Comfrey— A Controversial Crop

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Comfrey is an uncommon crop that had great potential for food production in city dooryards and as a forage crop. However, discovery of a potential toxicity problem terminated, at least temporarily, its further development as a food crop. This publication summarizes current information on comfrey and reports research data not available elsewhere.

The Comfrey Plant

Comfrey is a large, perennial plant that kills to ground level each winter. Regrowth usually starts in mid-April and by early May dense clusters of young leaves are evident in the crown of the old plant. These basal leaves grow rapidly and within a few weeks the leaf blades on their long petioles resemble a fountain of leaves over 12 inches high. The stem elongates rapidly reaching a height of over 3 feet (Figure 1). The upper leaves do not have long petioles and are closely attached to the stem. All of the leaves are conspicuously hairy on both sides. Flowering begins in late May or early June and persists until autumn. Growth does not stop with flowering, and the plant continues to add new stems and branches. The plant regrows rapidly after harvest and will bloom again.

The root system is deep and large like that of a woody shrub. Unlike annual crops, the leaves do not wilt in extended drought periods indicating that the roots are extracting moisture from greater depths. The type of comfrey grown in Minnesota rarely produces seed so new plantings are established by planting root cuttings, crown cuttings, or plants.

Diseases and insects have not been a problem with comfrey in the United States. Comfrey rust fungus (*Melampsorella symphyti*) overwinters in comfrey roots and reduces yield of old plantings in England. However, plant quarantine regulations on importation of roots or plants have prevented its spread to the United States.

Types, Botanical Relationships, and History

Comfrey and the annual herb borage are the only crop plants in the Boraginaceae family. *Symphytum*, the comfrey genus, has about 25 species but only three are relevant to the crop known as comfrey.

Common or wild comfrey (*Symphytum officinale* L.) is native to England and grows as a wild plant throughout much of Europe. English immigrants brought it to America for medicinal and healing uses. Except for the purple-flowered botanical variety *patens*, common comfrey has cream-yellow flowers. Other cytotypes of this species found in continental Europe have white, red, or purple flowers.

Prickly or rough comfrey [*Symphytum asperum* Lepechin (*S. asperrimum* Donn.)] was introduced to England from Russia about 1800. It has pink and blue flowers. The USDA and several state experiment stations tested this species more than 75 years ago and reported that it yielded less than some common forage crops and that its high water content made forage preservation difficult.

Quaker, Russian, or blue comfrey [*Symphytum* x *uplandicum* Nyman (*Symphytum peregrinum* Ledeb.)] is a hybrid ($2n=36$) between a cytotype ($2n=40$) of common and prickly ($2n=32$) comfrey. The species originated from a natural hybrid, but the hybrid has also been made experimentally (5). This hybrid has blue, purple, or purple-red flowers and is taller than either parent. A pink-flowered cytotype ($2n=40$) of Quaker comfrey is a hybrid of prickly comfrey ($2n=32$) and a cytotype ($2n=48$) of common comfrey (4). Both hybrids are fertile and breed true from seed (4).

Henry Doubleday (1813-1902) introduced Russian (Quaker) comfrey to England as a possible substitute for gum arabic in the manufacture of postage stamp glue. However, comfrey protein failed to stick stamps securely. The Henry Doubleday Research Association (Bocking, Braintree, Essex, England) started in 1954, and its director, Lawrence D. Hills, collected and described the many Bocking strains of comfrey (7). He

Figure 1. Comfrey in prebloom stage on June 3 at Rosemount, Minnesota.

arranged for the export of 5,000 comfrey plants to Canada in 1954 and called them Quaker comfrey. Henry Doubleday was a Quaker. Much of the presently grown comfrey in the United States traces to this introduction.

Culture

Comfrey is propagated vegetatively in the United States because seed production is very low[1]. Transplants, crown cuttings with buds (eyes), and root cuttings are planted. Production the first year is greatest from transplants and least from root cuttings, but after the first year there is no difference. Root cuttings are the least expensive and, consequently, are most extensively used. Root cuttings from 1½ to 6 inches long and from ¼ to ¾ inches in diameter are common. Even smaller pieces will generate plants, but longer pieces are more certain to establish and emerge faster. Root cuttings develop buds 3 to 6 weeks after planting and consequently are much slower than crown cuttings which usually emerge in 10 days.

Wilted cuttings should be soaked in cold water for several hours or until they become firm before planting. Cuttings should be laid flat and covered with soil. Planting depths range from 2 to 8 inches depending on soil texture and expected moisture at the various depths. A common depth is 4 inches but 2 inches is sufficient with irrigation. Very small cuttings or pieces of root should not be planted as deeply as normal size cuttings. Young transplants should be planted upright with their crowns about 2 inches deep.

The optimum time of planting is in April or as early as the soil can be tilled, but the crop can be planted throughout the growing season. Although a small crop can be expected the first year if planting is early, more efficient use of land is achieved by planting comfrey after harvest of small grain or other crops. Transplants and crown cuttings can be planted as late as October, but root cuttings should preferably be planted before September. The plants must establish and grow before winter in order to produce a high yield the next year.

Plantings are often made in a checkerboard arrangement to allow cross cultivation for weed control. Rows 3 to 4 feet apart are common. Closer spacings such as 30 inches probably produce higher yields. However, the cost of cuttings or transplants and the need to cultivate for weed control have encouraged the wider spacings.

If weeds are controlled and soil fertility is maintained, comfrey plantings should last indefinitely. Comfrey is an excellent weed competitor because of its rapid and dense growth, but under a several-cut harvesting regime, weeds establish between the clumps of comfrey. Consequently, at least two cultivations per year are needed. Quackgrass and other perennial weeds allowed to establish in a comfrey planting will probably destroy it. Rototilling between plants is an excellent method of destroying weeds, and it leaves the soil level to facilitate harvesting.

[1]Prickly comfrey is propagated by seed in the USSR (4).

Broadcasting seed of grass crops like bluegrass or timothy over an established comfrey planting in late summer is an untried but possible way to avoid cultivation. Mixed comfrey-grass forage could be harvested or the grass between the comfrey plants could be mowed like a lawn. Comfrey might not persist well in the mixture, but that would not be serious in a crop rotation. A comfrey-grass mixture would be more easily cured and preserved than pure comfrey.

Comfrey is a high-protein forage crop but, unlike legumes, it obtains all of its nitrogen from the soil. Old, formerly productive plantings may develop a lighter green leaf color which can be corrected by broadcasting or sidedressing nitrogen fertilizer. Barnyard manure is an excellent fertilizer for comfrey. Productive comfrey crops, like alfalfa and corn silage, remove large amounts of potassium, calcium, and phosphorus from the soil. Comfrey is not highly sensitive to soil pH, but best adaptation is reported on soils of pH 6 to 7.

Comfrey has generally been grown by people who do not use herbicides. Consequently tillage is used to kill it. Tillage should start with deep moldboard plowing in September or October followed by secondary tillage with a field cultivator to expose roots to drying and freezing over the winter. Close grazing and rooting by hogs through the summer and late into the fall is also an effective control. Comfrey is reported to be tolerant of 2,4-D and 2,4,5-T and susceptible to atrazine, sodium chlorate, and ammonium sulfamate, but this information was not obtained in Minnesota. Glyphosate herbicide spray in June at Rosemount killed stems and leaves, but regrowth from roots resulted in a full stand by September.

Performance of Comfrey at the Rosemount Agricultural Experiment Station

Comfrey yields are often quoted on a fresh weight basis and this exaggerates the yielding ability of the crop. The yields in Table 1 range from about 1.5 to 6 tons of dry forage per acre, but on a fresh weight basis, the same yields range from 13 to 61 tons per acre. The moisture content of comfrey forage is higher than that of

Table 1. Moisture percentages and oven-dry yields of comfrey forage at Rosemount, 1979-81

	Year harvested		
Date planted	1979	1980	1981
		moisture (percent)	
April 28, 1975	92	87	88
October 14, 1977	90	88	88
April 23, 1979	89	87	88
April 23, 1979	—	88	90
		yield/acre (pounds)	
April 28, 1975	5,340	8,650	9,485
October 14, 1977	12,140	7,950	9,485
April 23, 1979	2,720	6,240	9,480
April 23, 1979	—	10,210	8,110

commonly grown legume and grass forage crops. Comfrey forage averaged about 89 percent moisture or only 11 percent dry matter (Table 1). Comparable figures are about 80 percent moisture for alfalfa cut in early bloom and from 75 to 85 percent moisture for winter rye cut between the 7-inch and boot stages. The high moisture concentration in comfrey is a serious problem in curing the crop for hay or silage.

The yields in Table 1 are the totals from four or five harvests per year. Slow regrowth from plots harvested the previous year and other observations indicated that root reserves were being depleted and that high production could not continue. Consequently, systems of fewer harvests per year or rest periods are needed to build up root reserves.

The low yields in 1979 and 1980 from the 1979 planting compared to the high yield (10,210 pounds per acre) from the same planting not harvested in 1979 indicates that the crop needs time to develop root reserves before intensive harvesting is started.

Despite root reserve depletion from intensive harvesting, comfrey showed high longevity in these trials. No plants died, and there were no diseased plants. The lower yield of the 1975 planting in 1979 was due to lack of fertilizer nitrogen rather than to any weakening of aged plants. The plants were 4 feet apart in rows 4 feet apart, and a rototiller was used between the rows twice each year to control annual and winter annual weeds. Young comfrey plants developed between the rows, and these probably developed from roots severed by the rototiller.

The average yields and quality from each of the four or five harvests per year are reported in Table 2. More than half of the annual yield was produced in the first two harvests. The second harvest was greater than the first because of slow regrowth in the spring on plots harvested the previous year. This suggests that harvesting only in June and July might permit root reserves to increase in late summer, result in higher first cutting yields the following year, and maintain productivity at a sustainable level. Researchers in China found that highest yields were obtained from three cuttings starting in mid-June at full bloom stage when protein concentration was 19 percent (12).

Comfrey was very high in crude protein (Kjeldahl nitrogen percentage x 6.25), and protein percentage increased from first to last harvest (Table 2). Alfalfa cut at one-tenth bloom stage averages about 18 percent protein. Acid detergent fiber (ADF) percentage is a measure of digestibility used for grasses and legumes, and ADF data can be converted to percentage digestible dry matter (DDM) by a formula. The DDM values for comfrey in Table 2 using the procedures for grasses and legumes indicate that comfrey is a forage of high digestibility. However, research has not determined whether or not the procedures applicable to grasses and legumes apply to comfrey. USDA researchers reported that the Tilley and Terry two-stage method of measuring dry matter digestibility gave in vitro dry matter digestibility percentages of 37, 61, and 62 percent, respectively, for comfrey, orchardgrass, and alfalfa harvested from plots at Beltsville, Maryland. Crude protein percentage in these USDA trials ranged from 13 to 17 percent for comfrey and 16 to 17 percent for alfalfa (6). Other research indicated that the digestibility of comfrey ranged from 37 to 77 percent and is similar to or occasionally lower than that of other forages.

Comfrey for Livestock Feed

The hairs on comfrey leaves limit its use for pasture. The fresh leaves are eaten by sheep, pigs, and poultry but are often not palatable for cattle and rabbits. The leaf hairs collapse when the forage is wilted or ensiled; consequently, cattle and rabbits will eat the wilted forage. The forage is also fed to horses, goats, chinchillas, and caged birds.

Daily harvesting and feeding as green chop is an effective use of large plants; apparently, cattle do not object to the hairiness after the plants are chopped. For silage, the crop must be cut and allowed to wilt for at least 24 hours, and carbohydrate preservatives such as molasses or grain are needed. Probably the most economical preservation is to ensile a forage mixture by blending up to 25 percent comfrey with small grain or corn forage.

Hay making is difficult for mechanized farms because comfrey takes at least 3 days of dry weather to cure in a windrow and the hay may get dirty on the cultivated soil. Good hay has been made by drying the leaves on lawns or on shed roofs. The hay may turn dark, but it is palatable.

Comfrey for Food

Comfrey produces high yields of leafy vegetable from late May until freezing in October or November. Furthermore, the leaves can be dried and stored in glass jars. The dried leaves can be cooked in water and consumed as a cooked green vegetable. Consequently, two plants in a city yard can supply a family with all of its cooked

Table 2. Yields and quality of forage at each harvest date from comfrey cut four to five times per year at Rosemount, 1979-81

Cutting dates	Yield/acre (pounds)[1]	Moisture (percent)	Protein (percent)[1]	DDM (percent)[2]
First, June 3-June 28	2,130	88	21	65
Second, June 21-July 26	3,190	87	23	60
Third, July 18-August 21	1,910	91	25	64
Fourth, August 14-Oct. 7	1,430	90	26	71
Fifth, Sept. 19, 1980	1,470	92	31	74

[1]Oven-dry. [2]Digestible dry matter (DDM) calculated from acid detergent fiber (ADF) percent. $[59.0-(2.26 \times \text{ADF}) + (14.2 \times \sqrt{\text{ADF}})]$.

green vegetable food throughout the year. Other green leaf vegetables such as spinach, New Zealand spinach, Swiss chard, mustard, amaranth, turnip tops, and beet tops produce lower yields and for much shorter periods of time than comfrey. Comfrey will grow in partially shaded areas that are typical of city yards. However, the hairs on the leaves give it a different (furry) texture than that of other leaf vegetables. Longer cooking reduces the furriness.

Many foods can be prepared from fresh and dried comfrey leaves (7, 8). Comfrey flour is made by grinding the dried leaves (7). The potential of comfrey as a food crop to be grown in the consumer's backyard led to analyses of its nutritive value. Proteins differ in nutritional quality depending upon their digestibility and amino acid composition. The 18 amino acids found in comfrey grown at Rosemount are ranked in descending order of their percentages of oven-dry forage in the second, third, and fourth columns of Table 3. The total protein and essential amino acid requirements for human nutrition (3) are supplied in 0.75 pound per day of dry comfrey if digestibility is about 55 percent. Cuttings in July were higher in protein than those in June which accounts for the higher percentages of each amino acid in July when expressed on the "In forage" basis (Table 3). The last three columns in Table 3 show the protein composition that could result from separating the protein from other constituents in manufacturing food or industrial products. These columns are of interest if comfrey is considered a potential "phytomass" crop for protein or leaf protein concentrate.

Protein percentages of foods are calculated by various methods. However, the methods are calibrated to give protein percentages based on the product of percent nitrogen times a nitrogen-to-protein conversion factor. The factor used for most crops is 6.25 (10). Calculations based on the amino acid composition in Table 3 show that 6.36 is the nitrogen-to-protein conversion factor for comfrey protein. However, factors for converting nitrogen to protein in all crops overestimate the amount of true protein because nonprotein nitrogen is included in the nitrogen analyses. The overestimates may not be important if amino acid requirements are satisfied because the nonprotein nitrogen compounds may have nutritive value equal to that of protein.

Summations of the amino acid percentages in Table 3 compared with the nitrogen percentages in the original samples revealed that 65 percent of the plant nitrogen was in the protein and 35 percent was in other compounds. The latter figure is somewhat higher than the 15 to 25 percent found in some crop seeds. Comparable work on other forage crops for comparison with comfrey has not been reported.

Comfrey forage is a good source of several vitamins and may be a unique plant source of B-12. Vitamin B-12 originates in nature from bacteria or fungi that live in the soil or in the intestines of some animals. Neither field crops nor animals synthesize B-12 in their tissues (1). The major sources of B-12 for humans are meat, eggs, and dairy products (1). Strict vegetarians may develop sore tongues and other symptoms of B-12 deficiency. Comfrey has been promoted as the only crop that contains B-12. In contrast to comfrey grown in England and Washington (7), comfrey grown in Cheyenne, Wyoming did not contain B-12 (6). Comfrey grown at Rosemount showed a B-12 concentration of 0.04 parts per million when tested by the same laboratory that reported none at Cheyenne. Although care was taken in harvesting, contamination of the hairy leaves with soil or with microorganisms that synthesize B-12 is a possibility. Additional research is needed.

The allantoin ($C_4H_6N_4O_3$) concentration in comfrey, particularly the root, has let to its extensive use in natural and folk medicine for promoting healing of wounds, ulcers, broken bones, swellings, and burns (7, 8).

Table 3. Amino acid concentrations in the first and second cuttings of comfrey forage at Rosemount, Minnesota

	In forage (percent)			In forage protein (percent)		
Amino acid	June	July	Average	June	July	Average
Glutamic acid	1.65	2.00	1.83	12.25	12.73	12.49
Leucine	1.36	1.57	1.47	10.07	10.01	10.04
Aspartic acid	1.25	1.47	1.36	9.30	9.37	9.34
Valine	0.93	1.12	1.03	6.91	7.13	7.02
Arginine	0.87	0.98	0.93	6.49	6.26	6.37
Phenylalanine	0.84	1.02	0.93	6.22	6.46	6.34
Alanine	0.77	0.92	0.85	5.75	5.83	5.79
Proline	0.74	0.85	0.80	5.47	5.43	5.45
Glycine	0.72	0.85	0.78	5.33	5.41	5.37
Isoleucine	0.72	0.83	0.77	5.37	5.26	5.31
Lysine	0.76	0.76	0.76	5.60	4.81	5.21
Cystine	0.63	—	0.68[1]	4.67	—	4.67[1]
Threonine	0.62	0.70	0.66	4.57	4.44	4.51
Tyrosine	0.49	0.60	0.55	3.63	3.84	3.74
Serine	0.42	0.44	0.43	3.10	2.83	2.96
Methionine	0.31	0.41	0.36	2.34	2.59	2.46
Histidine	0.27	0.32	0.29	2.03	2.01	2.02
Tryptophan	0.12	—	0.13[1]	0.91	—	0.91[1]

[1]Data adjusted to be comparable with other averages.

Comfrey on a dry weight basis is very high in ash, averaging 18 percent at Rosemount and ranging from 13 to 42 percent in other parts of the world (4). A partial elemental composition of comfrey forage is reported in Table 4. The forage is particularly high in potassium and is higher than many other forage crops in calcium, phosphorus, iron, and copper. Carbon, hydrogen, oxygen, nitrogen, and sulfur are the major nonmineral elements. The combined high nitrogen and high mineral concentrations make comfrey forage an unusually good material for composting, mulching, and organic fertilization of crops.

Table 4. Partial elemental composition of first and second cuttings of comfrey forage at Rosemount, Minnesota

Element	June	July	Average
		(percent)	
Potassium	5.89	5.84	5.86
Nitrogen	3.36	3.70	3.53
Calcium	1.37	1.51	1.44
Phosphorus	0.49	0.51	0.50
Magnesium	0.27	0.32	0.30
		(parts/million)	
Aluminum	294	477	385
Iron	283	446	364
Manganese	105	128	116
Sodium	64	76	70
Zinc	49	42	45
Boron	45	46	45
Copper	9	11	10
Cobalt	7	—	—
Lead	5	7	6
Nickel	2	2	2
Chromium	1	2	1
Cadmium	<1	<1	<1

The Safety of Comfrey

Interest in the pyrrolizidine alkaloids developed because animals grazed on pastures containing plants (*Crotalaria* sp., *Senecio* sp., and *Heliotropium* sp.) with those alkaloids developed liver and lung lesions (11). Alkaloids extracted from Quaker comfrey leaves and injected into rats at dosages of 9 to 71 milligrams of alkaloid per kilogram of body weight three times per week for several weeks caused liver damage or death (2). Research in Japan published in 1978 showed that a ration of 0.5 percent wild comfrey root or 8 percent comfrey leaf produced liver tumors in rats. These reports caused great concern, and much agronomic research on comfrey was terminated.

Consumption of comfrey is generally at lower levels than those used in toxicity research, and comfrey has not been reported to cause liver damage or cancer in farm animals or humans. Low or normal intake studies are needed for a proper evaluation of the hazard. Reasonable consumption of mature leaves or of comfrey tea is unlikely to cause problems and occasional topical use of root products should not be hazardous (9). The use of comfrey leaves for feeding cattle, sheep, goats, horses, and rabbits appears to have a satisfactory margin of safety (9).

Conclusion

Comfrey continues to be used, and it is sold in tablet and other forms at many food stores in the United States. Cuttings for propagation of comfrey continue to be sold. Occasional use of the crop for food variety and medicinal purposes will probably continue. However, comfrey can no longer be considered a crop that can be consumed by humans or animals with complete safety. Research to establish the safety of a reasonable intake of comfrey in a varied diet is unlikely to be undertaken since it is an uncommon crop. Comfrey continues to be an excellent crop for composting, mulching, and organic fertilization. Comfrey is a potential phytomass crop for protein extraction.

Literature Cited

1. Bogert, L.J., G.M. Briggs, and D.H. Calloway. 1973. Nutrition and physical fitness. p. 157-161. W.B. Saunders Co., Philadelphia, PA.
2. Culvenor, C.C.J., M. Clarke, J.A. Edgar, J.L. Frahn, M.V. Jago, J.E. Peterson and L.W. Smith. 1980. Structure and toxicity of the alkaloids of Russian comfrey (*Symphytum* x *uplandicum* Nyman), a medicinal herb and item of human diet. Experientia 36:377-379.
3. FAO Nutrition Committee. 1973. Energy and protein requirements. FAO Nutrition Meetings Report 52:1-118.
4. Forbes, J.C., A.D. McKelvie, and P.J.C. Saunders. 1979. Comfrey (*Symphytum* spp.) as a forage crop. Herb Abstr. 49:523-539.
5. Gadella, T.W.J. and E. Kliphuis. 1969. Cytotaxonomic studies in the genus *Symphytum*. Acta Botanica Neerlandica 18:544-549.
6. Hart, R.H., A.J. Thompson III, J.H. Elgin Jr., and J.E. McMurtrey III. 1981. Forage yield and quality of Quaker comfrey, alfalfa, and orchardgrass. Agron. J. 73:737-742.
7. Hills, L.D. 1976. Comfrey fodder, food & remedy. 253 p. Universe Books, NY.
8. Hylton, W.H. (ed.). 1976. The Rodale herb book. p. 107-108, 142, 410-415, Rodale Press Inc. Emmaus, PA.
9. Pembery, J.A. 1981. The safety of comfrey. Henry Doubleday Research Association, Braintree, Essex, England.
10. Robinson, R.G. 1978. Chemical composition and potential uses of annual canarygrass. Agron. J. 70:797-800.
11. Wogan, G.N. and W.F. Busby, Jr. 1980. Naturally occurring carcinogens. p. 329-369. *In* I.E. Liener (ed.). Toxic constituents of plant foodstuffs. Academic Press Inc. New York, NY.
12. Zhao, C.Y. and Z.J. Chen. 1981 Optimum time for cutting *Symphytum peregrinum*. Liaoning Inst. Anim. Husb. and Vet. Med. 6:19-21. Liaoning, China.