ARIZONA COOPERATIVE EXTENSION
THE UNIVERSITY OF ARIZONA
College of Agriculture and Life Sciences

AZ1519 July 2010

# Summer Cover Crop Use in Arizona Vegetable Production Systems

*Guangyao (Sam) Wang and Kurt Nolte*

## Fit and benefit of cover crop

Many vegetable growers in the low deserts of Arizona and California fallow their fields during the hot summer months, providing an excellent window to grow warm-season cover crops that are adapted to the intense desert heat. Cover crops are any ground cover grown to add nitrogen to the soil, suppress pest populations, mitigate soil erosion, and reduce nutrient leaching. Most importantly, growing cover crops can build up and maintain soil organic matter, a major source for sustaining and increasing agricultural productivity. This is particularly important in the desert southwest because soils in the area are typically low in organic matter. In addition, the combination of pest suppression and nitrogen fixation from legumes could be especially useful in organic production systems, where no synthetic pesticides or fertilizers can be used. Despite the benefits of integrating cover crop rotations into commercial production schemes, careful management is required since cover crops can modify the availability of soil nitrogen and other critical nutrients.

## Residue carbon nitrogen ratio (C:N) and breakdown rate

As cover crops decompose, soil microbes increase dramatically in response to the availability of readily accessible plant residues. All soil microbes require nitrogen for the synthesis of proteins and other compounds. If nitrogen in the residue is not adequate for microbial growth, microbes use immediately available soil nitrogen. The ratio between carbon to nitrogen (C:N) in decomposing plant biomass is a critical indicator of the overall process of breakdown and eventual release of nutrients. The higher the C:N biomass ratio, the more soil nitrogen is required to support increased microbial growth due to more carbohydrate availability in plant biomass. Since microbes are better nitrogen competitors than plants, cash crops could be deficient in nitrogen, particularly if the nitrogen uptake period by crop plants falls into a period of high microbial activity. Therefore, when cover crops which produce large amounts of biomass with high C:N ratios are used, the subsequent cash crop would require supplemental nitrogen during growth to meet crop yield potentials. Other factors that could affect the ability of microorganisms to break down organic matter and release nutrients include soil temperature, soil moisture, and other soil properties.

Since the C:N ratio affects the nitrogen release rate from cover crop residues, it is one of the most important indices that should be considered when a cover crop is chosen. Legume cover crops have more favorable C:N ratios (21-35) compared to non-legume cover crops such as Sudangrass and pearl millet (>50). The goal of this report is to provide a brief overview of cover crops which can be readily adopted by Arizona commercial producers. Some characteristics of these cover crops are listed in Table 1. These characteristics and planting rates may vary from location to location, depending on soil conditions, management practices, and seed quality.

Table 1. Biomass yield and other characteristics for several cover crop species in the low deserts

| Species | Crop biomass in 75 days (Tons/A) | Growing period | C:N ratio | N in above ground biomass (lbs/A) | N fixation * (lbs/A) |
|---|---|---|---|---|---|
| Cowpea | 1.5 – 2.5 | March to Sept. | Medium (21-23) | 80 – 130 | 100-150 |
| Lablab | 1.5 – 2.5 | March to Oct. | Medium (30-34) | 90 – 150 | 50-200 |
| Sesbania | 2 – 3 | March to Sept. | Medium (23-30) | 90 – 130 | 60-150 |
| Sudangrass | 3.5 – 6 | March to Sept. | High (50-68) | 60 – 100 | 0 |
| Pearl Millet | 2.5 – 4 | March to Sept. | High (50-60) | 50 – 70 | 0 |

* The amount of nitrogen fixed by legume crops is determined by a number of factors including rhizobial inoculants effectiveness, soil fertility, soil compaction, and soil pH.

## Summer cover crops suitable for Arizona's vegetable production systems

### Cowpea

Cowpea (*Vigna unguiculata*), also called blackeye pea or southern pea, is probably the most commonly used summer legume cover crop in the United States. This crop can also be grown as a grain crop in spring or fall in the southwest. Cowpea is adapted to tropical conditions, can tolerate high temperatures and drought, and can produce about 2 tons/A of dry biomass in 75 days at Maricopa, Arizona. This crop has a favorable C:N ratio and breaks down rapidly. As a legume cover crop, cowpea could fix an average of 175 lbs/A of nitrogen. In a study conducted in Coachella Valley, CA from 1999 to 2004, summer cowpea cover crops increased the yield of the following fall lettuce and spring cantaloupe crop by 22% and 13%, respectively. If planted in July, cowpea starts flowering in mid September in the low elevation deserts of Arizona and southern California. The cover crop should be terminated before seed set to avoid cover crop volunteers in the cash crop. 'Iron Clay' is one of the most common varieties planted as cover crops. A 20-30 inch row spacing and 35-60 lbs/A planting rate are recommended.

Cowpea

### Lablab

Lablab (*Lablab purpureus*) has been studied intensively as a legume forage crop. However, a few characteristics of this crop make it an excellent cover crop for the low deserts. When planted in late spring, the legume grows very well in the hot weather of Arizona. Variety 'Rongai' produced about 2 tons/A of biomass in 60-70 days. The biomass contains 110 lbs of nitrogen in the above ground biomass and has a C:N ratio of 30-34. The crop could also contribute 50-200 lbs/A of nitrogen to the soil. Lablab continued to grow vegetatively without flowering after October in central Arizona, making planting and incorporation dates flexible for growers. A 20-30 inch row spacing and 50-60 lbs/A planting rate are recommended. Lablab grows erect in the early growth stages and climbs if grown with a tall crop.

Lablab

### Sesbania

Unlike cowpea and lablab, sesbania (*Sesbania exaltata*) does not need herbicide applications to be established in weedy fields because of its fast growth and establishment. It is an excellent cover crop in the hot Arizona climate. When planted in late spring, using a 15 inch row spacing at Maricopa Ag Center, this crop covered the ground in less than 4 weeks. In 50 days it grew to 6 feet tall and produced over 2 tons/A of dry biomass with a C:N ratio of 23-30. Nitrogen fixation is estimated to be 60-150 lbs/A for this cover crop. Sesbania did not need inoculants to produce root nodules at Maricopa. Sesbania starts to flower in early September in the low deserts and needs to be cut or incorporated into the soil before seed set at the end of September. Otherwise, volunteer plants could be a problem the following summer. A planting rate of 30-40 lbs/A seed should be used.

Sesbania

### Sorghums

This group of summer cover crops includes sorghum-Sudangrass hybrids, Sudangrass, and forage sorghum. When planted using a 7.5-inch row spacing, Sudangrass or sorghum-Sudangrass hybrid covers the ground in less than 4 weeks. Herbicide input may not be necessary for crop establishment in weedy fields. The crop can be planted in either late spring or summer. If planted in early spring, this crop can be harvested as forage in early summer and the last re-growth incorporated as a cover crop. It produces 3-6 tons/A of dry biomass in 70 days. However, Sudangrass residue has a high C:N ratio and could require several months to break down, depending on soil and environmental conditions. A study in Coachella valley from 1999 to 2003 with summer Sudangrass – fall lettuce – spring cantaloupe rotation found that Sudangrass reduced lettuce yields due to a slow nitrification and nitrogen release rate and possible allelopathic interactions. However, Sudangrass cover crops have shown to increase cantaloupe yields in the following spring because nitrogen released from Sudangrass residue provided cantaloupe with a more stable and higher rate of nitrogen supply. If planted as a cover or rotational crop, the residue should be allowed at least one month to break down. Nitrogen status of the following cash crop needs to be carefully monitored. The most common varieties are 'Piper' Sudangrass and 'Trudan' sorghum-sudangrass hybrid. A seeding rate of 40-60 lbs/A is recommended.

Sundangrass

### Pearl Millet

Pearl Millet (*Pennisetum glaucum*) is a grass that can grow 4-5 feet tall and produces 3-4 tons/A of dry biomass in 60-70 days in Arizona. When planted in late June, flowering began in late August at Maricopa Ag Center. The crop has a deep root system and can grow well with low nitrogen and water input. When used in a vegetable cropping system, pearl millet can use residual nitrogen and reduce nitrate leaching. High C:N ratio also makes this crop a good surface mulch for an extended period. A 20-inch in-row spacing and a planting rate of 5 to 10 lbs/A are recommended for pearl millet.

Pearl Millet

Other warm season cover crops that were studied elsewhere and might be acceptable cover crops in Arizona's vegetable systems include sunn hemp (*Crotalaria juncea*), velvet bean (*Mucuna deeringiana*), German (foxtail) millet (*Setaria italica*), and Japanese millet (*Enchinochloa frumentacea*). Please use the links found in the reference section for more information on these crops. A test plot should be planted before the crop is grown in your farm.

## Choosing a cover crop or mixtures

The most appropriate cover crop species in a specific vegetable system depends on the desired purpose, growing period, and the following cash crop. A legume should be chosen if the desired purpose is to provide the following cash crop with readily available nitrogen or to enhance soil organic matter. If a surface mulch is needed to suppress weeds for a longer period (especially in organic systems) or nitrogen cycling after vegetable crops is needed to reduce nitrate leaching to ground water, then non-legumes with high C:N ratios should be used. The growing period and the duration of the following cash crop should also be considered when choosing a cover crop.

When both nitrogen availability and weed suppression are desired, mixtures of a legume and a non-legume cover crop species can be planted to obtain desired C:N ratios to optimize the benefits of cover crops. When mixing cover crops, the competitive ability (growth rate and plant height as major factors) of each cover crop species needs to be considered to avoid one cover crop outcompeting another. For example, when planting a Sudangrass and cowpea mixture, the proportion of cowpea population

needs to be higher since Sudangrass is a more competitive crop. A mixture with a ratio of 75:25 of cowpea:Sudangrass produced 1.9 tons/A of cowpea and 2.7 tons/A of Sudangrass biomass in two months in Coachella valley, California.

## References


Creamer, N.G. and K.R. Baldwin. Summer Cover Crops. http://www.ces.ncsu.edu/depts/hort/hil/hil-37.html

Murphy, A.M. and P.E Colucci. 1999. A tropical forage solution to poor quality ruminant diets: A review of Lablab purpureus. *Livestock Research for Rural Development.* (11) 2. Available on **http://www.lrrd.org/lrrd11/2/colu112.htm.**

Sustainable Agriculture Network. Managing Cover Crops Profitably, Third Edition. **http://www.sare.org/publications/covercrops/covercrops.pdf.**

UC Sustainable Agriculture Research and Education Program. UC SAREP Cover Crop Resource. **http://www.sarep.ucdavis.edu/ccrop/**

Wang G., M. Ngouajio, M.E. McGiffen, and C.M. Hutchinson. 2008. Summer cover crop and in-season management system affect nitrogen availability and weed density in lettuce and cantaloupe. *Agronomy Journal.* 100, 1587-1593.

Wang G., M. Ngouajio, M.E. McGiffen, and C.M. Hutchinson. 2008. Summer cover crop and in-season management system affect growth and yield of lettuce and cantaloupe. *HortScience.* 43, 1398–1403.



ARIZONA COOPERATIVE EXTENSION
THE UNIVERSITY OF ARIZONA • COLLEGE OF AGRICULTURE AND LIFE SCIENCES

**The University of Arizona**
**College of Agriculture and Life Sciences**
**Tucson, Arizona 85721**



**Guangyao (Sam) Wang**
*Assistant Specialist, School of Plant Sciences/Maricopa Ag Center*

**Kurt Nolte**
*Director, Yuma County Cooperative Extension*

**Contact:**
**Guangyao (Sam) Wang**
**samwang@ag.arizona.edu**



**This information has been reviewed by University faculty.**
**cals.arizona.edu/pubs/crops/az1519.pdf**

**Other titles from Arizona Cooperative Extension can be found at:**
**cals.arizona.edu/pubs**