



Forage Brassicas for Winter Grazing Systems

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Mississippi livestock producers looking for methods to reduce feeding costs may find forage brassicas a crop 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 intensive rotational grazing and stockpiled grazing could allow producers to rely on forage as the main source of nutrition for their livestock enterprise along with other winter annuals such as small grains and ryegrass.

Forage brassicas are a cool season crop. Members of the forage brassica family include kale, rape, swede, and turnips. These are annual crops which are highly productive and digestible and can normally be grazed 80 to 150 days after seeding, depending on the species. Depending on the species, both tops (stems plus leaves) and roots (bulbs) can be grazed. Brassicas do have some limitations as a feed source due primarily to the chemical composition of most species, but properly managed could provide an excellent feed source in pastoral systems.

Types of Brassicas

Kale (*Brassica oleracea*): Kale is grown for its leaves and stems. Kale is very winter-hardy (survival tolerance down to 10°F), highly palatable, and high in protein. Because of its cold tolerance, it can be rotationally grazed well into the fall. Kale could have good forage dry matter production at 150 days with yields up to 6 tons/acre, making it ideal for dairy or beef cattle especially for late season forage. There are two types of varieties: narrow stem and stemless. Varieties with stems can grow to 60 inches in height 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. Kale can be grazed by rotational or strip grazing into December and January most years. Average protein content ranges between 15 and 17%.

Rape (*Brassica napus*): Rape is a multi stemmed crop with fibrous roots. Stem height, diameter, and palatability vary with variety. Rape is considered to be very winter-hardy. Forage rape is ready to graze 60 to 120 days after establishment. There are two kinds of forage rape, a giant type which is leafy and upright and a dwarf type which is short and branched. The giant varieties are best suited for cattle grazing due to higher palatability. Most hybrids produce the greatest yields when allowed to grow for 60 days before the first harvest and 30 days after the second harvest. Plants develop a reddish tinge color when ready for harvest. Leaving a 10-inch stubble height is recommended to allow rapid regeneration or regrowth. For optimum yields, a 3 to 4 lb/acre seeding rate is recommended.

Swede (*Brassica napus*): Swede is a long-season plant with a large edible root. Swede yields are generally higher than turnips, but growth is slower and requires 150 to 180 days to reach maximum production and is best suited to late-fall grazing. Swedes usually produce a



short stem but can have stems up to 2½ feet long when grown with tall crops that shade the swede and allow for crop competition.

Turnips (*Brassica rapa*): Turnips are short-season root brassicas that provide roots (bulbs), stems and leaf growth for rotational or strip grazing. Turnips have bushy tops and large white roots that are rich in carbohydrates. Turnips are seeded at rate of 2 to 3 lb/acre. Turnips, an excellent late-fall forage, can reach maximum production 80 to 90 days after establishment. Turnip's tops (stems and leaves) can be grazed 60 to 70 days after planting while roots can be utilized 12 to 14 weeks after planting. Turnips can germinate in soil as low as 40°F and they can continue to grow until temperatures drop between 15 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 any time from when soil temperature reaches 50 °F until 50 days prior to a killing frost. Many varieties can be grazed twice, once for top growth and then later for the roots. Turnips have a lower dry matter yield than kale or rape. The tops could have 15 to 24 percent protein while roots may contain 8 to 15 percent protein.

Establishment

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 and cultipacking is recommended. Good stands can be established by planting 3 to 4 lb/ac of kale or rape, or 1 to 3 lb/ac of swede or turnip. **Table 1** gives the basic seeding information and utilization of different types of brassicas. The higher seeding rates are recommended for broadcast plantings. They can also be broadcast (higher rates are recommended for broadcasting) 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 to germinate before secondary tillage is completed to form a firm and fine seedbed that is free of weeds.

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

Type	Seeding Rate (lb/ac)	Plant Utilization	Days of Grazing	Regrowth after Harvest	% Utilization	Potential Yield (ton/ac)
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 ¹ and root	150 – 180	No	80 – 90	9 - 10
Turnip	1 – 3	Top and root	60 – 120	Yes	85 – 95	3 – 5

¹Tops include leaves and stems

Sources: Hall, 1992; Wrightson Seeds Brassica Brochure (2007).



Fertilization

Fertilizers should be applied at the time of seeding to give the brassicas a competitive edge on weeds. Fertility requirements should be based on soil test results. Phosphorus (60 lbs/acre) and potassium (100 lb/ac) soil test levels should be in the optimum range prior to planting to ensure optimum growth and help increase the crude protein levels. Nitrogen application rates of 50 to 70 lb/ac can be applied at planting and then again 60 to 80 days after planting to increase yields. It is recommended to avoid using fertilizer products that contain sulfate or sulfur since 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 fertilization guidelines for different brassicas.

Table 2. Guide to brassica fertilization.

Type	Fertilizer			N Application Time	
	Nitrogen (N)	Phosphorus (P ₂ O ₅)	Potassium (K ₂ O)	At Planting	Later
	----- lb/ac -----				
Kale	90 – 120	90 – 100	90 – 100	50%	50 % at 10 to 12 weeks
Rape	50 – 90	45 – 70	45 – 70	100%	Further 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%	Further N may be applied for regrowth
Stubble	50 – 90	60 – 80	60 – 80	60%	40% at 6 to 8 weeks

Source: British Seed Houses: Forage Brassicas.

Forage Quality and Grazing Management

Brassicas have an off flavor and cattle may preference them less than grasses. Brassica quality remains high until vegetative growth ceases. Thereafter fungal diseases may develop following crop maturity that can cause quality losses. Above-ground parts of brassicas normally contain 20 to 25 percent crude protein, 65 to 80 percent *in vitro* digestible dry matter (IVDDM), about 20% neutral detergent fiber (NDF) and about 23% acid detergent fiber (ADF). The roots contain 10 to 14% crude protein and 80 to 85 percent IVDDM. The roots of turnips and kale usually have 10 to 14% crude protein (CP) and 80 to 85% digestibility. Dry matter digestibility generally exceeds 90 percent for all plant parts except kale stems at maturity. Brassicas are extremely low in fiber which affects proper rumen activity. Therefore, brassicas should never comprise more than 75% of the forage portion of livestock diet with the remainder provided by grass, hay, or stockpiled pasture. Animals should be gradually introduced to the crop to allow for development of the rumen microbial population that is adequate to digest the high 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 anaemia 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 75 days after planting. **Table 3** provides information about different brassicas species grown in Mississippi. Strip grazing and rotational grazing provide the most efficient utilization of brassicas. Strip grazing where forage is rationed every day or two provides the most efficient usage. Grazing large areas increases trampling and wastes the available forage. Allow 90 days of turnip growth to maximize root development before grazing. Rape and kale have regrowth potential if not grazed below six inches and a four week rest period is allowed. Turnips will regrow if the growing point at the top of the bulb is not removed. Two or more cycles should be possible with rotational grazing if rainfall is adequate. Rapes and kale could be green chopped for confined animals. Brassicas are difficult to ensile because of their high water content, and wilting them down is impractical. If they are ensiled, chopped hay or straw can be added. However, harvesting and packing problems may still occur.

Table 3. Total and seasonal yield distribution of brassicas grown at Mississippi State University, 2006-2007.

Type ¹	November 21	January 24	March 26	Total
----- lb/ac -----				
Rape				
Barnapoli	812	2898	4257	7968
Bonar	924	2630	4222	7776
Dwarf Essex	1232	3121	4855	9209
T-Raptor	1799	4112	6211	12123
Turnips				
Appin	1571	2657	3928	8256
Barabas	1402	1746	1957	5105
Barkant	1241	1902	2434	5577
FL Broadleaf	1512	2505	3473	7491
Pasja	1420	3661	5761	10842
Purpletop	2375	2201	3389	7965
LSD_{0.05}²	560	445	532	866

¹Planted at 5 lb/ac and fertilized with 400 lb of 15-5-10 at planting and after each harvest.

²LSD = Least Significant Difference. LSD for comparison of varieties within each column.

Source: Lang et al., 2007. Brassicas as Alternative Winter Forage for Mississippi. Mississippi State Univ.

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 brassica's related disorders with cattle occur during the first two weeks of grazing. The main disorders are polioencephalomalacia, 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. 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) which accumulates in the plants during the season is responsible for both of these conditions. Turnips contain a chemical that prevents the uptake of iodine by the thyroid gland. This results in hypothyroidism and goiter. Feed an iodized salt-trace mineral mix. Hemolytic anemia is characterized by red urine, pale mucous membranes, and unthrifty appearance. Some animals may collapse and suddenly die. 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 two days. Surviving animals have a slow recovery over 7 to 20 days.

Nitrate poisoning has been documented from excessive nitrogen fertilization. Reported instances of high accumulation of calcium and potassium that can reduce the availability of magnesium to animals have also been observed. Utilize feed analyses to check and modify the mineral balance of animal diets. Bloat can also occur when grazing rape or turnips, causing abdominal distension. Some animals become chronic bloaters. To prevent bloat, ensure that 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, and purple brassicas. This occurs when the crop is grown under very wet conditions on poorly drained soils, inadequate amounts of fertilizer have been used or an early frost occurs.

Although there are many management factors to consider, forage brassicas do provide producers with a high yielding, quality forage option at a time when most cool season grasses are not available. Animal disorders can be avoided by the following three management practices: (1) Introduce grazing animals to Brassica pastures slowly (over first 5 to 7 days), (2) don't turn hungry animals that are not adapted to brassicas into a brassica pasture (two to three pounds of hay or straw should be fed to each animal each day), and (3) brassicas should not constitute more than 75 percent of the animal's diet. A good quality pasture can also be used as a preconditioning diet before grazing brassicas.