
RESEARCH ARTICLE

Participatory rural appraisal of new okra varieties and farmers' management practices on okra farms in Mali

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Manuscript received: June 1, 2024; Decision on manuscript, June 30, 2024; Manuscript accepted: July 15, 2024

Abstract

Growing okra in the Koulikoro region of Mali is an important source of income for farmers in this region. The main objective was to enhance the value of okra cultivation through the introduction of new okra varieties according to the choices made by farmers in the region. The plant material consisted of eight randomized okra varieties, with three varieties coded A, B and C per package for 250 growers. The three varieties were tested in a single block at each grower's site, without repetition. A questionnaire was formulated to take into account the socio-economic characteristics of the producers and the agronomic characteristics of the varieties in the field. Based on their observations, they made comparisons between varieties. The results showed that okra production had become a predominantly a women's activity in the Koulikoro region. Growers lived in large polygamous families, and their main activity was housework. Farming activities were generally carried out on inherited land. Most producers sell their produce. The producers expressed their preferences for the different

varieties of okra in the questionnaires. The varieties AVOK1501, Sassilon, Batoumambe and Konni are suitable for release in the Koulikoro region because they were preferred by producers for a combination of interesting characteristics.

Keywords: Okra, producer, preference, variety, characters

Introduction

Okra (*Abelmoschus esculentus*) is a plant belonging to the *Malvaceae* family, whose fruit is eaten as a vegetable, particularly in Africa. Traditional African vegetables play an important role in the diet of rural and urban populations and are one of the main sources of cash income. They help to improve the quality of food rations by providing micronutrients (Aglinglo *et al.*, 2022). Originating in East Africa (Ethiopia), okra is now grown on every continent and can be used in a variety of ways: for human consumption (glutinous sauce, oil refined from the seeds, etc.), for medical purposes (anti-inflammatory, diuretic properties, etc.). Okra is a major source of

nutrients (proteins, carbohydrates, lipids, fibers), vitamins (B1, B2, B3, B5, B6, C, K, etc.), and minerals (potassium, phosphorus, etc.) (Aglinglo *et al.*, 2022). Okra is a plant of considerable socio-economic importance. It is distinctive in that all parts of the plant are useful for food, medicine, handicrafts and industry (Ouedraogo, 2009). In Mali, okra is one of the seasonal vegetables that fill the markets and is a source of income, especially for women. Another advantage of okra is that it produces fruit continuously for several months. Okra fruit contains a mucilaginous substance with a gelatinous texture, useful for thickening soups and stews (Aglinglo *et al.*, 2022). Okra, like all other vegetables, also plays a central role in the fight against poverty through two mechanisms: it is often harvested or grown in lowlands and swamps. They are produced mainly by small, marginalized farmers, for whom they simultaneously contribute to nutritional balance and provide a small income through their sale (Gockowski *et al.*, 2003). In addition, they are generally marketed through short distribution channels that require few resources to access and generate numerous jobs for marginalized urban populations (Combris *et al.*, 2008). However, okra cultivation faces enormous constraints, including: poor agricultural soils; drought; abundance of insect pests; high pressure from microbial pathogens; low technical skills among growers; and difficult access to high-performance varieties. The selection and dissemination of new okra varieties adapted to different agro-ecological zones could help reduce the impact of the various constraints listed above. This study aims to contribute to the advancement of okra cultivation in Mali by gaining a deeper comprehension of okra cultivation practices and introducing novel okra varieties based on farmers' preferences.

Material and methods

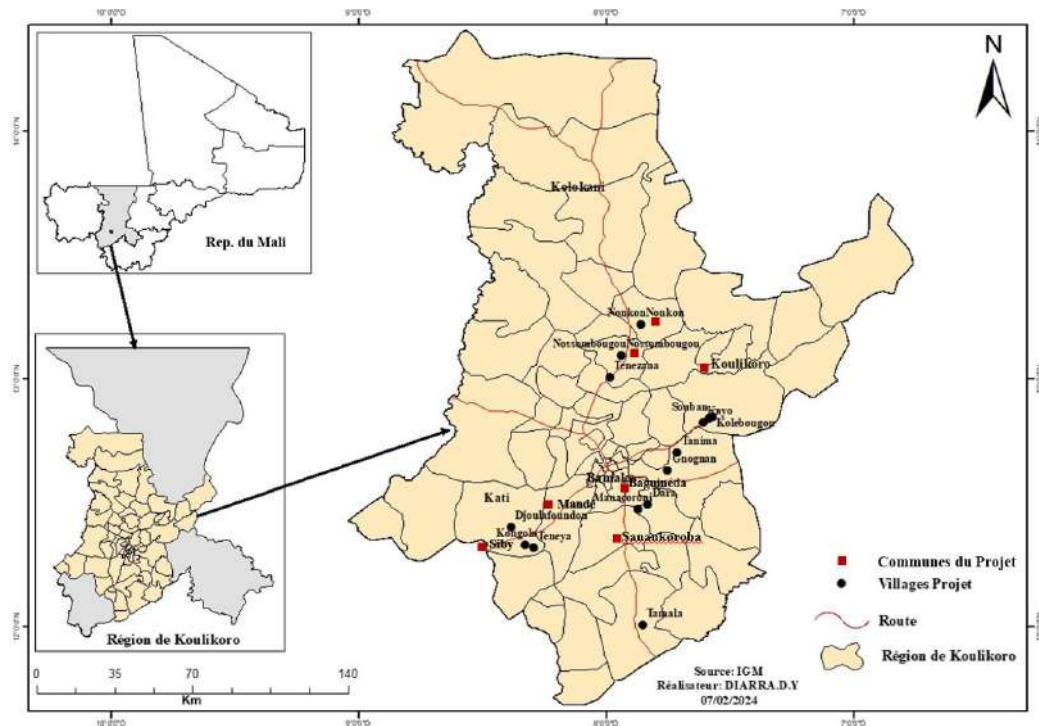
The survey was conducted in 27 villages of

seven rural communes (Baguineda, Mandé, Sanankoroba, Koulikoro, Siby, Nonkon and Nossombougou) in the Koulikoro region (Fig. 1). The Koulikoro region is the second-largest administrative region of Mali, located in the centre of the country (13° 56' 41" north, 7° 37' 28" west). It covers an area of 90,120 km². The climate is Sudanian in the south and Sahelian in the north. Average annual rainfall is between 700 and 1200 mm/year. Koulikoro's climate has an average annual temperature of 36°C. Over the course of the year, the average monthly temperature can fall as low as 29°C and rise as high as 40°C. The production systems are agro-pastoral and the park system is more widespread. The economy is essentially rural, based on rain-fed agriculture. The main crops are millet, sorghum, rice, maize, cowpea and fonio. Livestock rearing, bee-keeping and fishing complete the picture (Diarra, 2021). The region is highly developed in horticulture and tree farming, with vegetables (tomatoes, onions, lettuce, cabbage, eggplant, amaranth, okra, peppers, etc.) and tubers (sweet potatoes, cassava, and yams). Tree cultivation involves the production of fruits such as mangoes, shea nuts, oranges and bananas (Dabo, 2023). The plant material consists of eight varieties of okra: Konni, TZSMN86, Sasilon, AVOK1501, Batoumambè, VI033783, C101 and Paysan (local variety).

Distribution of variety seeds (packages)

The approach used was the "Tricot approach". Each grower received a package containing seed for three varieties coded A, B and C as indicated by Tricot ("sets of three"), resulting from a random allocation of the different varieties, of which there were eight (8). The eight okra varieties were randomized to three varieties coded A, B and C per package for 250 producers. A balanced distribution of 25 okra packages for each of the 10 surveyors.

Fig 1: Map of the study area



Trial set-up

The trials were set up in farmers' fields. Three varieties were tested in a single block at each grower's site, without replication, with plots 5 m long and 2 m wide, i.e., an area of 10 m² separated by 1 m wide aisles. Each elementary plot had three rows and was marked with the letters A, B and C. The growers do not know the names of their three varieties (so they are not influenced), but only know them as A, B and C. Each grower is responsible for his own plots. Direct sowing was carried out at a rate of one seed per hole, with a spacing of 80 cm between rows and 50 cm between sowing holes.

Data collection

A questionnaire was devised to cover the socio-economic characteristics of the producers and the agronomic characteristics of the varieties in the field. Ten surveyors were recruited and trained in the use of the questionnaire and tablets for data collection.

Socio-economic characteristics of producers

The respondent should be the person in charge of the trial. Gender, age, number of years of education, reading ability (French and local language), type of household, household size, occupation, land ownership, size of farm, availability of irrigation system, type of irrigation system, responsibility at farm level, sale of okra production, where okra production is bought and main vegetable crops.

Agronomic characteristics of varieties

The producers observed the trial plots throughout the growing cycle. On the basis of these observations, they made comparisons between varieties, in terms of vigor at emergence, survival rate, disease resistance, pest resistance, drought resistance, flood resistance, better yield, better taste, and being easier to sell.

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Data analysis

The data collected was input directly into the tablets and then uploaded to ClimMob via the ODK Collect application for analysis. The downloaded data were analyzed using IBM SPSS Statistics 25 software. Descriptive statistics were used to estimate means and extreme values. Graphs were produced using Excel version 2019.

Results and discussions

Of the 250 producers scheduled to be surveyed, a total of 239 responded to the questionnaire. The average age of the 239 respondents was 41, with a minimum age of 16 and a maximum age of 78. The average age of those surveyed for okra was 41, with a minimum age of 16 and a maximum age of 78. Camara *et al.*, (2022) reported an average age of 46, a minimum age of 30 and a maximum age of 65 for tomato growers in the major vegetable-growing areas (Koulikoro, Ségou, Sikasso) of Mali. In Côte d'Ivoire, a similar study was carried out on okra, with 94 growers surveyed aged between 23 and 71 (Fondio,

2005). The minimum number of years of schooling was 0, and the maximum was 17, with an average of about two years. Similarly, according to the results of the study by Fondio (2005), the majority of vegetable growers are illiterate.

The number of family members living together over a 6-month period was 60 for the maximum and one person for the minimum, with an average family size of approximately 18 persons per household. The minimum area farmed was 50m², with a maximum of 80,000m² and an average of 12,780m² (Table 1).

The results in Table 2 show that of the 239 producers surveyed, 71% were women and 29% men. These results confirm the study by Dembélé *et al.*, (2022), which revealed that many women's organizations are involved in vegetable production in the Koulikoro region. This proves that vegetable growing, which was initially a man's activity, is increasingly becoming a woman's activity in the Koulikoro region. The results of studies carried out in the Bouaké area by Fondio (2005) show that vegetable growing is done more by men than by women. Out of 94 producers interviewed, 74% were men and 26% were women. Housewives represented 55.6% and agricultural workers 39.3%. The majority could read neither French nor the local language (78% and 69% respectively).

Table 1: Description of okra farms surveyed

Designation	N	Minimum	Maximum	Mean	Standard deviation
Age	239	16	78	40.54	9.981
Number of years of education	239	0	17	2.03	3.509
Family size	239	1	60	17.76	12.177
Total land area (m ²)	239	50	80,000	12,780.04	16,533.049

Table 2: Characteristics of some of the variables studied in the farms

Variable	Number (n)	Percentage (%)	Variable	Number (n)	Percentage (%)
Gender			Irrigation type		
Female	169	70.7	Watering can	80	33.5
Male	70	29.3	Aspersion	1	0.4
Profession			Manual	104	43.5
Farming	94	39.3	Gravity	18	7.5
Salaried job	3	1.3	Others	36	15.1
Housewives	133	55.6	Responsibility at okra farm level		
Others	9	3.8	Woman	104	43.6
Reading in French			Man	40	16.8
No	186	77.8	Both (Woman and Man)	71	29.6
Yes	53	22.2	Others	24	10
Reading in one of your local languages			Selling products		
No	165	69.0	No	209	87.4
Yes	74	31.0	Yes	30	12.6
Family type			Main point of sale for okra production		
Single-parent family	33	13.8	Field side sales	17	7.2
Nuclear family	85	35.6	Roadside sales	4	1.6
Polygamous family	121	50.6	Sale at the market	152	63.6
Land acquisition			Sale to wholesalers	17	7.2
Buying	5	2.1	Selling to neighbors	17	7.2
Gift	34	14.2	Don't sell	19	8.0
Inheritance	188	78.7	Others	12	5.2
Others	12	5.0			
Do you have land irrigation systems					
No	4	1.7			
Yes	235	98.3			

The study revealed three types of families: polygamous families (50.6%) made up of a head of household married to at least two women and with children. Nuclear families (35.6%) made up of two parents and children, possibly with grandparents, and single-parent families (13.8%) made up of one parent and children, possibly with grandparents. For the acquisition of farmland, 78.7% of land was acquired by inheritance, 14.2% by gift, 2.1% by purchase and 5% by other means (borrowing or renting). These results corroborate those obtained by Grazioli *et al.*, (2022). And that most of the respondents carry out their farming activities on inherited land. The same results were obtained by *et al.*, (2018) in the Communes of Dassa-Zoumé and Glazoué in Benin, where inheritance remains the main mode of access to land. Around 98.3% of farmers had an irrigation system, while 1.7% had none. Dembélé *et al.*, (2022) reported that in the Koulikoro region many women's organizations involved in vegetable growing use surface water sources (cesspools) or boreholes equipped with manual or solar pumps. And groups of producers near Koulikoro, Dioila, Kolokani and Kati use the Californian watering system, with motor-driven pumps drawing water from various sources: wells, micro-dams, marshes, rivers, etc. According to Fondio (2005), vegetable growers in the Bouaké area use manual watering. The majority of farm management responsibilities were held by women (43.6%), compared with 16.8% by men. It should be noted that 29.6% of respondents reported that responsibility is shared by both women and men. A total of 87.4% of producers sell their okra, mainly on the market (Table 2). According to Sow and Diarra (2020), okra growing provides a source of income for women in Mali as part of proximity farming, an economic opportunity for millions of women in Africa. Producers listed 16 types of vegetables as being grown in the study area. Onions were the most common vegetable grown on 20.5% of farms, followed by okra

and lettuce on 18.8% and 13.4% of farms, respectively. According to Dembélé *et al.*, (2022), in Mali, the vegetable sector has grown very rapidly over the last decade. Vegetables are produced by small-scale farmers throughout the country and the vegetables of greatest economic importance are okra, shallots, tomatoes, chillies, onions, lettuce, squash, eggplants, cucumbers and cabbage. In Mali and throughout West Africa, okra, which is of Bantu origin, is the most widely grown vegetable after the tomato (Saturno, 2018).

The agronomic and commercial data from only 173 of the 239 growers surveyed could be used. Data on 66 growers was not provided, either because the seed was received late and the plot was not set up, or because the producers lost one or two plots. The majority of growers set up plots in July (43.4%), followed by 35.3% in August, 8.3% in September and October and only 4.7% in June. Growers compared varieties on the basis of emergence vigor and survival rate. The most vigorous variety was AVOK1501 (17.9%) followed by Batoumambe (16.2%), the least vigorous was VI033783 (6.9%) followed by Paysan (8.1%). The variety with the highest survival rate was AVOK1501 (21.4%) followed by Batoumambe (14.5%); the lowest survival rate was recorded for varieties TZSMN86 and VI033783 (8.1%). The producers who responded found that the most drought-tolerant variety was AVOK1501 (15.6%), followed by C101 (11.0%) and Batoumambe (9.8%). The most susceptible variety was VI033783 (5.8%), followed by paysan (6.9%). The most flood-tolerant variety was AVOK1501 (9.8%), followed by Batoumambe and TZSMN86 (9.2%), the least flood-tolerant was VI033783 (3.5%), Konni and Paysan (5.8%). The variety reported as the most resistant to disease was Sassilon (14.9%), followed by Paysan (13.1%). The susceptible varieties were VI033783 (5.4%) and Batoumambe (7.1%).

The variety reported as the most resistant to pests was Paysan (14.3%), followed by Konni (13.7%). The most susceptible varieties were VI033783 (6.5%) and TZSMN86 (7.7%). Producers have identified okra varieties that are tolerant to diseases and pests, and varieties that are tolerant to drought and floods. Stresses such as drought and disease have a negative impact on the nutritional, primary production and reproductive functions of okra (Kouakou *et al.*, 2020). The result in Figure 2 shows that the highest yield was obtained with the cultivar Konni (17.9%), followed by Sassilon and AVOK1501 (16.1%). The advantages of the Konni variety were mentioned by Kumar *et al.*, (2010), cited by Grazioli *et al.*, (2022), who state that the Konni short-duration variety selected from a local population in Niger has proved to be the best advantage so far; it is currently being massively disseminated in the Sudan-Sahel under rain fed and irrigated conditions. Producers indicated that the easiest variety to sell was Sassilon, reported by 16.1% of producers, followed by Batoumambe (13.1%) and AVOK1501 (12.5%).

The hard-to-sell variety was VI033783: only 3.0% of growers found it easy to sell, followed by TZSMN86 (6.0%). At consumption, 14.3% of producers found that the local variety Paysan had the best taste (Fig. 3). Cultural issues also justify the preference for the local variety, specifically among the local population, who consider it to be a cultural heritage to be preserved, especially in terms of taste (Ado and Zakari, 2020). In Niger, in a study by Ado and Zakari (2020), the local Damergou variety of okra was appreciated by consumers for its taste and good viscous texture in the preparation of sauces. The local variety is followed by Sassilon (13.1%) and C101 (12.5%). The least appreciated taste was the VI033783 variety: only 3.6% appreciated

the taste, followed by TZSMN86 (8.9%). The producers who did not respond either do not sell their production or do not consume it (Fig. 3).

Hence, in conclusion okra is produced in Mali and throughout West Africa. Highly prized by the population, okra is used in the preparation of many Malian sauces. It is used not only fresh, but also dried and powdered. The results of the study showed that in the Koulikoro region, okra growing, which was initially a male activity, is increasingly becoming a female one. The producers surveyed lived in large polygamous families, and their main activities were housework and farming. Farming takes place on land that is generally inherited. Most producers sell their produce at the market. This survey enabled growers to express their preferences for the various characteristics of okra using questionnaires. The varieties AVOK1501, Sassilon, Batoumambe and Konni can be proposed for extension in the Koulikoro region because of their preference for productivity, tolerance to biotic and abiotic stresses, taste and ease of sale.

Acknowledgements

The authors would like to thank the CGT/BMZ (Bundesministerium für wirtschaftliche Zusammenarbeit und Entwicklung) project and the Rural Economy Institute (IER) of Mali for funding this research work as part of the taking charge of the end-of-course work of a Master's student. The authors would also like to thank the University of Science, Technology and Technology of Bamako (USTTB) of Mali and the Seed Laboratory (LABOSEM) for the training and various support provided to the Master's student.

Fig 2: High-yielding okra varieties according to producers

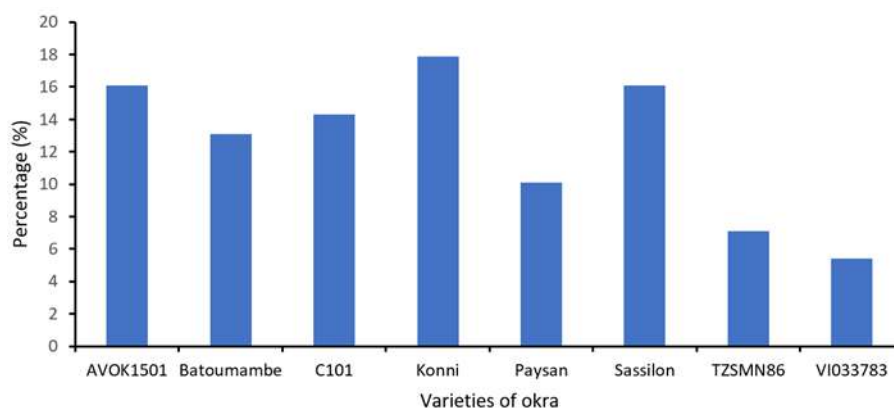
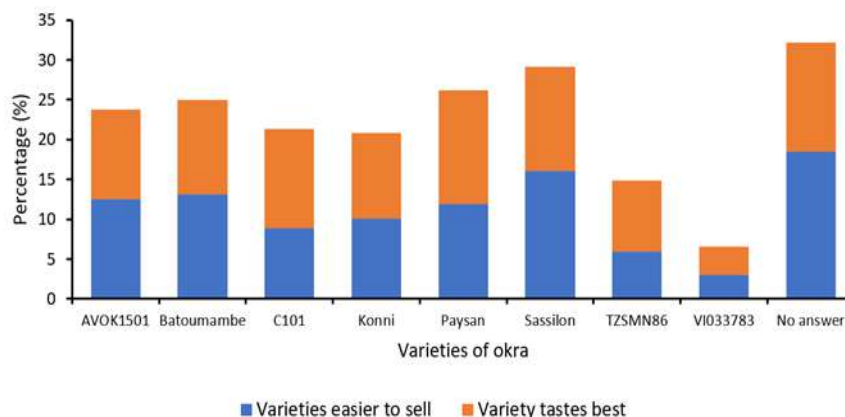


Fig 3: Varieties of okra that are easier to sell and taste better according to producers



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