requiring a ration containing at least 50% total digestible nutrients.

Water-stress associated with the highest plant population and later maturing cultivars greatly reduced grain yield per cm of water.

It can be concluded that use of later maturing cultivars and a closer plant spacing, under prolonged water-stress conditions, decreases water use efficiency of sorghum grain production. When water is not a limiting factor, as in the wet treatment plots, the highest yields of grain and stover will be obtained with higher seeding rates and with later maturing, tall-type cultivars.

## Grain Legumes

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Grain legumes have attracted only minor and sporadic interest of growers during the development of Arizona agriculture. However, several factors are stimulating interest in various grain legume species as potentially valuable crop plants. Firstly, there is a need for alternative crops, which are low water users for Arizona agriculture. Secondly, world demand for grain legumes both for human and animal use has been rapidly increasing and this trend appears likely to continue.

In order for the producer to utilize these market outlets which the statistics say are available there is a need to develop adapted varieties and production practices suitable to Arizona agriculture.

Grain legumes are characterized by seed protein content higher than those of cereal crops, and despite lower seed yield, protein yield/acre is generally higher than that of cereals. In addition, grain legumes may need only small applications of nitrogenous fertilizers, since the nitrogen requirements for the plants may be supplied through symbiotic nitrogen fixation.

### Garbanzo Beans

Current high market prices have placed considerable attention on initiation of garbanzo production in Arizona. From an economic standpoint, the garbanzo is a crop that competes directly with wheat. Advantages of growing garbanzos include its low water requirements and the ability to be grown in areas infested with wild oats.

Silty soils are recommended for garbanzo development. Clay-type soils are unfavorable due to their high water-holding capacity, which may result in root rot and yellowing of the foliage. Even though they do well at high pHs, garbanzos are very susceptible to salt damage, which is expressed as yellowing and aborted fruit and flowers.

Even though garbanzos are legumes, 44-55 lbs. of nitrogen at planting, in addition to seed inoculation is recommended. It is estimated that for production of one ton of garbanzo, 110 lbs., N, 40 lbs. P + 15 4 lbs. K are used.

Good water management is important in garbanzo production. Excessive moisture results in high mortality. Furrow irrigation appears to be the most adequate for garbanzos due to increased efficiency incidence of root rot.

A good pre-plant irrigation is necessary to leach salts and achieve a good moisture depth. In soils with adequate texture the next irrigation generally occurs when 20-30% of the moisture is used. From the plant view, irrigation should occur at flower initiation, first capsules, last flowers and grain filling.

Both chemical and mechanical weed control measures are necessary. Critical competition periods for weed control are during the first 40 days. Failure to control weeds at this time will result in production losses or yield reduction. Weeds appearing after this time do not severely affect the plants, but may cause problems at harvest.

Serious diseases of garbanzo include root rots caused by Rhizactonia solani, and Fusarium; damping off caused by Pythium, Rhizactonia and Fusarium.

The most important insect pests in garbanzo include the boll worm, army worms and the miner worm.

As garbanzos near maturity, the plants turn yellow and the capsules turn brown. Harvesting should start when 50% of the capsules are brown. The beans are harvested at about 10% moisture. After cutting and windrowing, a grain combine with a pick-up device can be used.

## Mung Beans

Mung beans are legumes that are used for both human and animal consumption world-wide. They perform well under high temperatures and require comparatively warmer temperatures for adequate growth than soybeans. Mung beans are more drought resistant than cowpeas. The short season nature of mung beans may be a useful drought escape mechanism. However, in order to attain highest yields adequate moisture is necessary. Mung beans are extremely susceptible to excess soil water moisture immediately after planting and prior to emergence. Once established they are more tolerant of water-logging even though prelonged periods may reduce nitrogen fixation.

Mung beans can be grown successfully over a wide range of soils: they do not perform especially well on shallow soils although they are often grown on them. Mung beans grow well on soils that are moderately alkaline and saline.

Depending on cutural practices followed 110,000-150,000 plants/acre may be optimal.

Mung beans, although characterized as a deep-rooted, drouth tolerant crop are highly responsive to irrigation. Adequate water in both pre-flowering and flowering stages is required to plants to bear the maximum number of pods. Moisture stress to mung beans particularly before and during flowering stages decreases yields significantly.

There are few serious disease affecting mung beans, although Cercospera leaf spot and powdery mildew may cause problems.

Potential pests of mung beans include - green bugs which feed on developing pods and seeds, and pod chewing caterpillars (Heliothis spp.). Mung beans are quite susceptible to nematodes on light sandy soils.

Mung beans are suitable for direct heading with standard grain harvesting equipment. The plants which have their pods at the top of the plant, present few problems except when lodged. In general, mung beans should be harvested as soon as possible after maturity to prevent drying seed which could result in severe cracking during harvest. Careful handling procedures are necessary with harvested seed to prevent cracking. Seed should be stored at a moisture content below 13%.

Research on grain legumes is fairly new and has generaly been geared to adhoc introduction and testing of accessions. Although efforts are being directed towards plant breeding, any new industry would be based on grain legume cultivars not developed especially for Arizona agriculture. There is a need to direct more research in plant improvement through breeding for local adaptation. Also, there has been little agronomic research and definitive information concerning planting dates, plant populations, moisture requirments and soil fertility of these potentially promising grain legumes.