Des producteurs de blé dur aux consommateurs de pâtes : rôle dans un programme de sélection participative

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INCLUS :
Résumés en français des interventions et des posters présentés au colloque ECO-PB sur la Sélection participative et ses enjeux pour l'agriculture biologique 11-13 juin 2006, La Besse, France.

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Organisers of the program: Edith Lammerts Van Bueren (Chair of ECO-PB, Louis Bolk Institute, the Netherlands), Dominique Desclaux (INRA, France).

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Préface

Ces actes compilent les articles basés sur les présentations orales et posters du colloque européen Eco-Pb sur la Sélection Participative, qui s'est tenu sur le Domaine de La Besse, Camon, France du 11 au 13 juin 2006. *(Dans cette brochure, les résumés des interventions sont traduits en français. Veuillez consulter le sommaire).*

Il s'agit du premier séminaire européen dédié à la Sélection Participative et à ses intérêts pour l'Agriculture Biologique.

La Sélection Participative est un concept relativement récent, développé initialement par des instituts internationaux de recherche afin d'accélérer la diffusion de cultivars auprès de paysans des zones dites marginales de pays du Sud. Afin d'identifier la pertinence de la Sélection Participative pour l'Agriculture Biologique dans les pays du Nord, S. Ceccarelli, ICARDA (Syrie), a été invité à tirer des leçons de ses expériences de Sélection Participative dans les pays du Sud et à les mettre en perspectives pour les pays européens.

Un documentaire réalisé spécialement pour le colloque, a montré les différents points de vue d'acteurs (producteurs et chercheurs) de la Sélection Participative en France. C. Bonneuil, en tant qu'historien des Sciences, a permis de comprendre pourquoi plusieurs programmes de Sélection Participative ont émergé de façon concomitante depuis 2001 en Europe.

L'originalité de ce séminaire a reposé sur le fait qu'agriculteurs et chercheurs se sont succédés pour expliquer à tour de rôle les motivations de leur implication dans des programmes de sélection participative.

Une table-ronde a permis d'aborder les aspects législatifs. Au-delà des problèmes d'inscription des variétés pour l'agriculture biologique au catalogue européen, les discussions ont porté sur les droits de propriétés des variétés issues des programmes de Sélection Participative.

Le séminaire s'est terminé par la visite d'une ferme conduite en agriculture biologique dont l'agriculteur, J.J. Mathieu est impliqué dans plusieurs programmes de sélection participative sur blé dur, tournesol, blé panifiable, potagères…. Cette visite a fait le lien entre le colloque ECO-PB et le séminaire COST 860/SUSVAR, qui se déroulait au même endroit du 13 au 15 juin 2006.
Au cours de cette visite, ont été présentés différents ateliers concernant (i) une collection de variétés anciennes de tomates, aubergines et carottes, (ii) la production de triticale à ultra basse-densité; (iii) la sélection participative de blé dur ; (iv) des essais de désherbage mécanique et thermique en production de semences potagères.

Plus de 100 chercheurs, agriculteurs et utilisateurs, originaires de 25 pays européens ainsi que du Moyen Orient (Syrie, Israël, Palestine), des Etats-Unis, et du Canada, étaient réunis pour échanger leurs expériences sur la Sélection Participative.

Par souci de cohérence, les organisateurs ont choisi d'organiser ce colloque sur le site d'une ferme en agriculture biologique avec la collaboration d'associations d'agriculteurs locaux (Biocivam 11, RSP).

Les capacités d'accueil limitées sur le Domaine de La Besse et le relatif isolement du site, n'ont pas permis l'ouverture de ce colloque à un nombre plus important de participants, notamment agriculteurs et techniciens agricoles. La qualité des interventions et la pertinence des thématiques abordées auraient pourtant méritées un public plus large.

D. Desclaux, E. Lammerts and M. Hédont

From durum wheat producers to pasta consumers: Role in a participatory plant breeding

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Abstract

An organic durum wheat participatory breeding program is actually being implemented in the South of France. Multi-level interactions and cross-linked learning processes about breeding methods are needed for effective communication between different stakeholders and scientific disciplines. Until now, the partnership was already fruitful and led to some interesting durum wheat lines. By evolving from participatory varietal selection (PVS) to participatory plant breeding (PPB), the ethical approach enables implementation of a range of different action systems in which the production of relevant knowledge and rules addresses the issue of the sustainable development of specific agro-food system.

Key-words: organic durum wheat production, participatory plant breeding, multi-disciplinary approach, socio-technical network.

Introduction

Participatory plant breeding (PPB) projects have been initiated by international research institutes to increase the adoption of cultivars by small farmers in developing countries (Almekinders & Elings, 2001, Hocdé et al. 2001) More recently, PPB has appeared in Northern countries especially in organic contexts.

Learning from Southern PPB experiments is of great interest for the implementation of sustainable organic farming in the North. Indeed, organic farming faces similar constraints as producers in marginal areas in developing countries: a heterogeneous environment, the wide range of different farmers' needs, and particularly the lack of suitable varieties and the lack of interest on the part of the formal breeding sector (Desclaux, Lançon, 2005).

There are nevertheless huge differences between Southern and Northern contexts, meaning Southern PPB programs cannot simply be "transferred" to Northern countries, especially as they produce nuanced results. In the South, PPB is mostly implemented for subsistence farming. The range of different actors involved is small and the participation of farmers and other stakeholders like manufacturers limited. In Europe, PPB may concern farmers embedded in more complex supply chains. The participation of all the different stakeholders and a multi-disciplinary approach are thus required to organize both the production and the valorisation of co-bred seeds. The case of organic durum wheat thus appeared to be a relevant opportunity to take up the challenge.

The Context

The initial request came from organic durum wheat producers in the South of France and manufacturers of organic pasta in 2001. Indeed, durum wheat produced in organic conditions does not fulfill the quality requirements of the processing industry (notably too low protein content). Therefore, more than half the French organic durum wheat harvest is sold for animal feed while pasta manufacturers are obliged to import durum wheat grain for human consumption without easy and real guaranteed traceability. The sustainability of the durum wheat supply chain is thus in question. Given the lack of interest by private breeding firms, a number of farmers turned to public researchers working on the diversity of cereal genetic resources at the National Institute of Agronomic Research (INRA).

Geneticists called on social scientists and agronomists to make a joint diagnosis in the two main French regions concerned by the production of organic durum wheat: the Camargue and the Pays Cathare. These territories differ particularly with respect to soil salinity, crop rotation and the extent of animal rearing. Initial investigations confirmed the lack (i) of varieties adapted to limiting nitrogen conditions that characterize the organic systems of these regions, (ii) of knowledge concerning organic growing systems, (iii) of consultation inside the organic market. We will focus here especially on the first point concerning the varieties. Indeed, all available durum wheat cultivars come from breeding programs implemented within conventional growing systems, without nitrogen limitation. Developing a breeding process in organic conditions thus appeared to be relevant and allowed to settle very strategic questions: how to reconcile the different needs of organic producers and pasta manufacturers? How to tackle genotype-environment interactions considering the environment in its broadest context? How to take into account the farmers' request about an active role in the plant breeding chain? Therefore, researchers, and all actors of the chain proposed a multi-disciplinary and multi-actors action-research program constructed around thematic activities.

Participatory? How?

To identify the needs of end-users and the different constraints faced by the farmers, representatives of the whole organic durum wheat supply chain were involved in the first stage of the project, i.e. the setting of objectives and of selection criteria. Each stakeholder, from farmers to consumers, was invited to formulate her/his ideotype as well as her/his reasons to produce, buy or eat organic durum wheat and the results they expected. This resulted in the identification of a wider range of needs and in a broader understanding of the requirements of all the professional partners.

At the same time, a wide survey including questions about farmers' cropping systems, varietal preferences and economic outlets, was conducted to identify the practices and points of view of a large number of organic farmers in the two regions concerned. The distribution of the questionnaires was facilitated by regional farmers' organizations. The needs differed greatly between the two regions. In the Camargue, bull and sheep rearing means that natural nitrogen is available for wheat during the vegetative period, but not during the period of elaboration of seed quality. Farmers consequently need varieties that can efficiently mobilize the nitrogen stored in their vegetative parts, and that are tall enough either to provide animals litter or to be plough in. In the Pays Cathare, nitrogen is also a limiting factor even during the vegetative period and weed infestation is consistently high, the farmers thus require a variety with a well-developed root system that is able to compete with weeds and to uptake nutrients efficiently and early. Conventional breeding has never focused on these particular traits and some criteria have even been "counter-bred" (stem height for example) (Desclaux, 2005).
In parallel, the results of enquiries with a contrasted sample of pasta and semolina manufacturers (big firms, family firms dedicated to organic food and markets) highlighted the wide range of buying criteria and strategies, especially with respect to organic products. Therefore, not only one but several ideotypes adapted to different situations emerge.

But, as this was an ongoing process, the setting of objectives was not completed after the first set of meetings, enquiries and observations. An additional step - the evaluation of lines - was implemented right at the beginning of the project and provided precious feedback for the definition of farmers' preferences as well as a description of the conditions in which the cultivars would be used (see Figure 1). It began with quasi-fixed varieties developed by public research. This evaluation mobilized different actors. Regular field visits were organized especially during flowering and at physiological maturity. This provided the opportunity for farmers, manufacturers and researchers to discuss genetic diversity in concrete terms around experimental plots (on the farms or in research stations). All the actors were invited to express their point of view and also to enter scores in a grid. The stake is to allow the widest possible "critical participation" (rather than "participation by assimilation", Friedberg, 1993), supporting the farmers' ability to score by providing genetic data or by adapting the scoring system to include specific terms of local farmers. Post-harvest evaluations were also made based on agronomical and technological results provided both by researchers and pasta manufacturers. The results were discussed by all the actors and this synthesis provided a further opportunity for manufacturers, distributors, farmers and researchers to decide jointly which lines to keep or to use as genitor. Finally, this form of evaluation, called participatory varietal selection (PVS), led to the re-examination of the initial breeding objectives. It helped to identify both parents and important target traits.

This phase requiring a previous agronomical participatory diagnosis is never finished. It evolves regularly as farming systems (change into rotation, associated crop, low density…) and production objectives are frequently moving.

Results and outlook

First results

The participatory selection in the most advanced lines is giving interesting results. Each year, about 30 pure lines were evaluated in a network of seven organic farms in contrasted environments.
After 5 years of evaluation, some lines appear really efficient in nitrogen uptake and may combine satisfactory productivity level and acceptable protein content under organic conditions (figure 1). Among them, two lines make the unanimity because they really respond both to farmer's ideotype and to manufacturer's demand. Indeed, they have phenotypical features required by organic farmers: very early vigor, important vegetative talls, high stem height, long ears with brown beards. And they present interesting criteria, concerning either physical grain, quality pasta appearance, or cooking quality. These criteria were analyzed by pasta manufacturers.
Simultaneously to this organic evaluation, a formal evaluation was conducted on four conventional farms on the same pure lines. It appears clearly that the range of varieties according to their yield level differed widely between formal and organic trials, highlighting the need to bred on target environment.

Thanks to the farmers' critical participation, the step concerned with disseminating varieties now arises very different from a conventional centralized breeding program. The question of property rights about co-bred materials is an urgent issue needing legal assistance. More generally, the challenge is now to move on from socio-technical networks in which pure lines were evaluated, to "organized action systems" (Friedberg, 1993) allowing the legal production and the economic valorization of co-bred cultivars. As manufacturers were involved from the start of the project, this process is facilitated but crucial issues about the way to organize and control "fair" partnerships nevertheless have to be faced. In practice, two kinds of "ethical" organized action systems are in progress: the first, "the semi-industrial process", tends to bring producers and quite big firms together around lines and may be framed by written contracts and technical guidelines. The second, more consistent with "small farmers" outlook, tends to attract small producers, family firms and "engaged consumers" around populations or mixes that may be valorized through diverse organic foods made from durum wheat and short-term marketing contracts.

From PVS to PPB

After a relatively short time, some actors asked to take part not only in the evaluation of fixed lines but also in the other preliminary steps (figure 2). At the beginning, the advantage of their being involved in generating variability was not clear for researchers. This step, which is generally performed by breeders, implies collecting, characterizing, and evaluating the use of adequate genetic diversity. Despite this precedent, we decided to evaluate wild species on the farms. A joint choice of parents was thus made from wild species and genetic resources preserved at INRA, and evaluated both on research station (*ex-situ*) and on-farm (*in-situ*). *In-situ* evaluation of genetic resources aimed both to increase farmers' and other actors' awareness of biodiversity and to open up new perspectives about suitable ideotypes. However public researchers performed the manual crosses to create new broad base populations.

Management of these populations was not only dynamic but also participatory insofar as a network of seven voluntary farmers was in charge of biodiversity maintenance in contrasted environments. This is accomplished not by allowing population drift at the risk of loosing favorable alleles, but by applying a low selection pressure to correct competitive effects. But the challenge is not only to maintain diversity but also to manage it, which supposes that the biology of cultivated species is well known. The farmers themselves asked for training in these subjects, even some who were not involved in the experimental network. Workshops were thus organized at regular intervals to improve the farmers' knowledge of genetics and to facilitate critical participation. The farmers' considerable expertise and capacity for observation was acknowledged by all the stakeholders involved and the complementarity of knowledge and know-how enabled dynamic *in-situ* conservation of genetic resources.

During this process interesting controversy about the most relevant varietal structures (pure lines, mixtures, populations) and the best breeding method (recurrent, pedigree method) appeared. We

tried to elucidate the debate through discussions with the different partners. In reproducible environments, researchers use to privilege stable structures such as pure lines. But as mentioned by our partners, this type of environment is rare in the context of organic agriculture and most organic farmers require heterogeneous structures. Heterogeneity is indeed synonymous with homeostasis, i.e. steady behavior, and enables adaptation of the cultivar to diverse environments (Wolfe, 1992). But some geneticist argued that heterogeneous cultivars are less productive than the best components (Gallais, 1990) and that pure lines may also be of great interest in certain situations, even though some farmers rejected them right away because they considered them to be intrinsically linked with multinational firms and GMOs. The different partners thus agreed to keep diverse kinds of varietal structures. Concerning breeding methods, open discussion led to the choice of the recurrent method as the most relevant for the maintenance of biodiversity and which respected the partners' values. As shown by Gallais (1990), it contributes both to improve the genetic resources pool and to create suitable new materials.

Up to 2005, some farmers had been given very early generations (F1-F2) to help researchers to better identify GxE interactions and to analyze the specific capacity of adaptation of the plant. But in this way, we also confirmed that giving farmers the opportunity to confront genetic diversity helped us identify their varietal preferences more efficiently than with a survey. Being able to handle diversity of plants freely in the target context enabled farmers to talk about other criteria than those that had been brought to light in the first stage, for instance associated crops and maturity.

Conclusion

Our ongoing project network combines four different objectives: to obtain suitable varieties by improving local adaptation, to promote genetic diversity, to valorize farmers' knowledge and know-how, to heighten pasta makers awareness of breeding and genetic diversity. It is neither a farmer-led nor a formal-led program but a program led by both professionals and researchers, in which farmers' critical participation began right from the first steps of the breeding scheme. The main decisions have been taken collectively to cope with the sustainability challenges addressed by organic agriculture. This represents a major break from conventional breeding schemes, insofar as farmers play the role of real partners and not only of consumers or end-users of newly created varieties.

This project also emphasizes the benefits to be obtained from open interactions between different professional partners and researchers from relevant disciplines. Involving pasta manufacturers in the program allowed farmers to leave behind them their original notion of manufacturers as multinational profit-makers with no societal preoccupations, and to identify concrete options for collaboration. Co-breeding is no longer only an end in itself but also a means of facilitating the production of knowledge and rules relevant for the development of circumscribed and meaningful agro-food systems, rather than merely the adaptation of models produced in other settings; Moreover , not only breeding but also agronomy and economy must become participatory.

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Figure 1 :
Durum wheat cultivar's efficiency for nitrogen assimilation.
Relation between yield (t/ha) and protein content (%)
under organic conditions (means 10 locations/year)

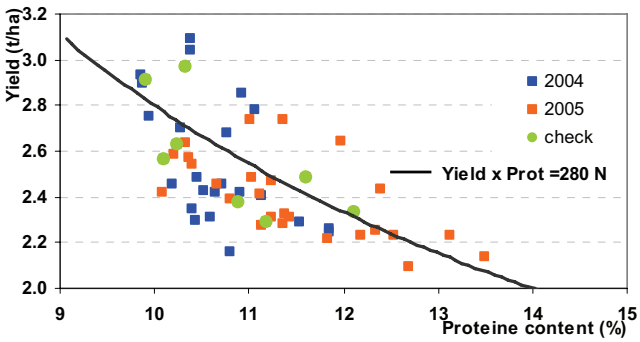
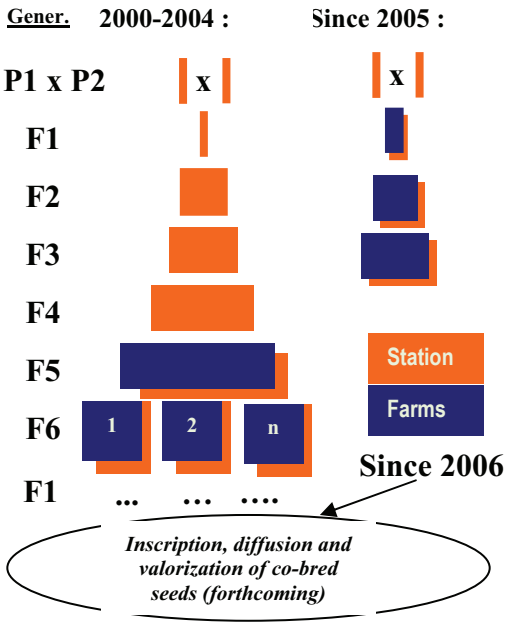


Figure 2 : From Participatory Varietal Selection to Participatory Plant Breeding



Résumé traduit en français

Des producteurs de blé dur aux consommateurs de pâtes: Rôle dans un programme de sélection participative

Le blé dur produit en conditions biologiques ne répond pas aux exigences industrielles de qualité (notamment taux de proteines trop bas). Par conséquent, plus de la moitié de la récolte de blé dur biologique française est vendue pour l'alimentation animale alors que les fabricants de pâtes importent du blé dur pour l'alimentation humaine sans traçabilité garantie. La durabilité de la filière « blé dur biologique » est remise en question. Face au manque d'intérêt des sélectionneurs privés, des agriculteurs se sont adressés à des chercheurs travaillant sur la diversité des ressources génétiques des céréales à l'Institut National de Recherche Agronomique (INRA).

Un programme sur la sélection participative de blé dur pour l'agriculture biologique est actuellement mis en œuvre dans le sud de la France. Ce projet combine quatre différents objectifs : obtenir des variétés adaptées aux conditions locales, promouvoir la diversité génétique, valoriser les connaissances et le savoir-faire des agriculteurs, accentuer l'intérêt des fabricants de pâtes pour la sélection et la diversité génétique. Il est nécessaire de mettre en place un système d'échanges interactif pour une communication efficace entre les différents acteurs (producteurs, transformateurs, chercheurs, consommateurs…) et disciplines scientifiques concernés par la problématique. Jusqu'à maintenant, les partenariats qui ont été mis en place entre professionnels de la filière et chercheurs ont été fructueux et ont aboutit a des lignées de blé dur intéressantes. Le passage de l'Evaluation Variétale Participative à une Sélection Participative, permet d'envisager différents systèmes d'action "éthiques" facilitant la production de connaissances et de règles appropriées au développement durable de systèmes agro-alimentaires spécifiques.