

2022 GLBRC KBS BCSE Agronomic Protocol

January 1, 2022

G1: Annual grain monoculture: Continuous Corn (no crop rotation). This treatment represents a best management practice for conventional, high-intensity grain produced for biofuel, with some portion of the corn stover removed for cellulosic yield.	
Site	KBS
Planting	Plant Pioneer Seed Corn (variety P0306Q) in late April or early May. The variety will be a triple stack variety of corn with Roundup Ready and Bt.
Cover Crop	No cover crops used
Tillage	No-till
Harvest	Harvest corn in October or November. After grain harvest remove plant stover (except not in 6 west rows, see micro-plots, below)
Fertilization	<p>Recommendations from MSU Soil and Plant Nutrient Laboratory</p> <ul style="list-style-type: none"> • 0.1 N: Corn price ratio • Medium Soil Productivity • Fertilizer recommendations based on corn silage (not corn grain). <p>Total nitrogen recommendations: 150 lb N ac⁻¹ (168 kg N ha⁻¹).</p> <p>Starter: 14 gals/A of 19-17-0 (29 lbs N acre⁻¹, 33 kg N ha⁻¹)(26 lbs P₂O₅ acre⁻¹, 29 kg P₂O₅ ha⁻¹)</p> <p>Sidedress: 41 gal/A 28% N solution (121 lbs N acre⁻¹, 136 kg N ha⁻¹).</p> <p>Phosphorus (P) recommendations applied pre-plant as 0-46-0 (if applied): G1 (r1) 0 lb ac⁻¹ (0 kg ha⁻¹) → [0 lb P₂O₅ ac⁻¹ (0 kg P₂O₅ ha⁻¹)] G1 (r2) 141 lb ac⁻¹ (158 kg ha⁻¹) → [65 lb P₂O₅ ac⁻¹ (73 kg P₂O₅ ha⁻¹)] G1 (r3) 141 lb ac⁻¹ (158 kg ha⁻¹) → [65 lb P₂O₅ ac⁻¹ (73 kg P₂O₅ ha⁻¹)] G1 (r4) 0 lb ac⁻¹ (0 kg ha⁻¹) → [0 lb P₂O₅ ac⁻¹ (0 kg P₂O₅ ha⁻¹)] G1 (r5) 76 lb ac⁻¹ (85 kg ha⁻¹) → [35 lb P₂O₅ ac⁻¹ (39 kg P₂O₅ ha⁻¹)]</p> <p>Potassium (K) applied pre-plant as 0-0-60: G1 (r1): 50 lb ac⁻¹ (56 kg ha⁻¹) → [30 lb K₂O ac⁻¹ (34 kg K₂O ha⁻¹)] G1 (r2) 267 lb ac⁻¹ (299 kg ha⁻¹) → [160 lb K₂O ac⁻¹ (179 kg K₂O ha⁻¹)] G1 (r3) 167 lb ac⁻¹ (187 kg ha⁻¹) → [100 lb K₂O ac⁻¹ (112 kg K₂O ha⁻¹)] G1 (r4) 50 lb ac⁻¹ (56 kg ha⁻¹) → [30 lb K₂O ac⁻¹ (34 kg K₂O ha⁻¹)] G1 (r5) 58 lb ac⁻¹ (65 kg ha⁻¹) → [35 lb K₂O ac⁻¹ (39 kg K₂O ha⁻¹)]</p>
Weed Control	<p>Burn down: Roundup (22 oz/A) or Liberty + 2,4-D Ester (1 pt/A 7 days before planting) at label rates.</p> <p>Preemergence: Broadcast Acuron at 3 qts/A (Acuron is a premix of: Dual II Magnum (1.36 pt/A) + Callisto (5.34 oz/A) + atrazine 4L (1.3 lb/A) + bicyclopyrone).</p> <p>Postemergence: Apply Roundup or Liberty at label rates as needed to control weeds.</p>
Micro-plots	<p>Corn Stover Retention. Leave stover on west 6 rows of each plot, all replications.</p> <p>Harvest of micro-plots: Using a Kincaid plot combine harvest the middle 5' (2 rows) of the outer 15' (6 rows) on both the east and west of each plot for use as yield check for stover retention and stover removal micro-plots.</p>

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G2: Annual biomass monoculture: Energy Sorghum (two-year crop rotation with soybeans, no cover crop). This treatment represents a best management practice for production of energy sorghum for biofuel biomass production.	
Site	KBS
Planting	Plant energy sorghum in May. Row spacing: 30 inches. Population: 70,000 seeds/A. Variety to be determined later.
Cover Crop	None
Tillage	No-till
Harvest	Harvest sorghum in October-November. Harvest with 7350 chopper.
Fertilization	<p>Total nitrogen recommendations: 50 lb N ac⁻¹ (16.7 gals/A) applied pre-plant.</p> <p>Phosphorus (P) recommendations applied pre-plant as 0-46-0 (if applied): G1 (r1) 130 lb ac⁻¹ (146 kg ha⁻¹) → [60 lb P₂O₅ ac⁻¹ (67 kg P₂O₅ ha⁻¹)] G1 (r2) 87 lb ac⁻¹ (97 kg ha⁻¹) → [40 lb P₂O₅ ac⁻¹ (45 kg P₂O₅ ha⁻¹)] G1 (r3) 54 lb ac⁻¹ (61 kg ha⁻¹) → [25 lb P₂O₅ ac⁻¹ (28 kg P₂O₅ ha⁻¹)] G1 (r4) 0 lb ac⁻¹ (0 kg ha⁻¹) → [0 lb P₂O₅ ac⁻¹ (0 kg P₂O₅ ha⁻¹)] G1 (r5) 0 lb ac⁻¹ (0 kg ha⁻¹) → [0 lb P₂O₅ ac⁻¹ (0 kg P₂O₅ ha⁻¹)]</p> <p>Potassium (K) applied pre-plant as 0-0-60: : G2 (r1): 267 lb ac⁻¹ (299 kg ha⁻¹) → [160 lb K₂O ac⁻¹ (179 kg K₂O ha⁻¹)] G2 (r2) 267 lb ac⁻¹ (299 kg ha⁻¹) → [160 lb K₂O ac⁻¹ (179 kg K₂O ha⁻¹)] G2 (r3) 267 lb ac⁻¹ (299 kg ha⁻¹) → [160 lb K₂O ac⁻¹ (179 kg K₂O ha⁻¹)] G2 (r4) 267 lb ac⁻¹ (299 kg ha⁻¹) → [160 lb K₂O ac⁻¹ (179 kg K₂O ha⁻¹)] G2 (r5) 267 lb ac⁻¹ (299 kg ha⁻¹) → [160 lb K₂O ac⁻¹ (179 kg K₂O ha⁻¹)]</p>
Weed Control	<p>Burn down: Roundup (22 oz/A) and/or Liberty + 2,4-D Ester (1 pt/A 7 days before planting) at label rates.</p> <p>Preemergence: Label rates of Dual II Magnum 1.3 pts/A</p> <p>Postemergence: None expected but scout for weeds and make application as needed.</p>
Micro-plots	No nitrogen (N) micro-plot located on one side of the plots.

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G3: Annual biomass monoculture: Energy Sorghum (two-year crop rotation with soybeans, no cover crop). This treatment represents a best management practice for production of energy sorghum for biofuel biomass production.	
Site	KBS
Planting	Plant Pioneer Soybeans (Pioneer P22T86E) in May. Row spacing: 15 inches. Population: 150,000 seeds/A.
Cover Crop	None
Tillage	No-till
Harvest	Harvest soybeans in October. Harvest with S660.
Fertilization	<p>Phosphorus (P) recommendations applied pre-plant as 0-46-0 (if applied): G1 (r1) 130 lb ac⁻¹ (146 kg ha⁻¹) → [60 lb P₂O₅ ac⁻¹ (67 kg P₂O₅ ha⁻¹)] G1 (r2) 141 lb ac⁻¹ (158 kg ha⁻¹) → [65 lb P₂O₅ ac⁻¹ (73 kg P₂O₅ ha⁻¹)] G1 (r3) 141 lb ac⁻¹ (158 kg ha⁻¹) → [65 lb P₂O₅ ac⁻¹ (73 kg P₂O₅ ha⁻¹)] G1 (r4) 141 lb ac⁻¹ (158 kg ha⁻¹) → [65 lb P₂O₅ ac⁻¹ (73 kg P₂O₅ ha⁻¹)] G1 (r5) 22 lb ac⁻¹ (24 kg ha⁻¹) → [10 lb P₂O₅ ac⁻¹ (11 kg P₂O₅ ha⁻¹)]</p> <p>Potassium (K) applied pre-plant as 0-0-60: G2 (r1): 333 lb ac⁻¹ (374 kg ha⁻¹) → [200 lb K₂O ac⁻¹ (224 kg K₂O ha⁻¹)] G2 (r2) 342 lb ac⁻¹ (383 kg ha⁻¹) → [205 lb K₂O ac⁻¹ (230 kg K₂O ha⁻¹)] G2 (r3) 325 lb ac⁻¹ (364 kg ha⁻¹) → [195 lb K₂O ac⁻¹ (219 kg K₂O ha⁻¹)] G2 (r4) 300 lb ac⁻¹ (336 kg ha⁻¹) → [180 lb K₂O ac⁻¹ (202 kg K₂O ha⁻¹)] G2 (r5) 300 lb ac⁻¹ (336 kg ha⁻¹) → [180 lb K₂O ac⁻¹ (202 kg K₂O ha⁻¹)]</p>
Weed Control	<p>Burn down: Roundup (22 oz/A) and/or Liberty + 2,4-D Ester (1 pt/A 7 days before planting) at label rates.</p> <p>Preemergence: Label rates of Warrant @ 48 oz/A. Postemergence: Scout for weeds and make application as needed.</p>
Micro-plots	No nitrogen (N) micro-plot located on one side of the plots.

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G4: Perennial Grass – Monoculture Switchgrass The will be the new planting (seeding) of switchgrass. These plots were in row crops and/or cover crop. See ag-log for plot history.	
Site	KBS
Planting	June 25, 2021 Cave-in-rock Switchgrass was planted.
Cover Crop	N/A
Tillage	None
Harvest	Harvest in 2022.
Fertilization	<p>Nitrogen (28-0-0) will be applied at 50 lbs N acre⁻¹ (56 kg N ha⁻¹), which is 16.7 gals/A, 28% weighs 10.67 lbs/gal.</p> <p>Nitrogen application to the East 75' of each plot only.</p> <p>No P or K in 2022.</p>
Weed Control	<p>If needed PRE application of Roundup at 22 oz/A applied before switchgrass begins to grow.</p> <p>If needed: PRE or POST application of Drive or Paramount (quinclorac) 0.5 lb/A + atrazine 0.5 lb/A.</p>
Micro-plots	<p>No N micro-plot on the west side of each plot.</p> <p>No-Nitrogen fertilizer strip. No N fertilizer will be applied to the west 15 feet of each plot for all replications.</p> <p>Harvest (yield check) switchgrass from the No-Nitrogen micro-plots separately from main plot (60 ft wide). Compare yield to opposite plot edge. (compare the west and east 15 feet of each plot edge).</p> <p>Harvest of micro-plot: Harvest the middle 7.6' of the outer 15' on both the east and west of each plot using a JD 7330 with Wintersteiger/Kemper biomass harvester.</p>

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G5: Perennial Grass – Monoculture Switchgrass	
Site	KBS
Planting	Cave-in-rock was planted June 19, 2008 and over-seeded in July 7, 2009 because of poor stand establishment of switchgrass in 2008 due to heavy rainfall at KBS. On April 21, 2021 Cave-in-rock was planted and/or over-seeded in the original establishment with the goal in mind of increasing the stand of switchgrass within the plots.
Cover Crop	N/A
Tillage	None
Harvest	Same as G6, G7, G9, and G10 Harvest so that 5-6 inches of stubble remain for wildlife cover. Harvest in fall after hard frost / senescence. Main plot harvest width will be 60 feet. Micro-plot harvest: see below. Main plot harvest is with JD 7350 forage chopper and Gnuse forage wagon (equipped with load cells to record total weight). Record each plot weigh from forage wagon and collect sub sample so that plant moisture can be recorded.
Fertilization	Nitrogen (28-0-0) will be applied at 50 lbs N acre ⁻¹ (56 kg N ha ⁻¹), which is 16.7 gals/A, 28% weighs 10.67 lbs/gal. Nitrogen application to the East 75' of each plot only. No P or K in 2022. No P or K was applied in 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, and 2021.
Weed Control	If needed PRE application of Roundup at 22 oz/A applied before switchgrass begins to grow. If needed: PRE or POST application of Drive or Paramount (quinclorac) 0.5 lb/A + atrazine 0.5 lb/A.
Micro-plots	No-Nitrogen fertilizer strip. No N fertilizer will be applied to the west 15 feet of each plot for all replications. Harvest (yield check) switchgrass from the No-Nitrogen micro-plots separately from main plot (60 ft wide). Compare yield to opposite plot edge. (compare the west and east 15 feet of each plot edge). Harvest of micro-plot: Harvest the middle 7.6' of the outer 15' on both the east and west of each plot using a JD 7330 with Wintersteiger/Kemper biomass harvester.

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G6: Perennial Grass – Monoculture Miscanthus	
Site	KBS
Planting	<p>Miscanthus x giganteus was planted May 20-23, 2008</p> <ul style="list-style-type: none"> • In 2011 the middle part of plot G6R4 was replanted with rootstock that has been growing at KBS since 2008.
Cover Crop	None
Tillage	None
Harvest	<p>Same as G5, G7, G9, and G10</p> <p>Harvest so that 5-6 inches of stubble remain for wildlife cover. Harvest in fall after hard frost / senescence.</p> <p>Main plot harvest width will be 60 feet.</p> <p>Micro-plot harvest: see below.</p> <p>Main plot harvest is with JD 7350 forage chopper and Gruse forage wagon (equipped with load cells to record total weight).</p> <p>Record each plot weigh from forage wagon and collect sub sample so that plant moisture can be recorded.</p>
Fertilization	<p>Nitrogen (28-0-0) will be applied at 50 lbs N acre⁻¹ (56 kg N ha⁻¹), which is 16.7 gals/A, 28% weighs 10.67 lbs/gal.</p> <p>Nitrogen application to the East 75' of each plot only.</p> <p>No P or K in 2022.</p> <p>No P or K was applied in 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, and 2021.</p>
Weed Control	None
Micro-plots	<p>No-Nitrogen fertilizer strip. No N fertilizer will be applied to the west 15 feet of each plot for all replications.</p> <p>Harvest (yield check) miscanthus from the No-Nitrogen micro-plots separately from main plot (60 ft wide). Compare yield to opposite plot edge (compare the west and east 15 feet of each plot edge).</p> <p>Harvest of micro-plot: Harvest the middle 7.6' of the outer 15' on both the east and west of each plot using a JD 7330 with Wintersteiger/Kemper biomass harvester.</p>

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G7: Perennial Grass – Multi-species	
Site	KBS
Planting	Planted June 18, 2008 and over-seed in June 2009 because of poor establishment in 2008.
Cover Crop	None
Tillage	None
Harvest	<p>Same as G5, G6, G9, and G10</p> <p>Harvest so that 5-6 inches of stubble remain for wildlife cover. Harvest in fall after hard frost / senescence.</p> <p>Main plot harvest width will be 60 feet.</p> <p>Micro-plot harvest: see below.</p> <p>Main plot harvest is with JD 7350 forage chopper and Gnuse forage wagon (equipped with load cells to record total weight).</p> <p>Record each plot weigh from forage wagon and collect sub sample so that plant moisture can be recorded.</p>
Fertilization	<p>Nitrogen (28-0-0) will be applied at 50 lbs N acre⁻¹ (56 kg N ha⁻¹), which is 16.7 gals/A, 28% weighs 10.67 lbs/gal.</p> <p>Nitrogen application to the East 75' of each plot only.</p> <p>No P or K will be applied in 2022.</p> <p>No P or K was applied in 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, and 2021.</p>
Weed Control	<p>None:</p> <p>Drive herbicide is not labeled for Canada wild rye.</p>
Micro-plots	<p>No-Nitrogen: No N fertilizer applied to west 15 feet of each plot for all replications.</p> <p>Harvest (yield check) Multi-species grass from the No-Nitrogen micro-plots separately from main plot (60 ft wide). Compare yield to opposite plot edge. (compare the west and east 15 feet of each plot edge).</p> <p>Harvest of micro-plot: Harvest the middle 7.6' of the outer 15' on both the east and west of each plot using a JD 7330 with Wintersteiger/Kemper biomass harvester.</p>

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G8: Short-rotation trees (Poplars)	
Site	KBS
Planting	Planting Date: June 27, 2019 Variety NM 6: Populus nigra x populus maximowiczii, Spring 2020 make herbicide application before trees start to grow for the year. Apply pre herbicide to control weeds in trees.
Cover Crop	None
Tillage	None
Harvest	Expected Harvest Date: February – March Year not determined at this time.
Fertilization	Nitrogen (28-0-0) will be applied at 50 lbs N acre ⁻¹ (56 kg N ha ⁻¹), which is 16.7 gals/A, 28% weighs 10.67 lbs/gal. No P or K will be applied in 2022. No P or K was applied in 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, and 2021.
Weed Control	Roundup and/or Liberty burndown before planting trees in 2019. Prow H20 at (2.1 qts/A) for annual grass and broadleaf weed control in poplar.
Micro-plots	None in 2019. Future micro-plot needs?

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G9: Old Field Community	
Site	KBS
Planting	No planting needed; plants provided by seed bank and natural colonization.
Cover Crop	N/A
Tillage	None
Harvest	<p>Same as G5, G6, G7, and G10</p> <p>Harvest so that 5-6 inches of stubble remain for wildlife cover. Harvest in fall after hard frost / senescence.</p> <p>Main plot harvest width will be 60 feet.</p> <p>Micro-plot harvest: see below.</p> <p>Main plot harvest is with JD 7350 forage chopper and Gnuse forage wagon (equipped with load cells to record total weight).</p> <p>Record each plot weigh from forage wagon and collect sub sample so that plant moisture can be recorded.</p>
Fertilization	<p>Nitrogen (28-0-0) will be applied at 50 lbs N acre⁻¹ (56 kg N ha⁻¹), which is 16.7 gals/A, 28% weighs 10.67 lbs/gal.</p> <p>Nitrogen application to the East 75' of each plot only.</p> <p>No-Nitrogen micro-plot: see below</p> <p>No P or K will be applied in 2022.</p> <p>No P or K was applied in 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, and 2021.</p>
Weed Control	None
Micro-plots	<p>No-Nitrogen: No N fertilizer applied to west 15 feet of each plot for all replications.</p> <p>Harvest (yield check) Old Field Community from the No-Nitrogen micro-plots separately from main plot (60 ft wide). Compare yield to opposite plot edge. (compare the west and east 15 feet of each plot edge).</p> <p>Harvest of micro-plot: Harvest the middle 7.6' of the outer 15' on both the east and west of each plot using a JD 7330 with Winterstieiger/Kemper biomass harvester.</p>

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G10: Native Prairie	
Site	KBS
Planting	Planted in 2008 and over-seeded in June 2009 because of poor establishment in 2008.
Cover Crop	N/A
Tillage	None
Harvest	<p>Same as G5, G6, G7 and G9.</p> <p>Harvest so that 5-6 inches of stubble remain for wildlife cover. Harvest in fall after hard frost / senescence.</p> <p>Main plot harvest width will be 60 feet.</p> <p>Micro-plot harvest: see below.</p> <p>Main plot harvest is with JD 7350 forage chopper and Gnuse forage wagon (equipped with load cells to record total weight).</p> <p>Record each plot weigh from forage wagon and collect sub sample so that plant moisture can be recorded.</p>
Fertilization	<p>The main plot in G10 treatment will NOT receive nitrogen application. The nitrogen will be applied to micro-plots (see below).</p> <p>Only fertilize the micro-plots: Nitrogen application to the West or East 15' of each plot only. Please see micro-plot location below.</p> <p>Nitrogen (28-0-0) will be applied at 50 lbs N acre⁻¹ (56 kg N ha⁻¹), which is 16.7 gals/A, 28% weighs 10.67 lbs/gal.</p> <p>Nitrogen micro-plot: see below</p> <p>No P or K will be applied in 2022.</p> <p>No P or K was applied in 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, and 2021.</p> <p>Fertilizer is to be applied only to the micro-plot area located on the west 15' of replications 2, 3, 4, and 5; and on the east 15' of replicate 1 to avoid gas chambers.</p>
Weed Control	No herbicides option for weed control with the number of species within the prairie mix.
Micro-plots	<p>Nitrogen fertilizer will be applied to west 15' of blocks 2, 3, 4, and 5. The micro-plot will be located on the east 15' of the plot in block 1 at KBS to avoid gas chambers.</p> <p>Harvest (yield check) Native Prairie from the Nitrogen micro-plots separately from main plot (60 ft wide). Compare yield to opposite plot edge. (compare the west and east 15 feet of each plot edge).</p> <p>Harvest of micro-plot: Harvest the middle 7.6' of the outer 15' on both the east and west of each plot using a JD 7330 with Winterstieger/Kemper biomass harvester.</p>