Summary of the seminar

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Summary of the seminar

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From 5/9 to 9/9, two meetings about rice were held in Egypt under the aegis of FAO:

- ❏ **"Future of water management for rice in mediterranean climate areas"**, scheduled by the Mediterranean Rice Network, was held from5/9 to 6/9, in Sakha, in the depths place of paddy land, where the Rice Research and Training Center (RRTC) is located. Research center and farmers paddyfields visits usefully complemented the workshop.
- ❏ **"The International Rice Commission, XIX session"** held in Caïro from 7/9 to 9/9 which concerned all the aspects of rice research and cultivation. Independantly of the presentations interest, this meeting allowed to compare the rice-producing mediterranean countries research results to the water saving world-wide achievements.

The Mediterranean Rice Network meeting was perfectly organized by Dr. Badawi Tantawi, head of RRTC, and his team. With 600.000 hectares rice cropped (located in the Nile delta) and a mean yield of 86 q/ha, Egypt is the most important rice-producing country of the mediterranean belt and the country which gets the best mean yield in the world.This high yield level can be explained by very favourable environmental conditions, the implication of a highly qualified research team, the rice farmers high technic level and a voluntarist egyptian policy in term of rice production.

The choice of the subject about future of water management for rice is closely linked to the egyptian prospectives in term of rice production in which the water saving and the control of its outcomes (drought, salinity) are having priority. So, this workshop was a good opportunity to compare the rice-producing mediterranean countries research results on this subject.

Ten papers were presented during the workshop:

- ❏ four on water saving one of which in relation to varietal behaviour,
- ❏ four on varietal behaviour in situation of hydric and/or salinity stresses,
- ❏ one on the biotechnologies role for salt tolerance improvement,
- ❏ one on field capacity soils characterization by teledetection.

Despite their summaries had been registered, Moroccan and Russian contributions could not be presented as foreseen. Nevertheless, these two papers will be included in the workshop proceedings.

For the drawing up clarity, the main points evocated during the workshop will be reported under three research results chapters which are very linked.

I – Water saving

Dr Badawi's presentation explained very clearly the water saving problematic for rice production in Egypt. Rice production must increase as fast as the demography in order to meet the food needs. Meanwhile, there is more and more competition with other water uses (particularly domestic). In order to reduce the used water quantities for rice cropping, two research ways are now privilegied.

1. Early varieties cultivation

Calculated according to transplanting cultivation, a 120 days cycle variety water needs are of 9300 m^3 versus 10500 m^3 for a 135 days cycle variety and 12400 m^3 for a 160 days cycle variety. This water saving is economically tolerable because of the early high yielding rice varieties releasing (particulary GIZA 177 which yielded an average of 100 q/ha in demonstration fields (with a 79q/ha to 123 q/ha range) with a 120 days cycle).

2. Reducing water quantities by water flushing

This way of doing consists in replacing permanent paddyfield flooding with more or less spaced out periodical water flushes. This method is efficient on water saving point of view (a 30% water supply reduction) but it leads to prejudicial yield losses (salinity effects even if varieties such as GIZA 178 are salt tolerant, weeds competition increasing, tillering reduction… And other still bad known reasons). Egyptian researchers think that it would be possible to improve rice varieties for water flushing conditions by working on root system adaptation.

Now, experimentation are focused on water flushing spaces optimization allowing the best water saving with the lowest yield losses. Moreover, spacing between two water flushes can be modulated in relation to the rice plants needs during their cycle (in this framework, end of tillering stage would be slightly demanding). Another way of water saving is to determine the optimal period for the paddyfield final drainage. Stopping water supply at milky grain stage seems to be without effect neither on paddy yield nor on grain quality.

A last research theme aims, on not salty soils fields, to substitute flooding by sprinkler irrigation (and obviously transplanting by direct seeding). The demonstration paddyfields observations show that weeds control is rather well performed.

3. Water saving in the other mediterranean belt rice-producing countries

As in Egypt, rice cultivation water saving is considered in the other mediterranean belt rice-producing countries because of the competition between users. However, some differences can be pointed out:

- ❏ If rice production increasing remains a rice farmers willing, it does not constitute a political priority; more than food supply for people, the response to the market needs (with a strong idea of product quality) is considered.
- ❏ Water saving is more considered in terms of yield regularity and environmental incidences than its effects on yield level.
- ❏ In the most part of north mediterranean rice-producing countries where direct seeding is practised, it is difficult to save water during the germination-establishment stages (flooding and draining alternances in order to succeed in a good plant establishment) when these stages are not considered in Egypt because of transplanting practise.

Hungary was the first country which succeeded in substituting flooded cultivation (with broadcast direct seeding in water) by sprinkler irrigation (with drill direct seeding on dry soil) with a water supply reducing from 14000-17000 m^3/ha to 4500-5500 m^3/ha. From other experimentations with intermediate water management, water needs were evaluated to 7800-9000 m^3/ha with periodic water flushes irrigations and to10500-12000 m^3/ha with alternating flooding and water flushes irrigating periods. From an economical point of view, it is difficult to evaluate these agronomical practises incidences on paddy yield and so on the final benefit. Indeed, with a good rice establisment and whatever the water management is, flooding cultivation gives the better yields; but on the other side, the rice seedling survival and establishment is almost systematically good with drill seeding when it is hypothetic with broadcast seeding in water (mainly depending on climatic conditions) with direct negative effects on yield.

On certain type of soils (free of salt sandy or loamy-sandy soils), France carried out a mixed method which consists in drill seeding in well landleveled paddyfields, managing rice cultivation in dry conditions till the 4th leaf-beginning of tillering stages (with an eventual water supply by flush) and then flooding the paddy-field till final drainage. According to climatic conditions, 2000 m^3 to 5000 m^3 can be saved by this way. Moreover, the probability to get a good rice establishment is secured that allows a seed quantity saving (60 to 80 kg/ha versus 200 kg/ha with the conventional way). Such a practise is undertaken in Romania too.

Italy tested no flooded rice cultivation with drill seeding and regular spaced flushes water supplies. This water management does not have any incidence on grain quality and the final paddy yields remain economically profitable. Moreover, this type of experimentation allowed to screen some genotypes, such as Koral variety, particularly adapted to this kind of practise.

Lastly, in South of Spain, the irrigation is traditionally practised by fresh water permanent recharge, the quantities of supplied water being very heterogeneous (20000 m^3/ha to 40000 m^3/ha). Spanish researchers studied the effect, on water saving and paddy yield, of an irrigation management where continual water supply is stopped 2 days/week from the 55th day of rice growing. By this simple way, it is possible to save about 5000 m^3 of water (21726 m^3/ha versus 27000 m^3 by the conventional method) without yield losses.

II – Varietal tolerance to hydric stress

Because water supplies remain under control, the research on varietal tolerance to hydric stress evocated during the workshop is quite different from the research on drought tolerance which is beneficial for upland rice cultivation. With alternative water management and except in the case of sprinkler irrigation, the rice plant must be able to take advantage of anaerobic/aerobic situations alternances in order to optimize its final yield.

The goal is to conceive of the characteristics of a root system adapted for taking advantage of these hydric state of soil alternances and how practically to improve it. The discussion about this point suffered of the lack of physiologists. The only conclusion was that research of deep rooting is not necessarily adapted to these conditions.

Practically, the varietal characterization for hydric stress tolerance aims, whatever the rice-producing countries are (Egypt, Hungary, Italy, Turkey), to test several varieties in situations of conventional flooding versus diverse ways of flushes irrigation (for example, 12 days spaced flushes in Egypt or, by experimental way, only 2 flushes during the cropping season in Italy). Paddy yield and grain quality are compared. In this framework, some varieties such as Koral from Italy, Sandora from Hungary, Krasnodarsky 424 from Russia and Ana/Mar from Turkey have been screened from their good behaviour with acceptable yield losses and constant grain quality.

IV – Varietal salt tolerance

The varietal salt tolerance research is an other outcome of water saving. Indeed, water control (irrigation and drainage systems), flooding and fresh water permanent recharges allow rice cultivation on salty soils. In this type of situation, it is impossible to conceive water saving without a varietal salt tolerance improvement. Except in Romania (salinisation due to irrigations from a river washing salt veins in the Carpathes mountains), the salt soils presence is straigthly linked to paddyland deltaïc situations; in case of water saving and because of a salty water table presence, there are important risks of salt rising by capillarity or by charge effect from the sea or lagoons (this last phenomenon can even occur in case of flooded cropping).

Increasing varietal salt tolerance is the way for a better development of salty paddylands (In Egypt, for example, rice yields are given to be 40% lower than those obtained on not salty soils). Varietal salt tolerance can also be specifically researched to decrease the risks of salt injury during the germination-establishment stages (conjonction of the draining necessity and dry wind manifestations which is frequent in France) or during the whole rice cycle (salty water pumping in case of a river weak discharge). It was stated during the workshop that direct field or greenhouse progenies screenings were efficient enough to obtain good salt tolerance varieties (for example; GIZA 178 in Egypt and Polizesti 28 in Romania).

With water saving, high salt varietal tolerance must be researched. A medium term strategy for varietal salt tolerance improvement was reported by France. According to the evolution of physiologic parameters (photosynthesis and transpiration) in salty conditions, the best rice behaviour is to keep its photosynthesis degree when its transpiration decreases. It is first expected to screen suitable rice varieties through greenhouse already available appropriate tests and then, after field tests for confirmation, to tranfer these favourable characteristics on cultivars. For Romania, direct screening on field remains efficient in this water saving context. Salt tolerance improvement achievements are reported from the screening of induced mutant progenies under water saving conditions.

An indirect way for salt tolerance increasing, based on “seeds hardness”, was reported by France. From two samples of rice seeds cropped for one in strong salty conditions and for the other in not salty conditions, germination ratios in salty and unsalty conditions were compared through greenhouse tests. Rice seeds cropped in salty conditions displayed a significative better germination ratio than rice seeds cropped in unsalty conditions in both situations. Field tests confirmed this result. The “seeds hardness” effect is quantifiable. It would be of a great interest to know if this acquired tolerance is still effective during the latest phenologic stages.

It was admitted that a drastic increase of salt tolerance could only be obtained by biotechnologies. Some possibilities were evocated: transfer on rice genes coding for proteins known to be involved in salt tolerance mechanisms, particularly in certain tobacco varieties. On the other side, Dr Cocking reported interesting results about the cybrids production between Oryza sativa and Porteresia coarctata. Furthermore, the use of this high salt tolerant Oryzae as a donor for improving Oryza sativa salt tolerance by biotechnologies is now more and more considered.

Conclusion

When it is stated about the water saving necessity during official meetings, often through general considerations, it is interesting to point out that problem is already considered in mediterranean belt rice producers countries with significative research results and even a release of alternative methods. Moreover, according to the results about water saving presented during the FAO XIXe International Rice Commission presentations, the mediterranean belt rice producing-countries are quite ahead of worldwide countries.

Independantly of climatic and cropping differences among mediterranean rice-producing countries, all are interested about salt and/or hydric stress varietal tolerance. Egypt proposed to consider two work groups, salt tolerance and hydric stress tolerance, which activities could be firstly focused on the salt and hydric stress tolerances evaluations from the FAO Network countries varieties. Egypt is ready to undertake this work. For this purpose, Egypt asks other countries to send 100 g samples of each variety having to be tested before end of February.

According to the complementarity between France (salt constraint during germination-establishment stages) and Egypt (salt constraint after transplanting), these varieties could also be tested by France through the greenhouse tests performed by Dr Puard.