

## MEDICS

*Medicago spp.*

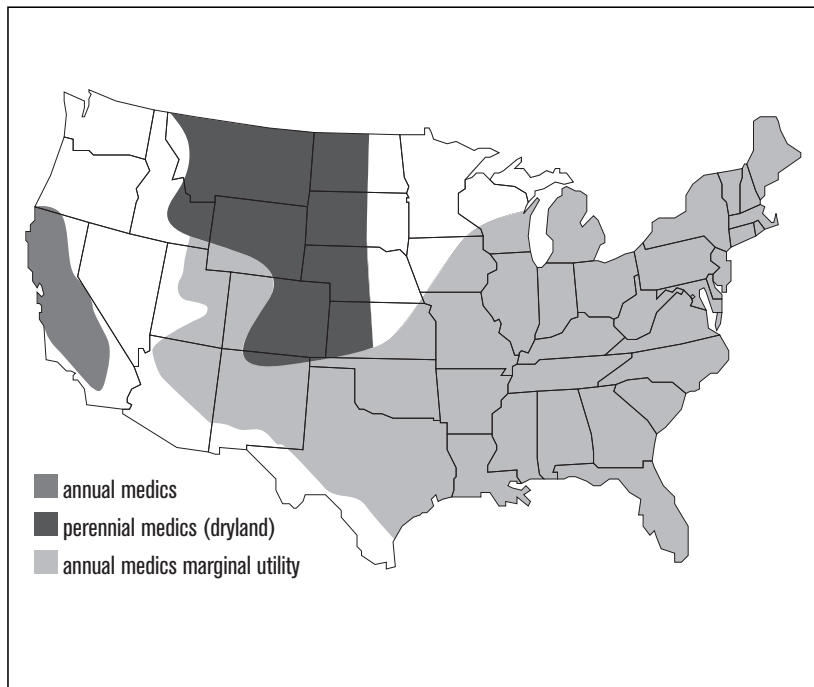
**Also called:** black medic, burr (or bur) medic, burclover

**Type:** Winter annual or summer annual legume

**Roles:** N source, soil quality builder, weed suppressor, erosion fighter

**Mix with:** Other medics; clovers and grasses; small grains

See charts, p. 66 to 72, for ranking and management summary.



Once established, few other legumes outperform medics in soil-saving, soil-building and—in some systems—forage, when summer rainfall is less than 15 inches. They serve well in seasonally dry areas from mild California to the harsh Northern Plains. With more rainfall, however, they can produce almost as much biomass and N as clovers. Perennial medics are self-seeding with abundant “hard seed” that can take several years to germinate. This makes medics ideal for long rotations of forages and cash crops in the Northern Plains and in cover crop mixtures in the drier areas of California.

**Annual medics** include 35 known species that vary widely in plant habit, maturity date and cold tolerance. Most upright varieties resemble alfalfa in their seeding year with a single stalk and short taproot. Medics can produce more than 100 lb. N/A in the Midwest under favorable conditions, but have the potential for 200 lb. N/A where the plants grow over winter. They germinate and grow quickly when soil moisture is adequate, forming a thick ground cover that holds soil in place. The more prostrate species of annual medic provide better ground cover.

Significant annual types include: **burr medic** (*M. polymorpha*), which grows up to 14 inches

tall, is semi-erect or prostrate, hairless, and offers great seed production and N-fixing ability; barrel medic (*M. truncatula*), about 16 inches tall, with many mid-season cultivars; and snail medic (*M. scutellata*), which is a good biomass and N producer.

Southern spotted burr medic is a native *M. polymorpha* cultivar with more winterhardiness than most of the current burr medics, which are imported from Australia. See *Southern Burr Medic Offers Reseeding Persistence* (p. 154). Naturalized burr medic seed is traded locally in California.

Annual medics broadcast in spring over wheat stubble in Michigan reduced weed number and growth of spring annual weeds prior to no-till corn planting the following spring. Spring-planted annual medics produced dry matter yields similar to or greater than alfalfa by July (373, 376).

**Black medic** (*M. lupulina*) is usually called a perennial. It can improve soil, reduce diseases, save moisture and boost grain protein when grown in rotations with grains in the Northern Plains. GEORGE is the most widely used cultivar in dryland areas of the Northern Plains. Black medic produces abundant seed. Up to 96 percent of it is hard seed, much of it so hard seeded that it won't

### Jess Counts on GEORGE for N and Feed

STANFORD, Mon.—Jess Alger can count on 13 inches of rainfall or less on his central Montana farm, occasional hail damage, too few solar units to raise safflower or millet, some bone-chilling winters without snow cover—and George. That's GEORGE black medic.

On-farm tests showed he got 87 lb. N/A and 3 percent organic matter on his Judith clay loam soils. He initially seeded the medic on 10-inch row spacings with barley at 10 lb./A, his standard rate and seeding method. He grazed the medic early in the second year, and then let it go to seed. In Year 3, he sprayed it with glyphosate in order to establish a sorghum-sudangrass hybrid as emergency forage on May 15. He had several inches of growth when frost hit about June 10 and killed the tender grass.

The medic came on strong. He let it mature to its full 12 inches to harvest it for seed. "It was already laying over, but the pickup guards on my combine helped to gather in about half the seed." The other half pumped up the seed bank for years ahead.

He did a comparison with side-by-side fields of spring wheat. One followed a spring wheat crop, the other he planted into a six-year-old

stand of GEORGE medic. The medic/wheat interplant yielded 29 bushels per acre—six bushels less than the other field. But the interplanted grain tested at 15 percent protein, a full percentage point higher. Those are high yields for Alger's area, partly due to timely summer rain. "The yield drop with medic was mostly a weed problem with Persian darnel," Alger explains, "but I now have that mostly under control."

Jess continues to fine-tune his system to maximize income and weed management. He became certified organic in 1999. He maintains the medic seed bank with no-till plantings of GEORGE with a nurse crop of Austrian winter peas. He is experimenting successfully with rye instead of summer fallow.

If weed pressure is high, medic fields are grazed closely to prevent weeds from going to seed, then plowed. Otherwise, he no-tills winter wheat into standing medic so he can leave most of the medic in place, bury less seed and allow GEORGE to rest more securely in his field.

*Updated in 2007 by Andy Clark*

germinate for two years. Second-year growth may be modest, but coverage improves in years three and four after the initial seeding if competition is not excessive (422) and grazing management is timely.

### BENEFITS

**Good N on low moisture.** In dryland areas, most legumes offer a choice between N production and excessive water use. Medics earn a place in dryland crop rotations because they provide N while conserving moisture comparable to bare-ground fallow (230, 380).

Fallow is the intentional resting of soil for a season so it will build up moisture and gain fertility by biological breakdown of organic matter. Black

medic increased spring wheat yield by about 92 percent compared with spring wheat following fallow, and also appreciably raised the grain protein level (379). GEORGE grows in a prostrate to ascending fashion and overwinters well with snow cover in the Northern Plains.

April soil N value after black medic in one Montana test was 117 lb./A, about 2.5 times the fallow N level and the best of six cultivars tested, all of which used less water than the fallow treatment (378). In North Dakota, however, unrestricted medic growth depressed yield of a following wheat crop (73).

**Great N from more water.** Under normal dryland conditions, medics usually produce about 1 T dry matter/A, depending on available soil mois-

### Southern Spotted Burr Medic Offers Reseeding Persistence

While annual medics, in general, are hard seeded, they usually cannot tolerate winters north of the Gulf South. Southern spotted burr medic (*Medicago arabica*) shows promise as a winter legume that can reseed for several years from a single seed crop in Hardiness Zone 7 of the Southeast.

Once as widely grown as hairy vetch in the mid-South region of the U.S., burr medic persists in non-cropland areas because it is well adapted to the region (326, 327). A local accession collected in northern Mississippi exhibits better cold hardiness and insect resistance than commercially available (Australian) annual medics.

In a replicated cold-hardiness trial spanning several states, spotted burr medic flowered in mid-March, about two weeks after SERENA, CIRCLE VALLEY or SANTIAGO burclover, but two weeks before TIBBEE crimson clover. The burr medic flowered over a longer period than crimson, matured seed slightly sooner than TIBBEE but generally did not produce as much biomass.

The big advantage of spotted burr medic over crimson clover was its ability to reseed for several years from a single seed crop. In studies in several states, the native medic successfully reseeded for at least two years when growth was terminated two weeks after TIBBEE bloomed. Only balansa clover (see *Up-and-Coming Cover Crops*, p. 191) reseeded as well as spotted burclover (105). The burr

medic cultivar CIRCLE VALLEY successfully reseeded in a Louisiana no-till cotton field for more than 10 years without special management to maintain it (103).

Research in the Southeast showed that if Southern spotted burr medic begins blooming March 23, it would form viable seed by May 2, and reach maximum seed formation by May 12. By allowing the cover crop to grow until 40 to 50 days after first bloom and managing the cropping system without tillage that would bury burclover seeds too deeply, Southern spotted burclover should successfully reseed for several years.

Native medic seed is being increased in cooperation with the USDA-Natural Resources Conservation Service's Jamie Whitten Plant Materials Center, Coffeeville, Miss., for possible accelerated release to seed growers as a "source-identified" cover crop.

Insect pests such as clover leaf weevil (*Hypera punctata* Fabricius) and the alfalfa weevil (*Hypera postica* Gyllenhal) preferentially attack medics over other winter legume cover crops in the Southeast, and could jeopardize seed production. These insects are easily controlled with pyrethroid insecticides when weevils are in their second instar growth stage. While not usually needed for single-season cover crop benefits, insecticides may be warranted in the seeding year to ensure a reseeded crop for years to come.

ture and fertility. When moisture is abundant, medics can reach their full potential of 3 T/A of 3.5 to 4 percent plant-tissue nitrogen, contributing more than 200 lb. N/A (201, 422).

**Fight weeds.** Quick spring regrowth suppresses early weeds. Fall weeds are controlled by medic regrowth after harvest, whether the medic stand is overseeded or interplanted with the grain, or the grain is seeded into an established medic

stand. In California orchards and vineyards where winters are rainy instead of frigid, medics mixed with other grasses and legumes provide a continuous cover that crowds out weeds. In those situations, medics help reduce weed seed production for the long-term.

**Boost organic matter.** Good stands of medics in well drained soil can contribute sufficient residue to build soil organic matter levels. One Indiana

## Hard-seeded medics are ideal for reseeding systems in orchards and vineyards.

and drought tolerance. Low, dense vegetation breaks raindrop impact while roots may penetrate 5 feet deep to hold soil in place.

**Tolerate regular mowing.** Medics can be grazed or mowed at intervals with no ill effects. They should be mowed regularly to a height of 3 to 5 inches during the growing season for best seed set and weed suppression. To increase the soil seed bank, rest medic from blooming to seed maturation, then resume clipping or grazing (285, 422, 435).

**Provide good grazing.** Green plants, dry plants and burs of burr medic provide good forage, but solid stands can cause bloat in cattle (422). The burs are concentrated nutrition for winter forage, but lower the value of fleece when they become embedded in wool. Annual medics overseeded into row crops or vegetables can be grazed in fall after cash crop harvest (376).

**Reseeding.** Black medic has a high percentage of hard seed. Up to 90 percent has an outer shell that resists the softening by water and soil chemicals that triggers germination (286). Scarified seed will achieve 95 percent germination, and 10-year old raw seed may still be 50 percent viable (422). Burr medic seed in the intact bur remains viable for a longer time than hulled seed (120).

Their status as a resilient, reseeding forage makes medics the basis for the “ley system” developed in dry areas of Australia. Medics or subterranean clover pastured for several years on Australian dry-lands help to store moisture and build up soil productivity for a year of small grain production before being returned to pasture. This use requires livestock for maximum economic

test reported a yield of more than 9,000 lb. dry matter/A from a spring-sown barrel medic (164).

**Reduce soil erosion.** Medics can survive in summer drought-prone areas where few other cultivated forage legumes would, thanks to their hard-seeded tendency

benefit. GEORGE black medic is prostrate, allowing other grasses and forbs to become the over-story for grazing. It is well-suited to cold winter areas of Hardiness Zone 4, where it can stay green much of the winter (6).

**Quick starting.** Black medic can germinate within three days of planting (286). About 45 days after mid-April planting in southern Illinois, two annual medics were 20 inches tall and blooming. In the upper Midwest, snail and burr medics achieve peak biomass about 60

days after planting. An early August seeding of the annuals in southern Illinois germinated well, stopped growing during a hot spell, then restarted. Growth was similar to the spring-planted plots by September 29 when frost hit. The plants stayed green until the temperature dipped to the upper teens (201).

**Widely acclimated.** Species and cultivars vary by up to seven weeks in their estimated length of time to flowering. Be sure to select a species to fit your weather and crop rotation.

## MANAGEMENT

### Establishment

Annual medics offer great potential as a substitute for fallow in dry northern regions of the U.S. with longer day length. Annual medics need to fix as much N as winter peas or lentils and have a competitive establishment cost per acre to be as valuable as these better-known legume green manures (383).

Medics are widely adapted to soils that are reasonably fertile, but not distinctly acid or alkaline. Excessive field moisture early in the season can



BLACK MEDIC  
(*Medicago lupulina*)

Elayne Sears

significantly reduce medic stands (373). Acid-tolerant rhizobial strains may help some cool-season medics, especially barrel medic, to grow on sites that otherwise would be inhospitable (422).

To reduce economic risk in fields where you've never grown medic, sow a mixture of medics with variable seed size and maturation dates. In dry areas of California, medic monocultures are planted at a rate of 2 to 6 lb./A, while the rate with grasses or clovers is 6 to 12 lb./A (422).

Establishment options vary depending on climate and crop system:

- **Early spring—clear seed.** Drill  $\frac{1}{4}$  to  $\frac{1}{2}$  inch deep (using a double-disk or hoe-type drill)

**Medics earn a place in dryland rotations because they provide N while conserving moisture.**

into a firm seed bed as you would for alfalfa. Rolling is recommended before or after seeding to improve seed-soil contact and moisture in the seed zone. Seeding rate is 8 to 10 lb./A for black medic, 12 to 20 lb./A for larger-seeded (snail, gamma and burr) annual medics. In the

arid Northern Plains, fall germination and winter survival are dependable, although spring planting also has worked.

- **Spring grain nurse crop.** Barley, oats, spring wheat and flax can serve as nurse crops for medic, greatly reducing weed pressure in the seeding year. The drawback is that nurse crops will reduce first-year seed production if you are trying to establish a black medic seed bank. To increase the soil seed reserve for a long-term black medic stand (germinating from hard seed), allow the medic to blossom, mature and reseed during its second year.

- **Corn overseed.** SANTIAGO burr medic and SAVA snail medic were successfully established in no-till corn three to six weeks after corn planting during a two-year trial in Michigan. Corn yield was reduced if medics were seeded up to 14 days after corn planting. Waiting 28 days did not affect corn yield, but medic biomass production was reduced by 50% (219).

Where medic and corn work together, such as California, maximize medic survival during the corn canopy period by seeding early (when corn is eight to 16 inches tall) and heavy (15 to 20 lb./A) to build up medic root reserves (47, 422).

- **After wheat harvest.** MOGUL barrel medic seeded after wheat harvest produced 119 lb. N/A in southern Michigan, more than double the N production of red clover seeded at the same time (373). In Montana, mid-season establishment of snail medic after wheat works only in years with adequate precipitation, when it smothers weeds, builds up N, then winterkills for a soil-holding organic mulch (72).

- **Autumn seeding.** Where winters are rainy in California, medics are planted in October as winter annuals (436). Plant about the same time as crimson clover in the Southeast, Zones 7 and 8.

## Killing

Medics are easy to control by light tillage or herbicides. They reseed up to three times per summer, dying back naturally each time. Medics in the vegetative stage do not tolerate field traffic.

## Field Management

Black medic > small grain rotations developed in Montana count on successful self-reseeding of medic stands for grazing by sheep or cattle. A month of summer grazing improves the economics of rotation by supplying forage for about one animal unit per acre. In this system, established self-reseeding black medic plowed down as green manure in alternate years improved spring wheat yield by about 50 percent compared to fallow (380).

Black medic is a dual-use legume in this adapted "ley" system. Livestock graze the legume in the "medic years" when the cover crop accumulates biomass and contributes N to the soil. Cash crops can be no-tilled into killed medic, or the legume can be incorporated.

A well-established black medic stand can reduce costs compared with annual crops by coming back for many years. However, without the livestock grazing benefit to supply additional utilization, water-efficient legumes such as lentils

and Austrian winter peas will probably be more effective N sources. Further, the long-lived seed bank that black medic establishes may be undesirable for some cash crop rotations (383).

Use of medics for grain production in the upper Midwest has given inconsistent results. Berseem clover may be a better choice in many situations. In a series of trials in Ohio, Michigan, Wisconsin and Minnesota, medic sometimes reduced corn yield and did not provide enough weed control or N to justify its use under current cash grain prices, even when premiums for pesticide-free corn were evaluated (141, 219, 373, 374, 376, 456, 457). One Michigan farmer's situation is fairly typical. He established annual medic at 10 lb./A when his ridge-tilled corn was about knee-high. The legume germinated, but didn't grow well or provide weed suppression until after corn dry-down in mid-September. The medic put on about 10 inches of growth before winterkilling, enough for effective winter erosion protection (201).

Black medic and two annual medics produced 50 to 150 lb. N/A when interplanted with standard and semi-dwarf barley in a Minnesota trial. Annual MOGUL produced the most biomass by fall, but also reduced barley yields. GEORGE was the least competitive and fixed 55 to 120 lb. N/A. The taller barley was more competitive, indicating that taller small grain cultivars should be used to favor grain production over medic stand development (289).

Midwestern farmers can overseed annual medic or a medic/grass mixture into wheat in very early spring for excellent early summer grazing. With timely moisture, you can get a hay cutting within nine to 10 weeks after germination, and some species will keep working to produce a second cutting. Regrowth comes from lateral stems, so don't clip or graze lower than 4 or 5 inches if you want regrowth. To avoid bloat, manage as you would alfalfa (201).

Annual medics can achieve their full potential when planted after a short-season spring crop such as processing peas or lettuce. Wisconsin tests at six locations showed medic produced an average of 2.2T/A when sown in the late June or early July (399). Early planting in this

window with a late frost could give both forage and N-bearing residue, protecting soil and adding spring fertility. Take steps to reduce weed pressure in solid seedings, especially in early July.

In another Michigan comparison, winter canola (*Brassica napus*) yields were similar after a green manure comparison of two medics, berseem clover and NITRO annual alfalfa. All the covers were clear (sole-crop) seeded in early May after pre-plant incorporated herbicide treatment, and were plowed down 90 days later. Harvesting the medics at 60 days as forage did not significantly lessen their green manure value (373).

**With abundant moisture, medics can produce more than 200 lb. N/A.**

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In the mid-Atlantic at the USDA Beltsville, Md. site, medics have been difficult to establish by over-seeding at vegetable planting or at final cultivation of sweet corn.

### **Pest Management**

Under water logged conditions for which they are ill-suited, annual medics are susceptible to diseases like *Rhizoctonia*, *Phytophthora* and *Fusarium*.

**Burr medic** harbors abundant lygus bugs in spring. It also appears to be particularly prone to outbreaks of the two-spotted spider mite, a pest found in many West Coast orchards (422).

Pods and viable seeds develop without pollinators because most annual medics have no floral nectaries (120).

### **COMPARATIVE NOTES**

**Snail medic** produced about the same biomass and N as red clover when both legumes were spring sown with an oats nurse crop into a disked seedbed in Wisconsin. Yields averaged over one wet year and one dry year were about 1 T dry matter and 60 lb. N/A (141).

Medics can establish and survive better than subterranean clover in times of low rainfall, and are more competitive with grasses. A short period of moisture will allow medic to germinate and send down its fast-growing taproot, while sub-

clover needs more consistent moisture for its shallower, slower growing roots (422). Medics are more susceptible than subclover to seed production loss from closely mowing densely planted erect stalks. Burr and barrel medics are not as effective as subclover at absorbing phosphorus (422).

Medics may survive where true clovers (*Trifolium* spp.) fail due to droughty conditions (422) if there is at least 12 in. of rain per year (292).

### Medics are easy to kill with light tillage or most herbicides.

Medics grow well in mixtures with grasses and clovers, but don't perform well with red clover (422, 263). Once established, black medic handles frost better than crimson or red clover.

GEORGE grows more slowly than yellow blossom sweetclover in spring of the second year, but it starts flowering earlier. It uses less water in the 2- to 4-foot depth than sweetclover, soybeans or hairy vetch seeded at the same time.

**Annual Medic Cultivars.** Species and cultivars of annual medic vary significantly in their dry matter production, crude protein concentration and total N. Check with local or regional forage specialists for cultivar recommendations

**Burr medic** (also called burclover) cultivars are the best known of the annual medics. They branch profusely at the base, and send out prostrate stems that grow more erect in dense stands (422). They grow quickly in response to fall California rains and fix from 55 to 90 lb. N/A, nearly as much as true clovers (294, 422). Most stands are volunteer and can be encouraged by proper grazing, cultivation or fertilization.

Selected cultivars include SERENA (an early bloomer), and CIRCLE VALLEY, both of which have fair tolerance to Egyptian alfalfa weevil (435). SANTIAGO blooms later than SERENA. Early burr medics flower in about 62 days in California, ranging up to 96 days for mid-season cultivars (422).

Naturalized and imported burr medic proved the best type of burclover for self-reseeding cover

crops in several years of trials run from northern California into Mexico in the 1990s. While some of the naturalized strains have been self-reseeding for 30 years in some orchards, Extension specialists say the commercial cultivars may be preferable because they are widely available and better documented.

Established burr medic tolerates shade as a common volunteer in the understories of California walnut orchards, which are heavily shaded from April through November. However, in Michigan trials over several years, SANTIAGO (a burr medic with no spines on its burs) failed to establish satisfactorily when it was overseeded into corn and soybeans at layby. Researchers suspect the crop canopy shaded the medic too soon after planting, and that earlier overseeding may have allowed the medic to establish.

There are at least 10 cultivars of **barrel medic**. Dates of first flowering for barrel medics range from 80 to 105 days after germination, and seed count per pound ranges from 110,000 for HANAFORD to 260,000 for SEPHI (422). A leading new cultivar, SEPHI, flowers about a week earlier than JEMALONG, commonly used in California (251, 422). SEPHI, a mid-season cultivar, has a more erect habit for better winter production, is adapted to high- and low-rainfall areas, yields more seed and biomass than others, has good tolerance to Egyptian alfalfa weevil and high tolerance to spotted alfalfa aphid and blue green aphid. It is susceptible to pea aphid.

**Snail medic** (*M. scutellata*) is a prolific seed producer. Quick germination and maturity can lead to three crops (two reseeding) in a single season from a spring planting in the Midwest (373). MOGUL barrel medic grew the most biomass in a barley intercrop, compared with SANTIAGO burr medic and GEORGE black medic in a four-site Minnesota trial. It frequently reduced barley yields, particularly those of a semi-dwarf barley variety, but increased weed suppression and N and biomass production (289).

In a Michigan test of forage legumes for emergency forage use, MOGUL **barrel medic** produced 1.5 T dry matter/A compared to about 1 T/A for SAVA **snail medic** and SANTIAGO **burr medic** (*M. polymorpha*). Nitrogen production was 66 lb./A

Clark, Andy (ed.). 2007. *Managing Cover Crops Profitably*, 3rd ed. Sustainable Agriculture Network, Beltsville, MD.

for MOGUL, 46 for SAVA and 22 for SANTIAGO. The seeding rate for SAVA medic is 29 lb./A, more than twice the 13 lb./A recommended for clear seedings of MOGUL and SANTIAGO (373, 376).

In a California pasture comparison of three annual medics, JEMALONG **barrel** had the highest level of seed reserves in the soil after six years, but didn't continue into the seventh year after the ini-

tial seeding. GAMMA medic (*M. rugosa*) had the highest first-year seed production but re-established poorly, apparently due to a low hard seed content. All the medics re-established better under permanent pasture than under any rotational system involving tillage (94, 422).

**Seed sources.** See *Seed Suppliers* (p. 195). 📌