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Effects of Soil Depths and Soil Types on the Seedlings Emergence of *Celosia argentea*, *Amaranthus viridis* and *Corchorus olitorus*

OLUWOLE[1*] Surukite Opeolu, OGUN[1] Mautin Lawrence,
MUTAIRU[1] Aishat Omowunmi and BABALOLA[1] Damilare Oluwasegun
[1]Department of Botany, Lagos State University, Nigeria

Abstract:- Seedling emergence and crop production is as a result of many factors, these factors include temperature, water availability, seed depth and so on. Seedling emergence is a function of seed size and depth of sowing during cultivation. It is also influenced by the types of soil. Thus, it is on this basis that this study tends to determine the effects of soil depths and soil types on emergence of Celosia argentea, Amaranthus viridis and Corchorus olitorus. The seeds Celosia argentea, Amaranthus viridis and Corchorus olitorus were obtained from Agricultural Input Supply, Agric Bus-Stop, Ojo- Lagos State, Nigeria and seeds were sown in bowls having soil as growth medium respectively. The seeds were subjected to emergent test at different depths (0cm, 1.5cm, 2.5cm and 4.0cm) and emergent records were taken for ten days. Also, the seeds were sown in loam, clay and sandy soils respectively. The results show that Celosia argentea emerged best at the surface (0cm) while Amaranthus viridis and Corchorus olitorus emerged best at 1.5cm depths respectively. However, loamy soil had the best emergent performance compared to clay and sandy soils for all the seeds. It is therefore concluded that, for effective and efficient crop production, the best soil depth and soil type should be used.

Keywords:- *Soil Depth, Soil Type, Clay, Loam, Sand, Celosia Argentea, Amaranthus Viridis, Corchorus Olitorus.*

I. INTRODUCTION

Crop production and yield is a product of so many factors. Some of these factors that affect crop production and yields are soil types, seed types, soil depth of seeds and so on. Seedling emergence and establishment has been reported to be a function of size of the seed and depth of sowing during cultivation [1]. Seedling emergence is the single most important phenological event that influences the success of an annual plant. Seedling emergence shows the point in time when a seedling is weaned from dependence upon non-renewable seed reserves originally produced by its parent and when phototrophic begins [2]. Thus, emergence occurs when a plant break out of its seed coat and the stem rises out of the soil.

Chachalis and Reddy [3] and Karayel and Ozmerzi [4] reported that environmental factors such as soil temperature, soil water, seed depth, light quality, soil fertility, soil salinity, soil compaction, soil types and so on are likeable environmental factors that could affects seedling emergence. Soil depth is one of the factors affecting emergence and is the depth of the soil to which the roots of a plant can readily penetrate in order to reach water and nutrients [4]. However, Odeleye and Olufolaji [1] reported that planting beyond 3cm depth led to the reduction in emergence vigor and yield. This affects the performance of crops. Seedling emergence is influenced by the depth of sowing small seeded crops like those of *Celosia argentia*. *Corchorus olitorus* and *Amaranthus viridis* are small and may exert limited axial growth pressure to support seedling emergence [1].

Seedling emergence could be influenced by the types of soil since the development of seed strength has been shown to be influenced by soil characteristics [1, 5]. Soil types refers to various types of soil which ranges from clay, loamy, sandy, silt and other types of soil. Clay soil is composed of very fine particles, usually silicates of aluminum, iron and magnesium. Clay soils impede the flow of water, meaning it absorbs water slowly and then retains it for a long time. Wet clay soils are heavy and sticky. Thus, make roots unable to penetrate through the soil easily. Adding organic materials to clay soil is an effective method [5]. Sandy soils are often dry, nutrient deficient and fast draining. Sandy soils have little or no ability to transport water from deeper layer through capillary transport. Therefore, tilling sandy soil in the spring should be kept to a minimum in order to retain moisture in the seed bed [5]. Thus, nutrient absorbing and water holding capacity of sandy soils are being improved through adding organic materials. Loamy soils contain sand, clay and silt in relative proportions. It is the ideal soil for most garden plants because it holds plenty of moisture but drains well so that sufficient air can reach the roots. It contains more of humus and moisture than sandy soil [5].

Celosia argentea L is an erect annual herb belonging to the family *Amaranthaceae*. It grows to a height of about of about 2cm with ridge and glabrous stem. The leaves are alternate, simple and without stipules. The leaf blade is ovate to lanceolate-oblong or narrowly linear, upto15-20cm x 7-9cm; there is tapering at the base and it is acute to obtuse and shortly mucronate at the apex, entire, glabrous and pinately veined. The fruit of *C. argentea* is ovoid to globose capsule of 3-4 cm long, circumscissile and few seeded. The seeds are black and shinning [6]. *C. argentia* comprises of about 50 species and it is commonly known as quail grass, soko, celosia, and feather cockscomb. *C.*

argentia is grown on raised beds, ridges or flat beds and it may be seeded directly into the soil at a depth of 0.75cm (0.25 Inch). The seeds are mostly been used for propagation but stem cuttings is inevitably used [7]. It is cultivated as a nutritious leafy vegetable in Nigeria where it is known as 'Sokoyokoto' meaning make husband fat and happy [6, 7]. The leaves and tender stems are cooked in soups, sauces or stews with various ingredients including other vegetables such as onions, pepper and tomatoes with fish or meat and palm oil. The new inflorescences are also used as potherb [7]. In Kenya, the Masia use the liquid extract from the leaves and flowers as body wash for convalescents; the whole plant is used as an antidote for snake bite and roots to treat gonorrhea and eczema while in Ethiopia, the flowers are used to treat dysentery and muscles troubles, the seeds for treating diarrhea. Also, *C. argentea* are rich in protein, vitamin A and C, calcium and iron which are more in harvested plants between 5-7weeks after planting [8, 9, 10]. More so, they are also composed of some phyto-chemicals such as anthocyanin, betalain, betaxanthins and so on.

Amaranthus viridis is an annual, erect herbaceous plant belonging to the family *Amaranthaceae*. It is widely found tropical and subtropical regions of the world such as Nigeria, Gabon, and Australia and so on as cosmopolitan weed [11]. It grows to a height of about of about 6-80 cm tall with glabrous to pubescent stem. The leaves are glabrous or pubescent on the veins of the lower surface, simple and without stipules [12]. The leaf blade is ovate to rhombic-oblong, upto2-7cm x 1.5-5.5 cm, there is tapering at the base and it is blunt to rounded and minutely mucronate at the apex, barely to clearly emarginate and pinately veined. The fruit of *Amaranthus viridis* is ovoid to globose capsule of 3-4 cm long, circumscissile and few seeded. The seeds are black and shinning [13]. *Amaranthus viridis* comprises of about 69 genera and 600 species and it is commonly known as Amaranth or pig weeds [2, 14]. *A. viridis* is grown on raised beds, ridges or flat beds [15] and the seeds sown directly into the soil at a depth of 2.5cm have been reported to show no germination [16]. The seeds are mostly been used for propagation but stem cuttings is inevitably used [17]. It is cultivated as a nutritious leafy vegetable in Nigeria where it is known as '*Efo tete* or *Arowo jeje'* meaning we have leftover for fish [18, 19]. The leaves and tender stems are cooked in soups, sauces or stews with various ingredients including other vegetables such as onions, pepper and tomatoes with fish or meat and palm oil. The leaves are also used as salad and have a slightly sweet flavor [20]; and the seeds have been grounded into flour for making bread [16]. In East Africa especially in Swahili, *A. viridis* leaves is used in treating low blood cell count; in West Africa especially Nigeria, it is used in cooking popular '*Efo riro*' soup. Also, *A. viridis* are rich in protein, vitamin B and C, calcium and iron which are more in harvested plants between 5-7weeks after planting [10, 21, 22]. More so, they are also composed of some phyto-chemicals (β- carotene and so on) used as anti-inflammatory, antidiuretic, antiemetic, anti-leprotic and so on [23, 24, 25]. It has also been reported for treating snakebites, eczema, scorpion sting and inducing abortion, and so on [13, 26, 27, 28].

Corchorus olitorus is an annual or biennial herbaceous plant belonging to the family *Teliaceae*. It is erect, stout and branched. It grows to a height of about 1.5m, leaves are lanceolate to ovate-lanceolate and subotuse at the base with serration at the margin extending to the most basal parts. The leaf apex are glabrous with 3-5 sparsely hairy nerves, petioles are 2-3 cm long, with pubescent, stipules are subulate with 8-12 mm long. Flowers are subsessile; bracts are subulate and 4-5mm long; sepals are linear, oblong, apiculate and about 5-7mm long; petals are oblong-satulate, obtuse and are 5-7mm long [29, 30, 31]. Seeds are bluish green to steel grey coloured with 25-40 small seeds per row with transverse partition between each seed. Roots are deeper with less number of lateral roots. *Corchorus olitorus* is commonly called jute and its origin is in Africa [32] but can be found in other parts of the world. It is grown for both fiber and culinary purposes. It is used as herb in Middle Eastern and African countries where leaves are used as an ingredient in a mucilaginous potherb called '*Molokhiya*'; in Nigeria, it is called *Ewedu* by the Yoruba tribes and grown for its nutritious leaves, thus, used for soup and eaten with starchy staples foods [9, 33, 34]. Many parts of *C. olitorus* have been reportedly used for pharmaceutical purposes such as treating various ailments such as stomach ulcer, fever, chronic cysti, gonorrhea and so on [35, 36, 37, 38] and also have been reported to contain high quantities of nutrients such as vitamin, protein, and so on [39, 40].

Moreover, the importance of these leafy vegetables cannot be underestimated; hence, farmers are faced with the challenge of increased demands for these vegetables in Nigeria (Lagos) where there is increase in population and or boost remuneration. Thus, this study tends to determine the effects of soil depth and soil types on the emergence of *Celosia argentea*, *Amaranthus viridis* and *Corchorus olitorus;* and the best soil depth and suitable soil types for the emergence of the seeds of these leafy vegetables.

II. MATERIALS AND METHODS

Experiments were carried out in a greenhouse of the Botanical Garden, Department of Botany, Faculty of Science, Lagos State University, Ojo- Lagos, Nigeria for the periods of 10 weeks. Mature seeds of *Celocia argentea, Amaranthus viridis and Corchorus olitorus* were obtained from Lagos State Agricultural Input Supply, Agric Bus-Stop, Ojo- Lagos State. The soil samples were collected from different locations: Clay- Post Service area, Lasu Ojo; Fine Sand- behind the new science Complex, Lasu Ojo; Loam- Homes and Garden designs, Village Bus Stop along Lasu-Isheri road. Each of the soil samples was analyzed at Kappa Biotechnology Laboratory at Bodija, Oyo State, Nigeria and the soil compositions determined (Tables 1 and 2).

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Parameters	Loam	Clay	Fine Sand
Porosity	68.10	55.33	71.47
pH	7.69	5.81	6.28
Moisture content (%)	16.53	24.67	12.93
Conductivity (µS/cm)	63.00	52.00	27.20
Total-Nitrogen(mg/Kg)	39.63	42.53	12.67
Total Organic Carbon (%)	34.08	19.50	14.22
Total organic matter (%)	32.23	4.90	1.41
PO^{-}_{4} (mg/Kg)	252.5	212.5	92.5
Pb^{++} (mg/ Kg)	0.60	0.06	0.04
Hg^{++} (mg/Kg)	0.02	0.02	0.00
Cd^{++} (mg/Kg)	0.01	0.02	0.01
Zn^{++} (mg/Kg)	1.50	1.60	1.20
Ni^{++} (mg/Kg)	0.60	0.05	0.05
As^{++} (mg/Kg)	0.09	0.01	0.1
Total-Petroleum Hydrocarbon (mg/Kg)	2.60	1.25	0.50

Table 1:- Soil analysis of Soil Samples use

Parameters	Loam	Clay	Fine Sand
Total heterotrophic Bacteria (CFU/s/g)	3.80×10^{4}	2.90×10^{5}	6.3×10^{4}
Organisms Identified	Bacillus sp Pseudomonas sp. Flavobacterium sp.	Flavobacterium sp Bacillus sp Pseudomonas sp. Staphylococcus sp.	Pseudomonas sp. Bacillus sp. Flavobacterium sp.
Total Anaerobic Count (CFU/s/g)	3.3×10^{6}	2.0×10^{3}	5.2×10^{2}
Organisms Identified	Lactobacillus spp.	Lactobacillus spp.	Lactobacillus spp.
Total fungal count (CFU/s/g)	7.5×10^{4}	3.9×10^{4}	4.8×10^{4}
Organisms Identified	Aspergillus sp. Penicillium sp. Geotrium sp. Mucor sp. Rhizopus sp.	Aspergillus sp. Penicillium sp. Rhizopus sp.	Aspergillus sp. Penicillium sp.
Total-Coliform Count	6.8×10^{3}	4.3×10^{4}	2.1×10^{3}

Table 2:- Soil Microbial Loads of the Soil Samples used

A. Preparation and Seed Planting

The soil samples collected were filtered to remove available hard objects. A preliminary test was first conducted to test for the seeds viability; thus, thirty seeds of *Celosia argentea*, *Amaranthus viridis* and *Corchorus olitorus* were sown respectively in loamy soils in different bowls to test their viability. Twenty seeds were sown per planting bowl at varying soil depth of surface (0cm), 1.5cm, 2.5 cm and 4.0 cm for four replicates on loamy soil respectively to determine soil depth on seed emergence. Also, equally perforated sixteen bowls of 5 litres each was labeled with corresponding soil types and twenty seeds of *Celosia argentea*, *Amaranthus viridis* and *Corchorus olitorus* per planting bowl were sown in clay, sandy and loamy soils respectively for replicates. All planting bowls were spaced apart and watering done once a day; number of emerged seeds were counted and recorded daily for 10 days. Emergence occurred two days after sowing for *Celosia argentea* and *Amaranthus viridis* while as at third day, *Corchorus olitorus* was recorded.

B. Statistical Analysis

The quantitative data collected were subjected to mean± standard deviation using MS excel 2007 version. All the data collected were in triplicates.

III. RESULT AND DISCUSSION

A. Effects of Soil depths on the Emergence

Table 3 shows the effects of different soil depths on the emergence of *Celosia argentea*, *Amaranthus viridis* and *Corchorus olitorus*. Thus, the results revealed that emergence was observed at all depths for all the vegetables (Table 3). As the depth increases, emergence of *Celosia argentea* decreases in the order of 0cm > 1.5cm > 2.5cm > 4.0cm. This progressive decrease in the number of emerged seedlings as sowing depth increase in *Celosia argentea* indicates that the small seeds of *C. argentea* have food reserve for the energy required for germination and emergence which is usually sustained through the process of oxidation during respiration [1]. However, this finding agreed with the work of Odeleye and Olufolaji [1], when they reported that *Celosia argentea* emerges well in the

order of 0cn > 1cm > 2cm > 3cm sowing depth. Also, the emergence of radical and hypocotyl have to develop a pressure to pierce the soil; at the distance, the hypocotyl has to transverse in the soil to the surface increases, while inherent seed energy decreases [1]. Similar results were reported by Mohammed [41] when he worked on *Convolvulus arvensis*, he reported that the emergence was reduced with increasing depth of sowing. *Amaranthus viridis* and *Corchorus olitorus* had their best emergence at 1.5cm depth, which is in the order 1.5cm > 0cm .> 4.0cm > 2.5cm and 1.5cm > 2.5cm > 4.0cm >0cm respectively (Table 3). This finding agreed with the findings of Okusanya [42]. He attributed this to slower activation of physical process of water uptake which leads to reduction in metabolic process at the surface compared to the depth of 1.5cm. Also, low and poor emergence of surface sown *Amaranthus viridis* and *Corchorus olitorus* could be due to the fact that such seeds were directly exposed to high surface temperature which may not be the optimum for *Amaranthus viridis* and *Corchorus olitorus* or effect of pest at the surface which could inhibit the growth of emerged seedlings immediately after they emerged [43].

B. Effects of Different Soil Types on the Emergence of sample plants

Table 4 shows the effects of different soil types on the emergence of *Celosia argentea*, *Amaranthus viridis* and *Corchorus olitorus*. The results revealed that *Celosia argentea*, *Amaranthus viridis* and *Corchorus olitorus* emerged on the all the soil types with the emergence observed in loamy soil. These findings concurred with finding of Okusanya [42] when he reported that *Amaranthus viridis* was significantly better in loamy soil compared to other soil types. This he attributed to the fact that loam contains high weight of remains of dead decomposing organism, which increases its nutritional content. Thus, according to the soil analysis comparison of loamy soil to other soil types (Tables 1 and 2), loam has the best optimum moisture content which means that it has relatively high water holding capacity compared to other soil types [43]. It is also rich in organic matter, and other microorganism that has been identified to be beneficial to the soil in the way of adding and recycling nutrients. Loamy soil commonly used substance in farming practices because it supports the widest range of crop production. Slow emergence of seeds in clay could be because the roots are unable to penetrate through hard, dry soil, or can be waterlogged in wet soil [43]. Sandy soils are often dry, nutrient deficient and fast draining. They have little or no ability to transport water from the deeper layers through capillary transport.

Vegetable/Soil Depth	0cm	1.5cm	2.5cm	4.0cm
Celosia argentea				
Mean ± S.D	13.73 ± 1.07	10.85 ± 0.95	9.88 ± 1.02	8.25 ± 1.11
Range	10.67 - 16.50	5.33 –13.50	4.67 – 12.75	1.00 -11.50
Amaranthus viridis				
Mean ± S.D	14.13 ± 1.36	15.38 ± 1.35	11.50 ± 0.96	11.63 ± 1.00
Range	11.50 -16. 75	14.00 – 16.75	10.75 – 12.25	10.00 -13. 25
Corchorus olitorus				
Mean ± S.D	12.50 ± 2.98	24.11 ± 1.03	17.67 ± 2.90	16.33 ± 0.88
Range	11.33 -13.67	12.67 – 25.00	12.67 – 22.67	10.67 -22.00
SD = Standard deviation				

Table 3:- Effects different soil depths on the Emergence of sample plants

Vegetable/Soil Types	Loam	Clay	Fine Sand
Celosia argentea			
Mean ± S.D	15.00 ± 2.27	9.52 ± 0.95	8.90 ± 2.00
Range	12.00 - 17.00	5.25 –12.00	8.33 – 9.50
Amaranthus viridis			
Mean ± S.D	14.75 ± 0.86	10.00 ± 0.82	11.50 ± 0.96
Range	14.25 -15. 25	9.25 – 10.75	10.75 –12.25
Corchorus olitorus			
Mean ± S.D	17.00 ± 1.52	11.50 ± 2.28	8.84 ± 2.77
Range	10.00 -24.00	9.33 – 13.67	8.00 – 9.67
SD = Standard deviation			

Table 4:- Effects of Different Soil Types on the Emergence of sampled plants

IV. CONCLUSION

Findings from this study have shown that soil depths and soil types are important factors in seedling emergence. Thus, the effects of soil depth and soil type on the seedling emergence of *Celosia argentea*, *Amaranthus viridis* and *Corchorus olitorus* showed significantly. As the results indicates that in order to have quick efficiency and crop yields, *Celosia argentea* seeds should be sown at 0cm depth (soil surface) while *Amaranthus viridis* and *Corchorus olitorus* should be sown at 1.5cm soil depth. Also, the results showed that loamy soil is best soil for growing the three vegetables. It therefore recommends that for optimum propagation of these three vegetables, the best soil depth and soil types should be considered.

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