Title	**Effects of hygienised human urine on the productivity of Sorghum (*Sorghum bicolor*), in the agro-ecological conditions of the village of Sabtenga in Burkina Faso**
Keywords	Sorghum, urine, fertiliser, treatment, yield, disease.
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Photograph	

1. Introduction

The regional centre for low cost water supply and sanitation (Crepa), addressing the problems attached to sanitary questions in West and Central Africa, have taken a great interest in the concept of ecological sanitation in seven of its member countries, among them Burkina Faso. This concept is based on the management and upgrading of human excreta as a fertiliser resource in agriculture. To that effect, with the aim to contribute to the amelioration of soil fertility and crop yield, agronomic research following the principles of ecological sanitation, is being conducted by Crepa headquarters at an experimental site in the village of Sabtenga about 20 km north-west of Ouagadougou (Burkina Faso).

This study, which directs the utilisation of hygienised human urine as a fertiliser resource on an ameliorated variant of sorghum named "SARIASO 14", has for specific objectives to (1)determine the effects of human urine on the chemical properties of the soil, the growth, the development and the yield of sorghum; (2) identify the optimal usage dose; and (3) to study the relation between applied dose of urine and the crop's sensibility to diseases. The method used for this test is the Fischer block in four repetitions.

2. Objectives

2.1 General Objective

Valorising human excreta (urine and fecal) in agriculture, to increase soil fertility for the improvement of agricultural production.

2.2 Specific Objectives

The specific objectives of the study consisted in :

- determine the effects of hygienised human urine on the chemical properties of the soil, the growth, the development and the yield of sorghum;
- identify the optimal dose of urine ;
- study the crops sensibility to diseases after urine application.

3. Materials

Vegetal Material: For this study, the vegetal material used is an improved variant of sorghum named « SARIASO 14 ».

Fertilisers: The fertilisers used in the different treatments are: Super Phosphate Triple,serving as source of phosphorous (46% P_2O_5); Potassium Chloride (KCl), serving as the potassium source (60% K_2O); cereal complex: vulgarised mineral fertiliser; urea (46% N); hygienised human urine serving as nitrogen source (0.80% N).

4. Soil Characterisation

The soil samples were taken at the experimental site of the village of Sabtenga before,during and after the experiment and then analysed by BUNASOL[1].

5. Method

5.1 Experimental plan

The experimental plan used in this test is the Fisher Block with six (6) treatments and four (4) repetitions.

[1] Bureau national d'analyse de sol

Six different treatments (T0 – T5) were used in the test.

Number	Sorghum: studied element: nitrogen
T0	Reference , no fertiliser
T1	PK
T2	PK + urine Q/2
T3	PK + urine Q
T4	PK + urine Q + Q/2
T5	Vulgarised mineral fertiliser (FMV)

Q = urine dose corresponding to the nitrogen quantity in the FMV for the chosen culture; Q/2 = half dose of urine;
Q+Q/2 = one and a half dose of urine.

5.2 The collect of urine

The samples of urine, collected from the Ecosan latrines in the village of Sabtenga were analysed before application on plants to determine the possible existence of germs and the content of nitrogen, phosphorous and potassium.

Photos 1 and 2: Ecosan Latrine in Sabtenga. Collecte of urine in a jerry can of 20 l

5.3 Method and period to use fertilisers

The fertiliser applied as basic treatment was spread in the air over the whole surface of the test plots before the sowing. The fertiliser given as regular treatment were applied locally around the seed holes when thinning fifteen (15) days after sowing, and thirty (30) days after sowing.

6. Results

6.1 Analyses of urine

Chemical Analysis:

Table 2 : Results from the analyses of collected urine from the latrines

Samples	1	2	3	4	5	6	Mean value
Total Nitrogen (%N)	0,90	1,40	0,79	0,59	0,49	0,63	0,80
Total Phosphorous (%P_2O_5)	0,14	0,08	0,10	0,03	0,06	0,04	0,07
Total Potassium (%K_2O)	0,40	0,77	0,58	0,18	0,22	0,21	0,39

Microbiological Analysis:
The urine samples (the 6 urine samples plus 2 in addition) were microbiologically analysed. The results from the analysis showed a minor presence of facultative germs (*Enterococcus faecalis, Proteus mirabilis)* in a few samples. Thus, the collected urine did not constitute any hazard against the sorghum plants nor the environment.

6.2 Effects on growth and development of the plants
The different observations were made on the four central seed holes on the two central lines. The measured parameters were: shoot rate, height of plant, stem diameter, mean length of panicle, weight of one thousand grains, estimation of yield and dry matter content of stems.

6.2.1 Shoot rate
The estimations of shoot rate were made 7 days after sowing, before the first application of urine of different doses. The variance analysis of the results has not showed any significant difference between the treatments. This seems to show that the urine does not have a negative impact on the germination of the seeds of sorghum.

6.2.2 Height of plants and stem diameter
The method used for calculation and statistical interpretation of the results is the variance analysis. Statistical analysis shows that the treatments T2, T3, T4, T5 (the three doses of urine and the FMV) appear in the most developed group for both height of plant and stem diameter at all measurements except from the last one of height of plant where treatment T2, T4 and T5 appear in the second group. This tendency seems to describe an availability and sufficiency of the nitrogen in urine of doses Q, Q/2 and 3Q/2, being in parity with the vulgarised mineral fertiliser concerning the physiological equilibrium between different nutritive elements.

Figure 1: Heights of plants (jas = days after sowing)

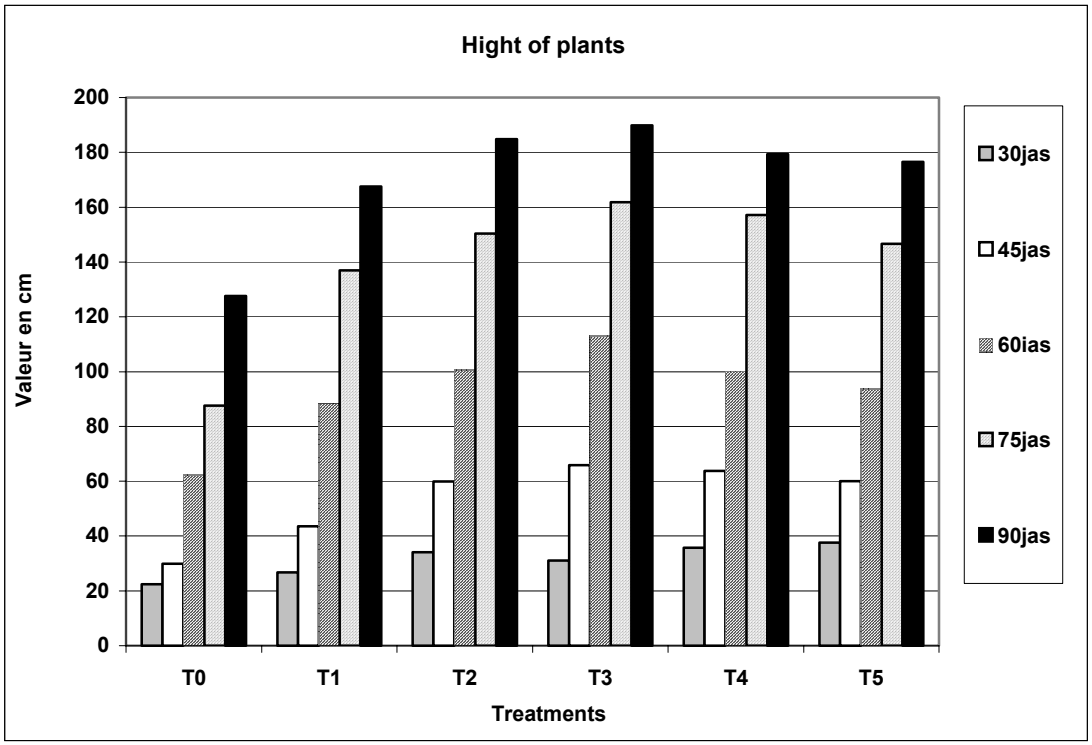
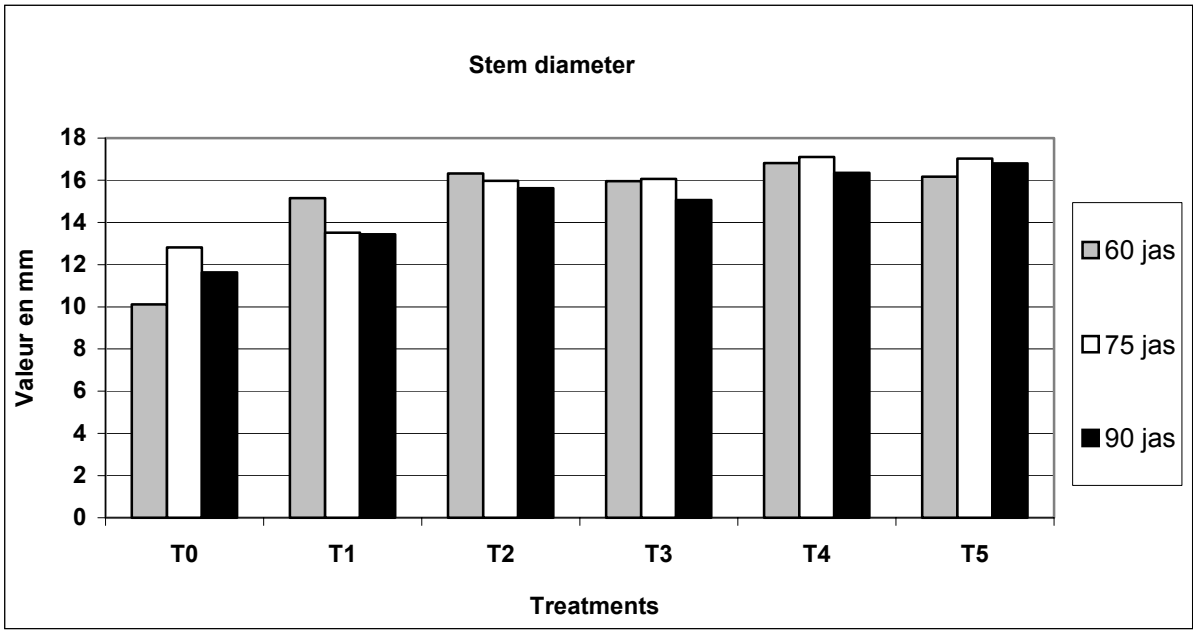


Figure 2:Stem diameter (jas = days after sowing)



6.2.3 Crop yield

The statistical analysis shows that the crop yield is significantly different according to treatment. Three homogenous groups appear, the first group containing the three urine treatments T4(4191), T3(3798), T2(3668) and the FMV T5(4112), the second containing the PK treatment T1(3276) and the third containing the non treated T0(2312).

Figure 3 : Crop yield

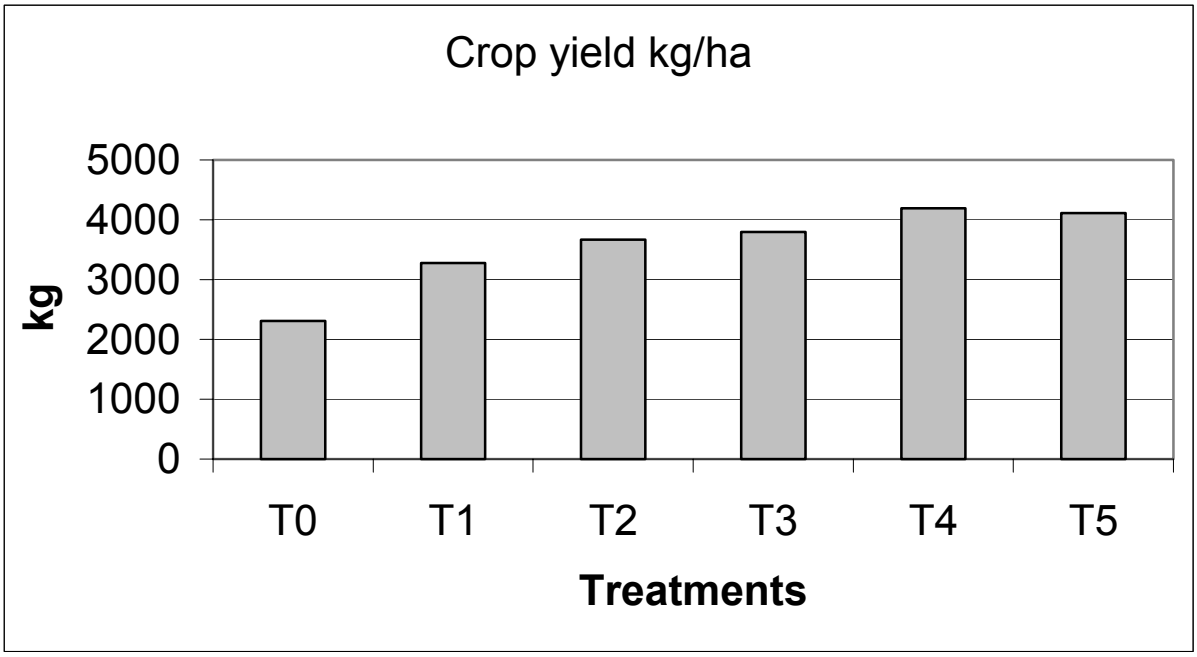
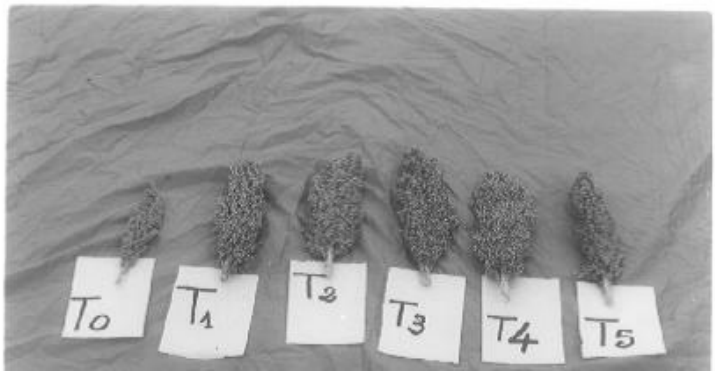


Photo 3: View of one panicle per treatment



6.3 Effects on sorghum diseases

During the field experimentation, two types of foliage diseases caused by fungi have been observed on “SARIASO 14”

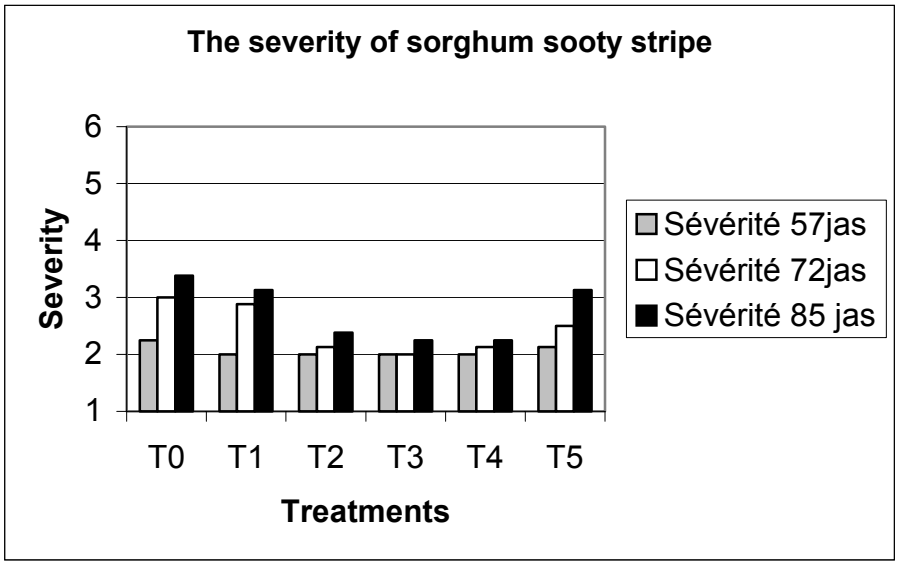
- Sooty stripe disease caused by *Ramulispora sorghi;*
- Sorghum antracnose caused by *Colletotrichum graminicola*.

To estimate the disease severity, a graded scale from 1 to 6 was adopted
Note 1: no symptoms
Note 2: up to 5 % of the foliage surface infected
Note 3: 6 to 25 % of the foliage surface infected
Note 4 26 to 50% of the foliage surface infected
Note 5: 51 to 75 % of the foliage surface infected
Note 6: more than 75 % of the foliage surface infectedde la surface foliaire infectée

6.3.1 Sooty stripe disease

The first symptoms of this disease appear about 45 days after sowing.

Figure 4: Severity of sorghum Sooty stripe (jas = days after sowing).



6.3.2 The sorghum anthracnose:

The symptomes of this disease due to *Colletotrichum graminicola* appeared late, by the time of spiking (about 80 days after sowing) on some plants of T5 (vulgarised mineral fertiliser). Later, by the time of harvest, some spots were observed on the stems of plants with other treatment

8. Conclusion

The statistical analysis of the results shows that the urine treatment of different doses (Q, Q/2 et Q+Q/2) remains competitive with the vulgarised mineral fertiliser in terms of growth, development of plants and crop yield.

The phytosanitary results permit also to conclude that the threshold of severity, that may induce loss in yield, has not been reached for neither of the two diseases observed on the variety « SARIASO 14 ».

In general, with the perspective to upgrade the hygienised human excreta in agriculture, the totality of the results from the agronomic studies in Sabtenga allows to conclude in favour of the application of urine to improve the productivity of sorghum.