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Comparative study of different germination tests to determine the germinative vigor of seeds of five cowpea varieties popularized in Burkina Faso

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ABSTRACT: *Aims:* Seed is the first basic input in agriculture, which is why seed production remains a key sector in a country's agricultural development. However, germination capacity is extremely important in the context of seed exchange. The aim of this study is to evaluate the seed quality of five cowpea varieties.
Methodology: One hundred (100) seeds of five cowpea varieties (Issa SOSSO, Neerwaya, Makoyin, Teeksongo and Yipoussi) were germinated in three germination tests (field test, Petri dish test and pot test). For this purpose, an Alpha design device with one repetition and five elementary plots for the germination test in open ground; 20 Petri dishes for the germination test in Petri dishes and 25 pots for the germination test in pots, were used to set up the various tests. Parameters such as germination rate, average germination time and seedling vigor were collected.
Results: The results showed that the Issa SOSSO variety performed best in terms of germination rate (100%) in Petri dishes, while the Yipoussi variety performed best in pots (91%) and in the field (94%). In addition, a good germination capacity ranging from 88% to 100% in Petri dishes, from 59% to 91% in pots and from 60% to 94% in the field was observed in this study. However, the results of this work showed that the germination test in Petri dishes is the best method for testing the germinative vigour of seeds.
Conclusion: On the other hand, the best seedling vigor performances were observed in pots and in the field. The good germinative capacity of seeds of the different varieties (>50%) observed could help boost cowpea production in Burkina Faso.

KEYWORDS: Seed, variety, cowpea, germination, production, Burkina Faso.

1 INTRODUCTION

The agricultural sector is the main source of employment and income for over 80% of the working population. Despite its role in the country's economy, the agricultural sector is faced with numerous socio-economic, abiotic and biotic constraints, including insect pests, pathogens, climatic hazards and soil poverty. In addition to these constraints, there is the quality of the inputs used in production. Among these inputs, quality seed is of paramount importance. Seed is the first basic input in agriculture, which is why its production remains a key sector in a country's agricultural development. Seed has intrinsic values that require special care to ensure a certain level of production fidelity, even if only for a defined period. However, germination capacity is extremely important in a seed exchange context. With this in mind, this study aims to assess the seed quality of five cowpea varieties. Specifically, the aim is to evaluate for each variety: i) germination performance; ii) seedling vigor.

2 MATERIALS AND METHODS

2.1 STUDY MATERIALS

2.1.1 PRESENTATION OF THE STUDY SITE

The center's environmental and agricultural research department is the site where our internship took place. It is located in the village of Saria, 23km from Koudougou. The research site covers an area of 400 ha. The village of Saria is located according to the following geographical coordinates: 12°16 North altitude, 2°09 West longitude and approximately 300m above sea level. It is bordered to the east by the village of NIANGODOGO (7km), to the west by the village of VILLY (3km), to the south by the village of GODIN (2km) and to the north by the village of NANDIALA (7km). The location map of the Saria research station is shown in figure 1.

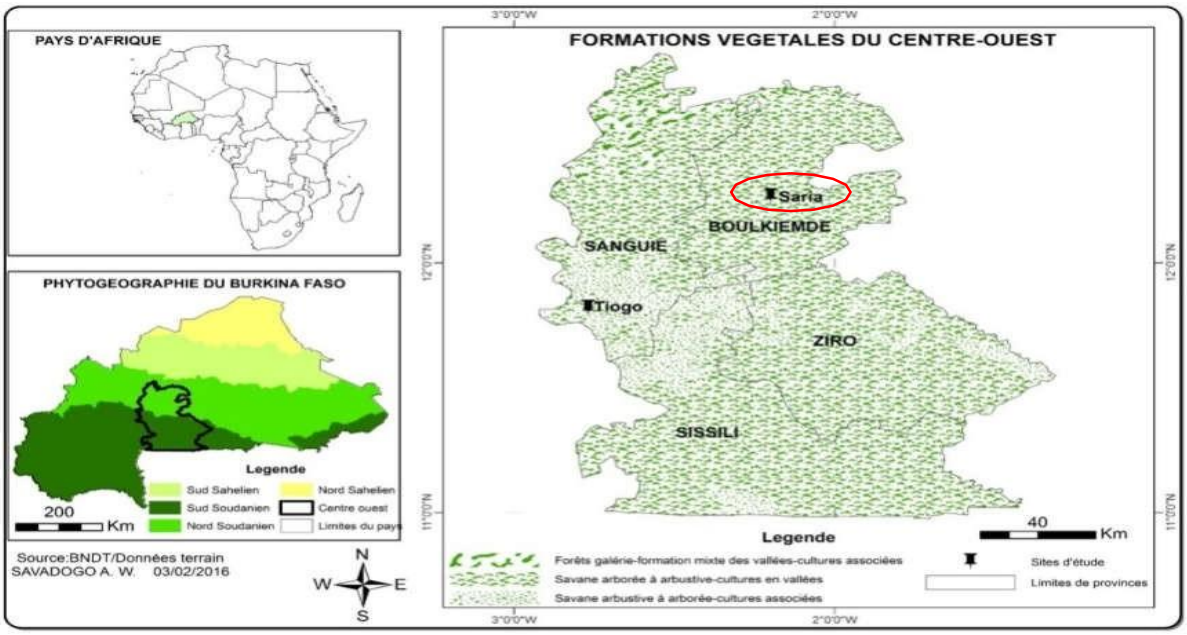

Fig. 1. Location map of the Saria research station

2.1.2 PLANT MATERIAL

The plant material used for the study is composed of five (05) cowpea varieties popularized in Burkina Faso (Figure 1). These different seeds are from the 2021 crop year and are stored in the germplasm of the protein crop program.

They are distinguished by their phenological and agronomic characteristics.

Fig. 2. Varieties used in the study

2.2 METHODOLOGY

Three germination test methods are used in this study:

Germination test in Petri dishes: 100 seeds of each variety are divided into 04 batches of 25 seeds. Each batch is germinated in five (05) Petri dishes, one per variety, for a total of 20 Petri dishes for the germination test (figure 3). Absorbent paper (lotus) is placed in each Petri dish, and batches of 25 seeds are placed on the water-soaked paper without touching each other, and left in a laboratory at room temperature. The moisture content of the paper is checked by observation, and water is added if it is dry. The number of germinated seeds is counted every day for approximately fourteen (14) days, the duration of the germination test.

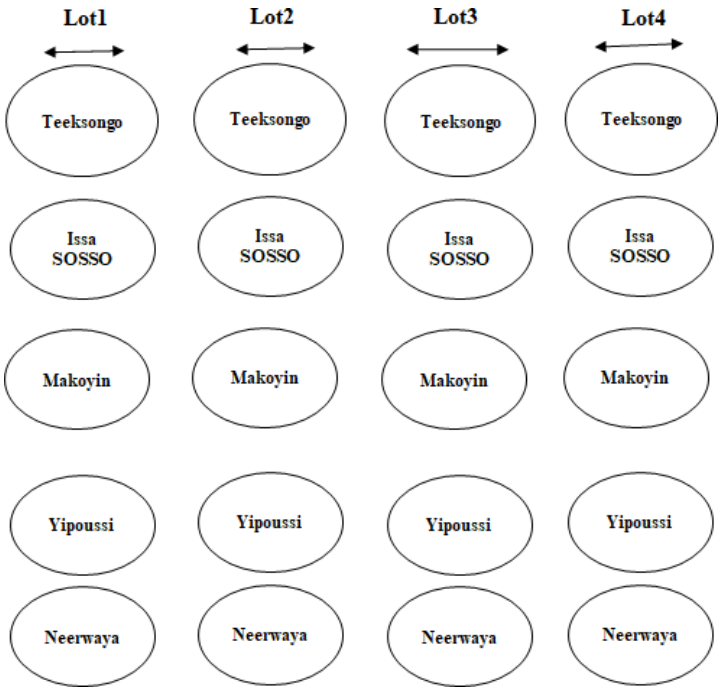

Fig. 3. Petri dish arrangement

Germination test in pots: The germination test was carried out in the middle of the agricultural season.

(01) volume of sand and two (02) volumes of soil. The mixture was then homogenized and filled into twenty-five (25) pots. The pots were divided into five (05) batches. Each batch comprises five (05) pots, one per variety, i.e. a total of five

(05) pots per variety for germination testing. One hundred (100) seeds of each variety were sown at a rate of twenty (20) seeds per pot (figure 4). The pots were pierced at the bottom to facilitate infiltration, and then placed under a greenhouse with a screened roof, alternating day and night, and regularly watered with the same quantity of water in the event of dry spells. The number of germinated seeds was counted every day for around fourteen (14) days, the duration of the germination test.

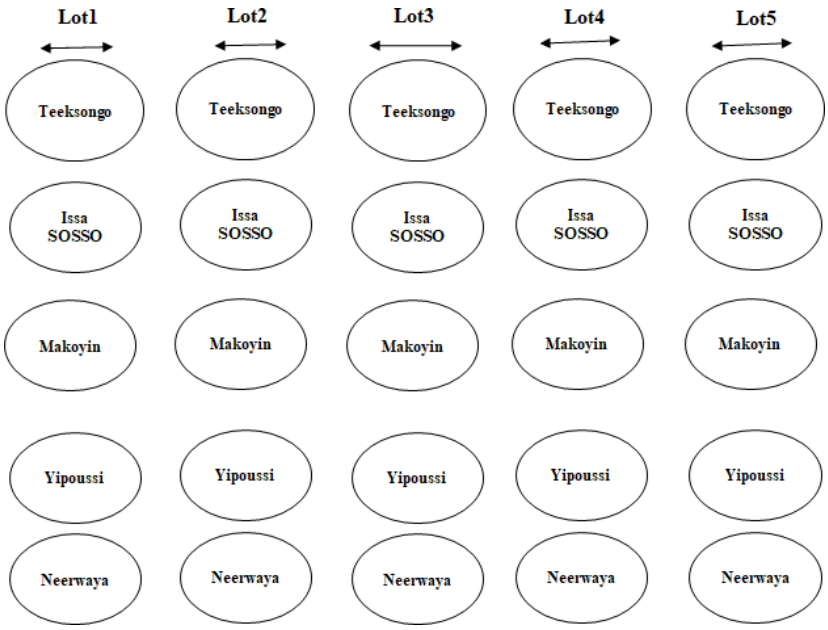

Fig. 4. Pot arrangement

- **Test germination in the field**: After ploughing and levelling, the various elementary plots were delimited and labelled. Five (05) elementary plots were delimited, with one (01) elementary plot per variety. Each elementary plot is 0.8 m x 2 m, i.e. a surface area of 1.6 m. The spacing between elementary plots is 0.4 m (figure 9). Sowing was carried out immediately after labelling, with five (05) 2m lines sown in each elementary plot. The spacing between lines was 20cm and 10cm between bunches, with one (01) seed per bunch for a total of 20 seeds per line and one hundred (100) seeds in each elementary plot. Plot maintenance is based essentially on maintaining humidity. Weeding was carried out when necessary. Observations on the number of germinated seeds were made daily and lasted 14 days, the duration of the germination test. The activities involved in setting up the system and sowing the seeds are shown in figure 5.

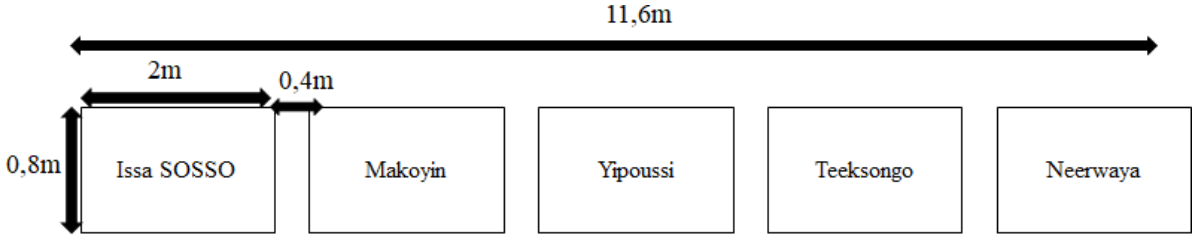

Fig. 5. open-ground system

Data collection

The following parameters were collected:

- **Germination rate (TG):** this is the ratio of the number of germinated seeds to the number of germinated seeds.

$$TG\ (\%) = \frac{\text{number of germinated seeds}*100}{\text{number of germinated seeds}}$$

Average germination time: this is the time it takes for the seeds to germinate, calculated using HARRINGTON's formula:

$$T_{moy.germ.} = \frac{N1T1+N2T2+\cdots\ldots\ldots NnTn}{ZNi}$$

Legend: N1: number of seeds germinated between T0 and T1; N2: number of seeds germinated between T1 and T2.

- **Seedling vigor**: this parameter is based essentially on observation of the uniformity of growth and sturdiness of seedling stems of different varieties after two weeks.

3 RESULT

3.1 VARIATION IN GERMINATION RATE OF VARIETIES ACCORDING TO DIFFERENT TESTS

The germination rate results for different varieties are shown in Table I. The germination rate of the varieties varied according to the germination test. For example. For the Petrie dish test, the Issa SOSSO variety performed best (100%) compared with the Neerwaya variety (88%);

For the test in pots and in the open ground, the Yipoussi variety recorded the highest average values, with 91% compared with the Teeksongo variety (59%) in pots; and 94% compared with the Mokoyin variety (60%) in the open ground. Figure 6 shows germination in relation to the different tests (figure 6)

Table 1. Variation in germination rate according to germination tests

Varieties	Test in Petri dishes	Test in pots	Test in open ground
Issa SOSSO	100	65	70
Makoyin	90	73	60
Neerwaya	88	76	86
Teeksongo	91	59	92
Yipoussi	98	91	94

Fig. 6. Seed germination according to different tests

Legend: A: germination in pots; B: germination in Petri dishes; C and D: germination in open

3.2 VARIATION IN MEAN GERMINATION TIME ACCORDING TO DIFFERENT TESTS

Table II shows the average germination time of the varieties according to the germination tests. The Yipoussi variety took less time (1.27 days) to germinate in Petri dishes than the Issa SOSSO variety (1.52 days). On the other hand, the Teeksongo variety took less time (4.34 days) to germinate in pots than the Neerwaya variety (4.61 days). In the open ground, however, Neerwaya germinated the fastest (3.81 days), compared with Issa SOSSO.

Table 2. Variation in average germination time according to germination tests

Varieties	Test in Petri dishes	Test in pots	Test in open ground
Issa SOSSO	1,52	4,43	4,1
Makoyin	1,37	4,42	4
Neerwaya	1,43	4,61	3,81
Teeksongo	1,41	4,34	4,07
Yipoussi	1,27	4,4	4,05

3.3 SEEDLING VIGOUR IN RELATION TO GERMINATION TESTS

Seedling vigor varied according to germination test (Table III). The Neerwaya variety had very good seedling vigor in all tests; the Teeksongo and Yipoussi varieties had very good vigor in pot and soil tests; while the Issa SOSSO variety had very good seedling vigor in Petri dishes.

Table 3. Variation in seedling vigor as a function of germination tests

Varieties	Test in Petri dishes	Test in pots	Test in open ground
Issa SOSSO	Very good	Very good	Very good
Makoyin	Good	Good	Good
Neerwaya	Good	Very good	Very good
Teeksongo	Good	Very good	Very good
Yipoussi	Good	Very good	Very good

4 DISCUSSION

Seed germination is highly dependent on the nature of the environment, with the substrate being an important parameter.

The best germination rate performances observed in Petri dishes show the ability of seeds to germinate when all germination conditions are met. This would also explain the good germinative capacity of seeds from germinated varieties. With regard to germination rates in pots and in the open ground, the variability in performance could be explained by variations in the physico-chemical and biological quality of the two types of soil. The better germination performance of the majority of varieties in the open ground compared with the germination method in pots, reflects the ability of these varieties to have a satisfactory emergence rate in the natural production environment. In short, the better germination rates recorded in Petri dishes compared with other methods would be due to the fact that germination in Petri dishes is based essentially on the rupture of the testa accompanied by the emergence of the radicle, whereas that of other methods is based on observation of the appearance of the seedling on the soil surface. However, the better performance of seedling vigor in pots and in the open ground would also explain why the soil is the best support for seedlings. The good germinative capacity observed in all three methods shows the good germinative vigour of the different seeds.

5 CONCLUSION

The seeds showed above-average germinative ability. However, the results of this work showed that the germination test in Petri dishes is the best method for testing the germinative vigor of seeds.

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