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FARMERS' SELECTION CUES IN COWPEA FOR VEGETABLE USE IN EASTERN UGANDA

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ABSTRACT

A participatory cowpea varietal selection was carried out in Eastern Uganda in Kumi district among farmers (n=30) in the sub-Counties of: Ongino, Kumi and Kanyum. A range of opinions were collected to identify farmers' selection criteria based on different sensory attributes and their most preferred genotypes for vegetable use. A preference analysis was carried out to obtain quantitative preference scores of each plot. This was followed by organoleptic tests which included attributes like taste, aroma and texture of the genotypes at the vegetative and immature R4 stages. Focus group discussions (FGDs) were also held to find consensus of the independent evaluations made by individual farmers. Data for sixteen (16) cowpea genotypes were collected at the different above mentioned stages. Quantitative data were analyzed based on farmers' scores made on the different evaluated attributes and ANOVA was used to provide mean differences between location, gender and genotype at a significant level of 5%. Preference score for each of the varieties tested was determined and presented. Data from FGDs were grouped, similarities and differences were later determined depending on their level of importance to the farmers. Significant differences ($p<0.05$) in farmer choices were observed for leaf taste, immature pod aroma, taste and texture; mature pod aroma, taste between farmer groups, age genotype and gender. Irrespective of age, gender, farmer group and genotype, farmers seemed to give more importance to the smooth texture, little hard leaves when chewing, sweet taste with a mild aroma (leaves) and a moderate aroma (pods). Majority (9%) of the farmers preferred Ebelat (landrace) at V4 stage; this was followed by Danila (8.7%). On the other hand, UCUCOW1 (13% at immature and 10.2% at mature cooked R4 stage) followed by Ebelat (9% and 9.8% for immature and mature R4 stage, respectively) were preferred by majority of the farmers. In terms of sensory attributes, farmers preferred genotypes with sweet taste, moderate aroma and tender texture. The information is a baseline for understanding key farmer selection criteria in utilization of cowpea as a vegetable which can be used in generating a demand-led variety design for the crop.

Key words: Farmer preferences, demand-led variety design, cowpea vegetable, sensory attributes

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INTRODUCTION

Cowpea (*Vigna unguiculata*) is a global vegetable whose cultivation is believed to have begun from Africa more than 5000 years ago [1]. It belongs to kingdom (*Plantae*), genus (*Vigna*), and Species (*unguiculata*) [2]. Cowpea is a valuable component in the farming systems of the majority of resource poor rural households in Sub-Saharan Africa (SSA) for its various attributes [3]. It is cultivated majorly as a vegetable as well as a cover and fodder crop [4]. The cowpea leaves, immature pods and mature pods are an important source of micro and macro nutrients like protein, crude fibre, minerals like (calcium, iron, zinc, phosphorus), and vitamins [5]. The tender green leaves contain 15 times more minerals, micro and macronutrients than in grains [6, 7]. In Uganda, cowpea is ranked third in importance [8] and Kumi district in Eastern Uganda is the largest producer and consumer of the crop with 90% of the country's production [8]. Consumption of cowpea leaves could offer an opportunity to reduce high prevalence of malnutrition especially among resource constrained rural and urban households in Africa and Uganda [9].

Cowpea is a neglected and an under-utilized crop in Africa. Research on cowpeas has focused mainly on its seed storage properties, seed yield potential, seed size, pest and disease tolerance, as a food security crop, and as a soil health crop [10]**.** Cowpea yield potential in sub-Saharan Africa is compromised by several biotic and abiotic factors such as insect pests, diseases (fungal, viral and bacterial), poor soil fertility, metal toxicity, and drought [11]. Development of improved varieties is needed for higher productivity and profitability. Further, employment of participatory variety selection (PVS) is a strategic way of bringing back the role of local farmers in identifying and developing suitable varieties for their location. Farmers' participation in early stages of any breeding program can contribute to the acceptance and adoption of newly developed varieties as their needs and expectations will likely be met [12].

This study aimed at understanding farmers' selection criteria of cowpea genotypes for vegetable use in Uganda. Since domestication of crops from the wild, traditional knowledge and skills of the local farmers has played a key role in maintaining crop and varietal diversity. As such the genetic make-up of such varieties was dynamic shaped by evolutionary forces. In that sense, plant selection by farmers has influenced important component of crop production systems. By involving the farmers in a participatory process in the various stages of selection, the approach aims to strengthen the dynamic farmer system of co-evolving and co-adapting varieties to the changing environment. Further farmers' expertise, their indigenous technical knowledge, and ecology and growing environment of the local varieties are synergistically integrated with appropriate scientific skill and knowledge [13]. Cowpea varieties have conventionally been bred for grain yield and fodder use [14], limited effort has been directed towards its development for vegetable use yet it forms an important staple source across sub-Saharan Africa. Cowpea leaves are commonly consumed in various forms and the pods are harvested when they are full-sized, just before they dry out, and then the grains are cooked and eaten as a vegetable. The consumption of cowpea as a fresh vegetable has rapidly increased in the semi-arid zone of Africa [11, 15]. There are no released varieties on record for vegetable use in Africa.

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MATERIALS AND METHODS

Study Site

The study was conducted among three farmer groups in Kumi district in eastern Uganda in three purposively selected sub counties of Kumi, Ongino and Kanyum. The district was selected because it is the largest producer and consumer of cowpea in Uganda [16]. The farmer groups were selected with the aid of the district production and marketing officer. Each farmer group had membership ranging from 40 to 60 persons. The eligibility and criteria used for selection was that: the group must have been registered at sub-county level for a minimum of two years, willingness to participate in the study, capacity to provide richly-textured information that is relevant to cowpea production and utilization as a vegetable, the group had been involved in cowpea production for a minimum of two years, and that the group could commit at least an acre for the trials.

Kumi is 914-1800 metres above sea level (mASL) and is located 250 kilometres, northeast of Kampala. Kumi has a rainfall pattern that is bi-modal with peaks in April – May and July – August; the annual mean range temperature is15 -32.5^{0}C and rainfall is 800 – 1000mm [17].

Plant Materials

The study evaluated sixteen (16) cowpea genotypes. Two (2) (Ebelat and black) were farmer land race varieties, ten (10) (WC 35C, WC35BXWC10, IT981K503, Pi 66-4518, Vi O 602-84, IT07K-292-10, IVU15-445, TVU134, Danila and MU9) genotypes were obtained from National Semi Arid Resources Research Institute (NaSARRI) and four (UCU COW1, UCU COW2, UCU COW3, UCU COW4) genotypes were obtained from Uganda Christian University seed bank.

Experimentation on acceptability of suitable material in farmers' fields

Replicated mother trials were designed on farmer fields in each sub-county. Farmers were compensated for growing the trial. The fields were farmer managed to ensure standard agronomic practices in time. Growth parameters yield and farmers' perception data were collected. Farmers' perceptions were measured by preference analysis as a group of farmers and simple ranking at individual trial farmer level [13].

Research design of replicated mother trial

A completely randomized block design (CRBD) was used for field layout with 3 replications. Fields were set up in a farmer field per sub-county with each farmer field acting as a replicate. The cowpea genotypes were planted with farmers in a randomized design. In each field, a spacing of 75cm between rows and 20cm between plants was used [18]. Each plot measured 4mx3m (12 sq. m) in size with six (6) planting rows. The two extreme rows were considered as guard rows leaving the four middle rows for evaluation. After land preparation, the blocks and plots were demarcated together with the farmers, keeping a one metre (1m) space between each block for easy demarcation and movement while collecting data from each plot. All the plots in a field were sown on the same day. Trial monitoring and data collection was done by the researcher.

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Methods of obtaining qualitative data

In each village, the FGDs were held in the group leader's home. The technical team scheduled focus group meetings in the three farmer groups in Kumi (22 farmers), Ongino (13 farmers) and Kanyum (14 farmers) Sub counties, respectively. Purposive sampling was used to obtain the leading sub-Counties in production and consumption of cowpea in the district with the guide of the district Agricultural production and marketing officer. These meetings were purposed to collect farmers' input regarding their preference to different cowpea varieties.

Preference Analysis

To obtain quantitative preference scores and list of characteristics of the preferred varieties liked by the farmers, each participant was given a score sheet and encouraged to make independent assessment of each plot. Groups of not more than ten participants were led by a technical guide through the field for genotype evaluation (per plot). Participants selected traits of their preference at three stages of growth (V4 and R4 stage). Before planting, seed samples were displayed to farmers to obtain their judgment. At the vegetative stage (V4), evaluation was done on the morphological characteristics and susceptibility of plants to biotic stress. The R4 stage was evaluated at the 50^{th} (premature pods) and 60^{th} (mature pods). Evaluation was done on their pod size before and after cooking. Each participant observed and ranked independently, farmers were encouraged to note the reasons behind their scores for the different varieties. Votes were tallied and the genotype with the highest votes for all traits was considered as the most preferred. Socio-economic characteristics of farmers were collected at both stages, data on gender, age, marital status and education level was captured.

Focus group discussions

Immediately after field evaluations, to elicit farmers' preliminary assessment of the genotypes, focus group discussions were held using a focus group discussion guide, led by the technical person. Farmers were led into a conversation that allowed them to make any necessary alterations of the initial evaluation until a consensus was obtained. During the FGDs, audio recordings were taken to document farmers' opinions and feelings for choices made. This procedure was followed across the three sub counties. A thematic analysis was conducted to obtain a summary of results.

Organoleptic test for cowpea varieties

In addition to the field performance, farmers' acceptance of a particular variety is also dependent on other desirable consumption attributes. A sensory analysis was conducted at the vegetative and immature pods for the sixteen genotypes were harvested at 21 and 50 days after planting respectively. At vegetative stage, the youngest shoots with the next tier of leaves were harvested from a quadrant ($1m^2$) placed in the two middle rows and labelled. The pods were also harvested using the same procedure. The harvested vegetables for each genotype were boiled in 300ml of water for ten minutes and put aside to cool. Salt was not added in all samples to avoid influencing the taste and aroma. Ten representative participants (men and women) from each group who were of

good health, non-smokers were invited to evaluate the prepared vegetables. The purpose and guiding instruction of the activity was shared prior to the evaluation. Evaluation was done following sensory attribute evaluation scale of: texture (1-smooth, 2-moderate, 3-rough), aroma (1-strong, 2-moderate, 3-mild), and taste (1-sweet, 2-bitter, 3-salty) at vegetative stage, and at R4 stage the scale followed included taste (1-sweet, 2-bitter, 3-flat, 4-salty), aroma (1-strong, 2-moderate, 3-mild), texture (1-tender, 2-rough, 3-dry, 4-succulent). After evaluating a sample, each evaluator had to rinse the mouth thrice with clean water to wash away the remains before proceeding to the next sample. Farmers voted for the best genotypes based on the preferred morphological and sensory attributes at both vegetative and R4 stages of evaluation before and after cooking.

Statistical Analysis

Quantitative data were analyzed based on farmers' scores made on the different evaluated seed, morphological and sensory attributes. Means, frequencies, tallies and percentages were generated from farmers' scores. Analysis of variance (ANOVA) was used to provide mean differences between location, gender and genotype at a significant level of 5%. Preference score for each of the varieties tested was determined by counting the ranking given by the participating farmers and listing against corresponding variety. The results were presented gender -wise and tabulated. Data from FGDs were grouped, similarities and differences were determined after tallying votes for all traits.

RESULTS AND DISCUSSION

Demographic and socio-economic characteristics of farmers

The number of respondents was categorized on the basis of sex, age group, marital status and level of education. The mean age of participants in the FGDs was 35 years. Females constituted 20% of the FGDs and no farmer had attained a tertiary education. All the female respondents were between 20 and 39 years and were all married. Sixteen percent (16%) of the female participants had attained primary education compared with 66% of males. Majority of the respondents were males (77.4%) between the age of 40 and 49 years (45.8%), married (45.8%) and attained primary level of education (83.3%). Only 3% of females had secondary education compared with 13% for male participants. The dominance of the males in the evaluation process is attributed to the culture in the region which does not allow females to be at the forefront in participation of most of the programs outside family affairs. Discussions were segregated by gender. Being a potential income generating prospect for the households, it was observed that men were more involved in cowpea production especially decisions that had to do with the acreage for production and its preparation and then the marketing and sales. Women were more involved in the less rewarding chores of planting, weeding, harvesting and post-harvest management. In terms of socio-economic characteristics in the localities, there were three main economic activities namely: farming, shop keeping and boda boda riding (local transport service of using motor cycles) (Table 1). Three (3) different crops were mainly grown on an acreage ranging from 0.5 to 4 acres and among them include: cowpeas, sorghum and cassava. These were marketed by the farmers in the target areas.

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Famers' Selection Criteria:

Illustration of patterns of variation of preferred traits for cowpea genotypes by location

The driving force behind the choice of the selection criteria are majorly the visual appeals and suitability for food. Results from the study showed significant differences in farmer choices were observed for leaf taste ($p<0.001$), immature pod aroma ($p=0.005$), taste and texture ($p<0.001$), mature pod aroma ($P=0.002$) (Figure 1). For immature pods significant differences in farmer group choices were observed for aroma ($p=0.005$), taste and texture ($P<0.001$). There was no convergence in preferred traits by location. This was attributed to the fact that traits were also acquired preferences [20]. This may be suggestive for the need of further exploration for the entire research questions. Need to explore multiple diverse perspectives.

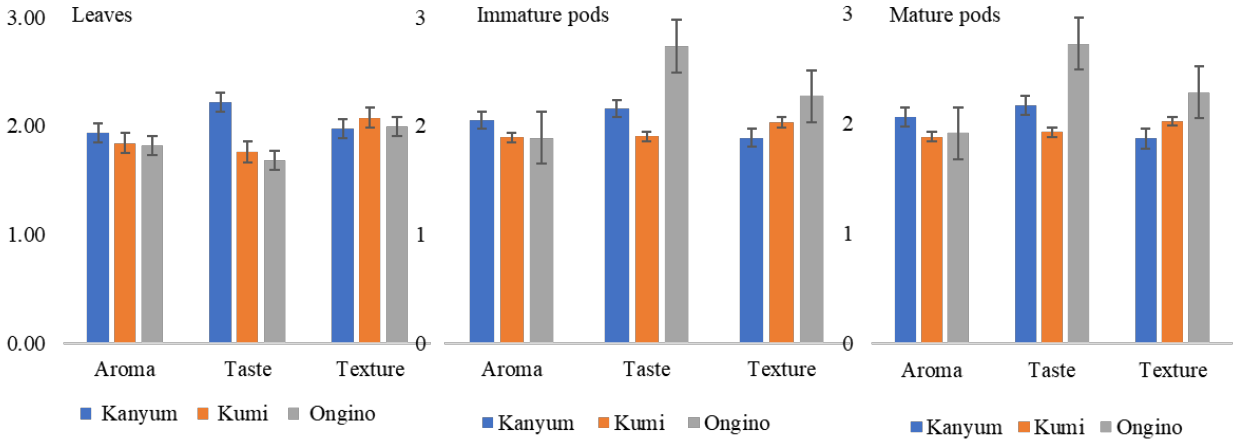

Figure 1: Farmers' preferred traits for cowpea genotypes by location

Variation in selection criteria for sensory attributes of vegetable cowpea as influenced by gender and age group

The driving force behind the choice of the selection criteria were majorly the visual appeals and suitability for food which was also influenced by gender and age. For leaf texture ($p< 0.007$), immature pods ($p=0.02$) for aroma, taste and texture ($p<0.001$); mature pod aroma ($p=0.01$), taste ($p<0.001$) significant differences in farmer choices were observed between age groups (Figure 2). While all age groups preferred a moderate leaf texture, the highest number of farmers that selected for it was between age group between 30-39 years with 48% (Figure 3). At leafy stage, sweet taste, moderate aroma and smooth leaf texture were the selected attributes of leaves of cowpeas. At pods stages, preferred sensory attributes were: tender texture, sweet taste of pods, moderately good aroma, and softness of pods. These were attributed to the small pod size which could be eaten while raw at R4 stage. According to farmers, the pod cover of a mature cowpea is tough, rough and hairy and therefore unpalatable. A recent study conducted by Orawu in Northern Uganda also showed that small pods were the most preferred [12]. None of the farmers preferred mature raw pods because of the tough and rough texture.

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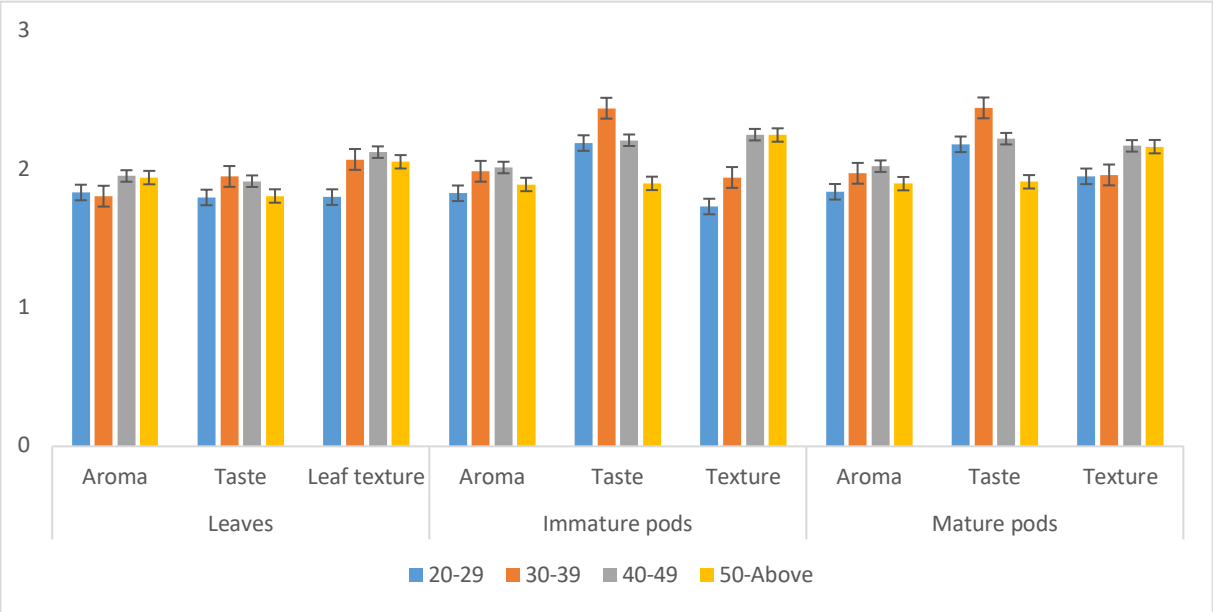

Figure 2: Farmers' preference for sensory attributes of vegetable cowpea as influenced by age group

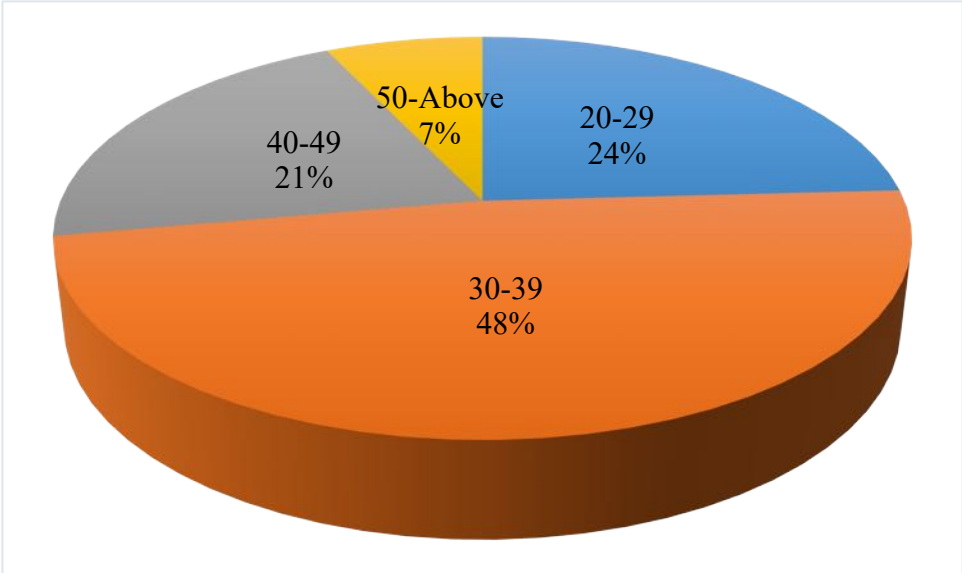

Figure 3: Percentage of participants according to age group

While significant differences were observed between gender for the taste of immature pods (p=0.03) and of mature pods (p=0.01), no differences in farmer preferences were observed between gender at V4 (Figure 4). Most of the participants selected sweet taste, moderate aroma, smooth texture and tender pod texture for mature pods. At V4 and immature pods, most male and female groups between ages of 40-49 and 30-39 respectively selected sweet taste, moderate aroma, and smooth texture. Although the scores between males and female participants were very close, the minor differences were an indication that male and female participants have specific preferences for certain traits. This may be attributed to attachment to the food chain in terms of roles

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and responsibilities. These results obtained are also in line with the findings from the focus group discussions carried out with the farmers during the evaluation process.

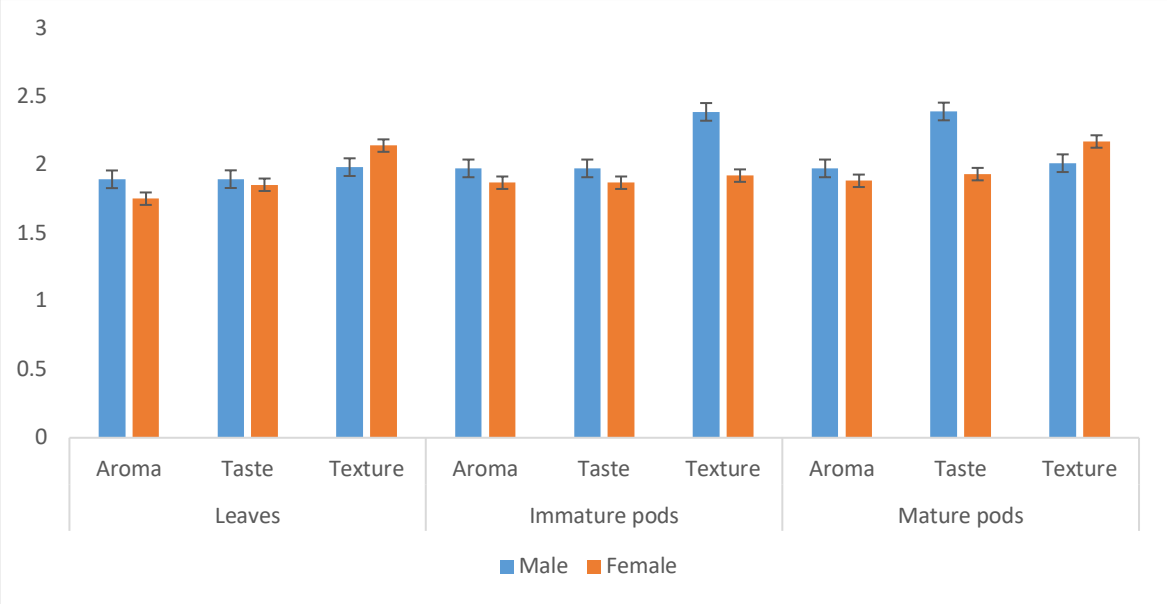

Figure 4: Farmers' preference for sensory attributes of vegetable cowpea as influenced by gender

Distribution of scoring scale for sensory attributes of vegetable cowpea at leaf and R4 stages

Focus group discussions on the genotypic features preferred by the farmers indicated that they gave more to: smooth texture, hard leaves when chewing, sweet taste with a mild aroma that soothes appetite when eating a meal. Farmers did not like cowpea leaves that were very tough, salty and hard to chew (Figure 5). At immature and mature R4 stage, preferred sensory attributes included sweet taste, moderate aroma, smooth, tender big pods that had not been attacked by pests as opposed to other attributes like bitter, flat and salty for taste, strong and mild for aroma and rough, moderate dry, and succulent for texture plus a long maturity period (Figure 6). These results are in line with the findings obtained from the focus group discussions with the farmers at all stages of the evaluation.

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Figure 5: Factors influencing farmers' choices based on leave traits

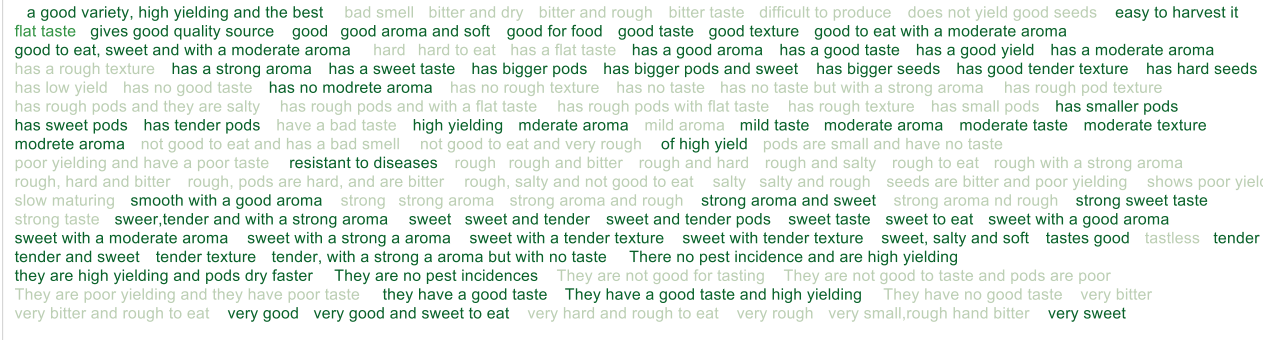

Figure 6: Factors influencing farmer's choices based on immature pods traits

Genotypic farmer Preferences

This study has also confirmed that farmers selected cowpea genotypes for vegetable use based on preferred morphological and sensory attributes [21]. A significant difference $p<0.01$ in selection of genotypes was observed at leaf stage, immature and mature stages for cooked pods. Majority (9%) of the farmers preferred Ebelat (landrace) at leafy stage followed by Danila (8.7%) (Figure 7) and immature raw and mature cooked R4 stages due to the smooth leaf, moderate aroma, sweet taste and ease of cooking in addition to tenderness and softness of pods. On the other hand, UCUCOW1 (13%) followed by Ebelat (9%) were preferred by majority of the farmers as immature cooked pod because of its tenderness and for mature raw pod because of soft grains, and sweet taste (Figure 8). At the mature cooked R4 stage, UCU COW 1 (10.2%) was preferred by majority of the farmers followed by Ebelat (9.8%) (Figure 9). Other characteristics considered important by farmers but not directly evaluated in this study were: high yielding, resistance pest and disease, faster maturing, and drought tolerance. These results indicate that breeding for vegetable cowpea should follow holistic approach other than focusing on attributes of relevance to vegetable nature as in case for other vegetables.

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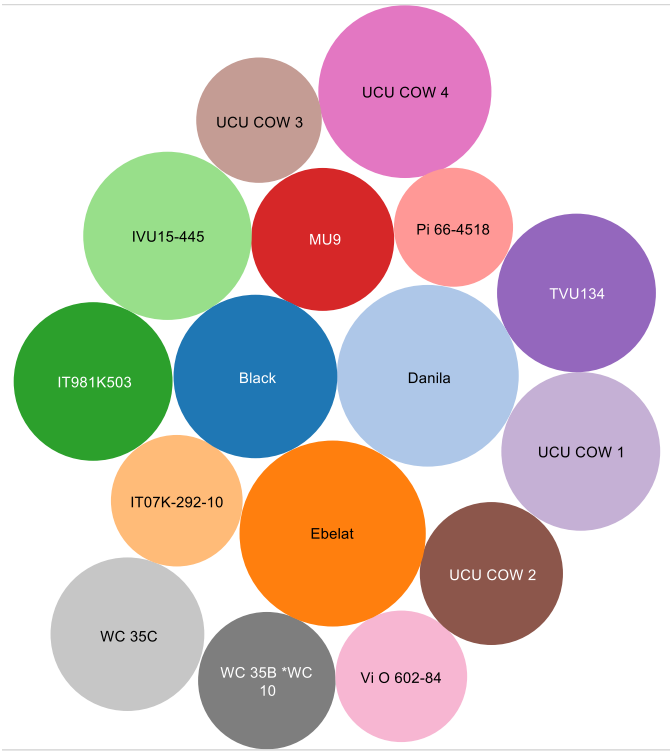

Figure 7: Farmer preference ranking for cowpea genotypes at leave stage

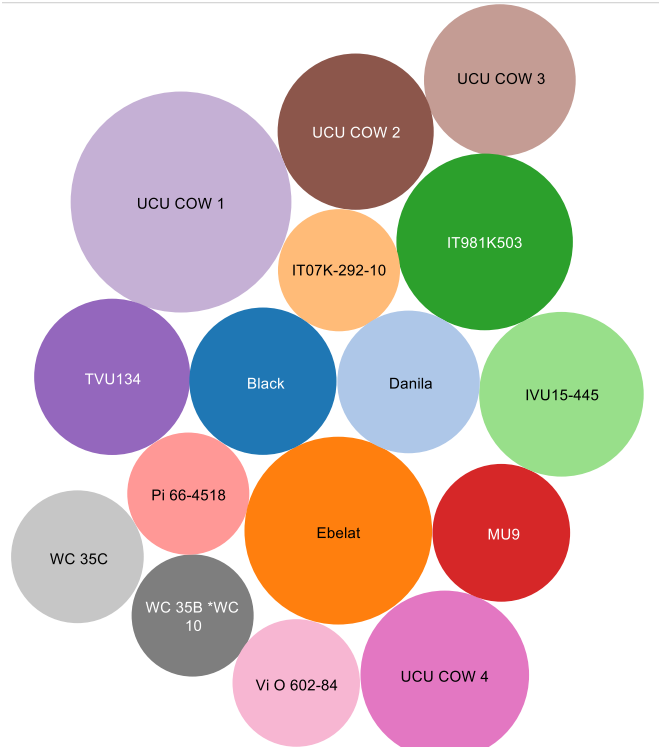

Figure 8: Farmer preference ranking for cowpea genotypes at immature R4 stage

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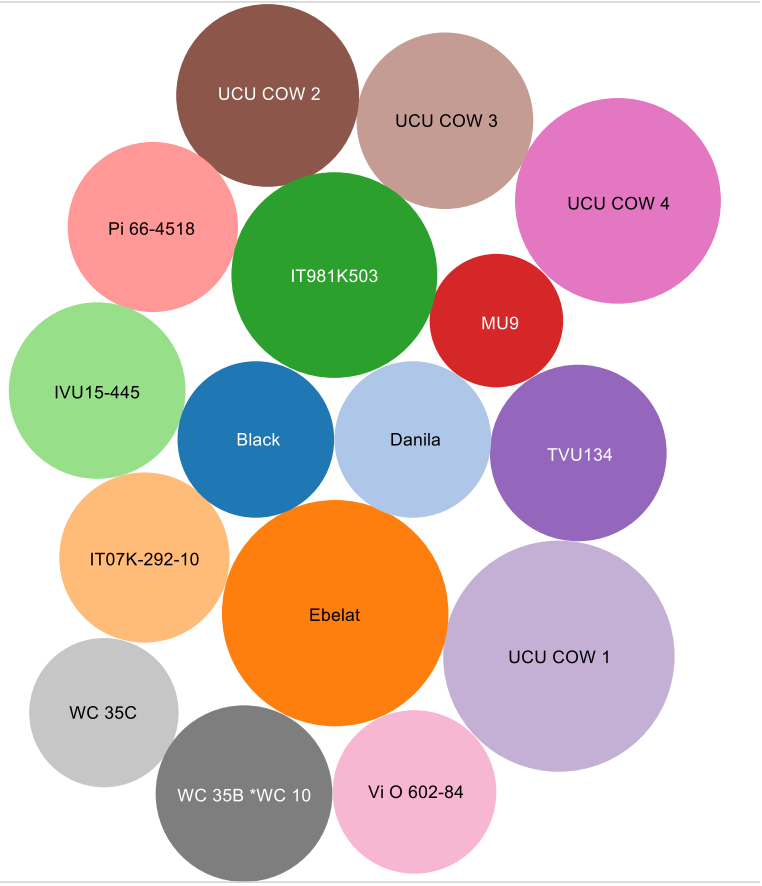

Figure 9: Farmer preference ranking for cowpea genotypes at mature R4 stage

There was a difference ($p<0.05$) in sensory attributes of cowpea genotypes across farmer groups located in different villages. Even though difference in mean values for farmer groups were observed, not all the differences were significant. At V4, significant differences were observed between farmer groups for Ebelat and Danila except for aroma whereas no significant differences were observed for UCU COW 1 (Figure 10). At immature R4 stage, significant differences were observed between farmer groups for Ebelat and UCU COW 1 for taste whereas no significant differences were observed for Danila (Figure 11). At mature R4 stage, significant differences were observed between farmer groups for Ebelat's taste whereas no significant differences were observed for Danila and UCU COW 1 (Figure 12). According to the participants, Ebelat seemed to be the bench mark variety, nevertheless there were differences in the way different farmer groups scored for it. The differences in choices are attributed to the physiological, psychological and traditional triggering [12, 20, 22].

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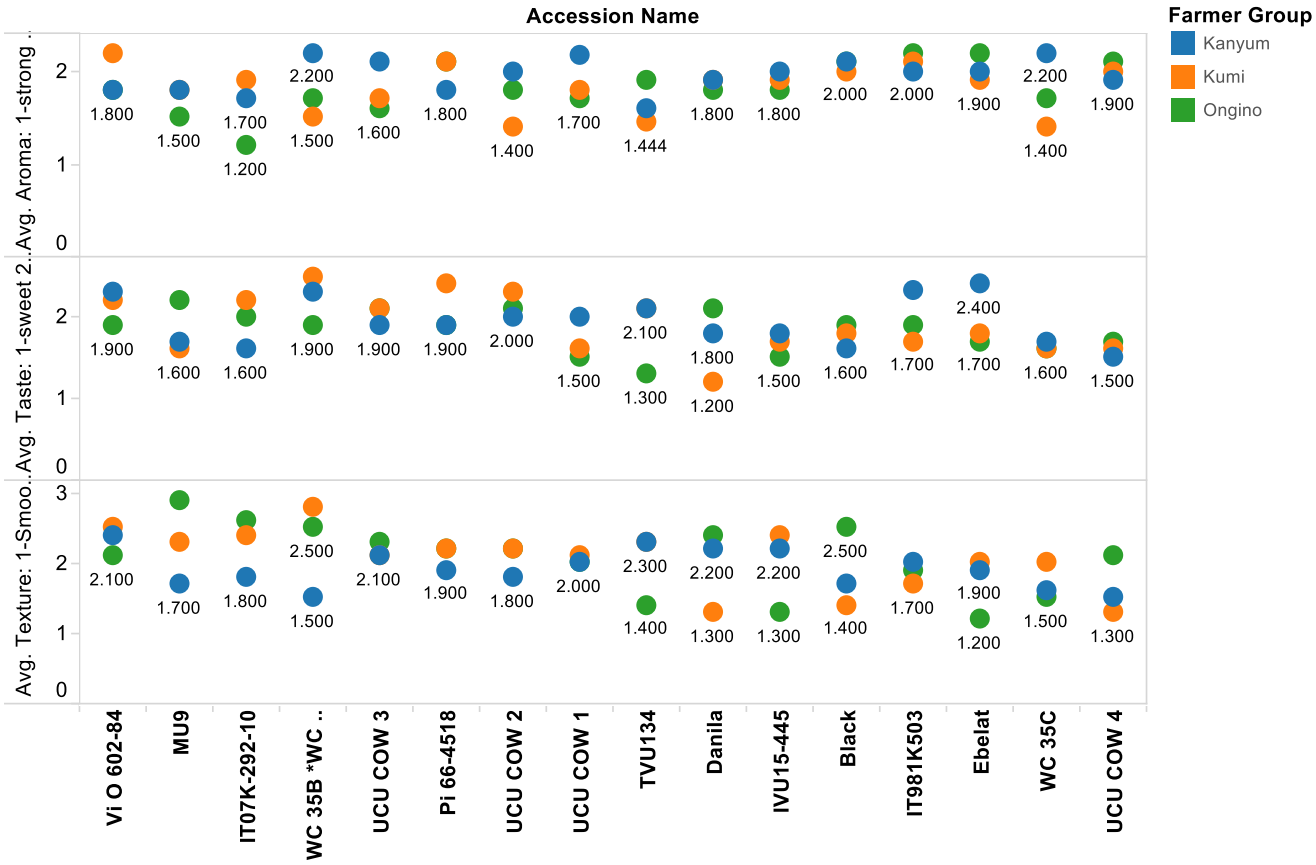

Figure 10: Farmers' assessment of different cowpea genotypes based on leaf sensory attributes

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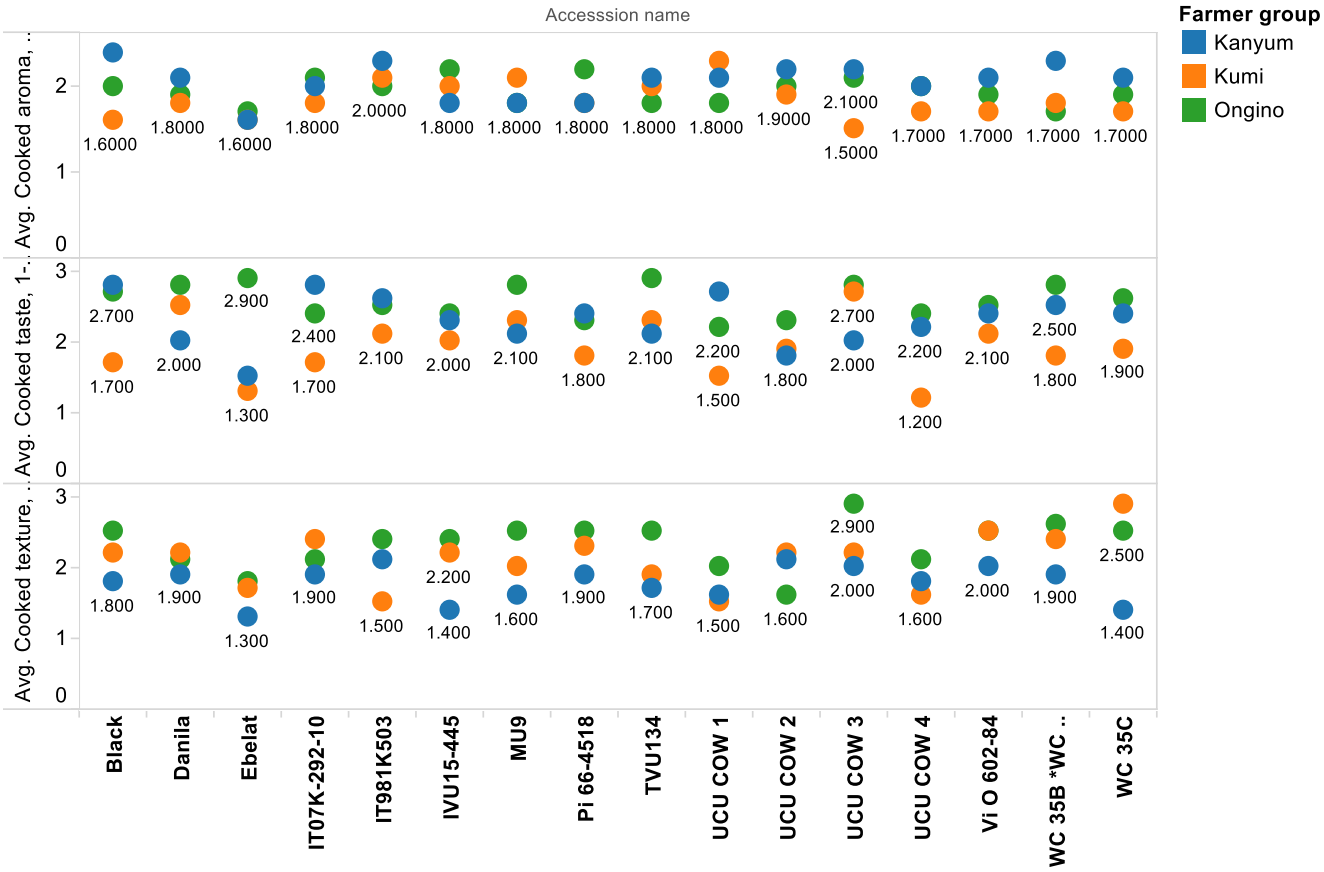

Figure 11: Farmers' assessment of different cowpea genotypes based on immature pod sensory attributes

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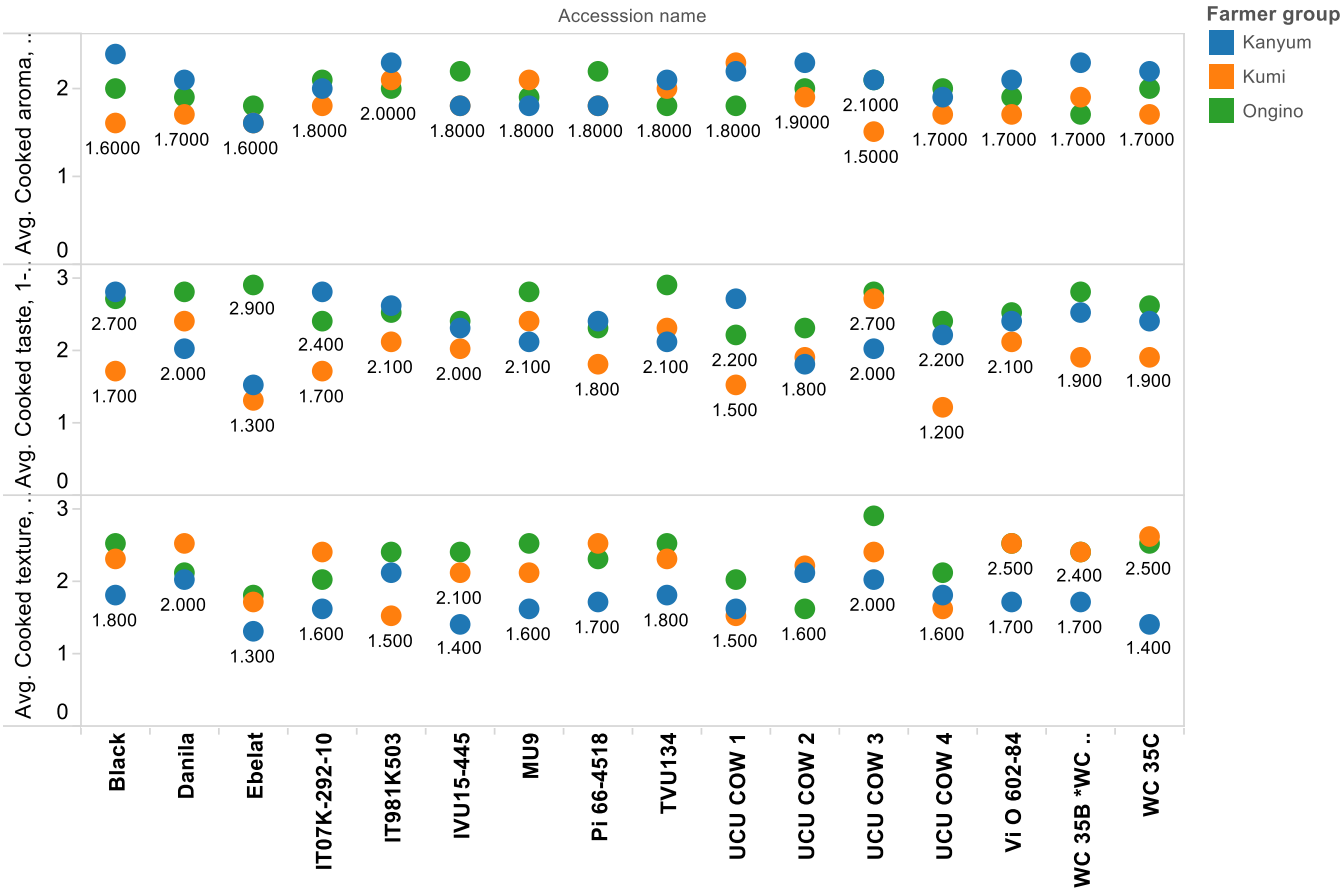

Figure 12: Farmers' assessment of different cowpea genotypes based on mature pod sensory attributes

CONCLUSION

This participatory variety selection showed that farmers' characterization of different genotypes is very useful in making decisions on what genotype can be adopted. The obtained results indicated that farmers give more importance to sweet taste, moderate aroma, and smooth texture at V4, raw and cooked pods plus small pod size were the most selected by farmers. However, this selection process was influenced by both gender and age. In this study, farmers preferred Ebelat at leafy stage, immature raw pods and mature cooked pod while UCUCOW1 was preferred at immature cooked and mature raw pod. Therefore, these findings provide a baseline for understanding key farmers' selection criteria and preferred genotypes which can be used in selection of parents in a breeding program to provide better options to choose improved cowpea varieties which farmers really want for their region for vegetable use. This same study could as well be carried out using a technical/trained panel.

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Table 1: Social characteristics of the three farmer groups

	Farmer groups	Kanyum	Ongino	Kumi
Major economic activity		Shop keeping and farming	Boda boda and farming	Farming and boda boda
Major crops		Cowpea, Sorghum	Sorghum, Cowpea	Cowpea, Cassava
Target market		Local market	Local and international market	Local market and export
Common varieties		Kor, Abir and Ebelet	Epuripuri, Black type and Ebelat	SESO 3 and Ebelat
Major challenges		Drought, Pests and diseases	Drought, Market	Poor storage, Pests and diseases

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