

Results of a global online expert survey:

Major constraints, opportunities, and trends for yam production and marketing and priorities for future RTB yam research

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1. Introduction

Yams (*Dioscorea* spp.) are a multispecies crop with a wide range of ploidies. They rank eleventh among global food crops in both total production (49 MT) and food consumption in developing countries. Production, mostly by smallholders, is concentrated in tropical Africa (96% of global production) (IITA 2009). Yams are a primary agricultural and culturally important commodity in West Africa, where it is still important for survival. Some varieties of these tubers can be stored up to six months without refrigeration, which makes them a valuable resource for the yearly period of food scarcity at the beginning of the wet season. Yam cultivars are also cropped in other humid tropical countries.

Yams are farmed on about 5 million ha in about 47 countries in tropical and subtropical regions of the world (FAO 2012a). Because of their abundance and importance to survival, yams were highly regarded in Jamaican ceremonies and constitute part of many West African ceremonies. But yam production is constrained by a number of factors. The seed yams are perishable and bulky to transport. Farmers who do not buy new seed yams usually set aside up to 30% of their harvest for planting in the next year. Yam crops face pressure from a range of insect pests, fungal and viral diseases, and nematodes. The crop has a low yield per hectare compared to crops such as cassava (manioc) or sweet potato. It is not an efficient food staple given the relatively large amount of planting material that is required and its long growing season. Yam's labor requirement exceeds that of other comparable crops. It is also difficult to preserve and store over extended periods of time.

The cost per 1,000 calories of yam is four times greater than those of other root and tuber crops (RTCs). For these reasons, and problems of storing harvested yam, the costs of yam production are high and yam crops are slowly losing ground to cassava and other food staples (FAO 2012b).

Despite these high costs, low technology, and low nutrient density, when compared to other RTCs, yam farming produces the highest amount of food calorie and protein annually per hectare per season, on average (FAO 2012a). Moreover, given the nutritional value of yam and its high cultural acceptance in certain parts of Africa, there is an interest in developing knowledge that would improve yam production. Similarly, the crop has high potential of contributing to poverty alleviation and food security. Hitherto,

technological improvements in yam have been underutilized and unexploited (IITA, 2013). Since 2008, based on the appreciation of the importance of yam to improving income and food security, investment in research on yam crop became intensified. One example is the \$12 million project “Yam Improvement for Income and Food Security in Africa” (YIIFSWA), funded by the Bill and Melinda Gates Foundation for five years. Activities in yam research by the International Institute of Tropical Agriculture (IITA) have then increased significantly, thereby making yam a priority crop.

However, given IITA’s mandate to provide global public goods and the need to improve livelihoods of farmers in Africa, where the crop is essentially grown, it is important to identify relevant problem areas and define priorities for yam research. On a general note, published results on priority setting on RTCs are limited to work done only in Asia, with an emphasis on sweet potato (Fuglie 2007; Horton 1989) and cassava. Although the study covered a wide geographical area, its strength has been limited by a very small sample and weak representation of some regions. Given its exclusive focus on sweet potato, its application to yam is extremely limited. There is scant literature on research into the constraints to yam production and use. A global expert survey is part of the activities earmarked in the project “CGIAR Research Program on Roots, Tubers and Bananas (CRP-RTB),” and is being undertaken to assess strategic research priorities for the CRP’s mandate crops (bananas/plantains, cassava, potato, sweet potato, and yam) to identify where and how to focus the program’s resources. The project aims at achieving the highest possible impacts on food security, nutrition and health, poverty reduction, gender equity, and environmental sustainability.

This expert survey study will provide empirical foundations to constraints and priority needs in yam production and utilization. This paper presents an empirical investigation into the priority research areas and constraints of production in yam. Following Ruttan (1982), it draws on and extends the approach taken by Horton (1989) and Fuglie (2007), which applied a scoring model to assess priorities for sweet potato research. Yam experts in areas ranging from production to sector development across the developing world were asked in a survey to score a broad range of research options according to the perceived importance for helping to reduce poverty and improve food security. Moreover, the experts

were asked to report their perceptions of constraints and relative importance of alternative research options based on their research and capacity development efforts.

2. Materials and methods

The expert survey employed a structured questionnaire administered in 2013. The questionnaire consists of two sections. In a first section, it asks for personal information about the respondents (e.g., gender and age, experience in work on yam, type of organization a respondent works for, the country or region and the crop agro-ecology his or her work is focused on, and the professional and disciplinary background).

The second (main) section of the questionnaire deals with the different constraints and research options. Respondents are provided with a list of 97 research options covering crop improvement-breeding (39); management of soil, water, weed, and harvest (10); improvement of seeds and planting materials (7); disease control and management (7); pest control and management (9); genetic resource management (4); value chain, postharvest utilization, and marketing (12); and socioeconomic, policy, and impact studies (9). This approach ensures, on one hand, a certain degree of comparability with the previous study, especially with the other crop expert surveys. On the other hand, it demonstrates relevance of the list of research options and its endorsement by crop scientists (Fuglie 2007). Moreover, the numbers of research options in different categories is a reflection of constraints associated with them. For example, yam production has the highest options because empirical evidence has shown that major constraints facing yam value chain are production of quality seed and associated problems (Phillips et al., 2013; Mignouna et al., 2014)

For each of the research options, respondents were asked to assign a score from 1 (not important) to 5 (very important), according to their perception of the importance of that option for helping to reduce poverty and improve food security through crop research and capacity development. The use of 1-5 score range was preferred to 1-9 score range because it is more handy and convenient to use. Moreover, it is more sufficient to capture differences in opinion compared with 1-3 score range. Being odd-numbered, the 1-5 scoring has two equal score on both sides of the central value of 3. Therefore, the scoring in this study gave results that were positive reflections of the expressed understanding

because it gives the respondent the ease of properly and correctly placing his opinion. In addition, for each area, respondents can specify and score other options that may not have been considered in the initial list.

The selection of the group of experts to take part in the survey was guided by several objectives. First, in order to obtain responses of sufficiently high quality, the respondents would need a sound knowledge of yam. This means the capability of identifying and assessing problems and constraints associated with production and sector development. Further, the target group should be selected in a way that the views of experts from a variety of backgrounds with a stake in yam research can be taken into account. Thus, the selection has to be wide enough to cover not only the science community, but also include representatives from the private sector and the development community.

Accordingly, a combination of approaches has been taken to reach out to the expert community. First, the questionnaires were distributed at professional meetings. These include the 16th International Symposium of the International Society for Tuber & Root Crops, held in Abeokuta, Nigeria, on 23–28 September 2012. The international symposium was particularly chosen because it provided a meeting point for the knowledgeable stakeholders in yam research thereby enabling respondents from all yam growing regions of the world to participate in the survey. Second, two scientists visited various research organizations, universities, and institutes of experts in Nigeria, Ghana, Benin, and Togo. Two countries each were purposively selected in Anglo- and Franco-phone countries, respectively. Third, the survey has been rolled out online at a global scale. For the online survey, a list with experts and stakeholders has been compiled based on information requested by IITA researchers, crop experts in individual countries, professional networks, and the Inter-American Institute for Cooperation in Agriculture (for Latin America and the Caribbean [LAC]). Individuals were invited to participate in the online survey by mail and via RTB's website. Also, a review of scientific publications was carried out to identify authors of relevant publications.

Further, the contacted experts were invited to forward the invitation to interested colleagues. The questionnaire was translated into English and French to make it available and accessible to a wider

audience. As expected, the number of participants in LAC was smaller compared to any other region in view of low volume of yam output, size of land area allocated and number of scientists and other stakeholders in yam value chain in the region.

Analysis of the results involves calculations of mean scores for each of the research options evaluated in the survey. Higher values indicate the perception of higher importance among the respondents. To provide a rough indication of the significance of observed differences, the standard errors of the mean are calculated. The results are presented at the global level, using the entire sample, and breakdowns by regions as well as by gender are provided.

A total of 216 questionnaires have been completed and returned to IITA (Table 1). Of those, 24% were female and 76% male. Respondents characterized their work as being global, regional (belonging to one of nine regions), or national. For this report, respondents who indicated “national” were assigned to the respective region. It was possible to give multiple responses. About two-third (66%) of the respondents indicated that their work is in West and Central Africa, which agrees with sources indicating that 96% of yam production takes place in West Africa (IITA, 2013). The second largest group of respondents indicated a global focus of their yam expertise/work (19%). Other experts limit the scope of their work to Eastern Africa (3%), North America (2%), and LAC (3%). Some 2% of the respondents work in Southern and eastern Asia.

Table 1: Number of respondents by region

Regions	Count	Share
West and Central Africa	150	0.66
Eastern Africa	6	0.03
North America	4	0.02
Central-America-Caribbean	7	0.03
Southern Asia	4	0.02
Eastern Asia	4	0.02
Other regions	9	0.04
Global	43	0.19
Total	227	1.00

Note: N =216; Share of female = 0.24

To respond to specific crop agro-ecologies, respondents have been provided with a list of agro-climatic regions corresponding to zones from the Köppen-Geiger climate classification (Peel, Finlayson, and McMahon 2007). The Köppen-Geiger classification has been chosen because it is widely understood and because it is considered meaningful for defining crop agro-ecologies (see Table 2).

Table 2: Number of respondents by crop agro-ecology

Crop Agro-ecologies	Counts	Share
Tropical sub-humid	22	0.10
Tropical humid savanna	53	0.25
Tropical humid	48	0.22
Sub-tropical sub-humid	8	0.04
Sub-tropical humid	15	0.07
Tropical-subtropical	21	0.10
Others (string)	49	0.23

Table 3 shows the distribution of respondents by professional orientation.

Table 3: Number of respondents by profession

Profession	Count	Share
NARS research leader/manager	8	0.04
NARS scientist	30	0.15
Scientist or lecturer at university	48	0.25
Extensionist	24	0.12
NGO representative	55	0.28
CGIAR donor	2	0.01
CGIAR scientist	5	0.03
Private company	9	0.05
Others	14	0.07

The survey was able to cover a broad range of disciplines (Table 3). The responses are multiple choices.

Table 3: Number of respondents by discipline

Disciplines	Counts	Share
Crop genetic resources	22	0.05
Participatory plant breeding	12	0.03
Transgenic research	3	0.01
Tissue culture	14	0.03
Soils/nutrient management	28	0.07
Cropping/farming systems	53	0.12
Economic or policy	15	0.04
Climate change specialist	18	0.04
Cultural anthropology or rural sociology	15	0.04
Training and knowledge management	38	0.09
Research planning and administration	19	0.04
Development planning and administration	34	0.08
Genomics, bioinformatics, molecular biology	27	0.06
Plant breeding and conventional genetics	43	0.10
Crop management, agronomy and physiology	6	0.01
Water management in crop production	12	0.03
Crop diseases and their management	23	0.05
Crop pests and their management	17	0.04
Postharvest crop utilization/marketing	6	0.01
Others disciplines	22	0.05

The following section presents the results obtained from the surveys, providing interesting insights into the perceptions of the yam experts about the relative importance of constraints and research options.

3. Results

3.1 Crop genetic improvement

The results are presented following the way information was gathered in the questionnaire. Results are grouped into four broad categories of research options: crop genetic improvement; production technology, agronomy, and crop management; improvement of seed and planting materials; and other options for yam research. For each category, the number of responses for each score overall responses (all regions) and the total number of responses are given. Further, for all options the mean score and the standard error of the mean are provided. Since those standard errors are around 0.10 on average, a 95% confidence interval lies roughly about 0.19 points around the mean.¹ To offer a breakdown of responses obtained, the mean scores for responses from sub-Saharan Africa (SSA), West and Central Africa (WCA), Central American-Caribbean (CAC), and CGIAR are reported. Finally, to make differences between male and female respondents explicit, the mean scores by gender are included in the tables.

The second aspect of the results presents the prioritization of research options for crop genetic improvement by the respondents (Table 5). The table ranks the options based on descending order of mean scores. In this category, respondents considered high yields and biotic stress resistance to yam mosaic disease to be of highest importance to yam breeding.

The third most important under crop genetic improvement is breeding for environmental adaptation or new crop uses especially early maturing varieties. However, the prioritization of options differed across different categories of respondents. Respondents from SSA ranked breeding resistance to mosaic disease to be the highest option in crop genetic improvement before high yield. The same pattern of ranking is demonstrated by respondents from WCA.

¹This calculation includes the questions on “others” at the end of each section of the questionnaires. These questions typically have higher standard errors. Thus, the confidence intervals will actually be smaller for most of the questions, in particular where specific research options were given.

Respondents from CAC ranked high yield and resistance to tuber rot disease as the most important options in genetic crop improvement. On the other hand, the two highest ranked options by CGIAR scientists are the breeding for early maturing varieties and nutrient-use efficiency. It is interesting to note that female respondents ranked breeding for better nutritional qualities—pro-vitamin A carotenoids and protein as the most important options in this category. This implies that respondents implicitly or explicitly recognize that yam breeding for crop genetic improvement should take into account parameters relating to crop yield, resistance to mosaic (in WCA), and tuber rot disease (in CAC). For the breeding options to be gender friendly, attempts should also be made to breed for better nutritional qualities, especially pro-vitamin A carotenoids and proteins.

Table 4: Prioritization of options for crop genetic improvement

	COUNTS					SCORES						GENDER	
	1	2	3	4	5	Mean score	S.e. (mean)	SSA mean	WCA mean	CAC mean	CGIAR scientists	Male mean	Female mean
CROP IMPROVEMENT													
High yields	3	7	40	67	74	4.06	.068	4.17	4.04	4.40	4.08	4.10	4.13
Biotic stress resistance (yam mosaic disease)	7	8	30	60	76	4.05	.078	4.19	4.05	3.60	4.11	4.05	4.06
Environmental adaptation or new uses (early harvest)	11	5	26	63	73	4.02	.083	3.77	3.98	3.80	4.36	4.13	4.06
Abiotic stress resistance (drought tolerance)	10	4	27	72	61	3.98	.080	3.87	4.01	4.00	4.17	4.02	4.18
Breeding for biotic stress resistance (tuber rot)	8	9	26	59	64	3.98	.085	3.78	3.96	4.40	4.12	4.07	4.03
Biotic stress resistance (yam anthracnose disease)	5	10	35	70	51	3.89	.076	3.78	3.85	4.20	4.06	3.90	4.03
Biotic stress resistance (nematodes)	6	10	35	64	48	3.85	.081	3.59	3.84	3.60	3.82	3.92	3.88
Nutrient-use efficiency	6	3	44	55	43	3.83	.081	3.81	3.85	3.80	4.30	3.82	4.10
Nutritional quality (protein)	3	17	37	59	51	3.83	.080	3.74	3.78	3.80	4.14	3.74	4.28
Biotic stress resistance (yam internal brown spot disease)	8	6	40	74	45	3.82	.077	3.77	3.86	3.80	3.68	3.86	3.91
Breeding for biotic stress resistance (yam leaf blight)	6	40	71	46	##	3.80	.078	3.68	3.79	3.80	3.78	3.82	3.97
Environmental adaptation or new uses (mechanization—specify operation)	8	19	20	59	50	3.79	.094	3.63	3.77	3.60	4.03	3.83	4.03
Crop improvement (breeding for processing quality)	3	16	53	56	53	3.77	.076	3.68	3.79	3.60	3.84	3.72	4.21
Breeding for improvement in nutritional quality (pro-vitamin carotenoids)	7	19	35	54	49	3.73	.089	3.46	3.77	3.60	3.92	3.59	4.32
Breeding for biotic stress resistance (yam beetles)	7	14	36	58	36	3.68	.088	3.54	3.76	3.20	3.42	3.76	3.60

	COUNTS					SCORES						GENDER	
	1	2	3	4	5	Mean score	S.e. (mean)	SSA mean	WCA mean	CAC mean	CGIAR scientists	Male mean	Female mean
Breeding for biotic stress resistance (yam leaf spot)	6	15	45	60	35	3.64	.082	3.36	3.64	4.00	3.74	3.63	3.87
Breeding for biotic stress resistance (tuber mealy bug)	7	12	41	54	33	3.64	.088	3.54	3.65	3.60	3.68	3.70	3.81
Other opportunities for crop improvement (germplasm enhancement and pre-breeding)	8	14	43	55	35	3.61	.088	3.82	3.53	3.40	3.84	3.55	3.89
Crop improvement (breeding for other consumer-preferred traits)	6	21	40	50	39	3.61	.089	3.53	3.50	3.33	3.81	3.55	4.13
Breeding for biotic stress resistance (other disease of yam)	8	14	21	36	27	3.57	.118	3.15	3.54	3.67	3.60	3.65	3.74
Breeding for improvement in nutritional quality (medicinal compounds)	12	19	42	43	43	3.54	.097	3.41	3.55	2.75	3.80	3.37	4.11
Breeding for improvement in nutritional quality (iron and zinc)	9	23	41	50	38	3.53	.092	3.45	3.54	3.40	3.86	3.37	4.19
Other opportunities for crop improvement (flowering ability/botanic seed production)	10	15	37	48	30	3.52	.097	3.94	3.53	4.00	3.69	3.47	3.77
Research options to reduce poverty and improve food security (other abiotic stress of yam) specify heat tolerance	8	15	35	43	27	3.52	.100	3.26	3.57	3.75	4.00	3.46	4.05
Breeding for improvement in nutritional quality (other)	6	3	7	8	13	3.51	.241	3.38	3.58	5.00	3.50	3.43	4.50
Crop improvement (breeding for dry matter, high starch, and flour yield)	12	22	43	56	35	3.48	.090	3.31	3.41	3.60	3.59	3.36	4.15
Other opportunities for crop improvement (exploitation of heterosis)	8	11	50	40	24	3.46	.093	3.62	3.42	3.60	3.74	3.37	3.75
Crop improvement (breeding for other specific producer-preferred traits)	5	25	57	51	30	3.45	.080	3.58	3.42	3.50	3.59	3.43	3.70

	COUNTS					SCORES						GENDER	
	1	2	3	4	5	Mean score	S.e. (mean)	SSA mean	WCA mean	CAC mean	CGIAR scientists	Male mean	Female mean
Breeding for biotic stress resistance (other insect pest yam)	7	17	20	33	21	3.45	.122	3.04	3.51	3.67	3.64	3.53	3.70
Other opportunities for crop improvement (others)	5	9	6	19	11	3.44	.183	3.50	3.42	4.50	4.14	3.41	3.64
Crop improvement (breeding for tuber meatiness)	10	17	61	48	24	3.37	.084	3.34	3.36	3.50	3.38	3.33	3.68
Breeding for environmental adaptation or new uses (other)	5	5	13	13	9	3.36	.186	3.07	3.38	5.00	3.60	3.52	2.89
Breeding for abiotic stress resistance (herbicide resistance)	15	20	47	50	25	3.32	.093	2.98	3.31	3.00	3.55	3.38	3.50
Research options to reduce poverty and improve food security (tolerance of marginal/toxic soils)	17	15	46	36	29	3.31	.104	3.27	3.39	2.60	3.33	3.30	3.67
Other opportunities for crop improvement (polyploidy)	9	19	41	34	20	3.30	.103	3.50	3.28	3.60	3.63	3.23	3.57
Crop improvement (breeding for starch quality traits)	11	29	52	46	25	3.28	.088	3.42	3.32	3.60	3.64	3.18	3.91
Crop improvement (breeding for low nutritional factors)	21	25	46	32	23	3.07	.104	2.88	3.07	3.20	3.38	2.86	4.00
Research options to reduce poverty and improve food security (water logging)	19	30	48	45	17	3.07	.093	3.19	3.05	3.00	3.24	3.07	3.26
Research options to reduce poverty and improve food security (low temperature)	38	29	40	28	7	2.56	.102	2.85	2.63	2.80	2.52	2.47	3.00

3.2 Production technology, agronomy and crop management

Options for production technology, agronomy, and crop management comprise constraints and technologies related to the management of soils, water, weeds and harvest, and the control and management of diseases and pests (**Error! Reference source not found.**). The mean scores range from 4.17 for improving soil fertility to 3.41 for managing soil salinity. On a general note, in this category, the highest ranked option by the respondents is improving soil fertility with micronutrients, fertilizer, and organic matter with a mean score of 4.17. Improving yam cropping system comes next with a mean score of 3.99. Managing soil acidity (3.61), production of gender-friendly labor-saving tools (3.56), and managing soil salinity (3.41) are the lowest ranked options. The pattern ranking does not vary significantly across different categories of respondents. This might indicate that the respondents perceive constraints facing yam production from the same perspectives.

Table 5: Prioritization of options for production technology, agronomy and crop management

	COUNTS					SCORES						GENDER	
	1	2	3	4	5	Mean score	S.e. (mean)	SSA mean	WCA mean	CAC mean	CGIAR Scientists	Male mean	Female mean
Production technology, agronomy, crop management													
Improving soil fertility (micronutrients, fertilizer, organic matter)	4	6	25	59	78	4.17	.073	3.98	4.10	4.17	4.31	4.15	4.41
Improving yam cropping system	6	11	34	71	40	3.99	.077	4.00	3.97	4.00	4.08	3.98	4.25
Harvesting methods or machinery for planting/harvesting	6	11	23	75	61	3.89	.085	3.90	3.84	4.00	4.03	3.84	4.29
Weed management and control (management)	11	16	47	48	41	3.79	.080	3.71	3.82	3.33	3.89	3.80	4.00
Water management in crop production	6	11	43	59	42	3.79	.080	3.64	3.78	4.17	3.76	3.78	4.03
Soil management and erosion control management	8	26	43	45	30	3.75	.082	3.66	3.83	3.83	3.78	3.67	4.16
Other production technology, agronomy, crop management	5	13	40	63	46	3.65	.149	3.21	3.43	4.50	3.70	3.75	3.43
Managing soil acidity (production technology, agronomy, crop management)	3	20	43	50	34	3.61	.085	3.58	3.64	3.50	3.53	3.57	4.00
Production of gender-friendly labor-saving tools	7	11	34	56	59	3.56	.091	3.41	3.54	3.33	3.85	3.49	4.03
Management of soil salinity	7	22	53	30	17	3.41	.093	3.57	3.44	3.50	3.42	3.34	3.86

3.3 Improvement of seeds or planting materials

Table 7 presents prioritization of options for improvement of seeds or planting materials. The mean scores in the category of planting materials and crop management range from 4.10 for informal improving crop technologies for farmer-based production and distribution of planting materials to an average score of 3.21 for alternatives for clonal vegetative seeds. The second highest ranked option is the formal improving crop technologies for farmer-based production and distribution of planting material (4.04). The third highest ranked option is mass propagation of planting materials (3.97). In all the categories of respondents except gender, these three options represent the first three options under planting materials and crop management options. On the other hand, the highest ranked option by female respondents is the alternative for micro- or mini-tuber from disease-free stocks (4.25).

In the category of disease and pest management research options, management of yam mosaic disease and yam tuber rot received the highest ranking by the respondents, with a mean score of 4.06 each. This might reflect the seriousness of the constraints to yam production. The highest ranked pest is weeds (3.87) followed by nematodes (3.85). The third devastating pest as ranked by the respondents is yam beetle. In all the categories of respondents, managing the incidence of grasshoppers is the least ranked option in disease and pest management.

Table 6: Prioritization of options for improvement of seeds or planting materials

	COUNTS					SCORES						GENDER	
	1	2	3	4	5	Mean score	S.e. (mean)	SSA	WCA mean	CAC mean	CGIAR scientists	Male mean	Female mean
Planting materials and crop management													
Improving technologies for farmer-based production and distribution of planting materials (informal)	1	10	38	53	68	4.10	.074	4.13	4.03	4.50	4.27	4.15	4.13
Planting materials, crop management (improving production and distribution of “clean” planting materials) (formal)	2	9	35	51	55	4.04	.073	4.10	4.02	4.17	4.30	4.03	4.15
Planting materials, crop management (mass propagation methods)	4	8	41	42	57	3.97	.079	3.89	3.93	4.33	4.32	3.96	4.14
Planting materials, crop management (alternatives for micro- and minitubers from disease-free stocks)	5	16	52	46	20	3.92	.085	3.75	3.90	4.17	3.97	3.90	4.25
Planting materials, crop management (others)	3	6	30	58	68	3.62	.156	3.06	3.53		3.73	3.61	3.70
Planting materials, crop management (production of hybrids from inbred progenitors)	7	23	53	31	17	3.43	.084	3.42	3.55	3.60	3.63	3.43	3.45
Planting materials, crop management (apomixes as alternative for clonal vegetative seed)	6	5	12	26	17	3.21	.092	3.11	3.22	3.00	3.44	3.14	3.61

Disease management													
Yam mosaic disease	4	8	11	21	16	4.06	.077	4.24	4.11	3.40	4.12	4.08	4.12
Tuber rot disease	4	16	47	51	37	4.06	.080	4.03	4.12	4.20	3.94	4.09	4.04
Yam anthracnose disease	8	12	40	61	33	3.82	.086	3.95	3.82	4.20	4.00	3.81	3.97
Other disease management	5	5	28	55	62	3.70	.149	3.65	3.79	3.00	3.78	3.62	4.09
Yam internal brown spot disease	4	10	29	57	72	3.68	.086	3.78	3.72	3.83	3.65	3.67	3.81
Yam leaf spot	8	11	35	59	51	3.65	.083	3.61	3.73	3.80	3.48	3.69	3.63
Yam leaf blight	7	15	44	53	43	3.64	.086	3.67	3.71	3.50	3.45	3.69	3.63
Pest management													
Weed management	13	33	50	42	20	3.87	.075	3.95	3.82	3.67	4.15	3.84	4.03
Nematodes management	4	8	14	19	22	3.85	.082	3.72	3.88	3.50	4.00	3.86	3.93
Tuber beetles management	5	16	47	49	28	3.72	.083	3.72	3.81	3.60	3.59	3.71	3.75
Management of tuber mealy bug	5	13	36	62	35	3.66	.082	3.72	3.73	3.50	3.61	3.68	3.65
Leaf beetles management	2	16	39	50	53	3.54	.086	3.62	3.60	3.00	3.40	3.55	3.54
Termites	3	19	38	59	33	3.54	.085	3.46	3.64	3.00	3.40	3.59	3.44
Others (specify)	5	9	30	78	42	3.48	.181	3.36	3.50	4.50	3.36	3.36	3.88
Millipedes	6	17	49	51	30	3.29	.089	3.28	3.43	3.00	3.23	3.33	3.27
Grasshoppers	11	24	53	45	23	3.15	.091	3.05	3.24	3.00	3.16	3.16	3.16

3.4 Other options for yam research

Other options for yam research are as shown in Table 8. These options include genetic resource management; value chain; postharvest utilization and marketing; and socioeconomic, policy and impact studies. Genetic resource management research options are not highly ranked. The highest globally ranked option responding to these scores is improving the shelf life of yam tuber with the value of 4.30 while the lowest is research options to reduce poverty and improve food security (low temperature) with value of 2.56. The mean scores in genetic resource management range between 3.79 and 3.50. The highest ranked genetic resource management option is the collection, characterization, evaluation and conservation ex situ with the mean score of 3.79. It is closely followed by phenotypic/molecular screening of land races in search of high value traits (3.78).

With regard to value chain, post harvest utilization and marketing, improving the shelf life of yam tuber receive the highest ranking across all the categories of respondents. Improving the shelf life of yam tuber has a mean score of 4.30 while it is followed by improving small scale production of yam for human consumption with a mean score of 4.13. Developing yam products for human consumption (4.00) and developing yam products for industrial application are the third and fourth highly ranked options in this category (3.96). Ethanol production from yam is ranked least among all the options on value chains with a mean score of 2.66. The low ranking of this option cuts across all the categories of respondents.

In socioeconomic, policy and impact studies, the highest ranked option is access to new technologies with a mean score of 3.98. Other highly ranked options are yam technology adoption, improving policy framework for yam planting (3.91) and impact of yam research and development (3.90). However, female respondents ranked impact of yam research and development and improving policy framework for yam planting as the first and second most important research option in this category.

Table 8: Prioritization of other research options

	COUNTS					SCORES						GENDER	
	1	2	3	4	5	Mean score	S.e. (mean)	Regional mean	WCA mean	CAC mean	CGIAR Scientists	Male mean	Female mean
Genetic resources management													
Collection, characterization, evaluation, documentation, and conservation ex situ	6	15	39	53	31	3.79	.095	3.88	3.79	4.00	4.17	3.72	3.97
Phenotypic/molecular screening of land races in search of high-value traits	8	16	33	42	57	3.78	.093	3.80	3.79	4.20	4.21	3.69	4.06
In situ genetic resource management)	5	5	15	11	14	3.61	.089	3.83	3.62	4.00	3.70	3.48	4.00
Other Genetic resource management	6	15	37	41	52	3.50	.957	3.00			5.00	3.50	
Value chain, postharvest utilization, and marketing													
Improving shelf life of yam tubers	1	0	1	0	2	4.30	.069	4.47	4.24	4.50	4.29	4.25	4.58
Improving small-scale processing of yam for human consumption	6	3	15	65	95	4.13	.073	4.23	4.13	3.80	4.16	4.02	4.55
Developing yam products for human consumption	7	4	48	62	51	4.00	.072	3.93	3.98	3.83	4.18	3.85	4.49
Developing yam products for industrial applications (flour and starch)	4	7	40	64	66	3.96	.077	3.93	3.96	3.40	4.16	3.86	4.38
Alternative on farm utilization/processing for value addition	6	3	30	63	78	3.85	.077	3.83	3.87	3.40	4.06	3.71	4.43
Development of competitive yam value chains	7	36	64	45	19	3.84	.083	3.85	3.81	3.20	4.09	3.80	4.19
Development of farmers organizations and farmer clusters linked to market	7	23	49	58	30	3.82	.079	3.88	3.84	4.00	3.94	3.79	4.12
Research on more gender-equitable value chains	6	13	30	65	48	3.49	.083	3.70	3.56	2.80	3.64	3.42	3.94
Developing yam products for animal feed	5	12	37	60	68	3.20	.092	2.95	3.23	3.00	3.42	3.18	3.42
Improving management of residues	36	49	34	34	15	3.19	.078	3.12	3.16	2.60	3.56	3.11	3.65
Others	4	14	40	60	50	3.03	.247	2.80	3.19	5.00	2.57	2.83	3.67
Ethanol production from yam	18	34	46	50	28	2.66	.098	2.65	2.74	2.80	2.71	2.62	2.97

Socioeconomic, policy and impact studies													
Access to new technologies	4	8	7	5	6	3.98	.067	4.07	3.98	3.67	4.30	3.97	4.12
Yam technology adoption	2	9	34	80	54	3.95	.067	4.00	4.02	3.80	4.14	3.97	4.09
improving policy framework for yam planting	8	14	50	56	44	3.91	.075	3.88	3.87	3.60	4.17	3.86	4.24
Impact of yam R&D	1	11	33	80	49	3.90	.069	3.86	3.95	3.75	4.11	3.87	4.26
Health and environmental risks of pesticide used in yam systems	3	8	39	78	47	3.84	.074	3.88	3.91	3.80	3.91	3.84	4.06
Food and agricultural policies affecting yam	10	32	58	40	21	3.66	.083	3.61	3.63	3.60	3.86	3.60	4.15
Others	4	13	30	74	52	3.58	.254	3.00	3.75	5.00	3.33	3.56	4.00
Health effects of biofortified yam varieties	5	7	40	72	43	3.53	.084	3.53	3.54	3.60	3.74	3.44	4.00
Gender inequality in yam production systems	8	20	48	58	33	3.19	.086	3.18	3.20	2.80	3.34	3.07	3.77

4. Discussion and conclusion

The prioritization of research options in yam presented in this report highlights the perceptions of the stakeholders, especially the experts, about the priorities and needs for yam research. The report indicates the relative importance of individual research options available in yam seed development, production, agronomic practices, value chain, marketing, and policy environment.

It is obvious that the largest parts of the research options—almost 98% of them—are ranked as important or very important. In fact, only two of the research options received a mean score lower than 3.0 (i.e., a score that would push the option into the area of low importance). The research options with low mean scores are ethanol production from yam (2.66) and research options to reduce poverty and improve food security with yam varieties resistant to low temperature.

Global prioritization of research options indicate that improving shelf life of yam tubers received the highest ranking (4.30) by all respondents (Table 9). This is followed by improving soil fertility through micronutrients, fertilizer, and organic matter, with the mean score of 4.17. The third highest ranked option is improving small-scale processing of yam for human consumption (4.13). Other global highly ranked options are informal improving technologies for farmer-based production and distribution of planting materials (4.10) and management of yam mosaic disease (4.06).

Yam mosaic disease management, management of tuber rot disease, and breeding for high yields received the same high ranking of 4.06. This reflects the gravity of the constraints posed by these options. Other similarly highly ranked options are breeding for resistance against yam mosaic (4.05), formal improvement of production and distribution of clean planting materials (4.04), and breeding for early-maturing varieties (4.02). Development of yam products for human consumption, improving yam cropping system, and assessment of small farmer access to new technologies are also highly ranked by the respondents. The mean scores of these last three options range from 3.98 to 4.00.

Table 7: Highest ranked options for yam research according to global mean score

	COUNTS					SCORES							GENDER	
	1	2	3	4	5	Total Responses	Mean score	S.e. (mean)	Regional mean	WCA mean	CAC mean	CGIAR Scientists	Male mean	Female mean
Improving shelf life of yam tubers	1	0	1	0	2	4	4.30	.069	4.47	4.24	4.50	4.29	4.25	4.58
Improving soil fertility (micronutrients, fertilizer, organic matter)	4	6	25	59	78	172	4.17	.073	3.98	4.10	4.17	4.31	4.15	4.41
Improving small-scale processing of yam for human consumption	6	3	15	65	95	184	4.13	.073	4.23	4.13	3.80	4.16	4.02	4.55
improving technologies for farmer-based production and distribution of planting materials (informal)	1	10	38	53	68	170	4.10	.074	4.13	4.03	4.50	4.27	4.15	4.13
Disease management (yam mosaic disease)	4	8	11	21	16	60	4.06	.077	4.24	4.11	3.40	4.12	4.08	4.12
Disease management (tuber rot specifically)	4	16	47	51	37	155	4.06	.080	4.03	4.12	4.20	3.94	4.09	4.04
Crop improvement (breeding for high yields)	3	7	40	67	74	191	4.06	.068	4.17	4.04	4.40	4.08	4.10	4.13
Breeding for biotic stress resistance (yam mosaic disease)	7	8	30	60	76	181	4.05	.078	4.19	4.05	3.60	4.11	4.05	4.06
Improving production and distribution of “clean” planting materials (formal)	2	9	35	51	55	152	4.04	.073	4.10	4.02	4.17	4.30	4.03	4.15
Breeding for environmental adaptation or new uses (early harvest)	11	5	26	63	73	178	4.02	.083	3.77	3.98	3.80	4.36	4.13	4.06
Developing yam products for human consumption	7	4	48	62	51	172	4.00	.072	3.93	3.98	3.83	4.18	3.85	4.49
Improving yam cropping system	6	11	34	71	40	162	3.99	.077	4.00	3.97	4.00	4.08	3.98	4.25
Assessment of small farmer access to new technologies	4	8	7	5	6	30	3.98	.067	4.07	3.98	3.67	4.30	3.97	4.12

Yam mosaic disease management, management of tuber rot disease, breeding for high yields received the same high ranking of 4.06. This is a reflection of the gravity of the constraints posed by these options. Other similarly highly ranked options are breeding for resistance against yam mosaic (4.05), formal improvement of production and distribution of clean planting materials (4.04) and breeding for early-maturing varieties (4.02). Development of yam products for human consumption, improving yam cropping system and assessment of small farmer access to new technologies are also highly ranked by the respondents. The mean scores of these last three options range from 3.98 to 4.00.

From gender perspectives, female experts tend to give higher scores on average than their male counterparts. Their ranking of research options, however, is similar. Given that differences between scores are only small and not significant, it broadly corresponds to the ranking given by the male peers. However, since there is a demand to make priority-setting processes for agricultural R&D gender responsive (Meinzen-Dick et al. 2011), a more thorough analysis on gender differences in the prioritization of research options is indicated.

The results conveyed in this report give an aggregate picture of the importance of the different constraints and research options. Options that rank low in this survey may well have high importance in a particular locality or region or for particular target groups.

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APPENDIX

Questionnaire

BEST BETS FOR YAM RESEARCH – 2012

A SURVEY OF YAM RESEARCH PRIORITIES AND NEEDS

Dear colleague, we appreciate you taking the time to complete the survey!

Section A. Please tell us a little about yourself

1. Your name (optional):
2. E-mail address (optional):
3. Your gender (please encircle): M F
4. Your Organization:
5. Would you characterize your Yam research as

Global

- Regional (tick boxes)
- Western and Central Africa
 - Eastern Africa
 - Southern Africa
 - Latin America and the Caribbean
 - Asia/Pacific
 - Other (specify) _____
- National (specify country) _____

6. On which agro-ecological zones is your Yam work focused? (tick all that apply)

- | | |
|---|---|
| <input type="checkbox"/> Tropical sub-humid environnements | <input type="checkbox"/> Subtropical sub-humid environnements |
| <input type="checkbox"/> Tropical humid savannas environnements | <input type="checkbox"/> Subtropical humid environnements |
| <input type="checkbox"/> Tropical humid forest environments | <input type="checkbox"/> Tropical or Subtropical Highlands |
| <input type="checkbox"/> Others (specify) _____ | |

7. In your opinion, what are the three top constraints to the Yam sector today? (please rank and be specific)

1. _____
2. _____
3. _____

8. In your opinion, what will be the single most important trend in Yam in the next ten years?

9. In your opinion, what are the three top constraints to the Yam Seed sector today? (please rank and be specific)

1. _____

2. _____

3. _____

10. Are you (please mark the one most relevant answer)

a research leader/manager from a national agricultural research institute?

a research scientist from a national agricultural research institute?

a research scientist or lecturer at a university?

an extension agent?

a representative of a non-government, not-for-profit organization (NGO)?

a representative of a donor to the CGIAR system?

a CGIAR center scientist?

Employed by a private, for-profit company?

Other (please specify)?: _____

11. What is your background? (please mark all that apply)

- Crop genetic resources Genomics, bioinformatics, molecular biology
- Participatory plant breeding Plant breeding and conventional genetics
- Transgenic research Crop management, agronomy, and physiology
- Tissue culture Water management in crop production
- Soils/nutrient management Crop diseases and their management
- Cropping/farming systems Crop pests and their management
- Economics or policy Postharvest crop utilization / marketing
- Climate change specialist
- Cultural anthropology or rural sociology
- Training and knowledge management
- Research planning and administration
- Development planning and administration
- Other (please specify): _____

Section

B.

Please assess the amount of Yam research done by your organization.

1. Is Yam research an important priority for your organization?

- Yam is the highest priority crop for my organization
- Yam is among the priority crops for my organization
- We do some research on Yam, but it is not a priority crop
- We rarely or never conduct research on Yam
- We don't conduct research on Yam but on other roots and tuber crops or banana/plantain
- I don't know
- We don't do research

2. Over the past five years, has the Yam research done by your organization –

- decreased
- stayed about the same
- increased

Section C. Please assess the importance of the following options for helping to reduce poverty and improve food security through Yam research and capacity development.

<p>Research options to reduce poverty and improve food security</p>	<p>Importance for research (please mark: not important = 1, low importance = 2, important = 3, very important = 4, most important = 5, don't know)</p>
A. Crop improvement	
1. Breeding for high yield	1 2 3 4 5 don't know
2. Breeding for other specific producer preferred traits (specify)	1 2 3 4 5 don't know
3. Breeding for dry matter, high starch and flour yield	1 2 3 4 5 don't know
4. Breeding for tuber meatiness	1 2 3 4 5 don't know
5. Breeding for other consumer preferred traits (specify)	1 2 3 4 5 don't know
6. Breeding for processing quality	1 2 3 4 5 don't know
7. Breeding for starch quality traits (specify)	1 2 3 4 5 don't know
8. Breeding for low ant nutritional factors (tannin, phenol, phytic acid)	1 2 3 4 5 don't know
Breeding for improvements in nutritional quality	
9. ProVitamin A carotenoids	1 2 3 4 5 don't know
10. Protein	1 2 3 4 5 don't know

Research options to reduce poverty and improve food security	Importance for research (please mark: not important = 1, low importance = 2, important = 3, very important = 4, most important = 5, don't know)
11. Iron and zinc	1 2 3 4 5 don't know
12. Medicinal compounds (in selected species)	1 2 3 4 5 don't know
13. Other (specify:)	1 2 3 4 5 don't know
<i>Breeding for biotic stress resistance</i>	
14. Yam mosaic disease	1 2 3 4 5 don't know
15. Yam internal brown spot disease	1 2 3 4 5 don't know
16. Yam leaf blight	1 2 3 4 5 don't know
17. Yam anthracnose disease	1 2 3 4 5 don't know
18. Yam leaf spot	1 2 3 4 5 don't know
19. Tuber rots (specify:)	1 2 3 4 5 don't know
20. Nematodes (specify:)	1 2 3 4 5 don't know
21. Yam beetles (specify)	1 2 3 4 5 don't know
22. Tuber mealybug (specify)	1 2 3 4 5 don't know
23. Other diseases of yam (specify)	1 2 3 4 5 don't know
24. Other insect pests of yam (specify)	1 2 3 4 5 don't know

Research options to reduce poverty and improve food security	Importance for research (please mark: not important = 1, low importance = 2, important = 3, very important = 4, most important = 5, don't know)
<i>Breeding for abiotic stress resistance</i>	
25. Herbicide resistance (specify)	1 2 3 4 5 don't know
26. Drought tolerance / water use efficiency	1 2 3 4 5 don't know
27. Low temperature / winter hardiness	1 2 3 4 5 don't know
28. Water logging	1 2 3 4 5 don't know
29. Tolerance of marginal/toxic soils (specify)	1 2 3 4 5 don't know
30. Nutrient use efficiency (specify)	1 2 3 4 5 don't know
31. Other abiotic stresses of yam (specify: heat tolerance)	1 2 3 4 5 don't know
<i>Breeding for environmental adaptation or new uses</i>	
32. Early harvest (6 months after planting)	1 2 3 4 5 don't know
33. Mechanization (specify operation)	1 2 3 4 5 don't know
34. Other (specify)	1 2 3 4 5 don't know
<i>Other opportunities for crop improvement</i>	

Research options to reduce poverty and improve food security	Importance for research (please mark: not important = 1, low importance = 2, important = 3, very important = 4, most important = 5, don't know)
35. Germplasm enhancement and pre-breeding	1 2 3 4 5 don't know
36. Exploitation of heterosis	1 2 3 4 5 don't know
37. Polyploidy	1 2 3 4 5 don't know
38. Flowering ability/botanic seed production	1 2 3 4 5 don't know
39. Others (specify)	1 2 3 4 5 don't know
B. Production technology, agronomy, crop management	
1. Improving soil fertility (micro-nutrients, fertilizer, organic matter)	1 2 3 4 5 don't know
2. Managing soil acidity	1 2 3 4 5 don't know
3. Managing soil salinity	1 2 3 4 5 don't know
4. Soil management and erosion control	1 2 3 4 5 don't know
5. Water management in crop production	1 2 3 4 5 don't know
6. Improving yam cropping systems	1 2 3 4 5 don't know
7. Harvesting methods or machinery for planting / harvesting	1 2 3 4 5 don't know
8. Gender friendly labor saving tools	1 2 3 4 5 don't know

Research options to reduce poverty and improve food security	Importance for research (please mark: not important = 1, low importance = 2, important = 3, very important = 4, most important = 5, don't know)
9. Weed management and control	1 2 3 4 5 don't know
10. Others (specify:)	1 2 3 4 5 don't know
C. Planting materials, crop management	
1. Apomixis as alternative to clonal vegetative seed	1 2 3 4 5 don't know
2. Production of hybrids from inbred progenitors	1 2 3 4 5 don't know
3. Alternatives for micro- and minitubers from disease-free stocks	1 2 3 4 5 don't know
4. Mass propagation methods	1 2 3 4 5 don't know
5. Improving production and distribution of 'clean' planting materials (formal)	1 2 3 4 5 don't know
6. Improving technologies for farmer based production and distribution of planting materials (informal)	1 2 3 4 5 don't know
7. Others (specify)	1 2 3 4 5 don't know
D. Disease management	
1. Yam mosaic disease	1 2 3 4 5 don't know
2. Yam internal brown spot disease	1 2 3 4 5 don't know

Research options to reduce poverty and improve food security	Importance for research (please mark: not important = 1, low importance = 2, important = 3, very important = 4, most important = 5, don't know)
3. Yam leaf blight	1 2 3 4 5 don't know
4. Yam anthracnose disease	1 2 3 4 5 don't know
5. Yam leaf spot	1 2 3 4 5 don't know
6. Tuber rots (specify)	1 2 3 4 5 don't know
7. Other diseases of yam (specify)	1 2 3 4 5 don't know
E. Pest management	
1. Nematodes (specify:)	1 2 3 4 5 don't know
2. Leaf beetles (specify)	1 2 3 4 5 don't know
3. Tuber beetles (specify)	1 2 3 4 5 don't know
4. Tuber mealybug (specify)	1 2 3 4 5 don't know
5. Termites	1 2 3 4 5 don't know
6. Millipedes	1 2 3 4 5 don't know
7. Grasshoppers	1 2 3 4 5 don't know
8. Weed	1 2 3 4 5 don't know
9. Others (specify:)	1 2 3 4 5 don't know

Research options to reduce poverty and improve food security	Importance for research (please mark: not important = 1, low importance = 2, important = 3, very important = 4, most important = 5, don't know)
G. Genetic resource management	
1. <i>In situ</i> genetic resource management	1 2 3 4 5 don't know
2. Collection, characterization, evaluation, documentation, and conservation <i>ex situ</i>	1 2 3 4 5 don't know
3. Phenotypic/molecular screening of landraces in search of high-value traits/new sources/tolerance/resistance to stress	1 2 3 4 5 don't know
4. Others (specify)	1 2 3 4 5 don't know
H. Value chains, postharvest utilization and marketing	
1. Improving shelf life of yam tubers	1 2 3 4 5 don't know
2. Improving small scale processing of yam for human consumption (e.g. <i>iyam</i> , <i>fufu</i> , <i>amala</i> , chips, <i>kokonte</i> , etc.)	1 2 3 4 5 don't know
3. Alternative on-farm utilization/processing for value addition	1 2 3 4 5 don't know
4. Developing yam products for human consumption	1 2 3 4 5 don't know
5. Developing yam products for industrial applications (flour and starch)	1 2 3 4 5 don't know
6. Developing yam products for animal feed	1 2 3 4 5 don't know

Research options to reduce poverty and improve food security	Importance for research (please mark: not important = 1, low importance = 2, important = 3, very important = 4, most important = 5, don't know)
7. Ethanol production from yam	1 2 3 4 5 don't know
8. Improve management of residues	1 2 3 4 5 don't know
9. Development of competitive yam value chains	1 2 3 4 5 don't know
10. Research on more gender equitable value chains	1 2 3 4 5 don't know
11. Development of farmer organizations and farmer clusters linked to markets	1 2 3 4 5 don't know
12. Others (specify)	1 2 3 4 5 don't know
I. Socioeconomic, policy and impact studies on yam	
1. Assessment of small farmer access to new technologies	1 2 3 4 5 don't know
2. Assessment of yam technology adoption	1 2 3 4 5 don't know
3. Assess impact of yam research and development	1 2 3 4 5 don't know
4. Assess health and environmental risks of pesticide use in yam systems	1 2 3 4 5 don't know
5. Assess health effects of bio-fortified yam varieties	1 2 3 4 5 don't know
6. Study gender inequality in yam production systems	1 2 3 4 5 don't know
7. Research on food and agricultural policies affecting yam	1 2 3 4 5 don't know

Research options to reduce poverty and improve food security	Importance for research (please mark: not important = 1, low importance = 2, important = 3, very important = 4, most important = 5, don't know)
8. Improving policy framework for yam planting materials (distribution, regulations, IPRs, etc.)	1 2 3 4 5 don't know
9. Others (specify)	1 2 3 4 5 don't know

12. Do the answers given here apply mostly to (please pick one) :

- a. D. Rotundata
- b. D. Alata
- c. Both

Please add any comments here:

THANK YOU VERY MUCH FOR YOUR COLLABORATION!

List of institutions visited (with date and number of experts interviewed)

Institution Visited	Date	No. of experts interview
Crop Research Institute, Umudike	24 th to 27 th July, 2013	6
Crop Research Institute, Kumasi	28 th to 31 th , July, 2013	2
Crop Research Institute, SARI, Tamale	1 st July to 3 rd August, 2013	2
University of Science and Technology, Kumasi	28 th to 31 st , July, 2013	2
IITA Scientists	23 rd July to 5 th August, 2013	6
Benin	23 rd July to 5 th August, 2013	3
Togo	23 rd July to 5 th August, 2013	3

Scores/results by sub-region (and agro-ecological zones if applicable)

	SSA	WCA mean	CAC mean
CROP IMPROVEMENT			
High yields	4.17	4.04	4.40
Biotic stress resistance(yam mosaic disease)	4.19	4.05	3.60
Environmental adaptation or new uses (early harvest)	3.77	3.98	3.80
Abiotic stress Resistance (drought tolerance)	3.87	4.01	4.00
Breeding for biotic stress resistance (tuber rots)	3.78	3.96	4.40
Biotic stress resistance (yam anthracnose disease)	3.78	3.85	4.20

	SSA	WCA mean	CAC mean
Biotic stress resistance(nematodes)	3.59	3.84	3.60
Nutrient use efficiency	3.81	3.85	3.80
Breeding for improvement in nutritional quality (protein)	3.74	3.78	3.80
Breeding for biotic stress resistance(yam internal brown spot disease)	3.77	3.86	3.80
Breeding for biotic stress resistance(yam leaf blight)	3.68	3.79	3.80
Breeding for environmental adaptation or new uses(mechanization specify operation)	3.63	3.77	3.60
Crop improvement(breeding for processing quality)	3.68	3.79	3.60
Breeding for improvement in nutritional quality (pro vitamin a_carotenoid)	3.46	3.77	3.60
Breeding for biotic stress resistance (yam beetles)	3.54	3.76	3.20
Breeding for biotic stress resistance(yam leaf spot)	3.36	3.64	4.00
Breeding for biotic stress resistance(tuber mealy bug)	3.54	3.65	3.60
Other opportunities for crop improvement(germplasm enhancement and pre-breeding)	3.82	3.53	3.40
Crop improvement(breeding for other consumer preferred traits)	3.53	3.50	3.33
Breeding for biotic stress resistance(other disease of yam)	3.15	3.54	3.67
Breeding for improvement in nutritional quality (medicinal compounds)	3.41	3.55	2.75
Breeding for improvement in nutritional quality (iron and zinc)	3.45	3.54	3.40
Other opportunities for crop improvement(flowering ability/botanic seed production)	3.94	3.53	4.00
Research options to reduce poverty and improve food security(other a biotic stress of yam) specify heat tolerance	3.26	3.57	3.75
Breeding for improvement in nutritional quality (other)	3.38	3.58	5.00
Crop improvement(breeding for dry matter, high starch and flour yield)	3.31	3.41	3.60
Other opportunities for crop improvement (exploitation of heterosis)	3.62	3.42	3.60
Crop improvement(breeding for other specific producer preferred traits)	3.58	3.42	3.50
Breeding for biotic stress resistance(other insect pest yam)	3.04	3.51	3.67
Other opportunities for crop improvement (others)	3.50	3.42	4.50

	SSA	WCA mean	CAC mean
Crop improvement(breeding for tuber mealiness)	3.34	3.36	3.50
Breeding for environmental adaptation or new uses(other)	3.07	3.38	5.00
Breeding for abiotic stress resistance(herbicide resistance)	2.98	3.31	3.00
Research options to reduce poverty and improve food security(tolerance of marginal/toxic soils)	3.27	3.39	2.60
Other opportunities for crop improvement(polyploidy)	3.50	3.28	3.60
Crop improvement(breeding for starch quality traits)	3.42	3.32	3.60
Crop improvement(breeding for low anti nutritional factors)	2.88	3.07	3.20
Research options to reduce poverty and improve food security(water logging)	3.19	3.05	3.00
Research options to reduce poverty and improve food security (low temperature)	2.85	2.63	2.80
MANAGEMENT OF SOILS, WATER, WEEDS AND HARVEST			
Production technology, agronomy, crop management (improving soil fertility)(micro-nutrients, fertilizer, ,organic matter)	3.98	4.10	4.17
Production technology, agronomy, crop management(improving yam cropping system)	4.00	3.97	4.00
Production technology, agronomy, crop management(harvesting methods or machinery for planting/ harvesting)	3.90	3.84	4.00
Production technology ,agronomy, crop management(weed management and control)	3.71	3.82	3.33
Production technology, agronomy, crop management(water management in crop production)	3.64	3.78	4.17
Production technology, agronomy, crop management (soil management and erosion control)	3.66	3.83	3.83
Production technology ,agronomy, crop management (others)	3.21	3.43	4.50
Production technology, agronomy, crop management(managing soil acidity)	3.58	3.64	3.50
Production technology, agronomy, crop (gender friendly labor saving tools)	3.41	3.54	3.33
Production technology ,agronomy, crop management (managing soil salinity)	3.57	3.44	3.50
IMPROVEMENT OF SEEDS OR PLANTING MATERIALS			

	SSA	WCA mean	CAC mean
Planting materials ,crop management (improving technologies for farmer based production and distribution of planting materials (informal)	4.13	4.03	4.50
Planting materials ,crop management(improving production and distribution of 'clean' planting materials)(formal)	4.10	4.02	4.17
Planting materials ,crop management(mass propagation methods)	3.89	3.93	4.33
Planting materials ,crop management(alternatives for micro-and mini tubers from disease -free stocks)	3.75	3.90	4.17
Planting materials ,crop management(others)	3.06	3.53	
Planting materials ,crop management(production of hybrids from inbred progenitors)	3.42	3.55	3.60
Planting materials ,crop management(apomixis as alternative for clonal vegetative seed)	3.11	3.22	3.00
DISEASE CONTROL AND MANAGEMENT			
Disease management(yam mosaic disease)	4.24	4.11	3.40
Disease management(tuber rot specify)	4.03	4.12	4.20
Disease management(yam anthracnose disease)	3.95	3.82	4.20
Disease management(other diseases of yam)specify	3.65	3.79	3.00
Disease management(yam internal brown spot disease)	3.78	3.72	3.83
Disease management(yam leaf spot)	3.61	3.73	3.80
Disease management(yam leaf blight)	3.67	3.71	3.50
PEST CONTROL AND MANAGEMENT			
Pest management(weed)	3.95	3.82	3.67
Pest management(nematodes specify)	3.72	3.88	3.50
Pest management(tuber beetles specify)	3.72	3.81	3.60
Pest management(tuber mealy bug specify)	3.72	3.73	3.50
Pest management(leaf beetles specify)	3.62	3.60	3.00
Pest management(termites)	3.46	3.64	3.00
Pest management(others specify)	3.36	3.50	4.50
Pest management(millipedes)	3.28	3.43	3.00
Pest management(grasshoppers)	3.05	3.24	3.00

	SSA	WCA mean	CAC mean
GENETIC RESOURCE MANAGEMENT			
Genetic resource management(collection, characterization, evaluation, documentation and conservation ex situ)	3.88	3.79	4.00
Genetic resource management (phenotypic /molecular screening of land races in search of high-value traits/new sources)	3.80	3.79	4.20
Genetic resource management (in situ genetic resource management)	3.83	3.62	4.00
Genetic resource management(others specify)	3.00		
VALUE CHAINS, POSTHARVEST UTILIZATION AND MARKETING			
Value chains, postharvest utilization and marketing(improving shelf life of yam tubers)	4.47	4.24	4.50
Value chains, postharvest utilization and marketing(improving small scale processing Of yam for human consumption)	4.23	4.13	3.80
Value chains, postharvest utilization and marketing(developing yam products for human consumption)	3.93	3.98	3.83
Value chains, postharvest utilization and marketing(developing yam products for industrial applications)(flour and starch)	3.93	3.96	3.40
Value chains, postharvest utilization and marketing(alternative on farm utilization/processing for value addition)	3.83	3.87	3.40
Value chains, postharvest utilization and marketing(development of competitive yam value chains)	3.85	3.81	3.20
Value chains, postharvest utilization and marketing(development of farmers organizations and farmer clusters linked to market)	3.88	3.84	4.00
Value chains, postharvest utilization and marketing(research on more gender equitable value chains)	3.70	3.56	2.80
Value chains, postharvest utilization and marketing(developing yam products for animal feed)	2.95	3.23	3.00
Value chains, postharvest utilization and marketing(improve management of residues)	3.12	3.16	2.60
Value chains, postharvest utilization and marketing(others specify)	2.80	3.19	5.00
Value chains, postharvest utilization and marketing(ethanol production from yam)	2.65	2.74	2.80
SOCIOECONOMIC, POLICY AND IMPACT STUDIES			
Socioeconomic, policy and impact studies on yam (assessment of small farmer access to new technologies)	4.07	3.98	3.67

	SSA	WCA mean	CAC mean
Socioeconomic, policy and impact studies on yam (assessment of yam technology adoption)	4.00	4.02	3.80
Socioeconomic, policy and impact studies on yam (improving policy frame work for yam planting materials distribution, regulations, etc)	3.88	3.87	3.60
Socioeconomic, policy and impact studies on yam (assess impact of yam research and development)	3.86	3.95	3.75
Socioeconomic, policy and impact studies on yam (assess health and environmental risks of pesticide used in yam systems)	3.88	3.91	3.80
Socioeconomic, policy and impact studies on (research on food and agricultural policies affecting yam)	3.61	3.63	3.60
Socioeconomic, policy and impact studies on yam (others specify)	3.00	3.75	5.00
Socioeconomic, policy and impact studies on yam (assess health effects of bio-fortified yam varieties)	3.53	3.54	3.60
Socioeconomic, policy and impact studies on yam (study gender inequality in yam production systems)	3.18	3.20	2.80

Time line of expert survey:

Started interview at the 16th International Symposium of the International Society for Tuber & Root Crops (ISTRC) held in Abeokuta, Nigeria between 23rd – Friday 28th September 2012.

Two Scientists administered the questionnaire. One went to Nigeria and Ghana and another went to Benin and Togo between 23rd July and August 10th, 2013.

On-line access stayed opened until Mid- September 2013.