African Crop Science Journal, Vol. 21, Issue Supplement s3, pp. 683 - 691 ISSN 1021-9730/2013 $4.00

PARTICIPATORY IDENTIFICATION OF FARMER ACCEPTABLE IMPROVED RICE VARIETIES FOR RAIN-FED LOWLAND ECOLOGIES IN UGANDA

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ABSTRACT

Rice (*Oryza sativa* L.) is increasingly an important food and income generating crop in eastern Africa. Unfortunately, its production is characterised by low yields largely caused by minimal utilisation of improved varieties and poor production techniques. In response to the rising rice demand, rain-fed lowland rice production in the country is associated with field expansion rather than intensification. Consequently, farmers are encroaching on vulnerable ecologies, especially the wetlands. The objective of this study was to identify farmer preferred and rain-fed lowland adapted improved rice varieties. Six varieties (*IR 64, Basmat 370, Supa, Wita 9, K85, Buyu*) were evaluated in four trials in the Kyoga plains agro-ecological zone in eastern Uganda. Varieties *K85* and *Wita 9* yielded 6133 and 5553 kg ha^{-1}, respectively; significantly higher (P<0.05) than *Buyu*, the local check. *Basmat, IR64* and *Supa* yielded 4191, 3554 kg and 3608 kg ha^{-1}, respectively; though not significantly different (P>0.05) from the local check. Variety *K85* was preferred by 59% of the farmers; and this was followed by *Wita* 9. Basimat 370 and *Supa* were selected by 50.4% as the worst performing varieties. Gender based preference for *K85* was 54.5 and 36.4% for male and female, respectively. The criteria for variety preference were level of grain yield, short maturity time, plant height and resistance to lodging.

Key Words: Gender, Kyoga, *Oryza sativa*, wetlands

RÉSUMÉ

Le riz (*Oryza sativa* L.) est sans cesse un important aliment et une culture de rente en Afrique de l'Est. Malheureusement, sa production est caractérisée par des rendements bas suite à l'utilisation minimale des variétés améliorées et des techniques de production pauvres. En réponse à la demande croissante du riz, la production dans les bas fonds du riz pluvial dans le pays est associée à l'expansion des champs plutôt que l'intensification. En conséquence, les fermiers se contentent des écologies vulnerables, spécialement les marais. L'objectif de cette étude était d'identifier les préférences des fermiers en variétés améliorées et adaptées de riz pluvial de bas fonds. Six variétés (*IR 64, Basmat 370, Supa, Wita 9, K85, Buyu*) étaient évaluées dans quatre essais dans la zone agroécologique des plaines de kyoga à l'Est de l'Uganda. Les variétés *K85 et Wita 9* ont produit un rendement de 6133 et 5553 kg ha^{-1}, respectivement; significativement élevé (P<0.05) que *Buyu*, le témoins local. *Basmat, IR64* et *Supa* ont produit un rendement de 4191, 3554 kg et3608 kg ha^{-1}, respectivement; bien que pas significativement différent (P>0.05) du témoins local. La variété *K85* était préférée par 59% des fermiers, suivi de *Wita* 9. Basimat 370 et *Supa* étaient sélectionnée par 50.4% comme étant la variété la moins performantes. La préférence par le Genre pour *K85* était 54.5 et 36.4% pour les homes et les femmes, repectivement. Les critères pour la preference des variétés étaient le rendement en grains, la précocité, la hauteur de plants et la résistance au lodging.

Mots Clés: Genre, Kyoga, *Oryza sativa*, marais

INTRODUCTION

Rice (*Oryza sativa*) is a growing staple and income sourcing crop in sub-Saharan Africa (SSA), with a rising consumption rate of 7.2% per year (AfricaRice, 2012). The rising consumption rate in the SSA is mainly influenced by surging urban populations due to the product being more convenient to store and prepare than most staple foods (AfricaRice, 2011).

In Uganda, rice ranks high both as a food security crop and income earner for over 76,868 small holder households (UBOS, 2011). Its production increased from a dismal 190,736 metric tonnes in 2009 to 230,000 metric tonnes in 2011 (MAAIF, 2009). Eastern Uganda alone contributes over 67.2% of total rice production in the country, produced on 36,033 ha in low-lying (wetland) ecologies (UBOS, 2010; 2011).

In response to increasing demand for the crop in eastern Africa, smallholder farmers who predominate rice production in the country, stretch production mainly through expansion of the area under rice production (MWE, 2009; NPA, 2010). The expansion has resulted into rain-fed lowland rice farmers encroaching on the marginal parts of the wetlands, threatening their existence and the ability to perform their ecological functions (MWE, 2009; NPA, 2010). Wetland degradation notwithstanding, expansion of area under production is not a sustainable strategy since land is an inelastic resource. Farmers must be equipped with rice production techniques that would result into increased production without necessarily expanding their production area. Utilisation of improved varieties is the first and most important step towards increasing the yield per unit area in any crop production (Chikelu *et al*., 2012). Improved varieties tend to possess high yield potential and respond better to external in-puts (Awika, 2011). If farmers are to adopt an improved variety, it must possess traits that are acceptable to them. Unfortunately, the government of Uganda currently recognises the lack of released lowland rice varieties in for the country (MAAIF, 2012).In eastern Uganda where rice production is most concentrated, over 80% of farmers grow local lowland rice varieties and mainly in wetlands (MWE, 2009). In order to minimise extensive encroachment by farmers on wetland systems for rice production, they should first of all be availed with rice production options that result into increased yield per unit area. There is however, a general lack of information on improved varieties that are not only high yielding and adapted to the rain-fed lowland ecologies but also acceptable by the farming communities. Therefore, the objective of this study was to identify in a participatory manner, improved rice varieties which are adapted to the rain-fed lowland ecology in Uganda.

MATERIALS AND METHODS

This study was conducted in Limoto wetland in Pallisa and Kibuku Districts in the Kyoga Plains agro-ecological zone in eastern Uganda, under rain-fed lowland conditions. The study was conducted for the two rainy seasons in 2012. Five improved varieties, namely, IR 64, *Basmat* 370, *Supa*, *Wita* 9 and *K85*, were used in the trial. One variety (*Buyu*) was included as the local check (control). Three farmers hosting the trials were purposively selected on the basis of possession of at least five years of rice production experience and interest in the study.

Treatments included 6 varieties (listed above) assigned in a randomised complete block design, with 3 farmers acting as replicates. Sowing was done in wet soil using the drilling planting method, at a spacing of 30 cm between lines and 1.7 cm between plants (Tsuboi, 2012). Di-ammonium phosphate (18-46-0) and urea (46-0-0) were broadcasted and mixed with the soil at planting at a rate of 62 kg ha^{-1} each (Tsuboi, 2012). Top-dressing with 62 kg ha^{-1} of urea was done at 65 days after planting (Tsuboi, 2012). Urea for top dressing, was drilled and mixed with wet soil between the lines.

At physiological maturity stage (about 115 days after seedling emergence), a variety selection exercise was undertaken by 119 (11 female and 108 male) participants. The participants were required to make their first, second and sixth preferences among the 6 varieties based on physical appearance in the field. While the first and second choices were meant to identify the two most preferred varieties, the sixth choice was meant to indicate the worst variety. Each participant received three cards marked with

different colours: red, pink and blue representing first, second and sixth choice, respectively. To differentiate choices made based on the participant's gender group, cards were also marked with sign M for male and F for female. The segmentation enabled the researchers to identify the variety most selected for by each category. To avoid biased choices, participants were not allowed to communicate to each other while in the evaluation exercise. Also, sample anonymity was maintained by removal of name tags showing names of varieties. Only one sex category was allowed into the variety evaluation field at a time.

After making field choices, the participants were engaged in a Focus Group Discussion, to avail data that would explain why the choices were made. The research team first presented results of the selection process to the participants and thereafter requested them to voluntarily give reasons for the choices made for or against a given variety.

From each plot, an area of 2.4 m^2 was harvested (equivalent to four middle lines each 2 m long) (IRRI, 2012). The harvested areas were taken randomly from each plot, but at least 30 cm from the plot boundary. The rice samples were cut using sickles at 15 cm above soil surface level (IRRI, 2012) and carefully threshed manually to minimise post-harvest grain losses. The recovered grain samples were dried by spreading them under the sun for 30 minutes per day and open dried at room temperature for 4 days, when its moisture content was between 12 and 17% (Tsuboi, 2011). The 30 minutes only drying was meant to prevent over drying which would result into grain breakage. Grain samples were weighed using an electronic digital balance (sensitivity 0.01 – 2 kg). The moisture content of each grain sample was determined using a grain moisture meter (Riceter manufactured by Kett Electrical Labaratory, model f 501). Weights of each variety were adjusted to the standard 14% moisture content gravimetrically (IRRI, 2012). Ten panicles were also randomly selected from the four middle lines outside the harvested area for determination of the number of grains per panicle.

Data analysis. Yields from the two seasons were pooled and analysed using GenStat statistical package 13th Edition version 13.3.0.5165; VSN International 2010. The Protected Fisher Least Significant Different test was used to separate significant treatments means at the probability level of 5%.

RESULTS

Rice variety selection. About 59% of the participants selected variety *K85* as their preferred first choice closely followed by Wita 9 (Fig. 1). The two varieties accounted for 95% of the most preferred varieties' choices. The rest of the varieties (*IR64*, *Basmat*, *Buyu* and *Supa*) were selected by only 5% of the participants as the most preferred. Buyu, the local check was particularly selected by less than 2% of the participants as their most preferred variety. About 39% selected *Wita* 9 as their second choice; while 50% selected *Basmat* 370 as their worst choice varieties, followed by *IR64* and *Supa*.

Rice variety selection based on gender. A total of 59.3% and 36.1% of the male participants selected *K85* and *Wita* 9, respectively, as the two best varieties accounting for 95.4% of their first choice (Fig. 2a). Similarly, 54.5% and 36.4% of the female participants selected K85 and wita 9 respectively as the two best varieties accounting for 90.9% of their first choice (Fig. 2b). The two varieties further dominated the second choice in both sexes accounting for 72.8% and 69.5% of the female and male selected second best varieties respectively (Fig. 2a and Fig. 2b). On the other hand, a total of 54.6% of the male participants overwhelmingly selected Basimat 370 variety as their worst choice (Fig. 2a), while their counterparts were equally divided between *Supa* and *Buyu* for the same choice at 36.4% each (Fig. 2b). From the Focus Group Discussion (FGD), farmers used yield components such as spikelet fertility, number of panicles per unit area, grain weight to assess the yielding ability of a variety (Table 1). Other attributes included early maturity, resistance to lodging as well as medium height (approximately 1 m) and lodging (Table 2).

Grain yield performance. Varieties *K85* and *Wita* 9 yielded 6133 and 5553 kg ha^{-1} of grain, respectively; which were greater than that of the

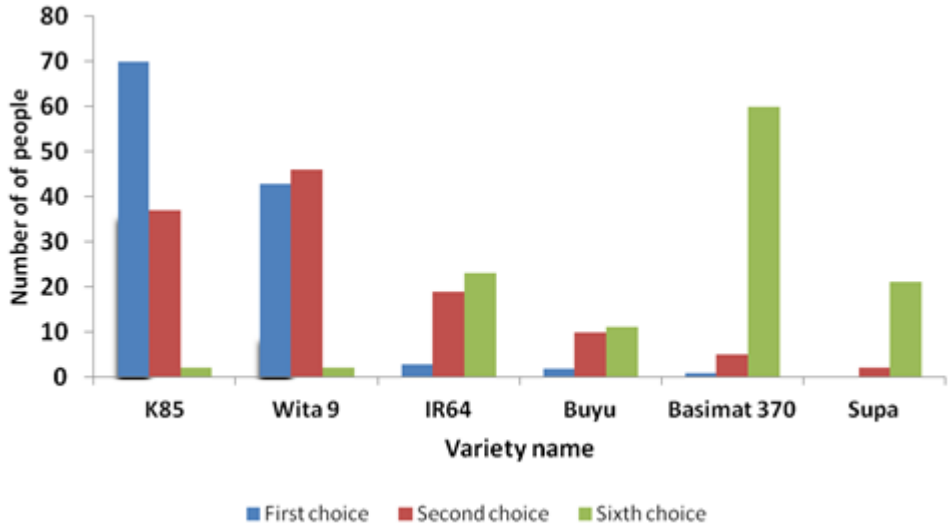

Figure 1. Farmer participatory preference of improved lowland rice varieiesyin eastern Uganda.

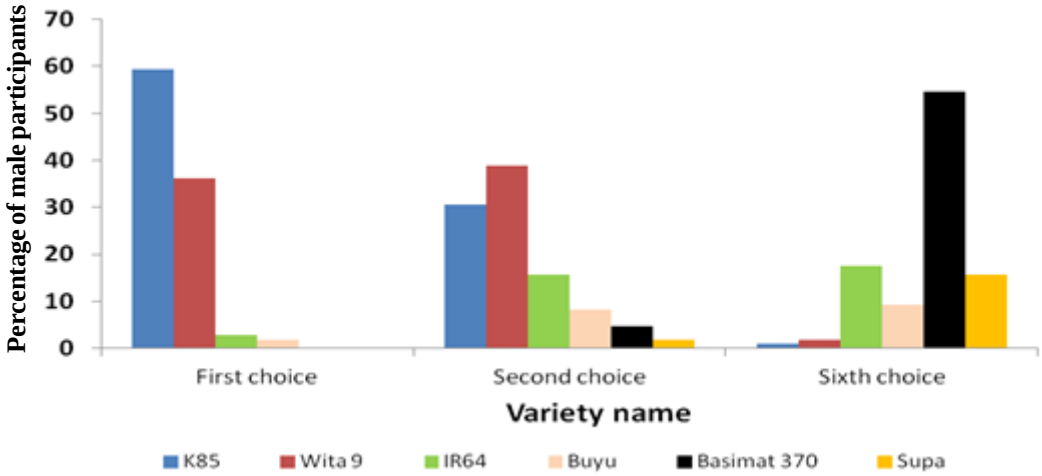

Figure 2a. Rice variety selection by male farmers in the eastern part of Ugamda.

local check *Buyu*. (Fig. 3). However, grain yields of improved varieties *Basmat*, *IR64* and *Supa* were not significantly different from that of the local variety *Buyu* (P>0.05). Buyu's grain yield in the trial was 1500 kg ha^{-1} above its reported performance.

DISCUSSION

K85 remerged to be the most preferred variety by farmers (Fig. 1), owing to its possession of unique and the most desired attributes which had a remarkable edge over the other varieties (Table 1). The variety was not only early maturing but also had high number of grains per panicle, tillers and spikelet fertility traits that are looked out for by rice growing households (Lamo, 2010). High tillering ability and spikelet fertility is precursor for high grain yield potential and consequently, overall production. Similarly, a large number of panicles is a precondition for high grain production in rice (Hill, 2004). On the other hand, early maturity of a material is a drought escaping attribute particularly important in rain-fed lowland

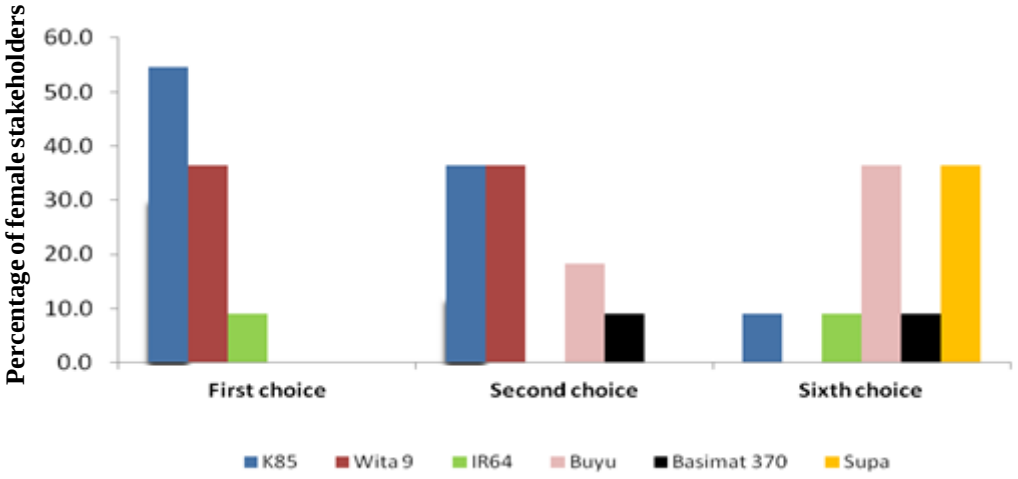

Figure 2b. Rice variety selection by female farmers in the eastern part of Ugamda.

TABLE 1. Reasons why participants liked varieties *K85* and *Wita* 9

Variety	Reasons for acceptability
K85	Heavy grains
	High spikelet fertility
	High number of panicles
	Early maturing
	Ability to perform well at the wetland periphery
	Disease resistant
	Resistant to lodging
Wita 9	High panicle number
	Big sized marketable grains
	Resistant to lodging
	Early maturity

ecologies that may be predisposed to seasonal low soil moisture stresses or occasional drought spikes, which are prevalent due to incursions of climate change effects (Fukai *et al.*, 1996).

The inherent ability of K85 to resist diseases is another vital attribute because most varieties available to the farming communities are susceptible to disease attacks, sometimes causing yield losses. The most endemic rice diseases in the study area are Rice Yellow Mottle Virus and rice blast (Lamo, 2010). These diseases are a threat to food security among communities; and the most effective management strategy is to plant disease resistant varieties (Mogga *et al*., 2012). The low disease occurrence in the trials is however contrary to Ochola's findings who found K85 as one of the most susceptible variety to RYMV (Ochola, 2011). It is however, in agreement with survey results in 2009 which found K85 among the least attacked varieties with RYMV disease (Ochola, 2011).

Resistance to lodging is another important feature of this variety since the study area experiences strong wind waves, causing considerable lodging damage to various crops including rice.

Variety *Wita* 9, though not rated as high as K85, was preferred closely to the latter. This is likely because of its less desirable traits than those of the latter. The variety provides an immediate substitute in cases that may challenge K85. On the other hand, *Wita* 9 can be upgraded through breeding to levels as competitive as K85.

Variety *Basmat* 370 scored poorest, among the study varieties, due to its susceptibility to lodging and small panicle size. Lamo (2010) also observed that *Basmat* variety was rejected by farmers due to its being low yielding and prone to diseases despite being aromatic and highly marketable especially, in the lucrative urban communities. This variety also presents further breeding opportunities to be adapted to the lowland conditions of Uganda.

The low number of female stakeholders (only 8%) who turned up for the variety selection and FGD exercise suggested that they were less involved in rain-fed lowland rice production

TABLE 2. Reasons why participants disliked rice varieties *Basmat* 370, *IR* 64, *Supa* and *Buyu*

Variety	Reasons for dislike
Basmat 370	Weak stems making it susceptible to lodging Small panicle size which appear light Low yielding
IR 64	It is a short variety and therefore easily submerged in case of flooding Because it is short, the variety is difficult to harvest, because one needs to bend while harvesting which is very tiresome Short in height thus easily overwhelmed by weeds
Supa	Late maturing Low yielding Susceptible to diseases It is too tall therefore difficult to harvest Requires deep waters (>30 cm) Highly preferred by birds requiring extra bird keeping labour
*Buyu**	Grains difficult to detach from panicles thus requiring more labour during threshing Itching on skin during weeding and harvesting Requires deep water (>30 cm) Late maturing

*Participants highlighted that they like Buyu because it has heavy grains and does not break during milling

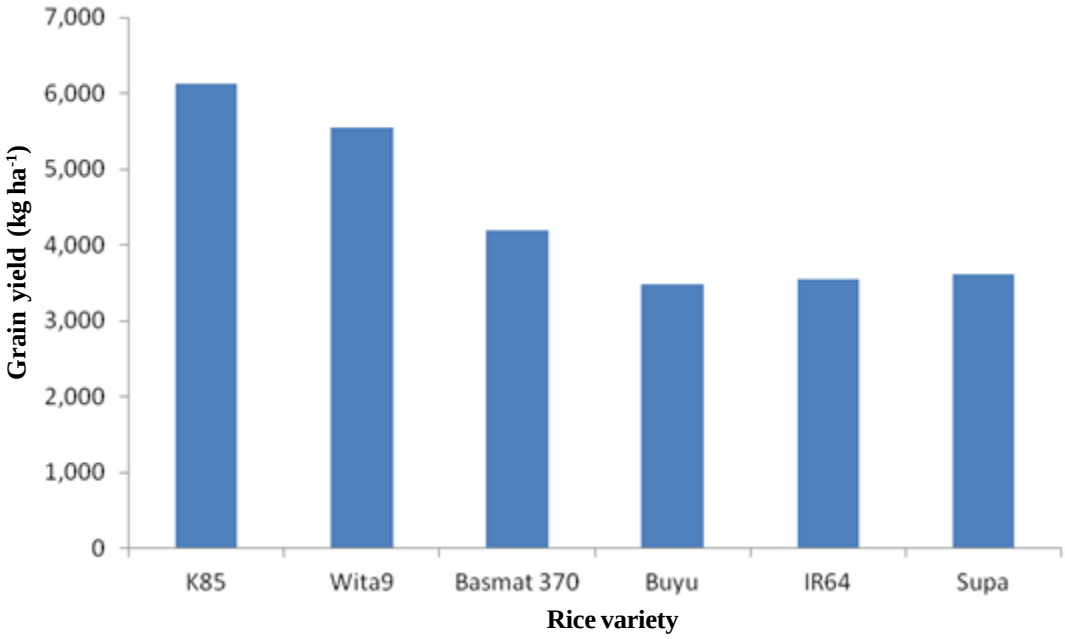

Figure 3. Grain yield of the improved rice varieties tested under rainfed lowland conditions in eastern Uganda.

compared to male. This result is consistent with findings of Adekunle (2013) on upland rice production in Sub Saharan Africa. He attributed low female involvement to them being more constrained by socio-economic factors (including resource endowment, capital and land). The similarity in the choice, *K85* and *Wita* 9, by both male and female participants, revealed that in rain-fed lowland rice production, the two sexes look out for the same desirable traits especially, on grain yield (Wanyonyi *et al.*, 2008). This result is contrary to others in maize where the female and male choices were different and strongly connected to the role played by each in the value chain (Wanyonyi *et al*., 2008). The participants' choice further suggested that the two varieties were the most acceptable by lowland rice farmers across the sexes. Both *Buyu* and *Supa* were observed to be late maturing, while *Basmat 370* was specifically rejected for its weak stems that make it susceptible to lodging. Male participants disliked lodging varieties more than their female counterparts, a result that is most likely explained by their leading role in Marketing. According to Wanyonyi *et al.* (2008), male rice farmers play a leading role in marketing. The male farmers therefore, viewed the variety's susceptibility to lodging at maturity stage, as a trait that directly results into spoilage of the grains that they would otherwise market. In-fact, by selecting *Supa* ahead of *Basmat 370*, the male participants indicated that they would prefer a late maturing variety to one that is early maturing but susceptible to lodging. Similarly, variety IR64, despite its early maturity trait, was disliked by male participants because of its early maturity. Ten percent of the female participants chose it as their best performing variety. Female participants were therefore found to strongly dislike late maturing varieties. This is, most likely, due to women's role in the crop's value chain. A late maturing variety would require more weeding times, demanding more labour from women while at the same time taking longer time for them to find food for their family (Wanyonyi *et al.*, 2008). Nevertheless, the results sugested that IR64, *Basmat 370*, *Supa* and *Buyu* rice varieties were not adapted and acceptable to the lowland rice communities.

Focus group discussion results, concerning the reasons why farmers selected or rejected a given variety, offer an insight of the characteristics that farmers deem important for a variety to be considered adapted and acceptable under lowland rice ecology. High yielding seems to be the over ridding factor in acceptability of a variety as farmers pointed at characteristics which results in the same for their acceptability of *K85* and *Wita* 9. These included high grain weight, good grain filling ability and high number of panicles (Lamo, 2010). Results also revealed that farmers were cautious of the effects of climate change preferring early maturity and ability of varieties to perform well at the periphery of the wetland (where effects of occasional drought spikes are more prominent) as some of the reasons for selecting Wita 9 and *K85*. Similarly, *Basmat* 370 was rejected for its weak stem which makes it susceptible to lodging (collapsing under strong winds). Likewise, Variety *IR64* was rejected because farmers viewed it as short and therefore susceptible to extreme flooding conditions which would submerge the plants resulting into either plant death or grain rot. The variety was also cited to be difficult to harvest because it is short which would require one to bend while harvesting it.

The focus group discussion results did not only confirm *K85* and *Wita* 9 as the most adapted and acceptable varieties, but also pointed out the fact that farmers look out for varieties that are not only high yielding and disease resistant but also resistant to the effects of climate change.

CONCLUSION

Varieties *K85* and *Wita* 9, owing to their yield being sinificantly higher than that of local variety and being selected by the farming community as their first and second choice; respectively, were the most adapted varieties for lowland rain-fed rice ecologies in the Kyoga plains agro-ecological zone. This is further confirmed by the yields of the two varieties being more than 2.5 fold higher than yield reported by MAAIF, 2012 for rain-fed lowland rice production ecology in Uganda.

ACKNOWLEDGEMENT

The International Developement Research Center (IDRC) for funding this research.

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