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Use of Indigenous Germination Bioassay to Test Maturity of Common Organic Fertilizers

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Authors' contributions

This work was carried out in collaboration between all authors. Authors Akanbi, W. B. and Jolaoso, M. A. designed the study authors Lawal, B A., Ilupeju, E. A. O. and Ojo, A. M. handled the field work. Authors Ilupeju, E. A. O., and Lawal, B. A. did the literature search authors Akanbi, W. B. and Lawal, B A. wrote the original draft of the manuscript. All authors read and approved the final manuscript.

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ABSTRACT

Compost quality has been described using different techniques. However, none of these techniques is efficient enough to provide a universal answer at all time and place to the question of when compost could be considered matured. In Nigeria, composition of compost varied according to materials and method used to prepare it as well as time interval between preparation and usage. To determine the quality of compost, seeds of nine cultivated crops divided into three seed size grades – large, medium and small were grown in four growing media namely Alesinloye organic fertilizer, Sunshine organic fertilizer, immature and matured Tithonia composts. The seeds were left to germinate and the seedlings allowed to grow for a period of twenty to twenty four days, data were collected on percentage germination and root length. From the data, germination index was computed for each of the crop seed in each of 18 the growth medium. Results show that groundnut and tomato are the least tolerant to poor compost quality among the tested seeds; they had the highest relative germination rate (88) and relative root length (28) respectively in matured Tithonia

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compost but did not germinate in immature Tithonia compost. Beans is the most tolerating among all seeds tried. In term of growing media, matured Tithonia compost positively influenced the crops' performance most. The solid waste compost (Alesinloye and Sunshine) are not significantly different in performance in supporting tried crops. The use of matured Tithonia compost enhanced crop seed germination, seedling growth and development for all seeds tried. Percent germination, root length and germination index were best in this medium when compared with the others. This trial reflected variability in seed germination and seedling development of different crops in response to different composts qualities. Among the tried species, groundnut and tomato are the most sensitive compost maturity indicators; their germination reflect the quality of compost growing medium. It is a quick, cost effective and easy to use method of ascertaining compost maturity among native farmers.

Keywords: Bioassay; compost maturity; compost quality; growth media; percent germination.

1. INTRODUCTION

Compost is a well pulverized organic fertilizer which when applied is capable of supplying needed nutrients to plant [1]. Composts have ability to improve the chemical, physical and biological components of the soil; hence, its use in crop production is inevitable [2]. Despite this, the use of immature compost could be detrimental to crop growth; hence there is the need for farmers to be able to test the maturity of compost before put to use [3]. The quality and maturity of organic fertilizers could be ascertained through many methods, among which are age of composting, maturity time, nutrient content, microbiological, biochemical, heavy metal and pesticide contamination, and chemical and physical properties [3]. The results obtained with the use of these methods are not consistent and it depends on materials used for composting, the composting technology used, and length of curing of the compost, among others.

Some of these methods relied on very expensive and time consuming analytical methods. Because of limitation of fund, knowledge and equipments, almost all the existing methods for determining compost quality and maturity are beyond the reach of local farmers in this immediate environment. Hence, the need to develop local indigenous method of determining quality of composts readily available in Nigeria before application by local farmers. Furthermore, germination of seeds of some identified plants species is among the test of compost maturity certified by CCME guidelines for compost quality [4]. Although cress species was recommended by Zucconi et al. in 1981 [5]; different researchers had tried different crop species, among whom are Pascual et al. [6] and Gajdos [7] who tried barley and ryegrass respectively. The identified test crops are not available here, therefore the need to test available crop species here and identify those that can be used for germination test as a test of compost quality.

2. MATERIALS AND METHODS

Seeds of nine (9) crop species were used in the study. They were obtained from open market in Ogbomoso, Nigeria. The seeds were groups into three (large, medium and small size) on the basis of their relative size. List of seeds used in the germination test are:

2.1 Large Seeds

Arachishypojea: Groundnut
Zea mays: Maize
Phaseolus spp: Beans

2.2 Medium Seeds

Lycopersicon esculentus: Tomato
Solanum melongena: Egg plant
Capscum annul: Sweet Pepper

2.3 Small Seeds

Amaranthus spp: Green amaranth
Celosia agentea Celosia
Jute malo: Cochorus olitorus

The seeds were sown directly into four organic fertilizer types namely: Alesinloye organic fertilizer (industrially produced from solid waste), Sunshine organic fertilizer (industrially produced from solid waste), immature and matured Tithonia composts (TC).The immature and matured TC were prepared in LAUTECH Ogbomoso. The growth containers are plastic bowl perforated at the base to enhance aeration

and drainage. Each bowl was filled with 5 kg of the organic fertilizer material and ten seeds of each crop species were sown directly into each test media.

There were nine seed type and four growth media, which gives 36 treatment combinations replicated three times arranged in Randomised Complete Block Design. They were watered as required. The seeds were left to germinate and the seedlings allowed growing for a period of twenty to twenty four days.

Data collected on the resultant seedlings include relative seed germination and relative root length. From the data, germination index was computed for each of the crop species in each of the growth medium. Data generated were subjected to analysis of variance with means separated by Duncan Multiple Range Test at 5% probability level using SAS package. Relative seed germination RSG (%) was computed as number of seeds germinated in the extract divided by number of seeds germinated in the control multiply by 100; relative root growth RRG (%) was computed as mean root length in the extract divided by mean root length in control multiply by 100 while the Germination index GI was RSG multiply by RRG divided by 100.

3. RESULTS AND DISCUSSION

Table 1 presented the effect of different organic fertilizer on relative seed germination of tested crop species seeds. Irrespective of the crop species and seed size, immature TC reduced seed germination significantly. All large seeds species but groundnut (0%) germinated while maize seeds had 12% and beans had 24%, which was the highest germination percentage for all crop species tried. Germination percentage of all other species is 0% except eggplant with 10%. Among the crop species, only beans, maize and eggplant germinated in all the growth media. Again, matured TC as germination medium significantly enhanced crop seed germination positively compared with other media. Among the large seed species, groundnut that did not germinate in immature TC had highest germination percentage in matured TC (88%); this is the highest in all the species and growth media. In the two solid waste organic fertilizers, groundnut also had the least germination percentage, which was significantly lower compared with others except celosia in Sunshine organic fertilizer growth medium. Among the nine tried species, groundnut followed by celosia appeared to be least tolerating to poor quality and immaturity of compost as a growth media. The reduction in germination of crop seeds in immature TC could be linked to incomplete decomposition of its feedlots. Everett and Phil [3] observed similar trend in their research study, they linked their results with presence of phototoxic chemical or compounds in immature compost. This inhibits or retards seed germination processes.

The relative root growth of each crop species in each medium of growth is shown in Table 2. Eggplant had the highest relative root growth (8) in the immature TC, maize and beans had 4 while other crop species had zero. In the solid waste compost, groundnut had the least RRG (10) which was significantly lower than others in Sunshine organic fertilizer while celosia had the least (12) which was also significantly lower than others in Alesinloye organic fertilizer. This observation was similar to relative seed

Table 1. Relative seed germination of the crop species in the tested organic fertilizers

Seed species	Growth media			
	Alesinloye organic fertilizer	**Sunshine organic fertilizer**	**Immature tithonia compost**	**Mature tithonia compost**
Arachis hypojea: Groundnut	16e	12d	0d	88a
Zea mays: Maize	80a	82a	12b	80a
Phaseolus spp: Beans	78a	86a	24a	86a
Lycopersicon esculentus: Tomato	50c	58bc	0d	86a
Solanum melongena: Egg plant	69b	62b	10c	74b
Capscum annul: Sweet Pepper	60b	62b	0d	81a
Amaranthus spp: Green amaranth	48c	54c	0d	60bc
Celosia agentea: Celosia	31d	40d	0d	58c
Jute malo: Cochorus olitorus	60b	52c	0d	62bc

Table 2. Relative root growth of the crop species in the tested organic fertilizers

Seed type	Growth media			
	Alesinloye organic fertilizer	Sunshine organic fertilizer	Immature tithonia compost	Mature tithonia compost
Arachis hypojea: Groundnut	21b	10d	0c	24b
Zea mays: Maize	24a	24a	4b	22b
Phaseolus spp: Beans	24a	22a	4ab	24b
Lycopersicon esculentus: Tomato	18c	18b	0c	28a
Solanum melongena: Egg plant	21b	18b	8a	26a
Capscum annul: Sweet Pepper	24a	20b	0c	21c
Amaranthus spp: Green amaranth	16c	18b	0c	20c
Celosia agentea Celosia	12d	14c	0c	18d
Jute malo: Cochorus olitorus	22a	16bc	0c	26a

Mean along the column with the same letter are not significantly different (DMRT, 5%)

germination response of the nine crop species. The reports also indicative that groundnut and celosia are the most sensitive to poor quality organic fertilizer among the tried crop species; this is in line with the observation of Warman [8] that crops seeds varied in their sensitivity to compost maturity.

4. CONCLUSION

Among the crop species tested, it could be concluded that groundnut and celosia are the most reliable in testing the maturity and quality of different organic fertilizers among the crop species tried. They are most sensitive to poor quality and immaturity of organic fertilizers tried. The low resource farmers who dominate the users of most organic fertilizers in Nigeria market could adopt this method.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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