

Influence of Soil Amendment, Season and Environment on the Germination Potential of Okra

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<https://doi.org/10.56201/jbgr.vol.12.no5.2026.pg29.36>

Abstract

Study on the influence of soil amendment, season and environment on the germination potential of Okra were carried out in the Department of Plant Science and Biotechnology and Rivers State Institute of Agriculture and Training Farm, Rivers State University. A total of 8 treatments were established based on the concentration of the amendments (ST1=6kg SMS+12kg soil, ST2=12kg SMS+12kg soil, ST3=18kg SMS+12kg soil and ST0=12kg soil) and the okra variety (P1=local variety and P2=improved variety) viz: P1ST1, P1ST2, P1ST3, P2ST1, P2ST2, P2ST3, P1ST0 and P2ST0. The established treatments were replicated three times and grown in the screen house and field. All experimental setups were evaluated for in the dry and wet seasons. Association of Official Analytical Chemists (AOAC) method was used to determine the physicochemical contents of utilized soil and SMS. Physicochemical assessment showed that SMS had highest contents of pH (6.62), total nitrogen (74.29mgkg⁻¹), total organic carbon (36.07%) and total organic matter (72.28%) while highest values of available phosphorus (26.4mgkg⁻¹) and electrical conductivity (250 μ S/cm³) were record for utilized soil. Germination percentage screening revealed highest percentage germination 91.66 & 83.33% for screen house and fields sections relatively at the dry season and 100% in both screen house and field sections at wet season for P2ST0. Generally, the study has revealed the implication of SMS soil amendment on the germination potential of okra. Okra performed best in dry, field and lower concentration of amended soils. The germination data also confirmed P2 variety to be superior to P1.

Keywords: Okra variety, germination, soil amendment and season

Introduction

Okra is an economical important vegetable crop grown in tropical and subtropical parts of the world usually cultivated throughout wet and dry seasons to produce green edible fibrous fruits or pods that contains white seeds (Ibitoye and Kolawole, 2022). According to Orluchkwu and Okosa (2018), okra is a tender heat loving vegetable that grows 2m long with broad palmated leaves with 5-7 lobes. The flowers of okra possess five white to yellow petals and red or purple spots at the base of each petal. Research has further showed that okra produce fruits 60 days after planting and the fruit should be picked on time to promote productivity; but when the fruit mature without being harvested, it leads to reduction of yield (Elsakhawy and Abed, 2020). In addition, okra pods are harvested at a particular stage and the fresh mature fruit picked are used as condiments to flavour soups, sold in the market as a source of income to farmers; while some matured pods are allowed to dry for another planting season (Farinde *et al.*, 2007).

According to Farinde *et al.* (2007) there are about eight (8) species of *Abelmoshus* namely, *Moschatus medikus*, *Abelmoschus manihot* (L) Medik, *Abelmoschus esculentus* (L) Monech, *Abelmoschus tubercularus*, *Abelmoschus crinitus*, *Abelmoschus angulosis* Wallex and *Abelmoschus kallei* (A. chev) stevels. *Abelmoschus esculentus* which is the most cultivated of all species. However, there are different varieties of okra, which vary by plant height, size of fruit, colour, early and late maturing such as white velvet, green velvet, long pod, lady figure, dwarf green pods (Udo *et al.*, 2005). Forbes *et al.*, (2021) reported that spent mushroom substrates is known to be the leftover of wastes after different flushes of mushroom have been harvested. Kwiatkowski *et al.*, (2021), reported that spent mushroom substrates are used as manure to grow crops without any support of fertilizer. Literature reviewed that; high organic matter is found to be useful to amend soil for crop growth. (Moses 2021). Parcedes *et al.* (2020) reported that spent mushroom substrate in vegetable farming operation is used as fertilizer to enrich the soil for high yield and to reduce the cost of organic fertilizer.

Natural products used for mushroom production are corn cobs, hays, cotton seed meal, cocoa bean, hulls, wheat bran, rice bran and cassava bran are rich in nutrients (Agbagwa *et al.*, 2020). These nutrients are also found in the spent mushroom substrate after concluding the mushroom production (Agbagwa *et al.*, 2023). Literatures have shown that spent mushroom substrate contains Nitrogen (0.4-13.7%), Phosphorus (0.4-3.77%), Potassium (0.2-2.4%) and other essential elements such as Calcium, Magnesium, Iron, Manganese and many others that makes it suitable for soil amendment (Eleamer, 2020).

It was based on these findings this research was established to evaluate the influence of mushroom waste amended soil on the germination potential of okra.

Materials and Methods

Collection of Materials

Okra seed (*Abelmoschus esculents* (L.) *moench*) used for the study were improved okra and local okra seeds. The improved okra seeds, (NHAR 47-7) were obtained from Agricultural Development Projects (ADP) in Rumuodumaya, Obi/Akpor Local Government Area while local okra seeds (*Otukwu.ru. oma/a'*) were purchased at Mgbede market in Ogba, Ndoni, Egbema Local Government Area, Rivers State. The Spent Mushroom Substrates (SMS) from *Pleurotus* species cultivation was obtained from the Dilomat Farms and Services Limited, Rivers State University Port Harcourt. The soil sample used were randomly collected at a depth of 10m from the Agricultural Teaching Farm of Rivers State University, Port Harcourt using a sterile manured soil auger.

Experimental design;

The experiment design used for the study were Randomized complete block design (RCBD), providing equal chances of growth and development under study. The total size of the plot used for the experiment was 10m X 10m and the area was marked into blocks and plots in a randomized complete block design (RCBD) Each treatment had three replicates, each of the plot distance was 10m and the subplots were 2m x 2m with 0.5m between each plot and 1m walkway between the plots. Each subplot in between had three subplots dimension of 3m x 3m with 0.5 distance from, each of the subplots. This method is adopted for two planting seasons at field and screen house experiment section, respectively

Experimental Treatment

Three different concentrations (6kg, 12kg & 18kg) of SMS were supplemented with a constant 12kg of soil. A total of eight treatments were established in relation to the interaction of the okra varieties and soil amendment levels viz: P1ST1, P1ST2, P1ST3, P2ST1, P2ST2, P2ST3, P1ST0 & P2ST0.

Where;

ST1 = 6kg SMS + 12kg Soil

ST2 = 12kg SMS + 12kg Soil

ST3 = 18kg SMS + 12kg Soil

ST0 = 18kg SMS + 12kg Soil

P1 = Local okra

P2 = Improved okra

Viability Test

The improved okra seeds and local okra seeds were test for viability and they were poured into separate bowls containing clean water and stands for 10 minutes. it was observed that the goods seeds settled at the bottom while the bad seeds floated. the good seeds selected were used for planting. Ten healthy seeds of both improved and local okra seeds were sowed in different transparent foil and placed in room temperature at about 25⁰C to further confirm the viability of the seeds. After two days, the seeds produced radicals, which showed that, the seeds are viable.

Cultivation Processes

The soil and spent mushroom substrate were dried using sunlight and were later collected in different labelled sterile perforated polyethene bag for aeration. The land was cleared and leveled with spade. Three seeds were sown into the bag containing the mixture and control with depth of 2-3cm. The same method was adopted for both screen house and field experiments for the two seasons of planting and observed for eighteen (18) Weeks. Dry season experiment was conducted from 2nd November, 2024 -22nd March, 2025. Wet season experiment was conducted from 3rd May -20th September, 2025.

Harvesting of the okra plant was handled carefully using sharp knife to ensure quality production. The okra pods were ready for harvest after six (6) weeks of planting when they were tender of 5.0-10.0cm in length and width. The pods were checked at interval of 2-3 days to encourage the plants to produce more pods and continued until after 18 weeks after planting.

Germination Percentage

The method of Parcedes *et al.* (2020) was used to evaluate the percentage germination of both varieties of Okra varieties planted in both seasons with the aid of the formula below.

$$\frac{x}{Y} \times \frac{100}{1} = \% \text{ germination}$$

Where:

X – Total number of germinated seeds

Y – Total number of seeds planted.

Soil Assessment

Physicochemical properties of utilized soil and spent mushroom substrate were done in accordance to the method described by AOAC (2005).

Results and Discussion

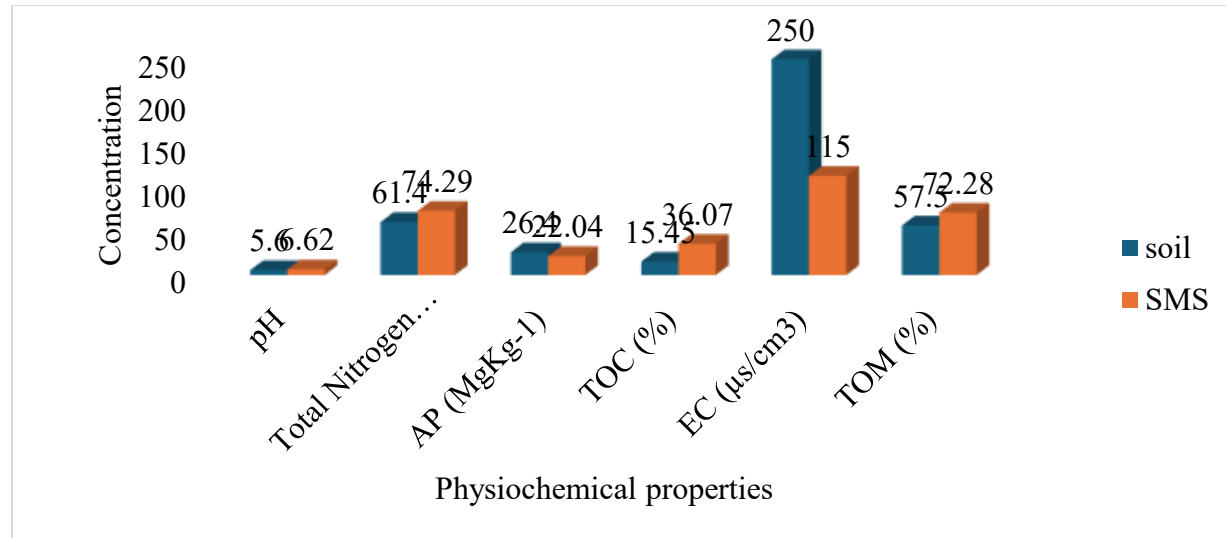


Figure 4.1: Mean Physicochemical properties of utilized soil and SMS

SMS= Spent Mushroom Substrate, TH=Total Organic Matter, EC=Electrical conductivity, TOC=Total Organic Carbon, AP=Available Phosphorus

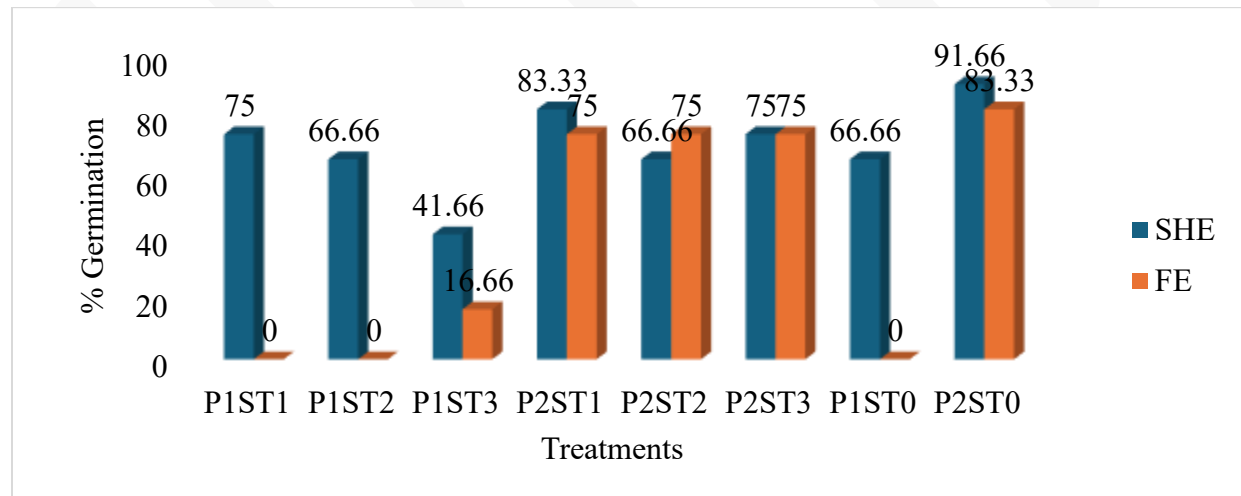


Figure 2: Mean Effect of Amendments on Percentage Germination of Okra in Dry Season (%)

SHE=Screen House Experiment, FE=Field Experiment, P1ST1=Local okra + amendment level 1, P1ST2=Local okra + amendment level 2, P1ST3=Local okra + amendment level 3, P1ST0=Local okra + control soil, P2ST1=Improved okra + amendment level 1, P2ST2=Improved okra + amendment level 2, P2ST3= Improved okra + amendment level 3, P2ST0=Improved okra + control soil

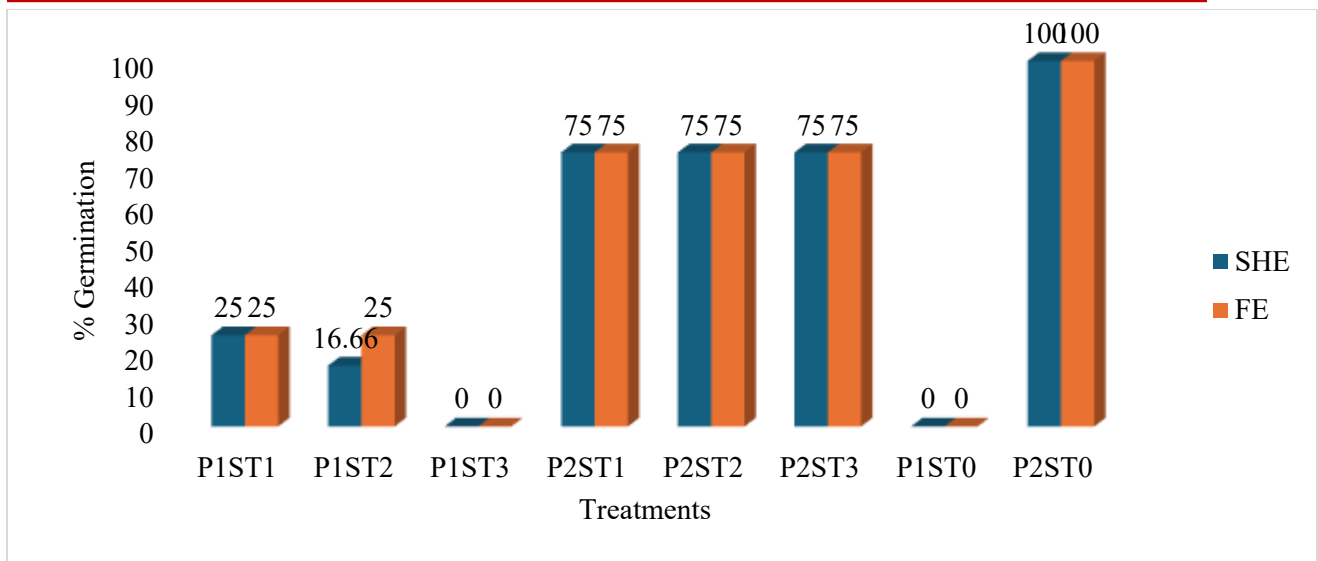


Figure 3: Mean Effect of Amendments on Percentage Germination of Okra in Wet Season (%)

SHE=Screen House Experiment, FE=Field Experiment, P1ST1=Local okra + amendment level 1, P1ST2=Local okra + amendment level 2, P1ST3=Local okra + amendment level 3, P1ST0=Local okra + control soil, P2ST1=Improved okra + amendment level 1, P2ST2=Improved okra + amendment level 2, P2ST3= Improved okra + amendment level 3, P2ST0=Improved okra + control soil Results of the physiochemical properties of utilized soil and SMS before application of amendment presented in Figure 1 revealed that the soil contained soil pH (5.60 ± 0.00), Total Organic Matter ($72.50 \pm 0.00\%$), Electrical conductivity ($500.00 \pm 0.00 \mu\text{S}/\text{cm}^3$), Total Organic Carbon ($15.45 \pm 0.07\%$), Available Phosphorus ($26.40 \pm 0.00 \text{ MgKg}^{-1}$). Furthermore, SMS recorded pH value of 6.62 ± 0.00 , Total Organic Matter ($82.16 \pm 0.00\%$), Electrical conductivity ($115.00 \pm 0.00 \mu\text{S}/\text{cm}^3$), Total Organic Carbon ($36.07 \pm 0.00\%$), Available Phosphorus ($22.04 \pm 0.00 \text{ MgKg}^{-1}$) The result of effect of amendments on percentage germination of both okra varieties presented in Figures 4.2 & 4.3 for dry and wet season experiments respectively revealed varying germination potentials of okra across the different levels of amendment and section of experiment. For the dry season experiment (Fig. 2) both okra varieties performed better in the screen house section than in the field. Although P2 showed higher germination percentage than P1. The result further revealed that the higher the amendment levels the lower the percentage germination of both species of okra. Notwithstanding, P2ST0 recorded highest germination percentage (91.66 & 83.33%) for the screen house and field sections respectively. On the contrary, there were no germination recorded for P1ST1, P1ST2 and P1ST0 for the field experiment. For the wet season experiment (Fig. 3) both okra varieties had similar germination performance at the screen house and field sections. Highest germination percentage (100%) were seen for P2ST0 at both experimental conditions. Although there were no germinations observed for P1ST3 and P1ST0 at both screen house and field sections. Generally, dry season, screen house and lower concentration of amendments supported higher percentage germination. P2 okra variety had higher performance than P1. The result of the present study has shown that the utilized soil and substrate to be acidic in nature with appreciable contents of organic carbon and phosphorus. Earlier reports have also implicated same physicochemical parameters in soil and mushroom substrate (Agbagwa *et al.*, 2020). These components are essential for growth and development

(Agbagwa *et al.*, 2023). The pH result of this study is in line with Gonani *et al.*, (2011) as they reported acidic soils to be the best suitable soil for okra production.

The result of percentage germination also indicated varying germination potential of both okra varieties across the treatments, environment and season. However, best germination potential was recorded for the dry season, screen house, control treatments and improved variety. The high potential recorded in the screen house could be as a result level influence of environmental factor and availability of moisture which is a basic requirement for germination (Rahbarian *et al.*, 2011). The presence of microbial activity in the substrate material could be the reason for the low germination potential in the amended soils. It also possible that the time frame required for the nutrients in the substrate to be released from the breaking down process could cause the reduced germination performance (Ifatimehin *et al.*, 2024). Literatures have shown the importance of sunlight, water and nutrients in seed germination (Luo *et al.*, 2017). The high germination percentage of the improved variety over the local further confirms its status as a hybrid vigour.

Conclusion

The experiment has revealed that both soil and SMS contain valuable nutrients required for plant germination. However, it further showed that dry season, screen house and lower concentration of amended soil supported higher percentage germination and P2 okra variety had higher germination performance than P1.

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