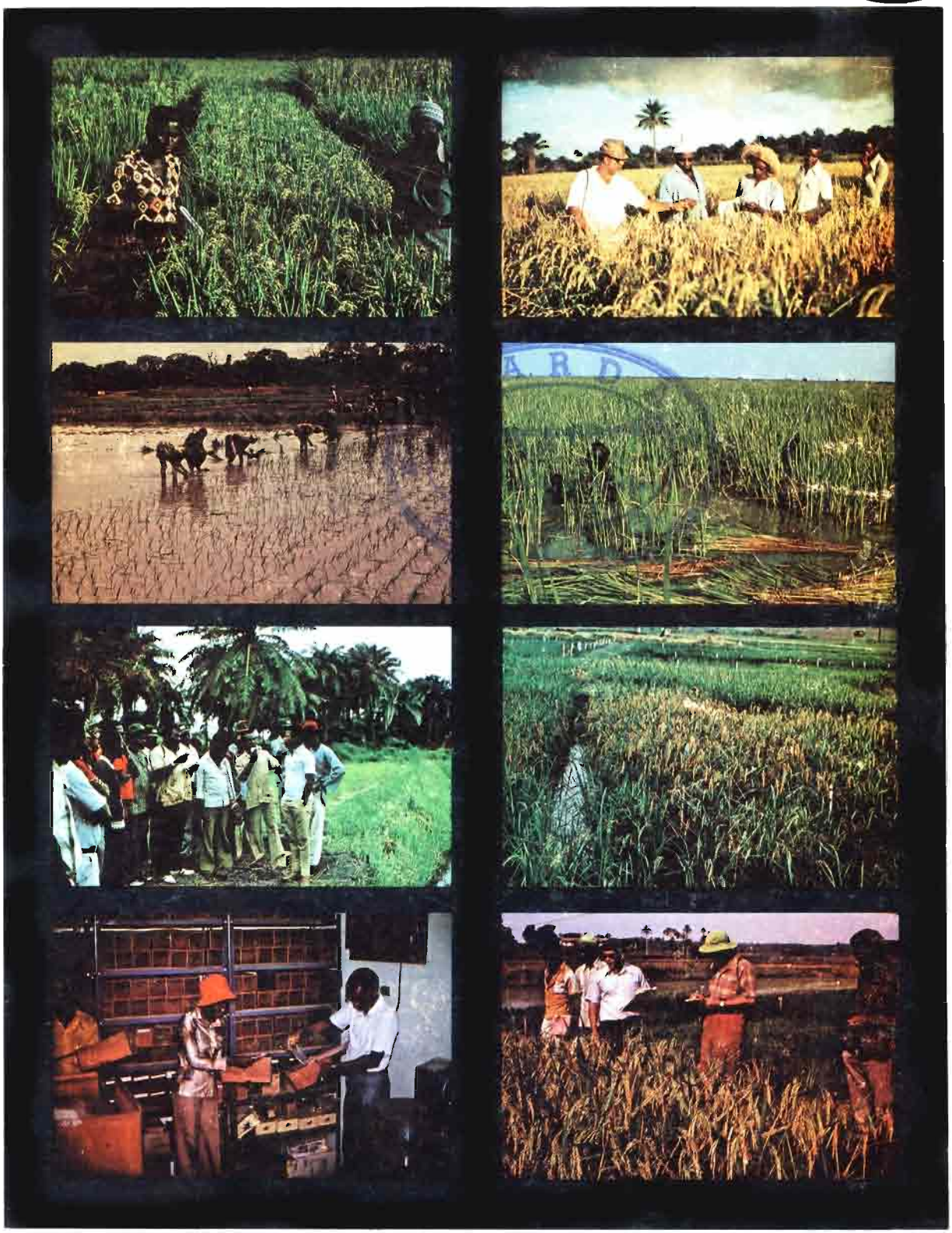
# WARDA RESEARCH DEPARTMENT

# 1980 ANNUAL REPORT



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

Correct Citation: West Africa Rice Development Association
1981 Research Department Annual Report
for 1980. Monrovia, Liberia

# ANNUAL REPORT

# 1980

# OF THE

# RESEARCH DEPARTMENT

# WEST AFRICA RICE DEVELOPMENT ASSOCIATION

# ABOUT WARDA

The West Africa Rice Development Association (WARDA) is an inter-governmental organization whose main aim is to make West Africa self-sufficiency in rice production. The Association started to function on 1st December 1971, and now 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 its 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 and research administration 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.

The functions of the Research Department include the establishment of coordinated, 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 network of sub-regional coordination offices. The Research Department is headed by the Director of Research.

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 con-

ferences, seminars, workshops as well as training on topics relating to development.

WARDA has a Training Department which provides middle level and specialized training for personnel from member countries at its Training Centre. It also arranges for higher training.

Other supporting divisions and sections include an Administrative section, a Finance and Accounts section, a Personnel section, 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.

# CONTENTS


Page

WARDA Research Department Professional Personnel ..... iv
FOREWARD ..... vi
Research Highlights ..... 1
Initial Evaluation Trials (IETs) ..... 1
Coordinated Variety Trials ..... 1
Coordinated Weed Control Trials ..... 1
On-Farm Trials ..... 1
Technical Supporting Services ..... 2
Seed Nursery Farm ..... 2
Seed Laboratory ..... 2
Germplasm ..... 2
International Rice Testing Programme ..... 2
Monitoring Tour ..... 2
Integrated Pest Management ..... 3
Special Research Projects: 3
Bouake, Ivory Coast — Upland Rice ..... 3
Mopti, Mali — Deep Water and Floating Rice ..... 3
Richard-Toll/ Fanaye, Senegal — Irrigated Rice ..... 4
Rokupr, Sierra Leone — Mangrove Swamp Rice ..... 4

RESEARCH ACTIVITIES ..... 4
Initial Evaluation Trials ..... 4
Coordinated Variety Trials ..... 5
Coordinated Weed Control Trials ..... 6
On-Farm Trials ..... 7
Support to National Research ..... 20
Seed Nursery Farm ..... 21
Seed Laboratory Activities ..... 21
Germplasm Activities ..... 21
Activities on the International Rice Testing Programme 23
Monitoring Tour ..... 24

SPECIAL RESEARCH PROJECTS
Bouake, Ivory Coast — Upland Rice ..... 25
Mopti, Mali — Deep Water and Floating Rice ..... 25
Richard-Toll/Fanaye, Senegal — Irrigated Rice ..... 25
Rokupr, Sierra Leone — Mangrove Swamp Rice ..... 25

Collaborative Activities with other Institutions ..... 53
Acknowledgement ..... 55
Visitors ..... 54
Departmental Publications ..... 54

# STAFF — 1981

## HEADQUARTERS

### RESEARCH COORDINATION

| | | |
|---|---|---|
| B.A.C. Enyi, Ph.D.,F.L.S., F.R.S.A., F.I. Biol., L.F.I.B.A. | | Director of Research |
| G.A. Paku, Ph.D. | — | Agronomic Statistician |
| G. Varango, B.Sc., D.P.L.G. | — | Architect |

### TECHNICAL SUPPORT SERVICE

| | | |
|---|---|---|
| M.A. Choudhury, Ph.D. | — | Senior Rice Breeder |
| A.O. Abifarin, Ph.D. | — | Senior Rice Breeder, IITA/ WARDA Liaison Scientist |
| D.N. Srivastava, I.I.S.T.I., Ph.D. | — | Senior Plant Pathologist* |
| E.A. Akinsola, Ph.D., M.I. Biol. | — | Entomologist |
| A.K. Koroma, Dr. Sc. Agric., Dipl.H.Ed., M.I. Biol. | — | Assoc. Plant Breeder |
| N.S. Bangura, M.S. | — | Assoc. Plant Pathologist |
| B.A. Larinde, M.S. | — | Seed Technologist |
| L. Kandakai (Mrs.), B.Sc. | — | Asst. Seed Technologist |

### SUB-REGIONAL COORDINATION

| | | |
|---|---|---|
| O. Koffi-Tessio, Ing. Pedologue | — | Sub-regional Coordinator (ZONE 5) |
| S.Assegninou, Ing. Agronome, D.E.A. | — | Sub-regional Coordinator (ZONE 3) |
| R.B. Kagbo, Ph.D. | — | Sub-regional Coordinator (ZONE 1) |
| K.M. Shambuyi, M.Sc. | — | Asst. Sub-regional Coordinator (ZONE 1) |
| D.K. Das Gupta, Ph.D. | — | Sub-regional Coordinator (ZONE 4) |
| D.C. Pankani, M.Sc. | — | Asst. Sub-regional Coordinator (ZONE 4) |
| S.D. Bangoura, Ing. Agronome | — | Asst. Sub-regional Coordinator (ZONE 2) |

### SPECIAL RESEARCH PROJECTS

**Rokupr, Sierra Leone**

| | | |
|---|---|---|
| E. Jones, M.Sc. | — | Soil Scientist and Head |
| J. Stenhouse, Ph.D. | — | Breeder |
| M. Agyen-Sampong, Ph.D. | — | Entomologist |
| K. Prakah-Asante, Ph.D. | — | Agric. Economist |
| M. Jones, M.Sc. | — | Research Asst./Breeding |
| H.M. Barnard, B.Sc. | — | Research Asst. — Weed Science |

* Left during the year.

| | | |
|---|---|---|
| C.A. Dixon, B.Sc. | — | Research Asst. — Soil Science** |
| S.N. Fomba, B.Sc. | — | Research Asst. — Entomology |
| M.A. Froment, B.Sc. | — | O.D.A. Trainee |
| Richard-Toll/Fanaye, Senegal | | |
| H. Van Brandt, M. Sc. | — | Soil Scientist and Head |
| A. Coly, Ing. Agronome | — | Research Asst. — Breding |
| T. Diop, B.A.C. (Agricole) | — | Research Asst. — Entomology |
| I. Camara, B.S.P. | — | Research Asst. — Soil Science |
| A.M. Diop, Ing. Agronome | — | Research Asst. — Weed Science |
| J. Dome, Ing. Agronome | - | Assistant Breeder |
| Mopti, Mali | | |
| M. Goita, Ing. Agronome, M.Sc. | — | Research Asst. — Breeding |
| | | Acting Director |
| S. Koli, Ph.D. | — | Agronomist, Deputy Director |
| A. Diarra, M.Sc. | - | Research Asst. — Weed Science |
| A. Toure, Ing. Agronome | — | Research Asst.— Agronomy |
| C. Dembele, Ing. Agronome | — | Research Asst. — Entomologist† |
| M. Dembele, Ing. Agronome | — | Research/Extension Officer |
| Bouake - Ivory Coast | | |
| J. Dallard, D.F.A. | — | Agronomist |

** On study leave
† Deceased

# FOREWORD

This report covers the activities of the Research Department in 1980. 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

The major results and activities of the Research Department in 1980 are summarized here. Strengthening and backstopping of the Special Project activities by Technical Service Staff at the headquarters coupled with improved efficiency in the conduction of the coordinated trials yielded useful results.

*INITIAL EVALUATION TRIALS (IETs)*

The Initial Evaluation Trials (IETs) form part of the WARDA multilocation testing programme. The IETs are unreplicated trials for screening a wide range of essentially advanced materials that could be, in many ways, utilized by WARDA and national scientists in their respective crop improvement programmes including the nomination of promising materials for the WARDA Coordinated Variety Trials (CVTs). Three types of IETs (upland, irrigated, and deep flooded) were conducted in the fifteen WARDA member countries during 1980. The trials consisted of 504 entries (upland 236, irrigated 235, and deep flooded 58) and were sent out to 41 locations (upland 14, irrigated 19, and deep flooded 8). Data was received from 25 locations (upland 8, irrigated 12, and deep flooded 5). Promising lines/entries were identified at almost all the locations where the trials were conducted.

*COORDINATED VARIETY TRIALS*

In 1980, there were eight different coordinated trials. These have been reorganized and from 1981 there would be 12 variety trials.

From the upland variety trials, IRAT 110 and IRAT 133 were found to have wider adaptability in both savanna and moist zones. MTU 8431 was identified as a superior new variety for the dry season irrigated trials. Nizersail showed excellent performance and out-yielded all entries under the main season irrigation condition.

Mangrove swamp trials revealed Djabon and Baligrodak as good varieties. IR2071-586-5-6-3 performed very well in deep flooded condition.

*COORDINATED WEED CONTROL TRIALS*

Tamariz, Stam F34 and Preforan 30 EC, gave greater yields than the no-weeding under upland conditions.

Some herbicides, such as Ordram + Stam F34 and Tamariz super gave greater yield than the control and also performed as good as weed-free and hand weeding treatments under irrigated condition.

The present findings under Mangrove Swamp condition confirm that good land preparation before transplanting offers adequate weed control under tidal mangrove swamp conditions.

*ON-FARM TRIALS*

Ten on-farm variety trials were conducted in each member country (except Zone II). Promising varieties with good yielding ability (selected from the WARDA coodinated trials) and local check varieties were included in these trials.

## *TECHNICAL SUPPORTING SERVICES*

The Technical Supporting Services continued to discharge its important role in varietal introductions and improvement, seed service, rice germplasm, coordination of the International Rice Testing Programme in the Region, disease monitoring, and backstopping the special research projects.

### *SEED NURSERY FARM*

At the Seed Nursery Farm at Suakoko, 2, 546 varieties were grown and tested, from which 24 promising ones were nominated to the WARDA coordinated variety trials and 260 to the IETs of 1981.

### *SEED LABORATORY*

In 1980, a total of 641 entries were packaged for WARDA 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 168 trials spread over 58 locations in 15 member countries of WARDA. A total of 1112 new varieties were introduced from outside the region while 1889 were dispatched to countries within and outside West Africa. From WARDA germplasm, 1787 varieties were sent both to Richard - Toll and the Suakoko Seed Nursery Farm for first stage studies and multiplication. In addition to the routine work, some storage and physiological experiments were carried out. Also, two students from the University of Liberia participated in a work-study programme for two months.

### *GERMPLASM*

Germplasm collection in Mali and Nigeria by WARDA consultants was completed during the early part of 1980. A total number of 104 cultivars were collected in Mopti, Gao and the Tenekou areas of Mali.

In collaboration with the Genetic Resources Unit of the International Institute of Tropical Agriculture (IITA) and in cooperation with National Cereal Research Institute (NCRI), a total of 562 cultivars were collected in Nigeria. These were made up of five different species.

Field evaluation and multiplication of cultivars received from cooperators like IRAT—ORSTOM, ITTA were continued during the period under review.

In 1980, a total of 47 sets of 9 different 1979 nurseries were planted in the region and 72 sets of 15 different 1980 nurseries were received from IRRI, excluding those for Nigeria. Some of these were planted in 1980 while others would be planted in 1981. Many of the cultivars in these nuseries have been used in the region for hybridization, national trials and for WARDA coordinated trials.

### *MONITORING TOUR*

The monitoring tours were carried out by the Headquarters Staff and Sub-regional Coordinators. The tours were to WARDA coordinated trials, National Research Trials and Special Research projects.

*INTEGRATED MANAGEMENT OF RICE DISEASES AND INSECT PESTS*

As a follow-up to recommendations in support of the formation of an Integrated Pest Management (IPM) project for rice in West Africa made at the plenary session during the seminar "Integrated Management of Rice Diseases and Insect Pests", at Bobo-Dioulasso, Upper Volta in September 1979, WARDA commissioned a team of crop protection specialists to begin work in organizing a regionally coordinated programme on IPM. The team visited selected areas in West Africa and worked out a plan of operation document. The project will include a variety of research, training, extension and farmer-demonstration activities in the representative rice agro-ecosystem.

## SPECIAL RESEARCH PROJECTS

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

*UPLAND RICE – BOUAKE, IVORY COAST*

At Bouake, WARDA's staff was involved in the upland rice improvement activities of the station. Many promising lines were selected from F3 populations. Study of grain shattering problem revealed that 40% of 222 cultivars screened did not shatter. Investigation on opened glumed cultivars bred at Bouake was carried out. A relationship appeared to exist between opened glumes and attack of *Sitophillus oryzae.* Preliminary study of mechanism of opened glumes indicated a recessive monogenic control for a group of the parents used. From the trials conducted at Bouake, four cultivars were recommended for Ivory Coast; IRRAT 109 and IRAT 112 as early maturing varieties, IRAT 104 medium duration and IRAT 136 as a late maturing variety.

*DEEP WATER AND FLOATING RICE – MOPTI, MALI*

Yield trials in two different water levels showed that DM 16, Cula and BKN 6323 gave the highest yields in the two zones.

Three varieties, Khao Gaew, Mali Sawn and Nang Kiew illustrated that sowing done on July 10 produced higher yields than sowings at four other dates.

Drilling and broadcasting produced significantly higher yields than transplanting in deep water rice. The application of 100kg of nitrogen in the form of ammonium phosphate showed a distinct yield increase in the variety BH 2 at Mopti-South.

Yields showed that weeding at 35 days after rice emergence was good enough, and subsequent weeding can only make a very little significance in deep water rice. Ploughing at the end of the harvest season reduced weed infestation tremendously, and only one weeding was necessary about three weeks after sowing the new crop.

Gramaxone applied at 2400 g a.i./ha performed better than four other

chemicals used in the control of *O. barthii,* while Glyphosate gave good results in the control of *O. longistaminata* at the rate of 4320 g a.i./ha.

Granular insecticide, for Furadan 3G, applied at 1000g a.i./ha 10 and 30 days after rice emergence, gave a grain yield increase of 38.4%. That of Birlane 10G, applied at 3000g a.i./ha, gave a yield increase of 28% over the control in the variety Khao Gaew.

*IRRIGATED RICE—RICHARD-TOLL/FANAYE, SENEGAL*

All the 13 varieties except one used in the assessment of yield potentials outyielded (except one) the check variety IR8. Yields ranged from 5027 to 7340 kg/ha. The two top varieties were SRIMALAYSIA-2 and FH-109. In another experiment, IR1820-210-3 and C-168 yielded 7220 and 6930 kg/ha respectively. Studies showed that the dates and intensity of cold weather varied with location and also from one year to another. Out of 33 varieties screened for cold tolerance, eight were identified as promising materials.

Fifty-two weed species had been identified. Sixteen herbicides were evaluated and BASAGRAN M and BASAGRAN PL hepled produce the highest yields (over 6000 kg/ha) while the unweeded control gave 3790 kg/ha.

Sulphur-coated urea and supergranules of urea confirmed their superiority over ordinary urea. Studies on vertisols of the Senegal River Valley did not show any response to phosphorus and potassium. Split application of nitrogen, however, significantly increased yields. Five varieties, KH-998, KN—1h-350, IET 1996, JAYA and IKP had similar nitrogen requirements under Hollalde soils with a maximum requirement of 140 kg N/ha. The response at Fonde varied.

Twenty-two strains of *Azolla* representing *Azolla caroliniana, A filiculoides, A. mexicana* and *A. pinnata* have been conserved in the laboratory after initial adaptation test. They are being used further in other laboratory and field experiments.

*MANGROVE SWAMP RICE—ROKUPR, SIERRA LEONE*

Previous multidisciplinary research efforts were continued during 1980. New programmes were also initiated. Among these are preliminary agro and socio-economic studies. The Project, despite several constraints, has been able to achieve valuable results. However, most of these results require further testing before they could be finally recommended for application/production in farmer's fields within the varying mangrove ecology of the West Africa region.

## RESEARCH ACTIVITIES

Under this section a relatively detailed summary of activities and results are presented with greater emphasis on On-Farm trials.

*INITIAL EVALUATION (IET)*

This summary focuses attention only on the yield data of the trials. However, the other traints reported by each cooperator could be found in relevant WARDA documents. The three types of IETs highlighted in this report were conducted under different conditions (ecologies and/or

seasons). In terms of the background of the materials (entries), the composition of the trials was also different. Additionally, the trials differed in the number of entries (trial size), and locations (trial sites). Despite these differences, and overall comparative evaluation of the results could be made.

The best five entries in the irrigated trial were: BG 404-1, BK 126, TOM 1-3, IET 6073-RP 827-1, and BR 161-2B-59. Their yields in grams per metre squared were 566, 560, 514, 514 and 514 respectively. Mission-Tove, Richard-Toll, and Kogoni were identified as the best individual locations. In the rainfed trial, the best five entries were: TOX 475-NI1-NK4-NI1, TOX 340-NI-1, IRAT 104, TOX 86-1-3-1, and DJ 12-539-2. Their overall average grain yields in grams per metre squared were 253, 250, 244, 241 and 239 respectively. With the exception of Farako-Ba and Sefa where the yield data for most of the entries was missing, the best location was Bouake followed by Bagou. The entries: SR 26B, BKN 6323, FAROX 126-6-8, ADNY 301, and FAROX 126-67-19 were the best in the deep flooded trial. Their grain yields in grams per metre squared were 310, 270, 248, 241 and 236 respectively. Average performance of the entries was best at Genoi followed by Djibelor.

In all the trials, there were wide ranges in the across-locations yield performance of the individual entries. A comparison between the average yields obtained at individual locations showed similar trends.

## *COORDINATED VARIETY TRIALS*

### *UPLAND VARIETY TRIALS*

Three upland variety trials, namely, savanna upland short duration, moist zone upland short and moist zone upland medium duration were conducted during the year at various locations in the member countries. From these trials, IRAT 142, IRAT 134, IRAT 133, IRAT 109 and IRAT 110 were identified as superior varieties for the savanna zone. Their yields were 2.8, 2.6, and 2.4 tons/ha respectively.

In the moist forest short duration trial the entries which produced the highest average yields over the 14 sites were IRAT 133, DJ8-341, IRAT 110, 949M/1/2 and CR 1015. Their average grain yields were 3.0, 3.0, 2.9, 2.6 and 2.6 tons/ha, respectively. The best five entries in terms of grain yields in the moist forest medium duration trial were MRC172-9, IR 1529-242-3, IRAT 138, IRAT 132 and SEL IRAT 194/1/2. Their average yields in tons per hectare were 2.8, 2.6, 2.6, 2.5 and 2.5 respectively. It is worth noting that both IRAT 110 and IRAT 133 were promising under both Savanna and moist zones.

### *IRRIGATED VARIETY TRIALS*

*Off Season: 1979-80:*

The short duration trial showed superiority of MTU 8431 (5.7 t/ha) during the off-season and confirmed high yielding ability of BG 90-2 (4.9 t/ha) and BR 51-46-5 (4.8 t/ha). The medium duration trial established good performance of BW 196 (4.6 t/ha) and BR 51-319-9 (4.4 t/ha).

*Main Season:*

Both the short and medium duration trials were very well conducted at almost all locations in all the member countries. In the short duration trial, BG 90-2 once again gave very good performance (5.4 t/ha) followed by IR 2042-178-1 (5.2 t/ha), IR 3273-P339-2 (5.1 t/ha), BR 51-46-5(4.9 t/ha) and TOX 514-16-101-1 (4.8 t/ha).

Among the medium duration entries, three new entries out-yielded BR 51-118-2 (5.2 t/ha) which maintained top yields for several years. Nizersail (5.5 t/ha) showed excellent performance closely followed by IR 1820-210-3 (5.2 t/ha) and IR 3464-4-3-2 (5.2 t/ha). The photoperiod sensitivity and excellent grain quality in addition to disease resistance, of Nizersail is likely to make it quickly acceptable to the farmers.

*MANGROVE SWAMP TRIAL*

Mahsuri, which has been tested under mangrove swamp condition earlier produced highest yield of 4.5 t/ha. Two new entries, Djabon (4.4t/ha) and Baligrodak (4.5 t/ha) showed very good performance also.

*Deep flooded condition trial*

DA 29 (2.9 t/ha) reestablished its superiority. The trial revealed the entry IR 2071-586-5-6-3 (2.6t/ha) as a promising one for the deep flooded condition.

*FLOATING CONDITION TRIAL*

FARO 14 (3.0 t/ha), DA 29 (2.5 t/ha) and Nang Kiew which are old entries, occupied top positions in 1980. No new promising variety could be identified.

*REORGANIZATION OF VARIETY TRIALS*

The coordinated variety trials have been reorganized from 1981 and will have the following trials:

1. Savanna Upland Short Duration
2. Moist zone upland short duration
3. Moist zone upland medium duration
4. Sahel irrigated short duration
5. Sahel irrigated medium duration
6. Moist zone irrigated short duration
7. Moist zone irrigated medium duration
8. Cold tolerance
9. Salt tolerance
10. Mangrove Swamp
11. Deep Flooded condition
12. Floating condition

*COORDINATED WEED CONTROL TRIALS*

The results show that manual weeding was generally superior but several of the herbicides exhibited comparable performance as far as grain yield is concerned. At most locations, several herbicides gave greater yields than the control. Tamariz (ordinary and super), Stam F34 and preforan 30 EC are common among the top five weed control treatments.

The present findings agrees with the earlier observation that weeds constitute a major limiting factor in rainfed rice production. To accomplish high grain yield, control of weeds is essential whether it is done by hand weeding or by chemical herbicides.

Some herbicides, such as Ordram + Stam F34 (Kaedi, Djibelor and Kogoni) and Tamariz super (Djibelor) gave greater yield than the control and also performed as good as Weed free and hand weeding treatments.

Unlike rainfed conditions, irrigation with good land preparation and puddling offered the advantage of water control and natural weed suppression. However, considering the high yields (3 to 6 t/ha) in unweeded plots at some locations, the grain yield increase of 20-98% at these sites by herbicides are unquestionably high. Thus even under irrigated conditions especially where water control cannot be accomplished satisfactorily, herbicides application can promote higher yields by controlling weeds. At some locations herbicides were generally superior to hand weeding under irrigated conditions.

*MANGROVE SWAMP CONDITIONS*

The effect of weed control treatments on grain yield was not significant (CV = 29%), although several herbicides gave more than 60% yield increase over control yield of 1.14 t/ha.

*ON-FARM TRIALS*

Each country was allowed ten trials to be funded by WARDA. Trials were conducted in Zones I, III, IV and V.

*ZONE I—GAMBIA, GUINEA BISSAU, MAURITANIA AND SENEGAL*

*Gambia*

Several trials were conducted during the wet season and involved a combination of promising improved and local varieties, fertilizer and method of sowing. The detailed results of these trials are combined in the national report. However, the variety ROK 5 performed well under deep flooded conditions, whereas under mangrove swamp, ROK 5 yielded as good as the best local varieties such as N'Kumba N'Dingo. Also, line drilled method of sowing resulted in higher grain yields than broadcast method.

*Guinea Bissau*

Out of the several trials conducted in Guinea Bissau, only four (Table 1) were successful mainly due to technical manpower limitations and erratic rainfall. Grain yields obtained considering that all the locations and for all the varieties except the local, Birguis. The varieties IR 442 and I Kong Pao were the current recommended varieties under irrigated conditions in Guinea Bissau.

*Mauritania*

No trial was conducted in this country inspite of all discussions with the Center for Agronomic Research at Kaedi.

**Table 1: Mean Rice Grain Yields of Four Irrigated On-Farm Trials Conducted in Guinea Bissau — 1980**

| Variety | VILLAGES | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Contuboel | | Djabicunda | | Saokunda | | Sanaco | | | |
| | FERTILIZER TREATMENT | | | | | | | | | |
| | FO | F1 | FO | F1 | FO | F1 | FO | F1 | | |
| | Tons Per Hectare | | | | | | | | Means | |
| | | | | | | | | | FO | F1 |
| IRAT 109 | 3.00 | 4.10 | 4.30 | 6.10 | 0.80 | 4.30 | 2.50 | 4.30 | (2.65 | 4.70 |
| IR 442-2-58 | 1.70 | 3.10 | 2.50 | 4.10 | 3.60 | 5.50 | 1.60 | 2.10 | (2.35 | 3.70) |
| I Kong Pao | 3.80 | 4.60 | 4.70 | 5.50 | 3.45 | 3.00 | 2.30 | 4.20 | (3.56 | 4.32) |
| Birguis (local) | – | – | – | – | 3.90 | 3.10 | – | – | (3.90 | 3.10) |
| Means | (2.83 | 3.93) | (3.83 | 5.23) | (3.94 | 3.98) | (2.13 | 3.53) | | |

FO = No fertilizer applied

F1 = 150 kg/ha 15:15:15 compound fertilizer (69 kg/ha N).

*Senegal*

Results of those conducted in the Casamance region are presented in Table 2. Fertilizer was applied at the rate of 85, 36 and 54 kg/ha each of N, P and K respectively as 8:18:27 compound fertilizer and urea. The used in the trals were promising ones from the national programme and coordinated trials. The variety BW 78, the highest yielder (4791d KG?HA), performed well in Southern Senegal under irrigated conditions. Yield differences among the six varieties in the trial grain yield obtained from Kong Pao was superior to the local check, 144B/9.

**Table 2: Rice Grain Yields of Three On-Farm Trials Conducted in Three Villages in Senegal — 1980**

| VILLAGES | | | | | |
|---|---|---|---|---|---|
| Simbandi 1/ | | Mampalago 2/ | | Enampore 3/ | |
| Variety | Kg/ha | Variety | Kg/ha | Variety | Kg/ha |
| BW 78 | 4,791 a | BR 51-46-5 | 3,299 | I Kong Pao | 3,386 a |
| BR 51-46-5 | 4,097 b | DJ 5-106-4 | 3,088 | DJ 11-510 | 2,942 ab |
| BR 51-319-9 | 3,650 bc | IR 4816-70-1 | 3,060 | DJ 12-519-1-3 | 2,672 ab |
| IR 1416-131-5 | 3,522 bc | BR 52-8-1 | 2,872 | DV 110 | 2,526 bc |
| DJ 5-106-4 | 3,456 c | IR 1529-680-3 | 2,771 | IR 2061-522-6-9 | 2,142 bc |
| BR 51-49-6 | 3,415 c | BW 191 | 2,524 | 144B/9 | 1,738 c |

1/ = Irrigated 2/ = Lowland 3/ = Upland

Mean yields within a column followed by the same letter are not significantly different.

## *ZONE III — IVORY COAST, MALI AND UPPER VOLTA*

The results of on-farm trials, carried out in the three countries, are presented in Tables 3, 4, 5, 6 & 7. The choice of varieties included promising varieties from the coordinated trials as well as from varieties already in wide use in the various countries. Locally recommended agronomic practices were followed at each site.

*Land preparation at Kou Valley — Upper Volta.*

*Weeding rice plots at Upper Volta.*

**Table 3: Yield (kg/ha) Performance of Upland Varieties at Various Sites in Ivory Coast**

| Varieties / Location | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | Mean |
|---|---|---|---|---|---|---|---|---|---|
| IRAT 110 | 1625 | 700 | 1100 | 685 | – | 2568 | 1229 | 2013 | 1417 |
| IRAT 112 | 1167 | 400 | 1100 | 554 | 2035 | – | – | – | 1063 |
| IRAT 109 | 1500 | – | – | 694 | 2145 | 1264 | – | 2633 | 1647 |
| IRAT 133 | 1708 | – | – | – | – | 2160 | 957 | – | 1686 |
| Local | | 600 | 900 | – | – | | | | 750 |
| **Dourado Precoce** | | | | 307 | 1382 | 572 | 903 | | 791 |
| IRAT 13 | | | | | | | | 2060 | 2060 |
| IRAT 144 | | | | | | | | 1523 | 1523 |
| IRAT 146 | | | | | | | | 1783 | 1783 |
| IRAT 147 | | | | | | | | 993 | 993 |
| IRAT 949 n | | | | | | | | 1480 | 1480 |

1 = Ande
2 = Bissagune
3 = Sapia
4 = Dourado P.O
5 = Daloa P.O
6 = Nielle
7 = Banandje
8 = Nambingui P.O

**Table 4: Yield (kg/ha) of Irrigated Varieties at San Pedro in Ivory Coast**

| Varieties | Duration (days) | Yield (kg/ha) | Per Cent of Local Check |
|---|---|---|---|
| BG 90-2 | 97 | 2450 | 102.1 |
| BR 51-118-2 | 130 | 2820 | 117.5 |
| 4414 | 116 | 2600 | 108.3 |
| **BR 51-46-5** | 110 | 2870 | 119.6 |
| BW 196 | 132 | 3370 | 140.4 |
| IR 5 (local check) | 138 | 2400 | 100.0 |
| Bouake 189 | 109 | 3451 | 143.8 |

**Table 5: Yield (kg/ha) Performance of Varieties at Various Sites in Upper Volta**

| SITE | C 74 | Vijaya | IR 1529-680-3 | IET 1996 | IET 2885 |
|---|---|---|---|---|---|
| Tcheriba | 360 | 200 | 960 | 40 | – |
| Kabuda (Bas-Fonds Pendogo) | 2388 | – | – | 2460 | – |
| Koupela Tensobentenga | 5580 | 7840 | – | 5840 | – |
| Yindougou | 113 | 209 | 181 | 205 | – |
| —Navielgan I | – | – | 1280 | 1372 | 1204 |
| —Holy | – | – | 3400 | 2816 | 2760 |
| —Karfiguela | 600 | 1320 | 680 | 1000 | – |
| —Koutoura | 2264 | 1928 | 2112 | – | – |
| Kaibo (Bas-Fonds de Koulipele) | 1538 | 1100 | 1190 | 1315 | – |

SOURCE: 1980 CERCI Report

**Table 6: Yield Performance of Deep Flooded Varieties at Klela in Mali**

| Variety | Duration (days) | Plant Height | Yield (kg/ha) |
|---|---|---|---|
| BD 2 | 86 | 150 | 4148 |
| H 4 | 86 | 150 | 3776 |
| C 74 | 84 | 120 | 3600 |
| IR 442 | 81 | 127 | 3440 |
| DM 16 | 91 | 140 | 3154 |
| DIOU (local) | 104 | 146 | 3072 |

**Table 7: Yield (kg/ha) Performance of Varieties at Two Sites in Mali**

| Variety / Location | H 1523-DA | IET 2911 | BH 2 | DK 3 | A 8 | A 23 | B 15 |
|---|---|---|---|---|---|---|---|
| KOLONGOTOMO | 5160 | 4077 | 3772 | 4690 | 3685 | 4692 | 4240 |
| NIONO | 3432 | 4000 | 3568 | 3392 | 2848 | 3096 | 3552 |
| MEAN YIELD (KG/HA) | 4296 | 4038 | 3670 | 4041 | 3266 | 3894 | 3896 |

*ZONE IV — GHANA AND NIGERIA*

*Ghana*

In 1980, ten locations were selected throughout the country for the sole purpose of carrying out on-farm trials.

The irrigated varieties nominated for the 1980 on-farm trials were Dawhenya 2, BG 90-2, BR 51-118-2, ADNY 11 and IET 2885. The upland varieties were: Besewar, 4418, IR 1820-210-2, ADNY 8, Dourado Precoce, IR 442, and IR 2053-205-2.

*UPLAND RESULTS*

The yields recorded at Zuo, show that Besewar (2.4 t/ha), IR 1820-210--2 (2.36 t/ha) and 4418 (2.1 t/ha) ranked first, second and third respectively. Comparing the results of 1979 to that of 1980, the first two varieties continued to maintain and show superiority in yields. The farmer selected IR 1820-120-2 as his first choice because it has high tillering capacity and fairly resistance to diseases. This variety also gave good yield in previous years in trials conducted by the Crop Research Institute, Nyankpala.

IR 1820-210-2 may replace the present recommended variety, IR 442 in the near future for commercial production. However, the short plant height of IR 1820-210-2 may be a limiting factor for wide scale production (Table 8).

At Kwame Danso, Local check ranked first followed by Dourado Precoce, IR 2053-205-2 and IR 1820-210-2. However, Dourado Precoce is becoming increasingly popular with the farmers at Atebubu district. Farmers like it because of its tall plant height, long grains, heavy panicle and a shorter duration (Table 8).

**Table 8: Grain Yield: Rainfed On-Farm Variety Trial at Zuo and Kwame Danso**

| Variety | ZUO | | | KWAME DANSO | | | |
|---|---|---|---|---|---|---|---|
| | Yield (t/ha) | Duration (days) | Plant Height (cm) | Variety | Yield (t/ha) | Duration (days) | Plant Height (cm) |
| 1. Besewar | 2.40 | 101 | 85 | 1. Local check | 2.90 | 90 | 125 |
| 2. IR1820-210-2 | 2.36 | 105 | 87 | 2. Dourado Pre. | 2.74 | 82 | 120 |
| 3. 4418 | 2.10 | 118 | 98 | 3. IR2053-205-2 | 2.45 | 101 | 61 |
| 4. HBDa2 (check) | 1.93 | 115 | 123 | 4. IR1820-210-2 | 2.36 | 98 | 75 |
| 5. ADNY 8 | 1.63 | 115 | 115 | 5. IR 442 | 2.18 | 95 | 76 |

*IRRIGATED RESULTS*

The yield results at Golinga were comparably low because of the difficulties in getting water to the trial field. Nevertheless, ADNY 11 and BR 51-118-2 ranked first and second respectively in yield. The results of the 1979 on-farm trial at Vea showed that BR 51-118-2 ranked second (5.40 t/ha). The farmer at Golinga selected ADNY 11 as his first choice because of its high yielding capacity, non-shattering, white long grains and resistance to diseases and pests (table 9).

**Table 9: Grain Yield: Irrigated On-Farm Variety Trial at Golinga**

| | Yield (t/ha) | Duration (days) | Plant Height (cm) |
|---|---|---|---|
| 1. ADNY 11 | 3.62 | 120 | 115 |
| 2. BR 51-118-2 | 3.30 | 127 | 117 |
| 3. Dawhenya 2 (check) | 2.80 | 127 | 116 |
| 4. IET 2885 | 2.50 | 127 | 90 |
| 5. HB 752 (check) | 1.85 | 120 | 105 |

*Nigeria*

In the 1980 season, there were 17 trials throughout Nigeria.

WARDA nominated varieties which exhibited promising yield performance in the coordinated trials were among the entries used for the above trials. In each trial, local check variety was included for comparison.

The results from five sites (using irrigated short and medium duration varieties) were available and are presented in Table 10 and 11. However, it has been reported that IR 2035-108-2 exhibited good yield performance under upland conditions and also was one of the top ranking promising varieties in the 1980 season.

*IRRIGATED SHORT DURATION*

Two local checks (IR 30 and TOS 103) and three tested varieties (IR 79-35-3, IET 2938 and IR 934-450-1) belong to short duration while the other seven (ADNY 11, ITA 212, Biplab, ITA 123, BP 76/9 × Dawn, ITA 121, BR 51-46-5) belong to the medium duration group (Table 10).

The yield data show that all the medium duration varieties (over 120 days) gave greater yields than the short duration (less than 120 days) varieties.

The highest mean yield was recorded for ITA 212 (5.9t/ha) followed by ITA 121 (5.7 t/ha), BR 51-46-5 (5.3 t/ha), ITA 123 (5.2 t/ha) Biplab (5.1 t/ha), ADNY 11 (5.0 t/ha) and BP 76/9 × Dawn (5.0 t/ha). BR 51-46-5 and ADNY 11 have been among top yielders in the coordinated trials since 1978 at various sites in Nigeria and Ghana.

*IRRIGATED MEDIUM DURATION*

The mean duration of varieties varied between 121 days in BG 94-1 and BG 94-2, and 149 days in FARO 15. The two local checks (FARO 13 and FARO 15) were longer in duration than the tested varieties (Table 11).

The highest mean yield of 5.4 t/ha was recorded for BG 90-2, followed by BR 51-49-6 (5.0 t/ha) FARO 13 (5.0 t/ha), BR 51-46-5 (4.9 t/ha) and FARO 15 (4.9 t/ha).

Entries such as BG 90-2, BR 51-49-6 and BR 51-46-5 performed well in the trials and matured earlier than the two local check varieties. Since 1978, BG 90-2 and BR 51-49-6 were among the top yielding varieties (5 to 8 t/ha) in the WARDA trials at various sites in Nigeria and Ghana.

**Table 10: Yield Performance of Irrigated Short Duration Rice Varieties in the National Zonal Trials of Nigeria**

| Varieties | Grain Yield (t/ha) at various locations | | | | | | Days to Maturity | Grain Type** |
|---|---|---|---|---|---|---|---|---|
| | Edozhigi | Badeggi | Abakaliki | Bende | Ogoja | Mean | | |
| 1. ITA 212 | 4.4 | 5.7 | 6.9 | 6.1 | 6.5 | 5.9 | 125 | B |
| 2. ITA 121 | 3.3 | 5.8 | 7.5 | 5.1 | 6.7 | 5.7 | 128 | A |
| 3. BR 51-46-5* | 2.5 | 5.8 | 6.8 | 4.7 | 7.6 | 5.3 | 133 | B |
| 4. ITA 123 | 3.7 | 5.5 | 5.6 | 4.3 | 6.9 | 5.2 | 124 | A |
| 5. Biplab | 3.9 | 5.1 | 5.4 | 4.9 | 6.2 | 5.1 | 128 | B |
| 6. ADNY 11* | 4.7 | 5.3 | 5.8 | 4.0 | 5.1 | 5.0 | 124 | A |
| 7. BP 176/9 x Dawn* | 3.4 | 4.3 | 5.8 | 5.0 | 6.3 | 5.0 | 124 | B |
| 8. IET 2938 | 3.6 | 5.2 | 4.8 | 4.6 | 5.7 | 4.8 | 116 | B |
| 9. IR 790-35-5-3 | 3.6 | 5.1 | 4.8 | 4.0 | 4.5 | 4.4 | 116 | A |
| 10. IR 30 (check) | 2.7 | 5.2 | 4.6 | 2.4 | 4.6 | 3.9 | 116 | A |
| 11. TOS 103 (check) | 2.7 | 5.1 | 5.0 | 2.9 | 4.0 | 3.9 | 117 | A |
| 12. IR 934-450-1 | 1.8 | 5.0 | 4.4 | 3.3 | 3.5 | 3.6 | 111 | A |

*WARDA Nominated entry. **Length/width ratio. A = 2.8-3.8. B = 2.4-3.0.

**Table 11: Yield Performance of Irrigated Medium Duration Varieties in the National Zonal Trials of Nigeria**

| Varieties | Grain Yield (t/ha) at Various Locations | | | | | | Mean Life Cycle (days) | Grain Type** |
|---|---|---|---|---|---|---|---|---|
| | Edozhigi | Badeggi | Abakaliki | Bende | Ogoja | Mean | | |
| 1. BG 90-2* | 3.9 | 5.2 | 6.4 | 3.6 | 7.8 | 5.4 | 133 | B |
| 2. BR 51-49-6* | 3.5 | 4.9 | 5.0 | 3.0 | 8.6 | 5.0 | 127 | B |
| 3. FARO 13 (check) | 3.2 | 5.6 | 5.0 | 3.2 | 7.9 | 5.0 | 136 | B |
| **4. FARO 15 (check)** | 3.1 | 4.9 | 5.6 | 2.6 | 8.5 | 4.9 | 149 | B |
| 5. BR 51-46-5* | 3.2 | 5.2 | 4.0 | 3.6 | 8.5 | 4.9 | 135 | B |
| 6. BR 51-118-2* | 3.2 | 4.9 | 3.9 | 3.9 | 8.3 | 4.8 | 134 | B |
| 7. M50/2/2/2 | 2.6 | 5.5 | 4.6 | 3.2 | 8.1 | 4.8 | 127 | B |
| 8. BR 51-319-9* | 2.3 | 4.9 | 3.9 | 3.8 | 8.3 | 4.6 | 140 | B |
| 9. IR 5496 | 2.5 | 5.0 | 4.8 | 2.8 | 6.8 | 4.4 | 124 | B |
| **10. IR 944-102-2-2-3-2** | 2.1 | 4.3 | 5.0 | 2.2 | 7.2 | 4.2 | 123 | A |
| 11. BG 94-1 | 2.4 | 3.9 | 4.0 | 2.8 | 6.9 | 4.0 | 121 | B |
| 12. BG 94-2 | 2.1 | 3.2 | 3.9 | 2.5 | 6.9 | 3.7 | 121 | B |

*WARDA Nominated Varieties **Length/width ratio A = 2.8-3.8 B = 2.4-3.0

## *ZONE V – NIGER, BENIN AND TOGO*

### *Benin*

### *UPLAND*

Under upland conditions, Co 38, LD 125 and CR 1002, gave the best results in the 1980 season (Table 12).

**Table 12: Yield (kg/ha) Performance of Upland Varieties at Various Sites in Benin (1980 Wet Season)**

| Varieties \ Sites | MOUSSOUROU | SAVE | MOKA | GRAND-POPO | BAGOU | Mean |
|---|---|---|---|---|---|---|
| Col 38 | 1732 | 2109 | 1916 | 2925 | 2712 | 2278 |
| LD 125 | 2531 | 2456 | 1987 | 2117 | 2150 | 2248 |
| CR 1002 | 1938 | 1900 | 2306 | 2349 | 2605 | 2219 |
| IRAT 112 | 1667 | 2000 | 1886 | 1205 | 1910 | 1733 |
| IR 442 (check) | 1246 | 1526 | 2010 | 1458 | 2402 | 1728 |

### *IRRIGATED*

In the 1980 rainy season, BG 90-2 and ADNY 11 were tested under irrigated conditions, they were less productive than in 1979, at least on farmers' fields at Mitro and Deve. (Table 13).

In the 1980 rainy season four entries were used in the irrigated on-farm trial at five locations. Yields were lower in some sites as compared to those of 1979. BW 196 and BG 90-2 were the top yielders (Table 13).

**Table 13: Yield (kg/ha) Performance of Irrigated Varieties at Various Sites in Benin (1980 Wet Season)**

| Varieties \ Sites | SAGBOVIZ-DOME | MITRO | KOUSSIN | DEVE | MALANVILLE | Mean |
|---|---|---|---|---|---|---|
| BW 196 | 4769 | 1046 | 2929 | 1540 | 4231 | 2903 |
| BG 90-2 | 3913 | 1098 | 3313 | 1347 | 3756 | 2685 |
| ADNY 11 | 3887 | 991 | 3316 | 950 | 3965 | 2621 |
| IR 8 (check) | 3455 | 685 | 3351 | – | – | |

*Togo*

On-farm trials were conducted under irrigated conditions only during the 1980 main season (Table 14). BR 51-319-9 and BR 51-49-6 produced fairly good yields.

**Table 14: Yield of Irrigated Varieties at Dapaong in Togo (1980 Main Season)**

| VARIETIES | YIELD (kg/ha) |
|---|---|
| BR 51-319-9 | 4125 |
| BR 51-49-6 | 3981 |
| ADNY 11 | 3856 |
| IET 1444 | 3581 |
| BG 374-1 | 2962 |

*Niger*

In the 1980 main season, on-farm variety trials were conducted at four sites under irrigated conditions (Table 15).

In Niger, all the four nominated varieties out yielded the local check (IR 22). BG 90-2 ranked first in yield and it out yielded the local check IR 22 by 2.0 t/ha (Table 15).

**Table 15: Yield (kg/ha) of Irrigated Varieties at Various Sites in Niger (1980 Main Season)**

| SITES / VARIETIES | N'DOUGA | SAADIA | SEBERI | SAGA | Mean |
|---|---|---|---|---|---|
| BG 90-2 | 5441 | 5471 | 4912 | 5862 | 5421 |
| H 5 | 4623 | 4547 | 4636 | 5073 | 4719 |
| IR 1529-680-3 | 4571 | 4400 | 4199 | 4855 | 4506 |
| MTU 770-7-2 | 4365 | 4335 | 4584 | 4286 | 4392 |
| IR 22 (Check) | 3490 | 3503 | 3394 | 3594 | 3493 |

## *SUPPORT TO NATIONAL RESEARCH*

As in the past, assistance was given to national programmes. Construction of Field Laboratories at Bohicon (Benin), Contuboel (Guinea Bissau), Kaedi (Mauritania) and Cacavelli (Togo) has been completed in 1980, and also equipment for these laboratories are ready for installation. Apart from the construction of laboratories, all member states received equipment for IET and coordinated trial programmes.

*SEED NURSERY FARM*

The Seed Nursery Farm located at Suakoko (Liberia) continued to discharge its vital role in varietal introduction, varietal improvement and seed increase. During the year under review, a total of 2,546 varieties and strains were grown and tested. Under the Seed Nursery Farm programme, 341 varieties were planted at Richard-Toll (Senegal) for seed increase and observation. Over three tons of foundation seed was also produced at Richard-Toll. From these materials, 24 very promising varieties were selected and nominated to the WARDA coordinated trials of 1981, and 260 varieties were nominated to the WARDA IETs of 1981.

The reorganization of WARDA coordinated variety trials, initiated in 1979 is being fully implemented from 1981. The reorganization of trials has caused an increase in volume of works and materials at least by 50%. An Agronomist has been provided from 1981 in addition to the existing Breeder and Assistant Breeder at the Seed Nursery Farm.

The construction of a guest house was started and expected to be completed by the middle of 1981.

*WARDA SEED LABORATORY ACTIVITIES*

In 1980, a total of 641 entries were packaged for WARDA 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 168 trials spread over 58 locations in 15 member countries of WARDA. A total of 1112 new varieties were introduced from outside the region while 1889 were dispatched to countries within and outside West Africa. From WARDA germplasm, 1787 were sent to both Richard-Toll and Suakoko Seed Nursery farms for first stage studies and multiplication. In addition to the routine work some storage and physiology experiments were carried out. Also two students of the University of Liberia participated in a work-study programme for two months.

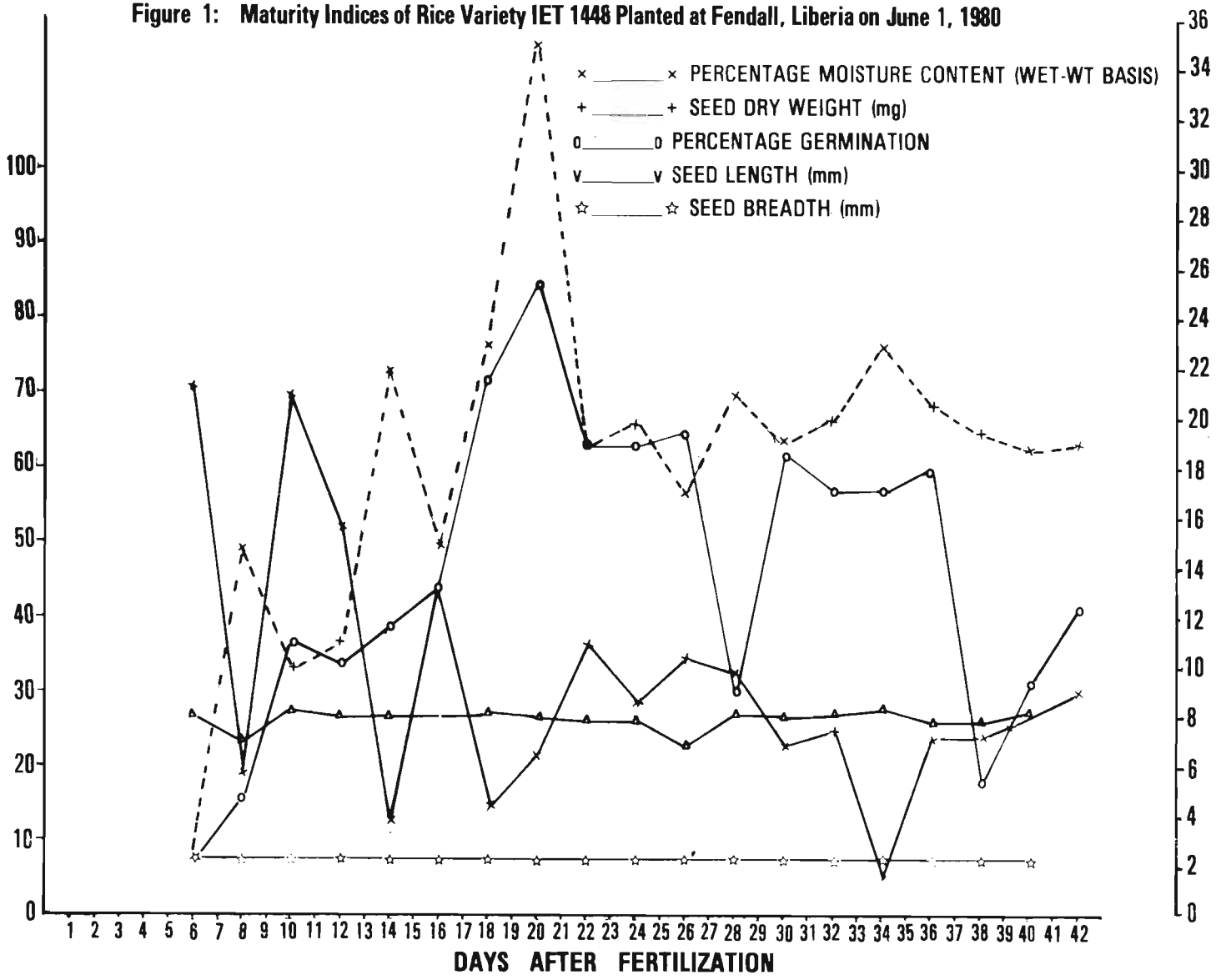
Maturity studies involving a low land variety, IET 1444 carried out at Fendall, Liberia (located in the moist-forest of zone of West Africa) in June, 1980 showed that Physiological (Functional) maturity was attained at 20 days after anthesis (Fig. 1)

Also preliminary survey of hot-water treated and untreated seed rice materials revealed that spore counts of dangerous pathogens such as *Pyricularia oryza, Trichoconis, Helminthosporium oryzae* and *Fusarium Moniliforme* decreased considerably after hot water treatment of the seed materials at 55 C for 20 minutes.

*GERMPLASM ACTIVITIES*

Activities in 1980 included exchange of collections, multiplication, evaluation and initiation of the germplasm bank construction at Fendall.

**Figure 1: Maturity Indices of Rice Variety IET 1448 Planted at Fendall, Liberia on June 1, 1980**



Samples of African collections, e.g. from Tanzania, were received from IRAT-ORSTOM in 1980. These were collected by IRAT-ORSTOM from various parts of Africa in 1977 and 1978.

A request for the screening of 252 collections under iron-toxic conditions were received from IITA in November, 1980. These were planted early 1981.

Seed increase and field assessment were started in 1979 and continued in 1980. Materials already received from cooperators were multiplied and evaluated at the Seed Nursery Farm in Suakoko, Liberia. An example is the 162 cultivars from the Ivory Coast collected by IRAT-ORSTOM and sent to WARDA in 1979.

The WARDA collections made late in 1979 to early 1980 were planted in October — December 1980 for seed increase and preliminary evaluations.

*ACTIVITIES ON THE INTERNATIONAL TESTING PROGRAM (IRTP)*

WARDA's participation and involvement in the Inernational Rice Testing Program (IRTP) increased in 1980. Not only were more nurseries received and planted but WARDA staff visited many of the nurseries. This has helped in the improved coordination of the nurseries in the region.

In 1980, many of the 1979 nurseries were planted as well as some 1980 nurseries throughout the region.

A total of 100 sets from 16 different 1979 nurseries were requested from IRRI for the WARDA region. Results received of nurseries planted in 1979 were sent to IRRI early in 1980. The rest of the nurseries were however planted in 1980. Detailed results of these nurseries received by April 1981 have been dispatched to the joint IRTP coordinators at IRRI. Only result highlights of the different nurseries are presented here.

In the 1979 IURON nurseries, common promising entries at two or more locations were C424-2, C732-14, IR3249-19-1 and IR8103-4-1. These and others have been used in some places as parents in hybridization programs or nominated into zonal trials in respective countries.

The best overall entries in the 1979 IRON planted in 1980 at CARI, Suakoko, are listed below. As in other nurseries, these have been used by the national breder for hybridization and some entered into yield countrials.

| | |
|---|---|
| IR7963-87-3-3 | Kaahsiung Sen yu |
| IR8073-231-3-3 | B1665B-MR-7-SI-5 |
| IR9299-47-1-1-6-2 | BW 170 |
| IR13214-52-2 | PAU 14-3-4-2-RP 508 |
| MONG NOHIEP 75-5 | IET 6420(CRM10-481-58-77) |

Out of the many promising entries at Nyankpala (Ghana) and Suakoko (Liberia) B5418-KN-47-1-1 and IR4712-38-1-2-3 were found to be good at both locations. The rice breeder at Suakoko has also recommended B461-B-PN-3-2-5 into the WARDA Initial Evaluation Trials.

Although there was some rat damage to the nursery, 12 promising cultivars were identified in the IRCTN nurseries.

In 1980, 89 sets of 15 different nurseries were received from IRRI in the WARDA region. Some of the result highlights are given below.

About 50 per cent of the 1980 IURON nurseries received were planted in 1980. Out of the many promising entries at four different locations in the region, IR 3880-29, IR 5929-12-3 were found to be good at more than one location.

Several of the promising cultivars from the 1980 IURON have been included in the 1981 WARDA Upland Initial Evaluation Trials (IETs). These will be conducted at 14 locations in West Africa in 1981.

Many good entries in the IRON nurseries were identified at the WARDA Seed Nursery Farm. These, have been nominated into the 1981 WARDA irrigated IETs. These trials will be conducted at 18 different sites throughout the WARDA region in 1981.

Four 1980 IURYN results were received by the end of March 1981. A comparative yield of the best 7 yielders and controls at three different locations in Nigeria showed BG 35-2, CI 71-136 and IR 5931-110-1 to be among the best 7 yielders at two of the three locations with a yield range of 2.2-3.9 t/ha.

*MONITORING TOURS*

The tours included visits to the WARDA coordinated trials and trials run by national programmes of the member countries.

Monitoring of the coordinated trials was done by Headquarters staff and the Sub-regional Coordinators. The countries visited in 1980 from Headquarters were Senegal, Ivory Coast, Mali, Niger, Nigeria, Sierra Leone, Guinea etc. The 1981 tour will include Gambia, Togo, Ghana, Benin, Liberia, Guinea Bissau and other countries as may be requested.

The visit to Senegal was made to confirm the presence of bacterial leaf blight, which had earlier been reported by the Entomologist at Richard-Toll.

The trip to Mali was made to further investigate and determine the cause of "dying off" reported in the deep-flooded zones of Mali and to suggest corrective measures. An attempt to reach Gao in 1980 failed, however, further attempt will be made in 1981.

In Mali, stemborers were the most important insect problem with *Chilo* and *Maliarpha* being the major species. All the straw found floating were infested by *M. separatella.* It was therefore concluded that severe stemborer infestation *(M. separatella)* was the cause of "dying off" which has been reported in deep areas of the flooded plains in Mali.

Definite information is, however, required as to the exact time of attack.

The observations at Niger were meant to study the three main ecosystems — irrigated, deep water and floating, and swamp rice cultivation.

In Niger, insect pests and disease did not seem to be much of a problem particularly at the early stages, but stemborers become a problem as the crop matures. Because of the uncertainty of the floods, farmers tend to spend more time on their upland crops.

The visit to Guinea showed that the limiting factors were manpower, high production costs, poor land preparation, poor water management and poor storage facilities. Blast and leaf scald have been increasing and may become a serious problem. Among the insect pests are stemborers, plant and leaf hoppers and leaf cutters. The caseworms are serious pests especially in Macenta.

## *SPECIAL RESEARCH PROJECTS*

### *UPLAND RICE: BOUAKE, IVORY COAST*

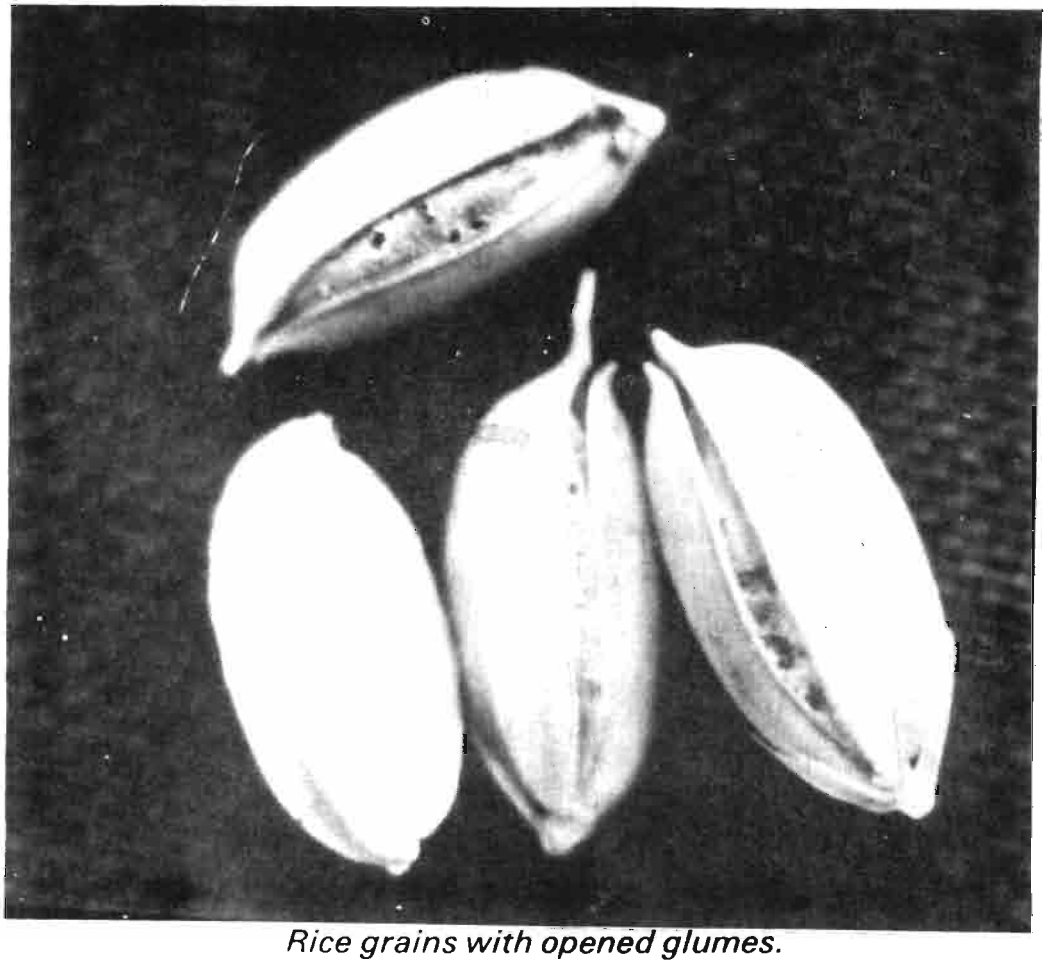
WARDA backed up the upland rice research program carried out at IDESSA/Bouake by the presence of a breeder who was fully integrated with the IDESSA staff.

In 1980 the field experiments conducted were as follows:

1. Selection in $F_3$ populations at the 1970-1980 off-season.
2. Screening work on shattering
3. Investigation of a problem caused by varieties with a high level of opened glumes.
4. Varietal improvement trials.

#### 1. *SELECTION IN $F_3$ POPULATIONS*

The populations are classified based on parents used in their crosses. Table 16 shows the characteristics of these parents.



*Rice grains with opened glumes.*

**Table 16: Characteristics of the Parents used for the $F_3$ Populations.**

| Types and cultivars | Undesirable traits to be eliminated | Desirable traits to be retained |
|---|---|---|
| 1. West African upland types - low tillering Makouta. | Too tall and awned | Good tolerance to disease, resistant to shattering and big grain size. |
| Moroberekan | Too tall and low yield | High adaptability and wide spectrum of disease resistance. |
| 2. Upland types with medium tillering ability 63-83 | Too tall, highly shattering and hairness | Good adaptability, disease tolerance, large and good quality of grains. |
| 3. Japonica-ponlai type No. IKU 1517 | Too round grain, open lemma, locally non adapted. | Short plant, good yield under some conditions |
| IRAM 1632 ( = Chianam B) | Too round grain | Good yield, diseases tolerance. |
| 4. Improved Upland Type IRAT 13 | Highly shattering and haireness | Optimum height, good yield wide adaptability, disease tolerance, drought tolerance and good grain size. |
| IRAM 31-9-7 | High shattering | Grain length, short plant good yield under some conditions. |
| 5. Type special (Laos - Thailand) - KU 86 | Height a little bit too short, poor grain quality, high shattering. | Good adaptability, large grain. |

*Results*

From about one thousand $F_3$ lines, only 87 have been retained for $F_4$ In $F_5$ the percentage of discarded plants were lower.

## 2. *SCREENING FOR SHATTERING RESISTANCE*

The problem of selection for resistance to shattering had been under investigation for some years now at Bouake. Screening was done at two maturity stages; at ¼ and ¾ maturity. This allowed the determination of variety and maturity interaction and to eventually determine variety having little or no difference in shattering between the two stages.

A maturity x humidity interaction existed at increased maturity shattering is increased by low relative humidity.

222 cultivars were screened and 40% of these did not shatter much. Some of the cultivars with low shattering were Pate blanc S3, 16-F, Laban, B3-13-4-23, B3-13-2-23, Makouta, IRAT 135A-2-4, 62-441, IRAT 8, K2-A22, TOX 490, TOX 515, IRAT 163 and IRAT 136. The highly shattering cultivars were SE 349D, Khao Dame, P13, Kaoshiung 21 etc., where over 80% shattering occurred.

### 3. *INVESTIGATIONS ON OPEN GLUMES*

It has been observed that the variety IRAT 10 is heavily attacked by *Sitophullus oryzae.* This variety also has the undesirable trait of opened glumes. This observation led to the detailed studies of opened glumes and damage caused by *Sitophillus oryzae.*

Two countings were made on 2 different samples at 2 different dates.

In the first example, the counting of weevils was done by manual sorting and in second sample by sieving. The results are presented in Table 17.

**Table 17: Percentage of Opened Glumes and No. of Weevils Present in Some Rice Cultivars.**

| Variety | Sample No. 1 | | Sample No. 2 | |
|---|---|---|---|---|
| | % of opened glumes | Weevils/ 200 grains | % of opened glumes | No of weevils/ 200 grains |
| IGUAPE CATETO | 0 | 0 | 0 | 0 |
| DOURADO PRECOCE | 1 | 18 | 10 | 34 |
| SEL IRAT 194 | 0 | 0 | 0 | 2 |
| IRAT 10 | 15 | 54 | 72 | 236 |
| IRAT 13 | 3 | 1 | 2 | 4 |
| IRAT 106 | 19 | 0 | 14 | 1 |
| IRAT 109 | 2 | 0 | 0 | 7 |
| IRAT 110 | 18 | 13 | 12 | 25 |
| IRAT 112 | 9 | 0 | 4 | 0 |
| IRAT 132 | 9 | 0 | 4 | 0 |
| IRAT 133 | 5 | 6 | 36 | 11 |
| IRAT 134 | 22 | 135 | 26 | 237 |
| IRAT 136 | 0 | 1 | 4 | 2 |
| IRAT 138 | 5 | 2 | 8 | 7 |
| IRAT 142 | 9 | 2 | 6 | 28 |
| M 18 | 1 | 1 | 0 | 4 |
| M 55 | 0 | 3 | 4 | 1 |
| 949/M2 | 11 | 2 | 12 | 7 |

In the two samples there was an apparent positive relationship between open glumes and the number of weevils. There were however other influencing factors beside opened glumes on the number of weevil present. For instance IRAT 106 had fewer number of weevils though it had a relatively high percentage of opened glumes. The rate of opened glumes was also affected by the harvesting and storage conditions.

*INHERITANCE OF OPENED GLUMES*

Preliminary inheritance studies were carried out. Parents having contrasting percentage of opened glumes were crossed e.g. Moroberekan (5%) and Lung Sheng 1 (90%). The percentage of their $F_1$ s. were determined as presented in Table 18.

**Table 18: Percentage of Opened Glumes of Parents and Their $F_1$ s.**

| Resistant parent | % | Susceptible parents | % | % of F 1 |
|---|---|---|---|---|
| MOROBEREKAN | 5 | LUNG SHENG 1 | 90 | 8 |
| CARREON | 0 | LUNG SHENG 1 | 90 | 2 |
| RT 1031-69 | 2 | TODOROKI WASE | 52 | 25 |
| IRAT 109 | 0 | MIZUHATA MOCHI | 30 | 12 |

Although no concrete conclusion can be made from this first study until the $F_2$. Nevertheless it appears that the Lung Sheng genetic mechanism was a monogenic recessive and it was different from that of the 2 other Japonica parents (Todoroki Wase and Mijushata mochi).

*SCREENING OF PARENTS FOR OPENED GLUMES*

Based on the first results 250 varieties were screened out of which 17 varieties had over 10% of their glumes opened. A rate above 10% is unacceptable.

4. *ANALYSES OF TRIALS CONDUCTED IN IVORY COAST*

The cultivars resulting from using IRAT 13 as a parent were tested in many locations since 1977. The trial and results of these cultivars were analysed by the analysis of variance and regression method of each genotype.

A significant effect of each factor studied was obtained and in particular the variety by trial interaction. These analyses showed that all the varieties in general were not completely adapted and that it is essential to choose the varieties in relation to the given conditions of the site and cultural practices.

Nevertheless these analyses revealed the superiority of IRAT 109 as an early duration variety although it is a highly shattering variety. IRAT

*Rice quality , work at Mopti — Mali.*

112 was also selected as an early duration variety. These two yielded higher than Dourado precoce which is the recommended variety. As medium duration variety, IRAT 104 was chosen to be extended in the central zone where it was better than IRAT 13 because of its more tolerance to drought. IRAT 136 was chosen as a late variety. It was consistently superior to Moroberekan without any major fault.

*DEEP WATER AND FLOATING RICE — Mopti, Mali*

1. *VARIETAL IMPROVEMENT:* The programmes involved:
   a) Screening Tests, (b) Yield potential studies under different water levels, (c) Multilocation yield trials in the ''Operation Rice Mopti'' and (d) Hybridization.

a) *SCREENING TESTS*

The studies (initial evaluation tests) showed that out of 58 varieties, only 33 could withstand the water level. The best introductions and their characteristics are shown in Table 19. Tiller dissection revealed a high percentage of stemborer damage, in which *Maliarpha sp* was more destructive than *Chilo sp.* ADNY 301 and Bakutu had infestations, while Gissi 27 had the lowest.

The varieties Sarsari, Chota Bawalia, DW8, GMS 12, GM 13, Baisbish and SPR 7292-296-1-3-B possessed good elongation ability and therefore could possibly be used as parents in the hybridization programme.

b) *YIELD POTENTIAL OF VARIETIES UNDER DIFFERENT WATER LEVELS*

These trials were put into two categories — deep and medium water Levels (to identify high yielding varieties for deep and medium water levels) and Medium and Shallow water levels (to identify new varieties which yield better than the recommended ones at these water levels).

Due to the small flood volume, the water level was low in the different zones. Slight symptoms of *Pyricularia oryzae* were observed.

The varieties DM 16, Cula and BKN 6323 gave the highest yields in the deep and medium zones, but these were not statistically different from the check (Khao Gaew) (Table 20). These results are similar to those obtained in 1979. Among the new varieties BKN 7022-105-P showed very good performance (Table 21).

**Table 19: Agronomic Characteristics of Best Introductions from the IET.**

| VARIETIES | Days to maturity | Height in cm | % of infested tillers by | | Number of Grains per panicle | Weight of 1,000 grains in gm. |
|---|---|---|---|---|---|---|
| | | | *Maliapha sp* | *Chilo sp* | | |
| 1. ADNY 301 | 140 | 158 | 64.4 | 2.2 | 163 | 23.58 |
| 2. Bakutu | 140 | 165 | 69.0 | 7.1 | 111 | 19.29 |
| 3. BKN 6323 | 140 | 165 | 17.3 | 5.3 | 138 | 25.31 |
| 4. BKN 6986-147-2 | 140 | 133 | 48.3 | 0 | 95 | 28.29 |
| 5. BKN 6987-161-1-3 | 135 | 130 | 24.1 | 0 | 118 | 20.29 |
| 6. DA 29 | 130 | 132 | 35 | 2.5 | 68 | 28.98 |
| 7. DM 16 | 135 | 174 | 31.6 | 0 | 75 | 30.22 |
| 8. FAROX 126-67-19 | 130 | 154 | 25 | 0 | 145 | 23.93 |
| 9. FAROX 126-68-8 | 130 | 133 | 58 | 0 | 116 | 23.98 |
| 10. FAROX 126-69-9 | 132 | 175 | 31.6 | 0 | 65 | 28.63 |
| 11. FAROX 127-59-6 | 135 | 135 | 24 | 0 | 108 | 25.05 |
| 12. Gissi 27 | 140 | 128 | 14 | 1 | 175 | 18.38 |
| 13. IR 4683-54-2-2-3 | 145 | 147 | 14.5 | 0 | 145 | 24.25 |
| 14. Pa Kenema | 150 | 164 | 45.1 | 0 | 194 | 18.12 |
| 15. SR 26 B | 130 | 167 | 56.4 | 0 | 143 | 30.42 |

**Table 20: Yield Performance of New Varieties in Deep and Medium Water Levels.**

| VARIETIES | Days to maturity | | Height in cm. | | Grain yield kg/ha. | | |
|---|---|---|---|---|---|---|---|
| | Deep Zone | Medium Zone | Deep Zone | Medium Zone | Deep** | Medium* Zone 1980 | Medium Zone 1979 |
| 1. DM 16 | 145 | 138 | 195 | 200 | 3052a | 3290a | 3263a |
| 2. BKN 6323 | 147 | 140 | 183 | 184 | 2998a | 3302a | 2585ab |
| 3. Cu la | 157 | 164 | 217 | 212 | 2981a | 3301a | - |
| 4. Khao Gaew | 161 | 158 | 220 | 230 | 2921a | 3250a | 2122 bc |
| 5. Nang Kiew | 160 | 154 | 221 | 228 | 2664ab | 2836a | 1933 bc |
| 6. BKN 6986-108-3 | 161 | 146 | 188 | 186 | 2632ab | 2874ab | 1877 bc |
| 7. BKN 6986-167 | 158 | 150 | 198 | 199 | 2476abc | 2858ab | 1937 bc |
| 8. MSP 11 | 158 | 150 | 190 | 203 | 2449abc | 2868ab | 1914 bc |
| 9. Mali Sawn | 173 | 160 | 221 | 228 | 1934 bc | 3208a | 1548 c |
| 10. BKN 6986-81-5 | 157 | 150 | 195 | 199 | 1814 c | 2169 b | 1396 c |
| CV = | | | | | 18.22% | 17.80% | 31.99% |
| Water level | | | | | 102 cm | 85 cm | 102 cm |
| Date of seeding | | | | | 16-7 80 | 25-7-80 | 25-7-79 |

* ** Values having same letter within a column are not significantly different respectively at 5% and 1% levels according to Duncans Multiple range test.

**Medium-shallow water level**

In this Trial variety Bh 2 was severely attacked by leaf blast (P. oryzae). The highest yielder in both zones was BKN 7022-105-P, with 4396 kg/ha in the medium and 4774 kg/ha in shallow zone. This was followed by BKN 7022-6-4. BKN 6986-38-1 confirmed its previously reported high yield potential in the shallow zone (Table 23).

**Table 21: Yield Performance of New Varieties in Medium and Shallow Water Levels.**

| VARIETIES | Cycle : Sowing maturity in days | | Plant height in cm | | Grain yield in kg/ha | | |
|---|---|---|---|---|---|---|---|
| | Medium Zone | Shallow Zone | Medium Zone | Shallow Zone | Medium Zone** | Shallow Zone * | Shallow Zone 1979 |
| 1. BKN 7022-105-p | 136 | 128 | 150 | 118 | 4396* a | 4774a | 3633 |
| 2. T442-36 | 139 | 135 | 156 | 129 | 3778 ab | 4070abcd | 3626 |
| 3. BKN 7022-6-4 | 141 | 135 | 155 | 133 | 3687 ab | 4373abc | 3756 |
| 4. DA 29 | 130 | 125 | 178 | 167 | 3668ab | 3591 cd | 3859 |
| 5. DM 16 | 134 | 133 | 216 | 171 | 3522 abc | 3894 bcd | 3756 |
| 6. BKN 7022-10-1-4 | 136 | 127 | 152 | 123 | 3548 abc | 4298abc | 3025 |
| 7. BKN 6986-38-1 | 141 | 136 | 150 | 123 | 3494 bc | 4524ab | 4217 |
| 8. BH 2 | 141 | 136 | 175 | 161 | 3286 bc | 3954abcd | 3677 |
| 9. DM 17 | 136 | 136 | 201 | 165 | 3137 bc | 4265abc | 3770 |
| 10. D52-37 | 130 | 127 | 182 | 163 | 2777 c | 3339 d | 4059 |
| CV | | | | | 13.61% | 14.64% | 16.74% |
| Water level | | | | | 0.85 m | 0.50 m | 0.60 m |
| Date of seeding | | | | | 27-7-80 | 7-8-80 | 11-8-79 |

*, ** **Values having same letter within a column are not significantly different respectively at the 5% and 1% levels according to Duncan multiple range test.**

(c) *MULTILOCATIONAL YIELD TRIALS*

A comparative study between new and promising varieties with those currently grown ones at some sites of the "Operation Riz Mopti" was carried out. The yields were generally higher at Bougoula where the water level did not exceed 30 cm, but there was so significant difference in the yields of the varieties (Tables 22 and 23).

Table 22: Yields (kg/ha) of Selected Varieties in Different Sites of "Operation Riz Mopti" (Shallow Zone).

| | Sites | | Mean |
|---|---|---|---|
| | Safara | Bougoula | |
| 1. BKN 6986-38-1 | | 4743 | 4743 |
| 2. DM 17 | 3221 | 4263 | 3792 |
| 3. BH 2 | 3197 | 4327 | 3762 |
| 4. DM 16 | 3184 | 3991 | 3588 |
| CV | 11.78% | 12.01 | |
| | NS | NS | |
| Sowing Dates | 4/8/80 | 7/8/80 | |

Table 23: Yields (kg/ha) of Selected Varieties in Different Sites of "Operation Riz Mopti" (Deep Zone)

| | Sites | | | Mean |
|---|---|---|---|---|
| | Mopti North Sevare | Syn | Mopti South Tibo | |
| 1. Khao Gaew | 2344 | 2115 | 2115 | 2191 |
| 2. Cuba | 1989 | 2368 | 2193 | 2183 |
| 3. MSP 10 | 1851 | 1911 | 2079 | 1947 |
| 4. MSP 11 | 1659 | 1791 | 1935 | 1795 |
| CV | 18.30% | 13.81% | 15.28% | |
| | NS | NS | NS | |
| Sowing dates | 19-7-80 | 25-7-80 | 26-7-80 | |

d) *HYBRIDIZATION PROGRAMME:*

Selection from previous crosses included 16 plants in the $F_4$ and 3 in the $F_3$ generations. Two new crosses made were IET 2911 x Khao Gaew and IET 2911 x Mali Sawn. From these crosses three lines were selected in $F_3$ and 16 lines in $F_4$ populations.

2) *AGRONOMY*

The research activities were closely linked with the weed control trials and included land preparation, cultural practices and fertilizer management.

*LAND PREPARATION*

Land preparation studies revealed that plots ploughed by either oxen or tractor yielded more than hand-hoed plots (Table 24).

**Table 24: Influence of Tillage Implement and Nitrogen (N) on Yield (kg/ha) of Floating Rice.**

| Tillage implement | Without N | With N | Mean |
|---|---|---|---|
| Hand hoe | 772 | 863 | 818 |
| Oxen ploughed B2 + Harrow | 1497 | 2028 | 1763 |
| Tractor ploughed + Harrow | 1535 | 2191 | 1863 |
| Mean | 1268 | 1694 | |

CV: Implement = 4.91% N : 3.31%
Implement x N = 6.37%
LSD: Implement 269 kg/ha, N: 155 kg/ha
Implement x N = 332 kg/ha
Maximum water level = 97 cm.

*Cultural Practices*

The influence of seeding date on deep water rice was studied. Three varieties, Khao Gaew, Nang Kiew and Mali Sawn were used. Khao Gaew and Mali Sawn produced significantly higher yields than Nang Kiew. The July 10 sowing gave significantly higher yield inall the varieties. (Table 25).

In the last sowing date the seedlings were drowned and therefore produced no grain. Studies on the effect of method of sowing on yield revealed that all varieties performed well regardless of the sowing treatments. Transplanting reduced grain yield significantly in the three varieties (Table 26).

**Table 25: Influence of Seeding Date on the Grain Yield of Deep Water Rice (kg/ha)**

| Seeding Dates | Khao Gaew | Nang Kiew | Mali Sawn | Mean |
|---|---|---|---|---|
| 1-7-81 | 1,329 | 1,303 | 1,310 | 1,315 |
| 10-7-81 | 1,548 | 1,450 | 1,541 | 1,513 |
| 20-7-81 | 1,215 | 1,193 | 1,207 | 1,205 |
| 31-7-81 | 1,012 | 865 | 971 | 949 |
| 10-8-81 | - | - | - | - |

LSD 5% for variety = 46 kg/ha
LSD 5% for date of sowing = 48 kg/ha

**Table 26: Influence of Seeding Methods on Grain Yields of Deep Water Rice (kg/ha).**

| Variety | Drilling | Broadcasting | Transplanting | Mean |
|---|---|---|---|---|
| MSP 11 | 4228 a | 3890 a | 2022 b | 3380 |
| Khao Gaew | 3853 a | 3667 a | 2074 b | 3198 |
| DM 16 | 3810 a | 3774 a | 1979 b | 3188 |

*FERTILIZER MANAGEMENT*

*RATE AND TIME OF FERTILIZER APPLICATION:*

In the rate and time of fertilizer application study, the objective was to find out the most suitable and economic package of fertilizer application for deep flooded water rice.

In Mopti-South, the plots with a supply of 100 kg/ha of urea yielded the highest; also in Sofara, the application of 100 kg/ha of ammonium phosphate appeared to play the key role in yield increase. In Mopti-North there were no significant differences among the treatments (Table 27.).

*NITROGEN–PHOSPHORUS PLACEMENT EFFECTS ON STEM ELONGATION AND PADDY YIELD*

There was no significant response to nitrogen for the second subsequent year. The effect of phosphorus on crop yield also was negligible. Nitrogen applied at the rate of 80 kg/ha produced yield increase of 12.92 and 1.16% over 0 and 40 kg.N/ha respectively.

The studies included the *source and time of nitrogen* application. There was no significant difference in the mean yields of the different N sources, regardless of the time of application.

3) *WEED CONTROL*

The frequency of weeding on the control of weeds and yield of floating rice was studied for the second time to compare the farmer's and recommended practices.

The best yields were obtained when weeding was done at 35 and 63 days after rice emergence (Table 28). The traditional method of weeding only once in water 63 days after emergence reduced the yield of Nang Kiew by 47%.

**Table 27: Influence of Rate and Time of Fertilizer Application on the Grain Yield of BH2 Grown under Deep Flooded Conditions**

| Treat ments | Periods of Application | | | Yield Kg/ha | | |
|---|---|---|---|---|---|---|
| | At Seeding | At Tillering | 1 Week Before Flooding | Mopti – South | Mopti – North | Safara |
| 1 | 0 | 0 | 0 | 1,726 b | 2,257 | 2,049 c |
| 2 | 100 kg A.P. | 0 | 100 kg Urea | 2,632 a | 2,518 | 2,732 b |
| 3 | 100 kg A.P. | 0 | 50 kg Urea | 2,386 a | 2,378 | 3,820 a |
| 4 | 100 kg A.P. | 0 | 0 | 1,905 b | 2,622 | 3,802 a |
| 5 | 0 | 100 kg A.P. | 0 | 1,899 b | 2,622 | 3,351 ab |
| 6 | 0 | 100 kg A.P. | 100 kg Urea | 2,379 a | 2,466 | 3,854 a |
| 7 | 0 | 100 kg A.P. | 50 kg Urea | 2,196 a | 2,570 | 2,726 b |
| 8 | 0 | 50 kg A.P. | 0 | 1,858 b | 2,466 | 3,021 b |
| 9 | 0 | 50 kg Urea | 50 kg Urea | 2,391 a | 2,430 | 3,021 b |
| 10 | 0 | 0 | 100 kg Urea | 2,199 a | 2,587 | 2,240 c |
| Mean | | | | 2,157 | 2,492 NS | 3,162 |
| CV % | | | | 13.64 | 14.63 | 13.20 |

| | Variety | Seeding Date | Maximum Flood Level |
|---|---|---|---|
| Mopti South | BH2 | August 2 | 59 cm |
| Mopti North | Khao Gaew | July 28 | 107 cm |
| Safara | BH2 | August 5 | 63 cm |

A.P. = Ammonium phosphate

Figures followed by the same letter in the columns are not significantly different at 5% level.

There was no statistical difference between two weedings practised before flood (21 and 49 days after emergence), and the two weedings done, one before flood (35 days) and the other during flood (63 days after emergence).

**Table 28: Effect of Weedings on the Weed Population, Weight and Grain Yield of Floating Rice (Nang Kiew)**

| Treatments | Total No. of Weeds/m 35 DARE | Dry Weed Weight g/m before the 1st Weeding | Grain Yield Kg/ha 156 DAS |
|---|---|---|---|
| Weeding at 35 + 63 DARE | 121 | 130.6 | 2539 a |
| Weeding at 35 DARE | 129 | 99.8 | 2266 a |
| Continuous weeding | 40 | 34.9 | 2244 a |
| Weeding at 21 + 49 DARE | 23 | 42.2 | 2179 ab |
| Weeding at 49 DARE | 113 | 164.5 | 2052 ab |
| Weeding at 21 + 63 DARE | 34 | 53.9 | 2023 ab |
| Weeding at 21 DARE | 39 | 73.1 | 1657 bc |
| No Weeding | 120 | 336.9 | 1453 c |
| Weeding at 63 DARE | 133 | 273.5 | 1338 c |
| CV (%) | 6.69 | 41.96 | 19.03 |
| LSD 5% | 32.56 | 83.31 | 489.89 |

DAS - Days after sowing
DARE - Days after rice emergence
Values having same letters within a column are not significantly different at 5% level according to Duncan multiple range test.
[Date of sowing, rice emergence, arrival of flood and harvesting were 7th, 11th August, 18th September, 1980 and 10th January, 1981, respectively.]

Studies on the mechanical and cultural practices in reducing yield losses due to weeds were also undertaken. Deep ploughing and harrowing done at the end of the harvesting season produced no significantly different results for sandy and clayey soils. Grain yields obtained when ploughing was done at the beginning of the planting season differed significantly from the treatments applied at the end of the harvesting season. Land prepared at the end of harvesting showed less weed infestation at three weeks after sowing, and needed only one weeding. On the other hand, two weedings were practiced on treatments effected at the beginning of the planting season.

The chemical control of the annual wild rice *O. barthii* was studied with the use of five chemicals. Gramaxone at 2400 g a.i. (active ingredient)/ha gave the highest yield, followed by Glyphosate at the rate of 1920g. a.i. (Table 29).

In the control of O. longistaminata, a very good result was obtained with Glyphosate at the rate of 4320 g. a.i./ha.

**Table 29: Efficiency of Some Herbicides on the Control of O. barthii and the Grain Yield of Rice (Variety BH2).**

| Treatment | Doses g ai/ha | Weed control rating | | Toxicity rating | | Grain yield kg/ha |
|---|---|---|---|---|---|---|
| | | 0 DAS | 35 DAS | 15 DAS | 35 DAS | |
| Gramoxone 200 g/l | 800 | 7.7 | 8.0 | 0 | 0 | 2475 ab |
| Gramoxone 200 g/l | 1600 | 8.7 | 7.3 | 0 | 0.3 | 2900 a |
| Gramoxone 200 g/l | 2400 | 9.3 | 9.0 | 0 | 0 | 3386 a |
| Glyphosate 480 g/l | 1200 | 5.7 | 7.7 | 0 | 0.3 | 2957 a |
| Glyphosate 480 g/l | 1920 | 7.7 | 7.7 | 0 | 0.3 | 3156 a |
| MSMA 72% CS | 1440 | 0.7 | 7.0 | 0.3 | 0 | 2134 ab |
| MSMA 72% CS | 2880 | 2.3 | 7.3 | 0 | 0.3 | 2313 ab |
| Zorial 80% WP | 1600 | 5.3 | 9.0 | 7.0 | 5.3 | 1374 b |
| Zorial 80% WP | 3200 | 4.3 | 7.7 | 8.7 | 6.3 | 1480 b |
| Control – | - | 7.7 | 6.3 | 0 | 0 | 2041 ab |
| Velpar 90% WP | 900 | 3.3 | 9.0 | 8.0 | 8.7 | 0 |
| Velpar 90% WP | 1800 | 5.3 | 10.0 | 9.0 | 10.0 | 0 |
| CV % | | 26.41 | 11.69 | 23.4 | 80.7 | 29.81 |
| LSD 5 % | | 2.69 | 1.54 | 0.64 | 1.79 | |
| LSD 1 % | | 3.68 | 2.11 | 0.88 | 2.47 | |

*ENTOMOLOGY*

Population dynamics studies of major rice stem-borers were undertaken. The most populous was *Scirpophaga subumbrosa,* whose population was high in September and November, reaching its highest peak in mid-October.

*Maliarpha separatella* and *Chilo zacconius* reached their peaks similarly in September, mid-October and the highest in early November.

The control of insect pests with granular and liquid insecticides was also studies. Grain yield increase of 34.8% in Khao Gaew was recorded when 1000 g a.i./ha of Furadan 3g was applied 10 and 30 days after rice emergence. Birlane 10G at the rate of 3000 g a.i./ha gave a yield increase of 28% over the control. No significant results were obtained with the liquid insecticides.

In the studies for the method and time of application, Furadan 3G at the rate of 2000 g a.i./ha broadcast at 10 and 30 days after rice emergence or incorporated during sowing showed a significant increase in grain yield over the untreated control.

*IRRIGATED RICE – RICHARD TOLL/FANAYE. SENEGAL*

*CROP IMPROVEMENT AND PHYSIOLOGY*

The main activities of this section centred around assessment of yield potentials of rice varieties and cold tolerance studies.

Table 29 summarises the yield performance of 13 varieties compared with IR 8 during the dry season. Two varieties, SRIMALASIA-2 and FH-109 were the top yielders (7184 and 7340 kg/ha respectively). All

the varieties except B9C MD-10-2 outyielded the check variety, IR 8. It is noteworthy, however, that the trial was attacked by white flies, *Aleurocybotus indicus*

In another trial (Table 30). IR 1820-210-3 and C-168 were the highest yielders (7220 and 6930 kg/ha respectively) and five varieties with yields ranging from 6710 to 7220 kg/ha significantly outyielded the check variety IR 8.

*COLD TOLERANCE STUDIES*

Studies have been carried out on the frequency of cold days in various stations on the Senegal and Niger rivers (Fig. 2, 3, 4). The reproductive phase of a rainy season crop sown late and whose reproductive phase was in December would be exposed to 10 days of cold weather every year in Timbuctu. This will occur in 50% of the cases in Niamey. When sowing occurs in February in Podor, the crop is subject to 5 days of cold weather in 85% of the cases and 15 days in 25% of the cases.

The dates and intensity of the cold weather vary from one year to the other. In Matam, for example, 20 years observations showed that during the month of December, the number of cold days varied from 0 to 27 (Fig. 5).

**Table 30: Yield and Characteristics of Varieties Compared with IR 8**

| Varieties | Yield (kg.ha ) | Height (cm) | Life Cycle (days) |
|---|---|---|---|
| SRIMALAYSIA-2 | 7 184 a | 105 | 110 |
| FH-109 | 7 340 a | 82 | 119 |
| BG-90-2 | 5 980 b | 101 | 122 |
| BR-51-91-6 | 5 807 b | 121 | 127 |
| IR 3273-P 339-2 | 5 417 bc | 89 | 123 |
| LD 125 | 5 373 bc | 101 | 124 |
| BW 196 | 5 373 bc | 96 | 125 |
| IR 1480-116-3-3 | 4 767 cd | 97 | 127 |
| IR 2071-586-5-6-3 | 4 959 cd | 85 | 130 |
| IR 2823-399-6-6 | 5 113 cd | 97 | 103 |
| IR 1820-210-3 | 5 027 cd | 96 | 125 |
| IR 8 | 4 593 d | 95 | 124 |
| B9C MD-10-2 | 2 253 e | 82 | 93 |
| CV (%) | 13.09 | | |

**Figure 2: Locations of Stations Studied.**

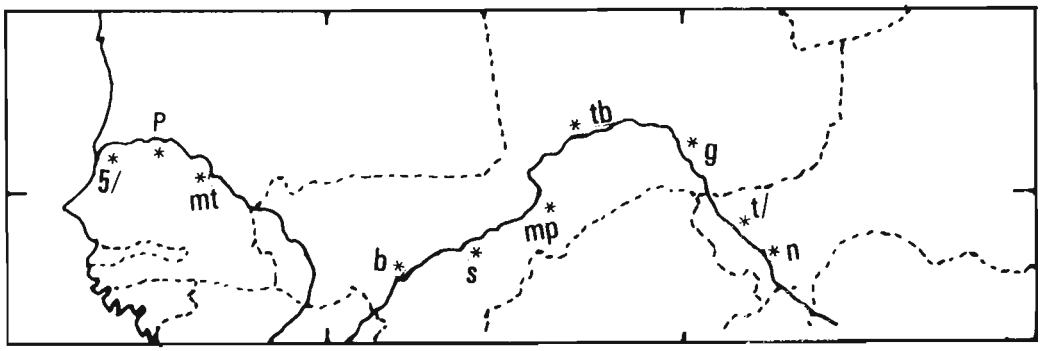
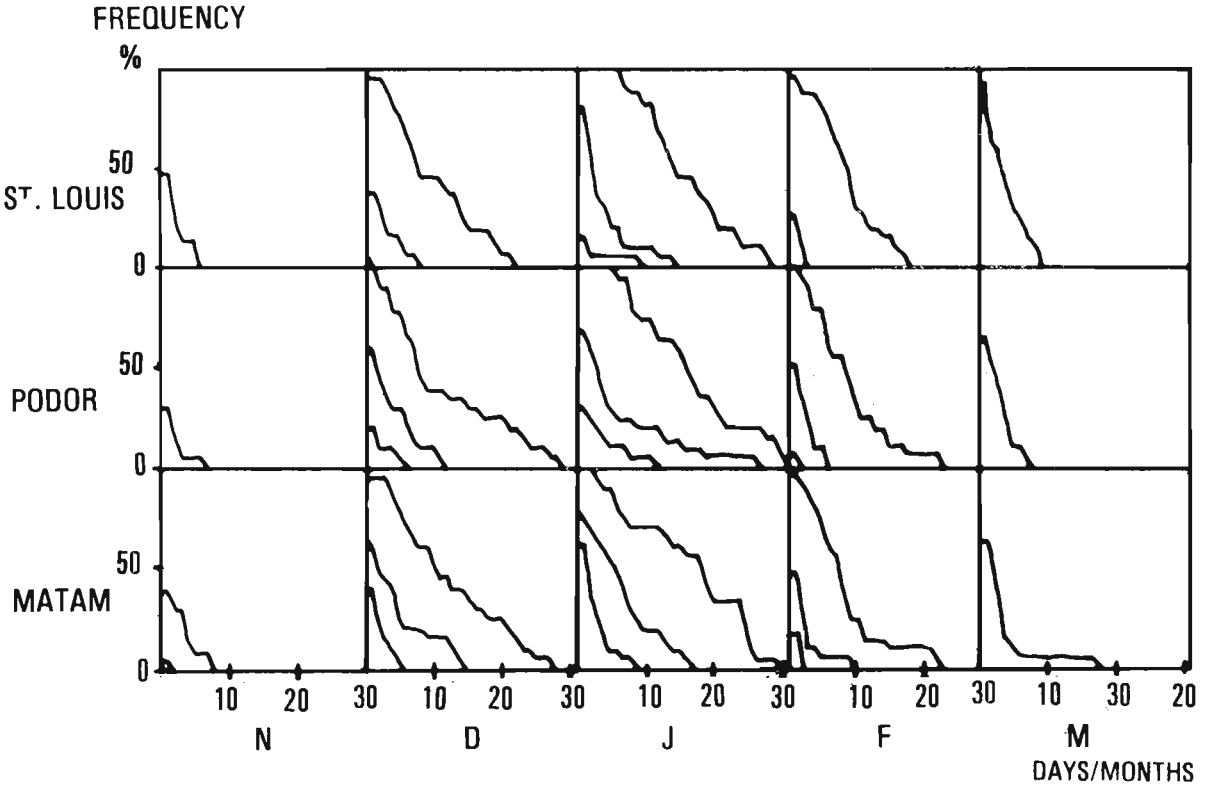



**Figure 3: Frequency of Days where the Minimum Temperature had been Smaller, Lower or Equal to 15° C, 12° C, 10° C for the Months of November, December, January, February and March.**




SOURCE: National Meteorology of Senegal 1960-1980.

**Frequency of Days where the Minimum Temperature has been Smaller, Lower or Equal to 15° C, 12° C, 10° C for the Months of November, December, January, February and March.**

The Meteorological Section of the Agency for the Security of Air Navigation. ASECNA 1966-1978.

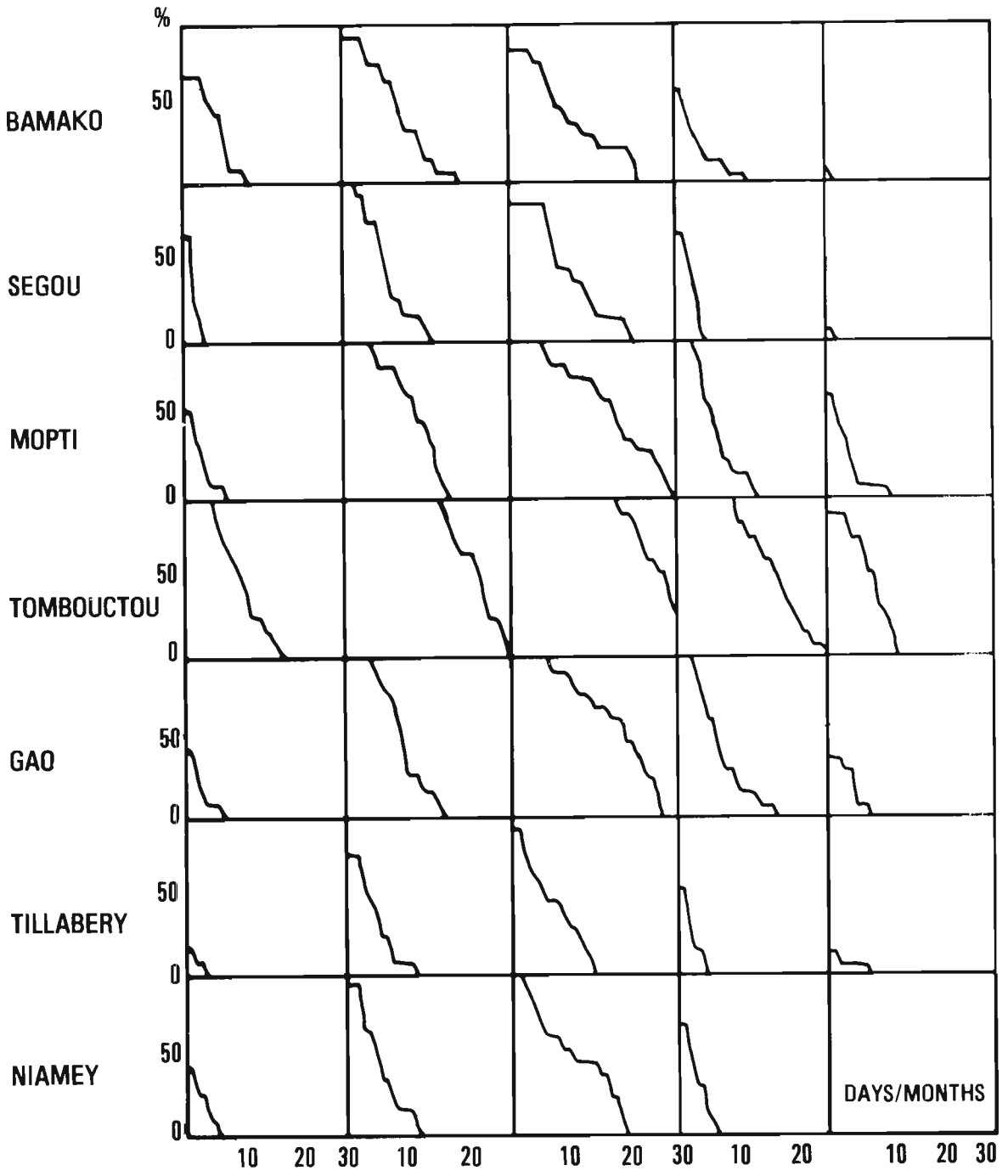
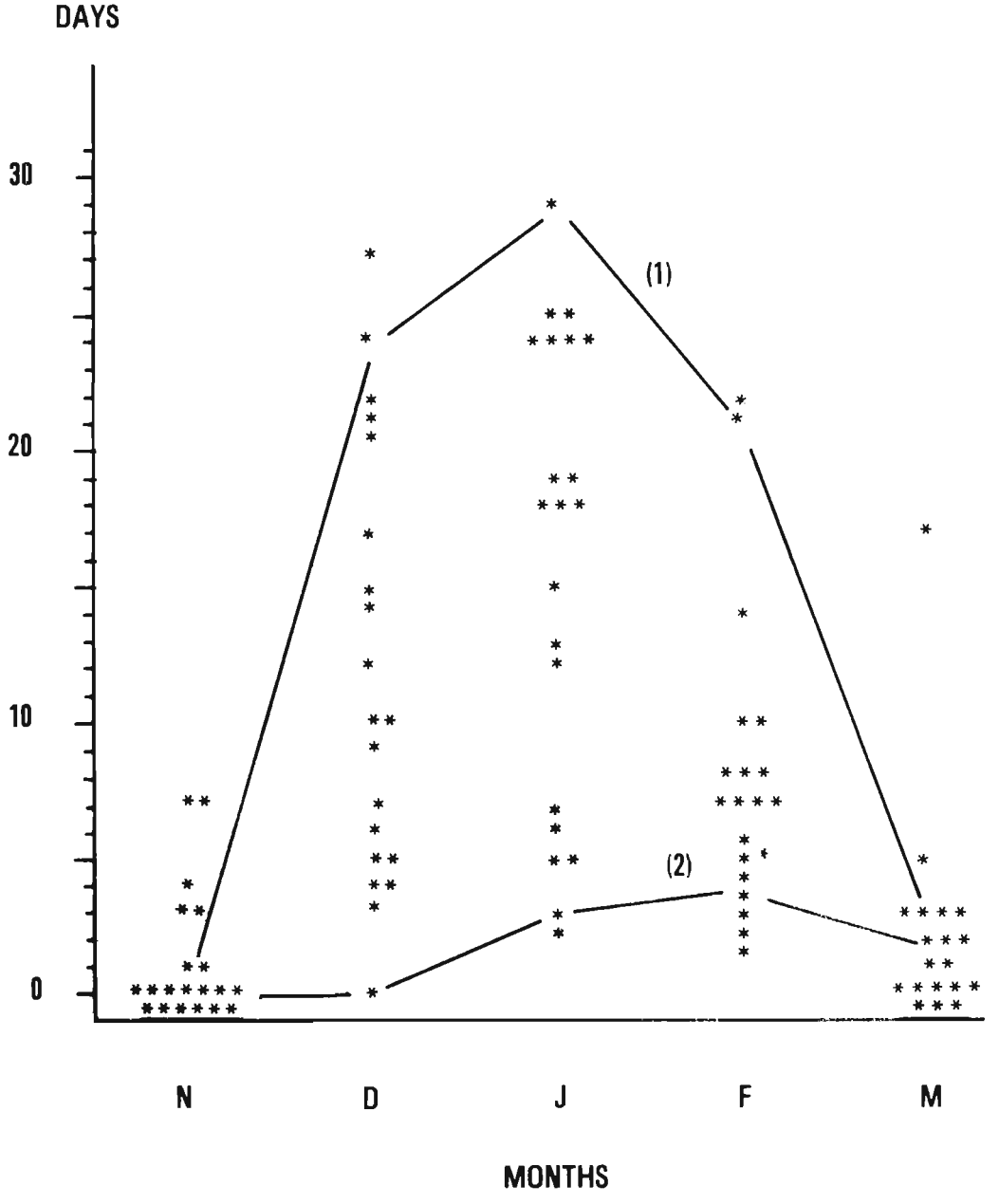


**FIG. 5: Matam Station: Number of Days where the Minimum Temperature has been Smaller or Equal to 15° C for the Months of November, December, January, February and March of 1960 to 1980.**

(1) Cold dry season 1965 - 1966

(2) Cold dry season 1978 - 1979



| Varieties | Yield (kg. ha ) | Height (cm) | Life Cycle (days) |
|---|---|---|---|
| IR 1820-210-3 | 7220 a | 90 | 132 |
| C-168 | 6930 ab | 93 | 121 |
| BR 51-46-5 | 6930 ab | 114 | 122 |
| B 2305-7-3-3-1 | 6858 abc | 105 | 121 |
| KN-144 | 6710 abcd | 111 | 117 |
| BR 541 B-PN-58-5-3-1 | 6530 abcde | 115 | 118 |
| IR 2061-628-1-6-4-3 | 6410 bcdef | 81 | 105 |
| ADNY 11 | 6360 bcdef | 107 | 121 |
| VIJAYA | 6197 cdef | 87 | 117 |
| IR 1529-680-3 | 6070 def | 86 | 119 |
| IET 2885 | 6070 def | 93 | 120 |
| IR 8 | 5980 ef | 96 | 125 |
| PARWANIPUR | 5939 ef | 88 | 114 |
| 75-4830 | 5780 f | 100 | 117 |
| IET 2775 | 4720 g | 94 | 110 |
| CV (%) | 11.84 | | |

During the 1980-81 cold season, 33 varieties selected from the 1978 IRCTN entries for their cold tolerance were screened using FUJISAKA-5 as the control. Eight varieties namely,

IR 5467-2-2-2
IR 1846-296-3
KN-1B-361-BLK-2-5
KN-1B-361-2-2-4-1
KN-1B-361-8-6-9-2-6
KN-1B-361-BLK-13-9
KN-1h-351
KH-998

were noted for their yielding ability as well as good agronomic characteristics.

*WEED SCIENCE*

Studies on weeds of both transplanted and direct seeded rice were mainly in the area of:

- collection and identification of weed species
- assessment of yield losses due to weed infestation, and
- evaluation of various herbicides

Fifty-two weed species were identified and their growth rate in the Senegal River Valley assessed.

Sixteen herbicides were screened. BASAGRAN M and BASAGRAN PL gave the highest yields (over 6000 kg/ha). All herbicide treatments outyielded the unweeded control (3790 kg/ha).

AVIROSAN and to a lesser degree, RONSTAR PL caused some phytotoxicity. Although the plants recovered gradually, their growth remained stunted. AVIROSAN-treated plots were harvested 10 days later than other treatments.

In another trial on Fonde soils previously fallow land at Guede, some herbicides were screened on irrigated rice. Yields were, however, not significantly different as a result of slight weed infestations on all the treatments. This was attributable to adequate land preparation prior to transplanting.

Results obtained on the study of effects of nitrogen fertilizers on vertisoils confirmed previous observations that sulphur-coated urea(SCU) and supergranules of urea were superior to ordinary urea. N65 dose of supergranules applied locally or SCU applied as broadcast was equivalent to N130 of split doses of ordinary urea both in the cold as well as in the rainy season.

The vertisoils of the Senegal River Valley, though poor in nitrogen and organic content, are generally quite fertile. There was no response to phosphorus and Potassium when applied over a short period of time (Table 31).

**Table 32: Effects of Long-term NPK Fertilization on Paddy Yields of IKP on Vertisoils (Hollalde)**

| NIVEAU DE FERTILITE | | | GRAIN YIELD | | | |
|---|---|---|---|---|---|---|
| N | P | K | 1979 Rainy Season | 1979 Dry Season | 1980 Rainy Season | Average kg/ha |
| $N_0$ | $P_0$ | $K_0$ | 2302 | 468 | 1675 | 1482 |
| $N_0$ | $P_{60}$ | $K_0$ | 3126 | 611 | 2125 | 1954 |
| $N_0$ | $P_0$ | $K_{60}$ | 3507 | 613 | 1900 | 2007 |
| $N_0$ | $P_{60}$ | $K_{60}$ | 2931 | 664 | 1950 | 1848 |
| $N_{130}$ | $P_0$ | $K_0$ | 7204 | 4260 | 3275 | 4913 |
| $N_{130}$ | $P_{60}$ | $K_0$ | 7053 | 3722 | 5350 | 5375 |
| $N_{130}$ | $P_0$ | $K_{60}$ | 6938 | 4472 | 3975 | 5128 |
| $N_{130}$ | $P_{60}$ | $K_{60}$ | 7360 | 4364 | 5100 | 5608 |

| F. TEST | | | | |
|---|---|---|---|---|
| N | 499.8554** | 1808.9538 | 155.5308** | |
| P | 0.4825$^{ns}$ | 1.1864$^{ns}$ | 21.0808** | |
| K | 1.9788$^{ns}$ | 6.3984* | 0.3849$^{ns}$ | |
| N × K | 1.6905$^{ns}$ | 2.4880$^{ns}$ | 0.2463$^{ns}$ | |
| N × P | 0.0009$^{ns}$ | 4.0794$^{ns}$ | 11.2256** | |
| N × K | 1.2275$^{ns}$ | 0.6585$^{ns}$ | 2.8064$^{ns}$ | |
| N × P × K | 6.9905* | 1.5723$^{ns}$ | 0.4658$^{ns}$ | |

| L.S.D.: | | | | |
|---|---|---|---|---|
| 1% | 528.7208 | 294.5932 | 570.8238; | N × P = 807.2667 |
| 5% | 776.4556 | 216.3132 | – | |
| ES | 527.79 | 2.94.07 | 569.82 | |
| CV(%) | 10.44 | 12.27 | 17.98 | |

Studies showed that split nitrogen application significantly increased yield on both Hollalde (vartisoils) and Fonde (ydromorphic) soils. The best results on Hollalde soils were obtained with split applications during the following periods:

- 50% 1 day before transplanting + 50% 20 days after transplanting.
- 50% 20 days after transplanting + 50% at panicle emergence.
- 50% 1 day before transplanting + 25% 20 days after transplanting + 25% at panicle emergence.

On Fonde soils, the last split application produced the highest yield.

Studies on compost showed a marked improvement in paddy yields with the application of compost even though the Nitrogen x Compost interaction was insignificant (Table 32). The effect of compost is represented in the linear equation $Y = 5565 + 80x$ whereas that of nitrogen is represented in the quadratic equation, $Y = 3605 + 43.24X - .011X^2$.

Three promising varieties, KH-998, KN-1h-350 and IET 1996; and 2 widely recommended varieties Jaya and IKP were used for a trial on Hollalde and Fonde soils to determine the optimum nitrogen rates for each type of soil and variety. The results at Hollalde showed that the 5 varieties had similar nitrogen requirements, the maximum being about 140 kg N/ha. At Fonde, the varieties showed varying responses to nitrogen application. The optimum doses were higher due to the highly permeable nature of the soils. The optimum doses for Jaya, IKP, KH-998 and IET 1996 were 146, 167, 154 and 160 kg N/ha respectively.

**Table 32: Effects of Nitrogen Fertilizer on Yield of Variety KH-998 With or Without Compost (Rainy Season, 1979)**

| | PADDY YIELD AT 14% MOISTURE CONTENT | | | | |
|---|---|---|---|---|---|
| (kg/ha) | 0 tonne compost/ha | 5 tonnes/ha | 10 tonnes/ha | 15 tonnes/ha | Average |
| 0 | 2437 | 3775 | 3979 | 4370 | 3640 |
| 60 | 4966 | 5629 | 6088 | 5782 | 5616 |
| 90 | 5959 | 6426 | 6445 | 7720 | 6638 |
| 120 | 7278 | 7108 | 7606 | 7737 | 7432 |
| 150 | 6962 | 7261 | 7669 | 8163 | 7514 |
| MEAN | 5520 | 6040 | 6357 | 6754 | |

F. TEST: Nitrogen 86.4991**
Compost 11.3927**
Nitrogen × Compost 1.039ns
CV (%) 11.20

*AZOLLA PROJECT*

The project was started in July 1980 and the first six months were devoted to the introduction of Azolla species and observing them for adaptability. They will eventually be used on irrigated rice.

Twenty-four species introduced from 16 countries were exposed to various degrees of temperature and light intensity in the laboratory at Richard Toll. Some of them adapted satisfactorily after a period lasting several weeks. At present, 22 species representing the *Azolla caroliniana, A. filiculoides, A. mexicana* and *A. pinnata* are conserved in the laboratory. The *A. nilotica* strains did not survive for more than 15 days after they were introduced.

Adaptation trials under natural conditions were conducted using *A. pinnata* strain G from India which had showed most vigour. The results indicated that the strain could be multiplied on a large scale at the Fanaye experimental station. Strain G was also introduced at the Suakoko and Rokupr stations in December 1980. Eleven other strains (5 *A. pinnata,* 3 *A. caroliniana,* 2 *A. filiculoide* and 1 *A. mexicana)* were also studied in small $2m^2$ basins in Richard Toll. The following observations were made: physiological condition, colour of foliage, population density, presence of sporocarps, ph and temperature. Two trials to study the variations in *A. pinnata* growth rate during the year were set up in Richard Toll.

*MANGROVE SWAMP RICE— ROKUPR. SIERRA LEONE*
*VARIETY IMPROVEMENT*

*NOMINATIONS FOR THE WARDA COORDINATED TRIALS:*

In 1980, seven long duration varieties have been nominated into the 1981 WARDA coordinated trials.

*Hybridization*

In 1980 thirty six crosses were performed, involving thirty three parents. Thirty of the crosses were aimed for production of improved varieties while six reciprocal crosses aimed specially for the production of salt tolerant varieties. The IRRI rapid generation advance system is being tested and modified for use at Rokupr.

*FARMERS FIELD TRIALS AND TRADITIONAL VARIETIES*

Over the past three seasons replicated yield trials of promising varieties have been run in the medium duration areas near the sea. Ten variety trials on farmers' fields under farm conditions contributed to the identification of seven promising varieties, six of which gave yields that were either equal or superior to that of the variety CP 4 the most popular of the improved varieties.

*GERMPLASM COLLECTION AND CHARACTERISATION*

The collection of traditional mangrove swamp varieties now stands at 507. The largest number come from Sierra Leone but there are some from the Gambia and Guinea Bissau. Their full characterisation has been completed.

As part of the program for the production of salt tolerant rice varieties all the local varieties were screened for tolerance to salt, based on the rate of root growth of seedlings when grown in saline solution. The data show that the traditional varieties grown in mangrove swamps are generally not tolerant of salt.

*PATHOLOGY*

The program was limited to collaborative work with other disciplines. All the breeder's materials were monitored for diseases incidence at all stages of growth on all sites. Trials to evaluate the effect of variety and fertilizers on the incidence of narrow brown leaf spot *(helminthosporium)* in the Rosino area, proved to be inconclusive, but they did confirm the beneficial effect of nitrogen, the absence of response to phosphorus and the depressing effect of potassium on rice yield.

*ENTOMOLOGY*

*Crop loss studies:* At first sight the mangrove swamp rice in Sierra Leone might be considered free of serious pests except for crabs that destroy newly transplanted seedlings. Studies over the past three years have shown that a wide range of pests are present on the crop, the most numerous being the stemborer *Maliarpha separatella* with stem infestation rates of up to 30% being common at harvest. In the absence of clear visible damage to the crop it has been necessary to establish the level of crop loss resulting from the presence of all pests.

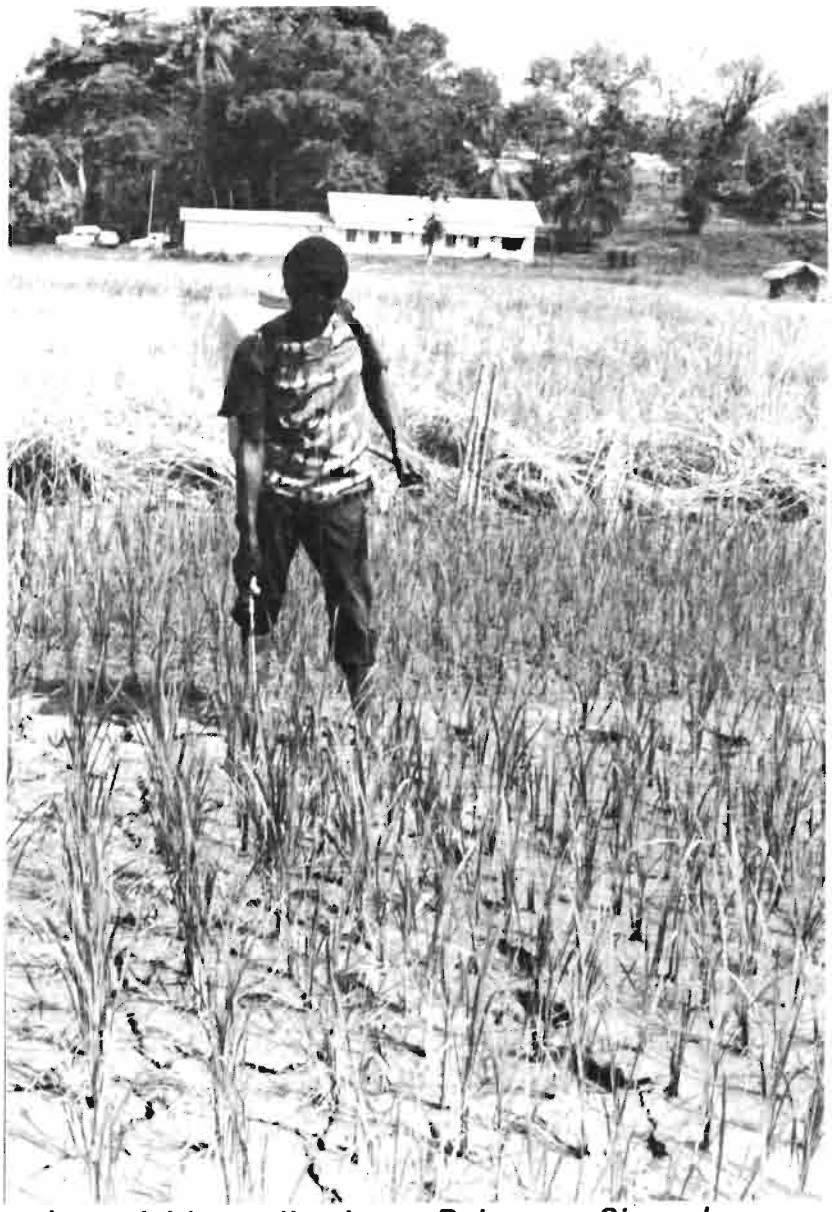
In 1979 season, intensive portection of rice crop throughout the growing season using a wide spectrum insectide, Furadan, showed that losses of the order of 400 to 800 kg per ha or 10 - 20%. Similar trials were run at five centres in 1980. These trials compared yields at different levels of protection on a number of varieties sown at different times. The maximum protection treatment was 1 kg. a.i. Furadan granules applied at three week intervals throughout the season.

*PRACTICAL METHODS OF APPLYING INSECTICIDES*

The particular conditions that prevail in the mangrove swamps make spraying which is the traditional application method for insecticides, impractical. Granular formulation of insecticides are being tested at Rokupr for time and rate and method of application. Results show a consistent increase in yields of rice in the two ecologies, mangrove and grass swamp, from applications of one and two kg. a.i. Furadan per ha.

*CRAB STUDIES:*

Traditionally farmers cope with the crab problem by transplanting large number of older, and presumably tougher, seedlings in each hill. This tends to restrict farmers to the use of long duration varieties that can tolerate a long period in the nursery without serious loss of yield. The use of insecticides can help with the problem but this is neither practical nor safe in the mangrove swamp environment. A more practical approach would be to use a variety that would be unattractive to crabs and observations in the breeders trials have suggested that this is possible. There was a wide variation in the attractiveness of different varieties to crabs.



*Insecticide application at Rokupr — Sierra Leone.*

*PEST COLLECTION AND BASIC STUDIES*

106 insects families have been collected at Rokupr. This comprised of 479 species, 27 of which were parasites.

Population studies of *Maliarpha, Chilo* and other pests at four widely scattered sites in Sierra Leone continued. The kerosene lamp light trap developed at Rokupr continued to be practical for this work. Factors that cause the death of *Maliarpha* were also studied. It is hoped that these studies will help in the development of practical methods of controls.

*SOIL SCIENCE*

Work in soil science aims to increase rice production by the use of fertilizers, manipulation of agronomic conditions and soil management.

*RESPONSE TO NITROGEN ON FARMER'S FIELDS*

The trials initiated in earlier years were run on twenty sites on farmers fields this year. Urea nitrogen injected at any time up to four weeks after transplanting at rates of 0, 20, 40 and 60 kg per ha was tested on fields prepared and planted by farmers. The response to increasing levels of nitrogen falls off gradually, but at all the three levels the increased yields was more than over the cost of the fertilizer and its application in terms of rice.

*SPLIT APPLICATION OF NITROGEN*

Observation of the crops suggests that a single application of 60 kg of nitrogen per ha does not meet the crop requirement for nitrogen throughout the season. Trials in 1979 and 1980 confirmed this view. Many farmers could derive further benefit from a second and later application of nitrogen. This will be tried on a farmers fields in the future.

*AGRONOMY*

*Delay between Uprooting and Transplanting*

Last year's trial to test the effect of this delay was repeated this season. The results from both seasons were general agreement. Using the variety CP 4 delays of up to 5 days had no noticeable effect on yield. Between 5 and 10 days there was a small reduction but beyond 10 days a loss of 12-25% occurred.

*PLANT POPULATION*

A trial in 1980 compared 23 and 100 hill per sq.m. at three levels of nitrogen. The results showed 25 hills per sq. m to be better than 100 hills per sq. m at the higher fertility. Widely spaced plants produced more tillers and were able to more than compensate for lower initial population. For medium duration varieties this may not apply.

*MECHANICAL CULTIVATION*

Over the past four years, the Project has been testing a single axle tractor 6 -8 hp., for the cultivation of mangrove swamps. This has been generally successful and in 1979 trials on farmers fields showed an increase in yield of rice following the use of the machine. These were repeated on six sites in 1980 season using CP 4 and the farmer's own variety at four levels of nitrogen. Results showed that the use of the tract-

tor for ploughing increased the yield of rice by 400 to 700 g per ha. If the gains in yield are general they will go a long way to meet the cost of tractor operation on the swamps.

*WEED SCIENCE*

The Weed Science section covers two distinct ecologies, the tidal mangrove areas where the weed kire-kire *(Paspalm vaginatum)* was the main problem, and the associated grass swamps where sedges, grasses and dicotyledons were problems.

In 1979 a long term trial was initiated on the effect of brushing with and without removal of the kire-kire, followed by cultivation by hand or machine in March or in June. The results in the second season showed that under these soft muddy conditions with heavy infestation of kire-kire the best time to do land preparation was in June. After a March cultivation the weed regenerated quickly. This confirmed recent work on the weed, but was at variance with the general view that early digging is advantageous. Under the conditions of the trials farmers always cultivate late in the season.

The use of mechanical ploughing and puddling on grass swamps belonging to farmers was done on twelve sites in 1980 season. The treatment had been very successful in controlling weeds and raising yields in the Rokupr swamp. The results showed some advantage to mechanical cultivation, but the yield increases were small. This aspect requires much more study before it can be recommended to farmers.

*AGRICULTURAL ECONOMICS*

The activities of the Section started in November 1980 and have not yielded substantial results yet. The following is a summary of the programmes initiated.

*FARM SURVEY*

The main work of the Economics section is to study the farm system existing in the Great Scarcies mangrove swamp area, assess the farming constraints and establish the basis for developing technology packages designed ultimately to improve the net income of the farmers.

The initial phase (November - December) involved the listing and sampling of villages and households engaged in mangrove swamp farming. Eight villages were sampled from the three sections for the listing of households. The sample frame consisted of the household heads who had at least one mangrove farm. The household heads were stratified on the basis of farm size reckoned in the number of bushels of seed rice nursed.

Results indicated that most of the farmers nursed from 1 - 5 bushels of seeds. Moreover, 35% of the farmers did mangrove swamp farming only, about 45% did mangrove swamp plus other farming, 10% did other farming only, while 9% did no work on the farm. These results are only preliminary, but they do give some insight into the farming system that exist in the study area.

*POST HARVEST LOSS ASSESSMENT*

The listing period for the Farm Swamps was also used to gather information for post-harvest loss studies. It was found that most of the farmers stored in "kuma" which is a large wood box. The next storage unit of importance was the "kothie" which is a cylindrical unit woven in the form of a basket. Bag storage is usually very temporary and in a few cases the farmers store on bare floor.

## COLLABORATIVE ACTIVITIES WITH OTHER INSTITUTIONS

In 1980 the collaborative and Cooporative agreement signed with many institutes and institutes within and outside of the region were maintained or renewed. Brief highlight of these and the programmes are presented below:

1. *Bangladesh Rice Research Institute (BRRI)*

The training, Research and rice development agreement reached with BRRI for exchange of scientists and germplasm was maintained. A staff of BRRI is the WARDA Senior Rice Breeder.

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

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

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

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

4. *International Fertilizer Development Center (IFDC)*

Both WARDA and IFDC have agreed on a cooperative programme of research on rice fertilizers as they relate to crop production. This was maintained during 1980.

5. *International Institute of Tropical Agriculture (IITA)*

For the purpose of promoting greater professional collaboration between IITA and WARDA, the mutual agreement by which an IITA Senior Rice Breeder was seconded to WARDA was renewed in 1980.

6. *International Rice Research Institute (IRRI)*

The decision made to further strengthen the linkage between WARDA and IRRI, resulting in posting an IRRI Liaison Officer to Africa based in IITA, but with major commitments to the West African region remained enforced in 1980.

7. *Ministry of Agriculture, Liberia*

The agreement reached between WARDA and the Ministry of Agriculture, for WARDA to assist in the technical supervision of the rice research programme of the Ministry was maintained.

8. *Sahelian Institute*

The WARDA and Sahelian Institute agreement to cooperate in the implementation of a programme to facilitate rice production in the Sahelian zone was maintained.

## VISITORS TO THE RESEARCH DEPARTMENT HEADQUARTERS IN 1980

1. His Excellency The Indian Ambassador to Liberia
2. Mr. S.J. Bai-Bangura, E.C.A. — ATRCW, Addis Ababa, Ethiopia.
3. Ms Lynn L. Pesson, Louisiana State University, Baton Rouge, USA.
4. Dr. Robert L. Beacher, MASI-USAID, Washington DC; U.S.A.
5. Mr. John N. Landers, M.U.D.B. 9/5 Brasilia.
6. Mr. Foehn Alexandre, Ing-Agr. AEAW.
7. Dr. Lekan AreOgun Oshun River Basin Authority,Abeokuta,Nigeria.
8. Mr. Leslie G.F. Herritt, Bita-Geigy, FAO Mission.
9. Dr. W. Warmbier, PB 11406 D-63, GIESSEN, FAO Mission.
10. Mr. Walter T. Wiles, CARI, Suakoko, Liberia
11. Mr. Pham I. Kham, Ing. Agr. de L'ONADER, Conakry, Guinea.
12. Dr. D. Janakiram, Rice Research Station, Rokupr, Sierra Leone .
13. Mr. M. Sanp-Ceesay, Dept. of Agriculture, Cape St. Mary, Banjul, The Gambia.
14. Mr. Vodouhe Sognou, Dept. of Agricultural Research, Rep. of Benin
15. Mr. John D. Leefe, UK Forestry Training Advisor, Box 9050, Monrovia, Liberia.
16. Dr. C.S. Ofori, AGL Division, FAO, Rome.
17. Dr. J. Yamaguchi, IITA, Oyo Road, Ibadan, Nigeria.
18. Dr. K. Alluri, IITA, Oyo Road, Ibadan, Nigeria.
19. Dr. Dale G. Bottrell, University of California, Berkeley, Cal. U.S.A.
20. Mr. Charles Steedman, USAID Project, Casamance, Senegal.
21. Mr. Lance H. Jepson, USAID, Agriculture Div., Dakar, Senegal.
22. Mr. George Gwyer, Overseas Dev. Administration, London.
23. Mr. Roger W. Smith, ODA, Eland House, Star Place, London.

## DEPARTMENTAL PUBLICATIONS

The major publications by the Research Department in 1980 were:

WARDA 1980 Research Department Annual Report for 1979, Monrovia, Liberia.

WARDA 1980 Technical Newsletter
Volume 2, No. 1 (in English and French).

WARDA 1980 Technical Newsletter
Volume 2, No. 2 (in English and French).

## ACKNOWLEDGEMENT

The Executive Secretary and staff of the West Africa Rice Development Association are immensely grateful to all the various donors: West Germany, Sweden, Netherlands, Canada, African Development Bank, IFAD, Japan, France, Nigeria, Belgium and OPEC: THE CGIAR Fund for the W-1 Programme of the Research Department, USAID, CIDA, IDRC, the Overseas Development Agency of the United Kingdom, Saudi Arabia and member states of WARDA for their financial support to the special projects programmes and to TAC for their moral support to the programmes of WARDA's Research Department; also, the Government of the member states of WARDA for ensuring that our formidable task was accomplished during the 1980 season.