	BW	Low	1	C	8	8.4	58	BW	Low	2	KB	8	10
10	BW	Low	1	KB	8	9.4	59	BW	Low	2	SB	8	8
11	BW	Low	1	SB	8	8.4	60	BW	Low	2	TF	8	10
12	BW	Low	1	TF	8	8.6	61	CR	Low	2	C	8	9
13	CR	Low	1	C	8	10.7	62	CR	Low	2	KB	8	8
14	CR	Low	1	KB	8	10.9	63	CR	Low	2	SB	8	7
15	CR	Low	1	SB	8	11.3	64	CR	Low	2	TF	8	8
16	CR	Low	1	TF	8	10.2	65	TB	Low	2	C	8	10
17	TB	Low	1	C	8	10.4	66	TB	Low	2	KB	8	10
18	TB	Low	1	KB	8	9.8	67	TB	Low	2	SB	8	10
19	TB	Low	1	SB	8	8.7	68	TB	Low	2	TF	8	9

69	MIX	Low	2	C	8	9.7	118	MIX	Low	3	KB	8	10
70	MIX	Low	2	KB	8	9.1	119	MIX	Low	3	SB	8	9
71	MIX	Low	2	SB	8	9.1	120	MIX	Low	3	TF	8	10
72	MIX	Low	2	TF	8	8.3	121	A	High	3	C	8	8
73	A	High	2	C	8	8.2	122	A	High	3	KB	8	8
74	A	High	2	KB	8	8.5	123	A	High	3	SB	8	7
75	A	High	2	SB	8	7.6	124	A	High	3	TF	8	8
76	A	High	2	TF	8	6.9	125	K	High	3	C	8	8
77	K	High	2	C	8	8.7	126	K	High	3	KB	8	8
78	K	High	2	KB	8	8.3	127	K	High	3	SB	8	8
79	K	High	2	SB	8	8.3	128	K	High	3	TF	8	9
80	K	High	2	TF	8	8.1	129	BW	High	3	C	8	13
81	BW	High	2	C	8	12.5	130	BW	High	3	KB	8	13
82	BW	High	2	KB	8	12.7	131	BW	High	3	SB	8	12
83	BW	High	2	SB	8	12.2	132	BW	High	3	TF	8	11
84	BW	High	2	TF	8	12.6	133	CR	High	3	C	8	11
85	CR	High	2	C	8	12.4	134	CR	High	3	KB	8	12
86	CR	High	2	KB	8	13.8	135	CR	High	3	SB	8	11
87	CR	High	2	SB	8	13.4	136	CR	High	3	TF	8	13
88	CR	High	2	TF	8	13.7	137	TB	High	3	C	8	12
89	TB	High	2	C	8	13.4	138	TB	High	3	KB	8	10
90	TB	High	2	KB	8	13.1	139	TB	High	3	SB	8	12
91	TB	High	2	SB	8	12.4	140	TB	High	3	TF	8	11
92	TB	High	2	TF	8	11.6	141	MIX	High	3	C	8	11
93	MIX	High	2	C	8	11.8	142	MIX	High	3	KB	8	12
94	MIX	High	2	KB	8	12.2	143	MIX	High	3	SB	8	11
95	MIX	High	2	SB	8	11.1	144	MIX	High	3	TF	8	11
96	MIX	High	2	TF	8	12.3	1	A	Low	1	C	9	5
97	A	Low	3	C	8	5.8	2	A	Low	1	KB	9	6
98	A	Low	3	KB	8	5.1	3	A	Low	1	SB	9	5
99	A	Low	3	SB	8	5.8	4	A	Low	1	TF	9	4
100	A	Low	3	TF	8	5.5	5	K	Low	1	C	9	6
101	K	Low	3	C	8	5.7	6	K	Low	1	KB	9	6
102	K	Low	3	KB	8	5.2	7	K	Low	1	SB	9	6
103	K	Low	3	SB	8	4.9	8	K	Low	1	TF	9	5
104	K	Low	3	TF	8	5.3	9	BW	Low	1	C	9	9
105	BW	Low	3	C	8	9.1	10	BW	Low	1	KB	9	10
106	BW	Low	3	KB	8	9.3	11	BW	Low	1	SB	9	8
107	BW	Low	3	SB	8	8.8	12	BW	Low	1	TF	9	9
108	BW	Low	3	TF	8	8.6	13	CR	Low	1	C	9	11
109	CR	Low	3	C	8	7.9	14	CR	Low	1	KB	9	9
110	CR	Low	3	KB	8	9.5	15	CR	Low	1	SB	9	11
111	CR	Low	3	SB	8	9.8	16	CR	Low	1	TF	9	11
112	CR	Low	3	TF	8	10.2	17	TB	Low	1	C	9	11
113	TB	Low	3	C	8	10.6	18	TB	Low	1	KB	9	10
114	TB	Low	3	KB	8	9.1	19	TB	Low	1	SB	9	9
115	TB	Low	3	SB	8	10.2	20	TB	Low	1	TF	9	8
116	TB	Low	3	TF	8	9.8	21	MIX	Low	1	C	9	11
117	MIX	Low	3	C	8	9.3	22	MIX	Low	1	KB	9	10

23	MIX	Low	1	SB	9	9	72	MIX	Low	2	TF	9	9
24	MIX	Low	1	TF	9	8.7	73	A	High	2	C	9	9
25	A	High	1	C	9	8.8	74	A	High	2	KB	9	9
26	A	High	1	KB	9	8.5	75	A	High	2	SB	9	7
27	A	High	1	SB	9	6.8	76	A	High	2	TF	9	7
28	A	High	1	TF	9	7.5	77	K	High	2	C	9	9
29	K	High	1	C	9	9.3	78	K	High	2	KB	9	9
30	K	High	1	KB	9	7	79	K	High	2	SB	9	8
31	K	High	1	SB	9	10.6	80	K	High	2	TF	9	8
32	K	High	1	TF	9	9.7	81	BW	High	2	C	9	12
33	BW	High	1	C	9	10.5	82	BW	High	2	KB	9	12
34	BW	High	1	KB	9	10.4	83	BW	High	2	SB	9	12
35	BW	High	1	SB	9	12.1	84	BW	High	2	TF	9	12
36	BW	High	1	TF	9	10.5	85	CR	High	2	C	9	12
37	CR	High	1	C	9	11.4	86	CR	High	2	KB	9	14
38	CR	High	1	KB	9	12.8	87	CR	High	2	SB	9	14
39	CR	High	1	SB	9	10.7	88	CR	High	2	TF	9	14
40	CR	High	1	TF	9	13.1	89	TB	High	2	C	9	14
41	TB	High	1	C	9	12.4	90	TB	High	2	KB	9	13
42	TB	High	1	KB	9	8.6	91	TB	High	2	SB	9	13
43	TB	High	1	SB	9	9.7	92	TB	High	2	TF	9	11
44	TB	High	1	TF	9	9.1	93	MIX	High	2	C	9	12
45	MIX	High	1	C	9	13.2	94	MIX	High	2	KB	9	12
46	MIX	High	1	KB	9	12.1	95	MIX	High	2	SB	9	11
47	MIX	High	1	SB	9	9.2	96	MIX	High	2	TF	9	12
48	MIX	High	1	TF	9	9.7	97	A	Low	3	C	9	6
49	A	Low	2	C	9	5.7	98	A	Low	3	KB	9	5
50	A	Low	2	KB	9	4.7	99	A	Low	3	SB	9	6
51	A	Low	2	SB	9	4.5	100	A	Low	3	TF	9	5
52	A	Low	2	TF	9	5.4	101	K	Low	3	C	9	6
53	K	Low	2	C	9	5.8	102	K	Low	3	KB	9	6
54	K	Low	2	KB	9	5.8	103	K	Low	3	SB	9	5
55	K	Low	2	SB	9	5.7	104	K	Low	3	TF	9	5
56	K	Low	2	TF	9	4.8	105	BW	Low	3	C	9	9
57	BW	Low	2	C	9	9.8	106	BW	Low	3	KB	9	10
58	BW	Low	2	KB	9	10.7	107	BW	Low	3	SB	9	9
59	BW	Low	2	SB	9	7.9	108	BW	Low	3	TF	9	8
60	BW	Low	2	TF	9	9.2	109	CR	Low	3	C	9	8
61	CR	Low	2	C	9	8.8	110	CR	Low	3	KB	9	9
62	CR	Low	2	KB	9	8.3	111	CR	Low	3	SB	9	10
63	CR	Low	2	SB	9	7.7	112	CR	Low	3	TF	9	10
64	CR	Low	2	TF	9	7.4	113	TB	Low	3	C	9	11
65	TB	Low	2	C	9	9.8	114	TB	Low	3	KB	9	10
66	TB	Low	2	KB	9	10.4	115	TB	Low	3	SB	9	10
67	TB	Low	2	SB	9	9.3	116	TB	Low	3	TF	9	10
68	TB	Low	2	TF	9	9.7	117	MIX	Low	3	C	9	9
69	MIX	Low	2	C	9	9.4	118	MIX	Low	3	KB	9	10
70	MIX	Low	2	KB	9	8.6	119	MIX	Low	3	SB	9	9
71	MIX	Low	2	SB	9	8.7	120	MIX	Low	3	TF	9	10

121	A	High	3	C	9	7.9	26	A	High	1	KB	10	7
122	A	High	3	KB	9	8.5	27	A	High	1	SB	10	7
123	A	High	3	SB	9	7.5	28	A	High	1	TF	10	8
124	A	High	3	TF	9	8.2	29	K	High	1	C	10	9
125	K	High	3	C	9	8.4	30	K	High	1	KB	10	6
126	K	High	3	KB	9	7.7	31	K	High	1	SB	10	10
127	K	High	3	SB	9	8.1	32	K	High	1	TF	10	9
128	K	High	3	TF	9	8.5	33	BW	High	1	C	10	10
129	BW	High	3	C	9	12.9	34	BW	High	1	KB	10	10
130	BW	High	3	KB	9	12.5	35	BW	High	1	SB	10	12
131	BW	High	3	SB	9	12.1	36	BW	High	1	TF	10	10
132	BW	High	3	TF	9	11.1	37	CR	High	1	C	10	11
133	CR	High	3	C	9	11.1	38	CR	High	1	KB	10	12
134	CR	High	3	KB	9	12.5	39	CR	High	1	SB	10	11
135	CR	High	3	SB	9	11.2	40	CR	High	1	TF	10	13
136	CR	High	3	TF	9	12.8	41	TB	High	1	C	10	13
137	TB	High	3	C	9	12.3	42	TB	High	1	KB	10	9
138	TB	High	3	KB	9	10.5	43	TB	High	1	SB	10	9
139	TB	High	3	SB	9	11.3	44	TB	High	1	TF	10	9
140	TB	High	3	TF	9	11.4	45	MIX	High	1	C	10	13
141	MIX	High	3	C	9	11.4	46	MIX	High	1	KB	10	12
142	MIX	High	3	KB	9	11.2	47	MIX	High	1	SB	10	9
143	MIX	High	3	SB	9	10.8	48	MIX	High	1	TF	10	9
144	MIX	High	3	TF	9	10.5	49	A	Low	2	C	10	6
1	A	Low	1	C	10	5.2	50	A	Low	2	KB	10	5
2	A	Low	1	KB	10	5.2	51	A	Low	2	SB	10	5
3	A	Low	1	SB	10	5.4	52	A	Low	2	TF	10	6
4	A	Low	1	TF	10	4.8	53	K	Low	2	C	10	6
5	K	Low	1	C	10	5.8	54	K	Low	2	KB	10	6
6	K	Low	1	KB	10	6.1	55	K	Low	2	SB	10	6
7	K	Low	1	SB	10	5.2	56	K	Low	2	TF	10	4
8	K	Low	1	TF	10	4.3	57	BW	Low	2	C	10	10
9	BW	Low	1	C	10	9.2	58	BW	Low	2	KB	10	10
10	BW	Low	1	KB	10	9.6	59	BW	Low	2	SB	10	8
11	BW	Low	1	SB	10	7.7	60	BW	Low	2	TF	10	9
12	BW	Low	1	TF	10	8.2	61	CR	Low	2	C	10	9
13	CR	Low	1	C	10	11.4	62	CR	Low	2	KB	10	8
14	CR	Low	1	KB	10	9.1	63	CR	Low	2	SB	10	8
15	CR	Low	1	SB	10	11.7	64	CR	Low	2	TF	10	7
16	CR	Low	1	TF	10	10.7	65	TB	Low	2	C	10	10
17	TB	Low	1	C	10	10.2	66	TB	Low	2	KB	10	10
18	TB	Low	1	KB	10	10.8	67	TB	Low	2	SB	10	9
19	TB	Low	1	SB	10	9.9	68	TB	Low	2	TF	10	10
20	TB	Low	1	TF	10	8	69	MIX	Low	2	C	10	9
21	MIX	Low	1	C	10	10.6	70	MIX	Low	2	KB	10	8
22	MIX	Low	1	KB	10	9.7	71	MIX	Low	2	SB	10	9
23	MIX	Low	1	SB	10	8.6	72	MIX	Low	2	TF	10	9
24	MIX	Low	1	TF	10	9.1	73	A	High	2	C	10	9
25	A	High	1	C	10	7.3	74	A	High	2	KB	10	9

75	A	High	2	SB	10	7.7	124	A	High	3	TF	10	8
76	A	High	2	TF	10	7.4	125	K	High	3	C	10	9
77	K	High	2	C	10	9.1	126	K	High	3	KB	10	7
78	K	High	2	KB	10	8.1	127	K	High	3	SB	10	8
79	K	High	2	SB	10	8.2	128	K	High	3	TF	10	9
80	K	High	2	TF	10	8.6	129	BW	High	3	C	10	13
81	BW	High	2	C	10	11.8	130	BW	High	3	KB	10	12
82	BW	High	2	KB	10	12.1	131	BW	High	3	SB	10	12
83	BW	High	2	SB	10	11.9	132	BW	High	3	TF	10	11
84	BW	High	2	TF	10	11.8	133	CR	High	3	C	10	11
85	CR	High	2	C	10	11.8	134	CR	High	3	KB	10	13
86	CR	High	2	KB	10	13.6	135	CR	High	3	SB	10	11
87	CR	High	2	SB	10	13.4	136	CR	High	3	TF	10	13
88	CR	High	2	TF	10	13.1	137	TB	High	3	C	10	13
89	TB	High	2	C	10	13.9	138	TB	High	3	KB	10	11
90	TB	High	2	KB	10	12.8	139	TB	High	3	SB	10	11
91	TB	High	2	SB	10	12.7	140	TB	High	3	TF	10	12
92	TB	High	2	TF	10	10.9	141	MIX	High	3	C	10	12
93	MIX	High	2	C	10	12.4	142	MIX	High	3	KB	10	12
94	MIX	High	2	KB	10	11.5	143	MIX	High	3	SB	10	11
95	MIX	High	2	SB	10	10.6	144	MIX	High	3	TF	10	10
96	MIX	High	2	TF	10	11.8	1	A	Low	1	C	11	5
97	A	Low	3	C	10	6.4	2	A	Low	1	KB	11	5
98	A	Low	3	KB	10	4.9	3	A	Low	1	SB	11	6
99	A	Low	3	SB	10	6.4	4	A	Low	1	TF	11	5
100	A	Low	3	TF	10	4.7	5	K	Low	1	C	11	6
101	K	Low	3	C	10	6.2	6	K	Low	1	KB	11	6
102	K	Low	3	KB	10	5.8	7	K	Low	1	SB	11	6
103	K	Low	3	SB	10	5.7	8	K	Low	1	TF	11	4
104	K	Low	3	TF	10	5.7	9	BW	Low	1	C	11	9
105	BW	Low	3	C	10	8.9	10	BW	Low	1	KB	11	9
106	BW	Low	3	KB	10	9.8	11	BW	Low	1	SB	11	7
107	BW	Low	3	SB	10	8.7	12	BW	Low	1	TF	11	8
108	BW	Low	3	TF	10	7.7	13	CR	Low	1	C	11	12
109	CR	Low	3	C	10	8.1	14	CR	Low	1	KB	11	9
110	CR	Low	3	KB	10	8.8	15	CR	Low	1	SB	11	11
111	CR	Low	3	SB	10	9.4	16	CR	Low	1	TF	11	11
112	CR	Low	3	TF	10	9.6	17	TB	Low	1	C	11	10
113	TB	Low	3	C	10	10.4	18	TB	Low	1	KB	11	11
114	TB	Low	3	KB	10	9.6	19	TB	Low	1	SB	11	9
115	TB	Low	3	SB	10	10.7	20	TB	Low	1	TF	11	8
116	TB	Low	3	TF	10	9.2	21	MIX	Low	1	C	11	10
117	MIX	Low	3	C	10	8.8	22	MIX	Low	1	KB	11	10
118	MIX	Low	3	KB	10	10.7	23	MIX	Low	1	SB	11	9
119	MIX	Low	3	SB	10	9.6	24	MIX	Low	1	TF	11	9
120	MIX	Low	3	TF	10	9.3	25	A	High	1	C	11	7
121	A	High	3	C	10	8.3	26	A	High	1	KB	11	7
122	A	High	3	KB	10	8.8	27	A	High	1	SB	11	6
123	A	High	3	SB	10	7.9	28	A	High	1	TF	11	7

29	K	High	1	C	11	8.2	78	K	High	2	KB	11	8
30	K	High	1	KB	11	6.4	79	K	High	2	SB	11	9
31	K	High	1	SB	11	10.7	80	K	High	2	TF	11	9
32	K	High	1	TF	11	8.9	81	BW	High	2	C	11	12
33	BW	High	1	C	11	9.9	82	BW	High	2	KB	11	12
34	BW	High	1	KB	11	10.1	83	BW	High	2	SB	11	12
35	BW	High	1	SB	11	11.3	84	BW	High	2	TF	11	12
36	BW	High	1	TF	11	10.2	85	CR	High	2	C	11	12
37	CR	High	1	C	11	11.6	86	CR	High	2	KB	11	13
38	CR	High	1	KB	11	12	87	CR	High	2	SB	11	13
39	CR	High	1	SB	11	10.2	88	CR	High	2	TF	11	13
40	CR	High	1	TF	11	12.8	89	TB	High	2	C	11	13
41	TB	High	1	C	11	11.3	90	TB	High	2	KB	11	13
42	TB	High	1	KB	11	8.4	91	TB	High	2	SB	11	12
43	TB	High	1	SB	11	9.2	92	TB	High	2	TF	11	11
44	TB	High	1	TF	11	8.8	93	MIX	High	2	C	11	12
45	MIX	High	1	C	11	12.5	94	MIX	High	2	KB	11	11
46	MIX	High	1	KB	11	11.8	95	MIX	High	2	SB	11	10
47	MIX	High	1	SB	11	8.5	96	MIX	High	2	TF	11	12
48	MIX	High	1	TF	11	9.8	97	A	Low	3	C	11	7
49	A	Low	2	C	11	6.1	98	A	Low	3	KB	11	5
50	A	Low	2	KB	11	5.5	99	A	Low	3	SB	11	7
51	A	Low	2	SB	11	4.6	100	A	Low	3	TF	11	5
52	A	Low	2	TF	11	5.5	101	K	Low	3	C	11	7
53	K	Low	2	C	11	6.6	102	K	Low	3	KB	11	6
54	K	Low	2	KB	11	5.9	103	K	Low	3	SB	11	6
55	K	Low	2	SB	11	6.3	104	K	Low	3	TF	11	6
56	K	Low	2	TF	11	3.9	105	BW	Low	3	C	11	9
57	BW	Low	2	C	11	9.2	106	BW	Low	3	KB	11	10
58	BW	Low	2	KB	11	10.1	107	BW	Low	3	SB	11	8
59	BW	Low	2	SB	11	7.6	108	BW	Low	3	TF	11	8
60	BW	Low	2	TF	11	8.9	109	CR	Low	3	C	11	8
61	CR	Low	2	C	11	9.4	110	CR	Low	3	KB	11	9
62	CR	Low	2	KB	11	7.6	111	CR	Low	3	SB	11	9
63	CR	Low	2	SB	11	7.5	112	CR	Low	3	TF	11	9
64	CR	Low	2	TF	11	7.3	113	TB	Low	3	C	11	10
65	TB	Low	2	C	11	9.6	114	TB	Low	3	KB	11	10
66	TB	Low	2	KB	11	9.8	115	TB	Low	3	SB	11	11
67	TB	Low	2	SB	11	9.5	116	TB	Low	3	TF	11	9
68	TB	Low	2	TF	11	10.4	117	MIX	Low	3	C	11	9
69	MIX	Low	2	C	11	9.6	118	MIX	Low	3	KB	11	11
70	MIX	Low	2	KB	11	8.2	119	MIX	Low	3	SB	11	10
71	MIX	Low	2	SB	11	9.1	120	MIX	Low	3	TF	11	9
72	MIX	Low	2	TF	11	9.2	121	A	High	3	C	11	8
73	A	High	2	C	11	9.1	122	A	High	3	KB	11	9
74	A	High	2	KB	11	9.1	123	A	High	3	SB	11	8
75	A	High	2	SB	11	7.8	124	A	High	3	TF	11	8
76	A	High	2	TF	11	7.6	125	K	High	3	C	11	9
77	K	High	2	C	11	8.8	126	K	High	3	KB	11	7

127	K	High	3	SB	11	7.7
128	K	High	3	TF	11	9.2
129	BW	High	3	C	11	13.5
130	BW	High	3	KB	11	11.8
131	BW	High	3	SB	11	12.6
132	BW	High	3	TF	11	10.8
133	CR	High	3	C	11	11.2
134	CR	High	3	KB	11	12.9
135	CR	High	3	SB	11	10.4
136	CR	High	3	TF	11	12.5
137	TB	High	3	C	11	12.1
138	TB	High	3	KB	11	10.9
139	TB	High	3	SB	11	11.7
140	TB	High	3	TF	11	12.1
141	MIX	High	3	C	11	11.5
142	MIX	High	3	KB	11	11.6
143	MIX	High	3	SB	11	11.3
144	MIX	High	3	TF	11	10.1

Appendix 2e. Light intensity data for the *Panicum virgatum* cultivars over three collection dates. CV = Cultivar (A='Alamo', K='Kanlow', BW='Blackwell', CR='Cave in Rock', TB='Trailblazer'), MOIST = Moisture Level, BLK = Block, INV = Invasive Species (C=Control, KB=Kentucky Bluegrass, SB=Smooth Brome, TF=Tall Fescue), and LIGHT= Light ($\mu mols^{-1}m^{-2}$).

POT ID	CV	MOIST.	BLK	INV	DAY	LIGHT	POT ID	CV	MOIST.	BLK	INV	DAY	LIGHT
1	A	Low	1	C	1	27.2	49	A	Low	2	C	1	23.8
2	A	Low	1	KB	1	26.4	50	A	Low	2	KB	1	24.5
3	A	Low	1	SB	1	28.1	51	A	Low	2	SB	1	25.9
4	A	Low	1	TF	1	24.9	52	A	Low	2	TF	1	23.7
5	K	Low	1	C	1	28.3	53	K	Low	2	C	1	26.1
6	K	Low	1	KB	1	30.7	54	K	Low	2	KB	1	27.6
7	K	Low	1	SB	1	34.1	55	K	Low	2	SB	1	32.5
8	K	Low	1	TF	1	28.3	56	K	Low	2	TF	1	25.3
9	BW	Low	1	C	1	31	57	BW	Low	2	C	1	28.4
10	BW	Low	1	KB	1	33.5	58	BW	Low	2	KB	1	32.6
11	BW	Low	1	SB	1	28.7	59	BW	Low	2	SB	1	26.6
12	BW	Low	1	TF	1	29.6	60	BW	Low	2	TF	1	26.9
13	CR	Low	1	C	1	25.1	61	CR	Low	2	C	1	24.7
14	CR	Low	1	KB	1	33.3	62	CR	Low	2	KB	1	31.1
15	CR	Low	1	SB	1	30.2	63	CR	Low	2	SB	1	27.4
16	CR	Low	1	TF	1	33.5	64	CR	Low	2	TF	1	30
17	TB	Low	1	C	1	29.7	65	TB	Low	2	C	1	27.3
18	TB	Low	1	KB	1	26.4	66	TB	Low	2	KB	1	24.9
19	TB	Low	1	SB	1	26.8	67	TB	Low	2	SB	1	24.3
20	TB	Low	1	TF	1	33.9	68	TB	Low	2	TF	1	31.6
21	MIX	Low	1	C	1	28.6	69	MIX	Low	2	C	1	25.7
22	MIX	Low	1	KB	1	27.3	70	MIX	Low	2	KB	1	25.5
23	MIX	Low	1	SB	1	30.9	71	MIX	Low	2	SB	1	28.4
24	MIX	Low	1	TF	1	32.5	72	MIX	Low	2	TF	1	29.1
25	A	High	1	C	1	32.4	73	A	High	2	C	1	33.6
26	A	High	1	KB	1	29.8	74	A	High	2	KB	1	32.9
27	A	High	1	SB	1	34.6	75	A	High	2	SB	1	29.4
28	A	High	1	TF	1	32.8	76	A	High	2	TF	1	30.1
29	K	High	1	C	1	33.8	77	K	High	2	C	1	27.4
30	K	High	1	KB	1	33.7	78	K	High	2	KB	1	29.3
31	K	High	1	SB	1	27.6	79	K	High	2	SB	1	35.1
32	K	High	1	TF	1	28.5	80	K	High	2	TF	1	32.4
33	BW	High	1	C	1	30.8	81	BW	High	2	C	1	33.8
34	BW	High	1	KB	1	21.3	82	BW	High	2	KB	1	30.1
35	BW	High	1	SB	1	30.1	83	BW	High	2	SB	1	29.6
36	BW	High	1	TF	1	27.9	84	BW	High	2	TF	1	28.3
37	CR	High	1	C	1	23.4	85	CR	High	2	C	1	30.3
38	CR	High	1	KB	1	27.7	86	CR	High	2	KB	1	27.2
39	CR	High	1	SB	1	29.4	87	CR	High	2	SB	1	33.6
40	CR	High	1	TF	1	33.5	88	CR	High	2	TF	1	27.4
41	TB	High	1	C	1	29.1	89	TB	High	2	C	1	31.3
42	TB	High	1	KB	1	31.8	90	TB	High	2	KB	1	34.7
43	TB	High	1	SB	1	28.7	91	TB	High	2	SB	1	28.1
44	TB	High	1	TF	1	24.5	92	TB	High	2	TF	1	36.3
45	MIX	High	1	C	1	30.6	93	MIX	High	2	C	1	30.9
46	MIX	High	1	KB	1	31.3	94	MIX	High	2	KB	1	36.6
47	MIX	High	1	SB	1	32.9	95	MIX	High	2	SB	1	33.8
48	MIX	High	1	TF	1	33.3	96	MIX	High	2	TF	1	36.2

97	A	Low	3	C	1	29.8	2	A	Low	1	KB	2	30.8
98	A	Low	3	KB	1	28.1	3	A	Low	1	SB	2	29.3
99	A	Low	3	SB	1	35.6	4	A	Low	1	TF	2	21
100	A	Low	3	TF	1	32.3	5	K	Low	1	C	2	32.4
101	K	Low	3	C	1	23.7	6	K	Low	1	KB	2	29
102	K	Low	3	KB	1	27.2	7	K	Low	1	SB	2	29.8
103	K	Low	3	SB	1	30.1	8	K	Low	1	TF	2	32.3
104	K	Low	3	TF	1	29.5	9	BW	Low	1	C	2	30.1
105	BW	Low	3	C	1	30.6	10	BW	Low	1	KB	2	30.2
106	BW	Low	3	KB	1	28.7	11	BW	Low	1	SB	2	35
107	BW	Low	3	SB	1	28.5	12	BW	Low	1	TF	2	35.8
108	BW	Low	3	TF	1	26.6	13	CR	Low	1	C	2	29.2
109	CR	Low	3	C	1	24.8	14	CR	Low	1	KB	2	33.8
110	CR	Low	3	KB	1	23.1	15	CR	Low	1	SB	2	33.9
111	CR	Low	3	SB	1	33.7	16	CR	Low	1	TF	2	35.9
112	CR	Low	3	TF	1	26.9	17	TB	Low	1	C	2	30.7
113	TB	Low	3	C	1	27.4	18	TB	Low	1	KB	2	28.2
114	TB	Low	3	KB	1	28.5	19	TB	Low	1	SB	2	31.3
115	TB	Low	3	SB	1	32.8	20	TB	Low	1	TF	2	32.8
116	TB	Low	3	TF	1	34.6	21	MIX	Low	1	C	2	38.2
117	MIX	Low	3	C	1	25.3	22	MIX	Low	1	KB	2	27.2
118	MIX	Low	3	KB	1	27.4	23	MIX	Low	1	SB	2	27.1
119	MIX	Low	3	SB	1	29.2	24	MIX	Low	1	TF	2	34.6
120	MIX	Low	3	TF	1	33.7	25	A	High	1	C	2	28.8
121	A	High	3	C	1	30.4	26	A	High	1	KB	2	35.9
122	A	High	3	KB	1	31.7	27	A	High	1	SB	2	28.6
123	A	High	3	SB	1	32.1	28	A	High	1	TF	2	38.8
124	A	High	3	TF	1	22.3	29	K	High	1	C	2	32.1
125	K	High	3	C	1	33.5	30	K	High	1	KB	2	24.7
126	K	High	3	KB	1	27.2	31	K	High	1	SB	2	29.5
127	K	High	3	SB	1	26.8	32	K	High	1	TF	2	31
128	K	High	3	TF	1	31.9	33	BW	High	1	C	2	26.6
129	BW	High	3	C	1	31	34	BW	High	1	KB	2	33.5
130	BW	High	3	KB	1	29.6	35	BW	High	1	SB	2	34.2
131	BW	High	3	SB	1	33.2	36	BW	High	1	TF	2	34.5
132	BW	High	3	TF	1	28.7	37	CR	High	1	C	2	33.3
133	CR	High	3	C	1	31.4	38	CR	High	1	KB	2	33.1
134	CR	High	3	KB	1	29.6	39	CR	High	1	SB	2	29.4
135	CR	High	3	SB	1	31.5	40	CR	High	1	TF	2	34
136	CR	High	3	TF	1	32.8	41	TB	High	1	C	2	33.7
137	TB	High	3	C	1	30.5	42	TB	High	1	KB	2	35.4
138	TB	High	3	KB	1	28.7	43	TB	High	1	SB	2	35.5
139	TB	High	3	SB	1	27.9	44	TB	High	1	TF	2	32.7
140	TB	High	3	TF	1	33.1	45	MIX	High	1	C	2	31.1
141	MIX	High	3	C	1	24.6	46	MIX	High	1	KB	2	29.7
142	MIX	High	3	KB	1	21.4	47	MIX	High	1	SB	2	28.1
143	MIX	High	3	SB	1	30	48	MIX	High	1	TF	2	25.3
144	MIX	High	3	TF	1	29.5	49	A	Low	2	C	2	31.7
1	A	Low	1	C	2	29.6	50	A	Low	2	KB	2	33.4

51	A	Low	2	SB	2	30.3	100	A	Low	3	TF	2	23.8
52	A	Low	2	TF	2	29.9	101	K	Low	3	C	2	33.2
53	K	Low	2	C	2	27.1	102	K	Low	3	KB	2	34.1
54	K	Low	2	KB	2	30.6	103	K	Low	3	SB	2	25.6
55	K	Low	2	SB	2	29.2	104	K	Low	3	TF	2	30.9
56	K	Low	2	TF	2	28.5	105	BW	Low	3	C	2	32.1
57	BW	Low	2	C	2	29.7	106	BW	Low	3	KB	2	34.4
58	BW	Low	2	KB	2	28.3	107	BW	Low	3	SB	2	28.3
59	BW	Low	2	SB	2	33	108	BW	Low	3	TF	2	33.2
60	BW	Low	2	TF	2	31.8	109	CR	Low	3	C	2	27.4
61	CR	Low	2	C	2	32.6	110	CR	Low	3	KB	2	32.4
62	CR	Low	2	KB	2	30.1	111	CR	Low	3	SB	2	29.8
63	CR	Low	2	SB	2	31	112	CR	Low	3	TF	2	34.6
64	CR	Low	2	TF	2	29.4	113	TB	Low	3	C	2	32.8
65	TB	Low	2	C	2	27.5	114	TB	Low	3	KB	2	33.8
66	TB	Low	2	KB	2	29.6	115	TB	Low	3	SB	2	39.1
67	TB	Low	2	SB	2	33.3	116	TB	Low	3	TF	2	36.7
68	TB	Low	2	TF	2	28.1	117	MIX	Low	3	C	2	31.8
69	MIX	Low	2	C	2	30.8	118	MIX	Low	3	KB	2	34.2
70	MIX	Low	2	KB	2	29.3	119	MIX	Low	3	SB	2	26.6
71	MIX	Low	2	SB	2	24.7	120	MIX	Low	3	TF	2	25.3
72	MIX	Low	2	TF	2	28.8	121	A	High	3	C	2	21.7
73	A	High	2	C	2	28.3	122	A	High	3	KB	2	31.5
74	A	High	2	KB	2	30.5	123	A	High	3	SB	2	26.1
75	A	High	2	SB	2	29.6	124	A	High	3	TF	2	27.4
76	A	High	2	TF	2	31.4	125	K	High	3	C	2	30.5
77	K	High	2	C	2	32.2	126	K	High	3	KB	2	28
78	K	High	2	KB	2	35.1	127	K	High	3	SB	2	31
79	K	High	2	SB	2	34.8	128	K	High	3	TF	2	28.1
80	K	High	2	TF	2	27.4	129	BW	High	3	C	2	27.7
81	BW	High	2	C	2	33.5	130	BW	High	3	KB	2	29.4
82	BW	High	2	KB	2	33	131	BW	High	3	SB	2	33.5
83	BW	High	2	SB	2	30.7	132	BW	High	3	TF	2	29.1
84	BW	High	2	TF	2	31.9	133	CR	High	3	C	2	31.8
85	CR	High	2	C	2	28.9	134	CR	High	3	KB	2	28.7
86	CR	High	2	KB	2	28	135	CR	High	3	SB	2	27.4
87	CR	High	2	SB	2	35.5	136	CR	High	3	TF	2	28.1
88	CR	High	2	TF	2	26.2	137	TB	High	3	C	2	30.2
89	TB	High	2	C	2	30.1	138	TB	High	3	KB	2	31.3
90	TB	High	2	KB	2	29.2	139	TB	High	3	SB	2	28.3
91	TB	High	2	SB	2	36.4	140	TB	High	3	TF	2	29.7
92	TB	High	2	TF	2	33.7	141	MIX	High	3	C	2	28.4
93	MIX	High	2	C	2	32.9	142	MIX	High	3	KB	2	25.4
94	MIX	High	2	KB	2	35.1	143	MIX	High	3	SB	2	26.7
95	MIX	High	2	SB	2	29.2	144	MIX	High	3	TF	2	32.4
96	MIX	High	2	TF	2	28.1	1	A	Low	1	C	3	29.2
97	A	Low	3	C	2	25.4	2	A	Low	1	KB	3	29.8
98	A	Low	3	KB	2	28.2	3	A	Low	1	SB	3	32.8
99	A	Low	3	SB	2	26.6	4	A	Low	1	TF	3	31.6

5	K	Low	1	C	3	33.1	54	K	Low	2	KB	3	30.4
6	K	Low	1	KB	3	35.2	55	K	Low	2	SB	3	33.5
7	K	Low	1	SB	3	26.7	56	K	Low	2	TF	3	28.1
8	K	Low	1	TF	3	30.2	57	BW	Low	2	C	3	28.7
9	BW	Low	1	C	3	30.9	58	BW	Low	2	KB	3	32.4
10	BW	Low	1	KB	3	31.3	59	BW	Low	2	SB	3	30.3
11	BW	Low	1	SB	3	32.9	60	BW	Low	2	TF	3	29.9
12	BW	Low	1	TF	3	33.3	61	CR	Low	2	C	3	29.1
13	CR	Low	1	C	3	27.7	62	CR	Low	2	KB	3	35.6
14	CR	Low	1	KB	3	30.4	63	CR	Low	2	SB	3	30.9
15	CR	Low	1	SB	3	31.9	64	CR	Low	2	TF	3	31.8
16	CR	Low	1	TF	3	27.3	65	TB	Low	2	C	3	29.4
17	TB	Low	1	C	3	29.1	66	TB	Low	2	KB	3	27
18	TB	Low	1	KB	3	27.4	67	TB	Low	2	SB	3	22.8
19	TB	Low	1	SB	3	26.5	68	TB	Low	2	TF	3	35.1
20	TB	Low	1	TF	3	27.7	69	MIX	Low	2	C	3	29.7
21	MIX	Low	1	C	3	27.1	70	MIX	Low	2	KB	3	30.7
22	MIX	Low	1	KB	3	31.8	71	MIX	Low	2	SB	3	31.4
23	MIX	Low	1	SB	3	27.8	72	MIX	Low	2	TF	3	36.3
24	MIX	Low	1	TF	3	33.8	73	A	High	2	C	3	28.3
25	A	High	1	C	3	20.3	74	A	High	2	KB	3	30.5
26	A	High	1	KB	3	30	75	A	High	2	SB	3	29.6
27	A	High	1	SB	3	30.5	76	A	High	2	TF	3	31.4
28	A	High	1	TF	3	20.1	77	K	High	2	C	3	32.2
29	K	High	1	C	3	25.6	78	K	High	2	KB	3	35.1
30	K	High	1	KB	3	23.6	79	K	High	2	SB	3	34.8
31	K	High	1	SB	3	23.5	80	K	High	2	TF	3	27.4
32	K	High	1	TF	3	23	81	BW	High	2	C	3	33.5
33	BW	High	1	C	3	30.2	82	BW	High	2	KB	3	33.7
34	BW	High	1	KB	3	28	83	BW	High	2	SB	3	32.9
35	BW	High	1	SB	3	26.5	84	BW	High	2	TF	3	35.1
36	BW	High	1	TF	3	30.7	85	CR	High	2	C	3	29.2
37	CR	High	1	C	3	31	86	CR	High	2	KB	3	27.2
38	CR	High	1	KB	3	32.7	87	CR	High	2	SB	3	27.8
39	CR	High	1	SB	3	34.3	88	CR	High	2	TF	3	30.5
40	CR	High	1	TF	3	34.9	89	TB	High	2	C	3	23.1
41	TB	High	1	C	3	26.2	90	TB	High	2	KB	3	28.7
42	TB	High	1	KB	3	29.9	91	TB	High	2	SB	3	28.9
43	TB	High	1	SB	3	32.1	92	TB	High	2	TF	3	22.6
44	TB	High	1	TF	3	36.2	93	MIX	High	2	C	3	32
45	MIX	High	1	C	3	29.2	94	MIX	High	2	KB	3	29.4
46	MIX	High	1	KB	3	36.7	95	MIX	High	2	SB	3	30.2
47	MIX	High	1	SB	3	27.8	96	MIX	High	2	TF	3	35.1
48	MIX	High	1	TF	3	21.2	97	A	Low	3	C	3	29.4
49	A	Low	2	C	3	26.4	98	A	Low	3	KB	3	30.3
50	A	Low	2	KB	3	29.1	99	A	Low	3	SB	3	30.2
51	A	Low	2	SB	3	27.3	100	A	Low	3	TF	3	27.1
52	A	Low	2	TF	3	29	101	K	Low	3	C	3	30.6
53	K	Low	2	C	3	27.9	102	K	Low	3	KB	3	26.7

103	K	Low	3	SB	3	28.2
104	K	Low	3	TF	3	29.5
105	BW	Low	3	C	3	35
106	BW	Low	3	KB	3	33.9
107	BW	Low	3	SB	3	33.6
108	BW	Low	3	TF	3	27.4
109	CR	Low	3	C	3	31.3
110	CR	Low	3	KB	3	33.5
111	CR	Low	3	SB	3	29.9
112	CR	Low	3	TF	3	31.4
113	TB	Low	3	C	3	35.6
114	TB	Low	3	KB	3	30.9
115	TB	Low	3	SB	3	30.3
116	TB	Low	3	TF	3	28
117	MIX	Low	3	C	3	31.9
118	MIX	Low	3	KB	3	28.3
119	MIX	Low	3	SB	3	34.7
120	MIX	Low	3	TF	3	33.5
121	A	High	3	C	3	30.9
122	A	High	3	KB	3	32.5
123	A	High	3	SB	3	28.3
124	A	High	3	TF	3	29.1
125	K	High	3	C	3	27.5
126	K	High	3	KB	3	28.6
127	K	High	3	SB	3	26.9
128	K	High	3	TF	3	28.7
129	BW	High	3	C	3	30.4
130	BW	High	3	KB	3	26.1
131	BW	High	3	SB	3	31.6
132	BW	High	3	TF	3	29
133	CR	High	3	C	3	30.9
134	CR	High	3	KB	3	27.3
135	CR	High	3	SB	3	29.6
136	CR	High	3	TF	3	26.7
137	TB	High	3	C	3	27.1
138	TB	High	3	KB	3	28.5
139	TB	High	3	SB	3	32.4
140	TB	High	3	TF	3	27.8
141	MIX	High	3	C	3	30.3
142	MIX	High	3	KB	3	28.5
143	MIX	High	3	SB	3	23.9
144	MIX	High	3	TF	3	29.5

Appendix. 2f. Biomass (g) data for the *Panicum virgatum* cultivars. . CV = Cultivar (A='Alamo', K='Kanlow', BW='Blackwell', CR='Cave in Rock', TB='Trailblazer'), MOIST = Moisture Level, BLK = Block, INV = Invasive Species (C=Control, KB=Kentucky Bluegrass, SB=Smooth Brome, TF=Tall Fescue), and .=Missing Values.

POT ID	CV	MOIST.	BLK	INV	ABOVE CV	ABOVE INV	BELOW
1	A	Low	1	C	0	.	0
2	A	Low	1	KB	3.32	0.36	3.91
3	A	Low	1	SB	0	0	0
4	A	Low	1	TF	2.93	0	1.01
5	K	Low	1	C	1.18	.	4.65
6	K	Low	1	KB	2.12	0.92	7.23
7	K	Low	1	SB	0	0	0
8	K	Low	1	TF	3.49	1.77	3.03
9	BW	Low	1	C	2.71	.	6.21
10	BW	Low	1	KB	3.03	0.68	2.42
11	BW	Low	1	SB	1.36	0	3.74
12	BW	Low	1	TF	1.54	0.44	11.46
13	CR	Low	1	C	1.49	.	3.66
14	CR	Low	1	KB	1.68	1.26	5.17
15	CR	Low	1	SB	1.56	0.04	3.19
16	CR	Low	1	TF	1.8	2.35	5.34
17	TB	Low	1	C	3.21	.	4.09
18	TB	Low	1	KB	3.68	0.07	5.44
19	TB	Low	1	SB	3.35	0	4.85
20	TB	Low	1	TF	4.39	0.37	2.95
21	MIX	Low	1	C	2.08	.	3.86
22	MIX	Low	1	KB	2.89	1.18	7.16
23	MIX	Low	1	SB	5.28	0	6.42
24	MIX	Low	1	TF	2.71	2.02	8.66
25	A	High	1	C	2.41	.	6.76
26	A	High	1	KB	1.34	0.01	4.03
27	A	High	1	SB	0.35	0	5.89
28	A	High	1	TF	0.6	1.69	1.04
29	K	High	1	C	2.83	.	6.83
30	K	High	1	KB	3.07	0	6.93
31	K	High	1	SB	3.12	0	5.69
32	K	High	1	TF	0	0	0
33	BW	High	1	C	1.83	.	4.17
34	BW	High	1	KB	4.92	0.38	3.94
35	BW	High	1	SB	4.57	0	3.18
36	BW	High	1	TF	2.72	3.74	7.6
37	CR	High	1	C	2.14	.	2.03
38	CR	High	1	KB	2.07	0.68	4.21
39	CR	High	1	SB	2.41	0	4.09
40	CR	High	1	TF	1.09	3.04	5.56
41	TB	High	1	C	3.26	.	5.39
42	TB	High	1	KB	1.23	0.87	3.65
43	TB	High	1	SB	0.2	0	2.45
44	TB	High	1	TF	3.4	2.01	4.59
45	MIX	High	1	C	2.96	.	5.67
46	MIX	High	1	KB	3.04	0.59	9.75
47	MIX	High	1	SB	2.96	0	8.88
48	MIX	High	1	TF	5.28	0	2.91

49	A	Low	2	C	3.29	.	7.22
50	A	Low	2	KB	3.55	0	7.95
51	A	Low	2	SB	1.92	0	6.57
52	A	Low	2	TF	4.01	1.74	12.11
53	K	Low	2	C	4.4	.	8.12
54	K	Low	2	KB	1.46	0.56	3.87
55	K	Low	2	SB	3.35	0	7.39
56	K	Low	2	TF	0.49	2.15	20.49
57	BW	Low	2	C	2.61	.	3.97
58	BW	Low	2	KB	3.03	0	11.87
59	BW	Low	2	SB	1.34	0	5.46
60	BW	Low	2	TF	1.89	1.69	7. 22
61	CR	Low	2	C	2.25	.	4.38
62	CR	Low	2	KB	2.42	0	7.58
63	CR	Low	2	SB	1.16	0	3.16
64	CR	Low	2	TF	2.16	2.52	21.34
65	TB	Low	2	C	3.26	.	4.04
66	TB	Low	2	KB	2.48	0.85	11.23
67	TB	Low	2	SB	2.38	0	3.89
68	TB	Low	2	TF	3.42	1.06	4.32
69	MIX	Low	2	C	4.03	.	7.12
70	MIX	Low	2	KB	2.29	0.84	3.88
71	MIX	Low	2	SB	3.34	0	12.18
72	MIX	Low	2	TF	4.25	0	13.05
73	A	High	2	C	4.28	.	6.38
74	A	High	2	KB	2.81	0.82	13.35
75	A	High	2	SB	5.87	0	9.21
76	A	High	2	TF	1.28	1.78	3.84
77	K	High	2	C	1.11	.	10.43
78	K	High	2	KB	4.07	0	10.51
79	K	High	2	SB	2.82	0	9.31
80	K	High	2	TF	0.6	2.53	6.15
81	BW	High	2	C	2.33	.	5.72
82	BW	High	2	KB	2.37	0.33	4.14
83	BW	High	2	SB	2.34	0	4.89
84	BW	High	2	TF	2.96	2.69	13.24
85	CR	High	2	C	2.4	.	4.34
86	CR	High	2	KB	0	0	0
87	CR	High	2	SB	1.98	0	5.89
88	CR	High	2	TF	2.14	2.43	4.37
89	TB	High	2	C	2.88	.	4.3
90	TB	High	2	KB	2.54	0.09	7.55
91	TB	High	2	SB	0.97	0.04	3.71
92	TB	High	2	TF	2.36	2.41	10.2
93	MIX	High	2	C	2.86	.	7.63
94	MIX	High	2	KB	2.36	1.38	9.39
95	MIX	High	2	SB	1.96	0	4.48
96	MIX	High	2	TF	3.72	3.61	18.33
97	A	Low	3	C	0	.	0

98	A	Low	3	KB	0	0	0
99	A	Low	3	SB	4.03	0	9.71
100	A	Low	3	TF	1.77	4.21	7.27
101	K	Low	3	C	2.52	.	5.1
102	K	Low	3	KB	1.98	2.11	9.05
103	K	Low	3	SB	4.87	0	7.29
104	K	Low	3	TF	2.06	1.74	2.99
105	BW	Low	3	C	3.44	.	6.05
106	BW	Low	3	KB	2.45	0.5	7.08
107	BW	Low	3	SB	2.88	0	5.83
108	BW	Low	3	TF	1.69	1.08	6.07
109	CR	Low	3	C	1.21	.	2.19
110	CR	Low	3	KB	0.92	0.69	4.15
111	CR	Low	3	SB	1.75	0	4.47
112	CR	Low	3	TF	2.26	1.57	7.42
113	TB	Low	3	C	4.14	.	7.39
114	TB	Low	3	KB	2.4	1.07	9.41
115	TB	Low	3	SB	1.91	0	3.78
116	TB	Low	3	TF	3.13	1.88	6.63
117	MIX	Low	3	C	2.53	.	5.57
118	MIX	Low	3	KB	1.76	1.21	6.01
119	MIX	Low	3	SB	2.42	0	4.62
120	MIX	Low	3	TF	2.73	1.25	9
121	A	High	3	C	0	.	0
122	A	High	3	KB	0	1.29	7.96
123	A	High	3	SB	4.62	0	13.16
124	A	High	3	TF	1.87	1.4	0.76
125	K	High	3	C	2.63	.	5.85
126	K	High	3	KB	3.28	1.27	8.27
127	K	High	3	SB	1.05	0	3.28
128	K	High	3	TF	1.58	1.47	5.53
129	BW	High	3	C	2.37	.	6.02
130	BW	High	3	KB	1.24	0.86	6.47
131	BW	High	3	SB	2.27	0	6.12
132	BW	High	3	TF	1.9	1.86	11.24
133	CR	High	3	C	2.29	.	4.09
134	CR	High	3	KB	2.86	0.35	4.94
135	CR	High	3	SB	1.77	0	4.25
136	CR	High	3	TF	2.3	2.03	7.19
137	TB	High	3	C	1.64	.	5
138	TB	High	3	KB	1.74	2.72	3.92
139	TB	High	3	SB	2.82	0.77	3.57
140	TB	High	3	TF	3.33	2.11	7.67
141	MIX	High	3	C	2.44	.	4.92
142	MIX	High	3	KB	1.74	1.11	6.04
143	MIX	High	3	SB	3.04	0	6.89
144	MIX	High	3	TF	2.93	1.6	9.15

Appendix 2g. Soil electrical conductivity (EC) and soil pH for the *P. virgatum* cultivars. CV = Cultivar (A='Alamo', K='Kanlow', BW='Blackwell', CR='Cave in Rock', TB='Trailblazer'), MOIST = Moisture Level, BLK = Block, INV = Invasive Species (C=Control, KB=Kentucky Bluegrass, SB=Smooth Brome, TF=Tall Fescue), EC=Soil Electrical Conductivity, and $[H^+]$=Hydrogen Ion.

POT ID	CV	MOIST.	BLK	INV	EC	[H+]	pH
1	A	Low	1	C	79.6	1.28991271	5.96
2	A	Low	1	KB	80.3	1.25211193	6.29
3	A	Low	1	SB	80.4	1.2608884	6.21
4	A	Low	1	TF	81	1.23523933	6.45
5	K	Low	1	C	80.9	1.28390394	6.01
6	K	Low	1	KB	82.7	1.21244973	6.68
7	K	Low	1	SB	81.9	1.2077075	6.73
8	K	Low	1	TF	83.4	1.22215638	6.58
9	BW	Low	1	C	83.7	1.23626835	6.44
10	BW	Low	1	KB	84.1	1.28271485	6.02
11	BW	Low	1	SB	81.8	1.2373007	6.43
12	BW	Low	1	TF	83.5	1.21629631	6.64
13	CR	Low	1	C	83.8	1.2564708	6.25
14	CR	Low	1	KB	81.4	1.28870242	5.97
15	CR	Low	1	SB	82.2	1.24568103	6.35
16	CR	Low	1	TF	85.1	1.25211193	6.29
17	TB	Low	1	C	84.3	1.22413429	6.56
18	TB	Low	1	KB	84.7	1.18242721	7.01
19	TB	Low	1	SB	82.1	1.19935085	6.82
20	TB	Low	1	TF	83.9	1.24356543	6.37
21	MIX	Low	1	C	82.2	1.22812767	6.52
22	MIX	Low	1	KB	80.6	1.22215638	6.58
23	MIX	Low	1	SB	81.3	1.21629631	6.64
24	MIX	Low	1	TF	84.1	1.21149547	6.69
25	A	High	1	C	80.2	1.28271485	6.02
26	A	High	1	KB	81.1	1.23319117	6.47
27	A	High	1	SB	81.5	1.24251281	6.38
28	A	High	1	TF	82.7	1.21823752	6.62
29	K	High	1	C	79.8	1.26762777	6.15
30	K	High	1	KB	81.3	1.22712459	6.53
31	K	High	1	SB	82.1	1.20211123	6.79
32	K	High	1	TF	84	1.19843623	6.83
33	BW	High	1	C	83.6	1.26311963	6.19
34	BW	High	1	KB	81.8	1.24888057	6.32
35	BW	High	1	SB	81.2	1.26876444	6.14
36	BW	High	1	TF	93.7	1.21149547	6.69
37	CR	High	1	C	84.4	1.24568103	6.35
38	CR	High	1	KB	82.8	1.21921266	6.61
39	CR	High	1	SB	83.1	1.23937541	6.41
40	CR	High	1	TF	84.5	1.17812731	7.06
41	TB	High	1	C	84.7	1.21823752	6.62
42	TB	High	1	KB	83.6	1.23937541	6.41
43	TB	High	1	SB	81.2	1.24781054	6.33
44	TB	High	1	TF	83.8	1.20583076	6.75
45	MIX	High	1	C	84.5	1.21244973	6.68
46	MIX	High	1	KB	83.2	1.24568103	6.35
47	MIX	High	1	SB	83.4	1.21054413	6.7
48	MIX	High	1	TF	84.9	1.19121638	6.91

49	A	Low	2	C	80.2	1.28991271	5.96
50	A	Low	2	KB	82.7	1.22913393	6.51
51	A	Low	2	SB	81.3	1.24356543	6.37
52	A	Low	2	TF	82.4	1.26762777	6.15
53	K	Low	2	C	80.6	1.27566709	6.08
54	K	Low	2	KB	83.7	1.2608884	6.21
55	K	Low	2	SB	81.4	1.26649497	6.16
56	K	Low	2	TF	83.2	1.22712459	6.53
57	BW	Low	2	C	82.8	1.20959569	6.71
58	BW	Low	2	KB	81.5	1.23319117	6.47
59	BW	Low	2	SB	81.9	1.23937541	6.41
60	BW	Low	2	TF	80.3	1.19935085	6.82
61	CR	Low	2	C	83.9	1.24356543	6.37
62	CR	Low	2	KB	84.2	1.21921266	6.61
63	CR	Low	2	SB	80.9	1.22612467	6.54
64	CR	Low	2	TF	85.2	1.18242721	7.01
65	TB	Low	2	C	82.4	1.20211123	6.79
66	TB	Low	2	KB	81.8	1.22215638	6.58
67	TB	Low	2	SB	80.6	1.23319117	6.47
68	TB	Low	2	TF	84.1	1.18766989	6.95
69	MIX	Low	2	C	83.9	1.19843623	6.83
70	MIX	Low	2	KB	82.4	1.25756964	6.24
71	MIX	Low	2	SB	83.7	1.21921266	6.61
72	MIX	Low	2	TF	84.5	1.19210954	6.9
73	A	High	2	C	83.4	1.26649497	6.16
74	A	High	2	KB	81.3	1.20303691	6.78
75	A	High	2	SB	81.5	1.22712459	6.53
76	A	High	2	TF	82.7	1.2745067	6.09
77	K	High	2	C	82.1	1.28870242	5.97
78	K	High	2	KB	83.7	1.2608884	6.21
79	K	High	2	SB	81.6	1.28152994	6.03
80	K	High	2	TF	84.2	1.21340693	6.67
81	BW	High	2	C	82.9	1.18069982	7.03
82	BW	High	2	KB	84	1.20026822	6.81
83	BW	High	2	SB	82.8	1.21436709	6.66
84	BW	High	2	TF	84.2	1.25211193	6.29
85	CR	High	2	C	83.7	1.24568103	6.35
86	CR	High	2	KB	81.9	1.24146361	6.39
87	CR	High	2	SB	83.2	1.29479722	5.92
88	CR	High	2	TF	85.1	1.20026822	6.81
89	TB	High	2	C	83.3	1.232172	6.48
90	TB	High	2	KB	84.1	1.21054413	6.7
91	TB	High	2	SB	81.6	1.24674404	6.34
92	TB	High	2	TF	83.7	1.20583076	6.75
93	MIX	High	2	C	80.6	1.25977842	6.22
94	MIX	High	2	KB	82.1	1.23937541	6.41
95	MIX	High	2	SB	80.9	1.22117207	6.59
96	MIX	High	2	TF	85.3	1.17304806	7.12
97	A	Low	3	C	79.8	1.29602932	5.91

98	A	Low	3	KB	80.3	1.20396538	6.77
99	A	Low	3	SB	81.5	1.2301434	6.5
100	A	Low	3	TF	81.8	1.24146361	6.39
101	K	Low	3	C	79.7	1.33106324	5.64
102	K	Low	3	KB	80.2	1.20865015	6.72
103	K	Low	3	SB	83.1	1.22913393	6.51
104	K	Low	3	TF	83.7	1.2710495	6.12
105	BW	Low	3	C	83.4	1.24356543	6.37
106	BW	Low	3	KB	82.9	1.25537562	6.26
107	BW	Low	3	SB	83.6	1.20959569	6.71
108	BW	Low	3	TF	81.9	1.19210954	6.9
109	CR	Low	3	C	83.7	1.24995413	6.31
110	CR	Low	3	KB	80.4	1.22612467	6.54
111	CR	Low	3	SB	80.9	1.25319621	6.28
112	CR	Low	3	TF	84.2	1.18069982	7.03
113	TB	Low	3	C	83.8	1.21823752	6.62
114	TB	Low	3	KB	82.4	1.22913393	6.51
115	TB	Low	3	SB	84.1	1.2373007	6.43
116	TB	Low	3	TF	85.2	1.20303691	6.78
117	MIX	Low	3	C	80.1	1.2862947	5.99
118	MIX	Low	3	KB	80.7	1.2373007	6.43
119	MIX	Low	3	SB	81.2	1.25977842	6.22
120	MIX	Low	3	TF	83.6	1.20211123	6.79
121	A	High	3	C	80.4	1.26311963	6.19
122	A	High	3	KB	81.6	1.2608884	6.21
123	A	High	3	SB	79.8	1.26649497	6.16
124	A	High	3	TF	82	1.24995413	6.31
125	K	High	3	C	80.1	1.28991271	5.96
126	K	High	3	KB	82.3	1.24146361	6.39
127	K	High	3	SB	81.2	1.24781054	6.33
128	K	High	3	TF	82.3	1.23833638	6.42
129	BW	High	3	C	82.7	1.20959569	6.71
130	BW	High	3	KB	81.9	1.21533021	6.65
131	BW	High	3	SB	83.1	1.23937541	6.41
132	BW	High	3	TF	84.4	1.20303691	6.78
133	CR	High	3	C	82.9	1.24674404	6.34
134	CR	High	3	KB	81.3	1.23937541	6.41
135	CR	High	3	SB	80.8	1.25867218	6.23
136	CR	High	3	TF	84.6	1.23115608	6.49
137	TB	High	3	C	84.5	1.20865015	6.72
138	TB	High	3	KB	83.1	1.22712459	6.53
139	TB	High	3	SB	80.7	1.24041781	6.4
140	TB	High	3	TF	83.8	1.22215638	6.58
141	MIX	High	3	C	84.1	1.20303691	6.78
142	MIX	High	3	KB	82.9	1.21149547	6.69
143	MIX	High	3	SB	85.3	1.2077075	6.73
144	MIX	High	3	TF	84.8	1.19121638	6.91

Appendix 3. Greenhouse Experiment 2

Appendix 3a. *Panicum virgatum* and invasive species height and number of leaves data over three collection dates. CV = Cultivar (A='Alamo', K='Kanlow', BW='Blackwell', CR='Cave in Rock', TB='Trailblazer'), MOIST = Moisture Level, BLK = Block, INV = Invasive Species (C=Control, KB=Kentucky Bluegrass, SB=Smooth Brome, TF=Tall Fescue), NO.SG = Number of Switchgrass, NO.INV = Number of Invasive Species, HT = Height (cm), NO.LVS = Number of Leaves, .= Missing Values.

							Switchgrass		Invasive Species		
POT ID	**CV**	**MOIST.**	**BLK**	**INV**	**NO.SG**	**NO.INV**	**HT**	**NO.LVS**	**HT**	**NO.LV**	**DAY**
1	A	Low	1	C	1	1	5.3	1	.	.	1
2	A	Low	1	KB	1	1	5.9	1	4.7	1	1
3	A	Low	1	SB	1	1	5.1	1	11.3	4	1
4	A	Low	1	TF	1	1	6.2	1	8.7	2	1
5	K	Low	1	C	1	1	6.3	1	.	.	1
6	K	Low	1	KB	1	1	5.8	1	5.6	1	1
7	K	Low	1	SB	1	1	5.2	1	13.1	3	1
8	K	Low	1	TF	1	1	5.6	1	9.2	1	1
9	BW	Low	1	C	1	1	8.3	1	.	.	1
10	BW	Low	1	KB	1	1	8.2	1	6.3	1	1
11	BW	Low	1	SB	1	1	8.6	1	10.8	2	1
12	BW	Low	1	TF	1	1	9.2	1	9.4	2	1
13	CR	Low	1	C	1	1	11.7	1	.	.	1
14	CR	Low	1	KB	1	1	11.3	2	3.9	1	1
15	CR	Low	1	SB	1	1	10.8	2	12.1	3	1
16	CR	Low	1	TF	1	1	11.5	2	11.2	3	1
17	TB	Low	1	C	1	1	14.9	2	.	.	1
18	TB	Low	1	KB	1	1	17.2	2	5.7	2	1
19	TB	Low	1	SB	1	1	15.4	2	10.5	5	1
20	TB	Low	1	TF	1	1	14.8	2	7.9	2	1
21	A	High	1	C	1	1	4.2	1	.	.	1
22	A	High	1	KB	1	1	6.3	1	5.3	2	1
23	A	High	1	SB	1	1	5.3	1	12.2	3	1
24	A	High	1	TF	1	1	5.1	1	7.1	1	1
25	K	High	1	C	1	1	5.8	1	.	.	1
26	K	High	1	KB	1	1	6.3	1	6.1	1	1
27	K	High	1	SB	1	1	6.1	1	12.8	4	1
28	K	High	1	TF	1	1	6.6	1	9.4	2	1
29	BW	High	1	C	1	1	9.4	1	.	.	1
30	BW	High	1	KB	1	1	9.7	1	3.9	2	1
31	BW	High	1	SB	1	1	8.4	2	13.3	3	1
32	BW	High	1	TF	1	1	9.1	2	12.4	3	1
33	CR	High	1	C	1	1	12.5	1	.	.	1
34	CR	High	1	KB	1	1	11.6	1	6	1	1
35	CR	High	1	SB	1	1	12.8	1	11.9	6	1
36	CR	High	1	TF	1	1	13.2	2	7.8	3	1
37	TB	High	1	C	1	1	13.9	1	.	.	1
38	TB	High	1	KB	1	1	13.4	1	5.3	3	1
39	TB	High	1	SB	1	1	14.3	1	10.7	7	1
40	TB	High	1	TF	1	1	14	2	9.8	2	1
41	A	Low	2	C	1	1	4.2	1	.	.	1
42	A	Low	2	KB	1	1	5.1	1	3.7	2	1
43	A	Low	2	SB	1	1	4.8	1	9.9	5	1
44	A	Low	2	TF	1	1	5.5	1	7.8	4	1
45	K	Low	2	C	1	1	5.1	1	.	.	1
46	K	Low	2	KB	1	1	5.6	1	4.8	3	1
47	K	Low	2	SB	1	1	5.8	1	10.2	5	1

48	K	Low	2	TF	1	1	5.3	1	9.3	2	1
49	BW	Low	2	C	1	1	7.4	1	.	.	1
50	BW	Low	2	KB	1	1	6.9	1	4.1	2	1
51	BW	Low	2	SB	1	1	7.1	1	11.4	2	1
52	BW	Low	2	TF	1	1	8.2	1	9.6	2	1
53	CR	Low	2	C	1	1	8.7	1	.	.	1
54	CR	Low	2	KB	1	1	9.4	1	5.3	1	1
55	CR	Low	2	SB	1	1	8.6	1	12.5	4	1
56	CR	Low	2	TF	1	1	9.2	1	9.5	2	1
57	TB	Low	2	C	1	1	11.4	1	.	.	1
58	TB	Low	2	KB	1	1	11.1	1	5.8	2	1
59	TB	Low	2	SB	1	1	10.7	2	12.7	3	1
60	TB	Low	2	TF	1	1	11.3	2	10.2	3	1
61	A	High	2	C	1	1	5.1	1	.	.	1
62	A	High	2	KB	1	1	4.9	1	5.7	1	1
63	A	High	2	SB	1	1	4.3	1	10.8	4	1
64	A	High	2	TF	1	1	5.2	1	9.3	1	1
65	K	High	2	C	1	1	5.1	1	.	.	1
66	K	High	2	KB	1	1	5.8	1	5.1	2	1
67	K	High	2	SB	1	1	6.3	1	10.7	3	1
68	K	High	2	TF	1	1	6.2	1	8.9	4	1
69	BW	High	2	C	1	1	9.1	1	.	.	1
70	BW	High	2	KB	1	1	9.5	1	6.1	2	1
71	BW	High	2	SB	1	1	8.9	1	11.4	6	1
72	BW	High	2	TF	1	1	8.8	1	8.7	2	1
73	CR	High	2	C	1	1	10.7	1	.	.	1
74	CR	High	2	KB	1	1	10.2	1	5.6	3	1
75	CR	High	2	SB	1	1	11.8	1	10.8	8	1
76	CR	High	2	TF	1	1	11.3	1	9	2	1
77	TB	High	2	C	1	1	12.5	1	.	.	1
78	TB	High	2	KB	1	1	12.2	1	5.1	2	1
79	TB	High	2	SB	1	1	12.8	1	12.8	4	1
80	TB	High	2	TF	1	1	13.1	1	10.1	3	1
81	A	Low	3	C	1	1	4.9	1	.	.	1
82	A	Low	3	KB	1	1	4.4	1	5.5	1	1
83	A	Low	3	SB	1	1	5.3	1	11.2	3	1
84	A	Low	3	TF	1	1	4.7	1	8.8	1	1
85	K	Low	3	C	1	1	5.5	1	.	.	1
86	K	Low	3	KB	1	1	5.2	1	5.8	1	1
87	K	Low	3	SB	1	1	5	1	10.7	2	1
88	K	Low	3	TF	1	1	6.1	1	7.5	2	1
89	BW	Low	3	C	1	1	6.3	2	.	.	1
90	BW	Low	3	KB	1	1	7.4	1	4.3	2	1
91	BW	Low	3	SB	1	1	8.6	2	9.9	2	1
92	BW	Low	3	TF	1	1	8.1	2	6.9	3	1
93	CR	Low	3	C	1	1	9.3	2	.	.	1
94	CR	Low	3	KB	1	1	10.2	2	5.1	2	1
95	CR	Low	3	SB	1	1	11.3	2	9.3	1	1
96	CR	Low	3	TF	1	1	9.7	2	8.7	2	1

97	TB	Low	3	C	1	1	12.1	2	.	.	1
98	TB	Low	3	KB	1	1	12.4	1	5.1	1	1
99	TB	Low	3	SB	1	1	11.5	1	10.7	3	1
100	TB	Low	3	TF	1	1	12	2	8.4	3	1
101	A	High	3	C	1	1	4.5	1	.	.	1
102	A	High	3	KB	1	1	5.1	1	5	2	1
103	A	High	3	SB	1	1	5	1	11.3	4	1
104	A	High	3	TF	1	1	4.9	1	9.2	2	1
105	K	High	3	C	1	1	5.4	1	.	.	1
106	K	High	3	KB	1	1	5.2	1	6.3	2	1
107	K	High	3	SB	1	1	5.6	1	11.5	5	1
108	K	High	3	TF	1	1	5.3	1	9.5	3	1
109	BW	High	3	C	1	1	9.6	1	.	.	1
110	BW	High	3	KB	1	1	8.8	1	5.8	3	1
111	BW	High	3	SB	1	1	8.5	1	13.4	6	1
112	BW	High	3	TF	1	1	9.3	1	9.6	4	1
113	CR	High	3	C	1	1	10.3	1	.	.	1
114	CR	High	3	KB	1	1	10.6	1	6.5	2	1
115	CR	High	3	SB	1	1	10.5	1	13.7	5	1
116	CR	High	3	TF	1	1	11.1	2	10.8	4	1
117	TB	High	3	C	1	1	12.3	2	.	.	1
118	TB	High	3	KB	1	1	13.1	2	6.6	2	1
119	TB	High	3	SB	1	1	12.8	2	13.8	5	1
120	TB	High	3	TF	1	1	13.4	2	11.2	5	1
1	A	Low	1	C	1	1	7.4	3	.	.	2
2	A	Low	1	KB	1	1	6.3	3	10.2	4	2
3	A	Low	1	SB	1	1	5.6	2	9.5	3	2
4	A	Low	1	TF	1	1	6.8	3	7.8	4	2
5	K	Low	1	C	1	1	6.9	3	.	.	2
6	K	Low	1	KB	1	1	6.2	2	13.1	4	2
7	K	Low	1	SB	1	1	5.7	2	15.2	2	2
8	K	Low	1	TF	1	1	6.1	3	14.2	2	2
9	BW	Low	1	C	1	1	8.5	3	.	.	2
10	BW	Low	1	KB	1	1	8.8	3	8.8	3	2
11	BW	Low	1	SB	1	1	9.4	1	10.8	4	2
12	BW	Low	1	TF	1	1	9.9	3	9.4	2	2
13	CR	Low	1	C	1	1	12.4	4	.	.	2
14	CR	Low	1	KB	1	1	13.1	1	10.7	3	2
15	CR	Low	1	SB	1	1	12.6	3	14.6	3	2
16	CR	Low	1	TF	1	1	12.3	3	12.8	3	2
17	TB	Low	1	C	1	1	16.2	4	.	.	2
18	TB	Low	1	KB	1	1	17.8	2	6.7	3	2
19	TB	Low	1	SB	1	1	16.4	2	13.1	2	2
20	TB	Low	1	TF	1	1	15.5	2	10	2	2
21	A	High	1	C	1	1	5.4	3	.	.	2
22	A	High	1	KB	1	1	8.1	3	7.2	3	2
23	A	High	1	SB	1	1	5.7	2	16.4	3	2
24	A	High	1	TF	1	1	5.7	2	9.9	2	2
25	K	High	1	C	1	1	6	4	.	.	2

26	K	High	1	KB	1	1	6.8	2	8.3	3	2
27	K	High	1	SB	1	1	6.6	2	15.6	3	2
28	K	High	1	TF	1	1	7.5	4	12.3	2	2
29	BW	High	1	C	1	1	10.7	4	.	.	2
30	BW	High	1	KB	1	1	11.1	1	5.7	3	2
31	BW	High	1	SB	1	1	9.3	2	17.5	4	2
32	BW	High	1	TF	1	1	9.7	2	13.8	3	2
33	CR	High	1	C	1	1	13.3	4	.	.	2
34	CR	High	1	KB	1	1	12.6	2	6.9	2	2
35	CR	High	1	SB	1	1	13.4	2	16.3	2	2
36	CR	High	1	TF	1	1	13.6	5	11.2	2	2
37	TB	High	1	C	1	1	14.9	3	.	.	2
38	TB	High	1	KB	1	1	14.1	1	7.4	3	2
39	TB	High	1	SB	1	1	14.7	1	14.1	3	2
40	TB	High	1	TF	1	1	14.3	3	11.6	3	2
41	A	Low	2	C	1	1	5.5	4	.	.	2
42	A	Low	2	KB	1	1	5.7	2	5.5	4	2
43	A	Low	2	SB	1	1	5.3	2	14.8	5	2
44	A	Low	2	TF	1	1	5.9	3	10.1	3	2
45	K	Low	2	C	1	1	5.6	4	.	.	2
46	K	Low	2	KB	1	1	6.1	3	6.3	3	2
47	K	Low	2	SB	1	1	6.4	2	17.5	2	2
48	K	Low	2	TF	1	1	5.5	4	13.4	2	2
49	BW	Low	2	C	1	1	7.7	3	.	.	2
50	BW	Low	2	KB	1	1	7.4	4	5.9	2	2
51	BW	Low	2	SB	1	1	7.9	1	12.8	2	2
52	BW	Low	2	TF	1	1	8.5	3	12.1	3	2
53	CR	Low	2	C	1	1	9.2	3	.	.	2
54	CR	Low	2	KB	1	1	10.1	2	6.2	4	2
55	CR	Low	2	SB	1	1	9	2	18.9	4	2
56	CR	Low	2	TF	1	1	9.7	3	12.4	3	2
57	TB	Low	2	C	1	1	11.6	3	.	.	2
58	TB	Low	2	KB	1	1	11.8	4	7.8	5	2
59	TB	Low	2	SB	1	1	11.1	2	19.4	3	2
60	TB	Low	2	TF	1	1	11.7	2	13.2	3	2
61	A	High	2	C	1	1	5.8	2	.	.	2
62	A	High	2	KB	1	1	5.4	2	9.1	3	2
63	A	High	2	SB	1	1	5	2	11.2	4	2
64	A	High	2	TF	1	1	5.4	3	13.4	3	2
65	K	High	2	C	1	1	5.7	2	.	.	2
66	K	High	2	KB	1	1	6.5	2	8.3	2	2
67	K	High	2	SB	1	1	6.9	2	14.6	3	2
68	K	High	2	TF	1	1	6.6	3	9.7	4	2
69	BW	High	2	C	1	1	9.6	3	.	.	2
70	BW	High	2	KB	1	1	10.3	3	9.2	2	2
71	BW	High	2	SB	1	1	9.5	3	12.1	6	2
72	BW	High	2	TF	1	1	9.2	4	12.3	2	2
73	CR	High	2	C	1	1	11.3	3	.	.	2
74	CR	High	2	KB	1	1	10.8	2	7.7	3	2

75	CR	High	2	SB	1	1	12.2	2	11.5	3	2
76	CR	High	2	TF	1	1	11.7	4	9.4	3	2
77	TB	High	2	C	1	1	13.5	3	.	.	2
78	TB	High	2	KB	1	1	14.6	3	8.1	3	2
79	TB	High	2	SB	1	1	14.2	3	17.8	3	2
80	TB	High	2	TF	1	1	13.8	4	11.7	4	2
81	A	Low	3	C	1	1	6.2	3	.	.	2
82	A	Low	3	KB	1	1	5.9	3	7.1	6	2
83	A	Low	3	SB	1	1	6.1	1	14.6	4	2
84	A	Low	3	TF	1	1	5.5	2	11	4	2
85	K	Low	3	C	1	1	5.8	2	.	.	2
86	K	Low	3	KB	1	1	6.4	2	6.2	3	2
87	K	Low	3	SB	1	1	5.9	2	14.2	4	2
88	K	Low	3	TF	1	1	6.6	2	9.4	3	2
89	BW	Low	3	C	1	1	7.2	2	.	.	2
90	BW	Low	3	KB	1	1	8.1	2	5.7	3	2
91	BW	Low	3	SB	1	1	9.5	3	11.1	5	2
92	BW	Low	3	TF	1	1	8.9	3	8.6	3	2
93	CR	Low	3	C	1	1	11.1	3	.	.	2
94	CR	Low	3	KB	1	1	10.9	2	6.6	5	2
95	CR	Low	3	SB	1	1	12.3	2	13.4	5	2
96	CR	Low	3	TF	1	1	10.5	3	9.7	4	2
97	TB	Low	3	C	1	1	12.8	3	.	.	2
98	TB	Low	3	KB	1	1	14.1	2	5.5	3	2
99	TB	Low	3	SB	1	1	13.7	2	17.2	3	2
100	TB	Low	3	TF	1	1	13.8	3	11.2	2	2
101	A	High	3	C	1	1	6	3	.	.	2
102	A	High	3	KB	1	1	5.7	3	5.9	3	2
103	A	High	3	SB	1	1	5.4	3	11.9	4	2
104	A	High	3	TF	1	1	5.6	3	10.1	5	2
105	K	High	3	C	1	1	6.4	3	.	.	2
106	K	High	3	KB	1	1	6.1	3	8.4	4	2
107	K	High	3	SB	1	1	6	3	13.7	4	2
108	K	High	3	TF	1	1	6.1	2	10.4	4	2
109	BW	High	3	C	1	1	11.6	2	.	.	2
110	BW	High	3	KB	1	1	10.1	3	6.8	3	2
111	BW	High	3	SB	1	1	9.6	3	17.3	4	2
112	BW	High	3	TF	1	1	10.3	3	12.1	3	2
113	CR	High	3	C	1	1	11.6	3	.	.	2
114	CR	High	3	KB	1	1	12.2	2	9.1	3	2
115	CR	High	3	SB	1	1	13.1	2	19.4	5	2
116	CR	High	3	TF	1	1	14.3	2	11.6	3	2
117	TB	High	3	C	1	1	13.6	2	.	.	2
118	TB	High	3	KB	1	1	13.8	2	8.2	3	2
119	TB	High	3	SB	1	1	13.1	3	18.4	5	2
120	TB	High	3	TF	1	1	14.6	3	14.1	4	2
1	A	Low	1	C	1	1	15.3	4	.	.	3
2	A	Low	1	KB	1	1	13.8	3	11.4	3	3
3	A	Low	1	SB	1	1	9.8	2	25.1	9	3

4	A	Low	1	TF	1	1	15	3	13	5	3
5	K	Low	1	C	1	1	27.5	3	.	.	3
6	K	Low	1	KB	1	1	15.1	3	11.3	2	3
7	K	Low	1	SB	1	1	11.5	2	20.1	6	3
8	K	Low	1	TF	1	1	13.9	4	12.2	3	3
9	BW	Low	1	C	1	1	14.7	3	.	.	3
10	BW	Low	1	KB	1	1	13.2	3	12.1	4	3
11	BW	Low	1	SB	1	1	10.1	3	23.2	7	3
12	BW	Low	1	TF	1	1	11.1	2	11.9	4	3
13	CR	Low	1	C	1	1	14.6	4	.	.	3
14	CR	Low	1	KB	1	1	11.4	4	9.4	2	3
15	CR	Low	1	SB	1	1	9.3	3	23.1	6	3
16	CR	Low	1	TF	1	1	14.2	3	12.1	3	3
17	TB	Low	1	C	1	1	19.4	4	.	.	3
18	TB	Low	1	KB	1	1	17.1	5	9.8	2	3
19	TB	Low	1	SB	1	1	10.3	3	27.3	8	3
20	TB	Low	1	TF	1	1	14.2	4	12.4	3	3
21	A	High	1	C	1	1	25.1	4	.	.	3
22	A	High	1	KB	1	1	23.4	5	11.1	5	3
23	A	High	1	SB	1	1	14.6	3	22	8	3
24	A	High	1	TF	1	1	21.4	3	14.5	4	3
25	K	High	1	C	1	1	24.2	3	.	.	3
26	K	High	1	KB	1	1	21.1	3	8.6	3	3
27	K	High	1	SB	1	1	16.2	2	21.8	6	3
28	K	High	1	TF	1	1	22.4	4	13.4	4	3
29	BW	High	1	C	1	1	22.7	4	.	.	3
30	BW	High	1	KB	1	1	19.3	5	11.6	3	3
31	BW	High	1	SB	1	1	14.8	3	24.3	6	3
32	BW	High	1	TF	1	1	20	3	13.7	3	3
33	CR	High	1	C	1	1	15.1	4	.	.	3
34	CR	High	1	KB	1	1	12.7	3	11.2	3	3
35	CR	High	1	SB	1	1	11.2	3	24.6	7	3
36	CR	High	1	TF	1	1	14.1	2	15.4	6	3
37	TB	High	1	C	1	1	15.3	3	.	.	3
38	TB	High	1	KB	1	1	10	2	11.1	2	3
39	TB	High	1	SB	1	1	9.7	3	22.7	8	3
40	TB	High	1	TF	1	1	13.2	3	8.7	3	3
41	A	Low	2	C	1	1	16.2	4	.	.	3
42	A	Low	2	KB	1	1	14.3	3	12.1	2	3
43	A	Low	2	SB	1	1	13.6	2	28.6	6	3
44	A	Low	2	TF	1	1	13.7	3	12.8	4	3
45	K	Low	2	C	1	1	24.3	5	.	.	3
46	K	Low	2	KB	1	1	20.1	3	13.5	3	3
47	K	Low	2	SB	1	1	17.3	4	26.7	9	3
48	K	Low	2	TF	1	1	19.6	4	10.8	4	3
49	BW	Low	2	C	1	1	28.9	5	.	.	3
50	BW	Low	2	KB	1	1	26.6	4	17.9	3	3
51	BW	Low	2	SB	1	1	21.8	4	26.7	8	3
52	BW	Low	2	TF	1	1	13.3	4	20.7	5	3

53	CR	Low	2	C	1	1	24.6	4	.	.	3
54	CR	Low	2	KB	1	1	21.5	2	9.8	3	3
55	CR	Low	2	SB	1	1	17.4	3	26.9	10	3
56	CR	Low	2	TF	1	1	20.7	4	11.2	4	3
57	TB	Low	2	C	1	1	20.6	4	.	.	3
58	TB	Low	2	KB	1	1	18.2	3	12.6	4	3
59	TB	Low	2	SB	1	1	12.1	3	21.4	7	3
60	TB	Low	2	TF	1	1	16.4	4	18.5	9	3
61	A	High	2	C	1	1	12.7	5	.	.	3
62	A	High	2	KB	1	1	8.2	2	16.4	7	3
63	A	High	2	SB	1	1	5.8	4	27.2	9	3
64	A	High	2	TF	1	1	10.1	4	19.1	4	3
65	K	High	2	C	1	1	17.9	5	.	.	3
66	K	High	2	KB	1	1	15.3	3	8.9	4	3
67	K	High	2	SB	1	1	8.8	3	21.9	6	3
68	K	High	2	TF	1	1	14.4	2	19.2	4	3
69	BW	High	2	C	1	1	24.1	5	.	.	3
70	BW	High	2	KB	1	1	17.4	4	13.9	2	3
71	BW	High	2	SB	1	1	13.9	3	22.8	7	3
72	BW	High	2	TF	1	1	19.4	5	14.6	4	3
73	CR	High	2	C	1	1	16.8	5	.	.	3
74	CR	High	2	KB	1	1	15.1	4	10.6	5	3
75	CR	High	2	SB	1	1	15.2	3	28.5	9	3
76	CR	High	2	TF	1	1	18.3	3	16.2	5	3
77	TB	High	2	C	1	1	26.3	2	.	.	3
78	TB	High	2	KB	1	1	20.1	4	14.1	4	3
79	TB	High	2	SB	1	1	21.7	3	32.8	11	3
80	TB	High	2	TF	1	1	18.6	4	17.2	4	3
81	A	Low	3	C	1	1	23.3	4	.	.	3
82	A	Low	3	KB	1	1	18.4	3	11.6	3	3
83	A	Low	3	SB	1	1	18.9	3	21.7	6	3
84	A	Low	3	TF	1	1	21.6	5	17.8	2	3
85	K	Low	3	C	1	1	18.8	3	.	.	3
86	K	Low	3	KB	1	1	17.4	4	16.1	3	3
87	K	Low	3	SB	1	1	14.3	4	32.1	7	3
88	K	Low	3	TF	1	1	15.5	6	21.1	3	3
89	BW	Low	3	C	1	1	12.7	5	.	.	3
90	BW	Low	3	KB	1	1	8.9	5	21.4	2	3
91	BW	Low	3	SB	1	1	3.6	2	27	9	3
92	BW	Low	3	TF	1	1	10.8	4	18.9	4	3
93	CR	Low	3	C	1	1	19.4	3	.	.	3
94	CR	Low	3	KB	1	1	17.9	3	14.7	5	3
95	CR	Low	3	SB	1	1	6.6	3	26.3	7	3
96	CR	Low	3	TF	1	1	19.8	5	21.2	4	3
97	TB	Low	3	C	1	1	21.7	4	.	.	3
98	TB	Low	3	KB	1	1	15.3	3	13.3	4	3
99	TB	Low	3	SB	1	1	16.4	3	28.3	6	3
100	TB	Low	3	TF	1	1	19.2	4	21.6	4	3
101	A	High	3	C	1	1	14.8	5	.	.	3

102	A	High	3	KB	1	1	7.9	3	10.7	6	3
103	A	High	3	SB	1	1	8.3	3	21.1	11	3
104	A	High	3	TF	1	1	12.6	4	14.5	5	3
105	K	High	3	C	1	1	23.2	4	.	.	3
106	K	High	3	KB	1	1	20.6	2	13.8	4	3
107	K	High	3	SB	1	1	17.1	2	23.6	9	3
108	K	High	3	TF	1	1	19.8	4	15.2	4	3
109	BW	High	3	C	1	1	21.9	4	.	.	3
110	BW	High	3	KB	1	1	14.5	3	14.7	5	3
111	BW	High	3	SB	1	1	18.6	3	22.3	8	3
112	BW	High	3	TF	1	1	20.1	3	9.5	4	3
113	CR	High	3	C	1	1	24.5	4	.	.	3
114	CR	High	3	KB	1	1	19.8	2	14.6	3	3
115	CR	High	3	SB	1	1	16.3	3	22.9	12	3
116	CR	High	3	TF	1	1	21.3	5	12.8	5	3
117	TB	High	3	C	1	1	25.8	3	.	.	3
118	TB	High	3	KB	1	1	13.4	3	14.9	4	3
119	TB	High	3	SB	1	1	18.2	2	24.1	10	3
120	TB	High	3	TF	1	1	23.1	5	13.5	5	3

Appendix 3b. Soil moisture data for the *Panicum virgatum* cultivars over three collection dates. CV = Cultivar (A='Alamo', K='Kanlow', BW='Blackwell', CR='Cave in Rock', TB='Trailblazer'), MOIST = Moisture Level, BLK = Block, INV = Invasive Species (C=Control, KB=Kentucky Bluegrass, SB=Smooth Brome, TF=Tall Fescue), and SM=Soil Moisture (cm/m).

POT ID	CV	MOIST.	BLK	INV	SM	DAY	POT ID	CV	MOIST.	BLK	INV	SM	DAY
1	A	Low	1	C	-1.4	1	49	BW	Low	2	C	0	1
2	A	Low	1	KB	2	1	50	BW	Low	2	KB	2	1
3	A	Low	1	SB	-3.9	1	51	BW	Low	2	SB	0	1
4	A	Low	1	TF	2.8	1	52	BW	Low	2	TF	0	1
5	K	Low	1	C	0.8	1	53	CR	Low	2	C	2	1
6	K	Low	1	KB	1.7	1	54	CR	Low	2	KB	2	1
7	K	Low	1	SB	0.1	1	55	CR	Low	2	SB	1	1
8	K	Low	1	TF	-0.3	1	56	CR	Low	2	TF	2	1
9	BW	Low	1	C	-0.1	1	57	TB	Low	2	C	2	1
10	BW	Low	1	KB	2.3	1	58	TB	Low	2	KB	1	1
11	BW	Low	1	SB	0.1	1	59	TB	Low	2	SB	-2	1
12	BW	Low	1	TF	0.1	1	60	TB	Low	2	TF	2	1
13	CR	Low	1	C	2.6	1	61	A	High	2	C	3	1
14	CR	Low	1	KB	1.2	1	62	A	High	2	KB	1	1
15	CR	Low	1	SB	1.4	1	63	A	High	2	SB	0	1
16	CR	Low	1	TF	1.3	1	64	A	High	2	TF	0	1
17	TB	Low	1	C	2.5	1	65	K	High	2	C	0	1
18	TB	Low	1	KB	1.8	1	66	K	High	2	KB	4	1
19	TB	Low	1	SB	-2.1	1	67	K	High	2	SB	0	1
20	TB	Low	1	TF	2.8	1	68	K	High	2	TF	2	1
21	A	High	1	C	3	1	69	BW	High	2	C	1	1
22	A	High	1	KB	0.4	1	70	BW	High	2	KB	5	1
23	A	High	1	SB	0.6	1	71	BW	High	2	SB	-1	1
24	A	High	1	TF	0	1	72	BW	High	2	TF	2	1
25	K	High	1	C	0	1	73	CR	High	2	C	5	1
26	K	High	1	KB	4.3	1	74	CR	High	2	KB	3	1
27	K	High	1	SB	0.9	1	75	CR	High	2	SB	-4	1
28	K	High	1	TF	2.5	1	76	CR	High	2	TF	1	1
29	BW	High	1	C	0.8	1	77	TB	High	2	C	3	1
30	BW	High	1	KB	4.4	1	78	TB	High	2	KB	1	1
31	BW	High	1	SB	-0.9	1	79	TB	High	2	SB	1	1
32	BW	High	1	TF	2.3	1	80	TB	High	2	TF	3	1
33	CR	High	1	C	5.6	1	81	A	Low	3	C	-1	1
34	CR	High	1	KB	2.4	1	82	A	Low	3	KB	2	1
35	CR	High	1	SB	-3.9	1	83	A	Low	3	SB	-3	1
36	CR	High	1	TF	1.7	1	84	A	Low	3	TF	2	1
37	TB	High	1	C	3.5	1	85	K	Low	3	C	1	1
38	TB	High	1	KB	0.5	1	86	K	Low	3	KB	1	1
39	TB	High	1	SB	1.7	1	87	K	Low	3	SB	0	1
40	TB	High	1	TF	3.9	1	88	K	Low	3	TF	-1	1
41	A	Low	2	C	-1.1	1	89	BW	Low	3	C	0	1
42	A	Low	2	KB	1.7	1	90	BW	Low	3	KB	2	1
43	A	Low	2	SB	-3.3	1	91	BW	Low	3	SB	0	1
44	A	Low	2	TF	2.5	1	92	BW	Low	3	TF	0	1
45	K	Low	2	C	0.3	1	93	CR	Low	3	C	3	1
46	K	Low	2	KB	1.8	1	94	CR	Low	3	KB	1	1
47	K	Low	2	SB	0.4	1	95	CR	Low	3	SB	1	1
48	K	Low	2	TF	-0.7	1	96	CR	Low	3	TF	1	1

97	TB	Low	3	C	2.1	1	26	K	High	1	KB	3	2
98	TB	Low	3	KB	2.3	1	27	K	High	1	SB	2	2
99	TB	Low	3	SB	-1.4	1	28	K	High	1	TF	2	2
100	TB	Low	3	TF	2.2	1	29	BW	High	1	C	3	2
101	A	High	3	C	3.4	1	30	BW	High	1	KB	4	2
102	A	High	3	KB	0.1	1	31	BW	High	1	SB	1	2
103	A	High	3	SB	0.9	1	32	BW	High	1	TF	5	2
104	A	High	3	TF	0.2	1	33	CR	High	1	C	4	2
105	K	High	3	C	-0.3	1	34	CR	High	1	KB	-0	2
106	K	High	3	KB	3.6	1	35	CR	High	1	SB	-1	2
107	K	High	3	SB	0.3	1	36	CR	High	1	TF	3	2
108	K	High	3	TF	2.8	1	37	TB	High	1	C	4	2
109	BW	High	3	C	1.2	1	38	TB	High	1	KB	5	2
110	BW	High	3	KB	3.7	1	39	TB	High	1	SB	-0	2
111	BW	High	3	SB	-0.1	1	40	TB	High	1	TF	1	2
112	BW	High	3	TF	1.8	1	41	A	Low	2	C	2	2
113	CR	High	3	C	5.9	1	42	A	Low	2	KB	0	2
114	CR	High	3	KB	2.7	1	43	A	Low	2	SB	-2	2
115	CR	High	3	SB	-1.4	1	44	A	Low	2	TF	4	2
116	CR	High	3	TF	1.5	1	45	K	Low	2	C	5	2
117	TB	High	3	C	3	1	46	K	Low	2	KB	2	2
118	TB	High	3	KB	0.6	1	47	K	Low	2	SB	-3	2
119	TB	High	3	SB	1.3	1	48	K	Low	2	TF	4	2
120	TB	High	3	TF	3.7	1	49	BW	Low	2	C	5	2
1	A	Low	1	C	2.1	2	50	BW	Low	2	KB	4	2
2	A	Low	1	KB	0.1	2	51	BW	Low	2	SB	-4	2
3	A	Low	1	SB	-2.4	2	52	BW	Low	2	TF	2	2
4	A	Low	1	TF	3.4	2	53	CR	Low	2	C	1	2
5	K	Low	1	C	5.2	2	54	CR	Low	2	KB	4	2
6	K	Low	1	KB	2.8	2	55	CR	Low	2	SB	-5	2
7	K	Low	1	SB	-3.2	2	56	CR	Low	2	TF	4	2
8	K	Low	1	TF	4.4	2	57	TB	Low	2	C	6	2
9	BW	Low	1	C	4.5	2	58	TB	Low	2	KB	2	2
10	BW	Low	1	KB	4.4	2	59	TB	Low	2	SB	1	2
11	BW	Low	1	SB	-4.7	2	60	TB	Low	2	TF	0	2
12	BW	Low	1	TF	2.5	2	61	A	High	2	C	3	2
13	CR	Low	1	C	1.6	2	62	A	High	2	KB	-1	2
14	CR	Low	1	KB	3.9	2	63	A	High	2	SB	0	2
15	CR	Low	1	SB	-5.7	2	64	A	High	2	TF	2	2
16	CR	Low	1	TF	4.8	2	65	K	High	2	C	2	2
17	TB	Low	1	C	5.4	2	66	K	High	2	KB	2	2
18	TB	Low	1	KB	1.6	2	67	K	High	2	SB	2	2
19	TB	Low	1	SB	1.3	2	68	K	High	2	TF	2	2
20	TB	Low	1	TF	0.5	2	69	BW	High	2	C	3	2
21	A	High	1	C	3.2	2	70	BW	High	2	KB	3	2
22	A	High	1	KB	-0.5	2	71	BW	High	2	SB	1	2
23	A	High	1	SB	-0.2	2	72	BW	High	2	TF	5	2
24	A	High	1	TF	2.6	2	73	CR	High	2	C	5	2
25	K	High	1	C	1.5	2	74	CR	High	2	KB	-1	2

75	CR	High	2	SB	-0.9	2	4	A	Low	1	TF	5	3
76	CR	High	2	TF	3.3	2	5	K	Low	1	C	4	3
77	TB	High	2	C	4.7	2	6	K	Low	1	KB	6	3
78	TB	High	2	KB	4.2	2	7	K	Low	1	SB	0	3
79	TB	High	2	SB	-0.1	2	8	K	Low	1	TF	5	3
80	TB	High	2	TF	1.4	2	9	BW	Low	1	C	5	3
81	A	Low	3	C	2.7	2	10	BW	Low	1	KB	6	3
82	A	Low	3	KB	0.6	2	11	BW	Low	1	SB	8	3
83	A	Low	3	SB	-1.2	2	12	BW	Low	1	TF	1	3
84	A	Low	3	TF	3.2	2	13	CR	Low	1	C	6	3
85	K	Low	3	C	4.1	2	14	CR	Low	1	KB	7	3
86	K	Low	3	KB	2.6	2	15	CR	Low	1	SB	3	3
87	K	Low	3	SB	-2.1	2	16	CR	Low	1	TF	5	3
88	K	Low	3	TF	4.5	2	17	TB	Low	1	C	6	3
89	BW	Low	3	C	4.9	2	18	TB	Low	1	KB	6	3
90	BW	Low	3	KB	4.1	2	19	TB	Low	1	SB	1	3
91	BW	Low	3	SB	-3.8	2	20	TB	Low	1	TF	4	3
92	BW	Low	3	TF	2.6	2	21	A	High	1	C	5	3
93	CR	Low	3	C	1.7	2	22	A	High	1	KB	4	3
94	CR	Low	3	KB	4.2	2	23	A	High	1	SB	6	3
95	CR	Low	3	SB	-5.1	2	24	A	High	1	TF	4	3
96	CR	Low	3	TF	3.9	2	25	K	High	1	C	6	3
97	TB	Low	3	C	5.1	2	26	K	High	1	KB	7	3
98	TB	Low	3	KB	2.7	2	27	K	High	1	SB	2	3
99	TB	Low	3	SB	1.1	2	28	K	High	1	TF	7	3
100	TB	Low	3	TF	0.1	2	29	BW	High	1	C	7	3
101	A	High	3	C	2.9	2	30	BW	High	1	KB	8	3
102	A	High	3	KB	-0.2	2	31	BW	High	1	SB	2	3
103	A	High	3	SB	0.1	2	32	BW	High	1	TF	4	3
104	A	High	3	TF	2.6	2	33	CR	High	1	C	9	3
105	K	High	3	C	1.9	2	34	CR	High	1	KB	5	3
106	K	High	3	KB	2.1	2	35	CR	High	1	SB	-2	3
107	K	High	3	SB	1.8	2	36	CR	High	1	TF	6	3
108	K	High	3	TF	2.1	2	37	TB	High	1	C	4	3
109	BW	High	3	C	3	2	38	TB	High	1	KB	5	3
110	BW	High	3	KB	3.6	2	39	TB	High	1	SB	5	3
111	BW	High	3	SB	0.8	2	40	TB	High	1	TF	6	3
112	BW	High	3	TF	4.6	2	41	A	Low	2	C	9	3
113	CR	High	3	C	4.2	2	42	A	Low	2	KB	6	3
114	CR	High	3	KB	-0.3	2	43	A	Low	2	SB	5	3
115	CR	High	3	SB	-0.4	2	44	A	Low	2	TF	5	3
116	CR	High	3	TF	2.9	2	45	K	Low	2	C	6	3
117	TB	High	3	C	4.2	2	46	K	Low	2	KB	6	3
118	TB	High	3	KB	3.9	2	47	K	Low	2	SB	3	3
119	TB	High	3	SB	0	2	48	K	Low	2	TF	6	3
120	TB	High	3	TF	1.7	2	49	BW	Low	2	C	4	3
1	A	Low	1	C	3.4	3	50	BW	Low	2	KB	4	3
2	A	Low	1	KB	5	3	51	BW	Low	2	SB	4	3
3	A	Low	1	SB	-3.7	3	52	BW	Low	2	TF	7	3

53	CR	Low	2	C	5.2	3
54	CR	Low	2	KB	5.3	3
55	CR	Low	2	SB	8.5	3
56	CR	Low	2	TF	6.5	3
57	TB	Low	2	C	7.2	3
58	TB	Low	2	KB	7.1	3
59	TB	Low	2	SB	2.5	3
60	TB	Low	2	TF	4.8	3
61	A	High	2	C	6.1	3
62	A	High	2	KB	6.2	3
63	A	High	2	SB	2.3	3
64	A	High	2	TF	7.2	3
65	K	High	2	C	5	3
66	K	High	2	KB	6.8	3
67	K	High	2	SB	-2	3
68	K	High	2	TF	6.8	3
69	BW	High	2	C	7.5	3
70	BW	High	2	KB	9.4	3
71	BW	High	2	SB	4.5	3
72	BW	High	2	TF	3.2	3
73	CR	High	2	C	6.7	3
74	CR	High	2	KB	9.2	3
75	CR	High	2	SB	6.3	3
76	CR	High	2	TF	5.9	3
77	TB	High	2	C	3.5	3
78	TB	High	2	KB	7.9	3
79	TB	High	2	SB	3.6	3
80	TB	High	2	TF	4.8	3
81	A	Low	3	C	3.4	3
82	A	Low	3	KB	5.9	3
83	A	Low	3	SB	-0.2	3
84	A	Low	3	TF	7	3
85	K	Low	3	C	5.7	3
86	K	Low	3	KB	4.6	3
87	K	Low	3	SB	1.4	3
88	K	Low	3	TF	6.3	3
89	BW	Low	3	C	8.3	3
90	BW	Low	3	KB	5	3
91	BW	Low	3	SB	-2	3
92	BW	Low	3	TF	4.9	3
93	CR	Low	3	C	6.7	3
94	CR	Low	3	KB	4.8	3
95	CR	Low	3	SB	2.1	3
96	CR	Low	3	TF	6.2	3
97	TB	Low	3	C	8.2	3
98	TB	Low	3	KB	4.2	3
99	TB	Low	3	SB	2.7	3
100	TB	Low	3	TF	2.8	3
101	A	High	3	C	6.4	3
102	A	High	3	KB	4	3
103	A	High	3	SB	0	3
104	A	High	3	TF	6	3
105	K	High	3	C	4	3
106	K	High	3	KB	6	3
107	K	High	3	SB	8	3
108	K	High	3	TF	6	3
109	BW	High	3	C	6	3
110	BW	High	3	KB	6	3
111	BW	High	3	SB	3	3
112	BW	High	3	TF	8	3
113	CR	High	3	C	5	3
114	CR	High	3	KB	4	3
115	CR	High	3	SB	4	3
116	CR	High	3	TF	7	3
117	TB	High	3	C	8	3
118	TB	High	3	KB	6	3
119	TB	High	3	SB	5	3
120	TB	High	3	TF	7	3

Appendix 3c. Light intensity data for the *Panicum virgatum* cultivars over three collection dates. CV = Cultivar (A='Alamo', K='Kanlow', BW='Blackwell', CR='Cave in Rock', TB='Trailblazer'), MOIST = Moisture Level, BLK = Block, INV = Invasive Species (C=Control, KB=Kentucky Bluegrass, SB=Smooth Brome, TF=Tall Fescue), and LIGHT= Light (μmols^{-1}m^{-2}).

POT ID	CV	MOIST.	BLK	INV	DAY	LIGHT	POT ID	CV	MOIST.	BLK	INV	DAY	LIGHT
1	A	Low	1	C	1	33.6	49	BW	Low	2	C	1	30.2
2	A	Low	1	KB	1	27.4	50	BW	Low	2	KB	1	33.5
3	A	Low	1	SB	1	31.3	51	BW	Low	2	SB	1	29.7
4	A	Low	1	TF	1	34.7	52	BW	Low	2	TF	1	26.4
5	K	Low	1	C	1	28.1	53	CR	Low	2	C	1	26.8
6	K	Low	1	KB	1	36.3	54	CR	Low	2	KB	1	33.9
7	K	Low	1	SB	1	30.9	55	CR	Low	2	SB	1	28.6
8	K	Low	1	TF	1	36.6	56	CR	Low	2	TF	1	27.3
9	BW	Low	1	C	1	33.8	57	TB	Low	2	C	1	30.9
10	BW	Low	1	KB	1	36.2	58	TB	Low	2	KB	1	32.5
11	BW	Low	1	SB	1	29.8	59	TB	Low	2	SB	1	32.4
12	BW	Low	1	TF	1	29.9	60	TB	Low	2	TF	1	29.8
13	CR	Low	1	C	1	31.7	61	A	High	2	C	1	34.6
14	CR	Low	1	KB	1	28.4	62	A	High	2	KB	1	32.8
15	CR	Low	1	SB	1	27.7	63	A	High	2	SB	1	33.8
16	CR	Low	1	TF	1	31.4	64	A	High	2	TF	1	33.7
17	TB	Low	1	C	1	29.8	65	K	High	2	C	1	27.6
18	TB	Low	1	KB	1	27.2	66	K	High	2	KB	1	28.5
19	TB	Low	1	SB	1	26.4	67	K	High	2	SB	1	30.5
20	TB	Low	1	TF	1	28.1	68	K	High	2	TF	1	29.6
21	A	High	1	C	1	24.9	69	BW	High	2	C	1	31.4
22	A	High	1	KB	1	28.3	70	BW	High	2	KB	1	32.2
23	A	High	1	SB	1	30.7	71	BW	High	2	SB	1	35.1
24	A	High	1	TF	1	34.1	72	BW	High	2	TF	1	34.8
25	K	High	1	C	1	28.3	73	CR	High	2	C	1	27.4
26	K	High	1	KB	1	31	74	CR	High	2	KB	1	33.5
27	K	High	1	SB	1	33.5	75	CR	High	2	SB	1	29.1
28	K	High	1	TF	1	28.7	76	CR	High	2	TF	1	30.7
29	BW	High	1	C	1	29.6	77	TB	High	2	C	1	31.9
30	BW	High	1	KB	1	25.1	78	TB	High	2	KB	1	28.9
31	BW	High	1	SB	1	33.3	79	TB	High	2	SB	1	29.3
32	BW	High	1	TF	1	29.4	80	TB	High	2	TF	1	23.7
33	CR	High	1	C	1	30.1	81	A	Low	3	C	1	27.2
34	CR	High	1	KB	1	27.4	82	A	Low	3	KB	1	30.1
35	CR	High	1	SB	1	29.3	83	A	Low	3	SB	1	29.5
36	CR	High	1	TF	1	35.1	84	A	Low	3	TF	1	30.6
37	TB	High	1	C	1	32.4	85	K	Low	3	C	1	28.7
38	TB	High	1	KB	1	33.8	86	K	Low	3	KB	1	28.5
39	TB	High	1	SB	1	30.1	87	K	Low	3	SB	1	26.6
40	TB	High	1	TF	1	29.6	88	K	Low	3	TF	1	24.8
41	A	Low	2	C	1	28.3	89	BW	Low	3	C	1	23.1
42	A	Low	2	KB	1	30.3	90	BW	Low	3	KB	1	33.7
43	A	Low	2	SB	1	27.2	91	BW	Low	3	SB	1	26.9
44	A	Low	2	TF	1	32.1	92	BW	Low	3	TF	1	27.4
45	K	Low	2	C	1	29.5	93	CR	Low	3	C	1	28.9
46	K	Low	2	KB	1	33.7	94	CR	Low	3	KB	1	31.1
47	K	Low	2	SB	1	31.6	95	CR	Low	3	SB	1	27.7
48	K	Low	2	TF	1	29.7	96	CR	Low	3	TF	1	29.2

97	TB	Low	3	C	1	26.9	26	K	High	1	KB	2	27.1
98	TB	Low	3	KB	1	23.8	27	K	High	1	SB	2	30.6
99	TB	Low	3	SB	1	24.5	28	K	High	1	TF	2	29.2
100	TB	Low	3	TF	1	25.9	29	BW	High	1	C	2	28.5
101	A	High	3	C	1	23.7	30	BW	High	1	KB	2	29.7
102	A	High	3	KB	1	26.1	31	BW	High	1	SB	2	28.3
103	A	High	3	SB	1	27.6	32	BW	High	1	TF	2	30.1
104	A	High	3	TF	1	32.5	33	CR	High	1	C	2	31.8
105	K	High	3	C	1	25.3	34	CR	High	1	KB	2	32.6
106	K	High	3	KB	1	28.4	35	CR	High	1	SB	2	30.1
107	K	High	3	SB	1	32.6	36	CR	High	1	TF	2	29.1
108	K	High	3	TF	1	26.6	37	TB	High	1	C	2	29.4
109	BW	High	3	C	1	26.9	38	TB	High	1	KB	2	27.5
110	BW	High	3	KB	1	24.7	39	TB	High	1	SB	2	29.6
111	BW	High	3	SB	1	31.1	40	TB	High	1	TF	2	33.3
112	BW	High	3	TF	1	27.4	41	A	Low	2	C	2	28.1
113	CR	High	3	C	1	29.7	42	A	Low	2	KB	2	30.8
114	CR	High	3	KB	1	27.3	43	A	Low	2	SB	2	29.3
115	CR	High	3	SB	1	24.9	44	A	Low	2	TF	2	24.7
116	CR	High	3	TF	1	24.3	45	K	Low	2	C	2	28.8
117	TB	High	3	C	1	31.6	46	K	Low	2	KB	2	28.3
118	TB	High	3	KB	1	25.7	47	K	Low	2	SB	2	30.4
119	TB	High	3	SB	1	25.5	48	K	Low	2	TF	2	31.7
120	TB	High	3	TF	1	28.4	49	BW	Low	2	C	2	32.1
1	A	Low	1	C	2	29.1	50	BW	Low	2	KB	2	22.3
2	A	Low	1	KB	2	33.6	51	BW	Low	2	SB	2	33.5
3	A	Low	1	SB	2	32.9	52	BW	Low	2	TF	2	27.2
4	A	Low	1	TF	2	33.7	53	CR	Low	2	C	2	26.8
5	K	Low	1	C	2	28.1	54	CR	Low	2	KB	2	29.3
6	K	Low	1	KB	2	33.6	55	CR	Low	2	SB	2	24.7
7	K	Low	1	SB	2	29.8	56	CR	Low	2	TF	2	32.4
8	K	Low	1	TF	2	31.3	57	TB	Low	2	C	2	31.1
9	BW	Low	1	C	2	30.9	58	TB	Low	2	KB	2	29.8
10	BW	Low	1	KB	2	30.8	59	TB	Low	2	SB	2	32.3
11	BW	Low	1	SB	2	31.1	60	TB	Low	2	TF	2	30.1
12	BW	Low	1	TF	2	30.1	61	A	High	2	C	2	30.2
13	CR	Low	1	C	2	27.9	62	A	High	2	KB	2	32.1
14	CR	Low	1	KB	2	23.4	63	A	High	2	SB	2	35.8
15	CR	Low	1	SB	2	27.7	64	A	High	2	TF	2	29.2
16	CR	Low	1	TF	2	29.4	65	K	High	2	C	2	33.8
17	TB	Low	1	C	2	33.5	66	K	High	2	KB	2	33.9
18	TB	Low	1	KB	2	29.1	67	K	High	2	SB	2	35.9
19	TB	Low	1	SB	2	31.8	68	K	High	2	TF	2	30.7
20	TB	Low	1	TF	2	28.7	69	BW	High	2	C	2	28.2
21	A	High	1	C	2	24.5	70	BW	High	2	KB	2	31.3
22	A	High	1	KB	2	30.6	71	BW	High	2	SB	2	32.8
23	A	High	1	SB	2	31.3	72	BW	High	2	TF	2	38.2
24	A	High	1	TF	2	32.9	73	CR	High	2	C	2	27.2
25	K	High	1	C	2	33.3	74	CR	High	2	KB	2	27.1

75	CR	High	2	SB	2	28.7	4	A	Low	1	TF	3	27.9
76	CR	High	2	TF	2	31.4	5	K	Low	1	C	3	33.2
77	TB	High	2	C	2	29.6	6	K	Low	1	KB	3	34.1
78	TB	High	2	KB	2	31.5	7	K	Low	1	SB	3	25.6
79	TB	High	2	SB	2	32.8	8	K	Low	1	TF	3	30.9
80	TB	High	2	TF	2	30.5	9	BW	Low	1	C	3	32.1
81	A	Low	3	C	2	28.7	10	BW	Low	1	KB	3	34.4
82	A	Low	3	KB	2	27.9	11	BW	Low	1	SB	3	28.3
83	A	Low	3	SB	2	33.1	12	BW	Low	1	TF	3	33.2
84	A	Low	3	TF	2	24.6	13	CR	Low	1	C	3	27.4
85	K	Low	3	C	2	21.4	14	CR	Low	1	KB	3	32.4
86	K	Low	3	KB	2	28.8	15	CR	Low	1	SB	3	29.8
87	K	Low	3	SB	2	29.5	16	CR	Low	1	TF	3	34.6
88	K	Low	3	TF	2	29.6	17	TB	Low	1	C	3	27.4
89	BW	Low	3	C	2	30.8	18	TB	Low	1	KB	3	26.5
90	BW	Low	3	KB	2	29.3	19	TB	Low	1	SB	3	27.7
91	BW	Low	3	SB	2	35.5	20	TB	Low	1	TF	3	27.1
92	BW	Low	3	TF	2	26.2	21	A	High	1	C	3	31.8
93	CR	Low	3	C	2	30.1	22	A	High	1	KB	3	27.8
94	CR	Low	3	KB	2	29.2	23	A	High	1	SB	3	33.8
95	CR	Low	3	SB	2	36.4	24	A	High	1	TF	3	20.3
96	CR	Low	3	TF	2	33.7	25	K	High	1	C	3	29.6
97	TB	Low	3	C	2	32.9	26	K	High	1	KB	3	30.5
98	TB	Low	3	KB	2	35.1	27	K	High	1	SB	3	20.1
99	TB	Low	3	SB	2	29.2	28	K	High	1	TF	3	25.6
100	TB	Low	3	TF	2	28.1	29	BW	High	1	C	3	23.6
101	A	High	3	C	2	25.4	30	BW	High	1	KB	3	23.5
102	A	High	3	KB	2	28.2	31	BW	High	1	SB	3	28.7
103	A	High	3	SB	2	26.6	32	BW	High	1	TF	3	29.1
104	A	High	3	TF	2	23.8	33	CR	High	1	C	3	27.8
105	K	High	3	C	2	35.2	34	CR	High	1	KB	3	30.7
106	K	High	3	KB	2	26.7	35	CR	High	1	SB	3	30.1
107	K	High	3	SB	2	30.2	36	CR	High	1	TF	3	29.5
108	K	High	3	TF	2	30.9	37	TB	High	1	C	3	31.2
109	BW	High	3	C	2	31.3	38	TB	High	1	KB	3	32.8
110	BW	High	3	KB	2	32.9	39	TB	High	1	SB	3	33.8
111	BW	High	3	SB	2	33.3	40	TB	High	1	TF	3	39.1
112	BW	High	3	TF	2	27.7	41	A	Low	2	C	3	36.7
113	CR	High	3	C	2	30.4	42	A	Low	2	KB	3	31.8
114	CR	High	3	KB	2	31.9	43	A	Low	2	SB	3	34.2
115	CR	High	3	SB	2	27.3	44	A	Low	2	TF	3	26.6
116	CR	High	3	TF	2	29.1	45	K	Low	2	C	3	25.3
117	TB	High	3	C	2	26.7	46	K	Low	2	KB	3	21.7
118	TB	High	3	KB	2	29.2	47	K	Low	2	SB	3	31.5
119	TB	High	3	SB	2	31.2	48	K	Low	2	TF	3	26.1
120	TB	High	3	TF	2	30.1	49	BW	Low	2	C	3	27.4
1	A	Low	1	C	3	27.3	50	BW	Low	2	KB	3	30.5
2	A	Low	1	KB	3	26.7	51	BW	Low	2	SB	3	28
3	A	Low	1	SB	3	29.8	52	BW	Low	2	TF	3	31

53	CR	Low	2	C	3	28.1	102	A	High	3	KB	3	32.8
54	CR	Low	2	KB	3	27.7	103	A	High	3	SB	3	31.6
55	CR	Low	2	SB	3	29.4	104	A	High	3	TF	3	33.1
56	CR	Low	2	TF	3	33.5	105	K	High	3	C	3	35.2
57	TB	Low	2	C	3	29.7	106	K	High	3	KB	3	30.2
58	TB	Low	2	KB	3	28.1	107	K	High	3	SB	3	28
59	TB	Low	2	SB	3	25.3	108	K	High	3	TF	3	26.5
60	TB	Low	2	TF	3	31.7	109	BW	High	3	C	3	30.7
61	A	High	2	C	3	33.4	110	BW	High	3	KB	3	31
62	A	High	2	KB	3	30.3	111	BW	High	3	SB	3	32.7
63	A	High	2	SB	3	29.1	112	BW	High	3	TF	3	34.3
64	A	High	2	TF	3	31.8	113	CR	High	3	C	3	34.9
65	K	High	2	C	3	28.7	114	CR	High	3	KB	3	26.2
66	K	High	2	KB	3	27.4	115	CR	High	3	SB	3	29.9
67	K	High	2	SB	3	28.1	116	CR	High	3	TF	3	32.1
68	K	High	2	TF	3	30.2	117	TB	High	3	C	3	36.2
69	BW	High	2	C	3	31.3	118	TB	High	3	KB	3	29.2
70	BW	High	2	KB	3	28.3	119	TB	High	3	SB	3	33.4
71	BW	High	2	SB	3	29.7	120	TB	High	3	TF	3	35.1
72	BW	High	2	TF	3	28.4							
73	CR	High	2	C	3	32.3							
74	CR	High	2	KB	3	30.6							
75	CR	High	2	SB	3	31.8							
76	CR	High	2	TF	3	29.9							
77	TB	High	2	C	3	32.4							
78	TB	High	2	KB	3	31.3							
79	TB	High	2	SB	3	32.7							
80	TB	High	2	TF	3	33.1							
81	A	Low	3	C	3	34.6							
82	A	Low	3	KB	3	28.8							
83	A	Low	3	SB	3	35.9							
84	A	Low	3	TF	3	28.6							
85	K	Low	3	C	3	38.8							
86	K	Low	3	KB	3	32.1							
87	K	Low	3	SB	3	24.7							
88	K	Low	3	TF	3	29.5							
89	BW	Low	3	C	3	31.8							
90	BW	Low	3	KB	3	26.6							
91	BW	Low	3	SB	3	33.5							
92	BW	Low	3	TF	3	34.2							
93	CR	Low	3	C	3	34.5							
94	CR	Low	3	KB	3	33.3							
95	CR	Low	3	SB	3	33.1							
96	CR	Low	3	TF	3	29.4							
97	TB	Low	3	C	3	25.4							
98	TB	Low	3	KB	3	26.7							
99	TB	Low	3	SB	3	32.4							
100	TB	Low	3	TF	3	29.2							
101	A	High	3	C	3	29.8							

Appendix 3d. Biomass (g) data for the *Panicum virgatum* cultivars. . CV = Cultivar (A='Alamo', K='Kanlow', BW='Blackwell', CR='Cave in Rock', TB='Trailblazer'), MOIST = Moisture Level, BLK = Block, INV = Invasive Species (C=Control, KB=Kentucky Bluegrass, SB=Smooth Brome, TF=Tall Fescue), and .=Missing Values.

POT ID	CV	MOIST.	BLK	INV	ABOVE SG	ABOVE INV	BELOW
1	A	Low	1	C	0.19	.	0.12
2	A	Low	1	KB	0.01	0.01	0.26
3	A	Low	1	SB	0.01	0.57	0.32
4	A	Low	1	TF	0.02	0.04	0.06
5	K	Low	1	C	0.01	.	0.01
6	K	Low	1	KB	0.02	0.01	0.04
7	K	Low	1	SB	0	1.07	0.67
8	K	Low	1	TF	0	0.19	0.1
9	BW	Low	1	C	0.06	.	0.05
10	BW	Low	1	KB	0.02	0	0.04
11	BW	Low	1	SB	0	0.34	0.13
12	BW	Low	1	TF	0	0.5	0.12
13	CR	Low	1	C	0.11	.	0.02
14	CR	Low	1	KB	0.04	0.07	0.14
15	CR	Low	1	SB	0.01	0.77	0.62
16	CR	Low	1	TF	0.01	0.39	0.36
17	TB	Low	1	C	0.03	.	0.1
18	TB	Low	1	KB	0.05	0.02	0.06
19	TB	Low	1	SB	0.02	1.08	0.76
20	TB	Low	1	TF	0.04	0.11	0.11
21	A	High	1	C	0.06	.	0.24
22	A	High	1	KB	0.01	0.01	0.04
23	A	High	1	SB	0.01	0.08	0.36
24	A	High	1	TF	0.08	0.23	0.12
25	K	High	1	C	0.06	.	0.03
26	K	High	1	KB	0.04	0.02	0.06
27	K	High	1	SB	0.01	0.34	0.3
28	K	High	1	TF	0.03	0.04	0.08
29	BW	High	1	C	0.02	.	0.01
30	BW	High	1	KB	0.08	0.01	0.05
31	BW	High	1	SB	0.03	0.59	0.5
32	BW	High	1	TF	0.01	0.07	0.07
33	CR	High	1	C	0.01	.	0.02
34	CR	High	1	KB	0.05	0.04	0.09
35	CR	High	1	SB	0.03	1.51	1.29
36	CR	High	1	TF	0.02	0.07	0.06
37	TB	High	1	C	0.08	.	0.01
38	TB	High	1	KB	0.04	0.01	0.07
39	TB	High	1	SB	0.01	0.6	0.55
40	TB	High	1	TF	0	0.11	0.09
41	A	Low	2	C	0.09	.	0.04
42	A	Low	2	KB	0.02	0.04	0.02
43	A	Low	2	SB	0.01	0.25	0.23
44	A	Low	2	TF	0.12	0.18	0.25
45	K	Low	2	C	0.03	.	0.04
46	K	Low	2	KB	0.07	0.01	0.04
47	K	Low	2	SB	0	0.21	0.45
48	K	Low	2	TF	0.01	0.24	0.18

49	BW	Low	2	C	0.2	.	0.07
50	BW	Low	2	KB	0.1	0.02	0.29
51	BW	Low	2	SB	0.01	0.22	0.2
52	BW	Low	2	TF	0.26	0.1	0.22
53	CR	Low	2	C	0.05	.	0.04
54	CR	Low	2	KB	0.09	0	0.02
55	CR	Low	2	SB	0.02	0.12	0.26
56	CR	Low	2	TF	0.02	0.06	0.09
57	TB	Low	2	C	0.02	.	0.11
58	TB	Low	2	KB	0.04	0.01	0.02
59	TB	Low	2	SB	0.03	0.92	0.17
60	TB	Low	2	TF	0.07	0.03	0.04
61	A	High	2	C	0.03	.	0.05
62	A	High	2	KB	0.01	0.02	0.12
63	A	High	2	SB	0.01	0.94	0.33
64	A	High	2	TF	0.04	0.08	0.11
65	K	High	2	C	0.06	.	0.04
66	K	High	2	KB	0.04	0.03	0.11
67	K	High	2	SB	0.01	0.86	0.54
68	K	High	2	TF	0.02	0.08	0.24
69	BW	High	2	C	0.08	.	0.06
70	BW	High	2	KB	0.05	0.02	0.12
71	BW	High	2	SB	0.03	0.29	0.28
72	BW	High	2	TF	0.03	0.05	0.12
73	CR	High	2	C	0.01	.	0.13
74	CR	High	2	KB	0.01	0.01	0.12
75	CR	High	2	SB	0.01	0.23	0.28
76	CR	High	2	TF	0.02	0.08	0.11
77	TB	High	2	C	0.01	.	0.02
78	TB	High	2	KB	0.03	0.01	0.02
79	TB	High	2	SB	0.04	0.57	0.33
80	TB	High	2	TF	0.01	0.05	0.12
81	A	Low	3	C	0.14	.	0.08
82	A	Low	3	KB	0.06	0.01	0.07
83	A	Low	3	SB	0	0.71	0.69
84	A	Low	3	TF	0.03	0.01	0.08
85	K	Low	3	C	0.07	.	0.05
86	K	Low	3	KB	0.01	0.03	0.08
87	K	Low	3	SB	0	0.64	0.32
88	K	Low	3	TF	0.01	0.06	0.06
89	BW	Low	3	C	0.07	.	0.06
90	BW	Low	3	KB	0.07	0.01	0.03
91	BW	Low	3	SB	0.02	0.37	0.34
92	BW	Low	3	TF	0.04	0.02	0.14
93	CR	Low	3	C	0.02	.	0.05
94	CR	Low	3	KB	0.03	0.01	0.09
95	CR	Low	3	SB	0.01	0.07	0.18
96	CR	Low	3	TF	0.04	0.06	0.27
97	TB	Low	3	C	0.07	.	0.15

98	TB	Low	3	KB	0.05	0.01	0.05
99	TB	Low	3	SB	0	0.24	0.71
100	TB	Low	3	TF	0.06	0.15	0.07
101	A	High	3	C	0.07	.	0.06
102	A	High	3	KB	0.22	0.04	0.16
103	A	High	3	SB	0.03	0.46	0.83
104	A	High	3	TF	0	0.1	0.14
105	K	High	3	C	0.04	.	0.01
106	K	High	3	KB	0.06	0.01	0.07
107	K	High	3	SB	0.01	0.17	0.43
108	K	High	3	TF	0.04	0.09	0.15
109	BW	High	3	C	0.09	.	0.16
110	BW	High	3	KB	0.04	0.01	0.11
111	BW	High	3	SB	0	1.25	0.41
112	BW	High	3	TF	0.02	0.05	0.09
113	CR	High	3	C	0.12	.	0.03
114	CR	High	3	KB	0.01	0.02	0.12
115	CR	High	3	SB	0	0.37	0.65
116	CR	High	3	TF	0.02	0.06	0.12
117	TB	High	3	C	0	.	0
118	TB	High	3	KB	0	0.03	0.05
119	TB	High	3	SB	0.01	0.19	0.32
120	TB	High	3	TF	0.04	0.07	0.08

Appendix 3e. Soil electrical conductivity (EC) and soil pH for the *P. virgatum* cultivars. CV = Cultivar (A='Alamo', K='Kanlow', BW='Blackwell', CR='Cave in Rock', TB='Trailblazer'), MOIST = Moisture Level, BLK = Block, INV = Invasive Species (C=Control, KB=Kentucky Bluegrass, SB=Smooth Brome, TF=Tall Fescue), EC=Soil Electrical Conductivity, and [H+]=Hydrogen Ion.

POT ID	CV	MOIST.	BLK	INV	EC	[H+]	pH
1	A	Low	1	C	80.6	1.239375409	6.41
2	A	Low	1	KB	81.3	1.203036907	6.78
3	A	Low	1	SB	84.1	1.246744038	6.34
4	A	Low	1	TF	80.2	1.239375409	6.41
5	K	Low	1	C	81.1	1.258672178	6.23
6	K	Low	1	KB	81.5	1.231156084	6.49
7	K	Low	1	SB	82.7	1.208650155	6.72
8	K	Low	1	TF	79.8	1.227124586	6.53
9	BW	Low	1	C	81.3	1.245681029	6.35
10	BW	Low	1	KB	81.8	1.210544126	6.7
11	BW	Low	1	SB	80.6	1.191216379	6.91
12	BW	Low	1	TF	84.1	1.289912705	5.96
13	CR	Low	1	C	83.9	1.229133933	6.51
14	CR	Low	1	KB	82.4	1.243565431	6.37
15	CR	Low	1	SB	83.7	1.267627765	6.15
16	CR	Low	1	TF	84.5	1.275667093	6.08
17	TB	Low	1	C	83.4	1.260888402	6.21
18	TB	Low	1	KB	81.3	1.267627765	6.15
19	TB	Low	1	SB	83	1.227124586	6.53
20	TB	Low	1	TF	79.2	1.202111233	6.79
21	A	High	1	C	81.1	1.198436227	6.83
22	A	High	1	KB	82.1	1.26311963	6.19
23	A	High	1	SB	79.6	1.248880569	6.32
24	A	High	1	TF	80.3	1.268764437	6.14
25	K	High	1	C	80.4	1.252111929	6.29
26	K	High	1	KB	81	1.224134288	6.56
27	K	High	1	SB	80.9	1.182427214	7.01
28	K	High	1	TF	82.7	1.199350852	6.82
29	BW	High	1	C	81.9	1.243565431	6.37
30	BW	High	1	KB	83.4	1.228127667	6.52
31	BW	High	1	SB	83.7	1.222156385	6.58
32	BW	High	1	TF	84.1	1.216296309	6.64
33	CR	High	1	C	81.5	1.240417813	6.4
34	CR	High	1	KB	82.7	1.222156385	6.58
35	CR	High	1	SB	82.1	1.203036907	6.78
36	CR	High	1	TF	83.7	1.211495467	6.69
37	TB	High	1	C	81.6	1.214367086	6.66
38	TB	High	1	KB	84.2	1.252111929	6.29
39	TB	High	1	SB	82.9	1.245681029	6.35
40	TB	High	1	TF	80.2	1.241463606	6.39
41	A	Low	2	C	83.1	1.294797222	5.92
42	A	Low	2	KB	83.7	1.200268219	6.81
43	A	Low	2	SB	83.4	1.232172002	6.48
44	A	Low	2	TF	82.9	1.218237518	6.62
45	K	Low	2	C	83.6	1.229133933	6.51
46	K	Low	2	KB	81.9	1.237300697	6.43
47	K	Low	2	SB	83.7	1.203036907	6.78
48	K	Low	2	TF	81.4	1.286294698	5.99

49	BW	Low	2	C	85.3	1.237300697	6.43
50	BW	Low	2	KB	79.8	1.259778424	6.22
51	BW	Low	2	SB	80.3	1.274506705	6.09
52	BW	Low	2	TF	81.5	1.288702422	5.97
53	CR	Low	2	C	81.8	1.260888402	6.21
54	CR	Low	2	KB	79.7	1.281529942	6.03
55	CR	Low	2	SB	80.4	1.213406932	6.67
56	CR	Low	2	TF	80.9	1.18069982	7.03
57	TB	Low	2	C	84.2	1.200268219	6.81
58	TB	Low	2	KB	83.8	1.289912705	5.96
59	TB	Low	2	SB	82.4	1.241463606	6.39
60	TB	Low	2	TF	84.1	1.247810545	6.33
61	A	High	2	C	79.6	1.238336376	6.42
62	A	High	2	KB	83.5	1.209595693	6.71
63	A	High	2	SB	83.8	1.215330206	6.65
64	A	High	2	TF	81.4	1.26649497	6.16
65	K	High	2	C	82.2	1.227124586	6.53
66	K	High	2	KB	85.1	1.209595693	6.71
67	K	High	2	SB	84.3	1.233191172	6.47
68	K	High	2	TF	84.7	1.239375409	6.41
69	BW	High	2	C	82.1	1.199350852	6.82
70	BW	High	2	KB	83.9	1.243565431	6.37
71	BW	High	2	SB	82.2	1.219212656	6.61
72	BW	High	2	TF	81.9	1.226124673	6.54
73	CR	High	2	C	80.3	1.246744038	6.34
74	CR	High	2	KB	83.9	1.210544126	6.7
75	CR	High	2	SB	84.2	1.246744038	6.34
76	CR	High	2	TF	80.9	1.205830762	6.75
77	TB	High	2	C	85.2	1.259778424	6.22
78	TB	High	2	KB	82.8	1.239375409	6.41
79	TB	High	2	SB	84.2	1.221172074	6.59
80	TB	High	2	TF	83.7	1.173048057	7.12
81	A	Low	3	C	81.9	1.211495467	6.69
82	A	Low	3	KB	83.2	1.245681029	6.35
83	A	Low	3	SB	85.1	1.219212656	6.61
84	A	Low	3	TF	84.7	1.239375409	6.41
85	K	Low	3	C	83.6	1.178127311	7.06
86	K	Low	3	KB	81.2	1.218237518	6.62
87	K	Low	3	SB	83.8	1.239375409	6.41
88	K	Low	3	TF	84.5	1.247810545	6.33
89	BW	Low	3	C	83.2	1.205830762	6.75
90	BW	Low	3	KB	83.4	1.212449731	6.68
91	BW	Low	3	SB	84.9	1.26649497	6.16
92	BW	Low	3	TF	84	1.249954128	6.31
93	CR	Low	3	C	83.6	1.289912705	5.96
94	CR	Low	3	KB	81.8	1.229133933	6.51
95	CR	Low	3	SB	81.2	1.243565431	6.37
96	CR	Low	3	TF	93.7	1.204896658	6.76
97	TB	Low	3	C	84.4	1.200268219	6.81

98	TB	Low	3	KB	80.1	1.203965377	6.77
99	TB	Low	3	SB	80.7	1.230143399	6.5
100	TB	Low	3	TF	81.2	1.241463606	6.39
101	A	High	3	C	83.6	1.331063242	5.64
102	A	High	3	KB	80.4	1.208650155	6.72
103	A	High	3	SB	81.6	1.229133933	6.51
104	A	High	3	TF	79.8	1.271049498	6.12
105	K	High	3	C	79.4	1.243565431	6.37
106	K	High	3	KB	80.1	1.255375623	6.26
107	K	High	3	SB	81.6	1.182427214	7.01
108	K	High	3	TF	83.7	1.202111233	6.79
109	BW	High	3	C	80.6	1.222156385	6.58
110	BW	High	3	KB	82.1	1.233191172	6.47
111	BW	High	3	SB	80.9	1.18766989	6.95
112	BW	High	3	TF	80.2	1.198436227	6.83
113	CR	High	3	C	82.7	1.257569642	6.24
114	CR	High	3	KB	81.3	1.219212656	6.61
115	CR	High	3	SB	82.4	1.192109536	6.9
116	CR	High	3	TF	80.6	1.26649497	6.16
117	TB	High	3	C	83.7	1.203036907	6.78
118	TB	High	3	KB	81.4	1.227124586	6.53
119	TB	High	3	SB	83.2	1.244621499	6.36
120	TB	High	3	TF	82.8	1.208650155	6.72

Appendix 3f. Trigonelline (TRG) for the *P. virgatum* cultivars. CV = Cultivar (A=‘Alamo’, K=‘Kanlow’, BW=‘Blackwell’, CR=‘Cave in Rock’, TB=‘Trailblazer’), MOIST = Moisture Level, BLK = Block, INV = Invasive Species (C=Control, KB=Kentucky Bluegrass, SB=Smooth Brome, TF=Tall Fescue), FW = Fresh Weight (g), OD_{264} = Optical Density at 264nm (nm), and $OD_{264}gFW^{-1}$ = OD per gram of FW.

POT ID	CV	MOIST.	BLK	INV	FW (g)	OD_{264} (nm)	$OD_{264}gFW^{-1}$
1	A	Low	1	C	0.31	0.0419	0.13516129
2	A	Low	1	KB	0.53	0.0796	0.15018868
3	A	Low	1	SB	0.42	0.0299	0.07119048
4	A	Low	1	TF	0.45	0.049	0.10888889
5	K	Low	1	C	0.28	0.025	0.08928571
6	K	Low	1	KB	0.71	0.0284	0.04
7	K	Low	1	SB	0.36	0.0717	0.19916667
8	K	Low	1	TF	0.81	0.031	0.0382716
9	BW	Low	1	C	0.22	0.0559	0.25409091
10	BW	Low	1	KB	0.39	0.0255	0.06538462
11	BW	Low	1	SB	0.41	0.0614	0.1497561
12	BW	Low	1	TF	0.43	0.415	0.96511628
13	CR	Low	1	C	0.27	0.4569	1.69222222
14	CR	Low	1	KB	0.34	0.4044	1.18941176
15	CR	Low	1	SB	0.24	0.386	1.60833333
16	CR	Low	1	TF	0.21	0.0782	0.37238095
17	TB	Low	1	C	0.66	0.0362	0.05484848
18	TB	Low	1	KB	0.38	0.4676	1.23052632
19	TB	Low	1	SB	0.45	0.5757	1.27933333
20	TB	Low	1	TF	0.4	0.0355	0.08875
21	A	High	1	C	0.25	0.0723	0.2892
22	A	High	1	KB	0.51	0.2575	0.50490196
23	A	High	1	SB	0.58	0.0141	0.02431034
24	A	High	1	TF	0.53	0.0431	0.08132075
25	K	High	1	C	0.61	0.1489	0.24409836
26	K	High	1	KB	0.49	0.0463	0.0944898
27	K	High	1	SB	0.57	0.0179	0.03140351
28	K	High	1	TF	0.44	0.0453	0.10295455
29	BW	High	1	C	0.68	0.0264	0.03882353
30	BW	High	1	KB	0.41	0.0863	0.2104878
31	BW	High	1	SB	0.57	0.0606	0.10631579
32	BW	High	1	TF	0.35	0.339	0.96857143
33	CR	High	1	C	0.39	0.0163	0.04179487
34	CR	High	1	KB	0.72	0.0261	0.03625
35	CR	High	1	SB	0.67	0.0675	0.10074627
36	CR	High	1	TF	0.53	0.0024	0.0045283
37	TB	High	1	C	0.47	0.0126	0.02680851
38	TB	High	1	KB	0.64	0.0806	0.1259375
39	TB	High	1	SB	0.58	0.0273	0.04706897
40	TB	High	1	TF	0.43	0.0177	0.04116279
41	A	Low	2	C	0.27	0.0572	0.21185185
42	A	Low	2	KB	0.41	0.0374	0.09121951
43	A	Low	2	SB	0.36	0.0423	0.1175
44	A	Low	2	TF	0.33	0.0347	0.10515152
45	K	Low	2	C	0.45	0.0259	0.05755556
46	K	Low	2	KB	0.51	0.031	0.06078431
47	K	Low	2	SB	0.29	0.0628	0.21655172
48	K	Low	2	TF	0.47	0.0274	0.05829787

49	BW	Low	2	C	0.42	0.0458	0.10904762
50	BW	Low	2	KB	0.41	0.0264	0.06439024
51	BW	Low	2	SB	0.56	0.0617	0.11017857
52	BW	Low	2	TF	0.62	0.0414	0.06677419
53	CR	Low	2	C	0.29	0.271	0.93448276
54	CR	Low	2	KB	0.52	0.3216	0.61846154
55	CR	Low	2	SB	0.4	0.4157	1.03925
56	CR	Low	2	TF	0.37	0.1722	0.46540541
57	TB	Low	2	C	0.34	0.0852	0.25058824
58	TB	Low	2	KB	0.46	0.0716	0.15565217
59	TB	Low	2	SB	0.44	0.5398	1.22681818
60	TB	Low	2	TF	0.47	0.4076	0.86723404
61	A	High	2	C	0.41	0.0521	0.12707317
62	A	High	2	KB	0.54	0.0894	0.16555556
63	A	High	2	SB	0.36	0.1371	0.38083333
64	A	High	2	TF	0.38	0.1264	0.33263158
65	K	High	2	C	0.31	0.0473	0.15258065
66	K	High	2	KB	0.34	0.0467	0.13735294
67	K	High	2	SB	0.37	0.0301	0.08135135
68	K	High	2	TF	0.61	0.0752	0.12327869
69	BW	High	2	C	0.49	0.0585	0.11938776
70	BW	High	2	KB	0.66	0.0361	0.05469697
71	BW	High	2	SB	0.52	0.1535	0.29519231
72	BW	High	2	TF	0.35	0.1742	0.49771429
73	CR	High	2	C	0.27	0.0248	0.09185185
74	CR	High	2	KB	0.32	0.0631	0.1971875
75	CR	High	2	SB	0.47	0.0127	0.02702128
76	CR	High	2	TF	0.42	0.0485	0.11547619
77	TB	High	2	C	0.53	0.0247	0.04660377
78	TB	High	2	KB	0.48	0.0151	0.03145833
79	TB	High	2	SB	0.57	0.0872	0.15298246
80	TB	High	2	TF	0.31	0.0757	0.24419355
81	A	Low	3	C	0.62	0.0031	0.005
82	A	Low	3	KB	0.44	0.0673	0.15295455
83	A	Low	3	SB	0.45	0.0142	0.03155556
84	A	Low	3	TF	0.3	0.0375	0.125
85	K	Low	3	C	0.28	0.0413	0.1475
86	K	Low	3	KB	0.43	0.0284	0.06604651
87	K	Low	3	SB	0.58	0.0297	0.0512069
88	K	Low	3	TF	0.36	0.0256	0.07111111
89	BW	Low	3	C	0.54	0.042	0.07777778
90	BW	Low	3	KB	0.62	0.0631	0.10177419
91	BW	Low	3	SB	0.58	0.2074	0.35758621
92	BW	Low	3	TF	0.45	0.4739	1.05311111
93	CR	Low	3	C	0.49	0.0822	0.1677551
94	CR	Low	3	KB	0.26	0.5837	2.245
95	CR	Low	3	SB	0.52	0.3271	0.62903846
96	CR	Low	3	TF	0.49	0.4794	0.97836735
97	TB	Low	3	C	0.6	0.0735	0.1225

98	TB	Low	3	KB	0.48	0.1967	0.40979167
99	TB	Low	3	SB	0.37	0.0483	0.13054054
100	TB	Low	3	TF	0.32	0.4746	1.483125
101	A	High	3	C	0.45	0.0621	0.138
102	A	High	3	KB	0.48	0.0424	0.08833333
103	A	High	3	SB	0.36	0.1216	0.33777778
104	A	High	3	TF	0.51	0.1028	0.20156863
105	K	High	3	C	0.47	0.0415	0.08829787
106	K	High	3	KB	0.39	0.0453	0.11615385
107	K	High	3	SB	0.32	0.0616	0.1925
108	K	High	3	TF	0.56	0.2471	0.44125
109	BW	High	3	C	0.42	0.0316	0.0752381
110	BW	High	3	KB	0.47	0.0471	0.10021277
111	BW	High	3	SB	0.63	0.0283	0.04492063
112	BW	High	3	TF	0.41	0.0623	0.15195122
113	CR	High	3	C	0.39	0.0719	0.18435897
114	CR	High	3	KB	0.33	0.0142	0.0430303
115	CR	High	3	SB	0.57	0.1832	0.32140351
116	CR	High	3	TF	0.42	0.0264	0.06285714
117	TB	High	3	C	0.46	0.0592	0.12869565
118	TB	High	3	KB	0.35	0.0138	0.03942857
119	TB	High	3	SB	0.62	0.0394	0.06354839
120	TB	High	3	TF	0.41	0.0283	0.06902439

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