



Agronomy Facts 33

Use of Brassica Crops to Extend the Grazing Season

Cool-season perennial grass and grass-legume pastures typically become less productive as the grazing season advances from June to November. Forage brassica crops such as turnip, swede, rape, and kale can be spring-seeded to supplement the perennial cool-season pastures in August and September or summer-seeded to extend the grazing season in November and December. Brassicas are annual crops that are highly productive and digestible and can be grazed 80 to 150 days after seeding, depending on the species (see table on back page). In addition, crude protein levels are high, varying from 15 to 25 percent in the herbage and 8 to 15 percent in the roots, depending on the level of nitrogen fertilization and weather conditions.

SPECIES AND VARIETIES

Kale (*Brassica oleracea* L.)

Varieties of kale differ markedly in winter hardiness, rate of establishment, stem development, and time required to reach maturity. The stemless type of kale (e.g. 'Premier') has a faster rate of establishment than varieties that produce stems. Crop height of the stemless type is approximately 25 inches, whereas that of narrow stem kale is 60 inches with primary stems often 2 inches in diameter. Stemless kale attains maturity in approximately 90 days, allowing two crops per year, whereas varieties that develop stems require 150 to 180 days to attain maximum production. 'Premier' has consistently survived winters in central Pennsylvania, whereas other varieties of kale usually are winter-killed in December.

Rape (*Brassica napus* L.)

Mature forage rape is one of the best crops available for fattening lambs and flushing ewes. Rape is a multistemmed crop with fibrous roots. The stems vary in length, diameter, and in palatability to livestock. Forage yields of spring-planted rape increase until plants become physiologically mature. Growth slows or ceases at maturity and yields plateau until leaves senesce and die. Varieties differ in when this occurs; however, 'Rangi' rape retains its leaves longer than most varieties. Generally, yields of rape varieties in Pennsylvania are maximized with two 90-day growth peri-

ods. However, performance of 'Emerald' and 'Winfred' rape varieties is best with one 180-day growth period, and yields of rape hybrids are greatest with 60 days of growth before the first harvest and a 30-day growth period before the second harvest.

Swede (*Brassica napus* L.)

Like turnip, swede produces a large edible root. Swede yields are higher than those of turnip, although growth is slower and requires 150 to 180 days to reach maximum production. Swede usually produces a short stem (neck), but can have stems 2 ½ feet long when grown with tall crops that shade the swede. Unfortunately, stem elongation is at the expense of root development. The variety 'Calder' is cold hardy in central Pennsylvania and thus ideal for stockpiling and for late fall or early winter grazing. In general, all swede varieties are recommended for late fall grazing.

Turnip (*Brassica rapa* L.) or Turnip Hybrids

These crops grow very fast, reaching near maximum production levels in 80 to 90 days. Studies in southwestern Pennsylvania showed that turnip can accumulate dry matter in October as fast as field corn does in August. Growing "out of season" (October/November) makes turnip a valuable crop for late fall grazing.

The proportion of tops and roots varies markedly depending on variety, crop age, and planting date. Research by the USDA Pasture Laboratory showed that turnip crops can vary from 90 percent tops/10 percent roots to 15 percent tops/85 percent roots. Some hybrids have fibrous roots that will not be readily grazed by livestock. All varieties produce primarily tops during the first 45 days of growth. Sixty to 90 days after seeding, turnip varieties such as 'Savannah' and 'All Top' continue to produce a high proportion of tops. During the same period, other turnip varieties have nearly equal top and root production, except 'Purple Top' has a greater root than top production. The significance in the proportion of tops and roots is that the crude protein concentration (8 to 10 percent) of roots is approximately one-half of that in turnip tops. Therefore, greater root production tends to reduce the crude protein

yield of the total crop. On the other hand, stockpiled tops appear to be more vulnerable to weather and pest damage than roots. Varieties differ in their resistance to diseases, but this often is not evident until the crop is more than 80 days of age and the plants are reaching full production.

Other Forage Brassicas

Several hybrids of brassica species are also used as forage crops; however, there is limited research information on the production and management of these hybrids. The more common hybrids include a cross between Chinese cabbage (*Brassica campestris sensulato* L.) and rape ('Perko'), turnip ('Tyfon' and 'Buko'), and swede ('Wairangi').

ESTABLISHMENT

All brassica crops require good soil drainage and a soil pH between 5.3 and 6.8 for optimum production. Good stands can be established by planting 3.5 to 4 pounds per acre of kale or rape, or 1.5 to 2 pounds per acre of swede or turnip. The higher seeding rates are recommended for spring plantings. The seeds should be planted in rows 6 to 8 inches apart and not more than one-half inch deep. However, brassica seed can also be broadcast and incorporated into tilled seedbeds by cultipacking. 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. In addition, the preplant incorporated herbicide Treflan (trifluralin) is labeled at 0.5 to 1.0 pint active ingredient per acre for control of annual grass and small-seeded broadleaf weeds in brassicas.

Brassica stands can also be established by no-till planting in grass sod that is suppressed with paraquat or glyphosate herbicides. Read pesticide labels and precautions before using either of these herbicides. Ideally, the grass sod should be grazed through June with the grazing prior to brassica seeding being very close. Approximately two weeks before

planting the herbicide should be applied to the grass sod. Another option for no-till establishment would be to apply a manure slurry to the sod, burn the sod back, and then no-till plant the brassica seeds through the slurry. In addition to reduced erosion concerns with no-till planting, there are generally fewer insect problems than with conventionally seeded brassicas. The following recommendations will improve the chances of successful brassica establishment.

1. Attempt establishment only on well drained soils.
2. Do not seed deeper than one-half inch.
3. When seeding into a sod, suppress the sod long enough to allow the brassicas to establish (two to three weeks).
4. Apply 75 pounds of nitrogen at seeding to stimulate establishment and growth.

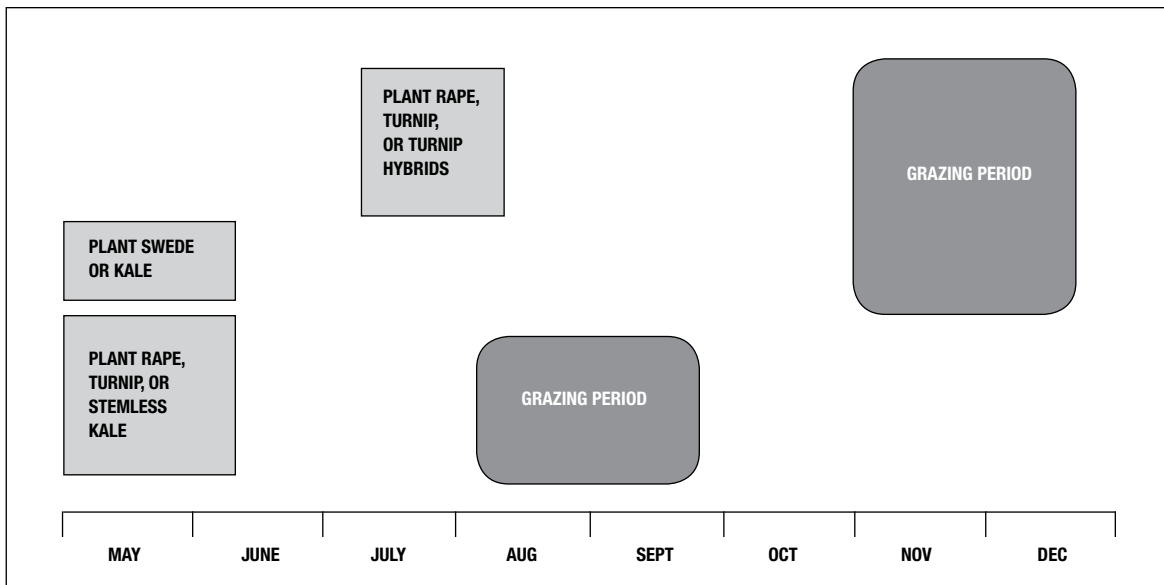
As previously mentioned, forage brassicas can be grown to supplement perennial cool-season pastures in August and September or to extend the grazing season in November and December. In the first instance, brassicas would be planted in May or early June because spring rains will help ensure production for August and September grazing (Figure 1). Turnip, rape, or stemless kale could be used for this purpose. In the second instance, swede or kale would be planted in spring, or rape, turnip, and turnip hybrids would be planted in late July or early August, and growth allowed to accumulate until November or December.

MANAGEMENT

Fertilization

Phosphorus and potassium soil test levels should be in the optimum range prior to planting. If the phosphorus level is below 55 pounds per acre, the application of phosphorus during brassica development may be warranted. Application under this condition tends to increase yield if nitrogen is not limiting growth. However, phosphorus applications decrease crude protein concentration of the brassica forage.

Figure 1. Planting and grazing sequence for forage brassicas.



In addition to the nitrogen applied at planting, when multiple grazings are planned, an additional 70 pounds should be applied between 60 and 80 days after seeding to increase yield and crude protein level of the brassica tops. Unfortunately, the nitrogen induced yield increase in turnip and swede tops causes a reduction in root yield. When seeding into a suppressed grass sward, nitrogen application tends to increase the efficacy of the suppressing herbicide and reduces the proportion of grass in the brassica-grass sward.

Grazing

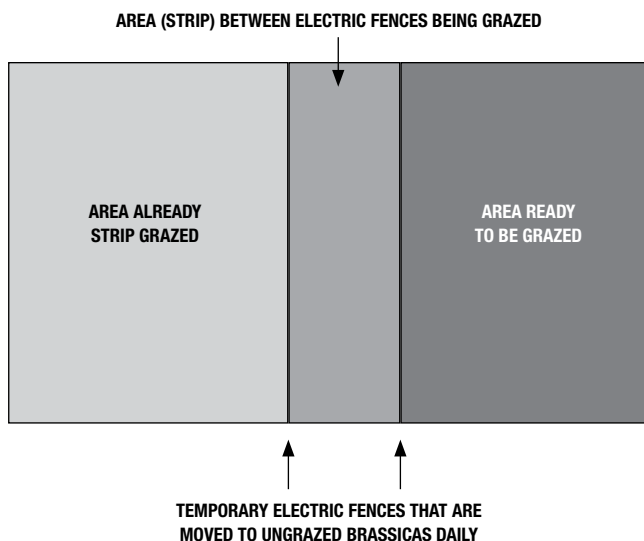
Brassicas can be harvested for greenchop or silage but are most frequently grazed. Grazing management is important to optimize the true potential of these crops. Strip grazing small areas of brassica at a time provides the most efficient utilization (Figure 2). Grazing large areas increases trampling and waste of the available forage. Rape is more easily managed for multiple grazings than are the other brassica species. Approximately 6 to 10 inches of stubble should remain after grazing rape to promote rapid regrowth. Regrowth may be grazed in as few as four weeks after the first grazing. Graze rape close to ground level during the final grazing.

When turnips are to be grazed twice, only the tops should be grazed during the first grazing. Turnip regrowth is initiated at the top of the root, so this part of the plant should not be removed until the second and final grazing when the whole plant can be consumed. Like rape, regrowth of turnips can be sufficient to graze within four weeks of the first grazing.

Pests

Diseases such as bacterial soft rot of brassica roots and leaf spot are generally not a problem until the plants near maturity. Stockpiling (delaying grazing until a date later than plant maturity) should not be attempted in fields where brassicas have high levels of foliar disease at maturity. Research has

Figure 2. Example of strip grazing method for brassica grazing.



shown yield reductions of 40 percent when disease infected brassica crops were stockpiled for 45 days. Generally, 'Forage Star' turnip and 'Rangi' rape are better suited for stockpiling than are other varieties because of lower disease infestation. To reduce disease occurrence, brassicas should not be grown on the same field for more than two consecutive years.

Insects that feed on brassicas, such as aphids, flea beetles, and imported cabbage worms, are not a consistent problem in Pennsylvania. However, appropriate use of insecticides may be warranted if insect populations become severe.

Once established, brassicas are very competitive with weeds. However, precautions should be made at planting to reduce weed competition during brassica establishment.

YIELD AND NUTRITIONAL VALUE

Brassica dry matter yield will depend on the production potential of the soil and environment and the brassica species. Average yields in Pennsylvania have been 3.1 tons of dry matter per acre at 90 days after planting. Slower maturing kale and swede average over 4 tons per acre at 120 days after planting. For a grazing situation, an average carrying capacity of a good brassica stand would be approximately 1,550 ewe-grazing or 160 cow-grazing days per acre.

Dry matter digestibility generally exceeds 90 percent for all plant parts except kale stems at maturity. By comparison, dairy quality alfalfa hay is approximately 70 percent digestible. With adequate fertility, brassicas can produce amounts of digestible energy per acre equivalent to corn yielding 115 bushel per acre. Unlike perennial forage crops, the dry matter digestibility of brassicas does not decrease markedly with increasing plant maturity. This characteristic makes them ideal for stockpiling. Ruminant diets should not contain more than 75 percent brassica forage because the fiber content of brassica crops is too low for maintenance of proper rumen activity. With their high digestibility and low fiber content, brassicas should actually be considered as "concentrates" rather than "forage" in nutritional planning for livestock. Crude protein concentration of brassicas ranges from 8 to 10 percent in turnip roots to 30 percent in rape leaves.

FEEDING CONCERNS

Brassica crops can cause health disorders in grazing animals if not managed properly. The main disorders are bloat, atypical pneumonia, nitrate poisoning, hemolytic anemia (mainly with kale), hypothyroidism, and polioencephalomalacia. Researchers have discovered that these disorders can be avoided by adhering to two management rules:

1. Introduce grazing animals to brassica pastures slowly. Avoid abrupt changes from dry summer pastures to lush brassica pastures. Don't turn hungry animals that are not adapted to brassicas into a brassica pasture.
2. Brassica crops should not constitute more than 75 percent of the animal's diet. Supplement with dry hay if continually grazing brassicas or allow grazing animals access to grass pastures while grazing brassicas. No-till establishment into existing sod will reduce the risk of these disorders because of grass in the brassica pasture.

SUMMARY

Brassica crops can produce high yields of highly digestible forage during periods when perennial forages have limited production. In addition, the digestibility of the forage remains high over a relatively longer period than perennial crops. Few crops offer as much potential as do brassicas to improve livestock carrying capacity from August through December. Spring-seeded brassica crops can be used to supplement low-producing cool-season pastures or as insurance against summer drought. Summer-seeded brassicas can extend the potential grazing season by providing forage for fall and winter grazing. These characteristics make the use of brassica crops in grazing situations very flexible and appealing to producers utilizing pastures in their livestock operations.

Table of characteristics and seeding rate of brassica forage crops.

CROP	PLANT PART CONSUMED	SEEDING TO HARVEST (DAYS)	SEEDING REGROWTH AFTER HARVEST	RATE (POUNDS/ ACRE)
Kale	herbage	150 to 180	no ^a	3.5 to 4
Rape	herbage	80 to 90	yes	3.5 to 4
Swede	herbage and root	150 to 180	no	1.5 to 2
Turnip	herbage and root	80 to 90	yes	1.5 to 2

^aAn exception is the stemless variety 'Premier' which is ready for harvest 80 to 90 days after seeding and will regrow after harvest if not grazed below 3 to 4 inches.

Prepared by Marvin H. Hall, professor of forage management, and Jerry Jung, adjunct professor of agronomy.

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