International Scholars Journals

Advanced Journal of Environmental Science and Technology ISSN 2756-3251, Vol. 15 (8), pp. 001-010, August, 2024. Available online at www.internationalscholarsjournals.org © International Scholars Journals

Full Length Research Paper

Assessing the Impact of Salinity on Tomato Production in Benin's Coastal Areas

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Accepted 24 April, 2024

The coast of Benin lies on a wide bay in the Gulf of Guinea called the Bight of Benin, about 125 km between Togo and Nigeria. The coastal areas of Benin cover part of the cultivable lands of the country. A total of 15 tomato varieties were recorded in the areas of study. The characteristics of each variety grown under salinity were also recorded based on the assessment of farmers. Salinity causes unfavorable conditions that restrain the normal crop production. The factors that contribute significantly to salinity were soil salinity, wet breeze from high tide especially between June to August and direct watering of crop with saline water. The wetted foliage of growing tomato absorbed the salts directly. The results obtained also show that salinity in the coastal areas of Benin affected tomato growth, leaf length, and number of leaves, which reduced yields and in severe cases, total yield was lost. Two varieties (aclinkon and petomèche) seemed to be tolerant to salinity because of their average yield. Due to the heavy losses in tomato production, producers were eager to be supplied with new varieties tolerant to salinity. Henceforth, it was imperative to have an evaluation of the coastal areas of Benin affected by the salinity.

Key words: Coastal areas, tomato production, salinity, wet breeze, high tide.

INTRODUCTION

Tomato is the most widely grown vegetable in Benin. It is an important source of income to those engaged in its production. In Benin, tomato increases the benefit of gardeners and producers and offers employment to thousands of people without jobs and contributes significantly to poverty reduction. Tomato plays a vital role in social, economic and nutritional scheme in Benin.

Tomato ranks first among vegetable crops produced in Benin Republic (Colin and Heyd, 1991). Vegetable crops are predominantly cultivated in the south of Benin, in urban and peri urban areas and in the valley of Ouémé (Adorgloh-Hessou, 2006). Over 80% of the national output is produced in the 6 Southern departments of Benin (Mono, Couffo , Atlantique, Littoral, Ouémé and plateau) (Mbaye and Renson, 1997). Despite the annual production of tomato, the supply does not meet the demand. The annual demand in the Cotonou market for tomatoes represents about 125% of supply for tomato and 120% of supply for the onion (LARES, 2001).

Several studies have shown that constraints such as biotic factors (pests and diseases) restrain the production of tomato in Benin while yet studies on abiotic constraints (salinity, flooding, drought, and temperature) are rare. Abiotic constraints include changes in latitudes and altitudes in the ecological zones, changes in agro-economics, land degradation, extreme geophysical events, reduced water availability, increase in the sea level and salinity (FAO, 2004). Climatic variations are determining factors in agricultural production around the world, Benin in particular, because crop suitability models predict that sub-Saharan Africa and the Caribbean will be most affected in terms of the reduction of suitable areas for a range of crops (Lane and Jarvis, 2007). A significant change in climate across the globe will impact agriculture and consequently affect the food supply (de la Peña and Hughes, 2007). Developing countries in the tropics are

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the most vulnerable to climate change. Climate change will affect areas already vulnerable where coastal erosion, salinization and flooding of low-lying coastal areas currently occur (Niang, 2010). Climate change is expected to accelerate the sea level rise and thus, aggravate the existing coastal problems (Niang, 2010).

Environmental stress is the primary cause of crop loss worldwide. It reduces average yields for major crops by more than 50% (Boyer 1982; Bray et al., 2000). The vegetable production which supplies 40% of the world's food is threatened by increasing soil salinity (FAO, 2004). Excessive soil salinity reduces productivity of many agricultural crops, especially vegetables that are particularly sensitive throughout the ontogeny of the plant. According to the Department of Agriculture United States (USDA), onions are sensitive to saline soils, while cucumbers, eggplants, peppers, and tomato are moderately susceptible. Climate change will influence the severity of environmental stress imposed on the production of crops.

Unless appropriate steps are taken to mitigate the effects of climate change, food security in developing countries will be under threat (de la Peña and Hughes, 2007). There is an imperative need to do more research in the Republic of Benin on how crops are affected by increased abiotic stresses. Hence, a study was conducted in coastal areas of Benin to assess the impact of salinity on tomato production in order to identify the problem for quality research.

For this purpose, the central objective of this study was to evaluate the impact of salinity on tomato production along the coastal area of Benin.

METHODOLOGY

Study site

The coastal zone of Benin lies on a wide bay in the Gulf of Guinea called the Bight of Benin, about 125 km between Togo and Nigeria. This area is characterized by a sub-equatorial climate with 4 seasons, two rainy seasons and two dry seasons. Annual rainfall varies from 1000 to 1400 mm. Rainy seasons are from March to July and from August to November. The Temperatures vary between 25 to 36°C. The average temperature is 27°C with the lowest at 22°C during July and the highest at 36°C in March.

The selection criteria of four departments surveyed

The areas of study were selected based on the new administrative division in Benin. After the new administrative division in December 2002, the country was split into 12 departments. Of the 12 departments within Benin; Plateau, Ouémé, Littoral, Atlantique, Mono, Couffo are the six departments of the south. The study was conducted in Ouémé, Littoral, Atlantique, and Mono for the following reasons:

- The fact that they are coastal regions of Benin and tomato producers.
- Due to insufficient data on the problems of salinity and flooding caused by tide.
- Owing to the socio-economic importance of tomato in these departments.

The selection criteria of five communes

Each department is divided into communes. Communes are generally composed of territorial entities of the districts, towns and villages. Five communes were visited (Figure 1). There were Seme Podji, Cotonou, Abomey-calavi, Ouidah and Grand Popo. The eleven districts surveyed in these communes were: Ekpè, Aglangandan, Fidjrossè, Godomey, Avlékété, Djegbaji, Oudah 1, Grand-Popo, Agoué and Avlo. These districts were chosen for two main reasons:

- Their close proximity to the sea
- Tomato-producing areas

Sampling and data collection

The sampling covered all coastal areas producing tomato. Two phases of survey were conducted: an exploratory survey and in-depth survey.

The exploratory survey carried out in the four departments enabled the researcher to know the constraints that salinity poses to the production of tomato through interview with producers (target group and individual discussion) selected randomly and observations made in the field. We then approached each local governmental center for agricultural development to collect data on the number of tomato producers in each district. Having collected the data the following formula was used to determine the number of tomato producers to be surveyed per district.

$$n = t^2 . \frac{p.(1-p)}{e^2} . \frac{N-n}{N-1}$$

Where n is the sample size, t student test, p the proportion of household tomato producer in the total number of agricultral households, N the number of tomato producers, and e margin of error fixed at 5%.

A total of 128 tomato producers were surveyed in the four departments. The in-depth survey was conducted based on interviews, observations, and structured questionnaires. Qualitative and quantitative data were collected. Parameters such as gender, age, education level, social status, number of dependents, credit accessibility, agricultural technicians' support obtained, input use, the number and diversity of cultivated varieties, land availability, cultivated area in 2008, cost price, effects of salinity on growth, development and yield of tomato, sensitivity to other stress, salinity and flooding control strategies etc. Small-scale farmers were regarded as farmers with less than 0.75 ha while larger-scale farmers were considered as farmers with 1 to 3 ha. This evaluation required that the farmer should be encouraged to express his view, idea, and explain observations made on each variety, and avoid the surveyor point of view transpire in the interview.

Data analysis

The data collected were subjected to descriptive statistics to determine mean, minimum, maximum, standard deviation, and percentage of age, sex, education level, social economic status, input use, land availability, cultivated areas in 2009, and cost price. SPSS was used for descriptive analysis, correlation of independent variable, and ANOVA.

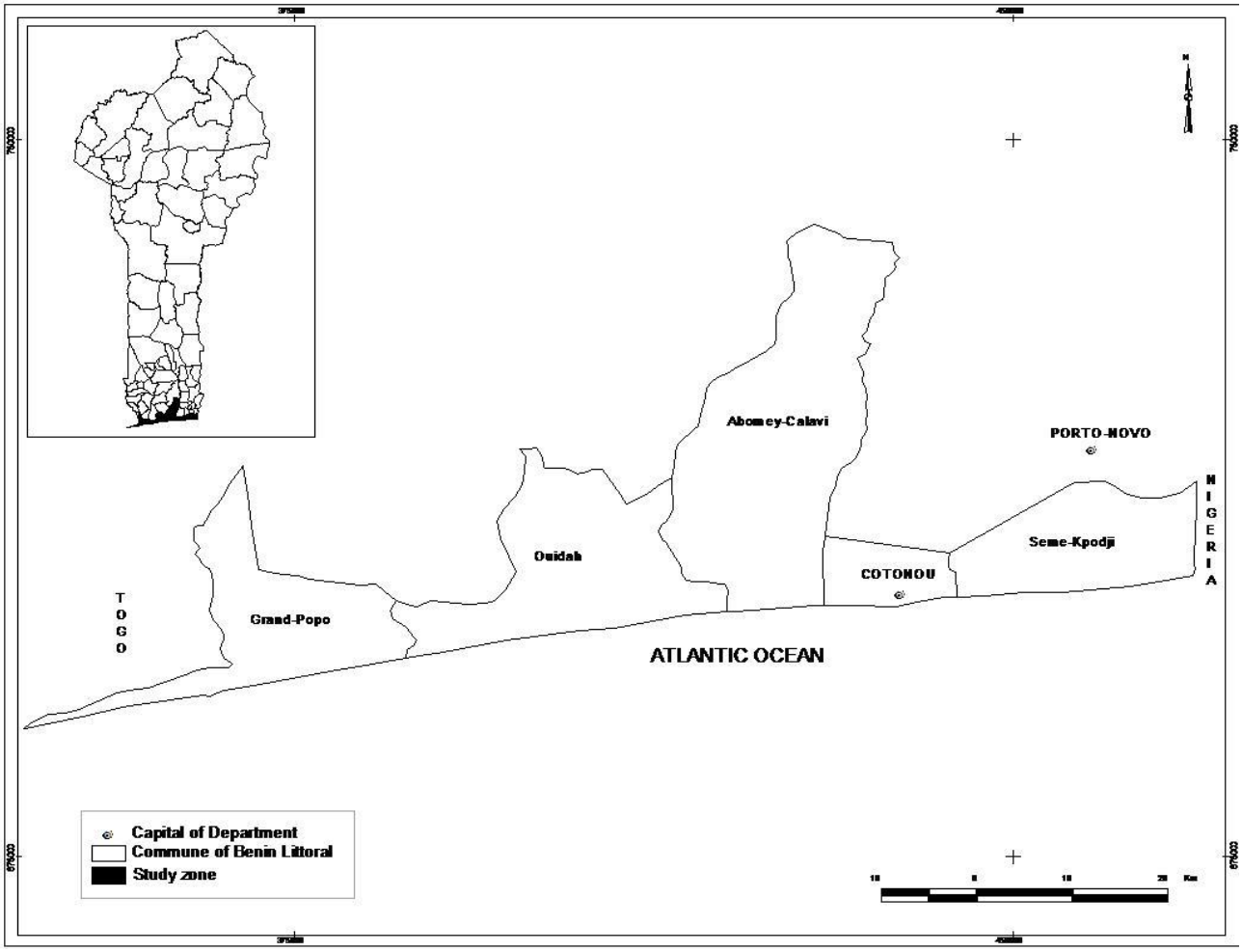

Figure 1. Benin Republic map and communes investigated.

Annual income of different farmers at two different agro-ecological zones was subjected to analysis of variance to determine the differences among annual income. Means separation was performed by Turkey's test.

RESULTS

Producers' characteristics

The typology was based on 20 variables likely to discriminate producers. Tables 1 and 2 show the statistical description of these variables. From the 127 farmers investigated, 80.5 and 19.5% were male and female, respectively. About 70.9% of producers were less than 45 years old, 25.2% from 45 to 60 years old, and 4.7% more than 60 years old. The average ages of farmers per district were 40 and the average experience was 7 years. About 78.1% of farmers were educated. Only 15% of farmers had access to agricultural loan. About 92% of them applied inorganic and organic inputs to the fields. The production of tomato (Figure 2) provides for the majority of farmers (59%) an annual income of less than 500000 F CFA. Tomato contribution to annual income represents 1 to 65%. The average size of the household varies between 6 and 12 persons.

With regards to means of production, the average means of cultivated and available lands were 0.944 and 0.65 ha, respectively. The average farm size was 0.5 ha in Aglangandan, 0.9 ha in Agoué, 0.61 ha in Avlékété, 0.57 ha in Djegbadji, o.56 ha in Ekpè, 0.50 ha in Fidjrossè, 0.50 ha in Godomey, 0.60 ha in Grand popo, 0.71 in Ouidah 1, and 0.79 ha in Sèmè podji. Moreover, the majority of the farmers (69.15%) use the available land.

Distribution of tomato varietal diversity: Designation and evaluation of varieties

A total of 15 varieties were recorded during the study

Table 1. Mean of characteristics of tomato producers.

Variables	Mean	Stdev	Min.	Max.
Age	39.4724	1.050	20	73
Sex	0.80	0.398	0	1
Experience	7.16	3.979	2	25
Land available	0.9441	0.753	0.17	4
Area cultivated	0.6501	0.4787	0.16	3
Formal credit	2.62	2.926	100000	9000000
Informal credit	7.93	8.054	100000	2000000
PLOANF	8.86	1.469	200000	5000000
PLOANI	2.20	1.095	100000	3000000
ILOANF	18	8.345	0	25
ILOANI	9.50	3.964	0	12
DLOANF	9.36	5.938	2	24
DLOANI	7.333	8.165	2	24

PLOANF = formal credit allocated to tomato production, PLOANI = informal credit allocated to tomato production, ILOANF = interest rate of formal credit, ILOANI = time-limit for reimbursement of formal credit, DLOANF = time-limit for reimbursement of formal credit, DLOANI = time-limit for reimbursement of informal credit.

conducted in the eleven districts investigated. The 15 varieties are namely: tounvi, gbataki, aclinkon, kekefo, pomme, adaka, gbamingbo, sonafel, ouaga, karaibo, ps royal, petomèche, mongal, tropimèche, 3fs. The highest number of varieties (7) was recorded at Avlékété and the least at Djegbadji (Table 3). Analysis of variance showed that there was significance difference (P≤0.05) between the numbers of varieties recorded per district.

Table 5 shows the evaluation of tomato varieties by farmers. Aclinkon and petomèche varieties were mostly cultivated and preferred when compared to other varieties. Both varieties were ranked above others due to their physiological and agronomical characteristics such as height yield and yield components (fruit bulkiness and thickness), commercial values and were moderately tolerant to salinity stress. Sonafel variety, highly tolerant to salinity stress, should be the most preferred to aclinkon and petomèche according to farmers 'observations but was not too productive and its market value was too low when compared to aclinkon and petomèche. The most sensitive and less productive varieties under salinity stress were mongal, kekefo, agbataki, ouaga, adaka, 3fs, topimèche and pomme. Most of tomato varieties demonstrated small leaves, wilting, yellowing, low yield, low market value, death of some plants, and decrease in plant height and leaf number (Table 5).

The cultivated areas and tomato varieties grown

The cultivated areas vary from 0.25 ha to 3 ha in the entire districts investigated (Table 4). The results indicate that aclinkon variety was not grown in two district Sèmè podji and Grand popo while petomèche was mainly grown in the two districts. More than 69% of farmers grew aclinkon in Cotonou, Abomey-calavi, and Ouidah whereas 43.3 % and 73.4% of farmers grew petomèche in Sèmè podji, and Grand popo respectively. The land on which petomèche grew was important (3 ha) when compared to other tomato varieties. Mongal was grown by less than 30% of farmers. Other varieties listed by farmers such as gbataki, pomme, ouaga, kekefo, tropimèche, were less produced.

Table 6 shows the comparison of annual income of a few farmers with more than one field. It reveals that the annual income of tomato grown in field 1 were significantly lower than that harvested from field 2 due to the fact that field 1 is closer to the sea. Farmers complained that they should have abandoned the sea side if they had enough land elsewhere. The demographical pressure makes the land to be less available in the areas.

The analysis of the interviews obtained and the frequency with which farmers had spontaneously mentioned varietal characteristics or specific criteria for evaluating the crop in question was performed. Table 7 illustrates this exercise in the case of the evaluation of tomato varieties: it highlights the important criteria used by farmers to visually assess the tomato varieties. The varieties petomèche and aclinkon were ranked the best based on yield and tolerance to salinity amongst the other varieties. The result shows that mongal is moderately tolerant to drought whereas, gbamingbo is moderately tolerant to flooding stress.

Strategies for mitigating salinity and desirable solution

Three different methods (fence with palisade, fence with

Table 2. Percentage of characteristics of tomato producers.

Variable		Percent (%)
Sex	male	80.5
	female	19.5
Age	ℜ 45	70.9
	Between 45 and 60	25.2
	℘ 60	4.7
Matrimonial status	Married	93.8
	Single	5.5
	divorced	0.8
Education status	literate	78.1
	illiterate	21.9
Education level	primary	53.5
	Junior secondary	37.4
	Senior secondary	7.1
	university	2
Literacy rate	yes	45.3
	no	54.7
Origin	native	48.4
	migrant	51.6
Agricultural cooperative	yes	12.5
	no	87.5
Annual income from crop production (2009)	ℜ 500000	59.4
	500000-1000000	25.8
	1000000-2000000	8.6
	2000000-15000000	6.2
Annual income from tomato production (2009)	ℜ 500000	85.2
	500000-1000000	7.8
	1000000-2000000	3.9
	2000000-8000000	3.1
Contact with CeRPA	Yes	44.9
	No	55.1
Input application	Yes	92.2
	No	7.8
Credit accessibility	Yes	14.8
	No	85.2
% of tomato contribution to annual income	1 to 75	

maize/sorghum and intercropping) were used to abate the effect of the tidal breeze responsible for the build-up of salinity in the coastal area of Benin Republic. 59.9% of farmers interviewed used fence with palisade (Figure 3), 11.9% and 2.4% (Table 8) used fence with maize/sorghum and intercropping, respectively to reduce

Figure 1. Overview of growing tomato in a farmer's field.

Table 3. distribution of tomato varieties in the eleven districts.

District	Number of farmer	Variety	Number of variety
Sèmè podji	10	Mongal, tounvi, petomèche tropimèche, karaibo	5
Ekpè	5	Mongal, ouaga, petomèche, karaibo	4
Aglangandan	6	Mongal, ouaga, petomèche, tropimèche, tounvi	5
Fidjrossè	7	Aclinkon, tounvi, gbataki, sonafel, kekefo, pomme	6
Godomey	15	Aclinkon, gbamingbo, tounvi, sonafel, kekefo	5
Avlékété	24	Aclinkon, tounvi, adaka, sonafel, 3fs, pomme, gbamingbo	7
Djegbadji	9	Aclinkon, tounvi, sonafel,	3
Ouidah 1	7	Sonafel, kekefo, tounvi, aclinkon, adaka	5
Grand popo	20	Mongal, petomèche, ps royal	3
Agoué	25	Mongal, petomèche, tropimèche, ps royal, karaibo	5
Total	128	15	15

the deleterious effect of tidal breeze which constitutes a constraint for tomato production in the regions. Only 25% of farmers produced tomato in an open air without any measure of protection. 100% of farmers were aware of salinity problem and had expressed great concern about the threat. During the focus group discussion, some farmers told us they stopped producing tomato and other crops at close proximity of the sea because of repeated loss recorded years back. All of the farmers (100%) investigated wished they could be supplied with varieties highly tolerant to salinity with high yield and commercial value.

DISCUSSION

Tomato cultivation in southern Benin contributes greatly to eradicate poverty in that area and supplies tomato to Cotonou and others towns of the southern parts of the country. The level at which tomato production contributes to the annual income was based on the areas cultivated and most importantly, to the yield and market value. The main activities of farmers in the study site were tomato production especially and vegetable crops in general. This could be due to the fact that their demand, especially in the metropolitan city, was greater than the supply. The selling-price of a tomato basket varies between 12000 and 30000 F CFA depending on the season.

The result shows that only 19% of females produced tomato. The participation of women in tomato production is very low. One possible explanation for this could be that women do not have easy access to land. Another contributing factor is that women are much more involved in fishing. The high participation of men (80.5%) in tomato production indicates that they devoted themselves

Table 4. The percentage of preferred varieties per commune and area cultivated in 2009.

Variety	Area (ha)	Cotonou		Abomey- calavi		Ouidah		Grand popo		Sème	
		n	%	n	%	n	%	n	%	n	%
Aclinkon	1 to 1.5	7	77.8	15	69.7	29	76.7	-	0	-	0
petomèche	1 to 3	-	0	-	0	-	0	45	72.4	23	43.3
sonafel	0.5 to 1	-	0	15	12.1	29	11.7	-	0	-	0
Tounvi	0.5 to 1	-	0	15	3	-	0	-	0	23	10
Mongal	0.5 to 1	-	0	-	0	-	0	45	15.5	23	23.3
Kekefo	≤ 0.5	7	11.8	15	6.1	29	5	-	0	-	0
Ps royal	0.75 to 1	-	0	-	0	-	0	45	10.3	-	0
Karaibo	0.5 to 1	-	0	-	0	-	0	45	1.7	23	10
Gbamingbo	≤ 0.75	-	0	15	9.1	-	0	-	0	-	0
agbataki	≤ 0.5	7	11.8	-	0	-	0	-	0	-	0
Ouaga	1	-	0	-	0	-	0	-	0	23	10
Adaka	≤ 0.5	-	0	-	0	29	3.3	-	0	-	0
3fs	≤ 0.5	-	0	-	0	29	3.3	-	0	-	0
tropimèche	≤ 0.5	-	0	-	0	-	0	-	0	23	3.3
pomme	≤ 0.25	-	0	-	0	-	0	-	0	-	0

n = number of respondent surveyed.

Table 5. physiological and agro-morphological traits listed by farmers.

Variety	Advantage	Disadvantage
Aclinkon	High yield, quality fruit, thick fruit, plant height was not too affected	Small leaves, wilting, decrease in yield, less tolerant to salt
petomèche	High yield, quality fruit, plant height was not too affected	Wilting, some plants died, blossom end, yellowing,
Sonafel	Quality fruit, normal plant height, no yellowing, more or less tolerant to salinity	Low yield,
Mongal	-	Small leaves, low yield, very sensitive to salinity
Tounvi	Quality fruit,	Low yield, low market value, plant height decreased, yellowing, death of plant, sensitive to salinity
PS royal	Quality fruit, no yellowing of leaves,	Low yield, low market value, plant height and leaf number decreased, death of plant, sensitive to salinity
Karaibo, gbamingbo	Quality fruit	Low yield, low market value, plant height and leaf number decreased, yellowing, death of plant, sensitive to salinity
Kekefo, gbataki, ouaga, adaka, 3fs, tropimèche, pomme	Quality fruit,	Low yield, fruit size reduced, low market value, plant height and leaf number decreased, yellowing, wilting, death of plant

to farming so as to provide for the family need. In a similar study by Assogba et al. (2008), it was reported that only 30% of women grew vegetable in the southern part of Benin. They further stated that it could be due to accessibility of land to women and its availability in their areas of study.

In our present study, the accessibility of farmers to agricultural credit was too low. As a matter of fact,

Table 6. Annual income of different farmers at two different agro-ecological zones.

Annual incomes at different districts	Field 1: close to the sea	Field 2: far to the sea
Agoué	4500000a	7000000b
grand popo	50000a	650000b
Seme podji	270000a	500000b
Avlekete	675000a	750000a

Numbers with the same letter in each row are not significantly different ($p<0.05$).

Table 7. Evaluation of varieties by farmers.

Variety	Age	Yield	Availability	Earliness	Drought	Flood	Salinity
Aclinkon	0	3	3	3	1	1	2
petomèche	0	3	2	3	1	1	2
sonafel	0	2	3	2	1	1	3
Tounvi	0	2	3	2	1	1	1
Mongal	0	1	2	3	2	1	1
Kekefo	0	2	2	2	1	1	1
Ps royal	0	2	2	3	1	1	1
Karaibo	0	2	3	3	1	1	1
Gbamingbo	0	2	2	2	1	2	1
agbataki	0	1	2	2	1	1	1
Ouaga	0	2	1	2	1	1	1
Adaka	0	2	2	3	1	1	1
3fs	0	1	1	2	1	1	1
tropimèche	0	1	1	2	1	1	1
pomme	0	1	1	2	1	1	1

0 = don't know; 1 = bad; 2 = average; 3 = good; 4 = very good.

Figure 3. Palisade fence set up against tidal breeze.

Table 8. Solution to salinity used and suggested by farmers.

	Type	Number of respondent	Percentage
Problem	salinity	128	100
	Fence with palisade	128	59.9
	Fence with maize/sorghum	128	11.9
Solution used	intercropping	128	2.4
	Nothing	128	25.8
Desirable solution	New varieties	128	100

agricultural loan is an important external factor that contributes tremendously to the expansion of land cultivation. These farmers lack this source of fund to intensify their production and grow tomato in the available land at their disposal. During the survey, we were surprised at the reaction of farmers due to their request on agricultural loan. This shows how interested they are to obtain agricultural loans. However, among the communes investigated, it was only in grand popo that farmers were given agricultural loan which was of great benefit to the farmers of the areas in terms of lands cultivated and the annual income, because the largest areas cultivated and the highest annual income were recorded in the region.

On an average, a producer did not handle more than two varieties to meet sale and subsistence farming. The preference of aclinkon, tounvi, sonafel to others in Cotonou, Abomey-calavi, and Ouida might be due to the soil type which is hydromorph while petomèche and mongal were preferred to other varieties in Grand popo and Sème where soil type is sandy. We hypothesized that such inclination to some particular varieties might be due to the ecological conditions of the sites and the soil types, which justify the diversity of different management of varieties between different communities and even amongst producers of the same communities. Further studies are required to find out how the diversity observed, results in the varieties-environment interaction.

The results in Table 8 show that all the farmers interviewed were aware of the salinity problem. One of them living at Togbin beach, an educated person with junior secondary certificate testified that between June and August, the level of the sea becomes high which causes the tides to be severe and damage their production on the field. The sea breeze is always loaded with salt which settle its salt on growing tomato and soil. In a similar study, Haque (2006) reported that the effect of tides is manifested in a regular alternation of rise and fall of the water level of the sea and the tidal channels and creek. Also, Niang (2010) reported that climate change will develop on already vulnerable zones where coastal erosion, salinization and inundation of low lying coasts take place. Climate change is expected to accelerate sea level rise thus aggravating existing coastal problems. For adaptation, strategies must firstly focus on better adapting agriculture to current climate vulnerability. Some farmers in Togbin beach, grand popo were unable to harvest tomato from the field because of the harmful effect of salt. No data was collected at Avlo district due to the high salinity of its soil. The tomato producers at that district told us they completely gave up on the vegetable production owing to the soil salinity that is not suitable for vegetable crops' (tomato, carrot, onion, lettuce, cabbage, pepper, leafy vegetable) production.

The annual incomes recorded from field close to the sea compared to those from field far away from sea elucidate the fact that salinity causes yield losses (Table 6). It ranges from 10 to 45% losses. Haque (2006) reported that salinity affects certain crops at different levels of soil salinity and at critical stages of growth, which reduces yield and in severe cases total yield is lost. The environmental stress is the primary cause of crop losses worldwide, reducing average yields for most major crops by more than 50% (Boyer 1982; Bray et al., 2000).

The respondents' observations showed that salinity had a deleterious effect on physiological and agro-morphological traits (small leaves, yellowing, low yield, low market value, and decrease in leaf length and plant height) of most tomato varieties recorded (Table 5) in the study area. In a similar study, Ezin et al. (2010) reported that salinity decreases plant height, leaf number, leaf length, chlorophyll content, and chlorophyll fluorescence, yield and yield components.

The various methods such as fencing with palisade and fence with sorghum, and intercropping used to hinder the effect salinity caused by tidal breeze is not solving the problem but gives a slight protection to plants. During the survey, it was discovered that tomato plants grown in the field were affected by salinity in two different ways: tidal breeze, which is loaded with salt regularly sprinkled the plants and the wetted leaves absorb salts directly; on the other hand, soil salinity. Bresler et al. 1982 reported that when foliage is wetted, leaves may also absorb salts directly; this becomes important under sprinkler irrigation. He stated further that when plants absorb salts readily through their leaves, tolerance to salinity of sprinkler-irrigated plants is greatly reduced.

The salinity problem in Benin Republic received no

attention in the past. Thus, it is necessary to have an assessment of the present state of the coastal regions of Benin affected by salinity. These regions are tomato producers, and supply Southern Benin Cities with tomato. It is then imperative to explore them and draw the attention of researchers so that adequate measures can be taken to abate the negative effects of abiotic stresses, considered as a direct potential consequence of climate change.

Conclusion

This study enabled us to assess the distribution of varieties of tomato grown under the influence of salinity along the coast of Benin, to analyze the practices and the socioeconomic importance of tomatoes in these regions. The analysis of agro-morphological characters revealed a great variability in plant height, leaves, quality of tomato, yield, and susceptibility to environmental stresses (salinity, flooding etc.). The positive and negative traits of each variety were recorded. The results obtained also show that three varieties, aclinkon, petomèche and sonafel, were moderately tolerant to salinity among the 15 varieties recorded. Plant height, yield and quality of tomato were seriously affected in these areas. In view of these results, it appears evident that the coastal regions of our country are affected by salinity.

We suggest that new tomato varieties may be developed as adaptive measure to overcome adverse effects of climate change on crop production and train farmers on how to adjust timing of sowing in the field.

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