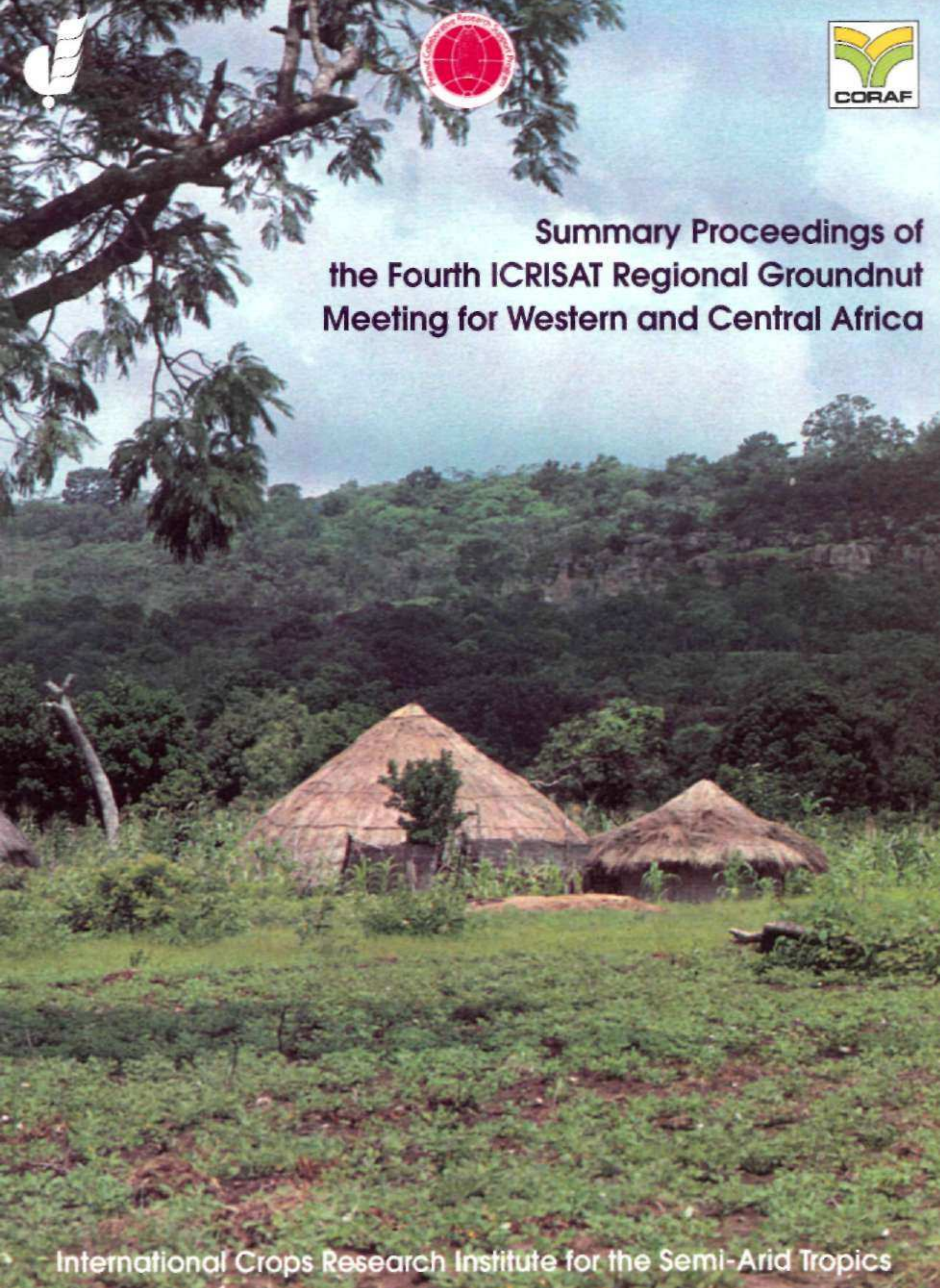
Summary Proceedings of the Fourth ICRISAT Regional Groundnut Meeting for Western and Central Africa



International Crops Research Institute for the Semi-Arid Tropics

Abstract

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Representatives from Benin, Burkina Faso, Central African Republic, Chad, Congo, Cote d'lvoire, France, Gambia, Ghana, Guinea, India, Madagascar, Mali, Niger, Nigeria, Senegal, Sierra Leone, Togo, and USA attended this Meeting which was organized as part of the National Agricultural Research Systems (NARS)/ICRISAT consultation process for effective collaboration. Cosponsored by ICRISAT, the Conference des responsables de la recherche agronomique africains (CORAF), and Peanut Collaborative Research Support Program (Peanut CRSP), the Meeting is a testimony to the cooperation between ICRISAT and other agencies working in the western and central Africa region.

The proceedings contain summaries of papers presented on agronomy, breeding, and crop protection and recommendations to improve and stabilize groundnut production in the region.

Summary Proceedings of the Fourth ICRISAT Regional Groundnut Meeting for Western and Central Africa

29 Nov to 2 Dec 1994

ICRISAT Sahelian Center, Niamey, Niger

Edited by

F Waliyar

ICRISAT

International Crops Research Institute for the Semi-Arid Tropics

Patancheru 502 324, Andhra Pradesh, India

1996

About ICRISAT

The semi-arid tropics (SAT) encompasses parts of 48 developing countries including most of India, parts of southeast Asia, a swathe across sub-Saharan Africa, much of southern and eastern Africa, and parts of Latin America. Many of these countries are among the poorest in the world. Approximately one-sixth of the world's population lives in the SAT, which is typified by unpredictable weather, limited and erratic rainfall, and nutrient-poor soils.

ICRISAT's mandate crops are sorghum, pearl millet, finger millet, chickpea, pigeonpea, and groundnut; these six crops are vital to life for the ever-increasing populations of the semi-arid tropics. ICRISAT's mission is to conduct research which can lead to enhanced sustainable production of these crops and to improved management of the limited natural resources of the SAT. ICRISAT communicates information on technologies as they are developed through workshops, networks, training, library services, and publishing.

ICRISAT was established in 1972. It is one of 16 nonprofit, research and training centers funded through the Consultative Group on International Agricultural Research (CGIAR). The CGIAR is an informal association of approximately 50 public and private sector donors; it is co-sponsored by the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP), the United Nations Environment Programme (UNEP), and the World Bank.

Sponsors

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Organizing Committee

F Waliyar, B R Ntare, A Ba, R Schilling

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Welcome Address

A M B Jagne[1]

Ladies and Gentlemen,

It is my privilege to welcome you, on behalf of Dr K Harmsen, Executive Director, ICRISAT Western and Central Africa Region, to the Fourth Regional Groundnut Meeting for Western and Central Africa. We feel deeply honored by your presence at the ICRISAT Sahelian Center and would like to express our gratitude to you all for responding to our invitation to participate in this Meeting, and for your willingness to share your experiences in groundnut research. It is through the exchange of ideas and experiences, such as we hope to have in this Meeting, that we can make rapid progress in removing farmers' constraints to groundnut production. We take this opportunity to extend our sincere gratitude to the Conference des responsables de la recherche agronomique africains (CORAF) and Peanut Collaborative Research Support Program (CRSP) for cosponsoring this Meeting.

The First Regional Groundnut Meeting, held in 1988, analyzed the main constraints to groundnut production and defined researchable issues. The discussions and recommendations guided us in formulating our research objectives in western Africa. Subsequent meetings, held at 2-year intervals (1990 and 1992), provided opportunities for groundnut researchers in the region to share their knowledge on the status of groundnut research and production in the various countries of the region, and to review progress.

As we are all aware, groundnut production in western Africa has declined over the past two decades. A revival of production seems however, both possible and desirable, as groundnut remains both a food and a cash crop. Such a revival will require a well-coordinated and sustained research program in which we should all participate as partners.

This Meeting is taking place at an opportune time, when ICRISAT is in the process of restructuring its research agenda, in response to external and internal environments which require a radical change in how we operate. One important step in this restructuring exercise was to consult with the Directors of National Agricultural Research Systems in the region. At the consultation meeting, held in Niamey, 7-8 Sep 1994, we presented our Medium-Term Plan and research agenda for 1994-98. The present Meeting can be seen as a continuation of this consultative process. Your contributions and suggestions will no doubt guide us in designing and implementing a research agenda that is in line with the aspirations of groundnut farmers and the national goals of the groundnut-producing countries in the region.

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1. Regional Administrator, ICRISAT Western and Central Africa Region, ICRISAT Sahelian Center (ISC), BP 12404, Niamey, Niger.

It is our hope that this Meeting will pave the way for increased collaboration between the various institutions that are represented here to attain our common objective of sustainable production.

I wish you success in your deliberations and an enjoyable stay in Niger.

Agronomy and Cropping Systems

Groundnut Agronomy in the Central African Republic

R P Yakende[1]

Groundnut is generally intercropped with two or three cereals (maize, sorghum, pearl millet) throughout the country. Research on the crop is carried out under a matrix system with research programs as the primary units of management at the Institut centrafricain de recherche agronomique (ICRA) which was established in Apr 1994. On-farm and on-station trials are generally conducted. The main results of research carried out recently on groundnut agronomy are given below.

- Short-duration varieties: CN 115, Flower 113 A, and QH 243 C gave higher average yield (2580 kg ha^{-1}) than the control variety 21 E that has already been released to farmers.
- Long-duration varieties: There is no significant difference in yield among the three varieties RMP 15, RRN 14, and 57-42. All the three gave average yield of 4500 kg ha^{-1}. As these results are at variance with those observed in the previous season, the trial should be replicated for confirmation of results. Trials involving various sowing dates for maize and groundnut in monocropping and intercropping with and without fertilizers were carried out. The main objective of these trials was to determine the optimal sowing date for each crop in the intercrop because it had been observed in previous experiments that:
  - groundnut production is badly affected if it is intercropped with fertilized maize; and
  - maize production is badly affected if it is not fertilized when it is intercropped with groundnut.

Main results of groundnut trials

The trials showed that the first sowing date (average pod yield of 1405 kg ha^{-1}) was better than the second (980 kg ha^{-1}), irrespective of the cropping system (monocrop or intercrop) used, with or without fertilizer. A 10-day delay in sowing led to a pod yield loss of 425 kg ha^{-1} (30%). Yield was higher in monocropping (1655 kg ha^{-1}) than in intercropping (725 kg ha^{-1}). The effect of fertilizer was not significant except for an unconfirmed gain of 210 kg ha^{-1}.

Main results of maize trials

In terms of yield, there were significant differences between various treatments which revealed the superiority of such factors as the first sowing date, monocropping

1. Institut centrafricain de recherche agronomique (ICRA), BP 122, Lakouanga, Bangui, Central African Republic.

(3875 kg ha^{-1}), and fertilizer application (3605 kg ha^{-1}) over the second sowing date, intercropping (1740 kg ha^{-1}), and no fertilizer application (2010 kg ha^{-1}).

It is recommended that in a groundnut/maize intercrop, if groundnut is the principal crop, it should be sown 10 days before maize and if it is the other way round, maize should be sown 10 days before groundnut, but without any fertilizer.

Aspects of Groundnut Agronomy in Southern Congo

M D N'zemba[1]

Research on groundnut agronomy is mainly carried out at the Centre de recherches agronomiques of Loudima. Some of the important results of experiments conducted recently at this Center are:

- Yield is significantly reduced—without exception—if sowing is delayed by more than 15 days after the onset of the first rains. This confirms the importance of early sowing.
- The following conclusions were drawn from trials on the mechanization of groundnut harvesting:
  - There is very little scope for mechanized harvesting in southern Congo as the soil contains over 60% clay and climatic uncertainties are severe. Yield losses are high when soil humidity is poor. Losses of up to 1.12 t ha^{-1} have been recorded in certain cases.
  - Dormant varieties could be used by farmers willing to wait for optimum soil humidity for mechanized harvesting.
- Samples from farmers' harvest revealed the presence of aflatoxins of up to 10.8 ppb 15 days after the harvest was left in the field for drying. The drying period in the field should be reduced to control such high levels of aflatoxin contamination.
- Use of resistant varieties of groundnut could be an alternative solution to the aflatoxin problem. In our future work we anticipate evaluating the level of contamination in the second-stage harvest, following the staggering of harvest operations.
- Groundnut trials are too localized. It is, therefore, necessary to set up a network of multilocational trials so that different options of cropping techniques adapted to the ecological environment of various users can be offered.

1. Centre de recherches agronomiques de Loudima, BP 28, Brazzaville, Congo.

Groundnut Agronomy in Cote d'Ivoire

A Adou[1]

In Cote d'lvoire, like all grain legumes, groundnut is grown in family holdings. But, compared with other cash crops, its cultivation is negligible, because of the low price it fetches; its yields are low as the production techniques used at present in most parts of the country are inefficient.

However, groundnut is the only legume that is commonly consumed in villages. It is grown in all parts of the country, and especially in the South throughout the year. But such factors as the use of low-yielding varieties, low plant density, poor germination rate, weeds, diseases and pests, and storage problems were found to be the main constraints to groundnut production in a survey conducted in 1985.

The survey helped to give guidelines to overcome such problems through multidisciplinary research. One of the suggestions was to set up a 'Crop Intensification On-farm Trial' at Lataha (Korhogo). The objective of this trial was to test plant response to different levels of intensification in the farmer's plot. The trial has helped identify some practical and effective ways to improve groundnut production:

- It is useless to increase the sowing density without applying additional fertilizer in this region.
- Replacing the local variety with RMP 91 is profitable as RMP 91 performs well under all conditions, even when no fertilizer is applied.
- As crop losses due to foliar diseases (rust, leaf spots, and rosette) are very high in this region, research should focus on this problem.
- Treating seeds before sowing is such an easy and inexpensive operation that it should be recommended irrespective of its effects on production. It would ensure uniform plant stand, avoid re-sowing, and reduce the work load.

1. Institut des Savanes, 01 BP 635, Bouake, Cote d'lvoire.

Effect of Dolomite on Phosphorus Nutrition of Groundnut Grown on Ferralitic Soils in the High Plateau Regions of Madagascar

R Rakotoarisoa[1]

In a trial to study the effect of the application of dolomite on groundnut yield and yield components, and also on the plant's P intake, a groundnut crop was grown on acid soils in the High Plateau regions of Madagascar.

The results of the trial showed that, compared with the control, the effect of dolomite was most significant when phosphatic fertilizer was added to it (500 kg^{-1} of dolomite + 50 U ha^{-1} of phosphate). At the same time, the shelling percentage and the seed quality were found to be better than the control. In addition, the P content of the groundnut leaves significantly increased.

1. Departement de recherches agronomiques, BP 1444, Antananarivo 101, Madagascar.

Irrigation Management near the Senegal River: Physiological Approach to Groundnut Cultivation

D J M Annerose, P Clouvel, and A Mayeux[1]

Senegal has considerable hydro-agricultural resources near the Senegal River; these facilities give to the region a significant potential for agricultural production.

In the villages of these regions, farmers generally use gravity or flow irrigation through a system of irrigation by rotation, which does not necessarily meet the crop's requirements.

Determining water requirements of the plant will be a significant advance towards an understanding of the required quantity and frequency of irrigation.

The method we adopted was based on the hypothesis that the temperature of the plant canopy (Tc) depends on the transpiration capacity of the plant, and hence on its capacity to absorb water available in the soil.

A linear correlation was observed between the growth in the temperature differential, temperature of the crop canopy (Tc), minus air temperature (Ta) and the vapor pressure deficit (VPD). On a well-irrigated plot, the maximum evapotranspiration, i.e., the gap between the Tc and Ta, increases with VPD in the course of the day, with a peak at 1300. This gap decreases on plots subjected to drought stress. The Crop Water Stress Index (CWSI), an indicator of stress, for a given plot can be calculated for each VPD value.

This method was validated through a comparison of reliable stress indicators (leaf water potential, stomatic conductance, photosynthesis). The comparison also helped to define CWSI of 0.3 as the threshold beyond which irrigation is required.

The application of this method in on-farm situations reduced the frequency of irrigation without decreasing significantly the pod or haulm yield. The method was applied with the help of remote temperature monitoring of irrigation from the 30th day after sowing.

This result confirms that determination of the water requirements of the crop by remote temperature monitoring can be an effective method for economic use of water. Moreover, the method is so simple that it could be used for other crops.

1. Centre de cooperation internationale en recherche agronomique pour le developpement (CI RAD)/ Institut senegalais de recherches agricoles (ISRA), BP 53, Bambey, Senegal.

Seasonal Differences in the Performance of Groundnut Cultivars in Sierra Leone

A Sesay[1], A Yarmah[2], and M K Kabia[2]

In Sierra Leone, groundnut is grown exclusively as a rainfed crop. Traditionally, a single crop is grown in the uplands during the rainy season (May to Nov). This crop is sown at the beginning of the rains. However, a recent trend among farmers is to sow a second crop after harvesting, around Sep. Thus, a new production system involving two cropping seasons—a major season (May to Aug) and a minor season (Sep to Dec)—is being adopted. The second crop has to depend largely on moisture stored in the soil. The performance of groundnut cultivars grown in the major and minor seasons was evaluated. It was found that the cropping season significantly affected crop phenology, growth, and productivity. Time to 50% flowering was delayed, and plant height was 43% lower in the minor season than in the major season. Pod yield declined by an average of 43 to 54% from the major to the minor season. In the minor season, haulm yield was reduced by 58%, the number of mature pods by 57%, crop growth rate by 40%, and partitioning by 13%. The responses appear to have been the result of low moisture availability and high evaporative demand during the minor season. The results suggest, however, that growing two groundnut crops in the uplands is a potentially viable management option in Sierra Leone.

1. Department of Biological Sciences, University of Sierra Leone, and Institute of Agricultural Research, PMB 540, Freetown, Sierra Leone.
2. Institute of Agricultural Research, PMB 540, Freetown, Sierra Leone.

Groundnut Cultivation in Togo

B Nambou[1]

Togo has two types of climate: a tropical Sudanian-type climate characterized by a monomodal zone with annual rainfall of 800-1500 mm in the North and a tropical Guinean-type climate characterized by a bimodal zone with annual rainfall of 1300-2000 mm in the South.

Research activities on groundnut initiated in 1973 by the Institut de recherches agronomiques tropicales et des cultures vivrieres (IRAT) are currently carried out by the Institut national des cultures vivrieres (INCV). Related work is done by such institutes as the Societe togolaise du coton (SOTOCO). Some of the important results of research carried out by INCV are:

Sowing date. In the bimodal zone: late Mar to early Apr is recommended for the first season and late Aug for the second season. In the monomodal zone, early Jun is recommended.

Sowing density. Trials on plant density have shown that 125 000 to 160 000 plants per hectare give the best results.

Fertilizer. The recommended dose is 150 kg ha^{-1} of single superphosphate or 15-15-15.

Yield trial. The varieties that have been released in the country are 61-24, TS 32-1, T 4-3, and RMP 12. The first three have a growth duration of 90-95 days and the last one, 130-135 days.

Herbicide. Two chemicals applied before preemergence were found to be quite effective: Stomp® (pendine 330 g L^{-1}) and Cotodon® (dynoperyne 240 g L^{-1}).

Germplasm collection. INCV is responsible for the collection of all local cultivars.

Groundnut cultivation is progressively declining in Togo; it fell from 52 300 ha (31 500 t) in 1985 to 39 700 ha (21 900 t) in 1991.

The major constraints to groundnut production in Togo are:

- Use of landraces or a mixture of genetically unstable and low-yielding varieties.
- Drought spells ranging from 2 to 3 weeks at the time of flowering or pod-filling.
- Non-adherence by farmers to recommended cultural practices (sowing date, sowing density, fertilizer, etc.,).
- Absence of any commercial outlet.
- Absence of any pricing policy which would serve as an incentive to farmers.

1. Programme Legumineuses a graines, Institut national des cultures vivrieres (INCV), Carcaveli, BP 2318, Lome, Togo.

Togo's groundnut program also suffers from lack of resources and requires both national and international financial support and assistance from the Conference des responsables de la recherche agronomique africains (CORAF) Groundnut Network.

It is necessary to provide for two specialists' posts for groundnut research in the Network research centers.

Diagnosis of Constraints to Short-duration Groundnut

P Cattan[1]

One of the tasks of the agronomist is to determine the reasons for poor yield levels. To do this, he should first find out if yields are actually low and if so, identify the crop growth stage when yields started declining and the causes for such decline. This paper focuses on crop growth stage in relation to poor yields.

It is necessary to define growth indicators at different growth stages of a plant in order to identify the periods when yields are low. The yield determinants used for other food grains could be used for groundnut. Yield can be broken up into different components—for example, the number of seeds and average seed mass—with each component reflecting the conditions of plant growth prevailing at the time of the formation of that component (for example, a low 100-seed mass indicates a constraint during seed formation).

This method was applied to groundnut in an experiment on phosphates conducted from 1988 to 1990 in two villages in the north-central region of Burkina Faso. The crop-growing conditions in these regions are extrememely diverse. In total, 38 trials were conducted. The pod yields of controls (without fertilizer) ranged from 324 to 1200 kg ha^{-1}. The periods of limited groundnut production were identified, and on this basis some hypotheses on the factors responsible for these limitations were made.

Water was found to be a crucial factor for determining the 100-seed mass and growth efficiency of a crop (defined as the ratio between the number of seeds and dry matter weight). The 100-seed mass seemed to be low in fine soils. Although seeds were fewer on plants grown in sandy soils and the vegetative growth poor, the seed mass was high.

Yield-limiting factors vary with soil types. The effect and effectiveness of different treatments such as the addition of fertilizer can be evaluated after these factors are identified.

1. Centre de cooperation internationale en recherche agronomique pour le developpement (CIRAD)/ Institut national d'etudes et de recherches agricoles (INERA), 01 BP 596, Ouagadougou, Burkina Faso.

Low-cost, Nondestructive Measurement/ Estimation of Plant Growth

J H Williams[1], F K van Evert[1], F Dougbedji[1], and P R Lawrence[2]

Growth analysis is important in research to examine the effects of such stresses as foliar diseases and drought, whose magnitude varies with time. However, the cost and the destructive nature of growth analysis measurements often prohibit its application. An alternative to destructive sampling is provided by measurements of light interception, from which biomass can be estimated via a model. Light interception data are relatively easy to obtain without destroying experimental material. Light interception can be measured at most locations without substantial infrastructural support. These techniques, therefore, offer important ways to enhance the value of experimental results in the region.

Biomass production may be modelled as the product of cumulative radiation intercepted by the crop (I) and a relatively conservative radiation use-efficiency (e). The success of this approach depends on the validity and constancy of the value of e through time. A plot- (or treatment-) specific value of e can be obtained from the seasonal I and the final harvest data. It can be used with the time-series data for I to estimate the biomass for any date. This approach has been validated for groundnuts.

Possible methods of measuring radiation interception by crops include: (1) direct measurement of the radiation above and below the canopy; (2) reflectance measurements; and (3) image analysis of photographs.

1. Agronomy Division, ICRISAT Sahelian Center (ISC), BP 12404, Niamey, Niger.
2. Center for Tropical Veterinary Medicine, University of Edinburgh, Easter Bush, Roslin, Scotland, UK.

Breeding

Characterization and Breeding of Groundnut Varieties Adapted to Different Ecological Zones of Benin

J Detongnon[1]

Groundnut is an important seed-bearing legume in the Republic of Benin. The plant is found in all the districts of the country; its seeds are consumed by human beings while animals consume the haulms after harvest.

Groundnut production in the country is still limited by several constraints: foliar diseases (leaf spots, rust, and rosette), farmers' nonadherence to cultural practices and nonuse of adapted varieties, in addition to climatic hazards.

Several initiatives have been taken in collaboration with the national and international institutions of the sub-region for varietal improvement of groundnut through exchange of material. Notable among these initiatives are the characterization, evaluation, and breeding of adapted varieties.

Groundnut varieties have been characterized and evaluated according to standard agronomic, morphological, and physiological descriptors. A genetic reservoir was created with the information available on pod and seed formation, growth duration, number of pods per plant, average weight of a pod, pod and haulm yields, 100-seed mass, shelling percentage for several short-, medium-, and long-duration varieties. Varieties such as ICGV 8361, JL 24, ICGV-SM 8545, ICGV 83708, ICGV-SM 85038, ICG (FDRS) 4, ICGS 11 were identified as having good characteristics.

Several multilocational trials were conducted in the northern and the southern zones of the country to select varieties adapted to different ecological regions. Promising varieties were identified based on these trials.

- Varieties adapted to the southern zone: lines of the 86 II and 86 I series, KH 149 A, ICG (FDRS) 4, and ICGS 11.
- Varieties adapted to the northern zone: ICGV-SM 83708, 69-101, RMP 12, ICGV 90135, ICGV 90084, and ICGV 9012.

These varieties will be further tested in multilocational trials in farmers' fields.

1. Institut national des recherches agricoles du Benin (INRAB), BP 884, Cotonou, Benin.

Breeding Groundnut Varieties for Adaptation to Drought in Burkina Faso

D Balma, J Gautreau, and Z Bertin[1]

An improved groundnut subpopulation (SPA) from the Institut senegalais de recherches agricoles (ISRA) was evaluated in a pedigree breeding trial in central Burkina Faso (600-800 mm rainfall) to select short-duration drought-tolerant varieties adapted to the Sahel. The trial was conducted as part of a breeding project launched in 1984 at ISRA, involving several countries and funded by the European Economic Community (now European Union—EU). In the initial experiments, eight varieties of diverse origins and characteristics were used in a pyramidal crossing to increase the genetic variability. This was followed up with recurrent breeding, alternatively taking into account agronomic and physiological criteria, in relation to drought adaptation.

In 1989, 2000 F_3 seeds of the first improved subpopulation from Bambey were sown in adjacent rows for pedigree breeding at Gampela in central Burkina Faso.

At the end of the 1990 cropping season, 96 progenies were selected on the basis of maturity rate, 100-seed mass, and pod yield per plant. Two Spanish types were used as controls: Chico (75 days) with poor agronomic qualities (small seed, low yield) and 55-437 (90 days) with drought tolerance and high pod yield potential.

The breeding trial continued in 1991 using the same procedure but with the addition of grain shape and appearance to the other three criteria. Emphasis was given to maturity index and individual pod yield. Sixty-five progenies were selected for evaluation in 1992.

The material tested in 1992 gave good results. Some pod yields per plant were high (around 30 or even 40 g), but this was observed mainly in progenies with a few plants (21 B-l, 21 B-5, 21 B-9, 21 B-10, 29-2-1, 28 B-4, 608-2-4). In 1993, eight lines were evaluated in a micro-plot trial using a randomized block design with three replications.

In the micro-plot trial, all the lines performed better than Chico. Two lines outyielded the control 55-437 (12.8 g per plant): 21 B-3 by 140% and 227-10 by 132%. They gave the highest pod yield and constituted the first group. Four lines, 151-12, 608-2-6, 110-2-1, and 137-1-2 formed the intermediate group with yields 102-116% higher than that of 55-437. In general, they showed greater 100-seed mass than the controls. The seeds were also bigger (42-73 g) except for the line 110-2-1 which produced the smallest seeds (38.7 g per 100 seeds). In fact, the seeds of three lines were quite large: 21 B-3 (73 g), 608-2-6 (59 g), and 227-10 (58 g).

1. Institut national d'etudes et de recherches agricoles (INERA), 01 BP 476, Ouagadougou, Burkina Faso.

In 1994, the F_8 generation was evaluated in three different trials at Gampela depending on seed availability: two using a randomized block design and one sown in rows, with the same controls. In the first trial, 10 lines were compared in four replications and in the second, eight lines in four replications. The results of the third trial in which the 14 remaining lines were sown in adjacent rows are being analyzed.

At the end of 6 years of breeding trials, we are reaching our objective: more or less fixed plant material is now available from which the best lines will be selected, based on agronomic performance and pod and seed quality. Some lines will be eliminated (or taken up again for breeding) because of high residual variability. We hope to develop improved short-duration varieties with large seeds, tolerance for drought stress, and pod and seed shape suited to commercial standards of confectionery groundnut.

Groundnut Research at the Gassi Research Station in Chad

N Batedjim[1]

The Gassi Research Station is situated 15 km away from N'Djamena and uses the Dougui site 50 km north of N'Djamena as an operational base. These sites have a Sahelian-type climate. Peak temperatures in these sites exceeded 40°C in Apr 1992 . The total rainfall in 1992 was 554 mm (in 43 days) at Gassi and 514 mm (in 35 days) at Dougui.

Germplasm collections, yield and agronomic trials, and breeding are some of the important research activities conducted at this Research Station.

1. The objectives of germplasm collections are:

- to study plant behavior, adaptability, yield, and drought resistance;
- to preserve, enrich, and diversify the gene pool;
- to identify the best ecotypes and varieties that could be used in trials.

The germplasm collection tested in 1992/93 included 48 local and introduced varieties. The main results of the trials carried out in 1992/93 are given below:

- The short-duration varieties (J 11, IC 79-2 I, IC 79-2 J, ICGS (E) 13, 44-434, and 59-246) attained 50% maturity at the end of 80 days.
- The accessions were classified into five groups, based on their yield per hectare which ranged from 1450 to 1950 kg ha^{-1}.

2. Varietal trials were sown at Gassi (with 10 varieties) and at Deli (with 16 varieties).

Data on growth duration, insect and disease resistance, and pod yields were obtained. J 11 gave the best pod yields at Gassi, with more than 2000 kg ha^{-1}. It attained 50% maturity 92 days after sowing. At Dougui, ICGS(E) 22 and JL 24 gave better yields than the control Rose de Deli.

RD(GR) 89, JL 24, and BS 5 were selected for further multilocational testing.

1. Direction de la recherche et des technologies agricoles, BP 441, N'Djamena, Chad.

Newly Improved Groundnut Cultivars for Farmers in Ghana

K O Marfo[1] and B Asafo-Adjei[2]

Groundnut production in Ghana has been on the increase during the last decade. The average yearly production was 85 000 t during 1977-79. It reached 207 000 t during 1987-89 with yields ranging from 500 to 800 kg ha^{-1}. Among the reasons for this encouraging performance is the increasing use of groundnut by farmers in northern Ghana, which is the most important groundnut-producing region of the country. The crop not only serves as a high nitrogen fixer for farmers who cannot afford to use inorganic fertilizers, but also as a nonhost crop of both *Striga hermonthica* and *Striga gesneroides,* two devastating parasitic weeds in the area.

Two high-performing groundnut varieties were released in the later part of the last decade for extensive cultivation in northern Ghana: F-mix in 1987, and Sinkarzei in 1989. However, the southern region lacks any improved varieties. Records indicate that the last groundnut variety released for cultivation in southern Ghana was in 1973. In order to evaluate the potentials of F-mix and Sinkarzei for possible adoption by farmers in southern Ghana, extensive tests on these two varieties, together with some farmers' cultivars, were conducted at selected farm sites in 1992 and 1993. The results indicated that the new varieties performed better than the farmers' varieties in various aspects: yield, reaction to rosette disease, early and late leaf spots, and rust. While the average seed yield of the new varieties was 1.2 t ha^{-1} and haulm yield 2.9 t ha^{-1}, the average seed yield of local varieties was 0.9 t ha^{-1} and haulm yield 2.5 t ha^{-1}. Seeds of the new lines are available for distribution to farmers. It is therefore possible that the area under groundnut cultivation with the improved varieties in the southern sector will be expanded.

1. Savanna Agricultural Research Institute, PO Box 52, Nyankpala, Ghana.
2. Crops Research Institute, Kumasi, Ghana.

Breeding Short-duration Groundnut Varieties in Guinea

C K Conde, S Dopavogui, N B Tounkara, and M Roland[1]

We evaluated 16 cultivars on station, six varieties on experimental sites, and three varieties on farm to identify high-yielding short-duration groundnut varieties with very large seeds. It is increasingly becoming important to make seed of such varieties available to Guinean farmers.

During the off-season 1992/93 and the rainy season 1993, on-station trials were carried out with a 4 x 4 lattice design, on-site trials with a randomized block design, and on-farm trials with a 'dispersed' block design.

The cultivars that performed well in the on-station trials were ICGV 88043 (1.45 t ha^{-1}), 55-437 (1.42 t ha^{-1}), ICGV 86015 and ICGV 887123 (1.37 t ha^{-1}).

Three of the six varieties tested on experimental sites were found promising for release in the country: ICG 88105, ICGV 86053, and ICGV 86017.

1. Institut de recherche agronomique de Guinee (IRAG)/Centre de recherche agronomique de Foulaya (CRAF), BP 156, Kindia, Guinea.

Groundnut Breeding in Mali: Summary of Results (1992-94)

S Traore[1] and M D Sanogo[2]

Groundnut cultivation in Mali is faced with various types of climatic, biotic, and agronomic constraints. Two research projects were launched to overcome these constraints:

- CL 14 (developing agronomic packages adapted to diverse agroecological zones);
- CL 15 (developing high-yielding and disease- and pest-resistant varieties).

This study focuses on the activities of the CL 15 project which comprises three parts:

Short-duration groundnut varietal trial. Fourteen new varieties from ICRISAT were compared with two control varieties (55-437 and JL 24). Five varieties had a higher pod yield than the controls, while the fodder yield of four varieties was higher than or equal to that of the controls. The varieties WB 9, TS 32-1, ICGV 86361, ICGV 86063, ICG SM 85045, and 796 were retained for further testing.

Drought-tolerant short-duration groundnut varietal trial. Thirteen varieties from ICRISAT were compared with the local variety, 55-437, which had the highest pod yield (2045 kg ha^{-1}), followed by ICGV 3704 (1670 kg ha^{-1}), and ICGV 2738 (1790 kg ha^{-1}). Three varieties had a haulm yield equal to or higher than that of the control. Drought reaction of the varieties was evaluated on the basis of visual observation of foliage after a prolonged drought spell. Two varieties have been identified for mixed cropping: ICGV 3704 and ICGV 4601. All these varieties will be included in advanced trials.

Introduction of varieties under the Peanut Collaborative Research Support Program (Peanut CRSP)/Institut d'economie rurale (IER) joint program. The results of the 1993/94 preliminary evaluation of genotypes introduced from USA were as follows: 15 varieties had over 1500 kg ha^{-1} pod yield; five of these had more than 2000 kg ha^{-1}. Two varieties yielded more than 3000 kg ha^{-1} of fodder.

The accessions of the groundnut collection from Mali were evaluated; 26 spanish-valencia types and 74 Virginia types were identified in the collection. The study on the characterization of these accessions will continue for another season and each batch of ecotypes will be evaluated in its agroecological zone.

1. Programme Arachide/Centre regional de recherche agronomique (CRRA) de Kayes, Institut d'economie rurale, BP 258, Bamako, Mali.
2. Centre regional de recherche agronomique (CRRA) de Kayes, Institut d'economie rurale, BP 281, Kayes, Mali.

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Collaborative Work in Breeding for Resistance to Groundnut Rosette Virus in Short-duration Varieties: Recent Progress in Nigeria

P E Olorunju[1], O Alabi[1], S R Boye-Goni[1], B R Ntare[2], and J W Demski[3]

Rosette is the most serious groundnut viral disease in Africa. It is endemic in Nigeria where epidemics occasionally occur. The country has now focused its research on the development of agronomically acceptable rosette-resistant varieties adapted to different ecological zones of the region. Short-duration rosette-resistant varieties, needed for the Sudano-Savannah ecological zone, are not available. Therefore, the Institute for Agricultural Research (IAR), Samaru, Nigeria, the Peanut Collaborative Research Support Program (Peanut CRSP), Georgia, USA, and ICRISAT, have combined efforts to transfer resistance to short-duration lines.

The only reported source of resistance in short-duration genotypes has been in the KH series (KH 149 A and KH 241 D). These two varieties have been used extensively in breeding programs in Nigeria and Malawi.

In Nigeria, resultant varieties showed resistance, but were agronomically unacceptable. In 1986, IAR scientists crossed resistant long-duration genotypes with agronomically acceptable susceptible short-duration genotypes using RMP 12, RG 1, RRB, 55-437, JL 24, and ICGS 56 (E) as parents. The resultant resistant lines derived from these crosses mature in 110 days, produce 2 t pods ha^{-1}, have a 67% shelling, and 100-seed mass of about 38 g.

IAR received the following breeding material for rosette screening and yield testing:

- 184 F_4 segregating populations;
- 15 F_3 segregating populations;
- 18 advanced breeding lines; and
- 24 IV IEGVT-1989 entries.

Screening results indicated that some lines have resistance and are also high-yielding. Advanced resistant lines will be included in regional and on-farm yield trials. High-yielding (2 t ha^{-1}) short-duration (90-100 days) genotypes were selected from the 24 short-duration groundnut varieties from ICRISAT Asia Center. But these genotypes will have to be screened for resistance to rosette before they can be included in the Groundnut Nationally Coordinated Research Project.

1. Institute for Agricultural Research, Faculty of Agriculture, Ahmadu Bello University, PMB 1044, Zaria, Nigeria.
2. ICRISAT Sahelian Center, BP 12404, Niamey, Niger.
3. Department of Plant Pathology, University of Georgia, Griffin, GA 30223, USA.

Supported in part by Peanut CRSP, USAID Grant no. DAN-4048-G-00-0041-00.

Peanut CRSP is contributing in the area of transformation and regeneration of groundnut, and in the utilization of viral genes to induce resistance to rosette disease.

Progress in obtaining rosette-resistant short-duration lines has been made and their ability to mature within 110 days gives them an edge over the 90-day lines whose resistance is questionable.

Study of the Deterioration in the Pod and Seed Size of the Confectionery Groundnut Variety GH 119-20

O Ndoye[1]

The pod and seed size of GH 119-20, the only confectionery groundnut variety released in Senegal, has reduced in the last few years. Because of this reduction in size, the quality of yield is considerably lower than that required for the international market.

The study aimed to verify if there was allogamy and/or varietal pollution in GH 119-20 . Seeds of the groundnut variety Krinkle used as marker, were mixed with those of GH 119-20 at a rate of 0%, 5%, 10%, 25%, and 50%. The study revealed that a very low rate of allogamy was present in the leaves, as indicated by the number of plants with leaves of the Krinkle variety and small pods of GH 119-20.

There is a possibility that GH 119-20 has adapted to its ecological environment, in view of the fact that the length of the rainy season has decreased where this variety is grown. However, to ensure varietal purity, the system of crop rotation in the fields used for seed multiplication of GH 119-20 must be changed.

1. Centre national de recherches agricoles (CNRA), Institut senegalais de recherches agricoles (ISRA), BP 53, Bambey, Senegal.

Supported in part by Peanut CRSP, USAID Grant no. DAN-4048-G-00-0041-00.

Current Status and Future Strategy in Breeding Groundnut for Resistance to Biotic and Abiotic Stresses in Western Africa

B R Ntare[1], F Waliyar[2], and J H Williams[3]

Groundnut production in western Africa has remained static in the last two decades. One major limiting factor has been the susceptibility of cultivars to several biotic and abiotic stresses that adversely affect yield. In recent years, cultivars resistant to or tolerant of the principal diseases—late and early leaf spots and rust—and to aflatoxin contamination have been identified and/or bred by ICRISAT. Some of these have been released in various Asian countries, and have been advanced to on-farm testing in some countries in western Africa.

Progress is being made at ICRISAT and elsewhere in breeding for resistance to foliar diseases, and to groundnut rosette virus disease. The strategy is to extend multiple resistance to stresses, while also seeking new and durable forms of resistance. Sources of resistance to foliar diseases, groundnut rosette virus, heat, and other important stresses, are now known and breeding is in progress to introduce these resistances into adapted lines.

The diversity of the national agricultural research systems (NARS) in western Africa calls for a continued emphasis on strengthening NARS by collaborating with them as equal partners in research, delivering appropriate genetic material in the form of parents, segregating populations, or finished lines; and linking NARS more strongly into research networks.

In order to reduce the adverse effects of diseases, further efforts are needed to:

- broaden the genetic base of resistance sources;
- identify sources of resistance where these are lacking;
- combine as many individual resistances as possible into acceptable cultivars; and
- develop integrated control strategies to complement genetic resistance while reducing pesticide application.

Two strategies are needed to minimize the effects of drought.

- Ensure that groundnut genotypes developed for drought-prone areas are characterized for their response to major patterns of drought to avoid releasing of susceptible material.
- Develop novel and simple screening tools to identify sources of drought-resistant traits. When significant genetic variation for drought resistance exists, the genetic traits must be assessed before they can be effectively used in breeding programs.

1. Genetic Enhancement Division, ICRISAT Sahelian Center (ISC), BP 12404, Niamey, Niger.
2. Crop Protection Division, ISC, BP 12404, Niamey, Niger.
3. Agronomy Division, ISC, BP 12404, Niamey, Niger.

To improve the yield and adaptation of cultivars with multiple stress factors, greater emphasis will be placed on the selection for yield in the breeding nurseries. Such yield-maximizing physiological traits as partitioning, crop growth rate, and phenology will be studied to determine which factors can be optimized for higher yield potential.

Increased productivity potential in groundnut genotypes for low-input cropping systems will be critical to the development of an agricultural system that is self-sustaining, less harmful to the environment, and yet productive enough to meet the increasing demands for the crop. The key to increased production under these conditions will be through the evaluation, identification, and use of selection and testing environments, a better understanding and quantification of yield stability, and an improved understanding of the components of tolerance for both biotic and abiotic stresses.

With the new potential of microbial genetics and biotechnology, additional methods will become available to plant breeders so that they can rapidly manipulate germplasm, and assemble new genetic combinations. This will enhance the genetic potential to respond to different cropping systems with new cultivars.

Plant Protection

Foliar Diseases of Groundnut in Burkina Faso

D Pare, S Bonkoungou, and C Dabire[1]

Results of experiments on foliar diseases of groundnut in Burkina Faso are given below:

Survey in farmers' fields

Surveys on foliar diseases were conducted in about a hundred fields in the country:

- Rust appears generally towards end Jul-early Aug with a severity gradient from the South-West to the North. Because of the unusual rainfall in 1994, infestations were high throughout the country.
- Earlier the leaf spot distribution pattern divided the country into two distinct zones. But now, these diseases are spread out over the entire country, and occur at different times of the year.

Support to research on breeding

- In the central and eastern parts of the country, foliar diseases have caused around 20% yield loss on research stations. In farmers' fields, yield losses were associated with agronomic factors; therefore, the effects of foliar diseases were overshadowed.
- In certain varieties, the application of Bavistin® increased the level of rust infestation. This increase in parasitic stress could be used for screening for varietal resistance to foliar diseases.

Epidemiology

Sowing early in the cropping season is a good method of controlling rust as its incidence increases during the season.

Chemical control

- A single treatment with Corvet CM® was not effective in controlling the infestation under favorable epidemiological conditions.
- Even regular applications of Corvet CM® could not prevent rust or leaf spot infestations.
- Three applications of Follicur® were found to be ineffective, but four applications controlled well the groundnut foliar diseases. But no difference was found between the liquid and concentrated forms of the chemical.
- Altocombi® proved to be the best of all the chemicals used in the experiments for controlling rust and leaf spots. An application of 0.2 L ha^{-1} of the commercial product (Horizon®) once every 2 weeks is recommended.

1. Institut national d'etudes et de recherches agricoles (INERA), BP 403, Bobo Dioulasso, Burkina Faso.

Fungicide Control of Foliar Diseases in Six Groundnut Varieties, Samaru, Nigeria

O Alabi, P E Olorunju, and S R Boye-Goni[1]

The reaction of six groundnut varieties (RMP 12, RMP 91, RRB, M 554.76, M 354.81, and 55-437) to fungicide control of foliar diseases was observed in the field during 1991-1993 at Samaru, Nigeria.

A split-plot design was used, with fungicide treatments as main plots and the varieties as sub-plots. There were three replicates, each plot consisting of five 5-m long, 75-cm wide ridges. The fungicide treatments included Dithane M 45® (2.5 kg ha^{-1}), Benlate® (0.6 kg ha^{-1}), Benlate® + Dithane M 45® (at the same rate as the two fungicides used singly) and water as control. All plots also received two or three sprays of insecticides.

RMP 12, RMP 91, and M 354.81 yielded more than the others especially when the plants received Benlate® + Dithane M 45®. The yield loss that could have occurred if no fungicide had been used varied from 3 to 88% depending on the variety and year. This suggests that variety, disease incidence, and season, and their interactions, may all influence disease-induced yield losses.

1. Institute for Agricultural Research, Faculty of Agriculture, Ahmadu Bello University, PMB 1044, Zaria, Nigeria.

Supported in part by Peanut CRSP, USAID Grant no. DAN-4048-G-00-0041-00.

Groundnut Pathology Research in the Gambia

K Trawalley[1]

In the Gambia, although research on groundnut diseases was initiated in 1924, more emphasis has been given to it in the last three decades.

Since early days, the disease constraints to production have been identified as: rosette, seedling diseases, foliar diseases, and aflatoxin contamination resulting in health hazards. However, rosette is no longer a problem after the recommended plant spacing was adopted by farmers, i.e., 50 cm between rows and 10 cm between plants.

Research on seedling diseases has shown that plots treated with the fungicide Super Homai® did better than the controls in terms of plant population, pod, and haulm yields. Unfortunately, complete results are not yet available, and the cost/ benefit analysis of using seed dressing chemicals needs to be made.

Groundnut plants were assessed for foliar diseases at harvest. They were rated 1-9 on the ICRISAT scale. The confectionery varieties, including ICRISAT-known tolerant varieties ICG (FDRS) 4 and ICG (FDRS) 10, were more susceptible to both early and late leaf spots than the oilseed types 28-206 and 47-16.

1. National Agricultural Research Institute, Yundum Research Station, Gambia.

Soil Pests of Groundnut in Africa

J A Wightman[1]

Until recently, the soil insects associated with groundnut have not been 1 studied with a view to developing management techniques to an extent that reflects their importance relative to other biotic constraints. There is now ample evidence that they can be serious pests—as single species, groups of a single taxon (e.g., termites), and as cohorts of taxa. Although formal entomological surveys have largely been limited to Nigeria, and South and southern Africa, it is possible to recognize three kinds of damage and the insects that cause them.

Root feeding

- Toxin injection, by *Hilda patruelis* (Homoptera, Tettigometridae). The southern end of range of this sporadically devastating insect is the Transvaal. The northern end is not clearly defined. Its feeding activity kills plants outright.
- Chewing, by white grubs (larval scarabaeids). Their feeding activity damages the roots, either killing plants outright (especially in the younger stages), or impairs their water and nutrient uptake. Low densities (± 1 m^{-2}) can be devastating.
- Root boring by many species of small termites that feed directly on the roots of groundnut plants and kill them.

Pod feeding

Termites make small regular holes in pod, remove the seed, and leave soil inside the shell. Doryline ants do the same, but do not leave soil in the empty shell. Millipedes feed on the pods from the stage when the pods are just a swelling on the tip of a peg, until they harden. Wireworms (elaterids) and false wireworms (tenebrionids) damage pods and seeds at all stages of development. White grubs make jagged holes in pods and destroy seeds. Termites, wireworms, and false wireworms can all etch and scarify the shell.

Above-ground activity

Harvester termites 'chop down' stems at ground level. Several other kind of termites tunnel through the stems. Termites also feed on the pods while the plants are drying after harvest.

The current challenge is to carry out diagnostic surveys specifically to relate environments to the distribution of specific taxa, and to management practices. Management practices need to be developed to lessen the effects of these pests within the context of farmers' economies.

1. Crop Protection Division, ICRISAT Asia Center, Patancheru 502 324, Andhra Pradesh, India.

Aflatoxin Contamination

Aflatoxin in Crude Groundnut Oil: Occurrence and Elimination

A Kane[1]

Aflatoxin contamination of groundnut may occur when crude oil is contaminated, either by mechanical transmission of toxin into the oil in the form of very fine particles, or by emulsion of phospholipides.

We carried out a study as part of the Peanut Collaborative Research Support Program (Peanut CRSP) to determine the contamination level of crude oil and identify various methods to eliminate the toxin. In 1989 and 1990, we had found that about 94% of the samples analyzed were contaminated (maximum of 363 ppb aflatoxin).

Exposure to sunlight for 18-24 h destroyed 100% of the toxin in contaminated groundnut samples (with an initial level of 600 ppb aflatoxin) kept in transparent and translucent containers. In other methods using various clays, bentonite and attapulgite detoxified the oil completely, while kaolin removed 78-87% of the aflatoxin from the oil, depending upon the period of contact and the quantity of clay used. Following these results, a laboratory press was used to introduce attapulgite (5-10%) into the crude oil production process before the steam cooking. The results showed an average elimination of more than 80% of the toxin. There was no significant difference between the control and the treated samples in some of the physiochemical characteristics of the oil (humidity, acidity, peroxide level) both in the case of treatment by solar radiation and with clay.

1. Institut de technologie alimentaire, Routes des Peres Maristes, BP 2765, Dakar, Senegal.

Supported in part by Peanut CRSP, USAID Grant no. DAN-4048-G-00-0041-00.

Isolation and Characterization of an Aflatoxin-producing Strain of *Aspergillus* from Groundnut

P A Nikiema[1], S A Traore[1], and B Singh[2]

Previous research on aflatoxin problems show that:

- Aflatoxins—usually exceeding the acceptable toxicity levels—are present in groundnut and groundnut products;
- Aflatoxin content in groundnut products increases during storage when such parameters as water content, hygroscopic capacity of seeds, and relative humidity of the storage environment are not controlled.

Surveys carried out in Bobo Dioulasso, Burkina Faso, on possible effects of aflatoxin contamination on human pathology have shown risks of sub-lethal toxicity associated with the development of liver cancer after 35 years or, even after 17 years as was shown in about 14% of cases in the surveys, where consumption of contaminated groundnut was regular. When these results were compared with data on early incidence of liver cancer at the Centre hospitalier national Yalgado Ouedraogo, Ouagadougou, there were strong indications that some of the deaths following liver cancer were due to aflatoxins. This study was conducted to obtain pure biological material for carrying out studies on aflatoxigenic fungi (biosynthesis, aflatoxin production, and inhibition of aflatoxin production).

After isolating and cloning the fungi on Czapeck medium in an incubator (28-30°C), a pure *Aspergillus* strain was obtained from groundnut seeds soaked and incubated at room temperature (25-27°C).

The strain was characterized according to Christensen's method and the aflatoxin dosage was determined by the ELISA method, after the strain was cultured on Reddy medium at 28-30°C. The immunoenzymatic dosage using ELISA kits was done on eight transfers of the isolate on the medium.

The morphological elements that were identified on the basis of the synoptic key used in the study enabled us to categorize the strain as that of *Aspergillus flavus*. Chromatographic analysis showed that the strain produced only aflatoxins of B_1 and B_2 types. The quantitative evaluation of aflatoxins produced during the eight transfers on 8 days each indicated that the strain produced on an average 4.1 ppb of aflatoxins (equivalent to B_1 ppb).

1. Faculte des Sciences et Techniques, Universite de Ouagadougou, 03 BP 7021, Ouagadougou, Burkina Faso.
2. Department of Food Sciences and Animal Industries, Alabama A&M University, Normal Alabama 35762, USA.

Supported in part by Peanut CRSP, USAID Grant no. DAN-4048-G-00-0041-00.

National and Regional Approaches to the Aflatoxin Problem

V K Mehan[1] and D McDonald[2]

Aflatoxin contamination of groundnut and of several other important food crops continues to be a serious problem in most countries and regions. Many national, regional, and international organizations have given high priority to research on the aflatoxin contamination of groundnut and maize. Increased awareness of the health hazards that aflatoxins pose to humans and animals, and of grave threats to exports of confectionery groundnuts from many countries of Africa, Asia, and South America, has ensured that the problem continues to receive high priority. It is necessary to adopt national and regional approaches for overcoming the groundnut aflatoxin problem. Similar approaches could be relevant for addressing the aflatoxin problem in maize and other commodities.

1. Crop Protection Division, ICRISAT Asia Center, Patancheru 502 324, Andhra Pradesh, India.

Collaborative Initiatives

Peanut CRSP—Accomplishments and Impacts of Collaborative Research Between US Land-Grant Universities and Developing Countries

K T Ingram and D G Cummins[1]

The Peanut Collaborative Research Support Program (Peanut CRSP) began in 1982 with funding from the United States Agency for International Development (US-AID). Through Peanut CRSP, four US land-grant universities have conducted collaborative research on groundnut production and utilization with developing countries around the world. The principal impacts of Peanut CRSP have been germplasm improvement and human resource development. With a total funding of about US$20 million since its inception, Peanut CRSP research has produced technologies worth more than US$20 million annually. The research paradigm of Peanut CRSP is built on long-term collaboration between a few scientists from US and developing countries. Although this model for collaborative research development has proved highly effective, few development agencies are able to make long-term program commitments in the current policy environment. A new model of research collaboration is needed to ensure continued agricultural development.

1. Peanut CRSP, University of Georgia, Griffin, GA 30223, USA.

Supported in part by Peanut CRSP, USAID Grant no. DAN-4048-G-00-0041-00.

Establishment of a Groundnut Germplasm Center in West Africa

R Schilling[1]

Several major organizations concerned with groundnut improvement in West Africa have drawn up a plan to establish a center for conserving, evaluating, and distributing groundnut germplasm in the region.

The main objective of the Center will be to collect varieties and lines used by groundnut researchers in West Africa. The Project will also be responsible for the conservation of germplasm accessions and evaluation of their genetic and agronomic characteristics. It will create an infrastructure which will put this material at the disposal of researchers and extension workers. All this work has been carried out until now to some extent with insufficient resources and in a fragmented way by a few institutions. It is proposed that henceforth this work will be entrusted to ICRISAT, within the framework of its mandate, with the participation of other major centers—particularly the Institut senegalais de recherches agricoles (ISRA) and CIRAD—in the development and distribution of groundnut germplasm.

The Project will also ensure an active liaison between breeding programs and seed multiplication agencies (public and private). Although this has been earlier unsuccessful, an effective coordination between the two is essential for improving groundnut production in Africa. The Project will therefore have a strategic and permanent function: an initial 5-year phase has been proposed as part of the Project under the aegis of FAO; financial contribution for this has been requested from the Common Fund for Commodity.

ICRISAT will look after the scientific aspects of the Project, in collaboration with ISRA which will be mainly responsible for the breeder seed, and CIRAD which will take care of general coordination. Participation from Nigeria, Niger, and Burkina Faso in their areas of competence will be required and the modalities of collaboration with other institutions will be worked out by mutual agreement. ICRISAT, the Principal Executive Agency, will be assisted by a Steering Committee composed of the major institutions participating in the Project. The Groundnut Network of CORAF will be a privileged, but not exclusive, partner of the Project.

The four main components of the Project will be:

1. To collect and conserve groundnut germplasm used or potentially usable in West Africa;
2. To characterize, evaluate, and identify material in the world groundnut germplasm collection that could be introduced and tested in West Africa;
3. To make genetic material and breeder seed available to institutions in West Africa;
4. To strengthen human resources and institutional capacity for effective collection, conservation, evaluation, and multiplication work in the region.

1. Reseau Arachide—Conference des responsables de la recherche agronomique africains (CORAF)/Centre de cooperation internationale en recherche agronomique pour le developpement (CIRAD), BP 5035, 34032 Montpellier Cedex, France.

It has been proposed to prepare a detailed program for regional collaboration on this issue. A collection center and the basic infrastructure will be set up in the first year of the Project.

Recommendations

General Recommendations

The participants of the Meeting stressed the importance of the aflatoxin problem in groundnut production, both in terms of the economic losses and health hazards it causes.

The participants approved the initiative taken by ICRISAT, CIRAD, CORAF, and Peanut CRSP to propose the constitution of a multidisciplinary program to control aflatoxin. A Task Force led by Dr Mehan, ICRISAT, will be in charge of organizing this project. He will identify the thrust areas in aflatoxin research with regard to breeding, agronomy, crop protection, and transfer of technology.

Recommendations of the Working Group on Agronomy

The Working Group, made the following recommendations after reviewing the follow-up action to the recommendations of the 1992 Meeting:

- The availability of seeds of selected varieties remains a major constraint to crop production. The Group felt that the Groundnut Germplasm Project proposed to be set up under the aegis of FAO was a positive development towards solving this problem. It was recommended that the FAO Project should—in addition to germplasm collection—extend its activity to distribution of breeder seed and to its attendant problems, especially with regard to postharvest technology and assistance to target institutions.
- A better understanding of agroclimatic factors in agricultural zones should help scientists to develop cropping techniques that would conserve soil fertility and increase crop productivity at the same time. It was recommended that decision-making tools—based on appropriate software and better knowledge of plant physiology and yield components—should be developed. The data collected should be made available to researchers concerned, in appropriate computerized form.
- Cropping techniques recommended to farmers should take into consideration the level of the farmers' technical knowledge and their socioeconomic constraints. The Working Group recognized that socioeconomic issues constituted a strategic domain that was not fully understood by research teams, nor taken into consideration while making recommendations. It was recommended that institutions involved in groundnut research, particularly ICRISAT, should strengthen their expertise in this field.
- Postharvest technology must receive greater attention from scientists, and results obtained in one country must be put at the disposal of other countries. The Group felt that although the major research projects on aflatoxin control, distribution of plant material, irrigation, and the development of confectionery groundnut had a significant component of postharvest technology, very little work has been devoted to it. Research and development of this technology must be strengthened at the national and regional levels. The ICRISAT database on postharvest technology could be used by all the interested institutions. The Group regretted that the 'Utilization' Working Group constituted at the Third Regional Groundnut Meeting (Ouagadougou, 1992) was not renewed during this Meeting.
- Increase in production is linked to a proper understanding of the groundnut production chain including the agronomic, logistic, and socioeconomic aspects, as this understanding determines the success of research results and their application. It was recommended that groundnut research activities be more integrated with the production chain on the basis of a good knowledge of the market, the constraints faced by farmers, and consumer preferences. These socioeconomic aspects must be incorporated in groundnut research programs, in close coordination with farmers' organizations, development officials, and commercial agencies.

- The Working Group was concerned that agronomy and physiology research activities remained fragmented, without any methodological or operational coordination between the activities. The Group recommended that the problem should be examined in depth before the next Regional Meeting. Regional research agencies and their donors would be approached to organize a brain-storming session to address this problem.
- The Group underlined the importance of the mandate given to the African Groundnut Council concerning promotion and utilization of groundnut products. It was recommended that these activities be strengthened and that the Council should actively participate in regional meetings organized by groundnut research agencies.
- For training of researchers, it was recommended that thematic workshops should be complemented by on-site visits where these themes would be illustrated and the methodological and practical aspects of research demonstrated. Regional trials must be incorporated in these visits. Organization of workshops to train scientists and technicians in the use of modeling tools for groundnut research was also recommended.

Recommendations of the Working Group on Breeding

- Following the successful establishment and functioning of a rosette screening nursery at Burkina Faso as recommended by the Group at the Third Regional Groundnut Meeting, members felt the need for ISC to continue its coordinating role by enabling groundnut breeders to benefit from each other's experience within the subregion.
- Each national institution should try to collect local landraces, and should send subsamples to ICRISAT Asia Center (IAC) so that the germplasm can be preserved there pending the establishment of the Germplasm Center in western Africa.
- Each National Program should be able to get advanced lines from ICRISAT, test them for 2 years, and report their findings at regional meetings. Unreported annual collections of material should be avoided. This will help members to work systematically as a group.
- The Group felt that breeders should acquire more information on the differences in pod-filling characteristics that exist among genotypes before exploiting these traits in the breeding program.
- The Group felt that specialized training is very important, and that ICRISAT should carry out more specialized training at both scientist and technician levels to provide the special skills needed by each discipline.
- The Group felt that specialized field visits should be regularly organized.

Recommendations of the Working Group on Crop Protection

- The Group supported the concept of intra-regional cooperation, that had become stronger since the 1992 Meeting, but recognized the constraints imposed by financial and logistic problems.
- The Group supported the formation of an 'Aflatoxin Task Force', and saw merit in extending this principle to other crop protection issues. It saw the possibility of connecting this idea with the concept of 'Centers of Excellence'.
- Farako-ba in southern Burkina Faso was viewed as being such a center for foliar disease studies, Bambey, Senegal for breeding, and Zaria, Nigeria for virus diseases.
- As there is an uneven distribution of information about the damage caused by, and the management of nematodes, it was recommended that efforts should be made to share relevant information and technology about nematodes among National Programs.
- ICRISAT should employ a scientist to collect and Collate information about millipedes in the region. Special attention should be given to epidemiological matters and recommendation for future action.
- Integrated surveys of soil insects and diseases across the region should be carried out to diagnose and prioritize areas of future activity, with accent on the farming system as a whole.
- Regional study tours should be held between Regional Meetings for free interchange of information among specialists of associated disciplines.
- Every effort should be made to enhance the resource base of scientists in the region in terms of crop protection developments around the world, by holding special training courses with regional and external resource people.
- The Group fully supported the West African Regional Center for the Conservation and Dissemination of Groundnut Germplasm, and recommended that ICRISAT discharge its role fully, especially with regard to the quarantine needs of the region.
- The Group suggested that groundnut scientists should take every opportunity to inform public officials about the importance of aflatoxin in groundnut as a public health risk. A pamphlet containing relevant information would support this recommendation.
- It was suggested that the previous recommendation on regional trials should be modified to include the evaluation of the cost and economic value of crop protection procedures as part of integrated pest and disease management.

Closing Session

Closing Speech

D G Cummins[1]

I thank ISC for hosting the Fourth Regional Groundnut Meeting for Western and Central Africa and for extending such a warm welcome to us in Niger. Participation from the region has been good, with representation from about 16 countries. I note the presence of representatives from the French Ministry of Cooperation, the Nigerien Ministry of Agriculture, and INRAN. Three support groups—CIRAD, ICRISAT, and Peanut CRSP—have also contributed significantly to the success of the Meeting.

Discussions have been fruitful and many important conclusions and recommendations made. The Meeting has given a valuable opportunity to the various research institutes in the region to share information.

Peanut CRSP supports the development of such groups as the Aflatoxin Task Force to address priority needs of the region. The absence of a Food Technology Working Group was noted in the recommendations made by the Agronomy Working Group. Peanut CRSP has and will continue to support research and development of groundnut food technology.

Peanut CRSP is very pleased to have participated in and supported the Meeting in various ways. I trust that the Program will remain viable and will contribute to the overall development of the region by continuing to be involved in the advancement of groundnut production.

1. Peanut CRSP, University of Georgia, Griffin, GA 30223, USA.

Closing Remarks

This meeting concludes on a very positive note. These 4 days of discussions were extremely productive and the results of work that were presented here will surely be useful to the participants of the Meeting.

Since the last Meeting organized at Ouagadougou, 14-17 Sep 1992, important advances have been made in groundnut agronomy, pathology, and breeding. Representatives of national research programs who participated in the Regional Meetings will help to pass on this information to their colleagues throughout the western and central Africa region.

Groundnut yields have generally declined in Africa, but that there is hope to reverse this trend and the discussions at this Meeting provide a basis for this optimism. Efforts will be made to ensure that the recommendations made at this Meeting will be considered by the authorities concerned and implemented to the extent possible.

It is hoped that these deliberations will make a positive and significant contribution to groundnut production throughout the region, and eventually to the well-being of small-holder farmers.

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