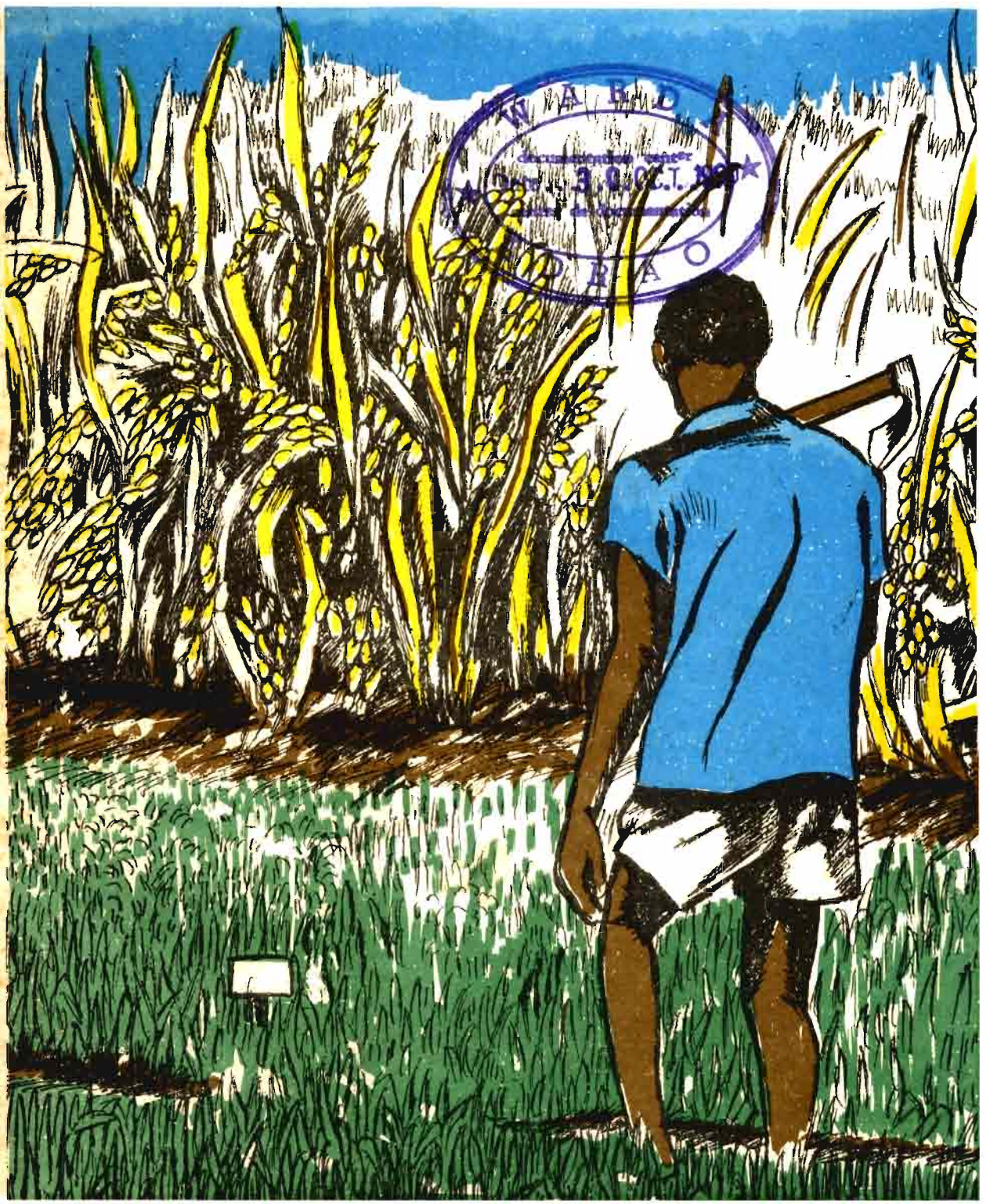
WARDA RESEARCH DEPARTMENT

1979 ANNUAL REPORT



WEST AFRICA RICE DEVELOPMENT ASSOCIATION, P. O. Box 1019
Monrovia - Liberia

WARDA's Objectives:

To promote and
increase the quantity
and quality of
rice produced in
West Africa

Features of the Objectives Statement

a) Encouraging, coordinating, and undertaking as necessary basic and applied research programmes in the scientific, technical and sociological fields;
b) collecting, analysing and disseminating information on method applied, experience gained, and results obtained within and outside West Africa.
c) organizing or arranging for conferences, seminars and training facilities, securing of fellowship, or assisting in the establishment of advisory services and training and extension facilities;
d) elaborating requests for special financial and technical assistances and receiving and administering separately such financial and technical assistance (including movable and immovable property services and loans), as may be madc available under the appropriate programmes of the United Nations, the Specialized Agencies, other organizations or governments desirous to support the aims of the Association;
e) providing as appropriate, regional rice research and development facilities; and
f) carrying out or promoting any other measures or activities at the regional as well as the national level, as determined by the Governing Council, for the purpose of developing rice production and marketing in West Africa.

Present and Future Strategies for Implementing the Mandate

Some useful results obtained in the short span of five (5) years are now in the take-off stage fot the package of practices to be developed and delivered to the member countries through the present set-up.

The main objective of the Research Department is to develop technical packages at the Special Project Centres.

Strengthening of the Special Project Centres is therefore essential. Ways in which this will be done are:

1. Identification of constraints by Sub-regional Coordinators.
2. Removal of constraints, through research by specialists at the Special Project Centres, by developing appropriate technical packages.
3. Trial of these packages by Sub-regional Coordinators under various ecological conditions in member countries.
4. Selection of appropriate packages for each ecological condition and the extension of this through the Development Department to farmers through the National Scientists.

In order to achieve and produce an acceptable package for our farmers, it is essential that high yielding varieties resistant to disease, pests and other adverse conditions, and those that compete well with weeds be produced either by selection from introduced lines and selected parents or breeding. The identification of such ideal varieties required for the development of the packages will form the main function of the Technical Service Division and the adoption of the technology as a joint function of Sub-regional Coordinators and the National Programme.

The Technical Service staff will also continue to backstop the research activities of the Special Project Centres and the member countries. Because of the high pressure of disease, insect pests and weeds under humid forest zone conditions, this will necessitate the expansion of the field nursery farm at Suakoko with the assignment of a Senior Agronomist, Assistant Plant Breeder and other supporting staff.

The Research Coordination at Headquarters will continue to carry out the function of the overall coordination of activities between the Research Department, national and international centres, arrangement of seminars, workshops, writing of project documents, analysis of the trial results, and provide guidance to the Special Project staff and Sub-regional Coordinators in methods of presentation of their results. This section of the Department will continue to be responsible for the publication of the Annual Review Reports, Annual Research Reports and Technical Newsletter.

The Administrative Support will still be required for the next five years to ensure efficient operation of the Research Department as a whole.

The Research Department will continue to assist the Training Department by providing teaching staff from Headquarters and Special Project Centres and the latter may provide specialized training to young national scientists.

Collaboration with other centres in the area of Azolla research, stemborer research and the mounting of special projects in the area of pest, disease and rodent management so as to minimize loss in yield caused by them will be undertaken.

CONTENTS

WARDA RESEARCH DEPARTMENT PERSONNEL

Professional Staff List

B.A.C. Enyi, M.Sc., Ph.D., F.L.S. F.R.S.A., F.I. Biol., L.F.I.B.A.	— Research Coordinator
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N.S. Bangura, M.S	— Assoc. Plant Pathologist
B.A. Larinde, M.S.	— Seed Technologist
L. Kandakai (Mrs.) B.Sc.	— Asst. Seed Technologist
G. Varango, B.Sc. D.P.L.G. (Town Planning)	— Architect
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Rokupr — Sierra Leone

E. Jones, M.Sc. — Soil Scientist and Head

J. Stenhouse, M.Sc. — Breeder

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C.A. Dixon, B.Sc. — Research Assistant — Soil Science

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Richard-Toll/Fanaye — Senegal

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T. Diop, B.A.C. (Agricole) — Research Assistant — Entomology

I. Camara, B.S.P. — Research Assistant — Soil Science

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J. Dome, Ing. Agronome — Assistant Breeder

Mopti — Mali

M. Goita, Ing. Agronome, M.Sc. — Research Assistant — Breeding Acting Director

S. Koli, M.Sc., Ph.D. — Agronomist, Acting Director

A. Diarra, M.Sc. — Research Assistant — Weed Science

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C. Dembele, Ing. Agronome — Research Assistant Entomology

M. Dembele, Ing. Agronome — Research/Extension Officer

Bouake — Ivory Coast

J. Dallard, D.F.A. — Agronomist

PREFACE

The West Africa Rice Development Association (WARDA) is an inter-governmental regional organization whose main aim is to make West Africa self-sufficient in rice production. The Association started to function on 1st December 1971, and has 15 members: Benin, The Gambia, Ghana, Guinea, Guinea Bissau, Ivory Coast, Liberia, Mali, Mauritania, Niger, Nigeria, Senegal, Sierra Leone, Togo and Upper Volta.

The main policy making body of the Association is the Governing Council, made up of one representative from each member state. A Scientific and Technical Committee periodically reviews the Association's work programme.

The member countries contribute to the administrative budget of WARDA, while a multiplicity of countries and organizations finance the technical projects. The Consultative Group for International Agricultural Research (CGIAR) finances the greater part of research administrative costs.

The main objectives of the Association are to promote and increase the quality and quantity of rice produced in West Africa; to encourage production and use of varieties suited to the conditions of the member countries and to existing and prospective demands; to explore, introduce, and contribute to the extension of rational production methods adapted to the conditions prevailing in the region; to promote and implement measures for effective phytosanitary controls in relation to rice; and promote storage and processing, as well as marketing of rice both within countries in West Africa and with respect to external trade in rice.

The Headquarters of WARDA is located in Monrovia, Liberia. Overall control is vested in the Executive Secretariat.

There is a Research Department whose functions include the establishment of coordinated agronomic, varietal, plant introduction and protection trials, phytosanitary services; integrated special research projects for irrigated rice (Richard-Toll, Senegal), mangrove swamp rice (Rokupr, Sierra Leone), deep flooded and floating rice (Mopti, Mali) and upland rice (Bouake, Ivory Coast); reinforcement of the existing network of research stations in member countries in order to fill gaps in their research efforts; arranging conferences, seminars and workshops on topics relating to research; sponsorship of certain low as well as high level training; and overall coordination of regional research from the headquarters as well as a network of sub-regional coordination offices.

There is also a Development Department whose functions cover mainly the economic and sociological aspects of rice production; outreach programmes in agricultural engineering, storage and processing, agronomy and extension, seed multiplication, etc., and participation in the planning and execution of major national rice projects. It also arranges conferences, seminars, workshops as well as training on topics relating to development.

WARDA has a Training Department and Centre which provides middle level and specialized training for personnel from member countries. It also arranges for higher training (beyond the means of the Centre).

Other supporting divisions include an Administrative Division, a Finance and Accounts Division, a Personnel Division, a Documentation Division and a Communications Division. The Communications Division provides translation services, a rather crucial function in a bilingual organization such as WARDA. It arranges or provides interpretation services at conferences, seminars and workshops of the Association. It edits and publishes documents; is responsible for the Association's language laboratory and for the maintenance of good public relations. The Documentation Division has collected, processed and disseminated rice information to member states while maintaining a library for the immediate use of WARDA staff and providing member states access to rice literature through microfiches.

This report covers the activities of the Research Department in 1979. Details are not included. Persons interested in the details are invited to contact the appropriate scientist or scientists involved directly or through the Executive Secretary of WARDA.

Although much has been achieved in the few years of existence of the Association, nevertheless, much needs to be done. We realize the need to re-double our efforts and resources in the ultimate goal of assisting the member states to reach self sufficiency in rice production and improve the economic and social well-being of the vast number of small farmers in the West African region.

We wish to thank all our numerous donors for their support, without which next to nothing would have been achieved.

Sidi Coulibaly
Executive Secretary

RESEARCH HIGHLIGHTS

Strengthening and backstopping of the Special Project activities by Technical Service Staff coupled with improved efficiency in the conduction of the Coordinated Trials yielded useful results.

Progress in Coordinated Trials

Significant progress has been made in the research coordination activities and the coordinated trials programme since 1973. After 1974, the number of trials more or less remained constant. This largely reflects the approach of maintaining high quality testing rather than emphasis on the total number of trials.

Up to 1977, combined Mangrove swamp/Deep flooded (medium and late) trials were conducted. However, beginning from 1978, separate mangrove swamp and deep flooded trials were conducted.

IR 442-2-58 was highly consistent as a medium duration upland crop in the early years in many sites. Apart from this, the IRRI varieties dominated only the irrigated crop whereas the local selections or breeding materials dominated under upland areas. In fact, variety improvement under these conditions is most difficult. The IRAT and other materials are coming to light now under upland conditions in the region.

Some of the most important conclusions from the trials are that:

(a) the best yields were obtained during the off-season;

(b) Higher yields were frequently obtained at Sapu from irrigated rice; apart from good management practice at Sapu, rich soil and favourable climate factors contribute to higher yields.

(c) the higher yields were obtained at the higher latitudes;

(d) the variety IR 1529-680-3 appears so far to be the most adaptable variety on yield basis in terms of reaction to soil conditions, season, and geographical location;

(e) as to be expected, variety performance is more consistent under *irrigated* than under other cultural conditions.

THE 1979 COORDINATED VARIETY TRIALS

Nine variety trials, 2 in the off-season and 7 in the main season, covering the broad rice ecologies of the region, were conducted during the 1979 season.

In the off-season trials, varieties 4448 (8.2 t/ha), BR 51-46-5 (6.4 t/ha), BG 90-2 (8.2 t/ha), BR 51-49-6 (6.4 t/ha),IET 2775 (4.4 t/ha) and IR 934-450-3 (7.0 t/ha) topped the list in Zones* I, II, III, IV and V, respectively.

Zone I : Mauritania, Senegal, Guinea Bissau and The Gambia.
Zone II : Guinea, Liberis and Sierra Leone
Zone III : Ivory Coast, Upper Volta and Mali
Zone IV : Ghana and Nigeria
Zone V : Togo, Benin and Niger

In the upland short duration trials, IRAT 109 (5.0 t/ha), B57C-MD 10-2 (3.5 t/ha), IRAT 109 (4.6 t/ha), IRAT 110 (5.9 t/ha) and IRAT 110 (4.6 t/ha) topped the list in zones I, II, III, IV and V, respectively.

In the upland medium duration trials, B541b-Kn-4 (6.8 t/ha), IRAT 13 (2.3 t/ha), Sel. IRAT 194/1/2 (4.3 t/ha), IRAT 132 (4.1 t/ha) and BG 90-2 (4.9 t/ha) topped the list in Zones I, II, III, IV and V, respectively.

In the irrigated short duration trials, IR 2042-1 (12.0 t/ha), IR 2042-178-1 (5.1 t/ha), ROK 12 (6.2 t/ha), BG 90-2 (8.1 t/ha) and BG 90-2 (8.9 t/ha) topped the list in Zones I, II, III, IV and V, respectively.

In the irrigated medium duration trials, BW 196 (9.8 t/ha), Improved Mahsuri (4.0 t/ha), FARO 15 (6.2 t/ha), Improved Mahsuri (7.9 t/ha) and BR 51-49-6 (7.9 t/ha) topped the list in Zones I, II, III, IV and V, respectively.

In the mangrove swamp trials, DA 29 (3.6 t/ha), ROK 5 (5.2 t/ha) topped the list in ZOnes I and II, respectively. In the mangrove swamp deep flooded trials, Improved Mahsuri (5.4 t/ha) and FRRS 43/3 (2.2 t/ha) topped the list in Zones I and II, respectively.

In deep flooded rice trials in Zone II, BKN 6323 (2.7 t/ha) topped the list while in the floating rice trials, BKN 6986-38 (4.2 t/ha) and Indochine 70 (2.9 t/ha) topped the list in Zone III and Iv, respectively.

INSECTICIDE TRIALS

Insecticidal application did not show any significant positive effect on grain in Zones I, II, III and V. However, Furadan appeared to be promising. In Zone III, a comparative trial on new insecticides gave profitable yield results. No insecticide trial was conducted in Zone IV.

HERBICIDAL TRIALS

No conclusion can be drawn on the effectiveness of the various herbicides tested but Tamariz appeared to be promising.

TECHNICAL SUPPORTING SERVICES

General

The Technical Supporting Services continued to discharge its vital role in varietal introductions and improvement, seed service, rice germplasm coordination of the International Rice Testing Program in the region and monitoring of disease and pests during the year.

Seed Nursery Farm

Fourteen nurseries/materials comprising of a grand total of 3816 entries were planted.

Seed Centre

During the period under review, a total of 641 entries were packaged for WARDA 1980 main season trials. The entries were composed into 3 Initial Evaluation Trials (IETs) and 8 Coordinated Variety Trials (CVTs), all making up a total of 151 trials spread over 56 locations in the 15 members countries of WARDA. A total of 2709 new varieties were introduced from outside the region; 69 varieties were dispatched to Mozambique, Ivory Coast, Nigeria and Philippines. The number of rice germplasm collection at the Centre is now 7,650. 1700 varieties/lines have been sent to both Suakoko and Richard-Toll for seed increase.

Germplasm

Germplasm activities continued as in the previous year with exchange of collected materials with cooperating institutes such as IITA, IRAT and ORSTOM in the region. The rejuvenation and assessment of materials received in the previous year was intensified and arrangement for WARDA's own collection expedition completed.

Initial Evaluation Test (IET)

The four types of IETs conducted during 1979 were: a) irrigated dry/off-season, b) rainfed main season, c) irrigated main season, d) deep flooded main season. The trial entries were 180, 275, 208 and 42, respectively. An examination of the data revealed few very good yielding entries at almost all locations where the four trials were conducted. However, the high level yield performance was found to be location specific.

International Rice Testing Program (IRTP)

WARDA continues to participate actively in the IRTP being coordinated by IRRI. In 1979, several 1978 sets of nurseries were planted in the region. One hundred sets from 16 different 1979 nurseries were received from IRRI for distribution to WARDA member countries.

SPECIAL RESEARCH PROJECTS

The special reseacrh projects of WARDA are located at Richard-Toll/Fanaye (Senegal) for irrigated rice; Rokupr (Sierra Leone) for irrigated mangrove swamp rice; Mopti (Mali) for deep water and floating rice; and Bouake (Ivory Coast) for upland rice.

Irrigated Rice — Richard-Toll/Fanaye, Senegal

Study on the effect of wind on the vegetative and reproductive organs of rice showed variety IR 2941-53 with wide and droopy leaves to be most affected, while varieties DoDo and HR-33 were affected mainly during the reproductive stage when it caused the plants to lodge.

Comparative study of cold tolerant varieties showed variety KH-998 to give greater yield than the standard variety Jaya which is superior to the remaining four varieties.

Of the 73 varieties collected and tested for cold tolerance, 25 were found to be promising and 12 selected for their cold tolerant ability.

High temperature (37° C) during flowering increased the rate of sterility of 9 varieties but varietal × temperature interaction occurred.

In the hot off-season, Gramineae (*Echinochloa* species and wild rice) and Cyperaceae (*Cyperus difformis, C. bulbosus, Scirpus maritimus* and *Heloechacis*) were in the majority. In the rainy season, the broad-leaved weeds were noted, particularly *Sphenoghlea zeylanica* which has an extremely vegetative growth.

Herbicidal screening trial showed that best results were obtained with Oxidiazon followed by Round-up. The weed control treatment gave significantly higher yield than the non-weeded control and there was a negative correlation between grain yield and weed weight ($r = -0.856$).

The most destructive insect pests in the Senegal River Valley are the stemborers and sap suckers. Estimate of grain losses due to insect pests during the hot dry season showed that the relationship between yields and damage was quadratic. Result for the hot wet season showed that

grain yield was negatively but linearly related to the number of tillers attacked by borers. The number of tillers attacked by borers and the number of white heads were positively and linearly related to the number of borers but the relationship between yield and the number of white heads was quadratic. In the control of Aleurodes which caused about 70% loss in grain yield during the hot season, 1 kg a.i./ha dose was shown to be adequate. June sowing increased the number of dead hearts which was reduced at all sowing dates by the application of Furadan. On the other hand, the number of attacked tillers was not affected by sowing date but Furadan application reduced the attack very considerably for the July sowing. It is suggested that since June and July sowing usually give higher grain yield, application of Furadan to plants sown during these months is justifiable.

In the cold dry season, the sowing date had a greater effect on grain yield and its components than any other factor. However, the number of fertile tillers per plant was closely and positively linked to the levels of nitrogen application.

The yield components which affected yield in the cold season were the weight of 1000 grains and the number of filled grains per panicle.

Owing to the low soil temperature during the cold season, nitrogen mineralization in the soil was less and consequently, the efficiency of nitrogen utilization was therefore reduced. For the cold season, planting between December to early January is recommended for high grain yields. NPK fertilizer experiment on alluvial soil of the middle valley of the Senegal River showed that N fertilizer was the essential nutrient for high grain yield—the highest yield being obtained at 150 kg/N application per hectare.

Mangrove Swamp Rice — Rokupr, Sierra Leone

The most notable feature of the variety improvement work in 1979 was the nomination of two varieties for the WARDA coordinated trials on mangrove swamps. The two varieties Bali Grodak and Djabon differed from the local standard variety, Rok 5, by having smaller grains; there was no difference in grain yield/ha in the three varieties.

The stemborer *M separatella* is the most common insect pest of mangrove swamp rice in the Rokupr area. The financial loss in grain due to the attack of *M separatella* in the 1979 season ranged between 100-200 US dollars/ha.

Control of crab damage of seedling by use of chemicals was successful but uneconomic.

Yields of mangrove swamp rice can be doubled by either hand weeding twice or thrice; use of a tiller to plough and puddle only; or by use fo Stam F 34 with one hand weeding. Yields were triple by either hand weeding twice or thrice after mechanical cultivation, or use of Stam F 34 with one hand weeding after mechanical cultivation.

Maximum yield of grain yield was attained by the application of about 100 kg N/ha.

The single axle tiller has been shown to be suitable for swamps.

Deep Water and Floating Rice — Mopti, Mali

Yield trials showed that highest yields were obtained from hybrid BKN 6986-38-1 (3.3 t/ha) followed by D52-37 (2.7 t/ha) and DA 29 (2.6 t/ha).

Hand hoeing was less effective than either oxen ploughing followed by harrowing, or tractor ploughing followed by harrowing, in the control of wild rice *O. barthii.* Seeds sown towards late July and early August gave significantly greater grain yield than those sown earlier.

Drilling produced significantly higher yield than broadcasting.

Application of nitrogen increased yield, the number of basal tillers and plant height. The height increase could help the plant escape submergence with arrival of flood.

Significant increase in grain yield occurred when phosphorus fertilizer was banded than when broadcast.

Economic analysis showed that the use of 59 kg/ha of ammonium phosphate at the beginning of the tiller phase gave the highest benefit: cost ratio (2.8).

Growth of the second short duration crop after harvesting was a failure. 33% reduction in grain yield occurred when weeding was delayed until 60 days after sowing and the traditional method of weeding once only during the flood was not effective in controlling all the weeds (*O. longistaminata, Panicum anabaptistum,* and *Melochia corchorifolia L.)*

Both mechanical and chemical weed control reduced considerably (66-99%) the population of *O. longistaminata.* Application of Glyphosate on August 15 at the rate of 2.88 kg a.i./ha or higher gave effective control of *O. longistaminata.* The percentage yield in farmers' fields between weeded and unweeded treatments ranged between 9 and 82%.

Population dynamics studies showed two peaks for *Chilo zacconius* Blez (October and last week November) and *Maliarpha separatella* Rag (end October and third week November). Varietal trials under farmers' fields showed that new introduced varieties performed poorly compared with local varieties (D52-37 and DM 16).

Problems encountered in implementing improved packages in the farmers' fields include lack of oxen and implements to plough the land at the right time; distance of the farmers' dwellings from the farms; old belief that broadcasting gave higher yield than row planting; inability of the farmers to control weeds for one reason or the other; non-profitability of modern inputs under farmers' field conditions; use of uncertified seeds; and damage of rice seedlings by fish and birds.

Upland Rice — Bouake, Ivory Coast

Yield indices of all varieties tested showed that IRAT 109, IRAT 104 and IRAT 15 topped the list in the early, medium, and late maturing varieties, respectively.

Studies on grain shattering showed that several genes exist which control shattering and that it is possible to develop with an optimum and stable shattering rate over a long period after maturity.

PROPOSED NEW ACTIVITIES

Apart from the normal activities of the Department, the following new activities are proposed:

a) Strengthening of the research programme on upland rice in both sanannah and moist forest zone.
b) Hybridization work at the special project centres especially for the improvement of grain yield in upland, floating and

mangrove swamp rice varieties. The work will involve active collaboration with IRRI.

c) Research on rice-based farming system under different ecologies in West Africa, especially where upland rice varieties are cultivated to minimize the deterioration of the soil fertility. This work will involve active collaboration with IITA and IRAT.
d) The development of appropriate technology for small rice farmers.
e) Extensive trials of packages developed at Special Project Centres in the farmers' fields through the sub-regional coordinated trials.
f) Investigation of the control of rodents and bird pests under farmers conditions.
g) Coordination of demonstration of improved rice production techniques and varieties in both WARDA and National Research Centres so as to stimulate rice farmers in the region to adopt the new varieties or new production techniques.
h) In collaboration with the Development Department and national scientists, assist in extending knowledge gained for improved rice production under farmers conditions.
i) In collaboration with the Development Department of WARDA, water management studies will be undertaken at Richard-Toll.
j) In collaboration with other institutions, the use of Azolla in improving the Nitrogen status of rice soil will be carried out in Suakoko, Richard-Toll and Rokupr.
k) In collaboration with ICIPE, work on rice stemborer will be started as soon as funding is available.

RESEARCH PROGRAMME

In 1979, the research programme emphasis was on integrated approach, consolidation in some areas and strengthening in others. The year saw increased collaboration with national and international organizations.

ANNUAL RESEARCH REVIEW MEETING

The seventh research review meeting of WARDA took place in Monrovia, July 21-25, 1980. A total of 72 delegates from the member states, donor countries and institutions participated. At the meeting, the WARDA research results and those of national reports and the 1980 programmes were presented.

RESUME OF WARDA'S SEMINAR ON INTEGRATED MANAGEMENT OF RICE DISEASES AND INSECT PESTS

WARDA convened a seven-day seminar entitled "Integrated Management of Rice Diseases and Insect Pests in West Africa" at Bobo Dioulasso, Upper Volta, in September 1979. Nominees from WARDA member countries, other scientists from the region and delegates from international organizations such as the FAO, IRRI, IRAT, USAID, OCLALAV, etc., participated.

Besides presentation and discussion of 37 papers, the seminar included a two-day field visit to important rice centres in Upper Volta.

The Seminar fulfilled the following major objectives:

a. Introduced the rice protection workers to the latest concepts of integrated pest management.
b. Updated the knowledge on rice diseases and pests in West Africa and their relative importance and distribution in various rice ecologies.
c. Enabled a critical comparison of the rice disease/pest problems in West Africa with those in South East Asia where the rice intensification programme has been going on for over 15 years.
d. Helped to identify the ingredients essential for the integrated management of key pests/diseases in the region.
e. Brought together most of the workers in rice production in the region and thus the identification of manpower and institutional resources in the region for future intensification of rice protection work with minimum additional inputs.

COORDINATED TRIALS

During the 1978-1979 dry season and the main season of 1979, a total of nine different sets of variety trials were carried out in the region. Two of these were in the dry season and seven in the main wet season, covering the broad rice ecologies of the region.

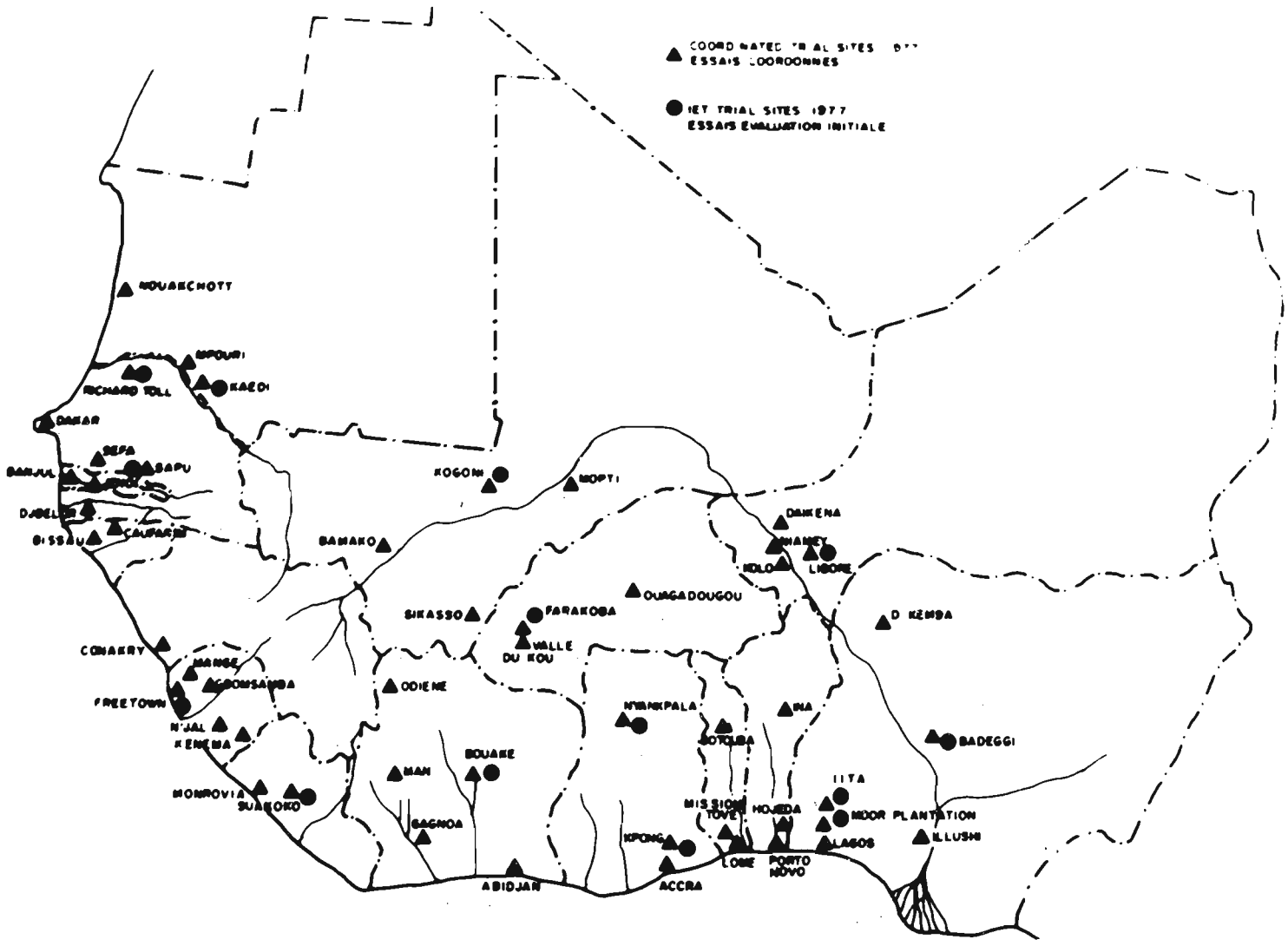
Varietal trials at the WARDA Training Centre in Monrovia — (Picture taken during the opening day in 1979.)

TRIAL RESULTS

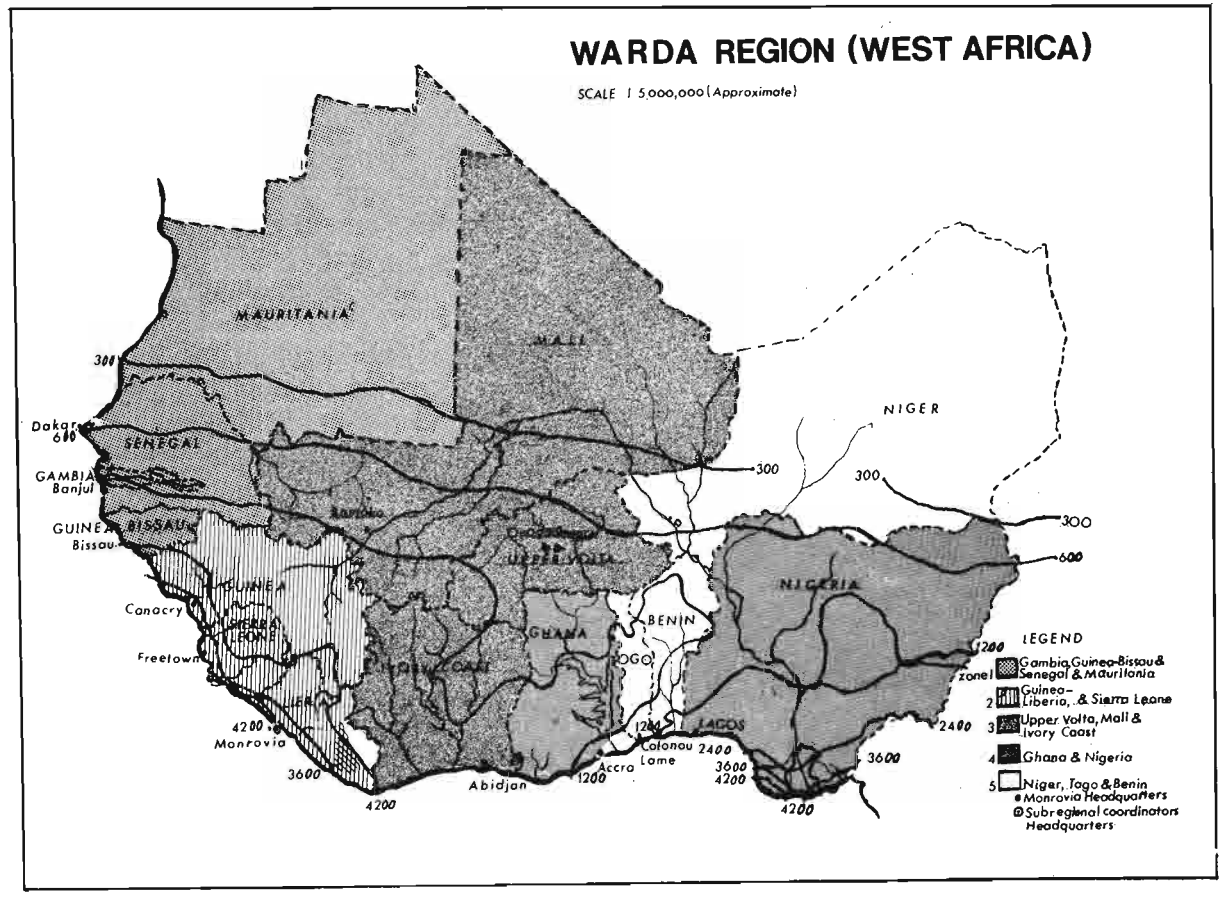
Off-season (Dry Season) Variety Trials 1978-19

A. Short and Medium Duration

The 1978 short and medium duration off-season trials were conducted in all five zones of the region.



A map showing the division of the member states of WARDA into five Zones. Each zone has one Sub-regional Coordinator and an Assistant Sub-regional Coordinator for supervision of trials, linkage between WARDA and National programmes.



A map of West Africa showing most of the Trial Locations in the WARDA Region.

Results for Zone I

The performance of the top five varieties in Zone I is shown in Tables Ia and Ib.

Table Ia: Performance of the Top Five Varieties in the 1979 Dry Season Irrigated Short Duration Variety Trial

Variety	Grain Yield (t/ha)	Maturity (days)	Height (cm.)
	(a) Sapu, Gambia		
IR 2035-250-3	6.3 a	148	78
BG 90-2	6.2 ab	138	84
NTU 770-7-2	5.9 ab	139	72
4448	5.8 ab	148	82
I Kong Pao	5.4 bcd	130	82
	(b) Contuboel, Guinea Bissua		
Bw 78	7.4 a	135	99
IR 28	6.9 ab	125	70
BG 90-2	6.9 ab	128	89
IR 2071-586-5-6-3	6.9 abc	140	-
I Kong Pao	6.9 abc	125	75
	(c) Richard-Toll, Senegal		
NTU 770-7-2	4.1 a	156	75
IR 20	3.4 b	170	88
BW 78	3.4 bc	178	106
4456	3.2 bcd	146	89
IR 934-480-5	3.1 bcde	147	83
	(d) Sefa, Senegal		
4448	8.2 a	138	90
BG 90-2	7.8 ab	138	96
BW 78	7.8 ab	138	107
IR 2071-586-3	6.9 bc	143	90
BR 51-46-5	6.5 c	138	95

Table Ib: Performance of the Top Five Varieties in the 1979 Dry Season Irrigated Medium Duration Variety Trial

Variety	Grain Yield (t/ha)	Duration (days)	Height (cm.)
	(a) Sapu, Gambia		
IR 1529-680-3	6.5 a	146	78
BW 196	5.8 b	160	82
4414	5.7 b	139	84
IET 1996	5.7 bc	147	75
BR 51-118-2	5.5 bcd	142	90
	(b) Contuboel, Guinea Bissua		
BR 51-118-2	6.7 a	146	88
BR 51-49-6	6.5 a	150	90
IET 2885	6.4 a	130	86
4414	6.3 ab	145	90
BR 1529-680-3	6.1 ab	143	77
	(c) Richard-Toll, Senegal		
IR 2070-414-9	6.7 a	184	93
IR 1529-680-3	4.5 ab	177	87
BG 374-1	4.4 abc	176	91
4414	4.3 abc	179	102
IET 1996	4.3 abc	185	91

Grain yields obtained in the seven trials conducted in three countries were generally satisfactory. With regard to short duration trial (Table Ia), highest grain yields were obtained from Sefa, Senegal, whereas in the medium duration trial (Table Ib), highest yields were obtained from Sapu (Gambia) and Contuboel (Guinea Bissau). The short duration variety BG 90-2 and the medium duration IR 1529-680-3 continue to perform well in all the locations.

Results for Zone II

In the 1978-79 off-season, short and medium duration varietal trial was conducted only at Suakoko (Liberia). The performance of top varieties is given in Table 2.

Table 2: 1978-79 Off-season Short and Medium Duration Trial Results

Duration	Variety	Grain Yield (t/ha)	Dura-tion (days)	Per Day Yield (kg/ha)	Plant Height (cm)
Short	BR 51-46-5	6.27 a	127	50.2	104
	ROK 12	6.36 a	106	60.0	89
	IR 28	6.29 ab	126	49.9	97
	BW 78	5.93 abc	133	44.6	103
	IR 2035-120-3 (check)	5.60 abcd	133	42.1	90
	IR 2053-407-2-1 (check)	3.75 e	125	30.0	119
Medium	Improved Mahsuri	5.42 a	135	40.1	131
	4445	4.76 ab	139	34.2	89
	IR 2058-435-2	4.73 ab	125	35.0	95
	BW 196	4.72 ab	145	32.5	98
	IR 5 (check)	4.43 abc	143	31.0	87
	IR 1416-131-5 (check)	4.21 abc	139	30.3	89
	Suakoko 8 (check)	3.89 abc	142	27.4	130

In the short durstion trial, the new entry ROK 12 exhibited its superiority in yield and per day yield both in the main and off-seasons. In the main season, it yielded 5.32 t/ha and ranked second. ROK 12 in the off-season belonged to short duration. The superior performance of ROK 12 for two consecutive seasons clearly points out that the variety has potential of becoming a commercial variety in Liberia. Compared with the main season, the varieties in general in the off-season had low incidence of helminthosporium.

In the medium duration trial, Improved Mahsuri was the highest yielder. However, IR 2058-435-2 deserves further observation as this variety ranked third in both main and off seasons. The yield of IR 2058-435-2 in the main season was 4.60 t/ha. Unlike the short duration trial, many varieties of the medium duration had higher incidence of helminthosporium disease in the off-season than in the main season.

The above two trials further show that some varieties are suited either in the main or in the off season under Suakoko conditions. However, ROK 12 and IR 2058-435-2 are exceptions to the above, as the two varieties were consistent in their high yielding ability both in the main and off seasons.

Results for Zone III

(a) Short Duration

The trials were conducted in the Kou Valley (Upper Volta) and at Korhogo (Ivory Coast). The results for this trial are presented in Table 3a.

Table 3a: Short Duration Off-season Trial Results for Some of the Entries

Location	No.	Varieties	Yield (t/ha)		Per day yield (kg/ha)
	1	NTU 770-7-2	4.08 a	111	40.3
Kou	2	ADNY 2	3.99 a	111	35.8
Valley	3	IR 20 (control)	3.96 a	-	-
(Upper	4	IR 2035-250-3	3.89 ab	119	32.7
Volta)	5	BR 51-42-5	3.85 ab	112	34.2
	6	BG 90-2	3.76 ab	120	31.3
	1	BG 90-2	8.42 a	127	66.3
	2	ADNY 11	7.19 b	122	58.9
Korhogo	3	BR 51-46-5	6.93 bc	127	54.6
(Ivory	4	IR 2035-250-3	6.88 bc	115	59.8
Coast)	5	IET 2775	6.27 bcd	127	49.3
	6	4456	6.03 cde	127	47.5
	7	CS 5 (control)	5.99 cde	127	47.3
	8	BW 78	5.92 cde	127	46.5

In the Kou Valley trial, yields ranged from 4.1 t/ha to 1.5 t/ha for BP 176/9 X DWN.

This low production was due to severe bird damage and low soil fertility.

The Korhogo trial showed more significant differences. Yields ranged from 8.42 t/ha to 4.29 t/ha for IR 28.

Medium duration variety trials were conducted in the off-season in the Kou Valley and at the Korhogo in 1978-79. Table 3b shows the yields of the top varieties.

Table 3b: Medium Duration Off-season Trial Results for Some of the Entries

Site	No.	Varieties	Yield (t/ha)	Duration (trans Planting—harvesting)	Per day yield (kg/ha)
	1	IET 1996	4.67 a	117	40.0
	2	BG 374-1	4.58 a	129	35.6
	3	BR 51-319-9	4.54 ab	129	35.2
Kou	4	IR 1529-680-5	4.40 ab	120	36.6
Valley	5	4414 (control)	4.30 ab	117	36.8
	6	IET 2885	4.24 ab	130	32.8
	7	BG 375-1	4.13 ab	129	32.0
	8	IR 2070-414-3-3	4.11 abc	120	34.2
	1	BG 374-1	6.31 a	127	49.7
	2	4414	6.27 a	127	49.7
	3	Improved Mah.	6.11 ba	-	-
	4	IET 1996	5.98 ba	127	48.1
Korhogo	5	BR 51-118-2	5.31 cba	127	47.1
	6	BW 196	5.28 cba	127	41.6
	6	BR 51-49-6	5.17 cba	127	40.7
	8	Jaya (control)	5.05 cb	127	39.8
	9	IET 2885	5.01 cb	127	39.4
	10	BG 375-1	4.96 cb	127	39.0

Yields were about 4 tonnes/ha for the first nine varieties in the Kou Valley.

At Korhogo, BG 374-1, 4414 and Improved Mahsuri produced more than 6.0 t/ha.

In the two trials, insect attacks and bird damage were not severe.

Results for Zone IV

(a) *Short Duration*

Results of the 1978-79 off-season irrigated short duration variety trial conducted at Badeggi (Nigeria) are shown in Table 4a.

Table 4a: Varietal Performance of the Off-season Short Duration Trials

Location	Variety	Grain Yield (t/ha)	Dura-tion (days)	Per Day Yield (kg/ha)	Plant Height (cm)
Badeggi	MRC 505	6.34 a	111	57.1	77
	IR 3273-P339-2	5.77 ab	112	51.5	74
	BG 90-2	5.60 ab	134	41.8	80
	BR 51-46-5	5.29 abc	128	41.3	83
	IR 2042-178-1	5.12 abc	108	47.4	76
	IR 30 (local)	4.15 abcd	131	31.7	68
	TOS 103 (local)	3.67 bcd	128	28.7	68

At Badeggi, the 1979 main season nominated varieties were used in the 1979-80 off-season trial due to higher incidence of neck blast and white head, the yield of varieties in the off-season was lower than those in the main season. Nevertheless, two new entries MRC 505 and IR 3273-P339-2 showed superiority in yield and produced 6.34 and 5.77 t/ha, respectively.

These two varieties belong to the short duration type with higher yield per day and deserve further close observation during the off-season. On the other hand, BG 90-2, BR 51-46-5 and IR 2024-178-1 showed more consistency in yield both in the 1979 main and 1979-80 off seasons. The two old entries BG 90-2 and BR 51-46-5, belonging to the medium duration type, also showed wider adaptability and high yield potentials in previous years.

B. *Medium Duration*

The results of the medium duration off-season trials are shown in Table 4b for Badeggi (Nigeria).

Table 4b: Varietal Performance of the Off-season Medium Duration Trials

Location	Variety	Grain yield (t/ha)	Dura-tion (days)	Per Day yield (kg/ha)	Plant height (cm)
Badeggi (Nigeria)	BR 51-49-6	6.40 a	112	57.1	91
	BR 51-319-9	6.31 a	135	46.7	77
	Improved Mahsuri	6.31 a	141	44.7	99
	BR 51-118-2	6.14 a	136	45.1	85
	TOS 103 (local)	5.67 a	128	44.3	55
	FARO 15 (local)	4.88 a	145	33.6	83

At Badeggi, the nominated varieties of the 1979 main season were used in the 1979-80 off-season. Due to higher incidence of neck blast and white head, the yield of varieties in the 1979-80 off-season was lower than those in the 1979 main season. However, yields of the top four varieties were reasonably good and ranged between 6.1 and 6.4 t/ha.

The three old entries BR 51-46-6, Improved Mahsuri and BR 51-118-2 were consistent in producing high yield (more than 6.0 t/ha) both in the main and off seasons. The three varieties were also top yielders and had shown wider adaptability in previous years.

Results for Zone V

The results for the short duration off-season trials are presented in Table 5.

Table 5: Varietal Performance of the Off-season Short Duration Trials (top 5 varieties only)

Varieties	Yield (t/ha)	Dura-tion (days)	Height (cm)	Per Day yield (kg/ha)
	(a) Tigbodji-Houeda (Benin)			
IR 8	3.90 a	125	87	30.9
BW 78	3.72 ab	125	111	29.8
ROK 12	3.71 ab	117	87	31.7
BR 51-46-5	3.63 abc	125	102	29.0
NTU 770-7-2	3.30 abc	108	80	30.6
	(b) Sagbovi Donne (Benin)			
IET 2775	4.43 a	114	94	38.9
NTU 770-7-2	4.36 ab	107	92	40.7
BW 78	4.08 abc	125	130	32.6
IR 8	4.05 abc	125	100	32.4
ROK 12	3.98 abc	114	111	34.9
	(c) Mission Tove (Togo)			
IR 934-450-3	6.98 a	105	88	66.5
ROK 12	6.50 ab	115	94	56.5
IET 1444	6.20 ab	110	94	56.4
4456	5.80 b	113	83	51.3
IR 2035-250-3	4.48	103	88	43.5

The results recorded for Tigbodji site showed marked improvement over those obtained in the same location with the same varieties during the 1978 rainy season.

The trial produced very significant results with a coefficient of variation of 12.4%. The average yield was 2830 kg/ha with the highest and lowest yields at 3902 kg/ha (for IR 8) and 1099 kg/ha (for IR 28) respectively.

This large rodent *(Thryonomys swinderianus)*, known locally as grass cutter, cutting grass or ground hog causes considerable damage to the shoots of upland rice, thereby reducing grain yield.

The results obtained during the dry season may have been better partly because of the low percentage of sterility recorded. Sterility was quite high during the rainy season, ranging from 10 to 46%, whereas in the dry season, it ranged from only 1 to 3 %.

The same comparative trial as the preceding one was conducted in the Sagbovi-Dome test location and produced even better results. These results were highly significant with coefficient of variation of 16.5% and an average yield of 3396 kg/ha. The highest and lowest yields were 4425 kg/ha for IET 2775 and 961 kg/ha for IR 28, respectively.

The varieties which appeared to be stable in Benin during both seasons were BW 78, ROK 12, IR 2071-586-3 and BR 51-46-5.

At Mission Tove in Togo, the trial produced highly significant results with variation coefficient of 13.4%. Yields were better than those obtained during the 1978 rainy season, generally averaging about 4.48 t/ha compared to 3.82 t/ha during the rainy season. Yields of varieties IR 934-450-3, ROK 12 and IR 1444 exceeded 6.0 t/ha.

During the rainy season of 1978, the rice plants were attacked by rats and were also attacked at grain stage by birds. These factors might have contributed to the difference in yields between the two seasons.

Upland Conditions Main Season 1979

Trial Results for Zone I

(a) *Short Duration*

Table 6a: Performance of the Top Five Varieties in the 1979 Wet Season Upland Short Variety Trial

Variety	Grain Yield (t/ha)	Duration (days)	Height (cm)
	(a) Sapu, Gambia		
SE 319G	33.3 a	93	76
IRAT 110	3.30 a	104	102
SE 302G	2.79 ab	93	83
IRAT 112	2.62 ab	103	118
IRAT 104	1.58 b	108	109
	(b) Contuboel, Guinea Bissau		
IRAT 109	5.00 a	97	98
IRAT 10	4.22 ab	96	102
IRAT 112	4.07 b	96	102
IRAT 110	3.78 b	97	103
ADNY 8	1.25 c	115	119
	(c) Sefa, Senegal		
IRAT 112	2.59 a	89	116
144B/1	2.54 a	88	106
IRAT 109	2.52 a	89	111
IRAT 110	2.29 a	89	115
IRAT 10	2.22 a	89	108

On the average, grain yields were higher in Contuboel (Guinea Bissau) than in either Sefa (Senegal) or Sapu (Gambia). IRAT 110 and IRAT 112 appeared in the top five varieties in the trial sites and IRAT 109 topped this list in Contuboel (Table 6a). Mean annual rainfall data in /sapu and Contuboel in 1979 were 734 and 804 mm., respectively.

From the rainfall data, one can safely predict that the three IRAT varieties have drought resistant characteristics. In Sefa, the crops were affected later by drought, blast and sterility, so that only the IRAT lines and the local check 144B/1 survived.

(b) *Medium Duration*

Higher grain yields were obtained in Sapu than in Contuboel. The highest yield of 6.75 t/ha was obtained from variety B 541b-Kn-91-3-4 and was superior to local chech IR 442 which gave a yield of 4.82 t/ha (Table 6b).

Table 6b: Performance of the Top Five Yielders in the 1979 Wet Season Upland Medium Duration Variety Trial

Variety	Grain Yield (t/ha)	Duration (days)	Height (cm)
	(a) Sapu, Gambia		
B 541b-Kn-4	6.75 a	125	97
Col 38	6.17 ab	139	107
LD 125	5.50 bc	139	107
IR 1529-242-3	5.41 bc	125	90
IR 1529-680-3	5.13 c	125	90
	(b) Contuboel, Guinea Bissau		
Sel. IRAT 194/1/2	2.36 a	108	108
IRAT 13	2.22 a	109	105
IET 3226	1.88 ab	95	77
IRAT 132	1.74 ab	109	95
IR 3880-17	1.52 ab	112	92

Owing to drought occurrence in Contuboel, IRAT varieties dominated the top five varieties, Sel. IRAT 194/1/2 giving the highest yield of 2.36 t/ha against local check IRAT 9 which yielded 1.48 t/ha.

Trial Results for Zone II

(a) *Short Duration*

The 1979 upland short duration variety trial was conducted at four locations. The performance of top and local check varieties in the trial are presented in Table 7a.

In general, the varieties gave moderate to poor yields. At most locations, the old varieties demonstrated superiority over the new entries.

Table 7a: Performance of Top and Local Check Entries in 1979 Wet Season Upland Short Duration Trial in Zone II

Location	Varieties	Grain Yield (t/ha)	Duration (days)	Per Day Yield (kg/ha)	Plant Height (cm)
	B57C-MD-10-2	3.50	116	30.2	64
Macenta	SE 319G	2.68	116	23.1	66
(Guinea)	IR 2053-205-2	2.54	145	17.5	62
	IR 1480-116-3-3	2.43	140	17.3	54
	Metou (local)	1.04	115	9.0	72
	SE 319G	2.13 a	86	24.8	67
Suakoko	CR 1002*	1.99 ab	125	15.9	112
(Liberia)	M 18 (local)	1.95 ab	108	18.0	114
	IRAT 110*	1.75 abc	99	17.7	112
	IRAT 110*	2.07 a	104	19.9	77
Rokupr	ADNY 8	1.64 ab	120	13.7	88
(Sierra	IRAT 10	1.64 ab	100	16.2	81
Leone)	ROK 16 (local)	1.61 ab	119	13.5	99
	ROK 16 (local)	1.65 a	116	14.2	109
Kenema	ADNY 8	1.60 a	119	13.4	96
(Sierra	ADNY 7	1.45 ab	120	12.1	96
Leone)	IR 2053-205-2	1.39 ab	119	11.7	82

* New entries

In Liberia, M18, SE 319G and IRAT 110 showed some promise as short duration varieties while in Sierra Leone, IRAT 110 showed promise.

In Guinea, the trial was conducted under irrigated conditions and the seddlings were transplanted.

(b) *Medium Duration*

In the 1979 main season, the upland medium duration trial was carried out at three locations. The performance of top yielding and local check varieties is summarised in Table 7b.

At Suakoko, among the new entries Col. 38 and IRAT 132 showed some promise and deserve further observation. The two varieties also had acceptable plant height for upland rice.

In Sierra Leone, IRAT 132 also showed some promise at two locations. While the old entry 4418 was consistent in its yielding ability in three seasons (1977, 1978 and 1979), this indicates again that the variety is well suited under wet conditions.

It is worth noting that IRAT 132 belongs to the short duration group and performed well in both Liberia and Sierra Leone. This new entry deserves close observation and multilocation testing in the two countries.

Table 7b: Performance of Top and Local Check Entries in the 1979 Wet Season Upland Medium Duration

Location	Variety	Grain Yield (t/ha)	Dura-tion (days)	Per Day Yield (kg/ha)	Plant Height (cm)
Suakoko (Liberia)	IRAT 13	2.33 a	106	22.0	112
	Col 38*	2.28 ab	140	16.3	99
	IR 1529-680-3	1.98 abc	118	16.8	74
	IRAT 132	1.93 abc	106	18.2	123
	LAC 23 (white) (local)	1.78 abcd	123	14.5	124
Rokupr (Sierra Leone)	IRAT 132	1.79 a	115	15.6	87
	ROK 15 (local)	1.68 ab	141	11.9	93
	MRC 172-9	1.44 abc	118	12.2	72
	IRAT 13	1.41 abc	109	12.9	70
Kenema (Sierra Leone)	4418	2.15 a	120	17.9	82
	IR 1529-242-3	1.96 ab	120	16.3	71
	B 541-Kn-91-3-4*	1.93 ab	120	16.1	71
	MRC 172-9	1.87 abc	118	15.8	80
	IRAT 132*	1.82 abc	117	15.5	91
	ROK 15 (local)	1.64 bc	130	12.6	102

* New entries

Trial Results for Zone III

(a) Short Duration

Upland rice trials were conducted in 1979 at Bouake, Odienne in Ivory Coast, Farako-Ba in Upper Volta and Sikasso in Mali.

The Farako-Ba station trials did poorly because of severe termite attacks, irregular rainfall in June and in particular, poor soil quality (sandy and defficient in fertilizers). A few varieities reached maturity with very low yields. At Sikasso, the trial involved new varieties from IRAT, Bouake. It was not conducted but the varieties were sown in the upland IET trials.

- The Bouake trial conducted in June suffered from severe drought in August. Rainfall was 30mm whereas the average for August is 110mm.
- Most of the varieties were attacked by blast. Yields were low but nevertheless promising because the varieties had been severely affected by drought and blast attack.
- The only successful trial was that at Odienne which gave very interesting and satisfactory results. The pressure of fungous diseases on certain varieties was very low.
- The varieties developed at Bouake performed well as far as their susceptibility to blast was concerned.
- Table 8a shows the results of the three trials.

Table 8a: Performance of Top Entries in the 1979 Wet Season Upland Short Duration

Site	Varieties	Duration (days)	Total Yield (t/ha)	Per Day Yield (kg/ha)
	Se 319 G	93	0.930	10.0
Farako-Ba	B90-MD-363	111	0.693	6.3
(Upper Volta)	IRAT 109	104	0.574	5.5
	IRAT 110*	104	0.530	5.1
	IRAT 112*	104	0.320	5.1
	IRAT 109	109	4.645	42.6
	IRAT 11	109	4.092	37.5
	IRAT 112*	109	3.276	30.0
Odienne	IR 2053-255-2	130	2.968	22.8
(Ivory Coast)	IRAT 10	109	2.920	26.8
	Dourado-Prococe	109	2.506	23.0
	B75C-MD-10-2	124	2.319	18.7
	ADNY 8	124	2.088	16.8
	ADNY 7	124	2.039	16.4
	IRAT 109	112	1.301	11.6
	IRAT 110	112	1.071	9.1
Bouake	IRAT 112	112	0.988	8.8
(Ivory Coast	Dourado-Prococe	112	0.576	5.1
	IRAT 10	112	0.471	4/2
	ADNY 8	141	0.204	1.5
	ADNY 7	141	0.140	1.0

* New entries

Of the 15 varieties tested this season, ten had already been tested in 1978 while only five were new introductions in 1979.

Yields obtained at Bouake, Farako-Ba and Odienne varied greatly from one location to the other.

The regularity of IRAT varieties which are usually at the top of the list is illustrated in Table 8a.

IRAT 10 which gave very high yields is very susceptible to lodging. IRAT 110 seemed to be more resistant as compared with IRAT 112 which is less productive.

There was low productivity at Farako-Ba due to termite attack and at Bouake due to drought.

(b) *Medium Duration*

Medium duration upland rice trials were conducted at Farako-Ba, Odienne and Bouake.

For the second consecutive year, the duration of the vegetative period of the tested varieties did not make it possible to obtain any yields at Farako-Ba for three reasons:

— Very severe termite attack of the plants (60-95% of the plots were attacked);

- Water stress caused by the August drought which brought about grain abortion on the remaining plants;
- Blast which destroyed most of the varieties.

The attacks were also severe at Bouake where the combined effects of poor rainfall distribution and the August drought caused low yields.

On the other hand, good yields were obtained at Odienne. Varieties did well and yields ranged from 4.266 t/ha for Sel. IRAT 194/1/2 to 0.063 kg/ha for Sein Tailey.

CAP 38, IRAT 1529-680-3 and IRAT 1529-242-3 gave yields of 1.755, 1.736 and 1.733 t/ha, respectively (Table 8b).

Table 8b: Performance of Top and Check Entries in the 1979 Wet Season Upland Medium Duration

Site	Varieties	Duration (days)	Total Yield (t/ha)	Per Day Yield (kg/ha)
	IRAT 13	131	0.533	4.1
Bouake	IRAT 132	133	0.466	3.5
(Ivory Coast)	Iguape cateto (check)			
(Ivory Coast)	Sel. IRAT 194/1/2	129	0.446	3.4
	Iguape cateto (check)	138	0.337	2.4
	4418	147	0.126	1.2
	Sel. IRAT 194/1/2	119	4.266	35.8
	IRAT 13	119	4.158	34.9
	4418	127	3.340	26.3
Odienne	LD 125	133	3.048	22.9
(Ivory Coast)	IRAT 132	119	2.668	22.4
	IR 3880-17	120	2.442	20.3
	MRC 172-9	127	1.966	15.5
	Iguape cateto (check)	119	1.806	13.5
	LAC 23 (white)	113	1.803	13.6

Trial Results for Zone IV

(a) *Short Duration*

The 1979 duration upland variety trial was conducted at four locations. The performance of top yielding and local check varieties are given in Table 9a.

The results show that some of the new entries have high yield potentials and even under upland conditions, very high (above 5 t/ha) yields could be obtained. At various trial sites some new entries outyielded the local checks. The two new entries, IRAT 109 and IRAT 110, exhibited high yield potentials with acceptable plant height at three locations, indicating their wider adaptability for upland conditions. These two varieties deserve further close observations. The Upland Special Research Project at Bouake (Ivory Coast) which tried the two varieties reported that the two varieties have some undesirable characteristics such as open lemmas and excessive shattering. Kn 144, CR 1002 and IRAT 112, with good yielding ability, belong to the medium duration group. Plant height of Kn 144 is short for upland conditions.

Table 9a: Performance of Top and Check Entries in the 1979 Wet Season Upland Short Duration

Location	Variety	Grain Yield (t/ha)	Duration (days)	Per Day Yield (kg/ha)	Plant Height (cm)
IITA (Ibadan, Nigeria)	IRAT 110*	5.94 a			91
	IRAT 109*	5.78 ab			98
	TOX 502-41-B-B (local)	4.62 abc			114
	IRAT 112*	3.74 cd			112
Moor Plantation (Ibadan, Nigeria)	IRAT 109*	4.01 a	116	34.6	102
	Kn 144	3.92 ab	146	26.8	66
	IRAT 112*	3.35 bc	145	23.1	113
	IRAT 110*	3.06 c	129	23.7	96
Ikenne (Nigeria)	CR 1002*	3.49 a	135	25.8	93
	ADNY 7	3.38 ab	120	28.2	109
	IRAT 109*	3.21 abc	102	31.5	106
	TOS 2513 (local)	2.75 bcde	105	26.2	115
Nyankpala (Ghana)	B9C-MD-3-3	1.63 a	107	15.2	88
	SE 319 G	1.31 ab	82	16.0	63
	C 168*	1.24 bc	125	9.9	77
	Dourado Precoce (local)	0.97 bcd	84	11.5	72

The highest yield was recorded at IITA (Nigeria) and the lowest at Nyankpala (Ghana). The poor varietal performance at Nyankpala was due to low and irregular distribution of rain at the critical growth stages of the rice crop, eg. the panicle initiation and grain filling stages. The rainfall pattern around Nyankpala/Tamale over the years indicates that for a 120-day variety to express its full potential, the sowing time should be early June instead of end of June which is the current practice.

(b) *Medium Duration*

The 1979 medium duration upland variety trial was conducted at four locations. The performance of top yielding and local check varieties is given in Table 9b.

Some new and old entries performed well and exhibited superiority over local checks.

It is worth noting that the two new entries IRAT 132 and Sel. IRAT 194/1/2 were consistant in their yielding ability at Moor Plantation, Ikenne and IITA, indicating their wider adaptability. The two new entries deserve further testing. Among the old entries, IRAT 13 and 4418 performed well.

The heighest yield of varieties were noted at Moor Plantation and Ikenne and the lowest at Nyankpala. At Nyankpala, low and irregular rainfall distribution at critical growth stages of rice crop caused poor performance of varieties. This indicates that the present time of planting at Nyankpala (end of June) needs further study.

Table 9b: Performance of Top and Check Entries in the 1979 Wet Season Upland Medium Duration

Location	Variety	Grain Yield (t/ha)	Duration (days)	Per Day Yield (kg/ha)	Plant Height (cm)
Moor Plantation (Nigeria)	IRAT 132*	4.07 a	-	-	-
	IR 3380-17	3.13 b	-	-	-
	Sel. IRAT 194/1/2*	3.07 bc	-	-	-
	B 541-Kn-91-3-4*	3.03 bc	-	-	-
	FARO 25 (local)	2.27 bcde	-	-	-
Ikenne (Nigeria)	Sel. IRAT 194/1/2*	3.31 a	115	28.8	97
	4418	3.21 a	126	25.5	88
	IRAT 13	3.16 a	110	28.7	103
	IRAT 132*	3.05 ab	115	26.5	104
	OS 6 (local)	2.64 abcd	115	22.9	146
IITA (Nigeria)	IRAT 13	3.21 a	-	-	92
	IRAT 132*	2.43 ab	-	-	95
	4418	2.40 ab	-	-	91
	Tox 515-22-111-1 (local)	1.52 bc	-	-	93
Nyankpala (Ghana)	IR 1529-242-3	1.86 a	123	15.1	80
	MRC 172-9	1.74 ab	123	14.1	95
	Sein Tailey*	1.54 abc	131	11.7	117

* New entries

Trial Results for Zone V

(a) *Short Duration*

Table 10a: Performance of Top and Check Entries in the 1979 Wet Season Upland Short Duration

Location	Variety	Grain Yield (t/ha)	Duration (days)	Per Day Yield (kg/ha)	Plant Height (cm)
Sotouboua (Togo)	Kn 144	1.942 a	120	16.2	89
	SE 319 G	1.733 ab	98	17.7	58
	B57C-MD-10-2	1.717 ab	118	14.6	80
	ADNY 8	1.562 abc	123	12.7	99
	IR 2053-204-2	1.558 abc	127	12.3	90
	Ainantchen 14 (check)	1.233 abc	90	13.7	65
Lama-Kara (Togo)	IRAT 110	4.462 a	106	42.1	73
	IR 2053-205-2	4.442 a	127	35.0	80
	IRAT 109	4.433 a	110	40.3	98
	C 168	4.117 ab	127	32.4	82
	IR 1480-116-3-3	3.833 ab	127	30.2	70

Fourteen varieties were grouped in a comparative yield trial with a local control in two locations. The results (Table 10a) showed that the varieties performed better in Lama-Kara than in Sotouboua. The yield in Lama-Kara varied from 4.641 to 1.641 t/ha with an average of 3.145 t/ha. The most productive variety in Lama-Kara (IRAT 110) was classified among the least productive in Sotouboua. Kn 144 which was the top yielder in Sotouboua dod not germinate in Lama-Kara. This trial will be repeated in Sotouboua on a more suitable land.

Results of the Top Five Entries are Presented in Table 10b.

(b) *Medium Duration*

Table 10b: Performance of the Top Five Entries in the 1979 Upland Medium Duration

Location	Variety	Grain Yield (t/ha)	Duration (days)	Per Day Yield (kg/ha)	Plant Height (cm)
Bagou (Benin)	Col. 38	5.595 ab	125	44.8	100
	LD 125	4.538 b	125	36.7	107
	Gambiaka	4.311 bc	135	31.9	136
	B 541b-Kn-91-3-4	4.283 bc	116	36.9	94
	4418	4.207 bc	120	35.1	110
Grand Popo (Benin)	BG 90-2	4.908 a	117	41.9	98
	IET 2885	3.955 b	147	26.9	106
	B 8051-28-2	3.859 b	147	26.3	136
	RPW 6-17	3.707 bc	147	21.8	101
	IR 8	3.411 c	147	20.0	101
Sotouboua (Togo)	B 541b-Kn-91-3-4	2.767 a	120	23.1	78
	4418	2.392 ab	118	20.3	94
	IR 1529-242-3	2.333 abc	120	19.4	80
	Sel. IRAT 194/1/2	2.275 abc	108	21.1	95
	MRC 172-9	2.175 abc	119	18.3	96
Lama-Kara (Togo)	IR 1529-242-3	4.842	127	38.1	80
	IRAT 13	4.783	119	40.2	105
	Sel. IRAT 194/1/2	4.633	119	38.9	107
	IRAT 132	4.325	119	36.3	110
	IR 1529-680-3	4.200	127	33.1	80

Highest average yields were obtained at Bagou and Lama-Kara. In Bagou, the yield varied from 5.594 to 1.657 t/ha with a general average of 3.606 t/ha. These results are comparable to those obtained under irrigated condition. It was noted that those with low yield had high sterility rate.

In Grand Popo, the yield of BG 90-2 was as high as in the 1978 rainy season. In this location, 50% of the varieties yielded more than the general average of 3.354 t/ha.

Yields at Sotouboua were marginal. In Lama-Kara, the average yield was 3.639 t/ha; 6 out of 15 varieties yielded over 4.0 t/ha and 11 out of 15 over 3.0 t/ha. These results were comparable to those obtained in some research stations under irrigated conditions.

Trial Results for Zone I

(a) *Short Duration*

Table 11a: Performance of the Top Five Rice Varieties in the 1979 Wet Season Irrigated Short Duration Trials

Variety	Grain Yield (t/ha)	Duration (days)	Height (cm)
(a) Sapu, Gambia			
BG 90-2	5.86 a	124	106
ROK 12	5.72 ab	120	103
Ir 3273-2	5.70 ab	138	97
IET 1785	5.63 ab	125	97
IR 2798-3	5.56 ab	140	110
(b) Contuboel, Guinea Bissau			
BW 78	4.22	126	105
IR 3273-2	4.12	129	90
BR 51-46-5	3.47	124	91
BG 90-2	3.46	123	83
MTU 8431	3.45	125	85
(c) Rindiao, Mauritania			
BG 90-2	8.33 a	133	97
IR 934-450	8.17 ab	111	85
IET 1444	8.06 ab	107	102
TN 1	7.99 abc	112	99
KS 2	7.96 abcd	113	97
(d) Djibelor, Senegal			
IR 3273-2	4.67 a	120	97
ROK 12	4.67 a	108	97
BR 51-46-5	4.52 ab	115	109
BG 90-2	4.51 ab	115	103
BW 78	4.30 abc	120	122
(e) Richard-Toll, Senegal			
IR 2042-1	12.01 a	133	102
BG 90-2	10.82 ab	129	109
MRC 505	9.89 bc	130	103
IR 3273-2	9.68 bc	124	103
BR 51-46-5	9.61 bc	125	116

(b) *Medium Duration*

TRable 11b: Performance of Top Five Rice Varieties in the 1979 Wet Season Irrigated Medium Duration Trials

Variety	Grain Yield (t/ha)	Duration (days)	Height (cm)
(a) Sapu, Gambia			
BR 51-49-6	5899 a	141	121
BW 196	5323 ab	140	103
BR 51-118-2	5243 b	139	114
BR 51-319-9	5086 bc	139	110
Improved Mahsuri	5008 bc	141	125
(b) Contuboel, Guinea Bissau			
BR 51-118-2	3391 a	133	89
BR 51-319-9	3239 ab	135	92
BR 51-49-6	3163 abc	135	91
H-5	2597 abcd	137	114
IR 5666-2	2489 abcde	128	77
(c) Rindiao, Mauritania			
BW 196	9.97	142	88
IR 1529-680-3	9.69	135	90
BG 375-1	9.63	136	104
IR 2070	8.40	122	91
BR 51-118-2	8.34	147	114
(d) Djibelor, Senegal			
BR 51-49-6	5257 a	139	125
IR 8	4753 ab	136	102
BR 51-118-2	4687 abc	136	115
ADNY 2	4633 abc	127	105
BR 51-319-9	4604 abc	142	116
(e) Richard-Toll, Senegal			
BR 51-118-2	9502 a	130	128
BR 51-319-9	8722 ab	132	124
BR 51-49-6	8679 ab	132	123
BG 375-1	8636 abc	127	118
IET 2885	8376 abc	127	141

Both the irrigated short and medium duration trials were conducted at five locations. Highest yields were obtained at Richard-Toll in Senegal and Rindiao in Mauritania. This could be attributed to the high solar radiation and less incidence of diseases and pests in these locations. The variety IR 2042-178-1 gave the highest yield of 12.01 t/ha at Richard-Toll. BG 90-2 continues to perform quite well in all the five locations.

With regard to the medium duration trial, highest yield (9.77 t/ha) was obtained with the variety BW 196 at Rindiao, Mauritania. The BR series performed generally well.

Trial Results for Zone II

(a) *Short Duration*

The irrigated short duration trial was conducted at two locations during the 1979 main season. The performance of top varieties and local check is given in Table 12.

Table 12: Performance of Top and Check Varieties in the 1979 Wet Season Irrigated Short Duration Trials

Location	Variety	Grain Yield (t/ha)	Duration (days)	Per Day Yield (kg/ha)	Plant Height (cm)
Suakoko (Liberia)	IR 2042-178-1*	5.13 a	130	39.5	105
	IR 2053-94-1-2 (local)	2.04 a	127	39.7	92
	BW 78	4.83 ab	135	35.8	110
	BG 90-2	4.75 ab	131	36.2	100
	ROK 12	4.70 abc	129	36.4	97
Mange (Sierra Leone)	BW 78	3.13 a	126	24.8	103
	IR 2042-178-1*	2.81 ab	128	21.9	113
	ADNY 2 (local)	1.97 cdef	120	16.4	91

At Suakoko, the yields obtained can be considered as good. The new entry IR 2041-178-1 exhibited its superiority in grain yield, while the local check IR 2053-94-1-2 was the second best. BG 90-2 and ROK 12 were top yielders in the 1978 season. Superior performance of the two varieties for two years clearly indicates that they have the potential of becoming commercial varieties in Liberia in non-iron toxic swamps.

At Mange, the old entries BW 78 and IR 2042-178-1 outyielded the local check variety ADNY 2.

At two locations, BW 78 and IR 2042-178-1 were among the top yielding varieties and could be considered as promising varieties for further observation.

(b) *Medium Duration*

The irrigated medium duration variety trial of the 1979 main season was conducted at three locations. The performance of top varieties is summarized in Table 13.

Table 13: Performance of Top and Check Rice Varieties in the 1979 Wet Season Irrigated Medium Duration Trials

Location	Variety	Grain Yield (t/ha)	Duration (days)	Per Day Yield (kg/ha)	Plant Height (cm)
Suakoko (Liberia)	Improved Mahsuri	3.99 a	135	29.5	136
	IR 5 (local)	3.94 a	146	27.0	114
	FARO 15*	3.94 a	151	26.1	119
	4414	2.93 a	130	30.2	118
	BR 51-118-2	3.90 ab	137	28.5	123
Mange (Sierra Leone)	Improved Mahsuri	2.36 a	139	17.0	108
	H 5*	2.27 ab	128	17.7	119
	BR 51-49-6	2.21 ab	139	15.9	104
	ROK 6 (local)	2.07 abcd	128	16.2	102
Kenema (Sierra Leone)	FARO 15*	7.92 a	157	50.4	104
	4414	7.28 ab	135	53.9	90
	IR 2070-414-3-9	6.82 abc	140	48.7	87
	BG 375-1	6.74 abc	135	49.9	86
	IET 2885	6.71 abcd	145	46.3	88
	ROK 6 (local)	6.54 abcde	142	46.2	81

The varieties gave poor yield at Suakoko and Mange, while at Kenema, the yields were extremely high.

Among the top varieties at each location, the yield differences were less evident while there were marked differences in per day grain as well as the duration of maturity. In this respect, Improved Mahsuri and 4414 deserve close observation and multilocation for wider testing in both Liberia and Sierra Leone.

The Suakoko Station has already included Improved Mahsuri on the list of promising varieties in Liberia.

BR 51-118-2 which is moderately tolerant to helminthosporium and tolerant to neck blast, occupied fifth position in the present trial and also gave good yields in 1977 (5.44 t/ha) and highest yield (5.25 t/ha) in 1978 at Suakoko. This indicates that the variety could be considered as a promising cultivar for non-toxic and non-problem soil conditions in Liberia.

Trial Results for Zone III

(a) *Short Duration*

The short duration irrigated rice variety trials were conducted during the 1979 rainy season at Korhogo, San Pedrto, Kogoni and the Kou Valley.

The results obtained ranged from fairly good to average in all the trial locations. Yields vary greatly from one country to another for the same variety but yields were very good at Korhogo.

Yield per day was very high at Korhogo, average in the Kou Valley and at San Pedro, and very low at Kogoni.

ROK 12 which was the most productive variety at Korhogo and Kogoni was sixth in the Kou Valley with yields higher than those at Kogoni (Table 14a).

Table 14a: Performance of Best Varieties in the 1979 Wet Season Irrigated Short Duration Trials

Location	Variety	Yield (t/ha)	Duration (days)	Per Day Yield (kg/ha)
Kou Valley (Upper Volta)	BG 90-2	5.143 a	112	45.9
	MTU 8431	4.825 ab	114	42.3
	IET 1444	4.735 ab	101	46.9
	IET 1785	4.591 bc	120	38.6
	BW 78	4.587 bc	121	37.9
	ADNY 11	4.577 bc	109	46.9
San Pedro (Ivory Coast)	IR 3273-P339-2	5.037 a	112	44.9
	IR 2042-178-1	4.655 ab	114	40.8
	BG 90-2	4.512 abc	102	44.2
	NW 78	4.392 abc	111	39.6
	BR 51-26-5	4.332 abc	110	39.4
	MTU	4.260 abc	102	41.8
	IR 2798-107-3	4.147 abcd	115	36.1
Korhogo (Ivory Coast)	ADNY 11	6.185 a	118	52.4
	BG 90-2	6.095 a	126	48.4
	BR 51-46-5	5.855 ab	121	48.4
	BR 5 (check)	5.790 ab	126	45.9
	MTU 8431	5.677 abc	118	48.1
	MRC 505	5.330 bcd	121	44.0
	IR 2042-178-1	5.277 bcd	118	44.7
	BW 78	5.262 bcd	126	41.8
	IET 1444	5.240 bcd	108	48.4
Kogoni (Mali)	ADNY 11	3.316 a	124	26.0
	BG 90-2	3.281 ab	131	25.0
	415-23-DA	3.242 abc	143	22.7
	IR 2798-107-3	3.028 abc	146	20.7
	BR 51-46-5	2.852 bcd	138	20.7
	BW	2.729 cde	143	19.1

BG 90-2 topped the list in Upper Volta but occupied the second place in Ivory Coast and in Mali. It was third in San Pedro.

Days to maturity were very variable in all the stations. They were particularly long at Kogoni.

Insect (borers) and diseases were very minor in the four stations but leaf scald and brown leaf spot attacks were more severe at San Pedro.

(b) *Medium Duration*

These trials were also conducted in the same stations as the short duration trials.

Table 14b: Performance of Best Varieties in the 1979 Wet Season Irrigated Medium Duration

Station	Variety	Total Yield (t/ha)	Duration (days)	Per Day Yield (kg/ha)
	BR 51-319-9	5.295 a	125	43.4
	4414	5.037 a	122	41.3
KOU	ADNY 2	5.004 ab	114	43.9
Valley	BG 375-1	4.606 bc	129	30.7
(Upper	IET 2885	4.564 bc	129	35.4
Volta)	H 5	4.497 cd	129	34.9
	IR 2070-410-3-9	4.406 cd	119	37.0
	BR 51-118-2	4.287 cdef	127	33.8
	ADNY 3	4.237 def	119	43.6
	BW 196	4.732 a	115	41.1
San Pedro	BR 51-118-2	4.712 a	111	42.4
(Ivory	BR 51-49-6	4.452 ab	118	37.7
Coast)	Improved Mahsuri	4.390 ab	119	36.9
	BR 51-319-9	4.387 ab	114	38.5
	IR 5 (check)	4.120 bc	129	31.9
	FARO 15	6.195 a	136	45.5
	Improved Mahsuri	5.850 ab	132	44.3
Korghogo	BG 375-1	5.715 abc	121	47.2
(Ivory	IR 5666-15-2	5.707 abc	126	45.3
Coast)	IR 2070-414-3-9	5.342 a	118	45.3
	4414	5.260 ca	118	44.6
	Jaya (check)	5.095 de	126	40.4
	IET 2885	5.080 dc	125	40.3
	BW 196	4.022 a	158	29.1
	H 5	2.881 ab	138	28.1
Kogoni	IET 2885	3.164 bc	144	22.0
(Mali)	ADNY 3	2.970 cd	121	24.5
	FARO 15	2.866 cd	148	19.4
	ADNY 2	2.788 de	124	22.4

On the whole, yield were better in the four stations. However, it should be pointed out that the Improved Mahsuri variety which gave the lowest yield at Kogoni, germinated poorly in this station.

This trial was made up of nine varieties already tested in 1978. Five new varieties (ADNY 2, ADNY 3, H 5, IR 5666-15-2 and Faro 15) were used in the coordinated trials for the first time (Table 14b).

The results were lower in all the stations than in 1978, but the best results were obtained at Korhogo (Ivory Coast).

Trial Results for Zone IV

(a) *Short Duration*

The short duration irrigated variety trial was conducted at four locations during the 1979 season. The performance of top yielding and local check varieties are given in Table 15a.

Table 15a: Performance of Top and Check Varieties in the 1979 Wet Season Irrigated Short Duration

Location	Variety	Grain Yield (t/ha)	Duration (days)	Per Day Yield (kg/ha)	Plant Height (cm)
Badeggi (Nigeria)	BG 90-2	8.11 a	130	62.4	112
	BR 51-46-5	7.34 ab	131	56.0	112
	ADNY 11	7.20 ab	139	51.8	108
	IR 2042-178-1	6.89 bc	125	55.1	105
	TOS 103 (local)	3.97 f	116	34.2	94
Bende (Nigeria)	BG 90-2	6.46 a	129	50.1	99
	BR 51-46-5	6.15 ab	145	43.0	108
	MRC 505*	5.54 ab	133	41.6	94
	IR 2042-178-1*	5.43 abc	133	40.8	94
	FARO 21 (local)	2.85 f	124	23.0	85
IITA (Nigeria)	IET 1785*	6.67 a	-	-	-
	ADNY 11	6.17 ab	-	-	-
	IR 3273-P339-2*	5.97 ab	-	-	-
	BR 51-46-5	5.57 bc	-	-	-
	IR 2042-178-1*	5.07 cd	-	-	-
	TOX 514-16-101-1-1 (local)	4.40 de	-	-	-
Kpong (Ghana)	IR 2071-586-5-6-3	7.09 a	142	49.9	108
	ADNY 11	6.72 ab	129	52.1	97
	IR 934-450-5	6.64 abc	120	55.3	98
	BR 51-46-5	6.56 bc	136	48.2	110
	IR 665-79-2 (local)	6.36 bcd	131	48.5	98
	DS 2 (local)	6.25 bcd	141	44.3	115

* New entries.

The top yielders were mostly old entries and demonstrated superiority over both new entries and local checks.

The varieties BG 90-2, BR 51-46-5 and ROK 12 exhibited high yield potentials at Badeggi, Bende and IITA, and were the top yielders at the three sites. In the 1978 season, also the above three varieties were among the top four varieties in Nigeria. The superior performance of BG 90-2, BR 51-46-5 and ROK 12 for two years clearly points out that

the varieties are widely adapted and have potential of becoming commercial varieties in Nigeria. Among the newly nominated varieties, IR 2042-178-1 was one of the top yielding varieties at Badeggi, Bende, and IITA. This variety deserves further close observation.

At Kpong, IR 2071-586-5-6-3, ROK 12 and BR 51-46-5 again showed very outstanding performance in the 1979 season. In the 1978 season, the three varieties were among the top yielders. The excellent performance of the three varieties for two years indicates their potential as commercial varieties.

It is worth noting that all the top yielders at the four trial sites were medium duration varieties (over 120 days duration), and both in Ghana and Nigeria, BR 51-46-5 and ROK 12 were common top yielding varieties. varieties.

(b) *Medium Duration*

During the 1979 season, the medium duration irrigated variety trial was conducted at four locations. The results in general were good and yields were high at most locations. The performance of top yielding and local check varieties are given in Table 15b.

Table 15b: Performance of Top and Check Varieties in the 1979 Wet Season Irrigated Medium Duration

Location	Variety	Grain Yield (t/ha)	Duration (days)	Per Day Yield (kg/ha)	Plant Height (cm)
Kpong (Ghana)	BW 196	6.70 a	138	48.5	103
	IET 2885	6.27 ab	129	48.6	102
	BR 51-49-6	6.03 b	136	44.3	115
	BR 51-319-9	6.02 b	130	46.3	107
	SML Pisari (local)	5.24 def	144	36.4	138
Badegii (Nigeria)	Improved Mahsuri	7.88 a	138	57.1	102
	BR 51-49-6	7.7 ab	139	55.9	97
	BR 51-118-2	7.20 abc	126	52.9	88
	BW 196	6.78 abc	136	49.8	78
	FARO 15 (local)	6.60 abc	144	45.8	94
	TOS 103 (local)	4.51 ef	119	37.9	67
Bende (Nigeria)	BW 196	6.05 a	145	41.7	99
	Improved Mahsuri	6.00 ab	140	42.8	108
	BR 51-49-6	5.56 abc	149	37.3	96
	FARO 23 (local)	5.49 abcd	149	36.8	93
	BR 51-118-2	5.33 abcd	144	37.0	98
IITA (Nigeria)	IET 2885	6.73 a	-	-	-
	ADNY 2	5.70 ab	-	-	-
	TOX 514-16-101-1-1 (local)	5.70 ab	-	-	-
	BR 51-118-2	5.33 b	-	-	-
	BW 196	5.27 b	-	-	-

Like the short duration variety, the top yielders of the medium duration were mostly old entries which maintained their superiority over both new entries and local checks.

At Kpong, BW 196, BR 51-49-6 and BR 51-319-9 again exhibited outstanding performance in the 1979 season. Superior performance of these varieties for two to three years clearly indicates their potential of becoming commercial varieties in Ghana.

In the 1979 season, Improved Mahsuri, BR 51-49-6, BR 51-118-2, and BW 196 were common top varieties at the three trial sites in Nigeria. These four varieties were also top varieties in the previous years. Superior performance of the above varieties for two or more years clearly indicates that the varieties are widely adapted and have the ability to maintain high yields in various years. Thus, these varieties have potentials of becoming commercial varieties in Nigeria.

It is also worth noting that BW 196, BR 51-49-6, and BR 51-188-2 were common top yielding varieties in both Ghana and Nigeria sites.

Trial Results for Zone V

(a) *Short Duration*

Table 16a: Performance of Top Five Varieties in the 1979 Wet Season Irrigated Short Duration

Location	Variety	Grain Yield (t/ha)	Duration (days)	Plant Height (cm)	Per Day Yield (kg/ha)
Libore (Niger)	IR 3273-P339-2	7.721 a	122	111	63.3
	BG 90-2	6.573 a	120	108	54.8
	BR 51-46-6	6.398 b	121	116	52.9
	BW 78	6.104 bc	122	120	50.0
	MTU 8431	6.042 bc	122	96	49.5
Sagbovi-Dome (Benin)	IR 2042-178-1	6.795 a	128	108	53.1
	BG 90-2	6.708 a	131	110	51.3
	ROK 12	6.683 a	122	111	54.8
	MTU 8431	6.268 ab	124	90	50.5
	IR 3273-P339-2	6.130 abc	131	104	46.8
Mission-Tove (Togo)	BG 90-2	8.906 a	123	98	72.4
	BW 78	6.291 b	125	99	50.3
	BR 51-46-6	6.275 b	128	110	49.0
	IR 2042-178-1	6.213 b	121	100	51.3
	IR 3273-P339-2	6.200 b	121	97	51.2
Dapaon (Togo)	BW 78	7.419 a	128	114	57.9
	ROK 12	6.672 ab	115	98	58.0
	BR 51-46-5	6.250 bc	124	106	50.4
	MRC 505	6.241 bc	126	90	49.5
	MTU 8431	5.978 bc	127	76	47.1
Amou-Oblo (Togo)	IET 1785	5.216 a	127	78	41.1
	ROK 12	5.203 a	123	87	42.3
	IR 3273-P339-2	5.163 ab	133	78	38.8
	BG 90-2	4.963 abc	128	87	38.8
	BW 78	4.709 abc	128	99	36.8

The performance of the top five yielders are shown in Table 16a. The results indicate very good performance and wider adaptability of some varieties in this zone. Varieties BG 90-2, IR 3273-P339-2 and BW 78 appeared in the top five yielders in four locations while ROK 12 and MTU 8431 appeared in the top five yielders in three locations.

At Libore, the average yield was 5.057 t/ha. The results in this location were highly significant with a coefficient of variation of 12%. All the new entries outyielded the local control Sintane Diofor.

In Sagbovi, the results were highly significant with C.V. of 11.2% and a general average of 5.614 t/ha. The new varieties were also promising.

In Mission-Tove, the C.V. was 8% and average yield was 5.756 t/ha. All the introduced varieties outyielded the local control AINANTCHEIN 14 (3.034 t/ha). The yield in this location was influenced by the high fertility of the soil.

In Dapaon, new entries gave very good yields and the C.V. in this location was 9.2%. Average yield was 5.789 t/ha. All introduced varieties outyielded the control AINANTCHEIN 14.

Trials at Amou-Oblo gave C.V. of 14.9% and an average yield of 3.786 t/ha. The yields of varieties ROK 12, BG 90-2, IR 2071-586-5-6-3, and BR 51-46-5 gave almost this same yield as in 1978. Variety NTU 770-7-2 suffered from blast, insect pests and sterility.

(b) *Medium Duration*

The performance of the top five yielders in the medium duration irrigated main season trial is shown in Table 16b. Varieties BR 51-319-9, IET 2885, BW 196, FARO 15, ADNY 2, 4418, and IR 2070-414-3-9-2 appeared amongst the top five yielders in two location, while varieties BR 51-49-6 and BR 51-118-2-4 appeared amongst the top five yielders in three and four locations, respectively.

In Libore, the C.V. was 18.5% with an average yield of 4.823 t/ha. Eight out of fifteen varieties yielded more than 5.0 t/ha. In Sagbovi-Dome, the C.V. was 13% with an average yield of 3.950 t/ha. In this location, almost 50% of the varieties were attacked by neck blast. In Mission-Tove, the C.V. was 9.2% with an average yield of 6.027 t/ha. The varieties showed a good yielding potential inspite of lodging, blast and insect attacks. In Dapaon, the C.V. was 8.4% with an average yield of 6.499 t/ha. The yields were the highest obtained in the zone during the main season. The local control (Timbou) was outyielded by all the introduced varieties. In Amou-Oblo, the C.V. was 11.9% with an average yield of 5.350 t/ha. Ten out of fifteen varieties yielded more than 5.0 t/ha. The results obtained this year were similar to those of 1978.

Table 16b: Performance of Top Five Varieties in the 1979 Wet Season Irrigated Medium Duration

Location	Variety	Grain Yield (t/ha)	Duration (days)	Plant Height (cm)	Per Day Yield (kg/ha)
Libore (Niger)	BR 51-49-6	6.177 a	128	90	48.3
	BR 51-118-2	5.646 a	128	114	44.1
	Improved Mahsuri	5.625 a	127	116	44.3
	BR 51-319-9	5.292 ab	128	128	41.3
	IET 2885	5.156 ab	127	110	40.6
Sagbovi-Dome (Benin)	BW 196	4.846 a	141	101	34.4
	BR 51-118-2	4.726 a	135	111	35.0
	IET 2885	4.589 a	139	106	33.0
	FARO 15	4.429 ab	150	128	29.5
	IR 8	4.246 ab	128	103	33.2
Mission-Tove (Togo)	ADNY 2	7.728 a	123	119	62.8
	4414	7.334 a	126	105	58.2
	IR 2070-414-3-9	6.519 b	130	117	50.1
	BR 51-319-9	6.178 bc	128	219	48.2
	BR 51-118-2	6.031 bc	128	108	47.1
Dapaon (Togo)	BR 51-49-6	7.869 a	138	111	57.0
	ADNY 2	7.434 ab	122	98	60.9
	4414	7.278 ab	126	110	57.8
	IR 2070-414-3-9	7.181 ab	126	97	57.0
	ADNY 3	7.031 ab	126	92	55.8
Amou-Oblo (Togo)	IET 2885	6.172 a	129	98	46.8
	BR 51-49-6	5.972 ab	132	106	45.2
	BW 196	5.834 ab	134	90	43.5
	BR 51-118-2	5.669 ab	133	102	43.7
	FARO 15	5.791 ab	143	109	40.5

MANGROVE SWAMP MAIN SEASON 1979

The Performance of the Top Five Varieties are Shown in Table 17a

Trial Results for Zone I

Trial results in Jenoi (Gambia) showed that yield ranged from 1.73-3.63 t/ha; variety DA 29 giving the highest yield. The top five yielders were of short duration and therefore likely to escape salt intrusion along the River Gambia towards the dry season. The variety ROK 5 continues to perform fairly well in Gambia as well as Guinea Bissau. Mangrove swamp yields continued to be higher in Guinea Bissau than in the Gambia. This would be due to the higher rainfall and/or fertile soil in the former than in the latter country. Furthermore, the cultural practice of bunding employed in Guinea Bissau checks the amount of salt water that enters the plots, thereby creating a more favourable growth environment for the rice crop.

Table 17a: Performance of Top Five Rice Varieties in the 1979 Wet Season Mangrove Variety Trials

Location	Variety	Grain Yield (t/ha)	Duration (days)	Plant Height (cm)
Jenoi (Gambia)	DA 29	3.63 a	130	103
	ROK 4	3.46 a	136	102
	ROK 5	3.32 a	131	102
	C 13 F 1	3.17 ab	134	102
	Phar Com En	3.13 ab	136	103
Caboxanque (Guinea Bissau) a) Less salty area	Improved Mahsuri	5.37 a	140	130
	Mahsuri	4.85 ab	141	129
	Sri Malayia	4.59 abc	131	108
	ROK 5	4.59 abc	136	126
	IR 2035-3	4.50 abcd	137	96
b) More salty area	Mahsuri	4.26 a	144	123
	BR 51-91-6	4.04 a	149	105
	Improved Mahsuri	3.91 ab	145	118
	ROK 5	3.57 bc	141	118
	Mange 2	3.46 d	144	83

Trial Results for Zone II

The trial was conducted at two locations. The performance of top yielding varieties is presented in Table 17b.

Table 17b: Performance of Top Yielding Varieties

Location	Variety	Grain Yield (t/ha)	Duration (days)	Per Day Yield (kg/ha)	Plant Height (cm)
Sonfonia (Guinea)	C13F1 (ROK 9)	1.95 a	139	14.0	125
	ROM 5	1.58 ab	139	11.4	117
	Kaolock (local)	1.56 ab	134	11.6	123
	ROK 4	1.53 ab	139	11.0	124
Rokupr (Sierra Leone)	ROK 5	5.23 a	147	35.6	129
	DA 29	5.01 ab	149	33.6	148
	ROK 5	4.68 abc	149	31.4	139
	C13F1 (ROK 9)	4.45 bcd	149	29.9	135

Among the Varieties tested, the old medium duration entries such as ROK 5, DA 29 and C13F1 again exhibited superiority in yields. These varieties also showed similar yield performance in the previous years in Sierra Leone and Guinea Bissau. The superior yield performance of the above three varieties for two or more years indicates that they are suitable medium duration commercial varieties for the mangrove swamp rice in West Africa.

The yields varieties at Rokupr were higher than those at Sonfonia. The local check variety Kaolock in Guinea deserves close observation and field testing at other locations in the region.

DEEP FLOODED MAIN SEASON 1979

Trial Results for Zone I

The varieties performed better in Djibelor, Senegal than in Medina, Gambia. However, for deep flooded conditions, the yields of the top five in Gambia were above average for deep water conditions (Table 18a).

Table 18a: Performance of Top Five Rice Varieties in the 1979 Wet Season Deep Flooded (60-70 cn) Variety Trial

Variety	Grain Yield (kg/ha)	Duration (days)	Height (cm)
	(a) Medina, Gamoia		
Molobadian	2934 a	140	184
BKN 6323	2841 a	140	160
DM 16	2801 a	140	166
FRRS 43/3	2227 abc	140	164
	(b) Djibelor, Senegal		
Phar Com En	4510 a	179	181
RH 2	4422 a	167	181
Mahsuri	3220 b	124	150
ROK 5	3042 bc	138	171
DA 29	2900 bcd	134	180

In Zone II, the deep flooded variety trial was conducted at one location in Sierra Leone. The yields of six varieties tested were very low and ranged from 2.22 t/ha for FRRS 43/3 to 0.96 t/ha for DM 16.

In Zone III, deep flooded rice trials were conducted at Longorola (near Sikasso) and Mopti, both in Mali. Yields were very low at Mopti but good at Sikasso where ten varieties produced more than 2.0 t/ha (Table 18b).

Yield results of the deep flooded trial in Zone IV conducted at Birnin Kebbi in Nigeria were very low due to rat damage and low plant population.

Table 18b: Performance of Rice Varieties Under Deep Flooded Conditions in Zone III

Location	Variety	Total Yield (t/ha)	Duration (days)	Per Day Yield (kg/ha)
	BKN 6323	2.738 a	138	19.4
Longorola	FRRS 43/3	2.702 ab	174	19.3
(close to	DM 16			
(close to	Cula	2.630 ab	174	15.1
Sikasso in	DM 16	2.630 ab	150	17.3
Mali)	Malobadian	2.547 abc	164	15.5
	T 442-36	2.452 abc	138	17.8
	RD 7	2.285 abc	124	18.4
Mopti	Diou (Temoin)	2.214 abc	164	13.5
(WARDA) in	IR 4442	2.154 abc	168	12.8
Mali	RD 5	2.023 abc	119	17.0
	DM 16	2.301 a	137	16.8
Mopti	Cula	2.249 ab	148	15.2
(WARDA) in	BH 2	2.111 ab	147	14.4
Mali	Maliaka	1.893 abc	128	14.8
(Water depth	FRRS 43/3	1.808 abc	143	12.6
102 cm)	Malobadian	1.798 abc	134	13.4
	BKN 6323	1.504 bcd	144	10.4
	T 442-36	1.083 cde	145	7.5

Floating Rice Varietal Trial in 1979

In Zone III, the trials were conducted at the WARDA Research Station in Mopti. The first, second and third trials were conducted where the water depth ranged between 0 and 85 cm, 85 and 105 cm, and 105 and 150 cm, respectively.

Results presented in Table 19a show that yields were very good at water depth of 85 cm and below, fairly average at water depth between 85 and 105 cm, and very poor at water depth between 105 and 150 cm.

This picture shows the infestation of Upland rice field with *Cyperus rotundus;* a terrible weed of upland crops in West Africa.

Table 19a: Performance of Floating Rice Varieties in Mopti, Mali during the Growing Season

Water Level (depth)	Variety	Yield (t/ha)	Duration (days)	Per Day Yield (kg/ha)
"High" Zone (0.85cm)	BKN 6986-38	4.217 a	136	30.6
	B 52-35	4.059 ab	118	34.4
	DA 29	3.852 ab	123	39.8
	BKN 7022-6-4	3.755 bc	133	28.2
	DM 16	3.755 bc	123	30.5
	DM 17	3.754 bc	123	30.5
	BH 2	3.677 bcd	133	38.1
"Middle" Zone (85-105cm)	DM 16	3.263 a	136	24.0
	DA 29	2.696 ab	136	19.8
	BKN 6323	2.584 ab	145	17.8
	KHAO GAEW	2.322 bc	154	13.8
	BKN 6986-167	1.937 bc	151	12.8
	Nag Kiew	1.932 bc	154	12.5
	MSP 11	1.914 bc	154	12.4
"Low" Zone	KLAO GAEW	1.662	0	0
	MSP 11	0.980	0	0
	Mali SAWN	0.820	0	0

In Zone IV, the first coordinated floating rice trial was conducted at Birnin Kebbi in Nigeria. The performance of top and local check varieties are given in Table 19b.

Table 19b: Performance of Top and Local Floating Rice Varieties during the 1979 Season in Zone IV

Location	Variety	Grain Yield (t/ha)
Birnin Kebbi (Nigeria)	Indochine 70	2.90 a
	Indochine Blanc	2.15 ab
	FRRS 43/3	2.13 ab
	FARO 7 (local)	0.78 cd

The three old floating varieties such as Indochine 70, Indochine Blanc and FRRS 43/3 were promising, however, no conclusion can be drawn from the results of this trial.

In Zone V, floating rice variety trial was conducted in Daikena Station in Niger. The C.V. was 34.5% and yield averaged 2.505 t/ha as compared to 4.0 t/ha in the 1978 season. The only variety that outyielded the local check Demba Heira (3.186 t/ha), was variety DA 29 (3.425 t/ha).

INSECTICIDAL TRIALS

In Zone I, the use of Furadan did not give any significant increase in grain yield. In Zone II, use of Furadan reduced incidence of both dead heart and white head under rianfed condition. However, under irrigated condition, application of Furadan led to increase in grain yield by 21 and 14% at Suakoko (Liberia) and Mange (Sierra Leone), respectively. In Zone III, application of Furadan slightly increased grain yield of irrigated. The effect was not commercial. Comparative trial of new insecticides against stem midge in Bobo Dioulasso (Upper Volta) showed that the application of insecticides gave significantly higher grain yield (Decis-4.450 t/ha, Acothion-4.600 t/ha, Miral-5.700 t/ha and Control-2.200 t/ha).

In Zone V, application of Furadan 10 G in two dosages made it possible to increase yield by more than 1.5 t/ha over the control under irrigated condition. Under upland condition, the effectiveness of Furadan was considerably reduced.

HERBICIDAL TRIALS

In Zone I, the chemical herbicides Tamariz and BAS 454-O2H performed fairly well in the four test locations (Sapu, Contuboel, Djibelor and Richard-Toll). Grain yields obtained from their application were as good as either the weed-free treatment or hand weeding twice, 21 and 40 days after transplanting.

The results of herbicidal screening trial at Richard-Toll, Senegal are shown in Table 20.

Table 20: Performance of I Kong Pao in the 1979 Irrigated Herbicide Trial at Richard-Toll, Senegal

Treatment	Grain Yield (kg/ha)	Increase over Control (kg/ha)	(%)
BAS M + Stam F 34	8625 a	6887	396
Machete EC	8500 ab	6762	389
BAS 454-O2H	2850 ab	6512	374
Weed Free	8250 ab	6512	374
BAS KV + Stam F 34	8000 ab	6262	360
Tri. + Surcopur EC	7750 ab	6012	346
Local	7687 ab	5950	342
Stam Super "A"	7250 abc	5512	317
Manual × 2	7125 bc	5387	310
Stam F 34	6250 cd	4512	259
Saturn 10G	4950 d	3212	184
Tamariz (Super)	3437 e	2262	130
Tamariz	3437 e	1700	97
Control	1737 f	0	0

In Zone II under upland condition, the trial was conducted at Suakoko (Liberia). On the basis of weed control efficiency and grain yield, Tamariz-Ordinary (3.04 t/ha) and Tribunil + Surcopur (2.67 t/ha) were as good as weed-free treatment (2.64 t/ha).

Under irrigated condition, the trial was conducted at Suakoko (Liberia) and Mange (Sierra Leone). At Suakoko, the yields were good. The result showed that some herbicides such as Tamariz-Ordinary and Basagran KV + Stam F 34 performed as well as weed-free treatment. At Mange, the yields of various treatments were low.

Under mangrove swamp condition at Rokupr (Sierra Leone), Basagran M + Stam F 34 showed some promise and gave 22% higher yield than both weed-free (2.15 t/ha) and control (2.15 t/ha) treatments.

In Zone III, Tamariz gave the best results in 1978 and 1979 in the Kou Valley (Upper Volta). At Korhogo (Ivory Coast), two mixtures of Basagran KV + Stam F 34 and Tribunil + Surcopur were very effective on weeds but these mixtures were very phytotoxic on rice plants. However, in Kolongo (Mali), the Tribunil + Surcopur mixture gave very good yields (5.6 t/ha followed by Saturn 10G (5.0 t/ha) with an efficiency rate of 96 and 60%, respectively. The toxicity of Basagran KV + Stam F 34 mixture on rice also occurred at this location.

In Zone V, the yields were average and varied from 5.7 t/ha for the treatment with BAS 454-024 to 4.0 t/ha for weed-free plots. Some of the herbicides like Stam F 34 and Tribunil were phytotoxic to the rice plants.

ON-FARM TRIALS

Trials on farmers' fields were proposed to member countries in 1978 by WARDA. They are intended to ensure the rapid extension of new, high yielding and more adaptable varieties to the environment, particularly those that are more acceptable by consumers.

Each country was allowed ten trials to be funded by the Association. Trials were conducted in Zones III and IV.

(a) *Zone III — Ivory Coast, Mali and Upper Volta*

The results of on-farms trials carried out in Ivory Coast, Mali and Upper Volta are shown in Table 21. The choice of varieties included promising varieties from coordinated trials as well as from varieties already in wide use in the various countries. Locally recommended agronomic practices were followed at each site.

(b) *Zone IV — Ghana and Nigeria*

Six on-farm variety trials were carried out in Ghana in the 1979 main season. There were two upland and four irrigated trials. Two trials at Tono Irrigation Project failed due to high incidence of insect pest infestation, while two trials at Dawhenya failed because of limitation of irrigation water during the various growth stages.

Five varieties including one local check were tested at six locations. The plot size was 50 m^2 (10 × 5m). Locally recommended agronomic practices were adopted at each site.

The yields of upland varieties at two locations are given in Table 22a. The results show that IR 1820-210-2 was the highest yielder at two locations. This variety also exhibited promising performance in previous years in trials conducted by the Crop Research Institute.

Compared with other varieties, the incidence of various diseases and insect pests on IR 1820-210-2 was negligible. However, the short plant height of this variety may not be suitable under upland conditions.

Table 21: Grain Yields of Varieties Under On-Farm Trial in Zone III

Country	Varieties	Yield in kg/ha by trial location									Average Yield Per Variety
		1	2	3	4	5	6	7	8	9	
Upper Volta	Vijaya	2160	1540	600	6000	2820	3240	2400	4160	1380	2589
	LR 200	1960	1540	1640	5000	2500	2440	2000	4400	1190	2519
	IR 1529-680-3	1800	1100	960	5200	3840	1400	1880	3640	1396	2357
	IRAT 10	560	-	920	2880	3000	-	-	-	2706	2013
	Koncnaka (Control Fert.)	1880	-	3600	2880	2120	3280	3080	3600	-	2013
	Koncnake (Control Unfer-TILIZED)	1640	-	-	-	-	1840	3880	2880		2540
	C74	-	1200								1200
Ivory Coast	Bouake 189	2799	3999	1600	2769						2792
	Bouake 8	2129	2799	1460	2625	-	-	-	-	-	2253
	IR 5 (control)	-	4000	-	-						4000
	Honnon-Hio	-	-	2340	-						2340
	BLS 929	-	-	1640	-						1640
	Tele	-	-	1440	-						1440
	IRAT 105	-	-	1420	-						1420
	IR 1529-680-3	-	-		3224						3224
	Jaya	-	-	-	2903						2903
Mali	IM 16	2925	5222	3165	2387	925					2925
	IET 2911	2725	4912	2602	2250	1100					2718
	IET 2885	2550	4400	2862	1425	800					2402
	BH 2 (control)	2475	4980	2932	2025	1350	2550				2719
	Segadis (con-trol)	2475	5375	2962	2350	750					2782
	H15-23DA	550	4600	2795	1600	1075					2124
	H4	-	-	-	-	-	2675				2675
	D52-37	-	-	-	-	-	2675				2675
	C74	-	-	-	-	-	2650				2650
	IR 8	-	-	-	-	-	2656				2656
	Dissicule	-	-	-	-	-	2575				2575

Table 22a: Grain Yield: Upland On-farm Variety Trial at Zuo and Atebubu (Ghana)

Zuo			Antebubu		
Variety	Yield (t/ha)	Plant Height (cm)	Variety	Yield (t/ha)	Plant Height (cm)
IR 1820-210-2	2.55	78	IR 1820-21-2	2.15	73
Besewar	2.07	83	IR 2053-205-2	1.60	69
IR 442	1.93	98	IR 442	1.35	72
BH Da (check)	1.90	129	Dourado Precoce	0.85	117
Dourado Precoce	1.20	127	Gomba (check)	0.11	107

The performance of varieties under irrigated condition at Vea is presented in Table 22b.

Table 22b: Grain Yield: Irrigated On-Farm Variety Trial in Ghana

Variety	Yield (t/ha)	Duration (days)	Per Day Yield (kg/ha)	Plant Height (cm)
IR 2071-586-5-6-3	6.00	145	41.4	90
BR 51-118-2	5.40	145	37.2	100
IR 442	5.40	140	38.6	100
Dawhenya II (check)	5.00	140	35.7	75
IR 665-79-2 (check)	5.00	140	35.7	90

IR 2071-586-5-6-3 and BR 51-118-2, the two top varieties, gave higher yields than the two check varieties. It is worth noting that in the 1978 main season coordinated trial, the above two varieties were among the top yielding ones. For example, at Badegii, Bende and Kpong, IR 2071-584-5-6-3 ranked first (7.04 t/ha), fourth (4.8 t/ha), and fifth (4.5 t/ha), respectively.

While BR 51-118-2 ranked first (7.9 t/ha), second (6.3 t/ha), and third (4.0 t/ha) at Bende, Badeggi and Kpong, respectively, this variety also showed high yield potential in previous years.

In the 1979 main season at Kpong, IR 2071-584-5-6-3 produced the highest yield (7.09 t/ha), while the yields of BR 51-118-2 at IITA, Bende and Badeggi ranged between 5.3 and 7.2 t/ha.

At Vea, farmers' first choice was IR 2071-586-5-6-3 due to its high yields, tillering ability and non-lodging characteristics. BR 51-118-2 and IR 443 were their second choice.

The excellent performance of IR 2071-586-5-6-3 and BR 51-118-2 in coordinated trials in Ghana and Nigeria for two or more years and also in one on-farm trial in Ghana indicates their potential of becoming commercial varieties. In the 1980 season, the trial will be modified.

VARIETY ADAPTABILITY STUDIES

Simple linear regression methods are used to describe the variability in the yield phenotype of the varieties from location to location. The method used is a variation of that suggested by Finley and Wilkinson (1963) and subsequently improved upon by Eberhart and Russell (1966). The model:

$$Yij = a + b\bar{Y}j + eij$$

is used, where

Yij = yield of the ith variety at the jth location.

$\bar{Y}j$ = mean yield over all varieties at the jth location. This is regarded as a grade level or index of environment j.

b = the regression coefficient which is interpreted as the yield response of a variety due to unit change in environmental index.

The definition of a widely adapted variety here is one that has:

i. yields above average in all environments; and
ii. regression coefficient close to or equal to one.

Varieties satisfying these conditions are classified as category 1.

Certain varieties do exceptionally well in low yield environments but do poorly in the high yield environments. These varieties would have:

i. average (or moderate) mean yield; and
ii. regression coefficient much lower than one.

These varieties are classified as belonging to category 2.

Yet some varieties may do exceptionally well in high yield environments but do poorly in the low yield environments. These varieties would generally have:

i. average (or moderate) to high mean yield; and
ii. regression coefficient much greater than one.

These varieties are classified as belonging to category 3.

Varieties not included under any of the three categories are grouped under others. These are varieties with either less than average yields or bad fits.

Table 23: Categorization of the Varieties on the Basis of Variety Adaptability Studies

1. Irrigated short duration: Off-season 1978/79 (Table 7.1)

   Category 1: BR 51-46-5, BW 78, ADNY 11, IR 2035-250-3, IET 1444.
   Category 2: NTU 770-7-2
   Category 3: BG 90-2, 4448
   Others : IR 28, IR 934-450-5, 4456, BR 36-13-5, IET 2775, BPI 76/9 × DAWN.

2. Irrigated medium duration: Off-season 1978/79 (Table 7.2)

   Category 1: IR 1529-680-3, BG 374-1, IET 1996, BR 51-49-6.
   Category 2: -
   Category 3: 4414, BR 51-118-2
   Others : IR 2070-414-3-9, IET 2885, BW 196, BR 51-118-2, BR 52-8 1, IR 2053-241-3-2-3, IMP. MAHSURI, BW 191.

3. Rainfed short duration: Main season 1979 (Table 7.3)

Category 1: IRAT 109, IRAT 110, IR 2053-205-2, ADNY 7, B57C-MD-10-2.
Category 2: ADNY
Category 3: -
Others : CR 1002, IR 1480-116-3-3, C 168, SE 319G, B9C-MD-3-3, KN 144, IRAT 10. IRAT 112.

4. Rainfed medium duration: Main Season 1979 (Table 7.4)

Category 1: 4418, MRC 172-9
Category 2: IRAT 13, IRAT 132, SEL. IRAT 194/1/2
Category 3: COL 38, B541B-KN-91-3-4, IR 1529-242-3, IR 1529-680-3
Others : LAC 23, IR 3880-17, IET 3226, SEIN TAILEY, LD 125.

5. Irrigated short duration: Main season 1979 (Table 7.5)

Category 1: BG 90-2, IR 3273-P339-2, ADNY 11, BR 51-46-5, MTU 8431
Category 2: BW 78
Category 3: IR 2042-178-1
Others : BPI 76/9 × DAWN, IET 1444, IET 1785, IET 2775, IR 2798-107-3, MRC 505, NTU 770-7-2.

6. Irrigated medium duration: Main season 1979 (Table 7.6)

Category 1: BR 51-118-2, BW 196, BR 51-49-6, BR 51-319-9, IET 2885, 4414, FARO 15.
Category 2: -
Category 3: BG 375-1
Others : ADNY 2, ADNY 3, H5, IMP. MAHSURI, IR 2070-414-9, IR 5666-15-2.

7. Mangrove: Main season 1979 (Table 7.7)

Category 1: ROK 5, ROK 4
Category 2: -
Category 3: BD2
Others : BG 11-11, ADNY 4, BG 34-8, BR 51-91-6, C13-F1, DA 29, POKKALI 9, SRI MALAYSIA.

8. Deep flooded: Main season 1979 (Table 7.8)

Category 1: FRRS 43/3, BKN 6323, MALOBADIAN, DM 16
Category 2: -
Category 3: -
Others : KAIKKA, T442-36, CULA, MSP 11, RD 5.

9. Floating: Main season 1979 (Table 7.9)

Category 1: KHAO GAEW
Category 2: MSP 11
Category 3: DM 16
Others : BKN 6989-167, MALI SAWN, NANG KIEW.

INITIAL EVALUATION TEST

Types of Trials Conducted

The following types of IETs were conducted during 1979:

1. Irrigated dry/off-season (a repettition of the 1978 irrigated main season trial);
2. Rainfed main season;

3. Irrigated main season;
4. Deep flooded main season.

Trial Entries

The trial consisted of a total of 705 entries and were distributed as follows:

1. Irrigated dry/off-season : 180
2. Rainfed main season : 275
3. Irrigated main season : 208
4. Deep Flooded : 42

Cooperators were requested to include a local check(s) after every twenty entries in each trial. However, the performance of the checks was not included in the returned data.

Trial Locations

The four IETs were conducted at twenty-four locations in fourteen WARDA member states.

The irrigated dry/off-season trial consisted of 180 entries from the 1978 irrigated main season trial that were sent to ten locations in nine countries. It was conducted at only two locations: Sapu (Gambia) and Suakoko (Liberia).

The rainfed main season trial was sent to fifteen locations in thirteen countries, but was conducted at twelve locations in eleven countries namely:

1. Sefa (Senegal
2. Sapu (Gambia)
3. Bordo (Guinea)
4. Suakoko (Liberia
5. Bouake (Ivory Coast)
6. Nyankpala (Ghana)
7. Sotouboua (Togo)
8. Bagou (Benin)
9. IITA/Ibadan (Nigeria)
10. Moor Plantation (Nigeria)
11. Farako-Ba (Upper Volta)
12. Sikasso (Mali)

The irrigated main season trial was distributed to nineteen locations in fourteen countries. It was conducted at the following twelve locations in eleven countries:

1. Kaedi (Mauritania)
2. Richard-Toll (Senegal)
3. Djibelor (Senegal)
4. Sapu (Gambia)
5. Mange (Sierra Leone)
6. Suakoko (Liberia)
7. Gagnoa (Ivory Coast)
8. Mission Tove (Togo)
9. Sagbovi-Dome (Benin)
10. Kagnoni (Mali)
11. Valle Du Kou (Upper Volta)
12. Libore (Niger)

The deep flooded main season trial was sent to five locations in four countries. However, it was conducted at three locations in two countries: Sapu (Gambia), Daikena (Niger) and Kolo-Moli (Niger).

Collection and Reporting of Trial Data

The data sheets included columns for data collection on:

Plant height in cm;
Duration in days of 50% flowering;
Number of panicles per hill;
Total number of hills harvested;
Grain yields in gms;

Leaf blast reaction;
Neck blast reaction;
Leaf scald;
Brown leaf spot;
Stemborers — dead heart;
Stemborers — white heads.

Irrigated Dry/Off-season Trial

The performance of the entries was generally better at Sapu than at Suakoko. The five highest yielding entries at the two locations were as follows:

Entry No.	Designation	Yield (g/sq.m)
Sapu (Gambia)		
127	IR 5254	904.5
152	IET 6057	736.5
149	IET 5924	688.0
161	B5416-Kn-47-1-1	687.0
162	B5416-Kn-53-1-1	675.0
Suakoko (Liberia)		
163	B5416-Kn	625.0
43	IET 5101	613.0
52	IET 6065	602.3
108	IR 4442-165-1-3-2	590.9
107	IR 4442-46-3-3-3	568.2

None of these entries was found to be common at both locations.

On the basis of average across-locations performance, the following were the best twenty entries:

Entry No.	Designation	Average Yield (g/sq.m)
152*	IET 6057	618.0
161	B5416-Kn-47-1-1	604.0
163*	B541b-Kn-22-7-2	559.0
127	IR 5254-3-5	577.0
177*	541c-10-3-1	545.0
168	B2350-7-3-3-1	522.0
117*	IR 4698-176-2-2	516.0
108	IR 4442-165-3-3-2	505.0
107	IR 4442-46-3-3-3	503.0
124	IR 4819-77-3-2	501.0
31	BR 169-1-1	488.0
155	IET 6136	488.0
140	KLG 6987-132-2	486.0
44	IET 5121	475.0

12	IR 2053-375-1-1-5	825.0
118	IR 4705-362-1-3	465.0
32	BR 168-28-2-4	462.0
169*	B 2360-6-9-5	450.0
45	IET 5233	448.0
173	B 2931-19-2-2-1-1	447.0
74	B 2362-6-2	445.0

*Entries that showed fairly high yields at the two locations

In terms of high yield combined with wide adaptation, only seven out of the twenty entries were found to be satisfactory. However, this information should be regarded with caution since the trial was conducted at only two locations.

Rainfed Main Season Trial

On the average, appreciably high yields were obtained at Sefa (Senegal), Sapu (Gambia), Suakoko (Liberia), and Moor-Plantation (Nigeria). The lowest yields were obtained at Bouake (Ivory Coast) and Bagou (Benin).

The best five entries at the different locations were as follows:

Sefa (Senegal)

Entry No.	Designation	Yield (g/sq.m)
32	62-155-C1	833.3
63	BR 51-291-3-3	650.0
66	BR 51-29-12/HR 62	633.3
230	ARC-10372	616.7
193	TOX 378-8-N16-NIB	583.3
Sapu (Gambia)		
165	DJ 11-511-3-1	828.8
115	M133/6/1/2	710.0
156	IET 3226	696.6
61	BR 51-132-3-1	673.2
105	DJ-341	672.2
Bordo (Guinea)		
183	ART 115	466.7
120	LAC 23 (White)	420.0
123	IR 30	410.0
97	I Kong Pao	366.7
193	TOX 378-N16-N18	342.2
Suakoko (Liberia)		
82	BR 52-85-3/HR 70	1125.0
96	MTU 8002	1025.0
85	BR 52-85-3-HR60	975.0
174	TOX 95-8-1-1LS-3	950.0

Bouake (Ivory Coast)

259	IRAT II	144.9
164	DJII-307-4-5	137.4
258	IRAT 10	234.9
256	IRAT 107	114.9
158	Sel. IRAT 194/1/3	104.9

Nyankpala (Ghana)

Entry No.	Designation	Yield (g/sq.m)
32	62-155C1	800.0
115	M1-33/6/1/2	650.0
168	DJ12-519-1-3	625.0
170	DJ 12-539-1	600.0
14	IR 1746-226-1-1-4-A1	450.0

Soutouboua (Togo)

168	DJ 12-519-1-3	637.5
207	TOX 504-N14-NK6-NIB	575.0
146	Pursur	487.5
155	IR 1529-242-3	475.0
158	Sel. IRAT 194/1/2	475.0

Bagou (Benin)

129	BR 52-85-3/HR 79	194.9
128	BP 176	182.7
157	Sein Tailey	173.9
159	B 293Z-9-5-2-5-1	166.7
168	DJ 12-519-1-3	164.5

Ibadan (Nigeria)

197	TOX 502-NIb-NK12-NIB	456.3
52	C46-15/IR24-2	349.8
198	TOX 502-NI25-N11-NIB	344.8
178	ART 9	328.8
145	IRAT 32	325.5

Moor-Plantation (Nigeria)

40	Kinandang	622.2
84	M 50/2	622.2
160	BW 241-6-A	622.2
221	TOX 516-NIB-N110	622.2
225	TOX 737-NIB-NIB	622.2

Farakoba (Upper Volta)

142	IRAT 109	507.5

143	IRAT 110	426.7
168	DJ 12-519-1-3	372.0
165	DJ 11-511-3-1	353.3
170	DJ 12-539-1	399.2
Sikasso (Mali)		
268	IRAT 7134-1-1	422.2
170	DJ 12-539-13	377.8
182	ART 102	322.2
225	TOX 737-NI-NIB	311.1
166	DJ-11-508-3	300.0

None of the sixty entries indicated above was common at two or more locations.

The top twenty entries in terms of average cross-locations performance are listed Below:

Entry No.	Designation	Average Yield (g/sq.m)	No. of locations with yields equal to or above average
168	DJ 12-519-1-3	352.0 (10)	5
32	62-155-C1	348.0 (9)	5
115	M 133/6/1/2	320.0 (11)	5
160	BW 241-6-A	328.0 (7)	4
170	DJ 12-539-1	326.0 (10)	6
3	IR 1746-226-16-2-2	325.0 (8)	5
82	BR 52-85-3/HR 70	325.0 (7)	2
174	TOX 95-8-1LS-3	325.0 (7)	3
235	BR 52-85-3/HR 68	318.0 (7)	3
96	MTU 8002	306.0 (7)	2
154	IR 3880-17	301.0 (7)	3
1	IR 2735-F56-35-A1	298.0 (9)	5
204	TOX 502-N147-N165-NIB	296.0 (7)	4
226	TOX 737-NIBI-NIB	294.0 (8)	5
12	IR 2053-375-1-1-5	292.0 (8)	3
5	IRAT 9 C1	291.0 (7)	3
60	BR 51-291-12	289.0 (8)	4
233	BR 25-71-7-8	287.0 (7)	3
152	MRC 172-9	286.0 (7)	3
151	4320	285.0 (7)	4

( ) : The number of location upon which the average yield was based.

The above data show that the across-locations performance of the entries was comparatively low. The data also indicate that none of the entries could be identified as high yielding and well adapted. However, a few such as the first five indicated above could be considered as fair.

2.8.4 *The Irrigated Main Season Trial*

Very good yields were obtained at Kaedi (Mauritania), Sapu (Gambia), Suakoko (Liberia), Mission-Tove (Togo), Sagbovi-Dome

(Benin), and Libore (Niger). Comparatively, the performance of the top 50 entries at Richard-Toll (Senegal) and Djibelor (Senegal) were found to be good.

Listed below are the top five among the high-yielding entries at each location:

Kaedi (Mauritania)

Entry No.	Designation	Yield (g/sq.m)
138	BR 40-300-2-1	850.0
81	IET 4094	850.0
33	Biplab	800.0
86	IET 4824	800.0
78	IET 3125	750.0
Richard-Toll (Senegal)		
70	CR95-JR-1512-1	700.0
24	B2227c-Mr-99-2	666.7
79	IET 3137	666.7
121	IR 2071-625-1-252	633.3
132	IR 2992-22	633.3
Djibelor (Senegal)		
47	BR 51-118-2	738.0
128	IR 2823-103-5-1	692.0
45	BR 54-74-6	666.0
142	IR 3483-109-2-3	638.0
44	BR-49-10/HR 41	538.0
Sapu (Gambia)		
81	IET 4094	831.7
205	Si-3	711.7
1	75-4830	665.8
111	IR 1820-52-2-4-1	647.9
2	75-5070	639.6
Mange (Sierra Leone)		
62	C166	379.3
20	B1367-26-1	370.0
61	BW 248-1	368.0
1	75-4830	365.0
159	IR 4432-28-5	362.0
Suakoko (Liberia)		
20	BL367c-26-1	1897.0
10	B4626-Pa-1-3	1882.4
30	BG 94-1	1500.0
39	BR 51-17-3	1458.0
57	BR 168-2B-23	1455.0

Cagoa (Ivory Coast)		
97	IET 6057	702.0
51	BR 51-319-9	693.3
114	IR 2042-102-2-3-2	693.3
96	IET 5609	671.1
171	IR 4859-38-3-3	653.3
Mission-Tove (Togo)		
32	BG 90-2	1673.3
60	BW 196	1505.0
41	BR 51-46-1-1c	1500.0
182	LD 125	1491.7
39	BR 51-17-3	1423.3
Sagbovi-Dome (Benin)		
50	BR 51-286-1	863.0
47	BR 51-118-2	770.4
198	RC 10	716.4
126	IR 2773-15-2	680.4
150	IR 4228-78-3-4-1	663.9
Kagoni (Mali)		
72	CR 1002	705.6
141	IR 3478-97-2-3	616.7
11	B 539b-KPJ-1-5-3-2	605.6
148	VIJAYA (Sel.)	597.2
10	B4626-Pn-1-13	561-1
Valle du Kou (Upper Volta)		
70	CR95-JR-1512-1	562.0
122	IR 2151-598-3-5	513-5
165	IR 3941-25-1	470.7
110	IR 1561-228-3-3	456.4
79	IR 5894-73-3	430.8
Libore (Niger)		
70	CR95-JR-1512-1	1050.0
105	IR 36	1050.0
11	B 539b-KPJ-3-3-5-3-2	1007.5
111	IR 1820-52-2-4-1	1000.0
12	B541b-Ka-35-4-4	975.0

Generally entries with very good yields were identified at almost all the locations, except at Mange, (Sierra Leone), where the yields were found to be lowest. Fantastic and unexplainable yields were recorded at Suakoko (Liberia), Mission-Tove (Togo), and Libore (Niger). Out of the fifty-four entries listed above, forty-eight were found to be location-specific, and six (1, 10, 20, 47, 81, and 11) were common at only two locations.

In terms of average across-locations performance, the following entries (with yield data from at least ten locations) were identified as the best twenty:

Entry No.	Designation	Average Yield (g/sq.m)	No. of locations with yields equal to or above average
20	B1367c-26-1	591.0 (11)	4
10	B462b-Pa-1-3	557.0 (12)	4
32	BG 90-2	551.0 (12)	6
41	BR 51-46-1-1c	531.0 (12)	6
47	BR 51-118-2	521.0 (11)	4
70	CR 95-JR-1512-1	515.0 (10)	4
15	B 5416-Pa-7-1-2-3	515.0 (L2)	6
11	B 539b-KPJ-3-5-3-2	500.0 (11)	6
182	LD 123	499.0 (11)	4
60	BW 196	489.0 (12)	4
40	BR 51-29-1-6	487.0 (11)	4
30	BG 94-1	483.0 (10)	3
128	IR 2823-103-5-1	480.0 (10)	5
44	BR 51-49-10/HR 41	480.0 (10)	6
61	BW 248-1	478.0 (11)	5
43	BR 51-49-6/HR 54	477.0 (11)	8
141	IR 3478-97-2-3	476.0 (11)	5
57	BR 168-2B-23	473.0 (11)	4
3	75-5072	471.0 (12)	6
148	VIJAYA (Sel.)	465.0 (10)	6

( ) Number of locations upon which the average yield was based.

With regard to average across-locations performance, the best twenty entries were good. About half of the entries (3, 11, 15, 32, 41, 43, 44, and 148), exhibited a combination of good yield with an appreciable level of wide adaptation. Entry No. 43. BR 51-49-6/HR 41, was found to be the best.

The Deep Flooded Main Season Trial

On the average, the yields obtained at Kolo-Moli and Daikaina were the highest and lowest respectively.

The best five entries at the individual locations were as follows:

Sapu (Gambia)

Entry No.	Designation	Yield (g/sq.m)
40	T442-36	477.5
25	Kumragoir	476.0
16	IM 16	474.3
5	BKN 6323	471.5
47	RH 2	471.0

Daikaina (Nigeria)

23	Khao Gaeuw	337.5
12	Habiganj A.I	300.0
11	FRRS 43/3	275.0
33	MSP 11	275.0
37	Rajasail	275.0

Kolo-Moli (Niger)

35	Neang Kheaw	760.0
17	Indochina 24	740.0
4	Bhadoia	720.0
29	Maliong	720.0
25	Kumragoir	670.0

Among the fourteen entries listed above, only the last one, Kumragoir was common at two locations, the rest were found to be location-specific.

Among the fourteen entries listed above, only Kumragoir was common at two locations, the rest were found to be location-specific. specific.

The following twelve entries (with data from all locations) were identified as the best in terms of average across-locations performance.

Entry No.	Designation	Average Yield (g/sq.m)	No. of location with yields equal to or above that of the Average
25	Kumragoir	457.0	1
11	FRRS 43/3	437.0	2
40	T 442-36	427.0	2
4	Bhadoia	415.0	2
36	Puang N'gem	410.0	2
5	BKN 6323	386.0	2
10	DM 16	383.0	2
29	Maliong	370.0	1
42	Taow Boon N'gern	369.0	2
17	Indochine 24	367.0	1
21	Kaika	356.0	2
19	Indochine Blanc	323.0	

Eight (67%) of the entries had yields equal to or above that of the across-locations average at two locations. The remaining four were found to be location-specific. However, this information should be interpreted with caution since the number of locations at which the trial was conducted was very limited.

SEED NURSERY FARM

Fourteen nurseries/materials (5 upland and 9 lowland) totaling 3816 entries (563 upland and 3253 lowland) were planted during the

1979/80 cropping seasons (Table 24). This indicates that most of the activities were centered on lowland (irrigated and deep flooded) rice. This situation was mainly due to the limited upland field facilities. However, this problem has been solved by the clearing of an additional 7.5 acres of upland that is currently being utilized.

Table 24: Nurseries/Materials Planted at the WARDA Seed Nursery Farm (SNF) Suakoko During the 1979/80 Cropping Seasons*

Nursery/Material	Date Planted	No. of Entries
IITA Variety Performance Trials	June, 1979	7
IURON (IRTP)	July, 1979	149
General Seed Increase	July, 1979	25
IET Seed Increase	Sept. 1979	35
IRBN (IRTP)	Sept. 1979	347
	Total:	563
LOWLAND		
IITA Variety Performance Trial	June, 1979	7
General Seed Increase	June, 1979	292
Blast Disease Nursery (Crop Protection Trial)	July, 1979	15
Germplasm	Aug. 1979	1098
General Seed Increase	Aug. 1979	113
F2	Sept. 1979	7
IRON (IRTP)	Sept. 1979	331
General Seed Increase	Jan. 1980	292
Germplasm	March 1979	1098
	Total:	2353
	Grand Total:	3816

* Continuous Cropping

IITA: International Institute of Tropical Agriculture
IURON: International Upland Rice Observational Nursery
IRTP: International Rice Testing Programme
IET: Initial Evaluation Trial
IRBN: International Rice Blast Nursery
F2: Segregation Population
IRON: International Roce Observational Nursery

WARDA SEED CENTRE

The Centre plays an important role in the overall research activities of WARDA. Since its establishment in 1974, its role has expanded from the basic quality control and supplies to such other important activities like germplasm maintenance and storage, importation of new rice varieties/lines for all WARDA member countries; rice disease diagnosis and training of personnel in seed handling practices.

During the period under review, a total of 641 entries were packaged for the WARDA 1980 main season trials. The entries were composed into 3 Initial Evaluation Trials (IETs) and 8 Coordinated Variety Trials (CVTs), all making up a total of 151 trials spread over 56 locations in the 15 WARDA member countries.

The highlights of the Centre's activities are summarized below:

1. *Distribution of Trial Materials*

The details of distribution for both the IETs and the CVTs are summarized in Tables 25, 26, and 27. With the re-classification of upland rice growing areas of West Africa, an additional trial (Savanna Upland Short Duration) was added to the list, thus bringing the total CVTs to 8. Of the total 641 entries packaged for the trials, 112 and 529 constituted the CVTs and IETs, respectively.

The bulk of the entries for the two main types of trials were either produced at Suakoko (Liberia), Richard-Toll (Senegal) and Mopti (Mali) during the 1979-80 cropping season or obtained from the reserved seed stock kept at the Centre. Also, research centres such as IRAT (Bouake, Ivory Coast), IITA and NCRI (Nigeria), and Rice Research Station (Rokupr, Sierra Leone) donated entries for inclusion in the current trials.

In addition to processing and treating with hot water, all the entries were evaluated for viability. All the CVT materials were assessed for viability before dispatch. Each seed package was provided with essential documents such as protocol, list of entries, phytosanitary certificate, and special information sheet on the handling of seed materials treated with chemicals.

Table 25: Number of Varieties, Trial Sites and Seed Packages for the WARDA IET and Coordinated Variety Trial – 1979

Type of Trial	No. of Entries	No. of Trials	No. of Packages for each trial
IET–Upland	236	14	3304
IET–Irrigated	235	19	4465
IET–Deep Flooded	58	8	464
Savannah Upland Short Duration	14	7	98
Moist Zone Upland Short Duration	14	18	252
Moist Zone Upland Medium Duration	14	21	294
Irrigated Short Duration	14	25	350
Irrigated Medium Duration	14	26	364
Mangrove Swamp	14	9	126
Deep Flooded	14	9	126
Deep Water	14	4	56
Total	641	160	9799

Table 26: Distribution of WARDA Initial Evaluation Trial – 1980/81 Main Season

SUB-REGIONAL ZONE	COUNTRY	LOCATION	UPLAND	IRRIGATED	DEEP FLOODED	TOTAL
I	GAMBIA	Sapu	x	x	x	3
		Total	1	1	1	3
	GUINEA BISSAU	Contuboel				
		Total	x	x		2
	MAURITANIA	Kaedi	1	1	0	0 2
		Total		x		1
	SENEGAL	Djibelor	0	1	0	1
		Richard-Toll		x	x	2
		Sefa		x		1
		Total	x			1
II	GUINEA	Gueckedu	1	2	1	4
		Kankan	x			1
		Kindia			x	1
		Total		x		1
	LIBERIA	Suakoko	1	1	1	3
		WARDA	x	x		2
		Total	x	x		2
	SIERRA LEONE	Mange	2	2	0	4
		Rokupr		x		1
		Total	x			1
	IVORY COAST (Cote d'Ivoire)	Bouake	1	1	0	2
		Gagnoa	x			1
		Korhogo		x		1

Table 26 (cont'd)

		Total	1	x 2	0	1 3
III	MALI	Gao			x	1
		Kogoni		x		1
		Mopti			x	1
		Total	0	1	2	3
	UPPER VOLTA (Haute Volta)	Farakoba	x			1
		Valle du Kou		x		1
		Total	1	1	0	2
IV	NIGERIA	Badeggi		x		1
		Benin Kebbi			x	1
		IITA	x	x		2
		Moor Plantation	x			1
		Total	2	2	1	5
	GHANA	Kpong		x		1
		Nyankpala	x			1
		Total	1	1	0	2
V	NIGER	Daikena			x	1
		Kolo			x	1
		Libore		x		1
		Total	0	1	2	3
	TOGO	Mission-Tove		x		1
		Sotouboua	x			1
		Total	1	1	0	2
	BENIN	Houeda		x		1
		Ina	x			1
		Total	1	1		2

Table 27: Distribution of WARDA Coordinated Variety Trials — 1980/81 Main Season

SUB-REGIONAL ZONE	COUNTRY	LOCATION	Savannah Upland short duration	Moist zone Upland medium duration	Moist zone Upland short duration	Irrigated short duration	Irrigated medium duration	Mangrove Swamp	Deep flooded	Deep Water Floating		
I	GAMBIA	Jenoi						x			1	
		Johali							x		1	
		Sapu		x	x	x	x				4	
		Total	0	1	1	1	1	1	1			6
	GUINEA BISSAU	Caboxanque						x			1	
		Contuboel		x	x	x	x				4	
		Total	0	1	1	1	1	1				5
	MAURITANIA	Kaedi				x	x				2	
		Mpouri				x	x				2	
		Total	0	0	0	2	2	0	0	0		4
	GUINEA	Gueckedu		x	x						2	
		Kankan							x	x	2	
		Kindia				x	x				2	
		Sonfonia						x			1	
		Total	0	1	1	1	1	1	1	1		7

Table 27 (cont'd)

II	LIBERIA	Fendall		x	x						2	
		Suakoko	x	x	x	x					4	
		WARDA										
		Total	0	2	2	1	1	0	0	0		6
	SIERRA LEONE	Gbomsamba						x			1	
		Kenema		x							1	
		Mange			x	x					2	
		Njala			x						1	
		Rokupr		x	x		x				3	
		Total	0	2	2	1	1		0	0		8
III	IVORY COAST	Bouake	x	x	x						3	
		Gagnoa		x	x	x	x				4	
		Korhogo				x	x				2	
		Man		x	x						2	
		Odienne		x	x						2	
		St. Pedro				x	x				2	
		Total	1	4	4	3	3	0	0	0		15
	MALI	Gao						x	x		2	
		Kogoni				x	x				2	
		Mopti							x	x	2	
		Sikasso	x						x		2	
		Totla	1	0	0	1	1	1	3	1		8

Table 27 (cont'd)

	UPPER VOLTA	Benfora	x	x	x						3	
		Farakoba	x	x	x						3	
		Valle du Kou				x	x				2	
		Total	2	2	2	1	1	0	0	0		8
IV	NIGERIA	Badeggi				x	x				2	
		Bende				x	x				2	
		Bernin Kebbi							x	x	2	
		IRAT		x	x						2	
		IITA		x	x	x	x				4	
		Moore Plantation		x	x						2	
		Total	0	3	3	3	3	0	1	1		14
	GHANA	Atebubu		x	x						2	
		Kpong				x	x				2	
		Nyankpala		x	x						2	
		Tono				x	x				2	
		Total	0	2	2	2	2	0	0	0		8

Table 27 (cont'd)

V	BENIN	Domego				x	x	xx			2
		Grandpopo									2
		Houeda				x	x				2
		Ina	x								1
		Total	1	0	0	2	2	2	0	0	7
	NIGER	Daikena				x	x		x		3
		Kolo							x		1
		Libore				x	x				2
		Total	0	0	0	2	2	0	2	0	6

II. *Seed Exchange and Supply*

A total of 2709 new materials were introduced from outside the region. Sixty-nine varieties were dispatched to Mozambique, Ivory Coast, Nigeria and the Philippines. The present accession number of rice germplasm kept in the Centre's conditioned storage room is 7,650. However, in view of the delay in the construction of WARDA's medium term storage facility, the materials are yet to be reviewed for elimination of duplicates and rejuvenation. To date, 1700 varieties/lines have been sent to both Suakoko and Richard-Toll for seed increase.

III. *Pathology*

The pathology wing of the Seed Centre was involved in the following studies:

i) Participation in the screening of the 1979 International Rice Blast Nursery (IRBN)
ii) Screening of fungicides for effectiveness in the control of neck blast fungi *(Pyricularia oryzae)*
ii) Appraisal of the rice disease situation in West Africa.

In addition to following up the above activities in the coming years, the Centre also plans to establish a seed health testing facility.

IV. *International Rice Testing Program — 1979/80 Nurseries for WARDA*

The 1979 and 1980 IRTP nurseries have been sent to WARDA from IRRI. The 1979 materials have already been cleared by the plant quarantine division and have been distributed to WARDA member countries.

V. *Miscellaneous Activities*

Training: At the request of the Government of the Republic of Sierra Leone, the Centre assisted in the training of 19 staff members of the Seed Multiplication Project in different aspects of Seed Certification and Seed Testing. The course which was held in Sierra Leone from November to December 1979 lasted for four weeks and was entirely funded by the project.

Also, two students from the University of Liberia participated in a work-study programme at the Centre for two months (December-January).

WARDA RICE GERMPLASM ACTIVITIES IN 1979

A. *Rejuvenation and Field Assessment*

In preparation for the completion of the WARDA germplasm bank, initial phase of rejuvenation and multiplication of field assessment of germplasm materials was started at the WARDA Seed Nursery at Suakoko in 1979. Most of the materials involved are those collections received from IRAT-ORSTOM, IITA and collections made by WARDA Special Research Project staff at Richard-Toll.

Table 28 summarizes the general information on the sources and germination of the materials sown. Some of the materials have been kept in the WARDA cold room (21%C, 60% R.H) for over four years hence there is a need to rejuvenate and determine how many are still viable. Out of a total of 1,103 collections planted, 77% was viable.

Table 28: Germplasm Collections Planted by WARDA in 1979 at Suakoko

	Date Sown	Total Sown	Total Germination	% Viability
Cassamance—Senegal	Aug. 1-6	148	143	97
IITA	Oct. 10-19	606	452	75
Guinea Bissau	Oct. 23	27	22	81
U. S. A.	Oct. 26	19	15	79
IRAT	Oct. 26	274	188	69
The Gambia	Oct. 29	19	19	100
Cassamance—Senegal	Oct. 29	10	6	60
	Total:	1103	845	77

Some of the characters recorded for the collection are stem colour, leaf colour, days to first flowering, days to 50% heading, days to maturity, reaction to iron toxicity, blast, leaf scald, white head, height at maturity, uniformity, grain colour, grain discolouration, general acceptability score.

B. *Collection in Three Countries*

In 1979 WARDA manned rice germplasm explorations in three member countries: Nigeria, Mali and Senegal.

The collections in Mali and Nigeria were made by WARDA consultants; Dr. T.A. Thomas and Dr. Mansoor Kazim. They were made available to WARDA for a period of three months as a special assistance by the Indian Council of Agricultural Research, New Delhi, India.

a. *Cassamance—Senegal:*

To complete the exploration started in late 1978, a second mission led by Mr. A Coly, a WARDA staff at Richard-Toll, was made to the Cassamance region in January 1979.

A total of 81 types were collected (61 *O. sativa* and 19.0 *O. galberrima).* These have been rejuvenated and evaluated both at Fanaye, Senegal and at Suakoko, Liberia.

b. *Mopti—Gao, Mali:*

The collection here was done by Dr. Kazim, WARDA consultant from October-December 1979. He collected deep flooded and floating rice in three main areas of the country as follows:

i) *Mopti:*
The places visited are Kouna, Koloni, Bussoura, Segue, Ngomo, Sareseni, Taikri, Diambacourou.

ii) *Gao:*
The places explored are Bara, Gargouna and Goutchien.

iii) *Tenêkou:*
Explorations were done at Daga, Boukari, Diondioni, Diaferabe, Kara, Koubi.

A total of 104 collections were made each with the following information: source, soil type, plant structure, maturity type, panicle type, grain types, grain color, kernel color and awn condition. The collection was made up of *sativa, glaberrima, longistaminata* and *barthii* species.

c. *Rivers Niger, Kaduna, Sokoto, Rima and Benue Valleys—Nigeria*

From October 1979 to January 1980 Dr. Thomas the WARDA consultant in cooperation with IITA and National Cereals Research Institute (NCRI) in Nigeria extensively explored many parts of Nigeria especially areas around River Niger and River Benue and northwards.

Table 29 shows the number of types of rice collected in the country.

Table 29: Total Number of Different Rice Species Collected in Nigeria by WARDA Consultant in 1979

Species	Total Number
Glaberrima	308
Sativa	237
Longistaminata	9
Barthii	6
Stapfii	2
Total	562

1979 WARDA'S ACTIVITIES ON THE INTERNATIONAL RICE TESTING PROGRAMME

1978 IRTP Nurseries

Most of the 1978 IRTP nurseries received in the region were planted in 1979. Up til May, results or information have been received on 17 out of 23 nurseries distributed (Table 30), this is about 74 percent of the nurseries.

Samples of the summarized highlights of the 1978 IRTP nurseries results are presented below for some of the participating stations.

1. *International Upland Rice Observation Nurserv (IURON)*

A total of six 1978 iuron nurseries were planted throughout the WARDA member countries in 1979 (Table 30).

a. *Sierra Leone:* The nursery was planted on June 19th, 1979. Rainfall was good and over 80 percent of the entries germinated. Diseases were not very serious but brown spot was moderate to severe. Scores ranged from 5-8 on a 1-9 scale.

There was a moderate to severe damage by rodents and domestic birds especially ducks. Entry 25 (Faro 15) one of the promising entries has been used in their crossing program and local yield testing.

b. *Bouake, Ivory Coast:* The 1978 IURON was planted 16th June 1978 at Bouake. Blast and sheath rot were severe. There were two periods of drought; one lasting for 30 days and the second 21 days. Therefore, there was no grain produced by any of the cultivars planted. Entries showing the least drought damage were: IR3880-10, IR3880-13-10, and IR9669 Sel.

These three entries had scores of 1 compared to 2-7 for the control (IRAT 13) in the 1-9 scales.

Table 30: 1979 IRTP NURSERIES RECEIVED AND DISPATCHED TO MEMBER COUNTIRES

Type of Nursery	Total No. of sets	Dispatched details: Destination	Dispatched details: No. of sets	Dispatched details: Date	Result information: Date received in WARDA from cooperator	Result information: Date sent to IRRI from WARDA	Comments
IURON	8	Ghana	1	10/01/79	7/03/79	April 1980	
		WARDA, Suakoko	1	Nov. 1978	Feb. 1980	April 1980	
		Ivory Coast	1	14/01/79	Sent directly to IRRI	July 25, 1979	
		Senegal	1				No germination
		Nigeria	2	09/08/78			No information yet
		Sierra Leone	2	May 1979	March 6, 1980	April 1980	
IRON	1	Liberia	1	Nov. 1978	Sent directly to IRRI	March 13, 1979	
IRLRON	3	Ghana	1	10/01/79			Destroyed by bush fire.
		Liberia	1	08/09/78	April 1980	April 1980	
		Sierra Leone	1	14/09/78	July 25, 1979	Sept. 19, 1979	
IRCTN	4	Mauritania	1	08/11/78			No information yet
		Nigeria	1	08/09/78			No information yet
		Senegal	2	14/09/78	Sent directly to IRRI		

IRDW[illegible]	4	Mali	1	May 1979			Destroyed by drought
		Niger	1	May 1979			No information yet
		Nigeria	2	May 1979			No information yet
IRBN	1	Liberia	1	May 1979	March 1980	April 1980	
IRSATON*	2	Senegal	1				(Not received from IRRI)
(salinity)		Sierra Leone	1				
IRYN-E					March 6, 1980	April 1980	
IRYN-E	1	Sierra Leone	1	14/08/78	March 6, 1980	April 1980	
IRYN-M	1	Sierra Leone	1	[illegible]4/08/78	March 6, 1980	April 1980	
IRYN-L	1	Sierra Leone	1	14/08/78	Sent directly to IRRI	July 25, 1979	
IURYN	1	Bouake	1	13/06/78			

c. *Suakoko, Liberia* (WARDA): Planting was done on July 3rd, 1979. One hundred forty-one out of the 171 (or 82% of the entries) planted germinated. Rainfall was satisfactory throughout the growing season. Disease problems were leaf scald and blast. Yields records were taken and ranged from 80-1 200 g per plot for 4.5 sq. m. The most promising entries have been nominated into the 1980 WARDA Upland Initial Evaluation Trials (IET).

2. *International Rainfed Lowland Rice Observational Nursery (IRLRON)*

a. *Rokupr, Sierra Leone:* This nursery was sown on 17th September 1978 and transplanted on 27th October 1978.

The nursery site was reported to have developed unidentified soil problem which coupled with drought, produced severe stunting and yellowing on most of the entries. Late maturing varieties were badly attacked by rodents and approximately 40 entries were lost.

The best acceptability ratios for the entries were 3 in a scale of 1-9. Some of the entries with acceptability ratios of 3 and seedling blast of 1 are listed below:

B2039c-Kn-7-2-5-3-1
IRAT 8
IRAT 13
63-83
C22
IR42
IR480-5-9-3
IR1529-430-3
IR1529-680-2-3
IR2035-117-3
IR2035-242-1
IR2797-125-3-2-2-2
IR2823-103-5-1
IR3260-P91-100
IR3351-38-3-1

WARDA TECHNICAL NEWSLETTER

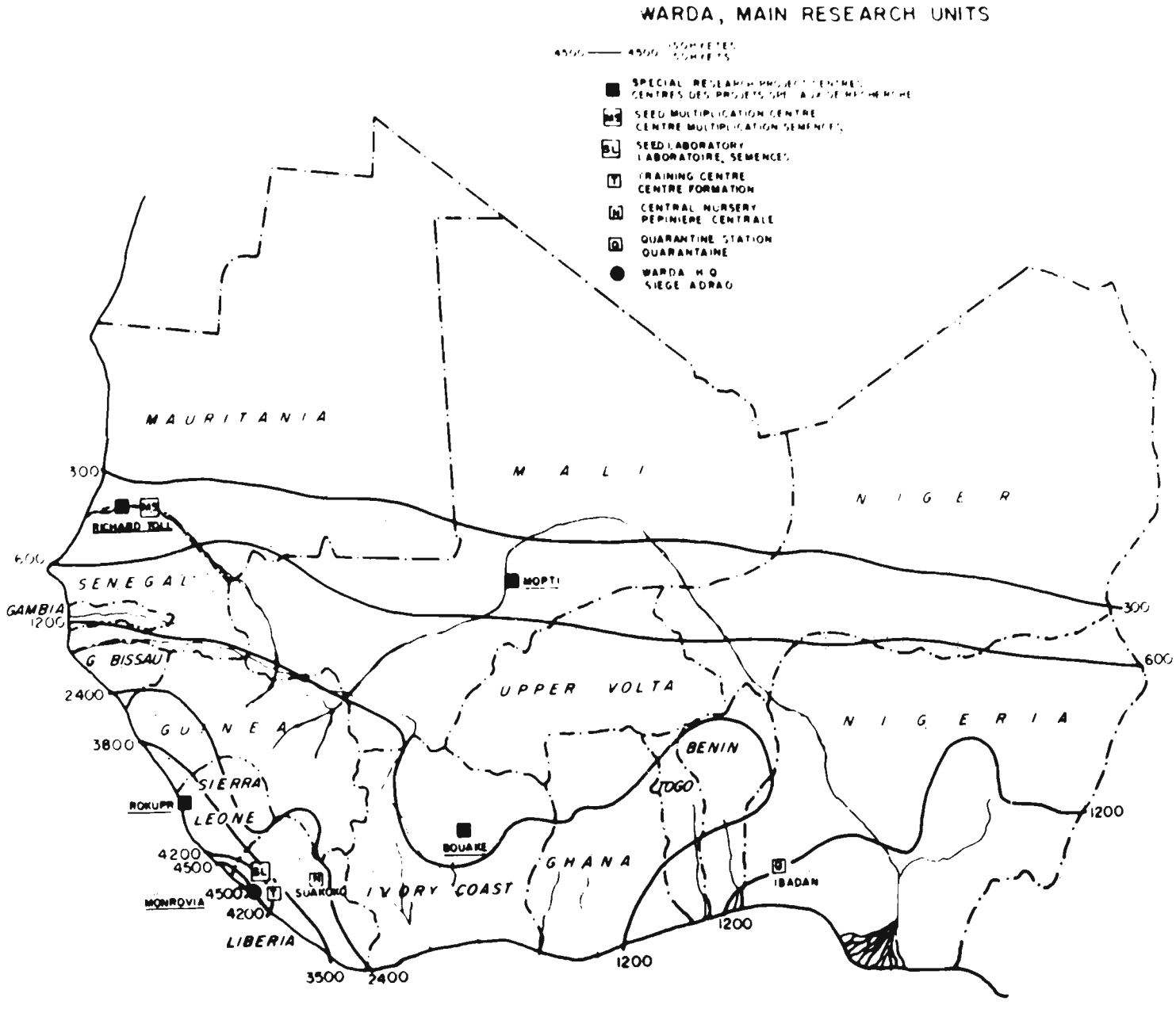
At the 1979 WARDA Research Review Meeting, participants unanimously approved the Research Department's proposal to have a Technical Newsletter. The premier issue of the Newsletter was published in English and French in October 1979.

SPECIAL RESEARCH PROJECTS

Introduction

The special research projects of WARDA are located at Richard-Toll/ Fanaye (Senegal) for irrigated rice, Rokupr (Sierra Leone) for mangrove swamp rice, MOpti (Mali) for deep water and floating rice, and Bouake (Ivory Coast) for upland rice.

The research project at Richard-Toll/Fanaye deals with Variety Improvement, Crop Physiology, Entomology, Soil Chemistry and Weed Control. The Rokupr project deals with Variety Improvement, Entomology, Pathology, Weed Control and Soil Science. The Mopti project deals with Variety Improvement, Agronomy, Weed Science, Entomology and pre-extension. The Bouake project deals with Variety Improvement only.



A map showing the member states of WARDA and the location of the Special Project Stations.

RESULTS OF THE 1979 TRIALS

Irrigated Rice — Richard-Toll/Fanaye, Senegal

1. *Variety Improvement and Physiology*

Under the variety improvement and physiology programme, the following experiments were conducted during the 1978/79 season.

a) Effect of wind on the vegetative and reproductive organs of rice;
b) Seasonal variations in the duration of the vegetative cycle of a few local rice varieties in the south of Senegal;
c) Yield and agronomic characteristics of a few cold tolerant varieties compared with variety Jaya;
d) Evaluation of the yield potential of a few promising varieties for cold tolerance;
e) Evaluation and characterization of rice collections.

In order to assess losses due to winds, a scoring scale was introduced ranging from 1 to 9 as follows:

1 organs unaffected
3 5% damage to the leaf area
4 25% damage to the leaf area
7 50% damage to the leaf area
9 all leaves completely damaged.

Table 31 shows the characteristics, yields and behaviour of 9 rice varieties tested against violent winds.

Table 31: Characteristics, Yield and Behaviour of 9 Rice Varieties Under Violent Winds

Variety	Leaf type	Height (cm)	Degree of damage (1)	Maturity cycle	Yield (kg/ha)
IR 2061-214-3-3-12	Plant with slender and erect leaves	92	3.5	100	6653
IR 3941	Plant with long, slender and thick leaves	92	1.5	100	6900
IR 3941-53	Plant with wide, smooth and erect leaves	95	4	103	5425
IR 3941-55	Slender and erect leaves	85	3.5	101	6047
IR 3941-4	Slender and erect leaves	85	3	97	6094
IR 3941-34	Slender and erect leaves with average width	88	3.5	98	5425
IR 3941-60	Slender and erect leaves	95	1.5	98	6545
Dodo*	Slender, long, droopy and thick leaves	143	1.5	110	3931
HR-33*	Wide, erect and thick leaves	147	2.5	105	2807

* : Total lodging of the two varieties (Dodo and HR-33)
(1) : Average of 4 replications

The leaves of 4 varieties were less affected than those of the other 5, the most affected being variety IR 3941-55 which had broad and flexible leaves. Varieties Dolo and HR-33 with thick leaves lodged during the reproductive stage. In the selection of varieties for the Sahelian ecology, the behaviour of varieties to strong wind which occurs in the ecology should therefore be studied.

The life cycle of 148 local varieties was more than 249 days with longer internodes when sown in February (cool and long daylight period) but reduced to 106 days and with shorter internodes when sown in August (wet season with shorter day length).

Five varieties considered to be cold tolerant (Calrose 76), KH-IB-350, KH-998, Kula and Fujisaka-5) were compared in the dry wet season with the Jaya variety which is popular in the region.

Table 32 showed that KH-998 produced higher yield than Jaya. The lowest yields were obtained with Fujisaka-5 and Calrose 76.

Table 32: Yield and Agronomic Characteristics of 5 Cold Tolerant Varieties compared with Jaya (Richard-Toll, 1979 wet season)

Variety	Height (cm)	50% Flowering	Cycle Maturity	No. of tillers/ (m2)	Yield (kg/ha)
KH-998	68	78	100	482	8407 a*
Jaya	63	99	116	489	7973 a
KN-1h-350	103	99	114	427	5872 b
Kulu	95	75	96	410	5635 b
Fujisaka-5	76	65	91	347	4221 c
Calrose 76	73	66	90	308	3725 c
CV (%)		8.43			
LSD (5%)		757.781			
LSD (1%)		1049.303			
F calculated		57.303**			

* Figures followed by the same letter are not significantly different.

In a second test, the Jaya variety was compared in the wet dry season with 9 other promising vartieties for cold tolerance. Table 33 shows that the variety with the highest yield was IR 3541-86-2-2-1 (10651 kg/ha) followed by IR 7167-4-3-2 (8339 kg/ha). Jaya came third in yield.

2. *Weed Science*

Damage caused by weeds to paddy yield has been estimated at about 80% in the Senegal River region.

Inventory of weeds showed that in the hot off-season, *Echinochlea,* wild rice, *Cyperus difformis, C bulbous, Scirpus maritimus* and *Heleocharcis* were the major weed species but in the rainy season, the major one was *Spehnochlea zeylanica* which had an extremely rapid vegetative growth.

Table 33: Yield and Agronomic Characteristics of a few Promising Varieties for Cold Tolerance (Richard-Toll, 1979 Wet Season)

Variety	Height		Wet Season Cycle		Cold Season Cycle		Yield (3)	
	W.S. (1)	C.S. (2)	50% Heading	Maturity	50% Heading	Maturity	(kg/ha)	Yield Index
IR 3941-86-2-2-1	97	80	83	108	122	145	10651 a*	0,62**
IR 7167-4-3-2	110	97	85	103	122	147	8239 b	0,48
Jaya	118	98	75	119	-	-	7283 bc	0,44
KN-1B-BLK-13-6	151	84	88	103	130	152	6915 c	0,45
IR 7167-33-2-5	110	94	83	105	119	144	6863 c	0,44
KN-1B361-779	150	95	85	107	130	152	6797 c	0,43
KN-1B-361-8-6-9-2-6	148	100	84	105	126	149	6432 c	0,42
KN1B-361-BLK-13-9	150	89	88	109	126	147	6423 c	0,42
KN-1B-361-BLK-2-5	146	94	87	106	130	152	6403 c	0,42
KN-1B-361-8-6-9-4-4	149	98	86	105	126	149	6215 c	0,41
CV (%) = 11.83								

(1) W.S.: Wet Season (2) C.S.: Cold Season (3) Yield in the wet season

* Figures followed by the same letter are not significantly different

** Yield Index = grain yield weight / biomass weight

Of the seven chemicals tested for their effectiveness on weeds, Oxidiazon and Glyphosate (Round Up) gave the best result. Oxidiazon/ Propanil was also effective but was the most phytotoxic, 15 days after treatment.

3. *Entomology*

The most serious destructive insects are stem borers and sap suckers. In 1979, this Division concentrated on estimating yield losses, identifying main insect pests and their economic tolerance threshold as well as the interaction of cultural practices and insect pressure.

Estimation of yield losses in the dry, hot season on farmers' field showed that the application of Furadan gave better yield (Table 34 a and b). The application of this chemical increased yield from 3.25 to 5.67 t/ha, grain quality, grain germination, and weight of 1000 grains.

Table 34a: Effect of ALEUROCYBOTUS INDICUS David (White Fly on Yield of the I Kong Pao Variety in the Hot Dry Season)

Trial	Treatment	Paddy Yield (t/ha)
1	1 kg a.i./ha × 2 Furadan 3G	5.26
	Control	2.01
2	1 kg a.i./ha × 2 Furadan 3G	7.80
	Control	2.13

Table 34b: Incidence of Borers on the Agronomic Characters of I Kong Pao on Farmer's Fields at Guede in the 1979 Hot Dry Season

Treatment	Yield t/ha at 14% moisture	Increases as compared with the control (t/ha)	Number of grains per panicle	Number of white panicle per m2	Number of tillers attacked
1 kg a.i./ha × 5**	6.83	3.00	81.37	0.30	32.83
1 kg a.i./ha × 3*	6.31	2.48	72.18	8.60	51.98
Untreated control	3.83		55.53	21.60	147.86
LSD 5%	0.92		15.49	10.39	3.10
LSD 1%	1.29		21.72	14.57	4.34
s.e.	0.42		7.11	4.77	1.42

Application was by the broadcast method using Furadan 3 G on the following dates:

*: 11, 39 and 54 days after transplanting

**: 11, 25, 39, 54 and 69 days after transplanting

Aleurodes which cause more than 72% yield losses in paddy fields in the hot dry season can easily be controlled with Furadan 3G. In order to determine the minimum dose necessary, 6 doses were tested (0, 0.25, 0.50, 1.00, and 2.00 kg a.i./ha). Table 35 shows that the 1 kg a.i./ha dose is adequate to control aleurodes.

Table 35: Effect of the Furadan Dose on the Control of Aleurodes — Guede, 1979 Hot Dry Season

Dose (kg a.i./ha)	Percentage of leaves covered with pupae
0	95.71
0.25	99.20
0.50	81.51
1.00	6.27
1.50	9.91
2.00	3.48
LSD 5%	13.61
1%	19.08

A study of the effect of sowing date and the level of Furadan application on some rice varieties showed that there was a high number of dead hearts on the sowing date of 21/6/79 (Table 36a), and that two applications of Furadan reduced the incidence.

On the other hand, there was a high number of attacked tillers on all the sowing dates (Table 36b). The effect of the treatment was remarkable on the sowing date of 22/7/79.

The number of panicles varied with the sowing dates (the greatest number was on the early sowing dates, (21/6/79 and 6/8/79) and varieties Chun Chun Aye seemed to be most affected.

The number of caterpillars for each 100 tillers was also highest on the Chun Chun Aye variety. However, treatments reduced the infestation (Table 36c).

Table 36a: Effect of Sowing Date and Protection Level on Number of Dead Hearts

		Number of Dead Hearts	
Sowing Date	Control	1 kg a.i./ha twice	1 kg a.i./ha every 15 days
21/6/79	19.50	6.12	2.87
22/7/79	7.50	2.43	0.43
6/8/79	9.18	3.81	3.51
22/8/79	9.31	3.68	2.62
LSD 5%		4.57	
LSD 1%		6.32	

Table 36b: Effect of Sowing Date and Insecticides on the Number of Tillers Attacked

		Number of Tillers Attacked	
Sowing Dates	Control	1 kg a.i./ha	1 kg a.i./ha every 15 days
21/6/79	34.57	30.61	4.20
22/7/79	38.44	4.71	1.37
6/8/79	36.12	14.59	16.97
22/8/79	33.6	20.61	9.86
LSD 5%		1.25	
LSD 1%		1.76	

Table 36c: Effect of Protection Level and Varieties on the Number of Borers per 100 Tillers

Protection Level	Number of Borers per 100 Tillers			
	Khaun She Shung	Chun Chun Aye	Miao-Jie	I Kong Pao
Control	5.11	9.67	5.90	7.08
1 kg a.i./ha × 2	1.54	1.39	1.51	2.28
1 kg a.i./ha every 15 days	0.16	0.49	0.18	0.04
LSD 5%		0.50		
LSD 1%		0.67		

The first sowing date was less infested than the others. All the factors studied had a significant effect on grain yield but the first dates of planting produced the best yields while the treatment with 5 applications gave significantly better yields. Variety I Kong Pao was the most productive in this trial.

4. *Soil Science*

Most of the research has concentrated on the development of nitrogeneous fertilizer on the one hand, and NPK fertilization in intensive rice cultivation on the other.

Study on the efficiency of different doses, source and method of nitrogen application in irrigated rice cultivation on Hollalde soil in the cold dry season showed that whatever the dose, source of N and method of application, there was always a response to N; highest yields being obtained by application of SCU (130 kg N/ha) or super granules, regardless of the method of application, and the yields obtained after the application of SCU or super granules at 65 kg N/ha were not significantly different from those obtained with the application of 130 kg N/ha in the form of urea. (Table 37a.)

Table 37b shows the effects of different treatments on yield components, cycle and height. It was noted that the number of fertile tillers and height followed the same trend as yields. Both increased with increasing doses of nitrogen whatever the source and method of application of N fertilizer. In this study, sterility decreased as the dosage of N increased and was less influenced by method of application and source of N fertilizer. The dose of 160 kg N/ha and 20 × 20 spacing gave the best yield when sowing was done on 15th November.

Results of studies on the effect of sowing date and spacing on the response of cold tolerant rice variety KH 998 are summarized in Table 38.

Table 37a: Effects of Different Sources of Nitrogen and Method of Application on Production of Dry Matter of Variety KH-998 in the Cold Dry Season at Fanaye (1978-1979 Season)

Treatments	Grain Yield (kg/ha)	Straw Yield (kg/ha)	Total Dry Matter Yield (kg/ha)	Yield Index*	Grain Straw Ratio
Control	1853 d	2400 e	4253	43.57	0.77
32 KgN/ha					
Urea (½-¼-¼)	2086 d	3372 d	5458	38.22	0.62
Urea (Strip application)	2094 d	3077 d	5171	40.50	0.68
SCU (Broadcast)	1843 d	3057 d	4900	37.61	0.60
SCU (Localised)	2292 cd	3694 cd	5986	38.29	0.62
Supergranule	2112 cd	3228 d	5340	39.55	0.65
65 KgN/ha					
Urea (½-¼-¼)	2149 cd	3442 cd	5591	38.44	0.62
Urea (Strip application)	3011 c	3678 cd	6453	46.66	0.82
SCU (Broadcast)	3263 bc	4565 b	7828	41.68	0.71
SCU (Localised)	3835 b	4667 ab	8502	45.11	0.74
Supergranule	3648 bc	3722 cd	7370	49.50	0.98
130 KgN/ha					
Urea (½-¼-¼)	4054 b	4290 bc	9344	43.39	0.94
Urea (Strip application)	3452 bc	4403 bc	7877	43.39	0.94
SCU (Broadcast)	5890 a	5583 a	11473	51.34	1.05
SCU (Localised)	5647 a	4916 ab	10563	53.46	1.15
Supergranule	5240 a	52 ab	10536	49.73	0.99

* Yield Index: $\frac{\text{Grain yield} \times 100}{\text{Total dry matter}}$

All the figures followed by the same letter are not significantly different at P = 0.01.

Table 37b: Effects of Different Sources of Nitrogen and Method of Application on Yield Components of Variety KH-998 (1978-1979 Season)

	YIELD COMPONENTS			CYCLE (Days)		
Treatments	Number of Fertile Tillers/ Plant	% of Sterility	Weight of 1000 Grains (g)	50% Flowering	Maturity	Height (cm)
Control	8.43 f	41.55	21.26	138	158	64
32 KgN/ha						
Urea (½-¼-¼)	11 e	41.40	19.95	130	153	68
Urea (Strip application)	12	29.75	22.23	138	155	69
SCU (Broadcast)	11 e	44.56	21.27	134	157	71
SCU (Localised)	11 e	31.43	22.14	137	156	69
Supergranule	12 de	34.25	20.08	136	157	71

65 KgN/ha						
Urea (½-¼-¼)	12 de	39.35	20.75	139	157	71
Urea (Strip application)	13 cd	20.47	19.90	136	157	72
SCU (Localised)	14 bc	18.53	20.41	139	158	77
SCU (Localised)	15 bc	22.72	21.28	137	157	74
Supergranule	15 bc	27.16	21.32	137	159	75
130 KgN/ha						
Urea (½-¼-¼)	13 cd	25.94	20.72	139	157	75
Urea (Strip application)	16 b	22.74	19.73	141	160	75
SCU (Broadcast)	19 a	23.51	20.83	143	172	81
SCU (Localised)	18 a	20.82	20.50	140	172	81
Supergranule	19 a	22.60	20.90	144	173	81

Table 38: Effect of Sowing Date, Nitrogen Dose and Spacing on Paddy Yield (kg/ha)

	Nitrogen dosses (kg N/ha)					
Sowing dates	Spacing (cm × cm)	70	100	130	160	Line averages
15 November	25 × 15	1208	2072	1490	1493	1566
30 November		2238	2259	3991	3452	2985
15 December		4350	4662	5985	6435	5358
30 December		3560	3829	6430	4567	4597
Average		2839	3206	4474	3987	3627
15 November	20 × 20	1505	1828	1449	2812	1899
30 November		1900	2375	2948	2259	2371
15 December		4539	4457	6097	5444	5134
30 December		3270	4054	4472	3909	3926
Average		2804	3179	3742	3606	3333
15 November	25 × 20	1220	2112	1695	2237	1816
30 November		2256	2912	3095	2605	2717
15 December		3459	6185	5741	5942	5332
30 December		3356	3438	3273	4546	3653
Average		2573	3662	3451	2833	3380
15 November	25 × 25	1247	2341	1745	1718	1763
30 November		2858	2660	2177	4307	3001
15 December		3498	5580	5697	4958	4933
30 December		3075	3521	4181	3653	3608
Average		2670	3526	3450	3674	3350
Overall Average		2721	3393	3779	3771	3417

Study on the effects of N, P, K on yields of a promising variety, KH-998, on a recently cleared Hollalde soil showed that nitrogen is the key factor affecting yields. The highest yields were obtained with the application of 150 kg N/ha only, without phosphorus or potassium fertilizers.

Application of P or K fertilizer gave no positive response regardless of the nitrogen dose. N increased the number of fertile tillers per plant in this study.

Mangrove Swamp Rice—Rokupr, Sierra Leone

1. *Variety Improvement*

Possibly the most notable feature of the variety improvement work in 1979 was the nomination by the project of two varieties for the WARDA coordinated trials. The two varieties nominated were Bali Grodak and Djabon. Detailed testing started in 1977, and in 1979, both varieties were shown to be as good as ROK 5, the local standard for varieties of this duration. The varieties were equally effective with or without extra nitrogen. Some of the characteristics of the two varieties and ROK 5 are presented in Table 39. Clearly the two nominated varieties were very different from ROK 5 since they produced yields equivalent to ROK 5 with very much smaller grains. The red seed coat colour is unlikely to be a disadvantage since most traditional varieties have the red seed coat.

Table 39: Characteristics of Bali Grodak, Djabon and ROK 5

	Bali Grodak	Djabon	ROK 5
Duration (days)	162	162	155
Height without N (cm)	124	128	118
Height with N (cm)	146	150	137
Lodging	Susceptible	Susceptible	Susceptible
Blast reaction	Susceptible	Susceptible	Moderately Susceptible
Husk colour	straw	straw	light straw
Grain-length (mm)	7.35	7.00	11.0
-length to width ratio	2.58	2.50	4.68
-1,99 grain weight (g)	23.65	23.24	31.64
-coat colour	Red	Red	White
Mean yields (kg/ha)			
-without N	2,840	2830	3,050
-with N	3,264	3,352	3,529

By the 1979 season all the stages of variety testing had been developed and at the initial evaluation stage this year over 500 lines were tested. Replicated yield trials with and without fertilizers were run both at Rokupr and Mapotolon, a saline area. Final testing on farmers fields under farmers fields and conditions on ten sites along the river is now an established routine.

A hybridization programme, involving 27 crosses was initiated in 1978 and this was expanded in 1979 with a further eight crosses. The main aim in the latest crosses was to improve blast tolerance. In late 1979, a start was made on the screening of all materials available for salt tolerance using the root growth technique. It is intended that this will lead to the development of salt tolerant varieties adapted to the conditions found in mangrove swamps.

The collection of traditional mangrove swamp varieties now stands at 522 with 355 from Sierra Leone, 147 from The Gambia, 17 from Guinea Bissau and 3 from Nigeria. Purification and characterization of these varieties is well advanced, and it is hoped to produced a catalogue in the near future.

Pathology

For the second season it was shown that a moderate attack of blast in the upland nursery had no effect on the yield of rice in mangrove or associated swamps. This confirms the generally held view that the condition of the seedlings when uprooted has little influence on the yield of crop of medium or long duration rice, and that varieties with moderate or better tolerance of leaf blast are acceptable. Neck blast is not a problem in the swamps.

Screening for horizontal blast tolerance continued both in the nursery and field; over 150 lines are being tested under field conditions. In addition all the breeders materials at all stages of testing were monitored for blast and other diseases.

A more intensive survey of disease on fewer sites on farmers fields was conducted and the results were very similar to those recorded in earlier seasons.

Entomology

The entomology programme at Rokupr has been developed on the basis that comprehensive information on the nature and intensity of rice insect pests in the mangrove swamp areas in West Africa is not available. Even less is known of the economic importance of the pests.

After three seasons of studies it has been established that the stemborer *M. separatella* is the most common insect pest of mangrove swamp rice in the Rokupr area. At Mapotolon, a site near the sea on the Sacrcies river, the dominant pest has been shown to be the stemborer, *Chilo* spp. A visit to the mangrove swamp area at Warri in Nigeria showed that there again *M. separatella* is the dominant pest with stem infestation rates of up to 80 percent, four times higher than the average at Rokupr. At Caboxanque, in Guinea Bissau, gall midge, *Orseolia oryzae,* unknown in Rokupr, is a major pest especially on late sown crops. The gall midge was accompanied by a heavy infestation of *Chilo* spp. in Caboxanque. In Casamance, in southern Senegal, *Chilo* spp. and *M. separatella* are major pests wheras gall midge is of minor importance. Further north in the Gambia, few stemborers were found on the rice crop but a large number of bugs, beetles, plant hoppers, leaf hoppers and grass hoppers were found.

Outside Sierra Leone these observations of rice pests are based on one or two visits by the project entomologists. The results do however,

point to a considerable variation in the nature of rice pests that does occur over relatively short distances in areas used for growing mangrove swamp rice. Another feature of the observations is the virtually complete absence of detailed records of the incidence of pests in these areas.

In an attempt to overcome this problem the project has initiated, with the relevant authorities in the respective countries, a scheme for trapping, recording and identifying rice pests. This will be done using the kerosene lamp light trap developed and tested by the project. Such a lamp has been operated for about one year in a remote village on the Scarcies river and has proved its ability to supply good data even when operated by an illiterate but conscientious individual.

Studies of crop loses caused by pests in previous seasons based on correlations between natural pest level and yield showed a wide range of losses from 50 to 1,000 kg per ha. This season a trial at Rokupr comparing maximum protection of the crop and no protection showed that pests, mainly *M. separatella* reduced yields between 400 and 800 kg per ha. Incidentally the yield in the experiment, 5.4 t/ha from ROK 5 was the highest ever recorded in a trial at Rokupr. As a result of this trial it is now possible for the first time to express the losses caused by pests in money terms (US$100-200/ha) and the challenge now is to develop economic means of controlling the pests.

Studies of the biology of *M. separatella* in relation to date of sowing, post harvest practices and most important varietal resistance, are still continuing and several possible management methods of control have been identified. However, most approaches are only practical if the traditional system of farming is drastically changed, e.g. early sowing, higher population per unit area, growing duration varieties and brushing straw immediately after harvest. The research for varietal tolerance, the most practical method, has made some progress, but it is felt that a more intensive search, involving field insectary studies, is essential for its further advancement.

Damage caused by crabs to newly transplanted rice has been studied for the past three years. It has been clearly shown that the damage becomes less as the age of seedling at transplanting increases and within the same age group the more vigorous the seedling the less the damage. At the same time studies on the effect of age of seedling at transplanting on yield have shown no consistent loss in yield up to eight weeks old. The use of chemicals by the seedling dip method to reduce crab damage has been shown to be effective, but the extra cost and labour involved is unlikely to be economic with the traditional long duration varieties.

Thus the entomology programme on crabs has collected basic information and demonstrated ways of reducing crab damage that will be useful if farmers change to fixed duration varieties. For the present traditional system of growing long photosensitive varieties, the farmer's own method of planting large numbers of old seedlings is preferred.

Weed Science

Experience over the past three seasons has shown that the weed *Paspalum viginatum* (Kire Kire) can reduce rice yields by more than fifty percent, and its presence makes the already onerous task of digging and puddling even more tiring. However, it has also been shown that

good digging and puddling by hand or by machine at the start of the season can suppress the weed to a level where it has little effect on yields. Furthermore, the experience of one farmer on the Little Scarcies river has demonstrated that complete physical removal of the weed can harden the soil and reduce its productivity.

These conflicting positions have resulted in the establishment in 1979 of a long term trial to study the effects of different treatment of ''kire kire'' on rice yield and soil properties.

The weed problem in the associated grass swamps is far more severe than in the true mangrove. After three seasons of trials it is now established that yields of rice from mannually dug and puddled plots can be more than doubled by any of the following:

- hand weeding twice or thrice.
- use a tiller to plough and puddle only.
- use Stam F34 and one hand weeding.

Yields are nearly trebled by:

- hand weeding twice or thrice after mechanical cultivation.
- use Stam F34 and one hand weeding after mechanical cultivation.

Thus the techniques are now available for doubling or even trebling the yield of rice from the associated grass swamps, what now remains is to develop practical options for farmers.

Some of the improved techniques were tried on farmers fields in 1979. They were only partially successful because the time lapse between mechanical cultivation and transplanting has to be as short as possible and many of the farmers delayed transplanting for up to one month, by which time weeds had re-established themselves and were able to compete with the rice crop.

Soil Science

At the start of the project the standard recommendation for nitrogen on mangrove swamps rice was 60-80 kg N/ha applied broadcast in three split doses. Over the past three seasons the soil science section has concentrated its efforts on developing a single application procedure, namely the injection method. Under the particular conditions of the mangrove swamps a single application is more practical than split applications. In trials the injection method was shown to be equal or better than the split broadcast which implies a more efficient use of the applied nitrogen.

In 1979 responses to lower levels of nitrogen applied by the injection methods were measured on farmers fields. The results showed that applications as low as 20 kg N/ha produced worthwhile responses. In money terms the cost benefit ratios for the 20 and 40 kg N/ha were over three and that for the 60 kg N/ha just under three.

This results suggests a very plastic situation where a farmer can decide what level of fertilizer investment he can afford, while still being sure of a resonable return on his money. In previous seasons it has been shown that the time of nitrogen application, anytime up to six weeks after transplanting, is also not critical. The combination of these two suggests a very desirable technique for passing on to the farmer, because variation in the amount invested or the time of execution seems to have

little effect on the profit margin a farmer can expect.

A possible reason for the flexible situation found with regards to the use of nitrogen fertilizer on mangrove swamps is that the present yield levels are well below the maximum for the ecology. With this in mind several new approaches have been initiated this season.

Level of Nitrogen applied

Levels of nitrogen from 0 to 180 kg N/ha were tried and the results showed a maximum yield at about 100 kg N/ha but the response to each extra increment of nitrogen falls off greatly after 60 kg N/ha.

Splitting the N application

In an attempt to correct the possibility of nitrogen supply being short in the later stages of growth, nitrogen application by injection, split between the main physiological growth stages of rice was tested. The results showed some benefit of the order of 10 percent from splitting the dose, but no major increase in yield.

Application of other nutrients

The application of potassium has without exception had no effect on yield of rice from mangrove swamps. Responses to the application of phosphorous however have been recorded. A trial was run this season to estimate which component of the phosphorous fertilizer was efffective, i.e. phosphorous or calcium or in the case of single superphosphate sulphur as well. The results showed that calcium applied as a nutrient was more effective than phosphorous alone. This, combined with a finding reported in 1955 that the level of calcium in Rokupr soils falls below the "detectable levels" after August, suggest that this is an aspect worth further studies.

Agronomy

Over the past three seasons project staff have been conscious that much of the formal testing of new varieties and new management techniques are done at Rokupr under ideal conditions, especially with regard to timing. To some extent this has been supplemented by an extensive network of trials on farmers fields under farmer conditions.

In addition, there is also a shift to testing of some farmers's practices even in the station trials. This refers in particular to the age of seedlings at transplanting. Trials over the past three seasons have been generally inconsistent except for the extreme values, and it is now project practice to transplant seedlings of 5-7 weeks old. It should be stressed the this practice is restricted to long duration photosensitive varieties. The advantages of planting older seedlings of 5-7 weeks are:

- Crab damage is considerably reduced
- peak labour requirement for transplanting is spread out
- the seedlings are sturdier and less liable to damage from handling.

The disadvantages of the practice are:

infestation by *M. separatella* is increased

— in some seasons and in some areas, yields may be reduced slightly.

It is felt that the advantages outweigh the disadvantages and it is certain that the results will be more meaningful in the farmer's context.

At Rokupr, seedlings are transplanted within twenty four hours of pulling from the nursery, wheras farmers can delay transplanting for up to two weeks because of transport difficulties between nursery and farm. A trial was established this season to test the effect of delaying transplanting up to 10 days which had little effect on yield, and up to 15 days which resulted in a considerable loss of yield. This result, if confirmed in the coming season will again reduce the project's peak labour requirement.

Mechanization

The mangrove swamp rice crop presents the farmer with three periods of heavy labour requirement. These are digging and puddling, transplanting and harvesting. Those farming the associated grass swamps have a further labour problem; weeding. It is the generally held view that on the Scarcies river hired labour is becoming very scarce and expensive, and this often results in poor crop management and occasionally the failure to plant rice.

The single axle tiller has been shown to be suitable for ploughing and puddling the mangrove and associated grass swamps. Over the past three years the project has used these tillers at many points along the river under varying farmer's conditions with generally considerable success. The only tillers available on the market in Sierra Leone are Honda's F650 and F700 and these were the ones used.

In the true mangrove swamps it has been shown that the tiller can plough all areas except for the heavily weeded soft areas (about 20 percent). This ploughing can be done any time from February to July. The tillers can also puddle the soils if this is required, but many farmers have expressed the view that good ploughing by tiller eliminates the need for puddling.

Observations have shown that ploughing by the tiller can suppress the main problem weed, kire kire, more effectively than hand digging. In the previous seasons it was also noted that the rice grew better on the ploughed areas. This was tested in trial on farmers field this year. On 12 out of 15 sites ploughing alone increased yields over hand digging by an average of 300 kg rice/ha.

Rough economic calculations based on actual use of the tiller over two seasons indicate that the cost per hectare is of the same order as that reputedly paid by farmers for hired labour. However, its general introduction to farmers must await the establishment of training facilities, supply of spares and repair centres.

On the associated grass swamps weeds are a major problem to the rice farmer. In trials run over three seasons it has been shown that ploughing and thoroughly puddling the land with the tiller can double the yield in comparison with the normal manual digging and puddling.

Unfortunately in this ecology the timing of the operations are critical, the ploughing cannot be done until the ground is thoroughly wet and the final puddling must be done within a few days of transplanting.

On the basis of this experience it is considered that the use of the tiller for ploughing and puddling has considerable potential in both mangrove and associated grass swamps.

The tiller has many other potential uses e.g. road transport, threshing, nursery site preparation and even propelling boats, an essential form of transport in the mangrove swamp ecology. If these could be tested and proved it would make the introduction of a single axle tractor extremely attractive in the area.

Deep Water and Floating Rice — Mopti, Mali

The programmes for varietal improvement are: a) rejuvenation of germplasm seeds, b) screening tests and varietal yield trials, and c) hybridization. Studies on yield performance of varieties in deep and medium water levels showed that varieties DM 16, DA 29 and BKN 6323 gave the highest yields (Table 40). However, under normal flooding conditions when the water recedes in November, DM 16 and DA 29 which mature before water recession, would have to be harvested by boat. There are indications that some new varieties, DA 29 and BKN 6986-38-1, may produce even higher yields when grown under shallow water conditions (Table 41).

Table 40: Yield and Other Agronomic Characteristics of Varieties in the Medium Zone

Varieties	Life Cycle in days	Plant Hieght in cm.	Stem-borer damage*	Leaf Eating insect damage*	Yield in kg/ha
DM 16	140	176	1	1	3263 a
DA 29	137	159	1	1	2697 a
BKN 6323	145	169	3	3	2585 ab
Khao Gaew	154	196	3	3	2122 bc
BKN 6986-167	151	179	3	1	1937 bc
Nang Kieu	154	205	3	3	1933 bc
MSP 11	154	173	3	1	1914 bc
BKN 6987-108-3	150	167	3	3	1877 bc
Mali Sawn	165	195	3	3	1548 c
BKN 6986-81-5	155	175	1	1	1396 c
C.V. = 31.9%					
LSD = 5% = 792.0		1% = 1058.3			

* Scale 0-9

Sown: July 25, 1979.

Harvested: Mid December to early January.

The values with the same letter are not significantly different at the 5% level.

Table 41: Yield Performance of some Promising Varieties (kg/ha) at Different Water Levels (5-year average: 1974-1978)

Varieties	Deep Zone	Medium Zone	Shallow Zone	1978 Medium Zone	1979 Shallow Zone
Khao Gaew	2 342	2 386	1 942*	2 032	-
DM 16	2 291	2 743	1 124	2 097	3 755
MSP 11	2 063	2 349	1 495*	-	-
DA 29**	-	-	-	1 890	3 859
BKN 6986-38-1**	-	-	-	2 522	4 217

* Four year average: 1974 - 1977

** New varieties introduced from 1977.

A comparison of the five new varieties with 3 IRAT hybrids (DM 16, DM 17 and BH 27), T442-36 and D52-37 showed that the best yields were obtained with the hybrid BKN 6986-38-1 (4.217 kg/ha) followed by D52-37 (4.059 kg/ha) and DA 29 (3.852 kg/ha).

1. *Agronomy*

Research activities in the Agronomy division were closely linked with the weed control programme and they covered the following areas: a) land preparation, b) cultural practices, c) fertilizer management, and d) investigation into the possibility of growing a second group after deep water and floating rice.

Studies on land preparation showed that 43 days after sowing, the number of rice weeds *Oryzae barthii* on plots prepared with the hand hoe was significantly higher than those of two other implements (Table 42).

Table 42: Population of O. barthii/m^2 at 42 Days After Sowing

Tillage Implement	Number of Weeds Without N	With N	Mean
Hand Hoe	103	104	103.8 a
Oxen plough + Harrow	28	42	39.9 b
Tractor plough + Harrow	32	28	30.0 b
Mean	54	58	
LSD			36.26

Study on seeding date showed that the yields of rice seeded on July 31st and August 10th were significantly higher than earlier sowing (Table 43).

Table 43: Influence of Seeding Date on the Grain Yield of Deep Water Rice (kg/ha)

Seeding Dates (1979)	Varieties: Khao Gaew	Nang Kieu	Mali Sawn	Mean
1-7	-	-	-	-
10-7	-	-	-	-
20-7	2386	1845	1590	1941 b
31-7	2549	3107	1990	2550 a
10-8	2975	2702	1901	2526 a
20-8	x	x	x	x
Mean	2637	2552	1829	
LSD 5% for variety	603			
LSD 5% for date	453			

Poor seed emergence due to drought and soil surface sealing.

x The seedlings were drowned in the flood water.

For the variety Khao Gaew, drilling produced highly significant yield over broadcasting (Drilled 2588 kg/ha, Broadcast 1620 kg/ha).

Source and time of nitrogen application studies showed that when ammonium phosphate was applied 3 weeks after seeding, yield was lower than when split application was practiced. (One dose application 3223 kg/ha, 40 kg N/ha 3 weeks after seeding, followed by 20 kg N/ha 2 weeks before flooding—4734 kg/ha).

Application of nitrogen not only increased yield but also the number of basal tillers and plant height. The height increase could help the plants escape submergence at the onset of flooding.

Studies on fertilizer placement showed that when phosphorus fertilizer was banded, grain yield of variety Khao Gaew was significantly greater than when it was broadcast (Banded 3224 kg/ha, Broadcast 2934 kg/ha). At the low rates of N application, N enchanced the positive action of banded phosphorus fertilizer on grain yield.

Studies on the rate and time of fertilizer application which were aimed at finding the most economic package of fertilizer application for deep flooded rice, showed that the recommended practice (100 kg ammonium phosphate/ha at seeding and 100 kg urea/ha one week before flooding) gave the highest yield. The yield increment under this practice was 105% over the no-fertilizer control (Table 44). The economic analysis showed that the use of 50 kg/ha of ammonium phosphate gave the highest benefit: cost ratio (2.8). Therefore, this practice is the most suitable for small farmers.

Table 44: Influence of Rate and Time of Fertilizer Application on the Grain Yield of BH2 Grown Under Deep Flooded Conditions

Time of Fertilizer Application			Paddy Yield	Yield Increase	Benefit	Fertilizer Cost	Benefit Cost
1	2	3	)kg/ha)	(kg/ha)	(FM)	(FM)	Ratio
0	0	0	1077 cd				
100 kg AP	0	100 kg Urea	2208 a	1,131	56,550	26,000	2.2
100 kg AP	0	50 kg Urea	1846 ab	769	38,450	20,000	1.9
100 kg AP	0	0	1611 bc	534	26,700	14,000	1.9
0	100 kg AP	0	1538 bc	461	23,050	14,000	1.6
0	100 kg AP	100 kg Urea	1774 b	697	34,850	26,000	1.3
0	100 kg AP	50 kg Urea	1688 b	611	30,550	20,000	1.5
0	50 kg AP	0	1474 bcd	397	19,850	7,000	2.8
0	0	100 kg Urea	*				

Date of Seeding: 03/08/79

1 – At seeding; 2 – At the beginning of tillering; 3 – One week before flooding

AP – Ammonium phosphate

* – Heavy grasshopper damage

Cost of the kg of Ammonium phosphate: 140 FM

Cost of the kg of Urea: 120 FM; Cost of kg of paddy – 50 FM

The extra expenditure due to fertilizer use was not taken into account.

FM – Malian currency; 1 US $ = 440 FM.

2. *Weed Control*

Dormancy study of weed seeds showed that *Oryzae stapfii* had the highest percentage germination followed by *O. barthii* and *O. longistaminata.* Regardless of the wild rice species, the overall germination percentage obtained from petri dishes was 14.7% higher than that obtained from the soil in plastic containers.

Although wild rice seeds are known to have a long dormancy period, seeds of *O. stapfii* were less dormant. At the beginning of the rainy season, around 90% germination occurred while only 20 to 30% germination occurred from seeds of *O. barthii* and around 10% from *O. longistaminata.*

Nevertheless, it should be remembered that under natural conditions, dormancy of the weed seeds are influenced by environmental factors such as seed depth, flood, soil disturbances and burning. A better understanding of the problem may be achieved by close field observations.

Studies of the dates of weeding on the control of weeds and the effect of these on yields of floating rice was not conclusive due to erratic weather condition.

The effect of different methods of weed control did not produce any significant increase in the grain yield of floating rice during the 1979 season.

Studies on the effect of some cultural and chemical methods on the control of wild rice *(O. longistaminata)* showed that all the seven treatments were effective in reducing the initial weed population and apart from treatment 2, the reduction was more than 90% (Table 45).

Table 45: Efficiency of Some Methods of Controlling O. longistaminata (1978-1979)

Treatment	No. Of O. longistaminata/m2 Before Treatment	After Treatment	Weed Control Rating 0-10	Percentage Reduction in the Weed Population
Mowing under water (twice)	812	53 b	6.5	93.5 ab
Plowing just before flood	840	273 c	4.4	67.8 c
Plowing just before flood + mowing under water once	791	49 c	9.6	92.2
Glyphosate 2 kg a.i./ ha + mowing under water once	938	21 ab	9.3	97.1 ab
Glyphosate 3 kg a.i./ ha 985	985	42 ab	9.3	93.8 ab
Glyphosate 4 kg a.i./ ha 911	911	46 b	9.8	93.8 ab
Glyphosate 5 kg a.i./ ha 966	966	10 a	9.6	98.6 a
F — Test	ns	s		s
C.V.	15.95%	20.17%		4.02%

The optimum rate of glyphosate in controlling *O. longistaminata* was shown to be 2.88 kg a.i./ha or higher, applied in the middle of August.

Chemical control study of *O. barthii* showed that the best control was obtained with application of paraquat (Gramoxone) at the rate of 2.4 kg a.i./ha and glyphosate (Round up) at 1.92 kg a.i./ha (Table 46). Due to the application of the herbicides, the rice sown did not germinate and so it was not possible to evaluate the effect of the herbicides on the crop yield.

Studies on yield losses due to weeds under farmer's field revealed that yield difference between weeded and non-weeded plots was statistically significant; the percentage loss varying between 9 and 82%. Factors such as late sowing, lack of optimum water depth in some locations might have caused the low yields of weeded plots.

3. *Entomology*

Determination of the peak period of adult stem borers using light trap showed that the population of *Chilo zacconius* Blez showed two peaks (end of October and last week of November), *Maliarpha separatella* —2 peaks, (end of October and third week of November).

In general, insect problems appear on deep water and floating rice when the flood arrives but there is no suitable method of spraying the insecticide at this time.

Studies on yield losses due to insects showed that only the treatment with carbofuran produced yield increase of 35.8% over the control.

Upland Rice—Bouake, Ivory Coast

During the 1979 rainy season, trials were conducted at several locations in the Ivory Coast. (Table 47.)

Assessment and characterization were done under same conditions for IRAT 109, IRAT 110, IRAT 112, IRAT 133, IRAT 134, IRAT 135, IRAT 10, IRAT 104, IRAT 105, IRAT 132, IRAT 138, IRAT 139, Iguope Cateto, IRAT 115, IRAT 136, and MOROBEREKAN.

Table 46: Effects of Glyphosate on the Control of O. longistaminata

Treatment	O. longistaminata/m2		Weed Control Ratings (0 – 10*)						O. longistaminata/m2	
	BHA		30 + 15 DAHA		65 + 50 DAHA		172 + 157 DAHA		172 + 157 DAHA	
	Aug. 1st	Aug. 15	Aug. 1st	Aug. 15	Aug. 1st	Aug. 15	Aug. 1st	Aug. 15	Aug. 1st	Aug. 15
1.44 kg ai/ha	161	158	2.0 a	5.5 a	0 b	4.5 a	0.0	2.5 a	583 a	263 a
2.16 kg ai/ha	126	128	3.5 ab	6.5 ab	1.5 a	6.25 b	1.0	5.75 b	438	97 b
2.88 kg ai/ha	150	131	4.25 b	7.25 b	0.5 b	7.25 b	0.0	7.00 bc	489 b	37 b
3.6 kg ai/ha	134	128	4.75 b	7.00 b	0.75 b	7.25 b	0.5	7.50 cd	371 b	96 b
4.32 kg ai/ha	142	101	4.25 b	7.50 b	1.0 b	7.25 b	0.0	7.75 cd	337 b	55 b
5.04 kg ai/ha	132	134	4.5 b	7.75 b	0.75 b	8.0 c	0.0	8.50 d	385 b	30 b
Mean	141	131	3.87	6.91	0.75	6.75	0.25	6.50	434	96
F-Test	NS	NS	S**	S**	S**	S**	S**	S**	S**	S**
LSD 1%			1.34		1.06		1.33		141	

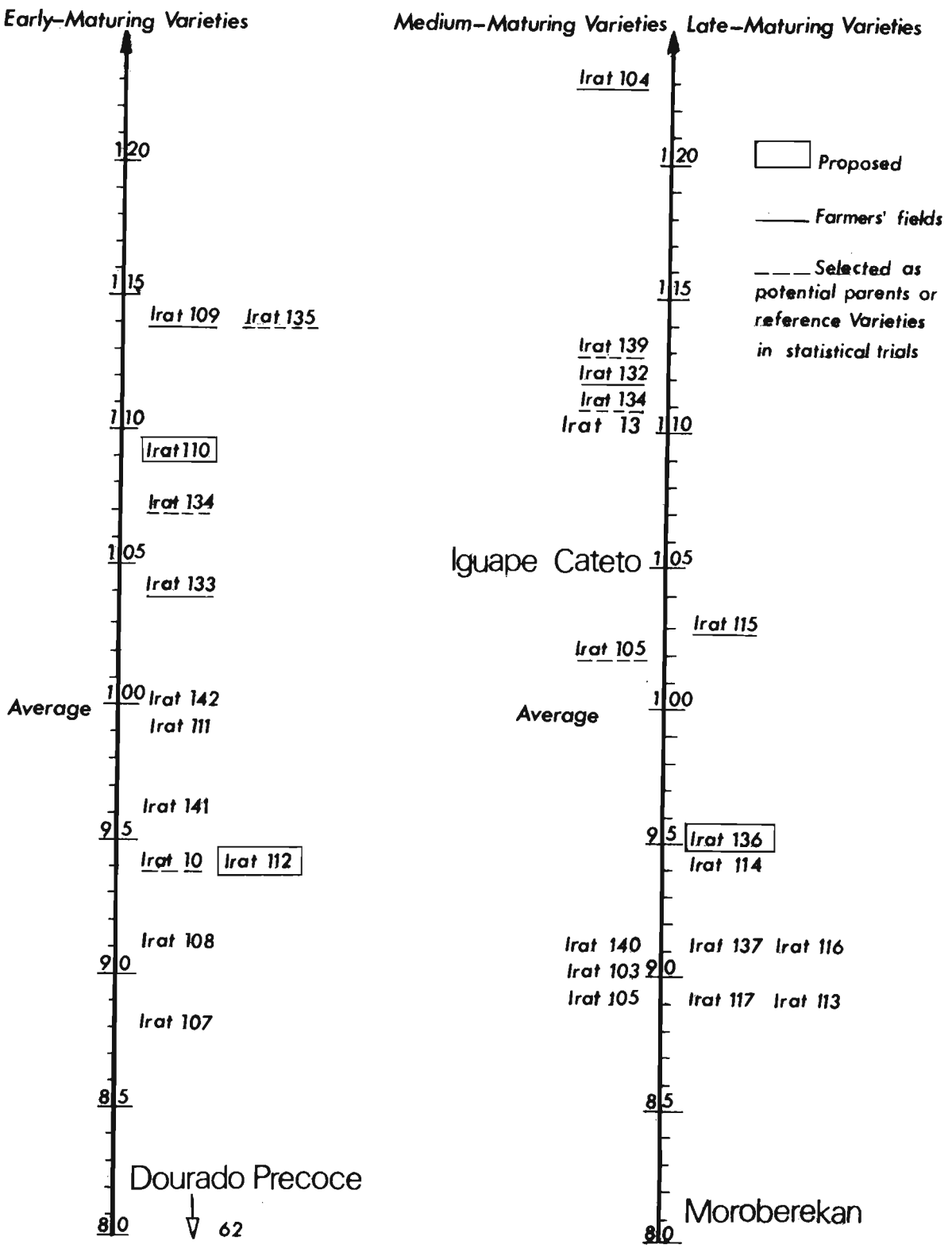
BHA = Before herbicide application.
DAHA = Days after herbicide application.
0-10* =)—no Control; 10—Complete control.
** = Significant at P = 0.01.

Local farmers method of preparing land for upland rice sowing in West Africa.

Table 47: Locations where Upland Variety Trials were Conducted in Ivory Coast

Location	Yield (t/ha)	Conditions	Average Annual Rainfall (mm)
Touba	4.2	Forest-savannah border line, fertile soil, monomodal rains, one cropping season	1330
Odienne	3.3	Savannah monomodal, well distributed, one cropping season	1612
Bouake	3.2	Plot irrigated by sprinkling	-
Tienigbou	3.1	Savannah, biomodal, one cropping season	1100
Boundiali	3.0	Savannah monomodal, one cropping season	1480
Beheke	2.6	Savannah, sandy soil biomodal, once cropping season	1150
Dianra	2.5	Savannah biomodal, first cropping season	1137
Man	2.4	Forest, adverse soil conditions, biomodal, one cropping season	1715
Katiola	2.3	Savannah, sandy soil biomodal, one cropping season	1232
Zagne	2.0	Forest, irregular rainfall biomodal, first cropping season	1526
Daloa	1.5	Forest, irregular rainfall biomodal, first cropping season	1400
Bouake (late sowing)	1.1	Savannah, irregular biomodal, one cropping season	1180
Bouake (early sowing)			

Table 48: YIELD INDICES (AVERAGE)



Lines in Breeding

A few offsprings of parents such as IRAT 13, PALAWAN, COLUMBIA II and Mut 312A were tested in the 1980 off-season trials. It is expected that the results will show a high degree of drought tolerance at both the grain initiation and filling stages and that generally the varieties will perform well.

This will represent the intermediate stage towards a new series, presently at the F_3 stage and cultivated in the 1980 off-season. This series uses crosses between genotypes that are different from the PONLAI West African variety.

Research on Grain Shattering

Research on grain shattering resistance has particularly led to the conception of a device and formulation of a method to measure the rate of grain shattering. This method is used to screen selected varieties from the F_3 stage onwards. A set of equipments is being manufactured and will be available as soon as possible for those who would request it.

Effort towards a better knowledge of the genetic mechanism of shattering are also being made. It would appear that many genes are control shattering. In fact in some cases, it has been possible to observe a simple resistance dominant gene. In other cases, it seems that a polygenic system exists and transgressions can be observed.

Furthermore, the shattering rate of some varieties increases as they ripen as is generally the case for the West African varieties. Parents identified in Bouake were screened to pin point the varieties with a decreasing or, at the very least, constant shattering rate during maturity.

The significance of this phenomenon is two-fold:

- on the one hand, it shows that several genes control shattering.
- on the other hand, it seems possible to develop varieties with optimum and stable shattering rates over a long period after maturity. This offers a wide freedom to choose the best harvest time. In addition, the late harvest grain has a lower humidity rate, thus facilitating the drying process, which poses a problem to many rice growers of the forest zone, when harvesting is done by cutting the rice plants above ground level manually or mechanically and not panicle by panicle.

SUPPORT TO NATIONAL RESEARCH

Assistance continued to be given to national programmes as in the past. Under construction or nearly completed in 1979 were field laboratories at Haouda, *Benin;* Niamey, *Niger;* Mission Tove, *Togo;* Contuboel, *Guinea Bissau;* and Kaedi, *Mauritania.* Apart from the construction of laboratories, all the member states received equipment for coordinated and IET trial programmes.

In the plant quarantine programme, another greenhouse has been funded at Ibadan, *Nigeria.*

WARDA'S COLLABORATIVE WORK WITH OTHER INSTITUTIONS

During the year in review, many new agreements were signed and former collaborative activities strengthened. Brief highlights of the

collaborating institutions and programmes are hereby presented:

1. *International Institute of Tropical Agriculture (IITA*

For the purpose of promoting greater professional collaboration between IITA and WARDA, the two parties reached a mutual agreement by which an IITA Senior Rice Breeder was seconded to WARDA for an initial period of two years with an option for extension by mutual agreemant.

2. *International Rice Research Institute (IRRI)*

To further strengthen the linkage between WARDA and IRRI, late in 1978 a decision was made to post an IRRI Liaison Officer to Africa based in IITA, but with major commitments to the West African region for the first two years.

3. *Bangladesh Rice Research Institute (BRRI)*

In promoting and accelerating the progress of rice research, a training and development agreement has been reached with BRRI for exchange of scientists (a Senior Rice Breeder has been made available to WARDA by BRRI) and the exchange of germplasm and breeding materials.

4. *International Fertilizer Development Centre (IFDC)*

Both WARDA and IFDC have agreed on a cooperative programme of research on rice fertilizers as they relate to crop production.

5. *Catholic University—Louvain, Belgium (UCL)*

The agreement between UCL and WARDA is to study the use of Azolla and Blue green algae as a source of Nitrogen for rice production.

6. *Indian Council of Agricultural Research (ICAR)*

Agreement had been reached between WARDA and ICAR to exchange scientists and technologists (WARDA Senior Pathologist was made available by ICAR) and exchange of germplasm and breeding materials.

7. *Sahelian Institute*

WARDA and the Sahelian Institute have agreed to cooperate in the implementation of a programme to facilitate rice production in the Sahelian zone.

8. *Assistance to the Ministry of Agriculture, Liberia*

Agreement has been reached between WARDA and the Ministry of Agriculture for WARDA to assist in the technical supervision of the rice research programme of the Ministry.

9. *Project on Management of Bird and Rodent Pest in West Africa*

In cooperation with national and international centres in the region, WARDA will undertake various studies on birds and rodents that are destructive to rice in the field and in storage. Testing of the available methods of control and the dissemination of practicable packages of practices to extension workers and farmers will be undertaken.

ACKNOWLEDGEMENT

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VISITORS FOR 1979

Visitors to the Research Department for the year 1979 included:

Dr. O.A. Ojomo, Assistant Director for Research, NCRI, Nigeria

Mr. M. Jacquot, IRAT, France

Mr. John Griffiths, World Bank, Washington D.C., USA

Dr. Kaung Zan, IRRI/Africa Liaison Scientist, Ibadan, Nigeria

Dr. W.K. Gamble, Director General, IITA, Nigeria

Mr. M.S. Kargbo, Project Co-manager, Land Resources Survey Project, Tower Hill, Freetown, Sierra Leone

Dr. Rama Rao Vellaulu, FAO Milling Technologist, FAO, Rome, Italy

Prof. T. Odhiambo, Director, ICIPE, Nairobi, Kenya

Mr. Tongul, Mission Leader, FAO, Rome, Italy

Mr. John Gordon, UNDP Resident Representative, Monrovia, Liberia

Dr. J.K. Egunjobi, UNEP, Nairobi, Kenya

Prof. Bashira Malik, FAO/IC, Rome, Italy

Dr. Kenneth L. Seone, Jim Thomas Int'l, Houston, Texas, USA

Prof. G. van Hove, Universite de Louvain, Belgium

Dr. B. Anastiadiasis, GMC, Athens, Greece

Dr. J. Vrugt, IITA/IBRD, Nigeria

Mr. G.S. Ayernor, Intertech, Abidjan, Ivory Coast

Dr. Silvio Steinmetz, LMBRAPA/CNPAF, Brazil

Dr. Gordon MacNeil, CRDI, Dakar, Senegal

Mr. M.D.V. Davis, FAO, Nairobi, Kenya

Dr. R.A.D. Jones, Director, Rice Research Station, Rokupr, Sierra Leone

Dr. R.H. Rust, University of Minnesota, USA

Dr. Tope Okusanil, University of Minnesota, USA

Dr. A.S.R. Juo, IITA, Ibadan, Nigeria

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