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COWPEA PRODUCTION BULLETIN FOR SENEGAL

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INTRODUCTION

Cowpea (*Vigna unguiculata* (L.) Walp.) was domesticated in West Africa and has been cultivated there for thousands of years. It was distributed to other parts of Africa and other continents by the migration of people and trade. West Africa still has the major area of cowpea cultivation in the world.

In Senegal the area of cowpea production during 1980 to 1994 varied from 42,000 to 128,000 ha with a mean of 73,000 ha. National production of dry cowpea grain also fluctuated between 9,000 and 70,000 tons with a mean of 27,000 tons during these years. The major areas of cultivation are the regions of Louga (48%), Diourbel (25%) and Thies (20%) in the peanut basin. Cowpea is an important rainfed crop in the Louga Region. It has greater adaptation to drought than the other available rainfed crops, pearl millet, and peanut, which have been severely damaged by drought in most years since 1968. Within these regions substantial areas of cowpea are cultivated in the departments of Louga (22%), Kebemer (17%), Mbacke (14%) and Tivaouane (12%). Small areas of cowpea are cultivated in the River Region (5%), and eastern Senegal and low Casamance (2%).

Cowpea is mainly grown to produce dry grains but, during the "hungry period" in August and September, substantial quantities (about 25% of total production) are consumed on the farm or marketed as a fresh vegetable called "green pods" which is equivalent to "southern peas" in the United States. The grains and fresh peas have a high protein content (about 25% on a dry weight basis), and an amino acid profile that complements the protein in rice, millet, maize or whea.t. A combination of 75% cereal and 25% cowpea, on a dry weight basis, provides sufficient protein for adults if sufficient grain is eaten to satisfy caloric requirements. Children and mothers require more protein in their diets. Cowpea hay is an effective feed for livestock in the dry season since it has a higher protein content than grass hay.

Scientific studies of cowpea in Senegal were initiated in the 1950's at CNRA, Bambey. A germplasm collection was developed based upon cowpea accessions collected throughout Senegal and obtained from other African countries. The collection is divided into early cowpea accessions, which flower before late September when sown at the beginning of the rainy season (about July) at Bambey, and cowpea accessions whose flowering is delayed by long days, such that they flower after September when sown in July at Bambey. The early accessions are suitable for production of pods during the rainy season, whereas the late accessions only are suitable for hay production or relay cropping with pearl millet. Agronomic and breeding studies resulted in the development of a set of adapted varieties and management recommendations by the early 1970's. Since 1980, ISRA has conducted a program of cowpea breeding, agronomy, plant pathology, entomology, and socioeconomics with collaborative assistance from personnel at the University of California, Riverside through the USAID-funded Bean/Cowpea Collaborative Research Support Program administered by Michigan State University. This cowpea production bulletin represents a synthesis of the results of the studies conducted prior to 197.5 and since 1980, and is designed to assist scientists, extension personnel and development agencies working on the improvement of systems for the production and utilization of cowpea in Africa. A bulletin written in French also is available from ISRA. Examples are presented of agricultural chemicals that have been used on cowpea production in Senegal. No specific recommendations are made concerning the use of agricultural chemicals and all such use must follow all regulations of the Government of Senegal and all recommendations of the manufacturer.

RAINFA.LL AND SOIL CONDITIONS

Water Reauirements

Cowpea is well-adapted to hot, semiarid climatic zones. Since 1968 there has been a drought in the northern peanut basin of Senegal with annual rainfall being only 63% (at Louga) and 70% (at Bambey) of the averages from 1918 to 1967. During the dry period from 1968-94, the average rainfalls at Bambey and Louga were 473 and 283 mm/year, respectively. The water requirements for maximum yields of a 75-day (period from planting to maturity) cowpea variety were estimated to be 370 and 430 mm at Bambey and Louga, respectively. Consequently, in most years there has been sufficient rainfall at Bambey to meet the maximal water requirements of a 75-day or even a 90-day cowpea variety. At Louga, in contrast, there has not been enough rainfall since 1968 to provide the maximal water requirements of a 75-day cowpea cultivar. However, certain new varieties with a cycle length of 60 to 64 days (such as CB5, Barnbey 21, and Melakh) have produced yields as high as 1 ton/ha in the Louga Region in years with only 200 mm of rain when crops of pearl millet and peanut produced very little food. Cowpea is extremely sensitive to excess water and must be grown in areas where it is not flooded for extended periods.

Soil Reauirements

Sandy soils (Dior and Dior - Deck) with free drainage are suitable for cowpea production. These soils provide good aeration which is essential for cowpea root function and plant growth, and can be rapidly prepared for sowing by manual or animal-draft harrowing.

VARIETIES

In the main cowpea production zone in the northern and tenter-north areas of the peanut basin the following varieties have been recornrne:nded: 58-57, Ndiarnbour, Mougne, Barnbey 21, and CB5. In addition, two new varieties were released, Mouride in 1992 and Melakh in 1993. Each of these varieties has specific characteristics whi.ch make them useful in specific areas of the main production zone and specific environmental conditions (refer to Table 1 for the agronomic descriptions of these varieties).

Several local varieties are grown by farmers in the main cowpea production zone. Ndiaga Aw, and Patate have large brown seed and are grown in the departments of Tivaouane and Kebemer. Marne Farna has large white seed with a black eye. Ndout, which is very photoperiod sensitive, and Baye Ngagne have large seed with grey-blue speckles and a cream colored background, and are grown in the departments of Thies and Barnbey.

In low Casamance and the eastern region variety 59-9 is recomrnended, and some late maturing local varieties are grown by farmers. The local variety Matam is grown on the edges of the Senegal River as the flood water retreats.

Two forage varieties are available, 58-74 and 66-35, but they only were used to a limited extent by farrners up to the date when this bulletin was written in 1996.

Tabie i. Cowpea Varieties Available for lise in Senegai

Name	Origin & Year of Introduction	Seed Characteristics		Days to Maturity	Plant Habit	Resistances to Biotic Stresses
		Weight(mg)	Color			
58-57	Landrace 1962	120	Cream with dark brown eye	75	spreading	Bacterial Blight
Ndiambour	CNRA 1969	160	Cream with light brown eye	75	spreading	Bacterial Blight
Mougne	CNRA 1969	150	Grey speckles on cream	75	spreading	Bacterial Blight
Bambey 21	CNRA 1975	180	White	62	erect	Mosaic Virus*
CB5	Univ. Calif. 1941	200	White with black eye	60	erect	Mosaic Virus*
Mouride	CNRA/CRSP 1992	160	Cream with light brown eye	66	semi-erect	Bacterial Blight, Mosaic Virus*, *Striga*, and Cowpea Weevil
Melakh	CNRA/CRSP 1993	190	White with brown eye	64	erect	Bacterial Blight, Mosaic Virus*, and Cowpea Aphid

*Common strains of cowpea aphid-borne mosaic virus.

CULTURAL METHODS

Cropping Systems

More than 95% of cowpea production in Senegal is from sole-crops. In the northern and center-north areas early to medium-cycle cowpea varieties are grown as sole-crops in annual rotation with pearl millet and peanut. Some relay intercropping of cowpea with pearl millet occurs in the departments of Bambey and Thies. For relay intercropping, photoperiod-sensitive varieties of cowpea are sown into pearl millet fields in mid-August and, if there is sufficient rain, are ready for harvest by mid-November. In most years since 1968, there has been insufficient rain for relay-intercropped cowpeas in the departments of Bambey and Thies. Some cowpea is grown along the edges of the Senegal River using the decrue system. In this system, seed is planted as the flood water recedes and the plants grow on stored soil moisture during the cool and dry season from November through March. In low Casamance, long-cycle cowpea varieties are grown.

Crop management methods are described for sole-cropping in the main production zone in the northem and tenter-north areas of the peanut basin.

Land Preparation

In most cases land is prepared for sowing at the beginning of the rainy season by manual or animal-draft harrowing. Much of the soil in the tenter-north area can develop high bulk densities, and it would be advantageous to plow the land at the beginning of the rainy season because this results in stronger root growth and higher yields of cowpea, pearl millet or peanut. However, most farmers do not have the plows, draft animals or tractors to enable them to plow the land in suffcient time, at the beginning of the season, so that they also can plant early. An alternative approach would be to plow the land just after the harvest, at the end of the rainy season, but this only is effective if there is sufficient moisture in the soil. Where crop residues or manure are available they would be most effective in improving soil fertility and structure if they are incorporated by plowing. Useful production of cowpea can be achieved if plowing is not possible and only harrowing is used to prepare the land.

Fertilization

One thousand kg of dry cowpea grain contain the equivalent of 50 kg of nitrogen (N), 17 kg of phosphate (P_2O_5) and 17 kg of potassium oxide (K_2O). The whole plant including seed, foliage and roots could contain double these amounts. Cowpea can fix substantial quantities of atmospheric nitrogen in the root nodules formed in association with rhizobia, which are soil-borne bacteria. All of cowpea needs for nitrogen could be met by nitrogen fixation; unfortunately, this process only begins to become active about three weeks after planting. Consequently, in soils that are very infertile it has been recomrnended that an application of 9 kg N/ha be made just prior to planting. Cowpea roots also form associations with mycorrhizae, which are soil fungi. These associations help the cowpea to take up P_2O_5, zinc and copper from infertile soils. These associations also take about three weeks to become established and a pre-sowing application of 30 kg P_2O_5/ha with 15 kg K_2O/ha has been recommended for infertile soils.

A commercial fertilizer is available in Senegal with $N:P_2O_5:K_2O$ of 6-20-l 0. The amount of this fertilizer that has been recommended for cowpea grown in infertile soil is 150 kg/ha. The fertilizer should be applied just before sowing and should be incorporated to a depth of at least 10 cm by harrowing.

Cowpea does not need fertilizer if the soil is at least moderately fertile, and any available commercial fertilizer or manure should be applied to the pearl millet crop in the rotation. Pearl millet has greater needs for nitrogen and is more responsive to fertilizer and manure than cowpea. Pearl millet grown the year following a cowpea crop will benefit from the improved soil nutrient conditions resulting from the rhizobial and mycorrhizal associations with the root system of the cowpea. An effective annual rotation consists of cowpea, pearl millet, peanut, pearl millet, cowpea, etc., with 50% of the cultivated area for pearl millet, 25% for peanut, and 25% for cowpea.

Sowing

Cowpea is mainly sown into wet soil at the beginning of the rainy season, after a rain of at least 15 mm. Since 1968, sowing often has occurred in July in the northern and tenter-north areas. Cowpea should be sown as soon as the soil is wet enough to establish the crop because it has substantial drought resistance during the vegetative stage but needs substantial supplies of water during early flowering and early pod development. Early sowing enables the crop to escape the late-season droughts which often occur.

Sowing is done by hand with two or three seeds per planting hole or, preferably, with a peanut seeder having a disk with 8 holes of a size that will deliver one or two seeds per hole. For maximum yields, row spacing of 50 cm is recommended with 50 cm between planting holes for the more spreading varieties: 58-57, Mougne and Ndiambour; and 25 cm between plants for the more erect varieties: Bambey 21, CB5, Mouride, and Melakh. The 8 hole disk delivers seed every 33 cm. The amount of seed required is about 10 to 30 kg/ha depending upon the spacing and the variety. In circumstances where seed supplies are limited, cowpea should be planted at wide spacing. For the more spreading varieties the maximum spacing that should be used is 75 cm x 75 cm with two seeds per planting hole which requires only 5 to 7 kg/ha. For the more erect varieties the maximum spacing recommended is 50 cm x 50 cm with two seeds per planting hole which requires 12 to 16 kg/ha. Plant emergence and survival can be enhanced if a chemical seed treatment is used. One treatment that has been used is Granox (containing 10% each of captafol, benomyl and furadan). Chemical seed treatments can be toxic to humans and must be applied carefully using protective gloves and face masks, and treated seed must not be eaten.

Weeding

Weeds should be controlled early to prevent them from either growing tall and shading the cowpeas or depleting soil moisture and nutrients. About two weeks after the ***cowpeas*** emerge any weeds should be killed with a push hoe or an animal-draft cultivator. This weeding should be repeated about two weeks later. Weeding is most effective if it is followed by dry weather which facilitates the death of the weeds. If the parasitic weed ***Striga gesnerioides*** is present in the fields the only effective control method is to use the resistant cowpea variety Mouride. If any ***Striga*** plants emerge they should be pulled up by hand, removing their roots, and this should be done prior ta flowering to prevent

propagation of *Striga* seeds. If *Striga hermonthica* is present in a field, it can damage pearl millet and sorghum, but not cowpea. Growing cowpea in this field may cause suicida1 germination of the seeds of *Striga hermonthica* and provide some protection to the following pearl millet or sorghum crops.

Disease Control

The major disease problems of cowpea in the tenter-north and northem areas of Senegal result from infection with two seed-borne organisms: bacterial blight *(Xanthomonas campestris* pv *vignicola)* and cowpea aphid-borne mosaic virus, which can substantially reduce yield.

Bacterial blight is transmitted from infected seedlings to adjacent plants by rain drops and causes chlorotic patches (orange with a yellow halo) and necrotic patches on the leaves. The pathogen also can cause cracking and cankers on the stem and peduncles. The only control is to use varieties with resistance to bacterial blight, such as Mouride, Melakh, Mougne, Ndiambour and 58-57. Bambey 21 and CB5 are very susceptible to bacterial blight and seed fields of these varieties must not have significant infection with bacterial blight.

Cowpea aphid-borne mosaic virus is transmitted by cowpea aphids *(Aphis craccivora)* and causes distortion and mottling of the leaves and can stunt the plants. The only control is to use varieties with resistance to cowpea aphid-borne mosaic virus, such as Mouride, Melalch, Bambey 21 and CB5. Recent research indicates that some virulent strains of cowpea aphid-borne mosaic virus are present in Senegal which cause mosaic symptoms on cowpea, all varieties are susceptible to the disease, and it is seed-borne. Several other mosaic viruses are present in Senegal which can cause leaf mottling symptoms in these varieties, including southem bean mosaic, cowpea severe mosaic, and cowpea mottle virus, but these other viruses are not widely distributed. Fields used for seed should not have significant infection with mosaic viruses, especially variety 58-57 which is very susceptible to cowpea aphid-borne mosaic virus.

Charcoal rot *(Macrophomina phaseolina)* can cause substantial dan-rage to cowpea when soils became dry and hot. The only potential solution to this problem, at this time, is to grow pearl millet for one or more years in infested soils because recent research indicates that this can reduce the levels of the sclerotia of the disease organism in the soil.

In wet conditions *Choanephora* species can infect green pods at the point where petals remain attached to young pods resulting in a black wet pod rot. The only solutions to this problem are to sow later or use varieties which flower later so that flowering does not coincide with periods of intense rainfall. This problem mainly occurs in wet locations and seasons.

When pods become crisp they become susceptible to rain damage which causes molds to proliferate in the pod walls and grains. The solution to this prolblem is to harvest pods as soon as they are crisp, dry them under the sun, and then thresh the pods and put the grain in a place where they will not be damaged by rain. Variety CB5 is very susceptible to this type of dry pod rot.

Insect Pest Control

T'he major insect pest at the beginning of the growing season is hairy caterpillar (*Amsacta moloneyi*). The occurrence of hairy caterpillar is sporadic but it can be particularly damaging in the drier part of the cowpea production zone in Louga Region. Waves of hairy caterpillar can completely destroy fields of cowpea seedlings by eating their leaves. If the wave of hairy caterpillar is late the cowpea plants may have sufficient vigor and leaf production to out-grow and survive the attack. The onl y control method, at this time, is to spray a. contact insecticide on the hairy caterpillar when it attacks cowpea seedlings (Thymu135 which contains endosulfan has been used for this purpose).

Cowpea aphids (*Aphis craccivora*) can cause problems at any time in the growing season but are most damaging when they infest seedlings during dry weather. Cowpea aphids feed on the phloem and are particularly damaging to young growing points causing plants to be stunted and they also transmit viral mosaic diseases. Strong genetic resistance to cowpea aphid is available but, to date, it has only been incorporated into the new variety, Melakh. When other varieties are used it is necessary to rely on natural biological control or if the plants are young or heavily infested to use sprays of insecticides (Dimethoate and Thymu135 have been used for this purpose).

In the wetter part of the cowpea production zone (south of Bambey) the most damaging insect pes: is the flower thrip (*Megalurothrips sjostedti*). These are small shiny black insects that are most readily observed in flowers. They can cause substantial damage, however, before flowers are produced by feeding on floral buds. Strong genetic resistance to flower thrips is not yet available. The resistance to flower thrips in TVx 3236 and other IITA materials, that are available at this date, is not sufficiently strong to protect cowpea against the flower thrips present in wetter parts of Senegal. The new variety Melakh may have moderate resistance to flower thrips. Where flower thrips are present an insecticide spray can be applied when the plants begin to produce floral buds, and are showing feeding damage on the stipules (Decis has been used for this purpose, and contains deltamethrine). A second spray may be applied 7 to 10 days later if there are 9 or more adult thrips per flower. For the major cowpea production zone north of Bambey, use of insecticides to control flower thrips often is not necessary but can increase grain yield in some cases.

Where insecticides are used, extreme care must be taken in all phases of the operation including disp osal of containers, and all regulations of the Government of Senegal and all recommendations of the manufacturer must be followed.

Harvesting

Pods should be harvested as soon as they become crisp. Pods usually are harvested by hand, without pulling up the plant, to provide additional opportunities for the plant to produce pods. Early erect varieties may only require one harvest, whereas, indeterminate and spreading varieties may procluce several flushes of pods. Pods usually are dried in the sun to facilitate threshing, and winnowing, which also are done manually. Dry pods must be protected against rain or they will develop pod molds which can totally destroy the grain.

Storage Methods

Cowpea storage weevil eats cowpea grain making distinctive round holes. Damage is apparent about 2 to 3 months after harvest and virtually all of the grains may have holes by 6 months. Consumers have a strong aversion to grain that has been damaged by weevils, but it still can be effective as seed; although, germination percentage may have been reduced.

Protective methods must be used if grain is to be stored longer than 2 months. Adult beetles lay eggs on the pods and grain both in the field and after threshing. The eggs hatch and the larvae bore into the grains and complete their development within them. Adults emerge from the grain through the characteristic round exit holes made by the larvae. The adults mate and then lay about 50 eggs on other grains and the cycle begins again. An individual life cycle is completed in 3 to 4 weeks. Consequently, from a modest initial infestation many of the grains may have either weevil eggs on them or holes within them after two months in storage and two cycles of weevil reproduction.

Several methods of protection are available. After threshing, grain can be disinfested. The most practical method for farmers is to use a solar heater. Late in the morning of a sunny day, a black plastic sheet is placed on a layer of dry grass, which reduces, transfer of heat into the soil. A layer of grains are placed on the black plastic and this layer of grains is covered by a transparent plastic sheet which is held in place with logs or bricks. Within four hours the grain will become hot enough (57 to 70°C) to kill all stages of the cowpea weevil without harming the germination capability of the seed. The grain should be removed from the solar heater in the late afternoon of the same day. An alternative method is to fùmigate cowpea grain in large plastic bags using phostoxin but this must be done carefully because a short exposure ta phostoxin gas can kill people.

After disinfestation or even without disinfestation, grain can be stored in air-tight containers consisting of metal drums. These containers not only prevent re-infestation but they also can kill all stages of the weevil present on or in the grain if they are kept closed for at least 2 months. During this period, respiration by the seed and any insects that are present reduces the oxygen concentration and increases the carbon dioxide concentration to levels that kill the weevils but do not harm the germination capability of the seed. An alternative method, for storing small quantities for use as seed the following year, consists of mixing grain with. an equal volume of ash, which has been sieved to remove wood and other large particles, placing the mixture into a clay pot, and then covering the top with a layer of ash. Another method has been used where large quantities of cowpea grain are to be stored in sacks. This consists of using the insecticidal powder K-othrine which must be thoroughly mixed with the grain. Any use of phostoxin and K-othrine must follow all regulations of the Govemment of Senegal and all recommendations of the manufacturer. One new variety of cowpea, Mouride, has a moderate level of genetic resistance which reduces damage caused by cowpea weevil but it is still necessary to use other protective measures when grain of this variety is to be stored more than two months.

Marketing

There is a free market for cowpea in Senegal. Prices for dry grain are lowest just after the harvesting of the main crop in October, but they progressivelly increase and can attain high levels by July. Varieties with large white or cream seed are preferred for export and making processed foods,

which require cowpea flour or grits, and are suitable for most uses. Local varieties with brown seed are preferred in some local dishes because of their flavor and the color they impart to the food. During August and September, relatively high prices can be obtained for cowpea as a fresh vegetable called "green pods" which are about double the prices received for dry grain. The varieties most suitable for use as green pods are Melakh, Bambey 21, and CB.5 because they produce pods early, when the price is high, and have good pod and seed quality. Fresh cowpeas sometimes are shelled and placed *in* plastic bags for sale. Cowpeas keep fresh for a longer period, however, if left in the pods, and a common cooking method is to boil the pods and then people shell the pods just prior to eating the cowpeas. Prices for cowpea for use as seed can be high in June, but the seed must have a high germination percentage and it must be pure and not contain seed of other varieties. Ideally, seed should be produced in large fields to reduce contamination by cross pollination or seed mixing during harvest. There should not be significant levels of bacterial blight or cowpea aphid-borne mosaic virus in fields used for seed because these diseases would infect the next crop.

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