Forage Brassicas for Winter Grazing Systems

Mississippi livestock producers looking for methods to reduce feeding costs may find forage brassicas worth exploring. Brassicas fit well with forage-based production systems by extending the grazing season into the late fall and early spring. The fall grazing of brassicas along with other production techniques, such as accumulating forage for grazing at a later time through intensive rotational stocking and stockpiling, could allow producers to rely on forage as the main source of nutrition for their livestock enterprise.

Forage brassicas are a cool-season crop. Members of the forage brassica family include kale, rape, swede, and turnips. These are annual crops that are highly productive, very digestible, and, depending on the species, can normally be grazed 80 to 150 days after seeding. Vegetative tops (stems plus leaves) and roots (bulbs) can be grazed with most species. Brassicas do have some limitations as a feed source, such as their chemical composition or oil content affecting palatability, but proper management can mitigate any negative effects.

Types of Brassicas

Kale (*Brassica oleracea*): Kale is grown for its leaves and stems. Kale is digestible and very winter-hardy with a survival tolerance down to 10°F, allowing it to be grazed well into the fall. It also has very good crude protein (CP) concentration ranging from 15 to 17 percent. Kale has good forage dry matter production at 150 days with yields up to 6 tons per acre, making it ideal for dairy or beef cattle late-season grazing.

There are two types of varieties: narrow stem and stemless. Varieties with stems can grow to 60 inches tall with 2-inch stems and require 150 to 180 days to attain maximum production. Stemless varieties reach crop heights of 25 inches and mature in 90 days, allowing a second harvest. Manage kale grazing by using rotational stocking or strip stocking into December and January.

Rape (*Brassica napus*): Rape is a multi-stemmed crop with fibrous roots, so only aboveground biomass is utilized. Stem height, diameter, and preference by grazing animals vary with variety. Rape is considered to be very winter-hardy. Forage rape is ready to be grazed 60 to 120 days after establishment.

There are two kinds of forage rape: a giant type that is leafy and upright and a dwarf type that is short and branched. The giant varieties are best suited for cattle grazing as cattle prefer them. Most hybrids produce the greatest yields when they are allowed to grow for 60 days before the first harvest and they are given 30 days to regrow before the second harvest. Plants develop a reddish tinge when they are ready for harvest. Leaving a 10-inch stubble height allows rapid regeneration or regrowth. For optimum yields, a seeding rate of 3 to 4 pounds per acre is recommended.

Swede (*Brassica napus*): Swede is a long-season plant with a large edible root, providing both aboveground and root forage. Swede yields are generally greater than turnips, but growth is slower and requires 150 to 180 days to reach maximum production. Swede is best suited to late-fall grazing. Swede usually produces a short stem but can have stems up to 2½ feet long when grown with tall crops like cereal rye (*Secale cereal*). Tall crops are good for shading the swede and encouraging crop competition.

Turnips (*Brassica rapa*): Turnips are short-season root brassicas that provide roots (bulbs), stems, and leaves. Turnips are best grazed using rotational or strip stocking.

Turnips have bushy tops and large white roots that are rich in carbohydrates. Turnips are seeded at a rate of 2 to 3 pounds per acre. They are an excellent late-fall forage and can reach maximum production 80 to 90 days after establishment. Turnip tops (stems and leaves) can be grazed within 60 to 70 days after planting, while roots can be used 12 to 14 weeks after planting. Turnips can germinate in soil as low as 40°F and can continue to grow until temperatures drop between 15°F and 20°F. They might require several days of temperatures continually below freezing before they begin to die. The proportion of top growth to roots can vary from 90 percent tops and 10 percent roots to 15 percent tops and 85 percent roots. Some hybrids have fibrous roots that are not readily grazed by livestock. Turnips can be seeded anytime when soil temperature reaches 50°F until 50 days before a killing frost. Many varieties can be grazed twice, once for top growth and then later for the roots. Turnips have less dry matter yield than kale or rape, and crude protein (CP) concentration can range from 15 to 24 percent in the tops and 8 to 15 percent in the bulbs.

Many varieties are commercially available for each species of brassicas; however, very little information is currently available as to the performance of these varieties in Mississippi. Much of the brassicas being planted in the state are only available in seed mixes typically designed for small food plots. The marketing of brassicas for food plots has caused increased seed prices, which has discouraged use by cattle producers.

Establishment

Planting in saturated or poorly drained soils typical in some low-lying areas of Mississippi fields will often result in insufficient stands and lower yields, especially with bulb-forming species. Brassicas require good soil drainage and a soil pH between 5.3 and 6.8 for optimum production. Seeds should be planted ½ inch deep in a firm, moist seedbed with 6- to 8-inch rows. Cultipacking may be necessary considering the small size of the seed. Good stands can be established by planting 3 to 4 pounds per acre of kale or rape or 1 to 3 pounds per acre of swede or turnip.

Table 1 gives the basic seeding information and use of different types of brassicas. The greater seeding rates are recommended for broadcast plantings. They can also be broadcast or seeded into an herbicide-killed sod with a no-till drill. When preparing a tilled seedbed for brassica planting, plow the ground several weeks before planting to allow weed seeds a chance to germinate before secondary tillage is completed. This will form a firm and fine seedbed that is free of weeds.

Fertilization

Fertilizers should be applied at the time of seeding to give the brassicas a competitive edge on weeds. Base fertilization on soil test results. Phosphorus (60 pounds per acre) and potassium (100 pounds per acre) soil test levels should be in the optimum range before planting to ensure optimum growth and help increase the crude protein levels. Nitrogen application rates of 50 to 70 pounds per

Table 1. Suggested seeding rates and plant characteristics of different types of forage brassicas.[1]

Type	Seeding rate (lb/acre)	Plant use	Days of grazing	Regrowth after harvest	% use	Potential yield (ton/acre)
kale	3–4	top	150–180	no	70–80	6–9
rape	3–4	top	70–110	yes	80–90	4–6
swede	1–3	top[2] and root	150–180	no	80–90	9–10
turnip	1–3	top and root	60–120	yes	85–95	3–5

[1]Hall and Jung, 1992; Wrightson Seeds Brassica Brochure, 2014.
[2]Tops include leaves and stems.

acre can be applied at planting and then again 60 to 80 days after planting to increase yields. Avoid using fertilizer that contain sulfate or sulfur because they may increase the levels of the amino acid compound S-methyl cysteine sulphoxide (SMCO) and the risk of anemia problems. Boron may also be needed. Table 2 provides fertilizer application guidelines for different types of brassicas.

Forage Quality and Grazing Management

Brassicas usually have lower palpaility than most cool-season grasses, so grazing cattle tend to prefer grasses first in mixed systems. Nutritive value of brassicas remains good until vegetative growth ceases (Figure 1). Thereafter, fungal diseases may develop and cause quality losses.

Aboveground parts of brassicas normally contain 20 to 25 percent crude protein (CP), 65 to 80 percent *in vitro* digestible dry matter (IVDDM), about 20 percent neutral detergent fiber (NDF), and about 23 percent acid detergent fiber (ADF). The roots of turnips and kale usually have 10 to 14 percent crude protein (CP) and 80 to 85 percent *in vitro* digestible dry matter (IVDDM). Dry matter digestibility of kale generally exceeds 90 percent for all aboveground plant parts. The exception is kale stems at maturity.

Table 2. Guide to brassica fertilization.[1]

Type	Fertilizer – Nitrogen (N) (lb/acre)	Fertilizer – Phosphorus (P_2O_5) (lb/acre)	Fertilizer – Potassium (K_2O) (lb/acre)	N application time – % at planting	N application time – Later
kale	90–120	90–100	90–100	50	50% at 10 to 12 weeks
rape	50–90	45–70	45–70	100	More N may be applied for regrowth
swede	90–120	85–110	85–110	50	50% at 10 to 12 weeks
turnip grazing	50–70	35–45	35–45	100	More N may be applied for regrowth
stubble	50–90	60–80	60–80	60	40% at 6 to 8 weeks

[1]Germinal Seeds, 2014.

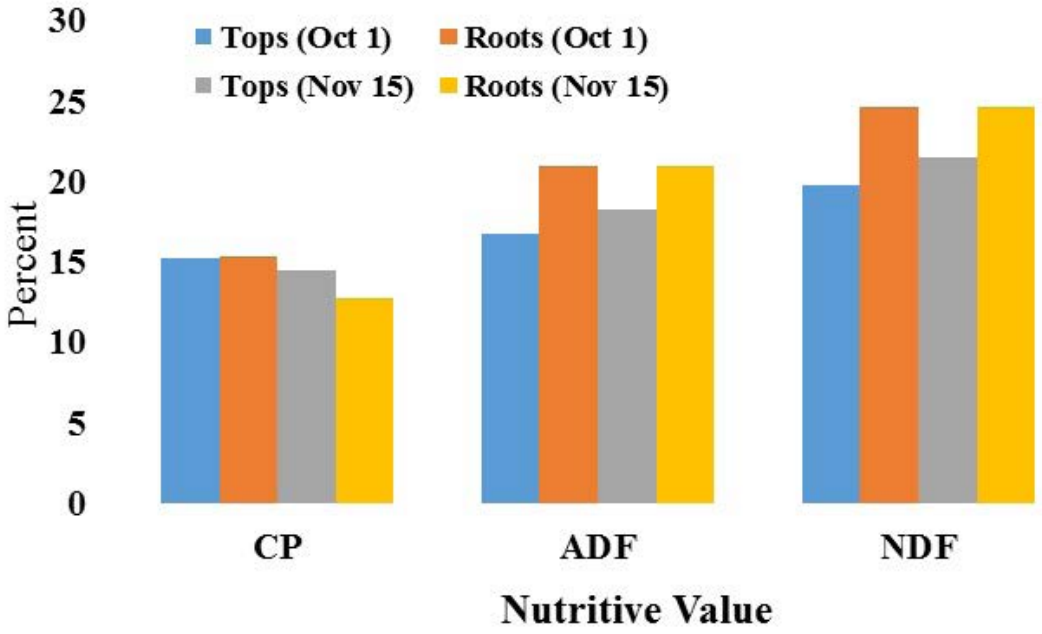

Figure 1. Forage quality of turnip tops and roots at two harvest dates (Smart et al., 2004).

Brassicas are extremely low in fiber, which may negatively affect rumen activity; therefore, brassicas should never comprise more than 75 percent of the forage portion in livestock diets. The remainder of forage protein should come from grass, hay, or stockpiled pasture. Gradually introduce animals to the crop to allow the development of a rumen microbial population that is adequate to digest the greater levels of protein in the crop. Copper, manganese, and zinc contents of forage brassicas do not meet the dietary requirements of ruminants, so mineral supplementation will be required. Iodine, iron, and copper supplements help to prevent anemia and goiter. Any mineral supplementation that is used should ensure that the calcium-to-phosphorus ratio in the feed does not exceed 7:1.

Brassicas are ready for grazing about 80 to 150 days after planting. Table 3 provides information about different brassicas species grown in Mississippi. For grazing management, rotational and/or strip stocking are recommended to provide the most efficient use of brassicas. Strip stocking where forage is rationed every day or two provides the most efficient usage. Grazing large areas increases trampling and can lead to waste of forage. Allow 90 days of turnip growth to maximize root development before grazing. Rape and kale have good regrowth potential if they are not grazed below 6 inches and are allowed a 4-week rest period. Turnips will regrow if the growing point at the top of the bulb is not removed. Two or more cycles of grazing should be possible with rotational stocking if rainfall is adequate. Rape and kale can be green chopped for confined animals. Brassicas are difficult to ensile because of their high water content, and wilting is impractical. If they are ensiled, chopped hay or straw can be added; however, harvesting and packing problems may still occur.

Animal Health Issues

Brassica crops can cause animal health disorders if not grazed properly. The low fiber content of brassicas can cause health disorders if they exceed 75 percent of the diet. Most brassicas-related disorders with cattle occur during the first 2 weeks of grazing. The main disorders are polioencephalomalcia, hemolytic anemia (mainly with kale), pulmonary emphysema, nitrate poisoning, bloat, and metabolic problems (glucosinolates).

Polioencephalomalacia is a brain degenerative disorder characterized by twitching of ears, eyes, and skin, along with lack of coordination and blindness.

Table 3. Total and seasonal yield distribution of brassicas grown at Mississippi State University, 2006–07.[1]

Type[2]	November 21 (lb/acre)	January 24 (lb/acre)	March 26 (lb/acre)	Total (lb/acre)
Rape – Barnapoli	812	2898	4257	7968
Rape – Bonar	924	2630	4222	7776
Rape – Dwarf Essex	1232	3121	4855	9209
Rape – T-Raptor	1799	4112	6211	12123
Turnips – Appin	1571	2657	3928	8256
Turnips – Barabas	1402	1746	1957	5105
Turnips – Barkant	1241	1902	2434	5577
Turnips – FL Broadleaf	1512	2505	3473	7491
Turnips – Pasja	1420	3661	5761	10842
Turnips – Purpletop	2375	2201	3389	7965
$LSD_{0.05}$[3]	560	445	532	866

[1]Lang et al., 2007.
[2]Planted at 5 pounds per acre and fertilized with 400 pounds of 15-5-10 at planting and after each harvest.
[3]LSD = Least significant difference for comparison of varieties within each column.

Other behaviors include circling and convulsions. Treatment includes thiamin injections. A diet of pure brassicas can cause livestock to develop haemolytic anaemia and goiter. The amino acid compound S-methyl cysteine sulphoxide (SMCO) that accumulates in the plants during the season is responsible for both of these conditions. Offering an iodized salt-trace mineral mix can mitigate the effects of S-methyl cysteine sulphoxide (SMCO). Turnips contain a chemical that prevents the uptake of iodine by the thyroid gland, which results in hypothyroidism and goiter. This can be prevented or treated by feeding an iodized salt-trace mineral mix.

Hemolytic anemia is characterized by red urine, pale mucous membranes, and unthrifty appearance. Some animals may collapse and die suddenly. Pulmonary emphysema causes rapid, difficult breathing accompanied by a grunt on expiration. Affected animals stand with extended heads, dilated nostrils, and open mouths with protruding tongues. Death may occur within 2 days. Surviving animals have a slow recovery that can last 7 to 20 days.

Nitrate poisoning has been documented from excessive nitrogen fertilization. There have also been instances of large accumulations of calcium and potassium that can reduce the availability of magnesium to animals. Use feed analyses to check and modify the mineral balance of animal diets.

Bloat can occur when grazing rape or turnips, causing abdominal distension. Some animals become chronic bloaters. To prevent bloat, make sure cattle are full before putting them on rape pasture for the first time.

Glucosinolates in brassicas can cause metabolic problems and taint milk in dairy animals. Livestock can suffer from rape poisoning if they graze stunted, low-growing, purple brassicas. This occurs when the crop is grown under very wet conditions on poorly drained soils, when inadequate amounts of fertilizer have been used, or when an early frost occurs.

Summary

Although there are many management factors to consider, forage brassicas do provide producers with an acceptable-yielding, good-quality forage option at a time when most cool-season grasses are not available. Follow these three management practices to avoid animal disorders:

1. Introduce grazing animals to brassica pastures slowly (for the first 5 to 7 days).
2. Do not turn hungry animals that are not adapted to brassicas into a brassica pasture. Feed 2 to 3 pounds of hay or straw to each animal each day.
3. Brassicas should not constitute more than 75 percent of an animal's diet. A good-quality pasture can be used as a preconditioning diet before grazing brassicas.

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