Modern Environmental Science and Engineering (ISSN 2333-2581)
March 2023, Volume 9, No. 1-3, pp. 30-35
Doi: 10.15341/mese(2333-2581)/01-03.09.2023/004
Academic Star Publishing Company, 2023
www.academicstar.us

Rainfall Accidents and Soybean in the Commune of Save in Benin, West Africa

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Abstract: In recent years, the commune of Savè has experienced rainfall accidents that have affected agricultural production in general and soybean production in particular. The aim of this article is to analyze the impact of rainfall events on soybean production in the commune of Savè. To achieve this objective, a methodological approach was adopted. It consisted of data collection (rainfall data over the period from 1987 to 2017 and soybean production data from 2003 to 2017), data processing and interpretation of the results. The results of this research show that the minimum yield was obtained in 2003 and 2017 (800 kg/ha), while the maximum was obtained in 2010 (1107 kg/ha). The correlation between rainfall and soybean yield revealed that annual rainfall alone does not explain soybean yield trends. Apart from rainfall, according to 90% of the growers surveyed, soil components, area sown, maintenance and temperature were identified as determining factors in soybean yields.

Key words: Savè, rainfall accidents, soybean, production

1. Introduction

Like air, light and temperature, water is indispensable to life and to the proper functioning of ecosystems, thanks to the various services on which living beings depend. However, for some time now, the various climatic parameters have been subject to uncontrolled variation, and the degree of climatic variability can be described by the differences between long-term average values of climatic parameters (rainfall, temperature, humidity, length of seasons) and observed values taken at different temporal and spatial scales [1].

Farming practices require a good knowledge of the seasonal rainfall cycle, i.e., the dry sequences at the heart of active agricultural seasons and the frequency of rainy days [2].

Agriculture remains essentially rain-fed, and therefore extremely dependent on the rainy season. Thus, this “agriculture, on which the economies of several countries and the food security of their populations depend, is affected by climatic disturbances due to its essentially rainfed nature” [3].

For better agricultural production, the regularity of rainfall is much more important than the amount of rain that falls. A good spatio-temporal distribution of rainfall is an essential element for the growth and productivity of cultivated plants [4].

Soya is one of the most widely grown cereals in central Benin and in the commune of Savè. It requires a significant amount of water for its development. Recently, given the climatic conditions, soybean yields have been low compared with previous years.

The aim of this article is to analyze the impact of rainfall on soybean production in the commune of Savè. The research area is located between 7°43'0" and

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8°21'0" north latitude and between 2°21'0" and 2°46'5" east longitude (Fig. 1).

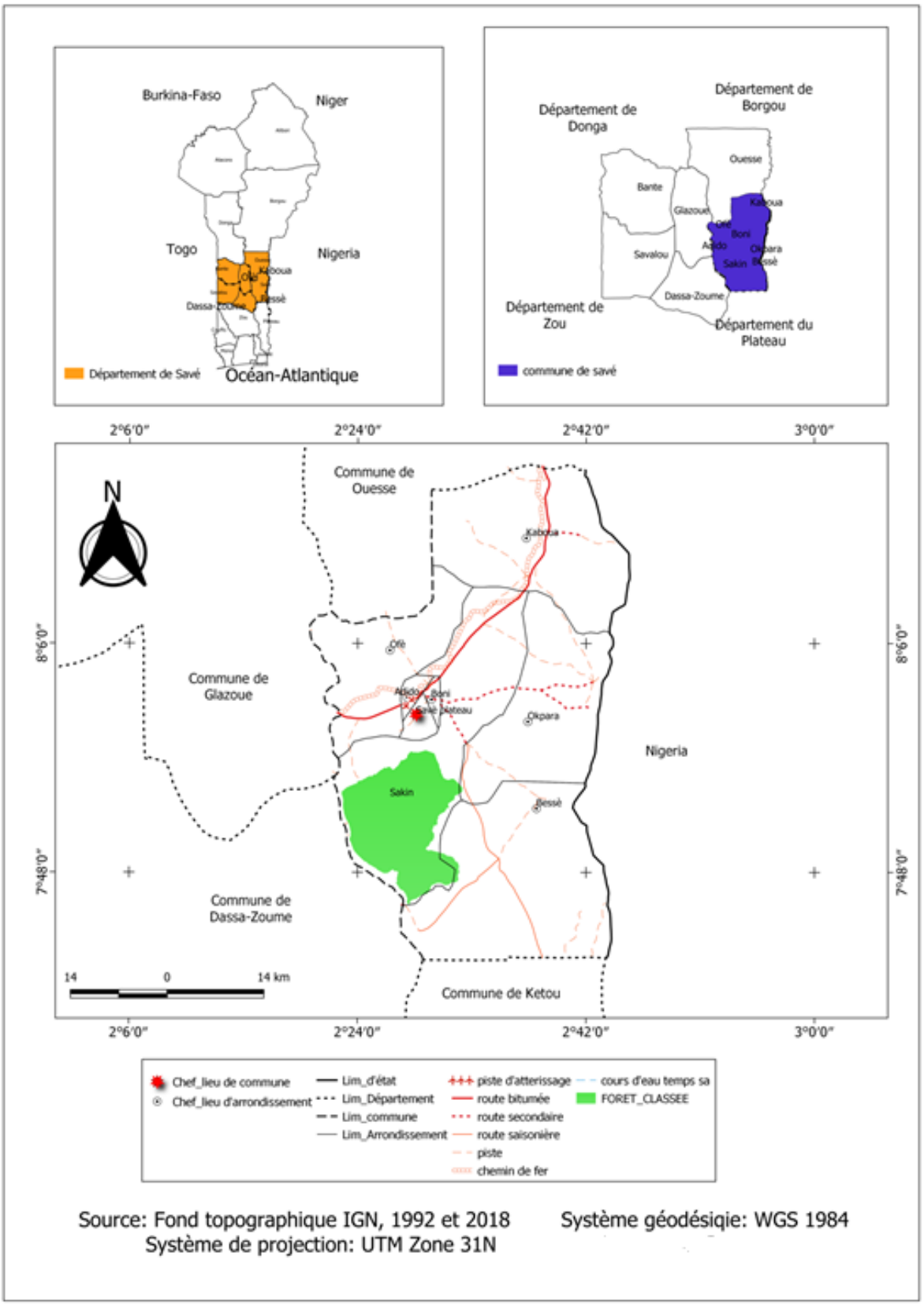

Fig. 1 Geographical location of the research environment.

2. Research Methodology

The data used are rainfall over a period of 1997-2017 and soybean yields over a period of 2003-2017.

A survey was conducted to collect soybean yield data. Given the large number of soybean growers in the commune, the sample size was determined. The formula used here is that of Schwartz (1994)

$$n = Z^2 \times P\,(1\text{-}P)/m^2;$$

where: Z = confidence level according to the moral centered reduced law (for a 95% confidence level, Z = 1.96; P = estimated household proportion (P = Stratum size/Sampling threshold); m = tolerated household margin of error 5% (5/100), $m^2 = 0.0025$.

The formula for determining the size of each stratum.

$$\frac{Number\ of\ strata}{Sample\ size} = \frac{size\ of\ strata}{Farm\ household\ size}$$

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Table 1 shows the number of people surveyed in the different strata of the Savè commune.

Table 1 Determining sample size.

Strata	Stratum sizes	Estimated proportions	Sample size	Number of strata
Adido	277	0.037	55	2
Besse	961	0.13	174	22
Boni	289	0.038	56	2
Kaboua	1451	0.19	236	45
Offe	1798	0.24	280	67
Okpara	1069	0.14	185	26
Plateau	451	0.060	87	5
Sakin	1231	0.16	206	34
Totales	7527	1	1279	203

Source: Calculated from data in RGPH 3, 2023.

A total of 203 people were surveyed in the various strata of the Savè commune.

The data collected was processed and analysed. The results of the data processing were presented.

3. Results and Discussion

3.1 Rainfall Patterns in the Research Environment

Fig. 2 illustrates the rainfall pattern of the research environment.

From observation of Fig. 2, the research environment has a unimodal regime, with the rainy season starting in April and the last rains in October. June, July and August are the wettest months, with rainfall amounts of 150.34 mm, 158.22 mm and 169.69 mm respectively. It should be noted that the various rainfall amounts recorded prove that the research environment is favorable to soybean cultivation. It is important to analyze the annual rainfall in the research environment.

3.2 Interannual Rainfall Variability

Fig. 3 illustrates the interannual variability of rainfall in the research environment.

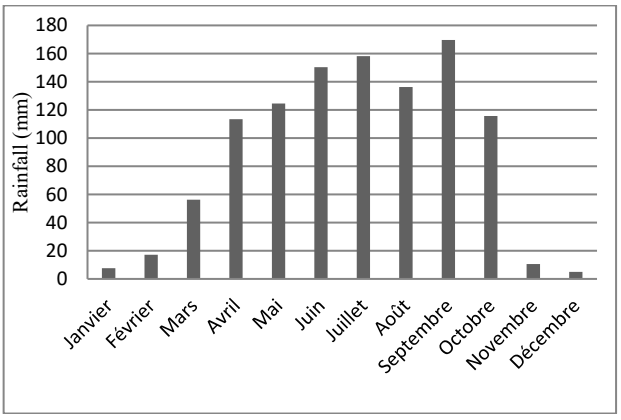

Fig. 2 Average rainfall pattern, 1987 to 2017.

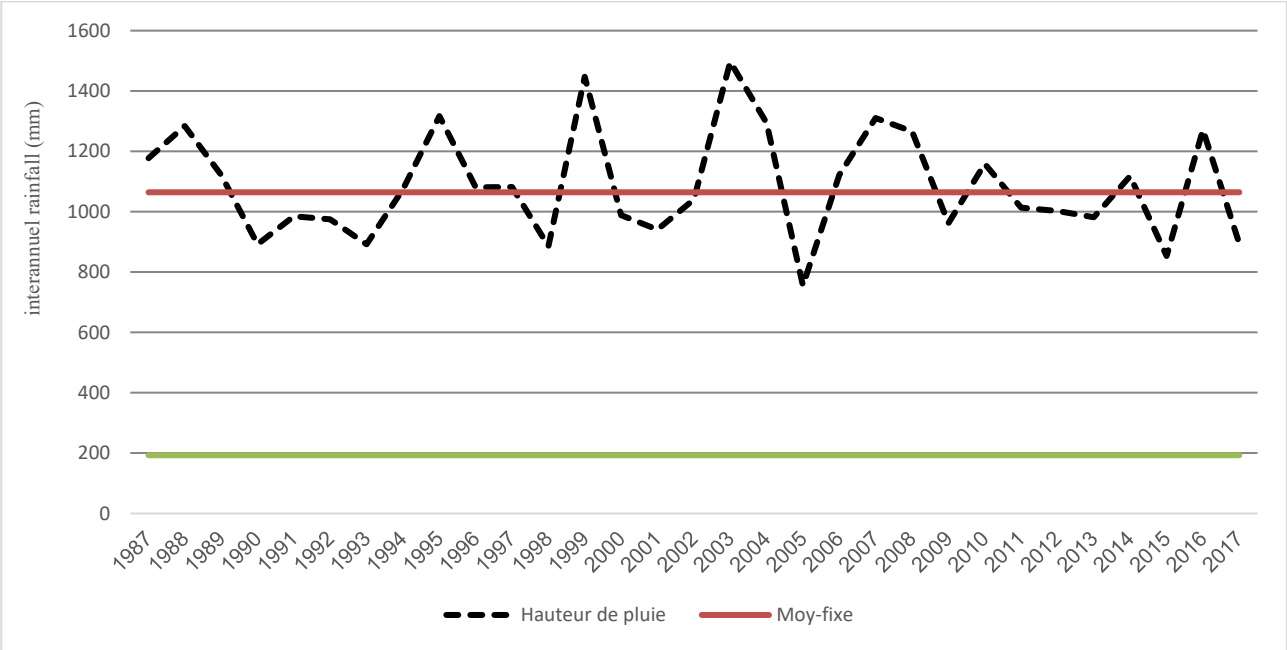

Fig. 3 Interannual variability of rainfall amounts.

Fig. 3 shows that rainfall varies from year to year. However, in 2003, a significant amount of rainfall (1496.8 mm) was recorded, whereas in 2005, a low rainfall (755.2 mm) was recorded. In view of the rainfall recorded each year, it should be noted that not all years are favorable for soybean production in the research environment. Rainfall indices deserve to be presented.

3.3 Rainfall Indices for the Research Environment

Fig. 4 illustrates the rainfall indices of the research environment.

Fig. 4 shows that the 1987-1998 and 2009-2017 periods correspond to deficit anomalies in the series, which have an impact on agricultural activities in general and soybeans in particular, since soybeans require a certain amount of water for their development. As for the period 1999-2008, it corresponds to the period of positive anomalies which will have more or less positive effects on soybean production. The relationship between rainfall and soybean yields is open to question.

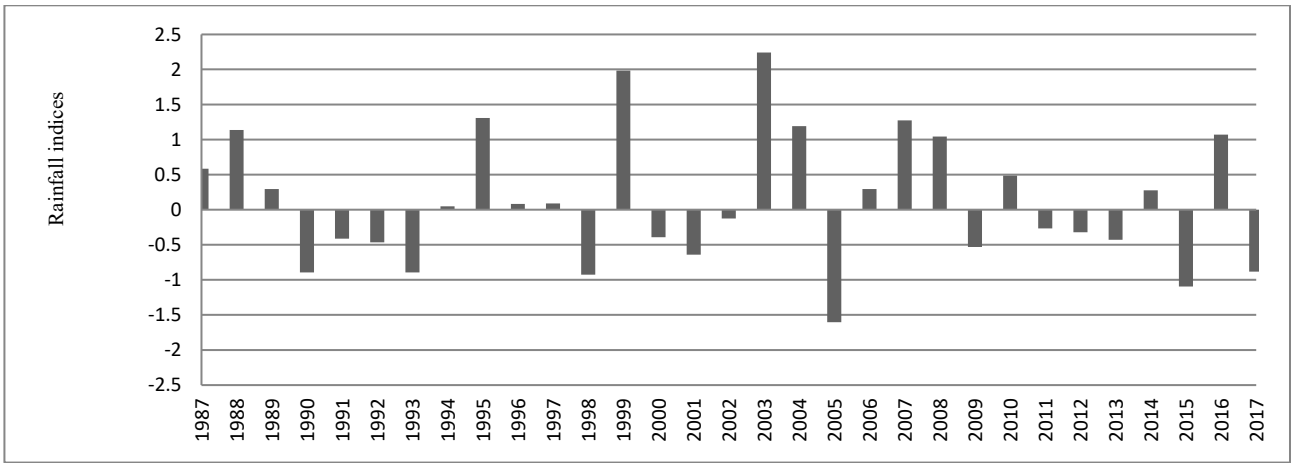

Fig. 4 Rainfall index for the research environment.

3.4 Relationships Between Rainfall and Soybean Yields From 2003 to 2017

Fig. 5 illustrates the relationship between rainfall and soybean yields.

Fig. 5 shows that there is a relationship between rainfall and yields. However, it should be noted that soybean yields are low in both surplus and deficit years. For example, 2003 was considered a surplus year, with a recorded rainfall of 1496.8 mm and a soybean yield of 948 kg/ha. As for the year considered to be in deficit (2005), with a rainfall of 755.2 mm, soybean yield was 850 kg/ha. This result shows that surplus and deficit years are not conducive to soybean production in the research environment. For higher soybean yields, an average rainfall of 1,000 mm is required, as shown by the years 2009, 2011, 2012 and 2013.

To further increase yields, growers use chemical fertilizers.

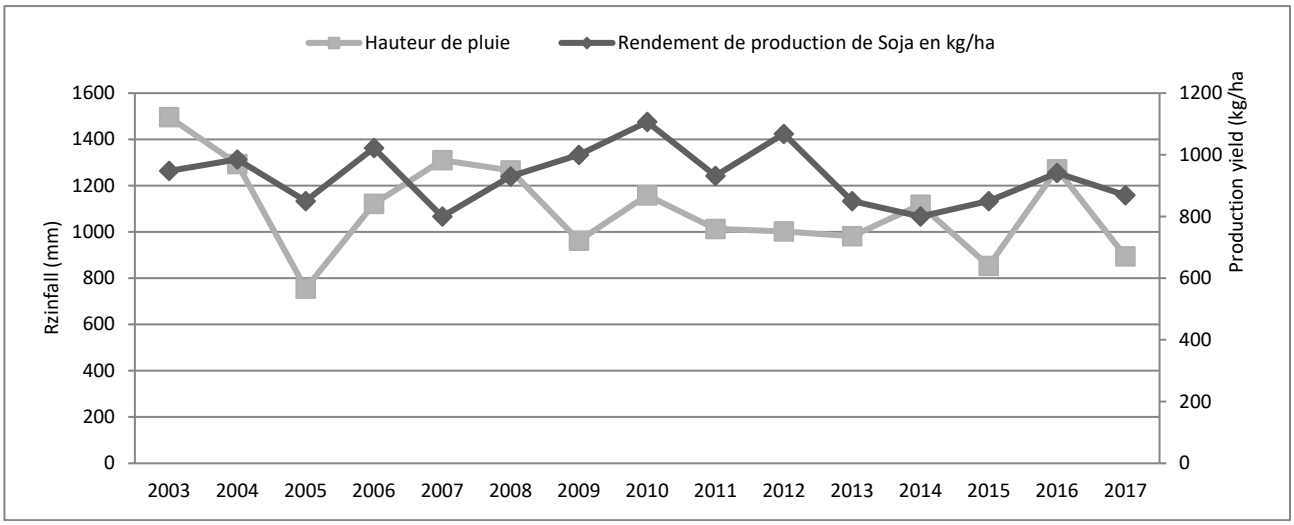

Fig. 5 Relationship between rainfall and soybean yields.

3.5 Chemical Fertilizers Used by Growers

To increase soybean yields, growers use chemical fertilizers such as ammonia phosphate (AP), potassium chloride (KCI), triple superphosphate (TPS), urea, nitrogen and phosphorus ....

The use of inoculum by growers also enables them to achieve good soybean yields. Inoculum is a concentrate of plant-specific bacteria produced by soil microbiology laboratories. Seed inoculation makes it possible to supply these bacteria, which are essential to the plant when they are not naturally present in the soil (Germineo). Figure 6 shows the inoculum sachet.

According to 62% of respondents, they use inoculum to achieve good soybean yields. The remaining 38% use other types of herbicides and insecticides to achieve good yields. To get good results, farmers need to respect the right rate of use. Figure 7 shows a soybean field.

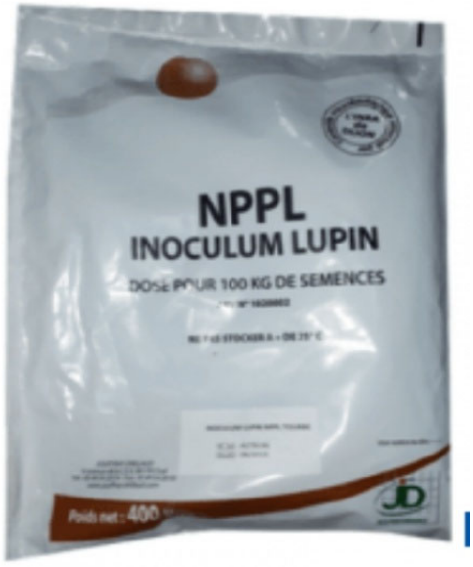

Fig. 6 Inoculum in sachets.

Fig. 7 Soybean field in Boni district (Shot: CHABI, May, 2020).

4. Conclusion

In short, surplus and deficit years are not favorable for soybean production in the research environment. For a better soybean yield, an average rainfall of 1000 mm is required, as shown by the years 2009, 2011, 2012 and 2013. According to 62% of respondents, they use inoculum to achieve good soybean yields. The remaining 38% use other types of herbicides and insecticides to achieve good yields. To get good results, farmers need to use the right dosage.

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