Vegetable Fodder & Forage Crops for Livestock Production:

Turnips and Hybrid Turnips

WASHINGTON STATE UNIVERSITY EXTENSION FACT SHEET • FS033E

There is interest among farmers in western Washington and many other regions of the United States to grow forage and fodder crops to meet their own livestock production needs. Forage is defined in this publication as feedstuff that animals search for and consume, and commonly refers to the non-reproductive portions of plants, while fodder refers to all plant portions which are harvested, stored, and fed to animals (Barnes et al., 1995). Successful local production of forage and fodder crops requires a review of past practices and the latest research on crop varieties as it applies to specific growing conditions.

Historically, livestock production relied on a large diversity of crops to sustain animals year-round, including vegetable root crops such as fodder beets, turnips, rutabagas, carrots, and sugar beets (Delwiche, 1924). Vegetable fodder crops were produced in significant amounts in the maritime Pacific Northwest until 1935, but by 1955 production was limited to a few acres (Schoth, 1957). As the scale of livestock production increased and intensified, livestock and fodder production became separate operations, each located in regions that were most conducive to optimizing production and minimizing costs. New cropping systems arose to best fit large-scale livestock production needs.

Now, new varieties of vegetable forage and fodder crops are available that promise larger yields, better storability, and greater flexibility in use. These new varieties offer the potential for western Washington livestock producers to grow an increasing amount of their own livestock feed that is well adapted to the growing environment, affordable to produce, and a good source of livestock nutrition.

This fact sheet is part of a series that presents production information for carrots, fodder beets, turnips, rutabagas, kale, and chicory in western Washington. More information can be found at http://whatcom.wsu.edu/ag/agriculture.htm.

Family, genus, and species: Brassicaceae *Brassica rapa* [Rapifera Group]

Historic varieties. Purple-top Mammoth, Carter Green Globe, Golden Ball, Cowhorn, and Mammoth (Fraser et al., 1907).

Current varieties for root production. White-fleshed varieties include Purple Top White Globe (Figure 1) and White Egg. Common yellow-fleshed varieties are Golden Ball, Amber or Yellow Globe, Yellow Aberdeen, and Orange Jelly.

Current forage varieties. All Top, Appin, Pasja (Figure 2), Seven Top, Tornado (Forage Star)

Note the difference in root/shoot biomass allocation between the varieties in Figures 1 and 2.

Hybrid family, genus, and species: Brassicaceae *Brassica napus x rapa*

Historic varieties. Aberdeen Yellow, Commonwealth, Carter Lightning, and Garton Pioneer (Fraser et al., 1907).

Figure 1. Purple Top White Globe.

Figure 2. Pasja.

Current varieties. See http://cuke.hort.ncsu.edu/cucurbit/wehner/vegcult/turnip.html.

Background

Turnips are native to temperate Europe. They have been eaten since prehistoric times and grown for human and livestock consumption for over 4000 years (Bailey, 1911, 1930). As early as the first century A.D., long turnips, round turnips, and flat turnips were described (Boswell, 2000). Turnips have been popular as livestock fodder for over 600 years and were grown extensively in England since the 1600s for winter feeding of sheep and cattle (Undersander et al., 1991; Smith, 1913; Prothero, 1888). Turnips were used as a pasture crop for pigs and winter fodder for sows (Smith, 1913; Wilcox, 1915).

Turnips were brought to North America with the first settlers in the mid 1600s (Boswell, 2000). They fell out of favor when less labor-intensive fodder such as corn silage became more widely available (Undersander et al., 1991). However, current research indicates that many Brassica forage crops such as turnips can be grown in soils and climates unsuitable for corn or alfalfa, which would allow farmers to extend the grazing season and improve soil fertility (Herbert and Hashemi, 2003).

Turnips are a short season crop and can be grown either as a spring or a fall crop. They are very similar to rutabagas in terms of production and handling but have a shorter growing season and are less cold tolerant. Turnips are moderately shade tolerant and can be successfully intercropped with corn (Duke, 1998). Because they are tolerant of colder climates, they are well suited for production in the northern United States and southern Canada. Turnip greens and roots are also widely grown throughout the southern United States (Undersander et al., 1991).

Uses

Turnip roots, stems, and leaves are palatable to livestock (Undersander et al., 1991). However, livestock can become sick if they are allowed to eat too much turnip too quickly, especially if they are hungry when first fed turnip leaves or roots. If livestock are subsisting on forage with low nutritional quality, gradually insert high quality feed such as turnips into their diet in order to build up healthy rumen microbial populations that can break down protein. When grazing turnip leaves, livestock should have access to hay or other pasture (Lardy and Anderson, 2003). Additionally, lower quality hay should simultaneously be made available to provide animals with adequate amounts of fiber (Undersander et al., 1991).

Figure 3. Beef cattle foraging on Pasja turnips.

As with rutabaga, turnip forage is high quality, similar to concentrate feeds, due to high total digestible nutrients and crude proteins. Similar to rutabagas, turnips contain glucosinolates which suppress thyroid function. If livestock are subsisting largely on turnips, they may need iodine supplements to counteract the thyrotoxic effect of the glucosinolates (Undersander et al., 1991; Lewis, 1998). Glucosinolate content is higher in older (90-day) turnip forage versus younger (60-day) forage. Furthermore, dairy cattle should not be fed turnips during their breeding season or after turnips flower because of potential problems with nitrate toxicity when plants are immature or soil nitrogen is high (Undersander et al., 1991).

Feeding rate. Turnips, like other root crops, have high moisture content, thus they help to increase milk flow in dairy cows and ewes (Smith, 1913). Dairy cows should not be fed turnips on an empty stomach or in excess of more than 50 pounds per day, as turnips can give a "turnipy" odor to the milk. Up to 10 pounds per day of turnips may be fed to horses; 5–8 pounds per day prevents indigestion (Wilcox, 1915).

Turnips were historically used as the main winter fodder for brood sows. Turnips can be fed whole to pigs but should be chopped up into smaller pieces for cattle and sheep that are susceptible to choking on whole roots (Lardy and Anderson, 2003; Fraser et al., 1907). Current farmers' experiences suggest different types of animals may not readily feed on turnips. It is thus advisable to grow a small amount in the first year to determine if your livestock will eat turnip. It may take time for some livestock to become accustomed to eating turnips.

Turnips may also be grown as a forage crop for grazing. With a short grazing rotation, turnip fields may be grazed up to four times. If grazed twice, roots may still be harvested (Undersander et al., 1991). If grazing rotations are too long and livestock consume the tops entirely, then the livestock will begin to consume the roots (Lardy and Anderson, 2003). Many of the modern varieties have been bred with a smaller root system, allowing for multiple grazing events and rapid re-growth.

Production

Like rutabagas and fodder beets, turnip roots consist of a modified hypocotyl, primary root, and tap root. The hypocotyl and primary root store most of the carbohydrates. The taproot can reach quite far but is usually broken partially or entirely broken off in harvest (Bailey, 1911). Turnips develop an extensive fine root system relatively quickly. Three-week old plants have been found to have

roots 2 feet in length. The roots of mature plants may penetrate 3 feet of soil (Ware and McCollum, 1980). The leaves form a rosette, are grass-green in color, and have sparse coarse hairs. Turnip is a biennial which generally produces seed its second year in the field.

Root types. There are five turnip shapes recorded: long, tankard, round, globe, and flat. Currently, most varieties are globe shaped. The long type is at least three times as long as wide and the primary root tapers gradually into a tap root. The tankard type was valued for its uniformity, with parallel straight sides, slightly oblong in overall form, and tapering abruptly into a tap root. Round types are uniform and tend to sit at or above the soil surface. Globe types are nearly spherical in form and the root remains below ground much more than tankard or long types. Thus, globe types tend to be more frost hardy. Flat types are similar to globe types but develop greater width than length, thus a large amount of the root remains exposed above the soil surface (Fraser et al., 1907).

Varieties. Historically, popular turnip varieties were selected for large roots with good keeping qualities. Today, two types of turnips are grown for livestock fodder: turnips with optimal root development and turnips with a high leaf to root ratio for grazing (Figures 2 and 3). Turnip root cultivars can be categorized into two groups: white-fleshed varieties and yellow-fleshed varieties (Ware and McCollum, 1980). The outer skin can range from white to green to purple (Duke, 1998). Today, turnips are most widely cultivated as a vegetable crop and there is a wide selection of available varieties. Vegetable breeding programs tend to focus on small tender roots and vigorous leaf production. While these varieties can be used for livestock fodder, they do not produce maximum yield as compared to older fodder varieties.

Forage turnip varieties include Pasja, Seven Top, Appin, All Top, and Tornado (also known as Forage Star). All Top and Tornado are resistant to turnip mosaic virus and tolerant of aphids (Goldman, 2005). These cultivars have been selected to produce high yields with repeated grazing. Three additional varieties grown for forage turnip greens are Green Globe, York Globe, and Sirius (Undersander et al., 1991). Sirius has lower levels of glucosinolates in leaves than Green Globe and York Globe but more variable yields.

Hybrid turnip. The first hybrid turnips documented as far back as 1844 were a cross between a green-topped rutabaga (swede) and a globe turnip, with either yellow or white flesh. This hybrid was developed to combine the cold tolerance and greater amount of dry matter of rutabagas with the faster growth and maturity of turnips (Fraser et al., 1907; Bailey, 1911). Hybrid turnips should be grown following the same recommendations as for turnips.

Historic hybrid turnip varieties appear to be independent from the more recent Japanese hybrid varieties developed for human consumption in the 1950s (Larkcom, 1991). Current turnip hybrid breeding programs are led by private seed companies seeking to hybridize turnips with other cultivars and species for a wide variety of vegetable characteristics, including high quality leaf production, tender root texture, lack of leaf pubescence, and general uniformity. The focus of these vegetable breeding programs shifted the characteristics of turnips away from large root size and long-term storability to qualities such as refined taste for humans.

Soil characteristics. Turnips are more tolerant of a greater variety of soil types than other root crops such as beets and carrots. They thrive on moist well-drained, slightly acid sandy loam soils and loam soil with a pH range of 5.5–6.8 (Undersander et al., 1991). In the Pacific Northwest, good soil drainage is required for fall and winter turnip production. Soil should ideally have good amounts (> 3.0%) of organic matter (OSU, 2004).

Fertilizer should be applied near the time when seeds are sown to give the crop a competitive advantage over weeds (Undersander et al., 1991). Spring crops require heavy fertilizing, but fall crops typically need less (Ware and McCollum, 1980). It is advisable to submit a soil sample to a laboratory for testing prior to planting. In general, apply 50–70 pounds of nitrogen (N) per acre, 20–150 pounds of phosphorus (P_2O_5) per acre, and 120 pounds of potassium (K_2O) per acre, depending on existing soil conditions and total amount of organic matter (OSU, 2004; Undersander et al., 1991). Sidedressing with nitrogen is not suggested (Egel, 2009). If the soil sulfur level is low, apply 15–25 pounds of sulfur (S) per acre (OSU, 2004; Undersander et al., 1991).

Seeding. Turnips can successfully be sown into pasture ground with minimum tillage if pasture crops are suppressed to allow young seedlings to compete (Undersander et al., 1991).

Turnips do not germinate well under cold soil temperatures. For spring crops, sow seed when soil temperatures have reached at least 50°F. While turnips are cold hardy, they do not withstand frost as well as rutabagas. For mid-summer harvest, sow seed in late May or early June. Once soil temperatures are warm enough, seed up to 70 days before the first hard frost (Undersander et al., 1991). Plant between July 20 and August 1 for fall harvest (OSU, 2004). There is an old adage, "On the twenty-fifth of July sow your turnips wet or dry" which may still provide good guidance regarding last planting dates (Bailey, 1930).

For pasture production, broadcast seed and harrow in lightly. Ideally, seeds are planted at a depth of ½–1 inch depending on soil moisture. When drilled, use 3–4 pounds of seed per acre. If seed is broadcast, increase to 4–6 pounds of seed per acre (Ware and McCollum, 1980; Halligan, 1911). If hand cultivation is preferred, rows should be spaced 12–15 inches apart. Space rows 1–3 feet apart for tractor cultivation (OSU, 2004; Ware and McCollum, 1980). Space seeds 2–6 inches apart within rows and thin as needed (OSU, 2004). Thinning plants is required to grow the largest and most uniform roots (Bailey, 1930). An ideal plant number is 5–6 plants per square foot (Undersander et al., 1991).

Irrigation. Consistent and adequate irrigation is important during root enlargement (Egel, 2009). Total irriga-

tion requirement is 8–12 inches of water depending on the region and time of year. Although total amount of water does not vary by soil type, lighter soils may require more frequent applications. Uniform irrigation will ensure adequate moisture for crop growth and for nutrient uptake from the soil (OSU, 2004).

Cultivation. The first and second cultivation for weed control may be relatively deep but succeeding cultivations should be shallow to avoid damaging roots. Do not cultivate more than four times (Ware and McCollum, 1980; Fraser et al., 1907). Once turnips become established, they are able to compete with most weeds (Undersander et al., 1991).

Pests. Two types of flea beetles, the cabbage flea beetle (*Psylliodes luridipennis*) and the striped flea beetle (*Phyllotreta striolata*) feed exclusively on Brassicas and attack the cotyledons and first true leaves, causing extensive loss to turnip crops. Turnip louse (*Aphis brassicae*) and aphid (*Lipaphis erysimi*) can also be problems, but aphid-tolerant cultivars such as Forage Star have been developed (Undersander et al., 1991). Crop rotation will help control diseases. To avoid pests, do not grow turnips in soil that was used in the previous 4–5 years to grow root crops or Brassica crops (Duke, 1998; Fraser et al., 1907). Rotate turnips with clover, beans, peas or grain crops (Duke, 1998).

Yield

Turnip greens grown for forage will yield 3–4 tons of dry matter per acre (Undersander et al., 1991). A good average yield of turnip roots is 15 tons per acre (OSU, 2004).

Harvest

Roots may be harvested 45–80 days after seeding (Duke, 1998). Turnips are frequently pulled by hand, but beet lifters can be used for lifting and topping the roots (Ware and McCollum, 1980). If turnips are being grown for forage or green chop, they should be harvested when leaves are 12 inches tall, approximately 70–90 days after planting (Undersander et al., 1991).

Storage

Topped roots may be stored in piles or pits in well-drained soil. To prevent heating, pile dimension should not be greater than 8 feet wide and 6 feet deep. According to Duke (1998), wooden chutes were inserted into the pile to promote sufficient aeration. Today, perforated PVC pipe can serve this purpose. Dig a ditch around the pile to allow for quick drainage of water runoff, and layer soil and straw over the pile to provide a protective covering on the outer surface. Smaller quantities of roots may be successfully stored in a root cellar but should be stored in wet sand to prevent drying out. Storage temperature in an indoor facility should range from 32°F to 60°F at 95–100% relative humidity (OSU, 2004; Duke, 1998). Under these conditions, turnips should keep for 4–6 months (OSU, 2004).

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WASHINGTON STATE UNIVERSITY EXTENSION

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FS033E