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COWPEA PRODUCTION PRACTICES, CONSTRAINTS, AND END-USERS PREFERRED VARIETIES AND TRAITS IN SOUTHERN BENIN

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ABSTRACT

Cowpea (*Vigna unguiculata* L. Walp.) is an important food and nutrition security crop in Benin, though its production is constrained by absence of information necessary for strategic planning. The objective of this study was to evaluate the diversity of preferred traits and production constraints of cowpea in southern Benin. A survey was conducted in three main cowpea-growing districts in southern Benin, namely Ketou, Zakpota and Klouekanmey. Data were collected from 175 respondents through structured survey, as well as using field observations and *via* focus group discussions. It was clear that the majority of farmers (82%) grew cowpea in association with other crops, though mostly with maize (*Zea mays* L.). A total of 75.9% of farmers purchased seeds from agro-dealers in local markets. The perception of cowpea production constraints varied among districts, with weeds infestation, unavailability of certified seeds, drought, low yield, and insect pest attacks as the major production constraints across the districts. Factorial analysis showed that for the sociocultural group Adja, selection of cowpea varieties is based on pod hardness and tolerance to *Striga gesnerioides;* while for the sociocultural group Fon, cooking time, grain colour and seed price were the main selection criteria. On the other hand, for sociocultural groups Nagot and Holli, selection of the cowpea varieties was based on the ease to separate the coat from the cotyledons and seed size (medium to large). These findings could guide cowpea breeders and extension officers in further research and dissemination programmes in Benin.

Key Words: Drought tolerance, *Striga gesnerioides*, *Vigna unguiculata*

RESUME

Le niébé (*Vigna unguiculata* L. Walp.) est une culture importante pour la sécurité alimentaire et nutritionnelle au Bénin. Cependant sa production est limitée par l'absence d'informations nécessaires à la planification stratégique. L'objectif de cette étude était d'évaluer la diversité des traits préférés et les contraintes de production du niébé dans le sud du Bénin. Une évaluation rurale participative a été menée dans trois districts producteurs de niébé du sud du Bénin, à savoir Ketou, Zakpota et Klouekanmey. Les données ont été collectées auprès de 175 répondants au moyen d'une enquête structurée, d'observations sur le terrain et de 15 discussions de groupe. La majorité des agriculteurs (82%) cultivent le niébé en association avec d'autres cultures, en particulier le maïs. 75,9% des agriculteurs achètent leurs semences auprès de négociants agricoles sur les marchés locaux. L'importance des contraintes de production du niébé varie d'un district à l'autre, l'infestation de mauvaises herbes, l'indisponibilité de semences certifiées, la sécheresse, le faible rendement et les attaques d'insectes nuisibles étant les principales contraintes dans tous les districts. L'analyse factorielle a montré que pour le groupe socioculturel Adja, la sélection des variétés de niébé est basée sur la dureté des gousses et la tolérance au *Striga gesnerioides* ; tandis que pour le groupe socioculturel Fon, le temps de cuisson, la couleur des grains et le prix des graines sont les principaux critères de sélection. Les groupes socioculturels Nagot et Holli basent la sélection des variétés de niébé sur la facilité à séparer le tégument du cotylédon et la taille de la graine (moyenne à grande), respectivement. Ces résultats pourraient guider les sélectionneurs de niébé et les agents de vulgarisation dans la poursuite des programmes de recherche et de diffusion des variétés au Bénin.

Mots Clés : Drought tolerance, *Striga gesnerioides, Vigna unguiculata*

INTRODUCTION

Cowpea (*Vigna unguiculata*) is an important multipurpose grain legume in the food systems in West Africa. It is rich in protein, coupled with other essential micronutrients (zinc, iron) and vitamins (vitamin E, vitamin B); which make it an ideal grain legume for promoting food security in the country (Gonçalves *et al.,* 2016). In association with rhizobia, cowpea plants improve soils fertility by biological fixation of atmospheric nitrogen into soils (Diouf, 2011). Compared to other legumes, cowpea can be grown in an area with 300 mm of annual rainfall (Boukar *et al.,* 2019); hence it is extensively cultivated in West Africa on over 10.6 million hectares, with an annual production of 6.1 million metric tonnes (FAOSTAT, 2018).

Overall, cowpea is the third most important cultivated grain legume crop in Benin, after soybean and groundnut; and remains the most widely consumed grain legume with a per *capita* consumption estimated at 8.1 kg per year (FAOSTAT, 2018; MAEP, 2018). The crop is adapted to all agro-ecological zones of the country and provides good yields on sandy-loamy to loamy-clay soils of pH >6 or neutral (Dugje *et al.,* 2009; Abadassi, 2014). Cowpea is consumed in various forms, and its grain provides a cheaper source of protein in diets (Aly *et al.,* 2017).

Despite the notable contribution of cowpea to food security in Benin, its average yield of 0.7 metric tonnes per hectare is just about 50% of the West African productivity average of 1.2 metric tonnes per hectare (FAOSTAT, 2018; Kamara *et al.,* 2018). This is largely due to environmental constraints including pest attacks, early drought, weed infestation and unavailability of quality seeds (Gbaguidi *et al.,* 2013; Anago *et al.,* 2021). Besides, the on-farm cowpea grain yields reported in southern Benin are low (0. 4 metric tonnes per hectare) compared to the national wide yield (0.7 metric tonnes per hectare) (Anago *et al.,* 2021) . To address this, the International Institute of Tropical Agriculture (IITA), through the

Cowpea Project for Africa [*Projet Niébé pour l'Afrique (PRONAF)*], introduced improved cowpea storage techniques, and disseminated improved white coat cowpea varieties (Aly *et al.,* 2017). Although, these varieties were high yielding and more resistant to biotic and abiotic stresses, they have not been widely adopted in major growing areas in Benin because of the end-users preference for small and/or red grains (Aly *et al.,* 2017), which were not fully integrated in the development and dissemination processes of these varieties (Abebe *et al.,* 2013; Ishikawa *et al.,* 2019). Integration of assessment of farmers' constraints, preferred traits, and plant management practices reportedly increases the adoption rate of innovative agricultural technologies (Rusinamhodzi and Delve, 2011).

In Benin, many studies have been conducted on the genetic diversity patterns of cowpea (Zannou *et al.,* 2008; Abadassi, 2014; Gbaguidi *et al.,* 2015a); however, knowledge on cowpea production constraints and end-users preferred traits is not fully documented to inform decision making in breeding programmes and policy making. The objective of this study was to evaluate the diversity of preferred traits and production constraints of cowpea in southern Benin as a basis for guiding breeding and dissemination of new cowpea varieties.

MATERIALS AND METHODS

Study area. The study was conducted in the southern Benin (West Africa); which has a bimodal rainfall regime, with mean annual amounts of 1,200 mm. Temperatures range from 25 to 29 °C; while relative humidity ranges from 69 to 97% (Sanchez *et al.,* 2012; Hounkpèvi *et al.,* 2016). The site has ferruginous, deep and low fertile ferralitic soils (Igue *et al.,* 2013). In total, the study involved three Departments and three Districts (Table 1) across the major cowpea growing districts in the southern Benin. The district of Ketou is dominated by the sociocultural groups Nagot and Holli; while the district of Klouekanmey is

TABLE 1. Characteristics of districts surveyed

Departments	Geographical coordinates		Districts	Altitude (masl)	Average annual rainfall (mm)	Average daily temperature (°C)	
	Latitude	Longitude				Minimum	Maximum
Plateau	7° 21' 36"	2° 36' 0"	Ketou	89	1100-1300	25	29
Zou	7° 15' 55"	2° 9' 46"	Zakpota	103	800-1400	25	29
Couffo	7° 0' 0"	1° 45' 0"	Klouekanmey	184	800-1400	26	28

Masl: Meters above sea level. Adapted from Akoegninou *et al.* (2006); ASECNA (2018)

dominated by the sociocultural group Adja. On the other hand, the district of Zakpota is dominated by the sociocultural group Fon.

Data collection. The targeted population of the study included cowpea farmers and processors as survey respondents. A three-stage sampling technique was used to select the districts from each department, villages from each district and respondents from each village. Based on the Ministry of Agriculture, Fishing and Livestock (MAEP) report of 2016, the major cowpea growing areas are Zakpota, Ketou and Klouekanmey that accounted, 25, 35 and 37% of the cowpea area, respectively (MAEP, 2018). From each of the districts selected for the survey, three to five villages were selected both based on the assistance of the legume advisors of Territorial Agencies of Agricultural Development (ATDA). Thirteen cowpea-producing villages (Fig. 1) represented by four important sociocultural groups (Adja, Fon, Nagot and Holli), were surveyed.

Cowpea respondents were sampled using a snowball technique; which consists of widening the sample starting from a respondent who helped to find other candidate respondents (Biernacki and Waldorf, 1981). Using this technique, 175 farmers and processors were selected in the 13 villages. In each village, sample size was obtained based on saturation of information. The data saturation point was reached when new respondents provided no additional information (Guest *et al.,* 2006).

The survey was completed in collaboration with the ATDA extension service and village leaders, within three months. A semi-structured questionnaire was designed based on factors related to the socio-demographic attributes, year of experience in cowpea processing/production, cowpea cropping and seed system. Farmer respondents cited constraints related to cowpea production, and ranked each constraint, using a scale of 1 (very important), 2 (important), 3 (less important). During the focus group discussion, farmers and processors were asked to list their major criteria for adopting cowpea varieties.

From each village, one to two focus group discussions (FGDs) (Table 2) centred on cowpea production constraints and preferences, were mobilised to triangulate the information gathered through face-to-face interviews. Eight to nine participants, including farmers, processors and the local leaders were included in each FGD. Across the three districts, 122 participants were involved in FGDs. Both men and women were included in the FGDs. In addition, complementary observations of daily practices of farmers were provided through direct observations during transect walks, in randomly selected fields in each village.

Data analysis. Descriptive statistics (frequencies and means) were used to assess quantitative data and were presented as a graphs and tables. Inferential statistics were made through contingency Chi-square tests to analyse for relationships between variables. A factorial correspondence analysis was performed to determine the relationships between preference criteria and sociocultural groups. All statistical analyses were performed in R version 3.5.3 (CoreTeam, 2018).

RESULTS

Demographic features of households. The composition of the respondents of the study was 75 females (42.86%) to 100 males (57.14%) belonging to the sociocultural groups Adja, Fon, Nagot and Holli (Table 3). Significant differences (χ^2=11.241; P=0.023) were observed among the ages of the respondents across districts. The majority (62.28%) of respondents involved in cowpea activities were between 30 and 50 years old. Young people (30 years old) accounted for an average of 31.43% of respondents.

Only 10.86% of respondents had received training on cowpea conservation techniques (Table 3). With respect to their experience in

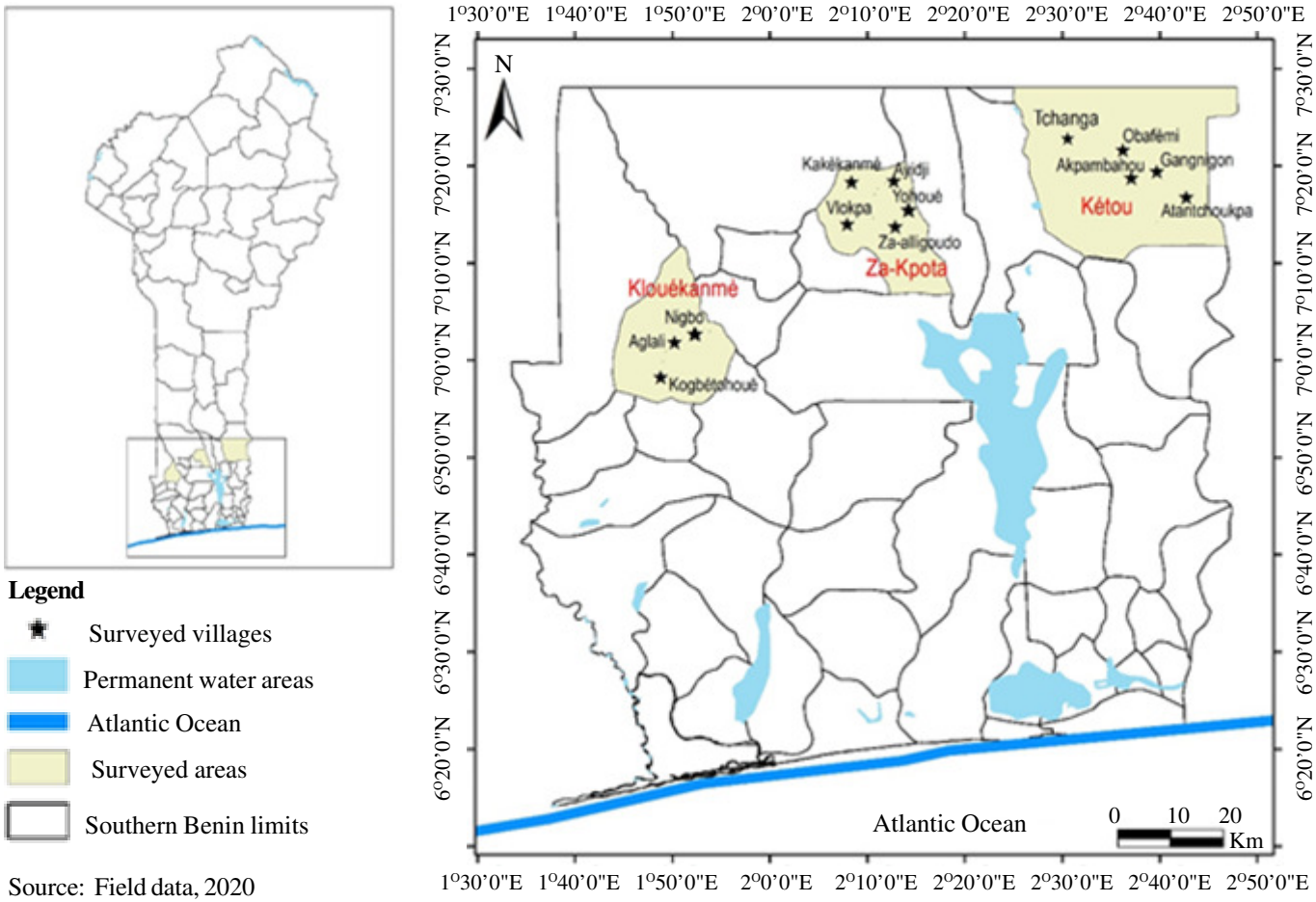

Figure 1 . Map of the southern Benin showing villages surveyed.

TABLE 2. Number of respondents surveyed and focus group discussions per village

Districts	Villages	Number of respondents surveyed	Number of FGDs
Ketou	Tchanga	12	1
	Obafemi	9	1
	Akpambahou	11	1
	Atantchoukpa	8	1
	Gangnigon	10	1
	Total	50	5
Zakpota	Kankekanme	11	1
	Ayadji	16	1
	Za-alligoudo	14	1
	Vlopka	09	1
	Yohoue	10	1
	Total	60	5
Klouekanmey	Nigbo	32	2
	Aglali	12	1
	Kogbetohoue	21	2
	Total	65	5

FGDs = Focus Group Discussion

growing cowpea, 79.72% were senior farmers having at least 5 years of experience; while 18.88 and 1.40% were junior farmers (3 to 4 years of experience), and beginner farmers (<2 years of experience).

Cowpea processors, mostly women, were mostly of the senior category (68.75%). About 18.75 and 12.5% of respondents were juniors and beginners, respectively. Although non-significant differences (χ^2=3.259; P=0.515) were observed among farmers in term of land area allocated to cowpea, the small-scale farmers allocated a higher percentage of land to cowpea production, followed by medium farmers and the large-scale farmers (Table 3).

Cowpea production and seed systems. Farmers in the study area primarily cultivated cowpea during the two rainy seasons per year. First, from April to July (the long rainy season), and then from August to October (short rainy season). Cowpea cultivation involved plowing, sowing, weeding, pest management, and harvesting. Transect walks in farmers' fields revealed that most cowpea is grown on ridges or on flat bed. During the vegetative cycle of the growing season, they usually weed the fields twice.

After flowering, the first pesticide application is made. Farmers repeat two to three times this operation depending on the severity of infestation and the available resources. Most cowpea farmers (82%) intercropped cowpea with other crops (e.g. maize and cassava); while 18% grew cowpea as a sole crop. Farmers reported not applying fertiliser on cowpea, but associated crop could be fertilised. Farmers often grew cowpea in rotation with cereals, cotton, or root and tuber crops; and incorporated crop residue during land preparation for the subsequent crops. In Zakpota, some farmers (53.33%) practiced agroforestry system where the space left between orange plants were often planted with

TABLE 3. Sociodemographic characteristics of the respondents

Variables	Districts			Total		df	Chi-square	P value
	Ketou	Zakpota	Klouekanmey	Eff	Freq (%)			
Gender								
Female	17	28	30	75	42.86	2	2.245	0.325
Male	33	32	35	100	57.14			
Age (years)								
30	23	20	12	55	31.43	4	11.241	0.023
30-50	23	37	49	109	62.28			
50	4	3	4	11	6.29			
Training on cowpea								
Yes	5	5	9	19	10.86	2	1.032	0.596
No	45	55	56	156	89.14			
Experience in processing (years)								
<2	2	1	1	4	12.5	4	2.685	0.611
3-4	3	1	2	6	18.75			
>5	7	11	4	22	68.75			
Experience in growing (years)								
<2	0	1	1	2	1.40	4	8.847	0.065
3-4	13	5	9	27	18.88			
>5	25	41	48	114	79.72			
Cowpea land (ha)*								
0.5	16	20	31	67	46.85	4	3.259	0.515
0.5-1	14	17	13	44	30.77			
1	8	10	14	32	22.38			

ha = hectare; Eff = effective; Freq = frequency; df = degree of freedom

cowpea to control weeds, but also used cowpea residues as manure for the orange plantations.

Purchased seed from agro-dealers in local markets was the predominant mode of access to seeds in the survey areas. Other sources of seeds comprised previous harvest, extension services, and the fellow farmers within and outside villages (Table 4).

For cowpea seed conservation, farmers cited three conservation materials, including plastic buckets (87%), glass bottles (7%) and bags (6%). The seeds were hermetically sealed in these containers, after application of control measures to protect them from pest damages. A total of 83% of farmers applied control measures; while the rest did not use any protective for the seeds against insect pests

TABLE 4. Sources of seeds used by farmers per village

Sources of seeds	Ketou N=38	Zakpota N=47	Klouekanme N=58	Mean
Local market	73.7	85.1	69	75.9
Previous harvest	2.6	6.3	17.2	8.7
Extension	15.8	4.3	3.5	7.9
Fellow farmers	7.9	4.3	10.3	7.5
Total (%)	100	100	100	100

N = Number of farmers

during storage. Most of farmers who applied protectives before storage, used synthetic products, such as sofagrain. Only 23% use traditional products such as chilli pepper fruit and ash.

Cowpea production constraints. Throughout the surveyed areas, farmers identified five major challenges to cowpea production (Table 5). Pest attacks in the fields and storage were the most reported production constraints (89.4% of respondents). The ranking of insect attacks did not show significant differences ($\chi^2 = 6.89$; P = 0.141) across the districts. Farmers often used Lambda-cyhalothrin and Pacha [Acetamiprid (10 g l^{-1})/lambda-cyhalothrin (15 g l^{-1})] to control insect pest attacks in the fields. Some farmers reported that they supplement these synthetic chemical products with cotton's insecticides such as Tihan [Flubendiamide (100 g l^{-1})/Spirotetramate (75 g l^{-1})] and Thunder [Betacyfluthrine (45 g l^{-1})/ Imidaciopride (100 g l^{-1})] for rapid control of the insect and diseases.

Unlike pest attacks, unavailability of certified seeds, the second most important cowpea production constraint, was significantly different ($\chi^2 = 44.21$; P=0.000) across the districts (Table 5). About 48.6% of the farmers considered the unavailability of seeds as a pressing constraint to cowpea production across the districts. However, 28.5 and 22.9% of the farmers considered this as moderate and low constraint to cowpea production, respectively.

Weeds, mainly *Striga gesnerioides,* were also a major constraint in cowpea production (Table 5). The highest perception of weeds as a major constraint (67.3%) was recorded in the district of Klouekanmey. Furthermore, 40.4 to 63.8% of the farmers felt that cowpea production was moderately constrained by drought. On the other hand, few farmers (17.3%) considered low yield as a major factor limiting cowpea production across the districts. For respondents, low yield was a consequence of the combined effects of many constraints on cowpea production (Table 5).

End-users' preferences. The frequencies of farmers' responses on their preference criteria are presented in Figure 2. Grain yield was the most important preference criterion, with 95% of farmers identifying it (>800 kg ha^{-1}) as the key criterion for variety selection. Early maturity (57%) and seed colour (48%) constituted the second and the third preferred traits. Preference of resistance to diseases and growth patterns (creeping or erect varieties) were cited by 36 and 25% of cowpea farmers, respectively (Fig. 2). Seed price and marketability of cowpea varieties were both cited by 13% of farmers. About 8 and 6% of farmers mentioned tolerance to *Striga gesnerioides* and to drought stress as selection

TABLE 5. Cowpea production constraints (in percentage) per district

Constraints	Importance	Districts			Mean	Chi-square	df	P-value
		Ketou	Zakpota	Klouekanmey				
Weeds	Very important	47.4	21.3	67.3	45.3	45.28	4	0.000
	Important	26.3	46.8	22.4	31.8			
	Less important	26.3	31.9	10.3	22.8			
Pest attacks in field and storage	Very important	92.1	83	93.1	89.4	6.89	4	0.141
	important	5.3	10.6	5.2	7.0			
	Less important	2.6	6.4	1.7	3.6			
Drought	Very important	50	23.4	53.5	42.3	37.20	4	0.000
	Important	26.3	63.8	31	40.4			
	Less important	23.7	12.8	15.5	40.4			
Low yield	Very important	31.6	44.7	39.7	17.3	23.61	4	0.000
	Important	39.5	40.4	18.9	39.9			
	Less important	28.9	14.9	41.4	21.5			
Unavailability of certified seeds	Very important	36.8	74.5	34.5	48.6	44.21	4	0.000
	Important	39.5	14.9	31	28.5			
	Less important	23.7	10.6	34.5	22.9			

df = degree of freedom

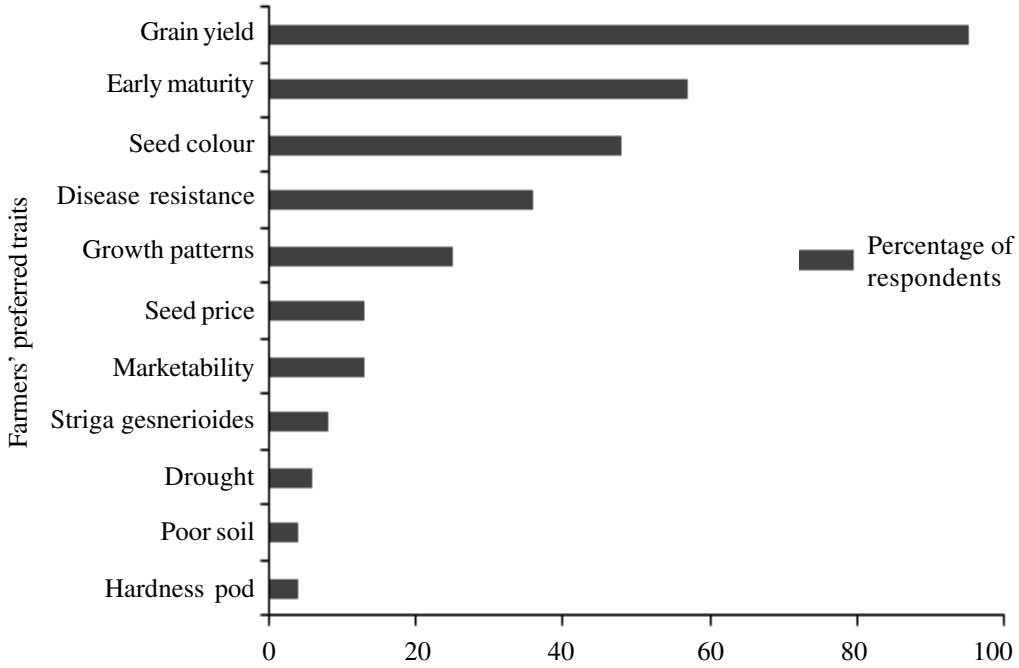

Figure 2. Preferred traits by farmers in selection of cowpea varieties.

criteria. Finally, the adaptation of the variety to poor soil and the hardness of the pods were both cited by only 4% of farmers.

The majority of processors (84%) mentioned dough quality (consistence and swelling ability of the dough) as an important characteristic in choosing cowpea varieties for processing (Fig. 3). Other key desirable attributes of the grains perceived by the processors included ease to remove coats of grains during processing (69%), grain colour (69%) and grain size (41%).

Organoleptic qualities (sweetness) of cowpea were the most important characteristics cited by 69% of respondents in choosing cowpea varieties for consumption. Grain colour was cited by 52% of the respondents, whereas medium to large grain was appreciated by 32%. The non-susceptibility of grains to pests' attacks and short cooking time were cited by 30 and 17% of consumers, respectively (Fig. 4).

Sociocultural groups for preference criteria. Preference criteria in farm households significantly varied among sociocultural groups surveyed ($\chi^2 = 143.660$; P= 0.000). Factorial correspondence analysis on the sociocultural groups, together with their preference criteria for cowpea varieties revealed that the two first axes explained 89.82% of the total variation (Fig. 5).

The projection on the axes showed that each sociocultural group had specific preference criteria for cowpea varieties (Fig. 5). In sociocultural group Adja: pod hardness, tolerance to drought stress and to *Striga gesnerioides* were more important; whereas seed price, the organoleptic characteristics, grain color, as well as, short cooking time, resistance to pest attacks, the marketability of variety and adaptation to poor soil were the selection criteria within sociocultural group Fon. In Nagot area, easiness to separate the coat of grains and the growth pattern were the most important criteria that guide stakeholders in the choice of cowpea varieties. For Holli, medium to large grain, short to early maturity and high yield were important (Fig. 5).

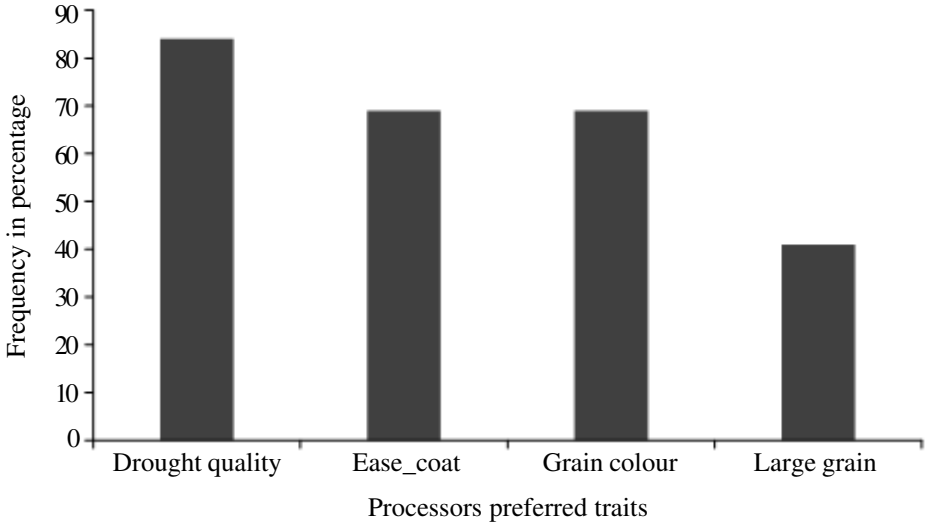

Figure 3. Processors preferred traits of cowpea varieties.

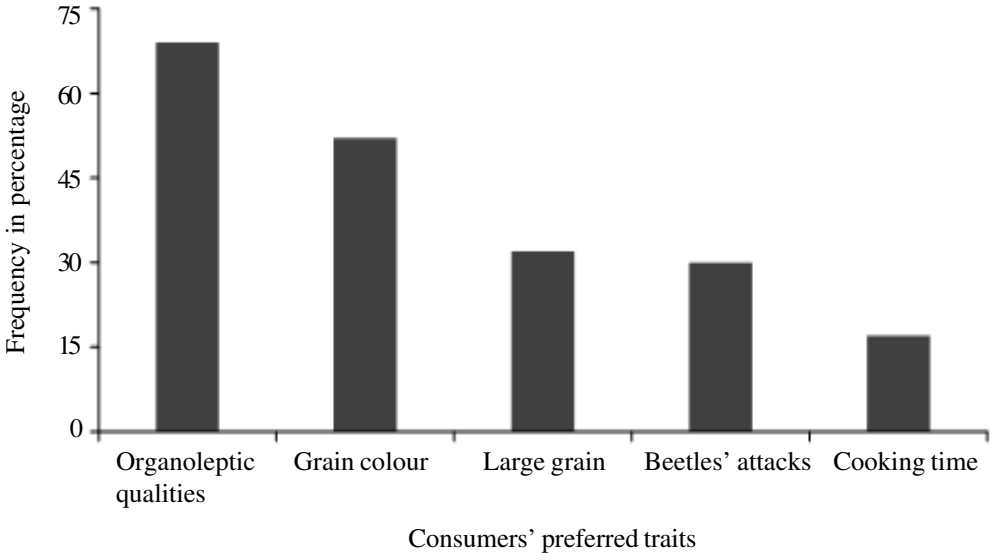

Figure 4. Consumers preferred traits on cowpea varieties.

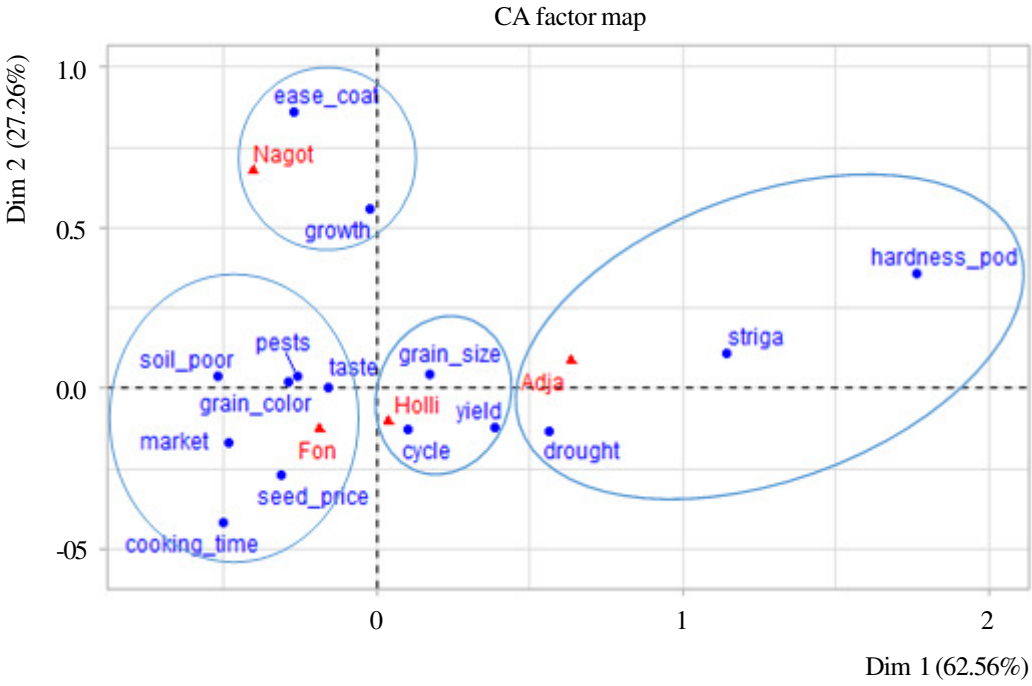

Figure 5. Factorial correspondence analysis of sociocultural groups in relation to their preference criteria for cowpea varieties.

DISCUSSION

Cowpea production system. From the survey and field observations, intercropping cowpea mainly with maize and cassava was the most popular planting system. Few farmers (18%) reported planting of cowpea as a sole crop. The majority of farmers perceived this association reduces weed emergence, fertiliser use, and restores their land. The integration of legumes, including cowpea in existing cropping systems, increases profit maximisation, more efficient use of labour and land; and enhances soil fertility (Tripathi *et al.,* 2019). Intercropping cowpea with other crops such as cereals and cassava reduces grain yield due to crop associated shading, soil nutrient competition between crop associate, and pest control failure (Ewansiha *et al.,* 2014; Anago *et al.,* 2021). Therefore, there is a need to initiate educational programmes targeting farmers on improved cropping practices to boost cowpea productivity and intercrop in general. The relatively high experience in cowpea growing in the study area could be an advantage for effective understanding and adoption of new production technologies, since experience in production constitutes important factor which influences the adoption innovation (Mbavai *et al.,* 2019).

Seed system and cowpea production constraints. The majority (75.9%) of the farmers in this study bought seeds from agro-dealers in the local markets. This contrasts with previous studies by Mula *et al.* (2013) and Njonjo *et al.* (2019), which concluded that cowpea farmers used mainly seeds of previous harvest. In fact, very few cowpea farmers (8.7%) from this area used their own-saved seeds. One possible reason for this could be that cowpea seeds are very susceptible to bruchid beetle attack, and therefore, difficult to store for long periods (Kpoviessi *et al.,* 2020). Another reason may be that farmers grew the crop either for consumption or

commercialisation (Aboki and Yuguda, 2013). The dominance of this farmers seed systems in the study areas could be responsible for the low productivity of cowpea because seed bought from market is often of poor quality (Njonjo *et al.,* 2019). It is therefore imperative to improve the farmers' seed systems through quality control of the seeds supplied to farmers.

Farmers perceived and ranked insect pest attacks in vegetative and in storage as the most limiting constraining to cowpea production in the study area. Moreover, cowpea pesticides offered limited choices owing to their ineffectiveness to fully control some pests such as the legume pod borer (*Maruca vitrata* Fabricius) (Oyewale and Bamaiyi, 2013; Sodedji *et al.,* 2019). This might be the reason why in the study areas some farmers used cotton pesticides to control these pests. This requires effort from cowpea plant breeders to develop technologies such as new varieties resistant to cowpea pests, and that effectively fit into the ever-changing growing environment.

Preference criteria. Agronomic criteria for selecting cowpea varieties were mainly cited by farmers were grain yield, early maturity and resistance/tolerant to insect attacks. These responses are in line with the results of Saka *et al.* (2018) who reported that the adoption of cowpea varieties is mainly determined by the yield potential, earliness and resistance to pests and diseases. Earliness and resistance to insect attacks were also reported as key criteria to circumvent the adverse effects of climate change on cowpea production, especially drought (Gbaguidi *et al.,* 2015b; Ishikawa *et al.,* 2019). The identification of early maturing varieties as a selection criterion by most surveyed farmers could be also attributed to the fact that short to early cycle cowpea have a strong market value compared to the late maturing varieties (Bediako *et al.,* 2009).

Across sociocultural areas, clear differences were observed in users' preferences. Tolerance to *Striga gesnerioides* was a preference specific to the Adja sociocultural group and may be due to the fact that the yield loss in Adja sociocultural area was mainly caused by the emergence of Striga in cowpea fields (Kamara *et al.,* 2008). This key criterion associated with sociocultural area Adja confirms their needs for varieties tolerant to Striga weed. Among the districts, the highest proportion of farmers (67.3%) who emphasised *Striga gesnerioides* as a high-priority problem was from Klouekanmey, a district predominantly represented by sociocultural group Adja. To reduce the level of *S. gesnerioides* infestation in the fields, early sowing cowpea and agronomic practices, namely which promote soil fertility, has been recommended by researchers (Vissoh *et al.,* 2008a; Silberg *et al.,* 2020).

Striga mainly emerges on poor soils (Sadda *et al.,* 2021) and the soil from Klouekanmey are mainly used for monocropping and their fertility is very low (Yemadje *et al.,* 2014). However, the number of *S. gesnerioides* seeds produced, estimated to 20,000 per plant makes the management of Striga very difficult (Omoigui *et al.,* 2017). In addition, about 75% of crop damage is inflicted underground, since the parasitic weed grows underground for many weeks before it emerges (Singh and Emechebe, 1991). Thus, Striga persists in the infested soils and spread in other areas (Runo and Kuria, 2018). Our study suggests the development and release of resistant cowpea varieties including users' preferred traits.

Grain colour and the ease to remove the coat of grain were among the most desired characteristics for processing and consumption in Benin. Ease of separation of the coat from the grain during processing was rated important in sociocultural group Nagot. Grain coat removal is tedious, and can be classified from easy to difficult, depending on the genotype (Amonsou *et al.,* 2009). As

cowpea grain coat contains some antinutritional constituents like tannins, removing the coat is an important step in processing the grain (Ojwang *et al.,* 2013). Thus, the ability to easily remove the tegument is specifically desired in the processing of cowpea into particular dishes like *Adowè*, *lèlè*, and *ata*, which are primarily consumed in southern Benin (Madodé *et al.,* 2011).

In Nagot area, the growth patterns have been mentioned as variety selection preference criteria for two reasons. One category of farmers preferred erect varieties to make pod harvesting easier. Also, they perceived pods to be less attacked when the growth pattern was not crawling. This finding is consistent with results of Ishikawa *et al.* (2019) who reported that farmers were sensitive to erect growth because of the high humidity and flooding risks for cowpeas. Unlike this first group, few farmers preferred creeping varieties such as Kpebo (Kplobe in Fon). According to them, creeping cowpea varieties help to reduce weed especially speargrass (*Imperata cylindrica*) (Vissoh *et al.,* 2008b).

These attributes valued by cowpea users, as well as the seed price, influence the choice of the varieties to grow. For instance, in sociocultural group Fon, seed price is particularly a determining factor for selecting varieties. Farmers find difficulty in purchasing certified seeds, without awareness of the importance of using them. Similar observations were made in many regions of Niger (Matsunaga *et al.,* 2006). Therefore, efforts to expedites cowpea breeding should concurrently integrate the development of the cowpea seed industry to easy farmers' access to quality cowpea seeds countrywide.

CONCLUSION

The study revealed that cowpea is adopted to all localities in southern Benin due to its nutritional value and farmers' awareness of its ability in soil fertility restoration. However, cowpea productivity in the surveyed areas is constrained by various biotic and abiotic factors, namely the unavailability of certified seeds, drought, and insect pest attacks, with varied importance across districts. It is also clear that the choice of cowpea variety depends on socio-professional and sociocultural considerations and varies across districts. Farmers desire to have seeds that will satisfy the preferences of consumers and processors in grain attributes which, also vary across the major sociocultural groups. Some of the varieties are abandoned due to its undesirable traits. To avoid loss of biodiversity in cowpea and favor the increase rate of varieties adoption, it is urgent that cowpea breeding programs, decision makers and other agencies in charge of agricultural promotion take into account the specific needs and preferences of users along the cowpea value chain.

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