December 28, 1993

To: Carol Frate, Mike Smith, Shirley Smith, Shannon Mueller, Mick Canevari

From: Don Helms (Fax 916-752-4906)

RE: California Garbanzo Growers Guide (?)

Dear Garbanzo Fans and Authors:

Find attached a beginning draft on garbs that I have written from information collected over the years in my files and from my own experience with them beginning in 1967. I have had several conversations with Shirley, and have incorporated information provided by Mike Smith and Mick Canevari (attached).

The county and surrounding areas that each of you represent, is a distinct growing area or region within Calif. You have the most knowledge of specific grower practices in your region. It is important that general statements do not mislead growers in any region. Suspecting there are no two growers who do things the same, and to avoid menu boredom, I used what is known about garbanzo history, variety recommendations, general cultural practices, and diseases and insects that might affect everyone.

Your help in editing what I started, and writing new sections or paragraphs is needed. I have numbered the paragraphs for identity, for phone conversations or when faxing new paragraphs, paragraph re-writes, or additional sentences back to me. This may also be helpful in dividing up work. Once we have a complete finished draft we can decide on a format and how to get it printed.

I think the history and evolution of varieties section is important because it provides an important lesson of disease introduction and spread. Growers and handlers will always be tempted (grass is greener sort of thing) to import seed. We are currently faced with the possible introduction and spread of Ascochyta, Fusarium, and Macrophomina.

GARBANZO BEAN DESCRIPTION

1 The large seeded garbanzo grown in California is a Legume with the scientific name Cicer arietinum; L., subgroup "Kabuli". The name "garbanzo" is Spanish from two Basque words; grau, meaning grain, and antuzua, meaning dry. In English speaking countries, the Garbanzo is often known as the chickpea.

2 The garbanzo plant is native to Western Asia. Its culture in Egypt and Greece dates back to ancient times. It is an important part of the diet of peoples of India, Northern Africa, and Spain, ranking next to cereals. It has become a characteristic food of Latin peoples, who have carried it to all parts of the world.

3 The garbanzo bean crop in California was one of the heritages of the Spanish Missions. This production dates back to the founding of the Spanish Missions. 'White Spanish' was the most widely grown variety in California through the 1960's. The term "white" is misleading, the beans were actually a light straw-color.

4 The garbanzo plant is a branched herb growing one to two feet tall, with a tap root that is 2 to 6 feet long. The leaves can be pinnately compound with 7 to 15 pairs of oval-toothed leaflets, or simple and have a unifoliate leaf structure. The flower is similar in form to the pea flower, white, self-pollinated, and borne on inflorescences that originate from stem axes. The pods are about one inch long and about one-half inch wide and contain one or two seeds. The light green herbage is covered with hairs that secrete a substance high in malic and oxalic acid. Prolonged contact may damage clothing and cause a skin rash.

EVOLUTION OF VARIETIES

5 In the 1960's and 1970's the garbanzo industry on the Central Coast of California was afflicted with a soil borne disease problem which was investigated and thought to be caused by the root rot pathogen Fusarium solani f. sp. pisi. In response selections were made from a root rot field planted to the landrace variety 'White Spanish'. The selections were tested in this root rot field for serveral years and in 1979 the variety 'Mission' was multiplied and certified. At the same time, a second variety selected for better seed quality was multiplied and certified from selections within 'White Spanish' and named 'UC-5'. During this period of time Fusarium wilt was not identified as a problem on garbanzos in California.

Several seasons before 'Mission' and 'UC-5' were released in
6 1979, growers and seed handlers brought in cultivars from Portugal, Spain, and Mexico to be tried as varieties. It is probable that several Fusarium wilt pathogens were introduced on seed from one or more of these foreign locations. When the identified California races were compared with known foreign races, the results indicated that two California races showed similar differential response with foreign country races.

The Fusarium wilt spread throughout the Central Coast
7 growing region which was essentially devastated. The industry was temporarily saved by the introduction of a variety from Mexico called 'Surutato' in 1982. 'Surutato' had been bred for resistance to Fusarium wilt and replaced 'Mission', 'UC-5', and 'White Spanish' which were all susceptible. Although resistant to Fusarium wilt, 'Surutato' proved to be low yielding and a problem canner in comparison with earlier yields and quality of 'Mission', and 'UC-5'. Since Fusarium wilt was much more devastating to garbanzos than root rot caused by Fusarium solani, work was concentrated on developing new varieties resistant to Fusarium wilt.

CURRENT VARIETIES, AREAS OF PRODUCTION, AND ADAPTATION

'UC-27', released in 1988, is the varietal name for the
8 Fusarium wilt resistant garbanzo line derived from a cross of wilt susceptible 'UC-5' x a wilt resistant Mexican variety 'Sonora'. 'UC-27' is recommended for growing in the Central San Joaquin Valley as a winter crop, to be sown from mid-November to early January. During the growth period the plant type and size of 'UC-27' will resemble 'UC-5' with a full open canopy that provides good ground coverage. In late May the plant senesces and drys in the warm early summer valley temperatures. The branches arch inward leaving the mature plant upright and suitable for direct harvest. Initially the direct combining of garbanzos with grain combines in furrowed fields in the San Joaquin Valley resulted in considerable field losses with the old variety 'Surutato'. This was due to its prostrate growth habit, which extended down into the furrows. 'UC-27' provides excellent plant posture at maturity, seed size uniformity, low clean-out percent, yield and seed quality, across valley environments from year to year.

'UC-15', released in 1988, is the varietal name for the
9 Fusarium wilt resistant garbanzo line derived from a cross of wilt susceptible 'UC-5' x a wilt resistant Mexican variety 'Sonora'. 'UC-15' is recommended for growing in the Central Coastal areas of California, specifically in the counties of San Luis Obispo, Santa Barbara, and in the Salinas Valley in Monterey County, as a summer crop to be sown from late April through May. It is well adapted to these areas, with appropriate duration for spring/summer dry-land cultivation as well as for cultivation with supplemental irrigation. In these cooler high moisture climates, cutting, windrowing, drying, and harvesting, as used with other dry bean types, works very well. Cutting and windrowing operations should be early in the morning when high moisture conditions help prevent pod shattering. The crop should be dry enough for threshing in one to two weeks after cutting.

Both varieties are public varieties developed by the
10 University of California Davis.

CULTURAL PRACTICES AND PLANTING

Garbanzos can be field planted every month of the year
11 being limited only by winter rains, and moisture retaining soil types, however, to achieve maximum production April 20 through May summer plantings and November 15 to January 15 winter plantings have been very successful.

Planting rates used by growers will vary considerably, from low plant populations per acre on dry-land production to very high plant populations per acre on double row 38" beds with irrigation. The wide range of soil types from heavy clay to silty sand, will also impact planting rate and irrigation frequency. Fertile, well-drained soils, with light to medium texture are ideal. Heavy clay soils need to be carefully managed for irrigation and winter drainage. A typical planting of three to four plants per foot on 30 inch beds is an ideal population.

Plant seeds 1-2 inches deep into spring rain fed or pre-
12 irrigated moisture. Seeds are often planted 3 to 5 inces deep depending on depth of moisture. It is very important that garbanzo seeds be treated with fungicide(s) to protect them from soil fungus. The use of fungicide seed treatments can drastically reduce the viability of rhizobium inoculum if there is direct contact with the seed. For this reason inoculum is often applied adjacent or just below the seed row at planting as a side dress operation separate from the seed boot.

13 Land perpetration for garbanzo beans is very similar to land preparation for any grain crop or bedded row or vegetable crop. Depending on location, soil type, rainfall patterns, weed problems, and disease considerations the following tillage operations are commonly employed. In coastal and central valley areas discing, plowing, or deep ripping (when perennial bind-weed is a problem-not recommended on sloping soils) are the usual primary tillage practices following a previous crop or before the start of winter rains. For spring plantings, when the winter rains are finished, the soil may be disced and then field-cultivated several times for a fine soil tilth and to control winter weeds before planting. For fall plantings the soil may be disced and then field-cultivated several times in preparation for furrowing before winter rains set in.

14 A current practice is to apply a starter fertilizer before planting. Example: 30 gallons of 4-10-10 or comparable mix. Phosphorus is particularly important to growing a winter legume. The addition of nitrogen fertilizers have not been used since it is believed that enough is produced by the plant itself when seed is treated with the appropriate "Cicer" Rhizobium bacteria at planting. Apply an inoculant of Rhizobium bacteria at planting to insure proper nitrogen fixation of nodules during the winter and spring months. Rhizobium bacteria inoculation may not always be necessary depending upon the quality of your soil, and the previous number of years in garbanzo production. Poorly drained, high ph, alkaline, or problem soils may be very hostile to Rhizobium bacteria, requiring a yearly application.

15 Weeds can be a serious problem with this crop. Garbanzos grow very slowly during winter months, thus making them a poor competitor to winter weeds. Current herbicides registered for use include: Treflan, Prowl, Dual, and Lasso applied pre-plant incorporated. Poast is also registered for post-emergence grass control if needed. Goal herbicide gained registration in December of 1992 and is applied as a broadcast spray immediately following planting. Goal is used pre-emergence to crop only and should not be applied once beans have begun to emerge. Spring germination of nightshade sp. can be a serious problem and must be managed with cultivations, hand hoeing or by a layby application of an effective herbicide.

16 In coastal areas where garbanzos are grown as a summer crop, tillage is the main weed control strategy since surface moisture is generally lacking at this time of year and germination of new weeds is minimal.

Control of field bindweed, Convulvulus arvensis in garbanzos
17 can be a major problem. Deep tillage with chisel plows or rippers help control bindweed, and cultivating between rows when plants are small also helps to minimize weed competition. The use of shielded sprayers to apply MCPA or glyphosate between rows helps control heavy infestations to this weed.

For winter valley plantings a pre-plant irrigation is
18 recommended in early fall to fill the soil profile. Garbanzo beans are deep rooted and need deep soil moisture for maximum root extension and development. If winter rainfall is insufficient an irrigation in the spring may be required. In very light sandy soils a well timed irrigation will be necessary. If an irrigation is required it is best to apply water during pod development or pod filling stage of growth. In fall planted garbanzo fields flowering begins in March and pods develop and fill through late April. The main point to remember is garbanzo roots should not grow into dry soil nor should they be regularly saturated with water.

INSECTS AND VIRUSES

Pod boring insects, such as armyworm and corn earworm,
19 should be monitored from before flowering through pod filling. A foliar application of liquid sevin provides good control.

Soil pests can cause damage to germinating seed and
20 seedlings. The most troublesome are the symphylid or garden centipede, cutworms, and wireworms. These live below ground and cause extensive damage to underground plant parts by boring into germinating seeds or into the roots and stems of plants. They usually have a 1 to 3 year life cycle and overwinter in the soil. Seed treatment and ground baiting are the best controls.

Large populations of lygus bugs and stinkbugs can cause
21 considerable damage to seeds when they are in the green or immature stages of development. The larval stage of the leafminer feeds in the plant leaves, leaving galleries. If not treated, heavy infestations can cause plant death.

Aphid transmitted viruses are a problem on garbanzos.
22 Aphids cause injury to garbanzos by sucking sap from plants and thereby introduce virus infections. Although the aphids do not survive very long because of the plants acid secretions, the virus infection has occurred. The number of virus infected plants may be up to 50% in growers fields and 100% in small research plots. Aphid vectors over-winter on weed hosts, in grain fields, and in

winter vegetable fields and bring the viruses into the garbanzo fields. In areas where winter plantings are common, incidence is correlated with aphid flights in the periods of October to November and March to May (Garb table #4). The amount of plant loss varies with the amount and timing of the infection, the viruses involved, and the level of tolerance of the variety. Years having little or no winter rainfall (drought), may result in a very modest aphid and virus pressure until the late part of the growing season.

Six viruses were identified as attacking garbs in California
23 and there is evidence of many more which remain unidentified at present (Garb table #5). The viruses which have been identified were infecting plants grown at UC Davis, California. It is possible that different locations or environments may have different viruses and aphid vectors.

In order to determine the best planting dates for winter
24 garbanzos several planting date studies were conducted at the West Side Field Station. In general it was determined that the best plant health and seed yield was obtained when winter garbanzos were planted between November 15 and January 15. Sharp decreases in yield and plant health were experienced in October and February plantings.

Garb table #4 APHIDS THAT TRANSPORT VIRUSES TO GARBANZOS

Acyrthosiphum pisum	Pea aphid
Aphis craccivora	Cowpea aphid
Myzus persicae	Green peach aphid

Garb table#5 APHID TRANSMITTED VIRUSES INFECTING CALIFORNIA GROWN GARBANZOS

Beet Western Yellow Virus (BWYV)
Subterranean Clover Red Leaf Virus (SCRLV)
Legume Yellows Virus (LYV)
Alfalfa Mosaic Virus (AMV)
Cucumber Mosaic Virus (CMV)
Lettuce Mosaic Virus (LMV)

DISEASE

25 There are numerous garbanzo seedling diseases, root rots, and vascular wilts that occur in specific local areas when environmental conditions are ideal. At this time we will focus on diseases known to be more prevalent, and have more potential to cause problems, on garbanzo production in California.

26 Pythium ultimum, a damping-off disease at germination, causing seed decay and seedling shoot rot. Pythium thrives particularly in cool, wet soils that occur in low spots of a field where there is too much soil moisture at germination. Seed bed irrigation "to irrigate up" after planting dry may cause severe Pythium problems in some soils. Damping-off is controlled with seed treatment fungicides.

27 Rhizoctonia solani can limit production in fields that have a high population of the fungus in the soil. Under certain conditions garbanzos following previously infected crops could develop severe infections. This organism invades the below-ground root (hypocotyl) producing a sunken oval lesion. The color of the lesion is usually brick red and often expands around the root. Most root destruction occurs in warm soils during the first 6 to 8 weeks after germination. The best method of control would be the use of seed treatment fungicides recommended for this pathogen.

28 Macrophomina phaseoli is known as ashy stem blight, or charcoal root rot. Infection begins on the bean stems at or below soil level and extends down into the roots and up into the branches. Lesions enlarge turning ash grey with numerous black fruiting bodies on the grey background. Infection is usually on young plants, which usually die before setting seed. This disease is most serious during periods of high irrigation moisture, high temperatures, and when the disease fungus is present in the soil. Macrophomina phaseoli was reported in one field, which was severely affected, in the northern San Joaquin valley delta area in the 1991-92 growing season. In 1984 a preliminary garbanzo cultivar observation trial at the West Side Field Station also developed a severe infection.

Macrophomina phaseoli is reported to cause crop damage in
29 soils with temperatures above 80 degrees F. This disease has also been reported to be seed-borne on may other crops including cotton, sunflower, sorghum, and corn. Garbanzos are produced on cooler soils on the Central Coast, the Salinas Valley and in some years the San Joaquin Valley of California where the fungus is present but does not cause disease When these seeds are planted in areas with high soil temperatures Macrophomina phaseoli may infect the plants and cause severe crop loss. Use locally grown seed from known disease free fields. Imported seed from other areas, states, or countries may be carrying this disease.

White mold, Sclerotinia sclerotiorum attacks the above
30 ground plant stems, lower leaves and aborted flowers during prolonged wet and humid conditions. Infection of stems and branches will cause the affected plant parts to wilt and die. The blackened sclerotia formed in the mold infection fall to the ground. White mold or "Sclerotinia" attack is mainly determined by soil borne sclerotia from a wide range of previous crops. Since white mold sclerotia can survive many years in the soil, crop rotation generally does not prevent infection.

The development of white mold is greatly influenced by
31 prevailing weather conditions and certain agronomic practices such as irrigation, plant density, and plant growth characteristics which are all closely linked with the life cycle of the pathogen. A thick dense plant growth provides a micro climate of cooler temperatures, and high moisture beneath the plant canopy where conditions are favorable for the disease. The disease may cause serious yield losses during wet, cool periods in the middle of the growing season. The best control is to avoid late extensive irrigation, and maintain high beds that keep lower plant parts and tops of the bed dry.

Fusarium Wilt - Fusarium oxysporum f. sp. ciceri is the most
32 damaging vascular disease known world-wide including California. Since the introduction of 'UC-27' and 'UC-15' the problem has been considerably lessened in central coast areas. The two new varieties are resistant to several identified races and isolates. A virulent race 8, potent to 'UC-27' and 'UC-15' affects these two varieties and has been isolated from several fields along the central coast region of California. The distribution within fields is spotty, but nevertheless this virulent strain is there and will

probably spread in time. So far virulent race 8 has not become established to the extent of other known races.

33 Fusarium wilt can be observed in susceptible plants within 25 days of planting and can attack and kill the plant any time up through pod set. Initially the plants become stunted, growing slow, with drooping and yellowing of the leaves. Slicing the plant stem diagonally, a dark discoloring of the xylem or center of the plant stem is observed. The typical symptom of Fusarium wilt is a wilting plant that gradually looses color and dies.

34 Central San Joaquin valley soils are believed to be free of Fusarium wilt that infects garbanzos. Fusarium wilt is spread through 1) Contaminated soil on equipment moved from one field to another (soil-borne) and 2) Fusarium pathogens carried in and on seed coats (seed-borne). These two types of transmission can introduce specific pathogens and their array of races into soils that are not contaminated. Right now seed-borne contaminated seed is the most serious threat to all California growers. Ask your seed supplier if his seed was grown on Fusarium wilt free soils. Use locally grown seed from known disease free fields. Imported seed from other areas, states, or countries may be carrying this disease.

35 Fusarium root rot - caused by Fusarium solani f. sp. pisi attacks the hypocotyls and lateral roots of the plants. Early infection is characterized by elongated reddish streaks and eventually a reddish-brown lesion surrounds the entire root. There is noticeable root decay and plants are usually stunted and low yielding. This Fusarium root rot is very specific to garbanzos and field peas. In San Luis Obispo county where winter peas are grown and followed by spring garbanzo plantings several infected fields have been observed.

36 Ascochyta rabiei - Ascochyta blight is caused by a fungus which is selectively pathogenic to garbanzo plants. Northern Idaho and eastern Washington have been severely affected by Ascochyta blight. Infections require cool weather and extended periods of plant wetness generally provided by rainstorms and sprinklers. Symptoms of Ascochyta blight are brown lesions on leaves, stems, and pods which contain circles of small brown fungal structures called pycnidia, which produce spores for further field transmission of the disease. The disease is spread to new areas by planting infested seed, which may not have visual symptoms. There have been no reports of this fungus in

California. Use locally grown seed from known disease free fields. Imported seed from other areas, states, or countries may be carrying this disease.

HELP WITH DISEASE IDENTIFICATION

37 We do not recommend trying to identify a specific disease from a list of symptoms that have been published. There are many variations and complex situations where diseases can exhibit identical symptoms. The best procedure to follow if you suspect your plants are diseased is to contact your local County Farm Advisor for help. Generally plant samples and laboratory cultures need to be taken and evaluated to identify a specific pathogen.

HARVESTING AND CANNING QUALITY

38 'UC-27' and 'UC-15' have good canning characteristics regardless of where the seed is grown within their recommended areas of production. The seed before canning is a light straw color with good uniform seed and a good seed-coat crinkle. 'UC-27' and 'UC-15' have a uniform seed size after canning, a uniform light golden color (compared to pale white of 'Surutato') after canning, and no starch leakage due to splits and cracks. The time of cutting or direct harvest is important in obtaining high seed quality. All pods should be yellow or dry at time of cutting. Cutting or direct combining immature or green pods and seeds will cause darkening and discoloration of seeds when canned and thus lower acceptability by canners. When dry, garbanzo seeds are tougher than many other beans, and can be threshed with regular grain combines equipped with windrow pick-up attachments for windrows or a regular cereal grain header with lifter guides for direct harvest. To maintain canning quality it is necessary to avoid cracking or splitting the seeds. The main adjustments to check would be cylinder clearance and speed.

MARKETING AND YIELDS

Garbanzo beans are marketed similar to other types of dry
39 beans. World price is affected by production from Mexico, Spain, and Turkey. California varieties are mainly sold for canning, which requires large seed size (54 beans per ounce) and a uniform light golden or cream color. To date, California varieties have met or exceeded canners' requirements.

In three years of San Joaquin Valley production, commercial
40 fields absent of severe weed, disease or soil problems have averaged 16 to 24 cwt per acre.

GARBANZO PRODUCTION

by
Michael J. Smith
Farm Advisor

PRODUCTION AREAS

For successful production garbanzos, like peas, require a cool climate with only a few light frosts. The central coastal counties of California, Santa Barbara, San Luis Obispo, and Monterey have grown this crop for years. The principal areas of production have traditionally been within 10 miles of the seacoast. This is due largely to soil types, rainfall, and better blossom setting conditions. With proper tillage and soil moisture conservation, or irrigation, garbanzos are being grown successfully in inland areas.

In the coastal area, planting occurs between April 20 and the end of May; garbanzos are a summer grown crop. Inland plantings, particularly those in the Central Valleys of California, are planted in the Fall, generally late October to the end of November, and grown as a winter crop. Ten to thirty inches of water are required to successfully produce the crop.

SOILS

Soil types with good drainage and high water-holding capacity are preferred. Germination and emergence problems can occur in cold, wet soils. Garbanzos can be grown on lighter soils, but with lower yields. Soil compaction can be an important factor, due to the nature of soils best adapted to chickpea production (high water holding soils with a high clay content). Seed is often planted as deep as 6 inches in order to reach moisture that places which in an area that may also have a "tillage pan" where roots have a great deal of trouble penetrating.

LAND PREPARATION

Land preparation for garbanzo beans is very similar to land preparation for any grain crop. Depending on location, soil type, rainfall patterns, weed problems, and disease considerations the following tillage operations are commonly employed. In coastal areas discing, chisel-plowing, or deep ripping (when perennial bind-weed is a problem) are the usual primary tillage practices before the start of winter rains. After winter rains are finished the soil may be disced and then field-cultivated several more times before planting to control winter weeds and to work the soil down to a fine tilth. In interior areas tillage practices are similar, except that deep ripping is not recommended on sloping soils, and all tillage is completed prior to the major winter rain season.

PLANTING

A planting rate of 35 to 50 pounds of seed per acre is used depending on seed size of the cultivar planted; heavier seeding rates are necessary when large seeded cultivars are used in order to maintain proper plant populations (≅175,000 - 200,000 plants/acre). Studies indicate that, independent of varieties, the number of plants per acre is the most important factor, all other things being equal, contributing to high yields. Garbanzos in coastal California are usually planted flat, in rows 24 to 30 inches apart and 4 to 8 inches between plants within a row. In commercial areas four or eight row "Ventura" type, or "plate" planters are used. Garbanzos are also planted on beds, with 1 or 2 rows per 30" to 40" bed, and may be planted flat with a grain drill, in 12" to 14" rows.

SEED VARIETIES

White Spanish, actually a "Landrace" rather than a "Cultivar", is generally accepted as the original variety of garbanzos grown in California. Over the years new varieties have been developed, mostly due to the infestation of much of the growing area with both fusarium wilt (*Fusarium oxysporum f. sp. ciceri*) and fusarium root rot (*F. solani f. sp. pisi*). UC-5 is a selection from White Spanish which is resistant to fusarium root rot. Sonora 80 and Surutato 77 were developed in Mexico and are both highly tolerant to fusarium wilt. Both Sonora 80 and Surutato 77 have been crossed with UC-5 to increase the yield capabilities of the Mexican cultivars and to increase the disease resistance and quality characteristics of the California cultivars. Two new California cultivars have recently been released as a result of this breeding program. UC-15 is a wilt tolerant type with UC-5 yield characteristics and "Mexican" quality, developed for the traditional coastal environment. UC-27 has the same yield, disease, and quality attributes as UC-15, but has a more erect growth habit, which makes it more adapted to the interior valleys and irrigated culture and to direct combining.

SEED TREATMENT

Garbanzos are legumes, which indicates that, with the help of rhizobium bacteria, they are able to "fix" atmospheric nitrogen and make it available for plant growth. In order for the garbanzo bean to properly "fix" nitrogen it must be inoculated with the proper Rhizobium bacteria. After properly inoculated garbanzos have been planted once, many soils will maintain an adequate bacterial population.

Rhizobia inoculum is available from:

Nitragen Company,
3101 West Custer Avenue
Milwaukee, Wisconsin 53209

Telephone contact can be made at: (414) 462-7600. ①

Garbanzo seed is often treated with fungicides and insecticide to protect against seedling-attacking insects and diseases. The use of fungicide seed treatments can drastically reduce the viability of rhizobium inoculum if there is direct contact for more than 2 hours. For this reason inoculum is often ~~applied in~~ alongside the seed row, at planting, as a separate operation, using a "Gandy" type metering device.

PESTS and DISEASES

Several soil pests can cause damage to germinating seed and seedlings. The most troublesome is the symphylid (garden centipede). Cutworms and wireworms can also be damaging to the crop. Aphids appear to be vectors for a number of viral diseases, and large populations of lygus bugs can cause considerable damage to the seed. The larval stage of the leafminer feeds in the plant leaves, leaving galleries. If not treated, heavy infestations can cause plant death. Corn earworms can attack the plants from the beginning of pod-set until maturity; heavy infestations can reduce yields 50%.

Fusarium wilt and fusarium root rot are serious disease problems in garbanzos in California. Fusarium wilt can be observed in susceptible plants within 25 days of planting and can attack and kill the plant at any time up through pod set. The initial symptom is a drooping of the ends of the leaves and within 2-3 days drooping can be seen on the entire plant Occasionally only one side of a plant is affected; ultimately plants thus affected die. The plant slowly fades to a dull green and gradually all the affected leaves turn yellow, then straw-colored. Investigation of the xylem tissue shows a dark discoloring from the soil line up into the stems, sometimes clear to the tip. Roots of affected plants will be clear and normal looking. Fusarium root rot exhibits similar above-ground symptoms as fusarium wilt except that one seldom sees one side of a plant wilt with F. solani. In contrast to F. oxysporum infected plants, those infected with the root rot organism show the xylem tissue of the roots to be discolored and absence of discoloration in the stem xylem. Both of these organisms are soil borne and are independent of garbanzos as a host plant. This means that once a soil has been infected it will remain infected for extended periods of time and crop rotation as a means of control is not effective. Although good field and seed handling sanitation can slow the spread of these diseases, the only really effective means of dealing with them is through the use of resistant cultivars. It is hoped that the newly released varieties mentioned above, and those released in the future will maintain at least a high degree of tolerance to these diseases.

It must be stressed that factors other than diseases can significantly contribute to stand losses in garbanzo plantings. Poor germination and seedling vigor can be of major importance but can be controlled by planting certified seed which has guaranteed germination. The incidence of fusarium infections in garbanzos, and other beans, has been shown to be higher in compacted soil. In these situations the roots grow laterally and remain in an area of high pathogen inoculant.

WEEDS

Control of field bindweed (*Convulvulus arvensis*) in garbanzos can be a major problem. Deep tillage with chisel plows or rippers help to control bindweed, cultivating between rows, particularly when the beans are small, also helps to minimize weed competition. The use of shielded sprayers to apply MCPA or glyphosate between rows helps to control heavy infestations of this weed. In the coastal areas where garbanzos are grown as a summer crop, tillage is the main weed control strategy since surface moisture is generally lacking at this time of year and germination of new weeds is minimal. In the

interior and irrigated growing areas (winter cropping area), weed control has been difficult. The recent registration ("24C" - "Special Local Needs" label) for *Oxyflurofen*, "Goal®" shows promise for the control of mustards (*Brassica sp.*) and wild radish (*Raphanus sp.*) as well as many other broadleaf and grassy weeds. There also appears to be interest on the part of some herbicide manufacturers to evaluate materials for possible garbanzo registrations.

HARVESTING

In coastal areas garbanzos mature from late-August through mid-September. The stage of maturity at cutting time is critical to maintaining a quality product, from both canning and seed stand-points. Cutting too early results in an excess of dark off-color beans that lower market value; cutting too late invites excessive shatter of pods and lowered yields. In coastal areas the plants are cut with tractor-mounted "bean-knives", usually 4 rows at a time, and a trailing windrower puts 8 rows together in a single windrow. Cutting-windrowing operations are done early in the morning when high moisture conditions help prevent shattering. The crop will be dry enough for threshing in one to two weeks after cutting. Garbanzos are tougher than many other beans and are threshed with a regular grain combine equipped with a windrow pick-up attachments, -- however proper combine adjustment is necessary to avoid cracking the seed. In irrigated and interior dryland areas the usual procedure for harvesting is to direct combine garbanzos when they are dead ripe. Yields of 700 to 1500 lbs/acre can be expected for dryland beans; 1500 to 2000+ lbs/acre are possible for irrigated crops. Harvested seed from commercial plantings must be taken to seed processors for cleaning and grading. After cleaning and grading the chickpeas are usually stored at the processor's warehouse until sold for canning, dry "package" beans, or planting seed.

①Trade names ape provided as examples only. No endorsement or criticism of these or other products is implied.

Issued in furtherance of Cooperative Extension work, Acts of May 8 and June 30, 1914, in cooperation with the U.S. Department of Agriculture. Kenneth R. Farrell, Director of Cooperative Extension, University of California.

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1993 CULTURE AND COSTS TO PRODUCE GARBANZO BEANS

Mick Canevari
San Joaquin County

Soil Requirements - Fertile, well-drained soils, light to medium texture. Heavy clay soils need to be carefully managed for irrigation and winter rainfall drainage.

Planting Dates - November to February, depending on location, soil type and winter conditions. This time frame also avoids aphid flights that vector viruses.

Harvest Dates - Late June to mid July. Harvesting has been very successful with a standard grain combine and direct harvest of dry standing bean plants. Cutting, windrowing and harvesting as used with other dry bean types has also worked well. This method can facilitate an earlier harvest. Bean plants must be dry before cutting or darkening and discoloration of seed will occur.

Varieties - UC 27 is the variety we most commonly use in the central valley. UC 15 is a sister line to 27 and designated as a more coastal variety. Both varieties are public varieties developed by University of California Davis.

Seeding Rate - 60-80 lb/acre depending on seed size. Three to four plants per foot of bed is an ideal population. Plant seeds 1-2" deep into pre-irrigated moist soil. Seeds should be treated with fungicide, and apply an inoculant of rhizobium bacteria at planting. This will insure proper nitrogen fixation of nodules during the winter and spring months.

Fertilizer - The current practice is to apply only a starter fertilizer before planting. Example: 30 gal. 4-10-10 or comparable mix. Phosphorus is particularly important to a winter growing legume. The addition of nitrogen fertilizers have not been used since it is believed that enough is produced by the plant itself when seed is treated with rhysobia bacteria at planting. Further research needs to be done in this area.

Weed Control - Weeds can be a serious problem to this crop. Garbanzos grow very slowly during the winter months, thus making them a poor competitor to winter weeds. Current herbicides registered for use include: Treflan, Prowl, Dual and Lasso applied preplant incorporated. Poast is also registered for postemergence grass control if needed. Goal herbicide gained registration in December of 1992 and is applied as a broadcast spray immediately following planting. Goal is used preemergence to crop only and should not be applied once beans have begun to emerge. Spring germination of nightshade sp. can be a serious problem and must be managed with cultivations, hand hoeing or a layby application of an effective herbicide.

Insects - Insects have not been a serious problem to date. However, one should be aware of aphid flights in the spring since they are vectors of virus. Currently there are no threshold levels established for treatment of aphid. Pod boring insects, such as armyworm and cornear worm, should be monitored during pod filling.

Irrigation - A preplant irrigation is recommended in early fall to fill the soil profile. Garbanzo beans are deep rooted and need deep soil moisture for maximum root extension and development. One irrigation in the spring may be required if winter rainfall is insufficient. In very light sandy soils an irrigation can be expected. Caution should be taken not to flood beans since injury or plant death may occur. If an irrigation is required it is best to apply water early at the pre-blossom or early blossom stage of growth. In fall planted garbanzo beans flowering begins in March.

Disease - We have only limited experience for garbanzo culture in the central valley. The diseases known to be a potential problem include: pythium, or damping off disease at germination, and white mold (*sclerotinia sclerotiorum*) during prolonged wet and humid conditions in the spring. Damping off is controlled with seed treatment fungicides. In the 1991-92 growing season one field in the delta area was severely affected due to ashy stem blight (*macrophomina phaseoli*). This disease is most serious during periods of high moisture and high temperatures when irrigating and the disease is present in the soil.

Yields - In the three years of San Joaquin County production, commercial fields absent of severe weed or disease problems averaged 18-20 cwt/acre. The highest recorded yield was 30 cwt uncleaned.

Marketing - Garbanzo beans are marketed similar to other types of dry beans. World price is affected by production from Mexico and Turkey. Locally they are sold for canning and dry package. Canning quality requires large size (54 beans/oz) and a light cream color. To date, our quality has met or exceeded canners' demand.