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Rice traits preferred by farmers and their perceptions of rice yellow mottle virus (RYMV) disease in Cascades Region of Burkina Faso

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A participatory research appraisal (PRA) was conducted in ten villages of the Cascades Region of Burkina Faso. Group discussions and individual interviews were employed. A total of 212 farmers including 176 women and 36 men were interviewed on their rice cropping management, the rice traits they preferred, and their perception on rice diseases with a focus on rice yellow mottle virus (RYMV). Taste, yield, grain quality, and cooking qualities were amongst the most valued traits. The taste was the paramount trait valued by farmers in their selection criteria. Moreover, taste is the reason why farmers still favour their local rice cultivars. The PRA also revealed that RYMV was the most damaging disease across the villages. Farmers recognised the disease through its symptoms (leaf yellowing, plant stunting, sterility, necrosis, and plant death). However, farmers were ignorant of the cause of RYMV disease. Resistant or tolerant varieties against RYMV were identified by farmers, and all belonged to the *Oryza glaberrima* species.

Key words: Participatory research appraisal (PRA), rice yellow mottle virus (RYMV), rice, grain and cooking quality.

INTRODUCTION

Burkina Faso is a landlocked country bordered by Ghana and Cote d'Ivoire in the South and by Mali in the North. In the South East, it is surrounded by Benin and Togo, and by Niger in the East and North. Rice is the staple food for many countrymen and women. In terms of production it occupies the fourth position in cereal production after sorghum, millet and maize (INSD, 2010). Rice production in 2008/2009 cropping season was estimated at 195,102 tonnes (INSD, 2010). This production was insufficient to meet the national demand for rice.

During the year 2008/2009, 203,403 tonnes were imported (INSD, 2010) at a cost of millions of dollars. The government of Burkina Faso is trying to increase local rice production and consequently reduce the imports. Providing fertilizer and seed of improved varieties at low cost to farmers are amongst the measures taken to boost rice production. These measures contributed to an increase in rice production to a level of production never reached before in the country, which translates to more than 100% production increase compared to the previous year (INSD, 2010). However, the seeds of improved varieties given to farmers could be rejected, if they do not meet farmers' requirements for both cropping and consumption. To avoid such situations, breeders should be aware of farmers' selection criteria. By using participatory plant breeding (PPB) programmes, farmers

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can contribute identifying rice cultivars that are acceptable in a given environment (Ceccarelli, 2009). Participatory research is defined as a "process of sequential reflection and action, carried out with and by local people rather than on them" (Cornwall and Jewkes, 1995). The collaboration between farmers, biologists, and plant breeders contributes to bridge differences between these key actors in the selection process (Cleveland and Soleri, 2007). Thus farmers should be consulted about and effectively involved in the creation of genetic diversity, the selection of desired traits, and the testing of progenies. Their involvement should not be limited to the third stage of the process called participatory varietal selection (PVS), as is often the case (Ceccarelli, 2009). However, involvement of farmers in the entire breeding process is expensive to breeding programmes and time consuming to the farmers. In the PVS processes, farmers assess progenies in the final stages of the breeding process.

The advantage of PVS is the "rapid spread and adoption of acceptable varieties" (Dorward et al., 2007). Conversely, the participatory research appraisal (PRA) is implemented in the first stages of the research process (Webber, 1995). Thus, farmers are actively involved in the initial stages by expressing their own selection criteria. Such use of a PRA approach has not been employed previously as part of rice breeding in Burkina Faso. In the present study, ten villages of the Cascades Region were targeted for a survey on local knowledge and breeding priorities. The objectives were to ascertain farmers' preferences for specific rice traits, survey farmers' rice cropping management, and capture farmers' perceptions of rice yellow mottle virus (RYMV) disease.

The outcome of this research should provide valuable information in support of Burkina Faso rice breeding programmes to deliver novel but also acceptable rice varieties that meet farmer as well as consumer wishes.

MATERIALS AND METHODS

Description of the study area

The Cascades Region is located in the South-West of Burkina Faso and is bordered by two neighbouring countries: Côte d'Ivoire and Mali, and by four provinces: Poni, Bougouriba, Houet and Kénédougou. The region includes two provinces: Comoé and Léraba, which are the names of the two principal rivers of the region. The Comoé Province accounts for 85% of the area of the region with an area of 15,826 km^2 (Lankoandé and Sébégo, 2005), while Léraba Province with an area of 2,810 km^2 accounts for 15% of the area of the Cascades region (Lankoandé and Paré, 2005). The region belongs to the Sudanean transition zone, with an annual rainfall between 1,000 and 1, 200 mm. The minimal temperature is nearly 17°C in the cold months (November – December) and the maximum temperature around 36°C in March and April. Rice cropping in the region is facilitated by the presence of rivers Comoé, Léraba and Bougouriba, and the existence of large plains ideal for rainfed lowland and deepwater rice cropping. This region is the granary of local rice in Burkina Faso (Sié, 1991) and is the third largest rice producing region of Burkina Faso averaging 35,635 tonnes (INSD, 2010). Rice is grown in deep water, rainfed lowland, and irrigated schemes with controlled water management.

Local rice varieties, including the African rice, *Oryza glaberrima* and the Asian rice, *Oryza sativa*, (introduced centuries ago in Africa:Linares, 2002) are grown widely in traditional basins by low income farmers. To promote and enhance rice production, two sites with complete irrigation management were built at Karfiguela (Comoé Province) and at Nionfila (Léraba Province). These irrigation schemes have boosted the introduction of improved varieties, exclusively *O. sativa* species that were introduced via the channel of research and agricultural extensions. In the 1990s the susceptibility of these varieties for RYMV disease was first reported in Cascades Region in the irrigation scheme of Karfiguela (WARDA, 2000).

Sampling procedure and interview techniques

Farmers in the two provinces (Comoé and Léraba) of the region were involved in the PRA. The villages were selected on the basis of secondary information on their long history of rice cropping because of the presence of several local varieties in the same village. Thus, ten villages were chosen: six in the Leraba Province (Noussoun, Baguera, Loumana, Kangoura, Kawara and Douna) and four in the Comoé Province (Diarabakoko, Siniena, Tengrela and Kiribina) (Figure 1).

The PRA activities were conducted in jointly by the agricultural extension units of the Cascades Region and the Burkina Faso Agricultural Research Institute, "Institut de l'Environnement et de Recherches Agricoles" (INERA). Agricultural extension officers of each of the relevant departments were contacted and were part of the team conducting the surveys. The PRA team was constituted by a social officer, an extension officer covering the target village, two technicians from INERA and the principal investigator, Honoré Kam. In each village, the team scheduled meetings with farmers. Group discussions and interviews were organised with farmers to obtain general information on rice cropping procedures and the diseases that threaten the rice crop. Visits to farmer fields, group discussions and interviews were conducted in Bambara, a local language most spoken throughout the Cascades Region. Iteration, open questions, structured questions and the 'six helpers' questions (why, who, what, when, where and how) were employed during group discussions. In iteration, the same question was asked more than once in different ways in order to confirm the answer. This technique is recommended in the context where most of the persons in the community are illiterate (Efisue et al., 2008). The open questions were used to allow the farmers to express themselves fully on a given topic. Pictures were shown to the groups so that the village community could identify the diseases that occurred in their fields and discuss them fully. The group discussions were recorded on a dictaphone and then transcribed to provide support information on the individual interviews.

After the group discussion, roughly, 20 farmers per village were selected randomly for individual interviews. The individual dialogue enabled selected farmers to express their own point of view without any influence from the community. The individual interviews first focused on personal information, identity, origin, and instruction level. Later, open and semi-structured questions were posed to farmers on their rice cropping management, the preferred and undesirable traits in rice varieties, as well as their perceptions on pests and diseases threatening their rice production. They were also questioned on their perception of RYMV, through questions and pictures. In villages where the number of individuals was below 20, all the individuals were interviewed. In larger villages about 20 individuals were selected at random. Overall, 212 farmers were interviewed, including 36 males and 176 females (Table 1).

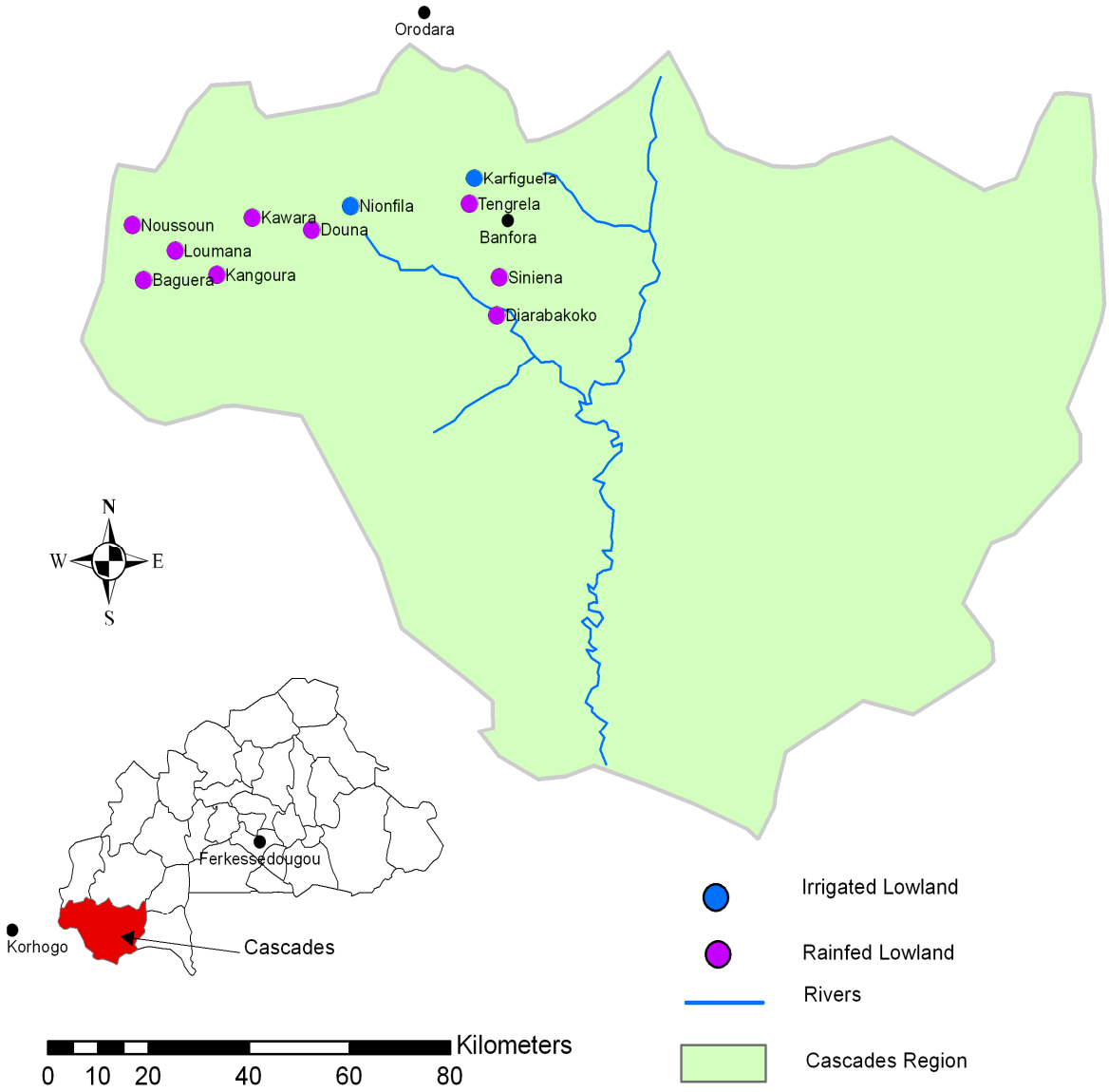

Figure 1. Map of the Cascades Region, portraying the selected villages and the two irrigation schemes, Karfiguela and Nionfila.

Table 1. Number of farmers in each village interviewed in the Cascades Region of Burkina Faso, by gender.

Village	Female	Male	Total
Baguera	28	0	28
Diarabakoko	30	2	32
Douna	6	5	11
Kangoura	25	0	25
Kawara	11	5	16
Kiribina	17	0	17
Loumana	21	0	21
Noussoun	7	11	18
Siniena	14	10	24
Tingrela	17	0	17
Total	176	36	212

Data analysis

Statistical analysis was done using a Statistical Package for Social Sciences (SPSS) version 17.0, SPSS Inc., Chicago, USA. Frequencies and percentage of responses were computed. Graphs were drawn to illustrate the outputs. Preferred and undesirable traits, as well as the importance and severity of rice diseases were ranked to highlight farmers' perceptions.

RESULTS

Rice cropping management practices

Rice farming in the Cascades Region is mostly the responsibility of women and accounted for 83% of the sample group. For the dominant ethnic group the Gouin people, a woman inherits her mother's rice field and the knowledge of rice cultivation is transmitted from mother to daughter. Most of the interviewees were small scale farmers. The rice fields of 72% of them did not exceed 1 ha. For 52% the rice field represented more than half of their total cropping area. The average age of the interviewed farmers across the ten villages was 43 years. The majority of the interviewees had been cropping rice for 19 years with a minimum of one year and a maximum of 50 years. Two third of the farmers interviewed were illiterate. Ninety six percent of farmers grew rice in the rainy season only, while the remaining 4% grew rice in both the rainy and dry seasons. The majority of farmers cultivated their rice in rainfed lowland areas. The few farmers growing rice in dry season had access to irrigation with controlled water management. Twelve percent of farmers cropped just one variety, 50% cropped two varieties at the same time and the remaining 38% cropped more than two varieties. Unreleased varieties were grown by 41% of the farmers, while 51% grew both local and modern varieties. Seventy four percent of the farmers kept enough seeds to ensure the establishment of their next season rice crop. Those lacking seeds bought their seeds in the local market and rarely from a neighbour. In the communities, seeds were obtained as gift, loan and exchanges.

Different ways of crop establishment were noticed: direct sowing by hand (56%) and transplantation from nursery (44%). The direct sowing of seeds is judged not to be time consuming, whereas transplantation is time consuming but has the advantage of reducing weeds competitiveness. The young plants are transplanted into ploughed and flooded fields that have been cleared of weeds. Consequently, the transplanted plants have the time to grow, become vigorous and compete with weeds. Fertilizers (urea, NPK or manure) were applied by 57% of farmers, while 45% used herbicide. Selective and mainly non-selective herbicides are used by farmers because they find them cheaper than hiring labour for the weeding.

The entire production of rice is self-consumed by 42% of farmers, while 54% sold a part of their production on the local market. A small proportion of farmers (2%), mainly in the irrigation schemes, sold their harvest to the cooperative. All the rice production of modern varieties from Douna village, both in irrigated schemes and in rainfed lowland fields, was sold to the cooperative. The modern rice varieties were produced under contract to the local cooperative. The local cooperative provided the seeds and the guarantee to purchase the harvest. However, the production of local varieties from Douna village was sold on the Douna local market. The absence of modern varieties and satisfaction with *O. glaberrima* and local *O. sativa* varieties were the justification of one third of the interviewees who never tested modern varieties. Seeds of modern varieties were mostly introduced to villages through the channel of agricultural extension. The government, through its Ministry of Agriculture and Non-Governmental Organisations, used the agricultural extension channel to reach farmer associations.

Preferred rice characteristics

Choice of a rice variety is determined by certain plant characteristics and the local natural environment. Thirty nine percent of interviewees preferred to grow local varieties (*O. glaberrima* and *O. sativa*) because they have mastered its cultivation, were confident about its adaptation to their environment, and liked its taste. Conversely, 47% preferred modern varieties because of their high yield potential, and 14% cropped both. Taste was the primary quality that farmers like in their varieties, followed by the yield. The other important traits making farmers value their rice cultivars were the cooking qualities, the resistance of rice plants to submersion, and the reduced requirements for weeding and low input utilisation like fertilizers. More than 42% of the respondents did not find any bad traits in the varieties they cropped. Disease and drought sensitivity of most of the traditional *O. sativa* and both low yield and the difficult de-husking of the grains of the *O. glaberrima* were mentioned by some farmers as weaknesses and disadvantages of local cultivars (Table 2).

The ranking of desired traits in rice varieties (Table 3) showed that taste of rice was the most important trait. Cooking characteristics (easy cooking and grain expansion after cooking) and disease resistance held significant place in farmers' selection criteria. Likewise, high tillering ability, high yield and post-harvest attributes (easy threshing and easy de-husking) were desirable characteristics taken into account by farmers. The above preferred traits were mentioned by at least 85% of the respondents. Resistance to lodging and to shattering were noted by 78 and 66% of the interviewees, respectively (Table 3). Certain farmers who did not choose resistance to lodging argued that heavy panicles are an indicator of good yield. According to them, lodging is due to heavy panicles. Similarly, some farmers think

Table 2. Good and Bad Traits of Rice Landraces in the Cascades Region of Burkina Faso.

Good traits in landrace varieties	% of respondents	Bad traits in landrace varieties	% of respondents
Good taste	53.4	No bad traits	42.1
High yield	52.8	Low yield	12.6
Grain swell when cooked	22.3	Drought sensitive	10.1
Plants tolerate submersion	20.7	Disease sensitive	7.0
Minimal management	15.5	Difficult husking	5.7

Table 3. Ranking of preferred rice traits across ten villages in the Cascades Region, Burkina Faso.

Villages	High tillering	Resist lodging	Resist disease	Low shattering	Easy threshing	Easy husking	High yield	Good taste	Easy cooking	Grain expansion
Baguera	75	57	75	46	82	86	71	93	89	82
Diaraba	100	94	100	78	84	94	100	97	100	100
Douna	91	91	100	82	91	91	100	100	91	100
Kangoura	100	80	100	64	76	72	96	100	100	100
Kawara	94	56	88	63	88	81	94	94	88	94
Kiribina	100	70	100	90	95	95	95	100	100	100
Loumana	90	81	90	62	90	81	90	100	81	90
Noussoun	83	89	83	39	94	89	72	94	89	83
Sinièna	92	83	96	67	88	79	83	96	96	96
Tingrela	88	82	100	71	65	88	94	94	94	82
Mean %	92	78	93	66	85	85	89	97	93	93
Ranking	3	6	2	7	5	5	4	1	2	2

that resistance to shattering is positively correlated to difficult threshing of the panicles. Therefore, they are satisfied with medium shattering varieties that are easily threshed during threshing after harvest.

On some parameters, farmer opinions were divided. Medium sized and tall rice plants were preferred by 37 and 39% of the respondents, respectively. Early and medium maturing rice were preferred by 51 and 32% of the respondents, respectively (Figure 2). According to farmers, a good rice variety is characterised principally by its high yield and its good taste. In addition, grain quality, expansion of the grains after boiling; white grain and short cooking time are characteristics of good rice. Other attributes like high tillering ability, easy de-husking of the grains and resistance to diseases were noted to characterise good rice (Table 4). Bad grain quality, absence of grain swelling after boiling, difficulty in cooking (need more time when cooking) and red grain define bad rice. Disease sensitivity, low tillering ability and the difficulty to de-husk the grain were also cited to characterise bad rice (Table 4).

Grain colour was an important feature: white grain colour was appreciated by 79% while red grain colour was preferred only by 8% of the respondents. The remaining 13% were indifferent about this trait (Table 5). Red grain colour is generally used by farmers to characterise *O. glaberrima* varieties while white grain colour appears to be a typical attribute of *O. sativa* varieties. From the farmers' point of view, white grains refer to attractive grains with a good appearance and good market value. Red grain is considered a disadvantage of *O. glaberrima*, as it

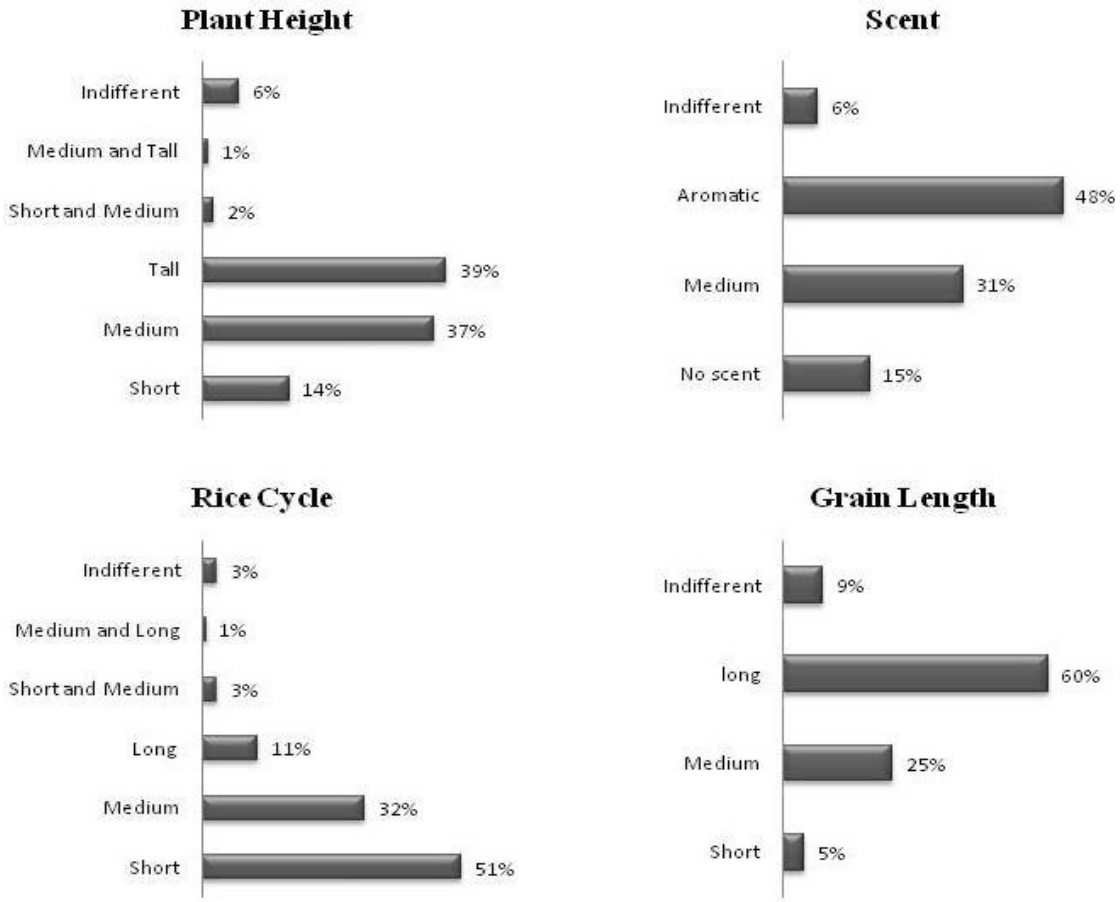

Figure 2. Bar charts showing farmers' choice of rice traits in Cascades Region of Burkina Faso.

Table 4. Traits characterising good and bad rice according to farmers of the Cascades Region of Burkina Faso.

Traits characterising good rice	% of respondents	Traits characterising bad rice	% of respondents
High yield	59.4	Not tasty	46.4
Good taste	57	Low yield	41.3
Swell when cooked	28.5	Do not swell when cooked	23.0
Nice grain[a]	18.8	Sticky rice	15.3
Easy cooking	18.8	Disease susceptible	12.8
Strong tillering	18.4	Weak tillering	11.2
Easy husking	13.0	Husking difficulty	10.2
Disease resistance	12.1	Red grain	06.6

[a]The term "nice grain" refers to an integrated evaluation by farmers of a number of traits that have been assessed subjectively and intuitively by the farmers. These include colour, length, width, shape, and dustiness.

requires an additional effort to whiten the grain during de-husking. This explains the low popularity of *O. glaberrima* over *O. sativa* in this region. *O. glaberrima* samples were collected only in four villages of the total villages surveyed: Douna, Kiribina, Noussoun and Sinièna with a maximum of four samples collected at Douna and Sinièna. In Sinièna village, *O. glaberrima* is widely grown by elderly women, and one third of the interviewees in this village were indifferent about the grain colour (Table 5).

Perception of farmers' crop damage caused by biotic and abiotic stresses

Crop losses observed in the field, in descending order of

Table 5. Preferred grain colour across ten villages in Cascades Region of Burkina Faso.

Grain colour	Village										
	Baguera (%)	Diaraba (%)	Douna (%)	Kangoura (%)	Kawara (%)	Kiribina (%)	Loumana (%)	Noussoun (%)	Sinièna (%)	Tingrela (%)	Total (%)
White	82.1	71.9	90.9	84.0	93.8	75.0	81.0	77.8	54.2	100.0	79.2
Red	10.7	9.4	0.0	12.0	6.3	10.0	0.0	5.6	12.5	0.0	7.5
Indifferent	7.1	18.8	9.1	4.0	0	15.0	19.0	16.7	33.3	0.0	13.2
Total %	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Table 6. Farmers' perception of major threats to their rice production in Cascades Region of Burkina Faso.

Village	Animal	Parasites	Disease	Drought	Flood	Fe toxicity
Baguera	4	21	75	11	25	0
Diarabakoko	59	22	50	9	0	0
Douna	27	45	55	9	0	0
Kangoura	0	32	88	8	8	0
Kawara	0	19	63	6	6	25
Kiribina	5	15	50	30	5	10
Loumana	5	48	81	19	5	0
Noussoun	0	61	50	11	17	0
Sinièna	4	17	25	42	0	0
Tingrela	24	35	53	24	6	0
Overall %	14	30	59	17	8	3

The values represent the % of respondents in each village who mentioned the threat.

importance, were due to diseases, parasites, drought, animals, flood and iron toxicity (Table 6). Animal damage occurred mainly in the villages of Diarabakoko, Douna and Tingrela. Elephants were the destroyers in Diarabakoko while hippopotami were damaging rice fields at Douna and Tingrela. Iron toxicity was a major concern at Kawara and Kiribina.

Farmers were knowledgeable about the threats occurring in their field. They differentiated between threats due to diseases from those caused by parasites. In regard to parasites, they identified the key insect pests affecting their rice crop, such as leaf and stem borers. In the case of diseases they ignored the cause and focused on visible symptoms. Nonetheless, they noticed that proliferation of the Onion leaf galls is caused by an insect: African Rice Gall Midge (AfRGM) of which the larvae cause the damage to the crop. Onion leaf galls, Bacterial Leaves Blight (BLB), blast and RYMV were considered as frequent diseases. RYMV was the most mentioned disease across villages, followed by blast, the diseases caused by AfRGM and BLB (Table 7).

The ranking of the frequent diseases or pests across villages revealed that RYMV is the most serious disease before blast and the diseases caused by AfRGM. The symptoms observed by respondents to describe RYMV disease were necrosis, stunting, sterility and yellowing leaves, provided rice plants did not suffer from water shortage. Resistant and/or tolerant varieties against RYMV were observed in Douna with the local variety called "Gnou", in Kiribina with the local variety called "Gnonrê" and in Tengrela with the local variety called "Douna". All the three resistant and/or tolerant varieties identified by the farmers belonged to *O. glaberrima* species. RYMV was given local dialect names in Baguera (Djiguikabila), Sinièna (Gbalô), Kiribina (Djoukounou) and in Tingrela (Kounagbê). Farmers had neither preventive methods nor a curative remedy against RYMV epidemics. Some farmers tried using potash, ash, shea butter, and insecticides against RYMV disease but in vain. Fertiliser was also used because some farmers thought that the disease occurred due to soil problems. Yield losses caused by RYMV were estimated by farmers to be between 30 and 100%.

DISCUSSION

Rice cropping practices

The survey noted that the women dominated rice cropping in the Cascades Region. This is common with rice cropping in most of West Africa. Nuijten and Treuren (2007), reported this trend in The Gambia. Women are the principal actors in rice cropping, grain processing and

Table 7. Farmers' perception of frequent pests and diseases threatening their rice production in Cascades Region of Burkina Faso.

Village	AfRGM	Blast	BLB	RYMV
Baguera	14	32	11	29
Diarabakoko	16	28	3	31
Douna	36	18	0	36
Kangoura	20	44	4	44
Kawara	31	0	0	31
Kiribina	30	30	15	50
Loumana	10	29	10	19
Noussoun	50	33	33	39
Sinièna	8	13	4	17
Tingrela	24	12	0	24
Overall %	22	25	8	32
Ranking	3	2	4	1

The values represent the % of respondents in each village who mentioned the disease.

marketing. Men, on the other hand, are involved in the cropping of maize, sorghum and millet. In almost all the surveyed villages, during the group discussions, women said as little girls they learnt rice cropping in their mother's rice field and the tradition is continuing with their daughters. The domination of women in rice cropping in the Cascades Region was already found in a PVS study at Badini, where 80% of the 570 farmers were women (Sié et al., 2008). Their noticeable contribution in all the processes of rice production and in the naming of varieties was also documented by Nuijten and Almekinders (2008) in Gambia. The development strategies of rice production in West African region therefore must take into account gender aspects.

The majority of the respondents were small scale farmers, growing rainfed lowland rice. Water availability limits the option of double rice cropping and also poses a risk during the rainy season. In the absence of rains, rice plants are exposed to drought. Inversely, abundant rainfall causes inundation. Both situations can induce severe damage. Therefore several varieties are grown to face these natural constraints and to minimise risks; thus a farmer may grow a variety (glaberrima or sativa) adapted to deep water ecology and another variety adapted to lowland ecology in the same season. The rice varieties grown in deep water environment are generally long cycle and tall, while both early maturing and late maturing varieties are grown in lowland ecology. In marginal environments, variety diversification is a risk-reducing strategy, that makes on-farm varietal diversity high (Virk and Witcombe, 2007). It is essential for farmers to have several varieties adapted to their marginal agro-systems; breeding for a widely-adapted, mega variety therefore could be hazardous (even risk-increasing) and would thus not meet the practical needs of small scale farming under diverse conditions. It follows that improved varieties that do not require much fertiliser and that compete with weeds should be developed for low income farming system.

Nearly 60% of the farmers were willing to crop novel varieties and 45% were already using herbicide. This shows that even small farmers are not opposed to the introduction of new varieties and cultural practices. They are curious and adopt a new variety or technique if they find it advantageous. For example, herbicides are being increasingly used by low income farmers because they are finding them profitable. However, the farmers must be trained in their utilisation in order to avoid causing any harm to themselves and to prevent pollution of the environment. Similarly, farmers were willing to test new rice varieties and explore whether they meet their requirements. If not satisfied farmers will usually reject them as was the case of Jola people in Senegal rejecting American rice because not satisfied with its taste considered as poor quality rice (Linares, 2002).

Preferred rice traits

The survey revealed the farmers' selection criteria. Farmers value their local rice varieties because of their taste, cooking qualities (grain expansion) and their high yield in their environment. These desired traits were equally important for Jola women's choice in the Casamance region (Linares, 2002). In Cascades Region, from a farmer's point of view, taste comes before yield. In West Africa, low income farmers are willing to trade-off yield for taste and grain quality (Linares, 2002; Efisue et al., 2008). However, rice farmers in Uganda and Malawi consider yield as the paramount desired trait (Lamo, 2010; Mzengeza, 2010). The difference is that rice farming is market oriented in Uganda and Malawi, while in West Africa most of the rice production is for domestic consumption.

An important point is that *O. glaberrima* originated in West Africa and is cultivated in most of the West African countries (Semon et al., 2005; Nuijten et al., 2009), where it is appreciated for its taste (Sié et al., 1998). In addition, *O. glaberrima* produces more waxy protein than *O. sativa* varieties (Sano, 1984) and waxy rice is similar to sweet rice. According to Traoré (2005), West African rice consumers prefer aroma, grain expansion and softness after cooking. These attributes are an overriding combination of traits that must be taken into account in breeding rice for West African countries. *O. glaberrima* and traditional *O. sativa* varieties have important gene pools to include in novel varieties development to meet farmers' requirements. The landraces favoured by farmers should be used as donor or recurrent parent regarding the genetic basis of the trait they harboured. In addition, landraces are valuable source of germplasm for breeders and should be well maintained to avoid their disappearance.

Low yield and drought susceptibility were noted as weaknesses for *O. glaberrima* and local *O. sativa* varieties, respectively. However, the continued survival of traditional varieties in farmer fields reflects the failure of plant breeders to provide any better alternatives (Virk and Witcombe, 2007). Most farmers of the Cascades region like white milled rice with a pleasant appearance characterised as "nice grains". Conversely, red milled rice (which refers to *O. glaberrima*) is seen as "bad rice", although certain farmers like it. Contrary to the finding in the Cascades Region, in Bohol Region in Philippines, red milled rice is preferred by farmers (Bertuso et al., 2005), while in Gambia, there is no preference between red and white grain colour (Nuijten and Treuren, 2007).

Perception of RYMV disease

The appraisal amongst communities revealed that RYMV was the most damaging disease across the villages. None of the villages were RYMV free. However, the disease severity varied across villages. Farmers recognised the disease through its visual symptoms. The discovery of local names and the recognition of symptoms were signs indicating that the farmers were aware of the existence of this disease. However, they were ignorant about its cause and none of their traditional methods to treat diseased plants succeeded. Therefore, the limitation of RYMV progression through prophylactic measures (Traoré et al., 2009) would be tricky without training farmers and agricultural technicians on the disease epidemiology. However, RYMV resistant or tolerant varieties were identified by farmers, and all of these belonged to the *O. glaberrima* species. This confirms earlier varietal screening studies that revealed a greater degree of resistance in *O. glaberrima* than in *O. sativa* (Ndjiondjop et al., 1999; Albar et al., 2006). Three different alleles of resistance have been identified in *O. glaberrima*, while only one is present in *O. sativa* (Albar et al., 2006). The recent screening of an *O. glaberrima* collection has now identified a second major gene of resistance to RYMV (Thiémélé et al., 2010). Dialogues with farmers could help breeders and pathologists to find additional landraces that are resistant or tolerant to RYMV. This is what happened in Madagascar, where a new *O. sativa* variety (Bekarossaka) bearing a major RYMV gene of resistance was identified (Rakotomalala et al., 2008). The exploitation of local landraces, mainly *O. glaberrima*, coupled with molecular techniques to transfer the *O. glaberrima* resistance to high yielding *O. sativa* varieties are promising ways to tackle RYMV.

The resistance of *O. glaberrima* to multiple constraints is a highly desirable character for rice cultivated by resource poor farmers (Futakuchi and Sié, 2009). *O. glaberrima* is more robust and adapted to different local environments in West Africa (Mokuwa et al., 2013). The New Rice for Africas (NERICAs) varieties were developed by overcoming the sterility barrier between *O. glaberrima* and O. sativa (Jones et al., 1997). Current NERICAs has less than 10% of *O. glaberrima* in their genome (Semagn et al., 2007). New NERICAs for resource poor farmers should be improved by incorporating the robustness of *O. glaberrima* by introgressing more *O. glaberrima* genes in their genome.

Conclusions

The PRA conducted in the Cascades Region of Burkina Faso gave insights on farmers' point of view on rice varieties they crop. Although yield is the paramount trait value in most of rice breeding programmes in Africa to achieve food security, West African rice farmers are ready to trade off yield with good taste. Rice breeders are then urged to couple good yield with good taste to meet small scale farmers' requirements which self-consume their production. The findings of the PRA are important for future rice breeding programmes in Burkina Faso, undertaken to meet the requirements of small scale farmers, and to avoid rejection of novel varieties.

However, RYMV was mentioned in this study as the most damaging disease in farmers' field. The rice cultivars identified by farmers to contain the disease belonged to the *O. glaberrima* rice species. Therefore, the diversity of the African rice should be tapped enough to identify and characterise genes of resistance against RYMV. Conventional and molecular breeding tools or techniques could be used to introgress resistant genes in promising varieties favour by farmers. Low yield, difficult de-husking and red pericarp of *O. glaberrima* were seen as the weakness of the African rice. Breeding programmes on intra-specific improvement of *O. glaberrima* to increase its yield, by reducing grain shattering and lodging, and increasing its number of

secondary branches are to be put in place. The difficult de-husking and the red colour of its grain should be improved to confer it a market value.

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