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Studies on the effect of *Chromolaena odorata* (L.) king & h.e. Robins on the growth performance of three varieties of *Abelmoschus esculentus* (L.) moench

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Abstract
In order to determine the effectiveness of Chromolaena odorata on the production performance of three kinds of Abelmoschus esculentus, namely HIRE, SAHARI F1, and KIRIKOU F1, greenhouse research were carried out. The studies were set up using a Split Plot Completely Randomized Design (CRD) with six treatments and four duplicates for each treatment. On the germination rate, plant height, number of leaves, leaf area, weight of fruits, number of seeds, length of longest root, fresh weight, dry weight, moisture content, and physicochemical characteristics of the soil, the impacts of various treatments were assessed. Analysis of Variance (ANOVA) was used to examine the data in order to determine whether the difference was significant at (p0.05). According to the study, Chromolaena odorata application changed the chemical properties of the soil, resulting in compost that was fertile enough for Abelmoschus esculentus. Following KIRIKOU F1 and HIRE, Chromolaena odorata exhibited the most stimulating effect on the development performances of variety SAHARI F1. Thus, given its economic significance as a green manure in Nigeria, this study suggests using Chromolaena odorata in farming techniques.
Keywords: studies, *chromolaena odorata, growth, performances, abelmoschus esculentus*

Introduction

Abelmoschus esculentus is a 2m tall yearly and annual plant. It maintains a genealogy with plants that includes Hibiscus, cotton and cocoa. The palmately lobed, 5 to 7 lobed leaves are 10 to 20 cm long and broad. The fruit is a capsule up to 18cm long that incorporates various seeds.

The flowers are 4–8cm in size and have five white to yellow petals, frequently with such a crimson or purple mark at the bottom of every petal. One of most significant fruit and vegetable crop is okra, which provides 4550 kcal of calories for direct utilization. Prior to certain other vegetable crops, it comes first (Babatunde et al., 2007) [9]. Okra production and cultivation have become common practices due to their significance for the growth of the economy and are present in practically all African markets. According to Mihretu *et al.,* (2014) [24] Okra serves a variety of purposes thanks to its fresh leaves, buds, flowers, pods, stems, and seeds. Green seed pods of juvenile okra, which can be used as vegetable, can also be used in salads, soups, and stews. They can also be fried or cooked. (Ndunguru and Rajabu, 2004) [25]. After boiling, it gives a mucilaginous reliability. To improve the reliability of various recipes, such as soups, stews, and sauces, the fruit extract is frequently used. Once administered as a blood volume expansion or plasma substitute, okra mucilage has therapeutic uses. Okra's mucilage traps toxins and bile acids conveying cholesterol that the liver has secreted into it. Pickles can also be made using the immature pods. The entire plant can be consumed and utilized to make a variety of foods (Madison, 2008) [22]. Restoring soil quality for better crop production is a common problem in the tropical regions, especially in a country like Nigeria, where the inhabitants is presently over 150 million. As a result, one of the most reliable strategies to increase food security is to establish sustainable ecological practices to boost soil fertility. However, due to the burning and alteration of forest, primarily for crop production, soil fertility continues to be an issue in many areas of the country. The depletion of nutrients in dissolving and solid bound forms occurs as a result of soil erosion, which is accelerated by forest clearing, high temperatures, and moisture. (Offiong and Iwara, 2011) [28]. Nevertheless, farmlands are purposefully left fallow after being used to grow food crops as a method of restoring their fertility. (Styger and Fernandes, 2005) [38]. Various plant species instantly overtake the region throughout this process, with Chromolaena odorata—also known as "Awolowo" in this region of the country—being the most prevalent. According to Roder *et al*., C. odorata (1995) [33]. A periodic shrub with 1.5–2.0 m in height and a maximum height of 6 m, Chromolaena odorata is a constituent of the Asteraceae family. When woodland trees and bushes are well entrenched, odorata is typically a plant of suitable habitat that intervenes fallows or recently cleared lands and is frequently shadowed out (Koutika and Rainey, 2010) [20].

Previous researchers admitted that the plant improved the accumulation of soil nutrients beneath its covering (Obatolu and Agboola, 1993; Ilori et al., 2011) [12]. Across most habitats aside from pristine rainforests, where its abundance is sparse it is in fact, a widespread and dominant fallow plant. C. odorata is one of the early colonists that helps the soil's nutritional status to rise up for later colonizers in Nigeria and the South-Western environmental zone. It grows readily and typically takes over newly plowed and deserted farmlands (fallows). However, indigenous farmers in the area employ the crop as a means of enhancing sustainability as green manure in addition to colonizing fallows and organically accumulating nutrients in the soil. Through its roots, strong seed production, and wind-aided spread, C. odorata rejuvenates and colonizes fallow fields and recently cleared ground (Koutika and Rainey, 2010) [20].

Organic manure is a crucial nutrient for plants and it can be found in a wide range of plant and animal materials. Debris and leftovers from livestock grazing are included in organic manure. More than half of the nitrogen, phosphorous, and potassium in the ground cannot really be replenished by organic manures alone. It has been discovered that adding organic manure to the soil raises its pH. (Abam et al., 2006 and Jinadasa et al., 1997) [1, 18]. When it is used effectively, organic manure promotes effective development in plants and, in overall, improves the size, height, and quantity of leaves.

The final outcome of a controlled biological degradation of organic matter which has been disinfected by thermal radiation and consolidated to the point where it is advantageous to growth of plant is compost. Compost is a source of organic matter that is rich in plant nutrition and has the special capacity to enhance the physical, chemical, and biological properties of soil or other growing media (USCC, 2008).

Due to its cost effectiveness, lack of expertise, and overall good agronomical impacts associated with integration into the soil, any use of crop residues and organic fertilizer amendments has emerged as a substitute for local farmers in Nigeria in boosting soil fertility. The structural, chemical, and organic qualities of the soil are known to be affected by the incorporation of these plant materials, which has a significant influence on plant viability and crop yield. (Odeyemi, 2011; Odeyemi et al., 2011; Atungwu, 2006) [26, 27, 8]. In Nigeria, governments and non-governmental institutions nowadays are able to generate organically reared fertilizer in significant quantities at prices that really reasonable for peasant farmers. These fertilizers are made using agricultural residues, residential trash, and plant matter. Asteraceae species like Chromolaena odorata (L.) King and Robinson are widespread in Nigerian farmer's fields. They produce a lot of biomass and break down quickly, which improves the characteristics of the soil. (Kanmege et al., 1999). Furthermore, the lack of thorns in these plant varieties makes them simple for farmers to manage. Compost can be made using the source material chromolaena odorata. It has been demonstrated that C. odorata has a significant amount of N and K, with the topmost forage containing 2% more of each. (Jamilah, 2010) [14]. Such plants outgrew the reeds' learning and expansion because they can flourish even on poor soil. Additionally, it has been demonstrated that utilizing C. odorata to apply composting has a positive impact on rice crops produced on pollution created with coal waste cement. (Jamilah et al., 2011) [17]. According to reports, maize plants thrive exceptionally well on marginal ground when compost Kronobio that contains C. odorata is used. (Jamilah, 2010) [14]. Understanding the mechanisms of chemical alterations in the natural world and the patterns of nitrogen uptake in crops treated by C. odorata compost are crucial. However, it was hypothesized that the nutrient composition for every type of plant will vary and are mostly dictated by the species of plants. Composting application utilizing C. odoarta can contribute to the reduction of chemical fertilizer on the crop nutrients. (Jamilah, 2011) [17]. Consequently, the purpose of this study is to ascertain how Chromolaena odorota influences the functioning of three different Abelmoschus esculentus kinds (HIRE, SAHARI and KIRIKOU FI).

Materials and Methods

Plant material resources and collection

The Agricultural Development Programme (AKADEP), governed by the Ministry of Agriculture and Food Sufficiency in Akwa Ibom State, Nigeria, provided the seeds for Abelmoschus esculentus. HIRE, SAHARI F1, and KIRIKOU F1 were the 3 categories that were obtained. The loamy soil was found behind the Akwa Ibom State University's Civil Engineering Building, while the Chromolaena odorata leaves were found behind the university's Botanic Garden at Ikot Akpaden..

Study area

The study and field experiment were carried out in Ikot Akpaden's Green House at the Akwa Ibom State University's Department of Botany.

Experimental Design

This study's experimental methodology is a completely randomized design (CRD). The experimental pot was set up with twenty four (24) experimental units in six groups treated of four repetitions each, referred to as T1, T2, T3, T4, T5, and T6.

Viability, Germination and Growth Studies

Tetrazolium chloride (TZ) staining method was used to determine the viability of 3 replicates of 26 seeds. (ISTA, 2003) [13]. For 24 hours, seeds were submerged in a 1% tetrazolium chloride solution at 30°C in complete darkness. After that, seeds were split in half and analyzed. Only embryos that were consistently coloured red or dark pink were deemed "viable."

Preparation of *Chromolaena odorata* incorporated with soil and seed planting

As a compost manure, Chromolaena odorata leaves were processed and applied. The leaves were divided into extremely small pieces and measured using a scale that was calibrated in kilograms. Chromolaena odorata was correctly blended with 7 kg of soil per 1 kg in a perforated planting bucket, labeled accordingly, and then left for 10 days to completely decompose and blend into the soil. There were four repetitions of each treatment. Ten seeds of each Abelmoschus esculentus variety were dropped into a planting bucket filled with damp soil. Four times each therapy was reproduced, and the setting was kept in a supportive manner.

Measurement of growth parameters

Plant height, leaf count, leaf area, fruit weight, seed count, number of roots, length of longest root, fresh weight, dry weight, and moisture content were all measured as growth metrics. Prior to planting (control) and after the experiment, the physicochemical characteristics of the research soil were also assessed (the soil combined with Chromolaena odorata).

Statistical analysis

The impacts of Chromolaena odorata on the plant height, number of leaves, leaf area, fruit weight, seed count, number of roots, length of longest root, fresh weight, dry weight, and moisture content of Abelmoschus esculentus from the first week of planting to the eighth week of planting were studied using statistical data by using Analysis of Variance (ANOVA).

Result

Germination Percentage

Sahari F1 variety had a 100% germination rate, while Hire and Kirikou Fi types had germination rates of 90% and 90%, correspondingly. This demonstrated the viability of the three different Abelmoschus esculentus seed types (Table 1).

Table 1: Percentage germination of three varieties of *A. esculentus s*eeds

S/N	Three varieties of *A. esculentus* seeds	Germination percentage
1.	HIRE	**90%**
2.	SAHARI F1	**100%**
3.	KIRIKOU F1	**90%**

When Chromolaena odorota was given to the soil, there was an increase in important components compared to that of control, according to the pre- and post-physicochemical results of the experimental soil (Table 2).

Table 2: Physical and chemical characteristics of the experimental soil Pre and Post

S/N	Mineral Elements/ Metals	Pre Physicochemical Analysis	Post Physicochemical Analysis
1	pH (1:1)	4.78	6.5
2	T.O.C %	5.474	33.47
3	C.E.C mol/kg	40.395	46.728
4	N %	2.153	6.423
5	P mg/kg	18.924	34.124
6	K mg/kg	1.325	4.112
7	Ca mg/kg	37.051	40.236
8	Mg mg/kg	2.516	3.660
9	Na mg/kg	0.609	2.172
10	Mn mg/kg	67.02	119.46
11	Fe mg/kg	59.96	126.94
12	Cu mg/kg	92.23	56.294
13	Zn mg/kg	18.47	29.47
14	Exchangeable Acidity g/kg	0.06	1.041
15	Conductivitym/s)	10.24	42.66
16	Sand %	75.8	70
17	Silt %	13.8	11
18	Clay %	10.40	19

Growth studies

Figures 1–10 show the findings of growth research. According to the findings (Figures 1, 2, 3, 4, 6, 8 and 9), Chromolaena odorota significantly (P0.05) improved plant height, number of leaves, leaf area, weight of fruits, number of roots, fresh weight, and dry weight in Sahari F1 variety, followed by Kirikou F1 and Hire varieties, respectively. However, Chromolaena odorota significantly (P0.05) improved moisture levels, number of seeds, and the duration of the longest roots in (Figures 5, 7 and 10)

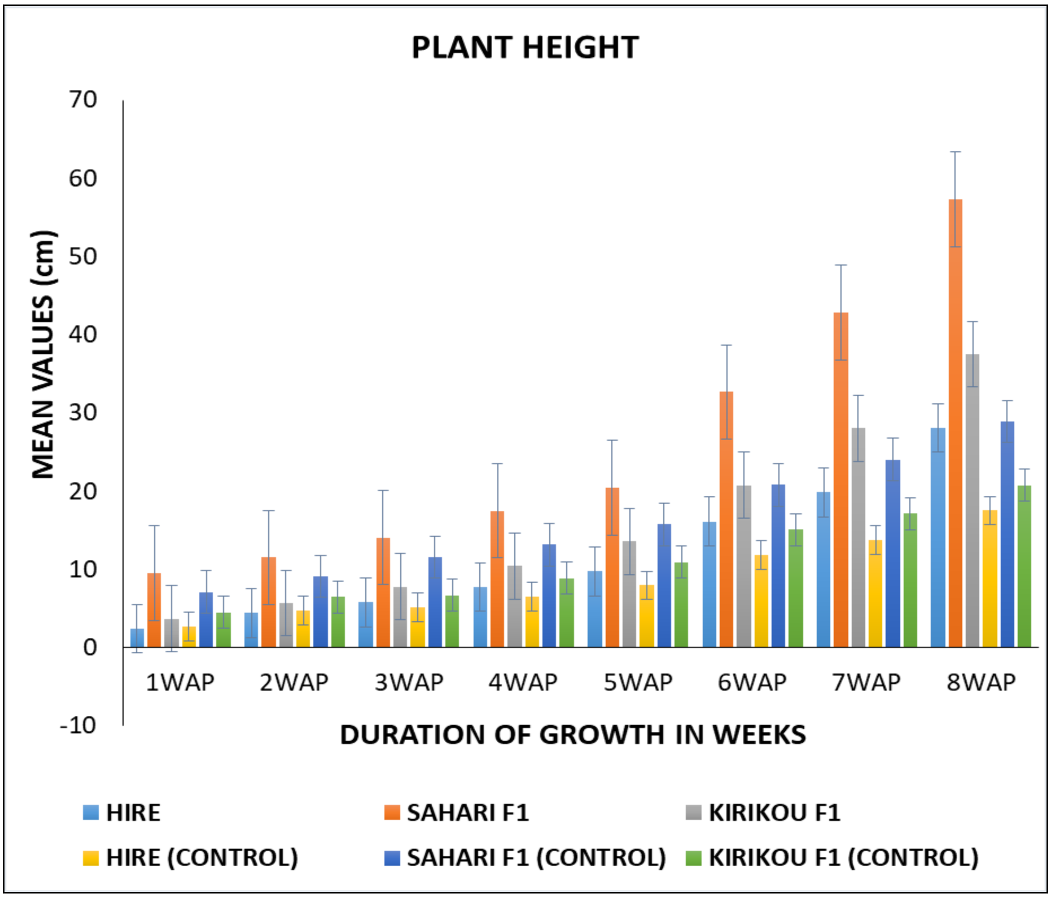

Fig 1: Impact of Chromolaena odorata on Abelmoschus esculentus variants 1–8 weeks after planting: Mean plant height (WAP).

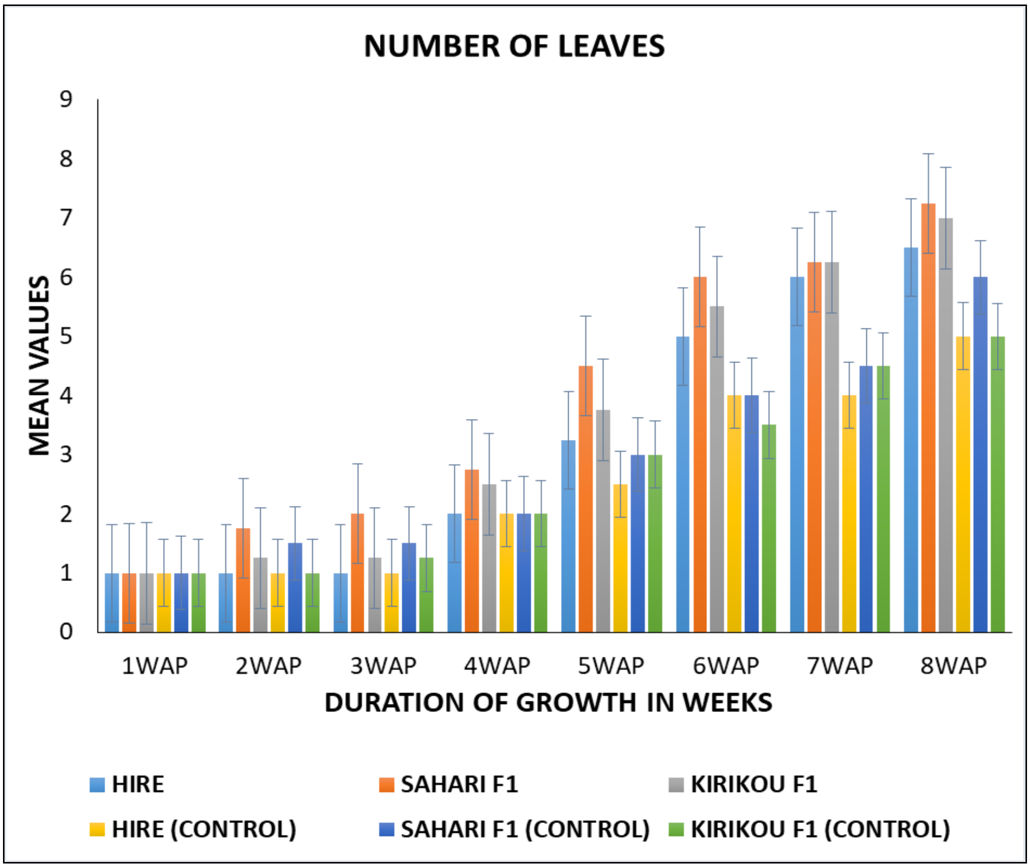

Fig 2: Abelmoschus esculentus of three different varieties: Chromolaena odorata impact on number of leaves at 1–8 weeks after planting (WAP).

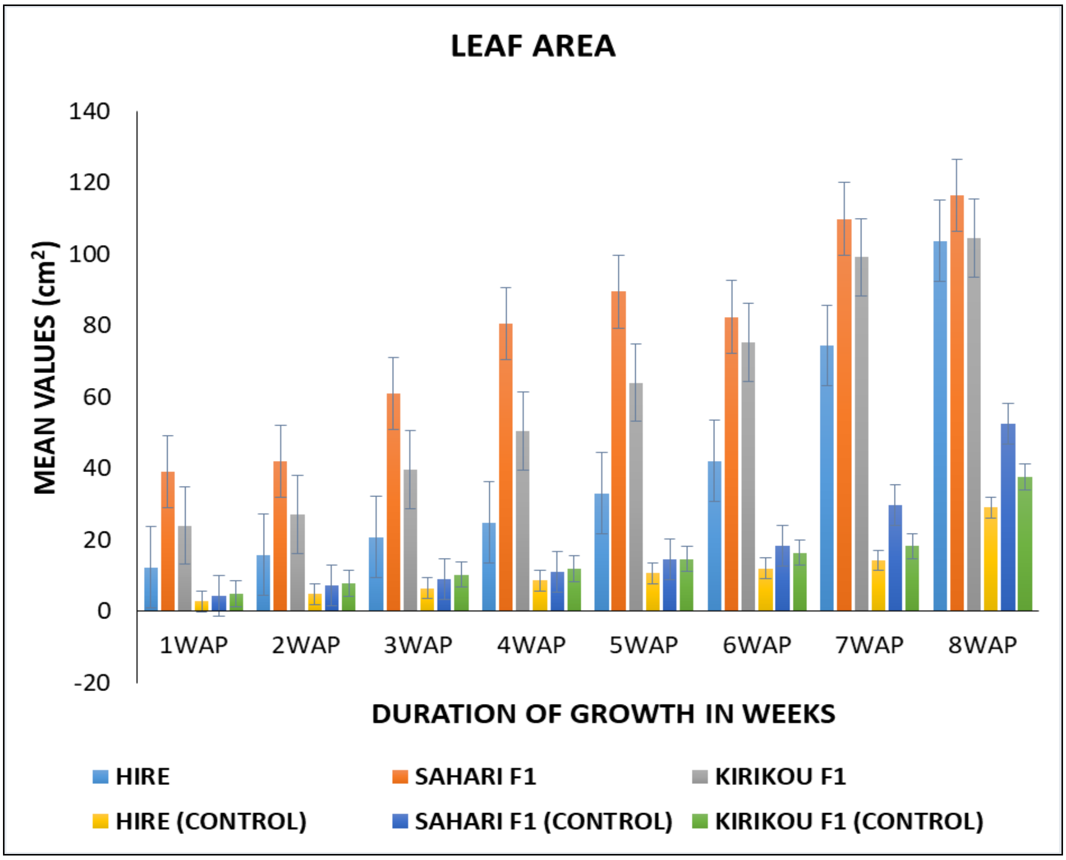

Fig 3: Impact of Chromolaena odorata on 3 distinct Abelmoschus esculentus types' mean leaf area at 1–8 weeks after planting (WAP).

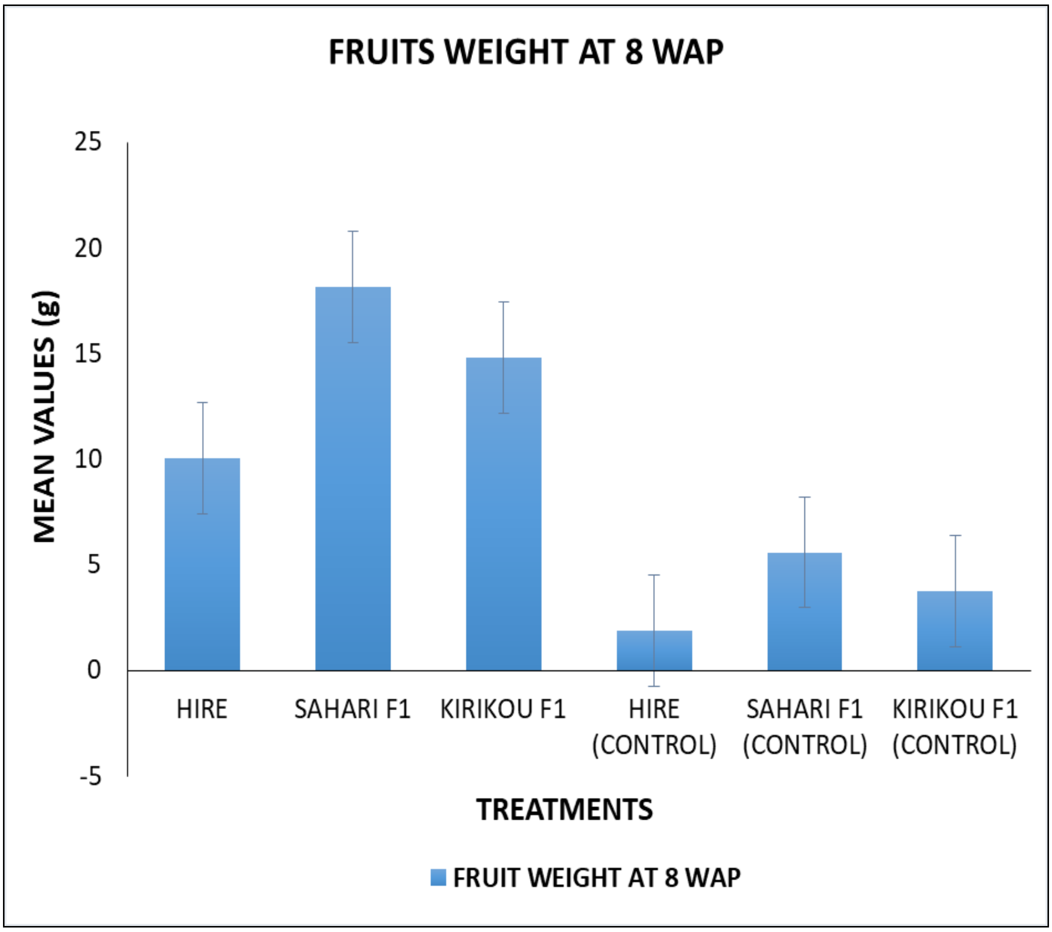

Fig 4: Impact of Chromolaena odorata on Abelmoschus esculentus fruit weight of three types at 1–8 weeks after planting (WAP).

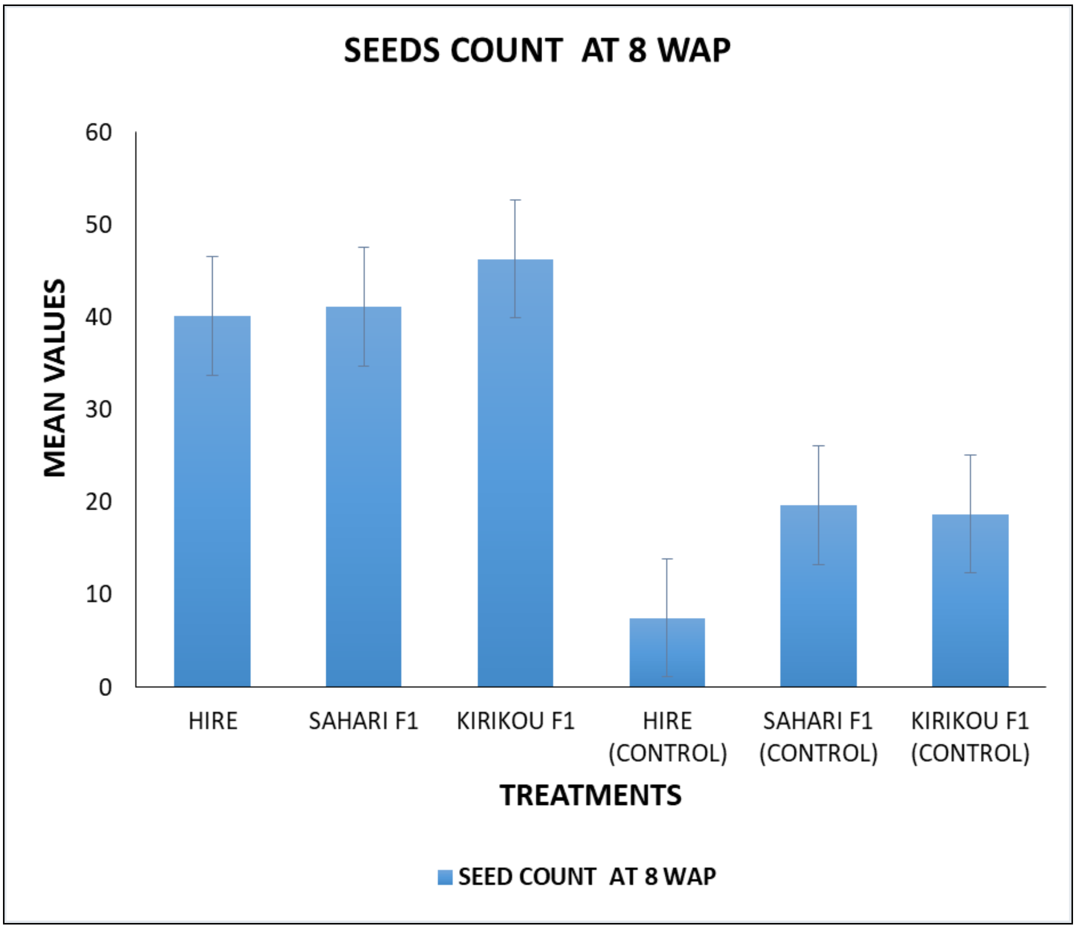

Fig 5: Impact of Chromolaena odorata on Abelmoschus esculentus seed production in three types, 1–8 weeks after planting (WAP).

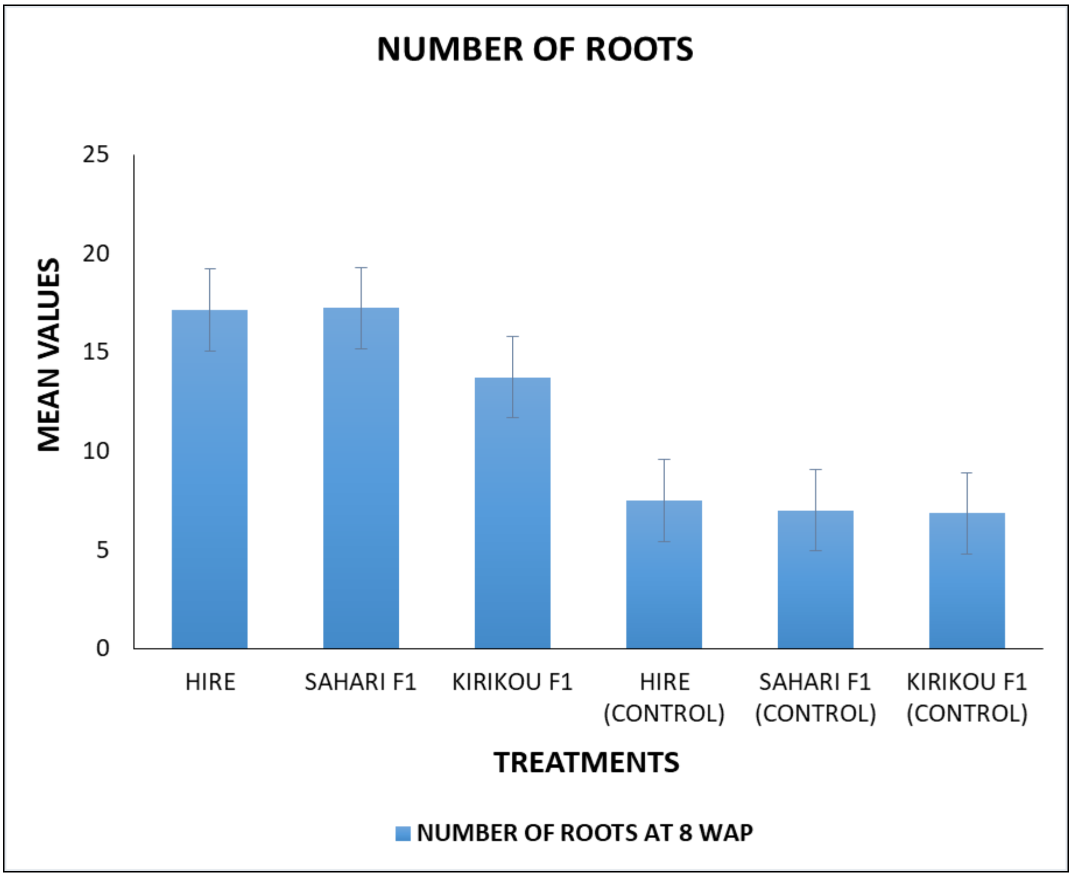

Fig 6: Effectiveness of Chromolaena odorata on Abelmoschus esculentus variations 1–8 weeks after planting: Number of roots (WAP).

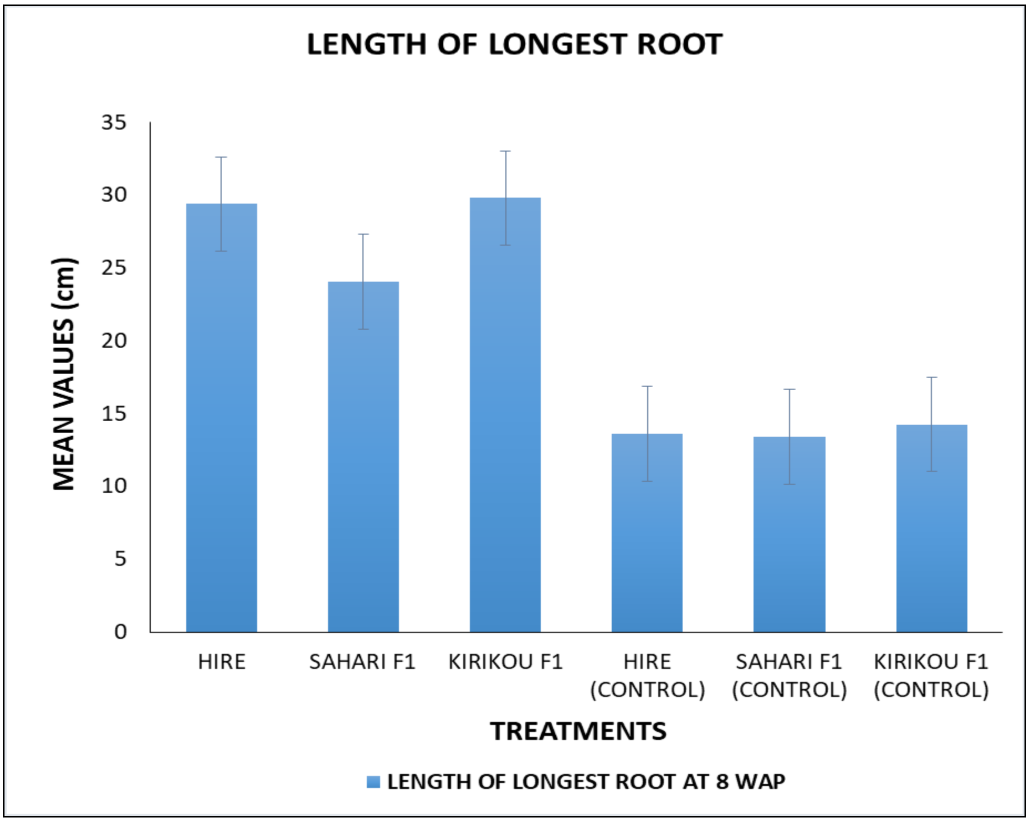

Fig 7: Effectiveness of Chromolaena odorata on Abelmoschus esculentus cultivars 1–8 weeks after planting, measured as the length of the longest roots (WAP).

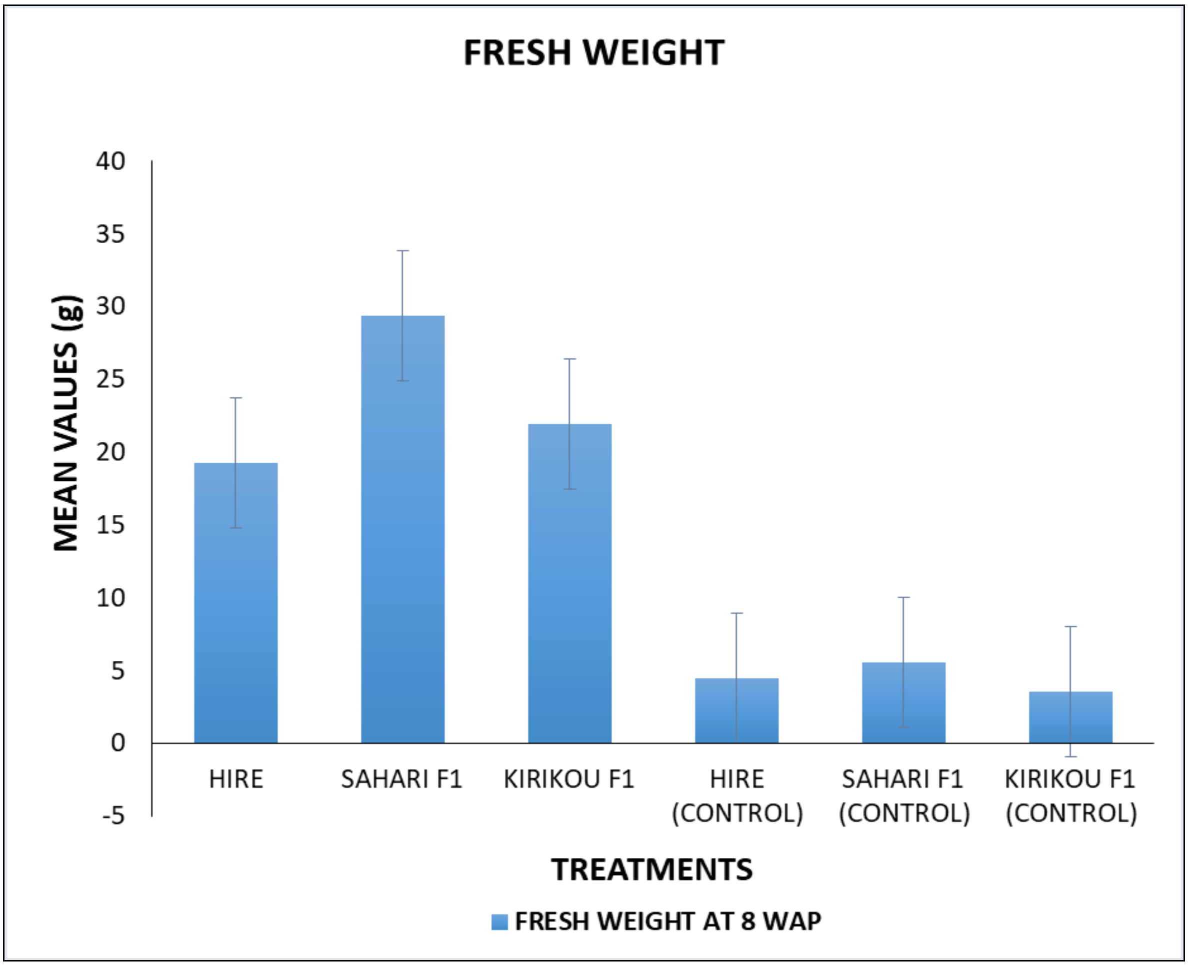

Fig 8: Abelmoschus esculentus variations of three different species' fresh weight at 1–8 weeks after planting, as influenced by Chromolaena odorata (WAP).

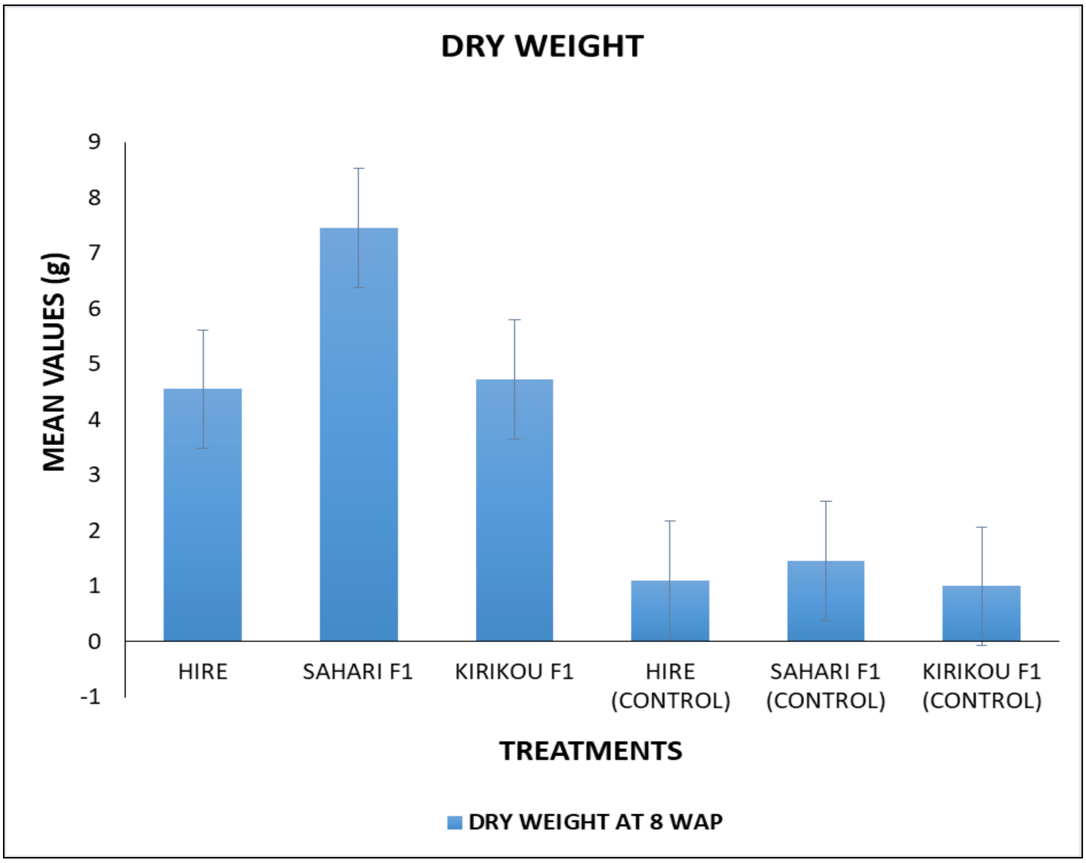

Fig 9: Three different kinds of Abelmoschus esculentus' dry weight at 1–8 weeks after planting are affected by Chromolaena odorata (WAP).

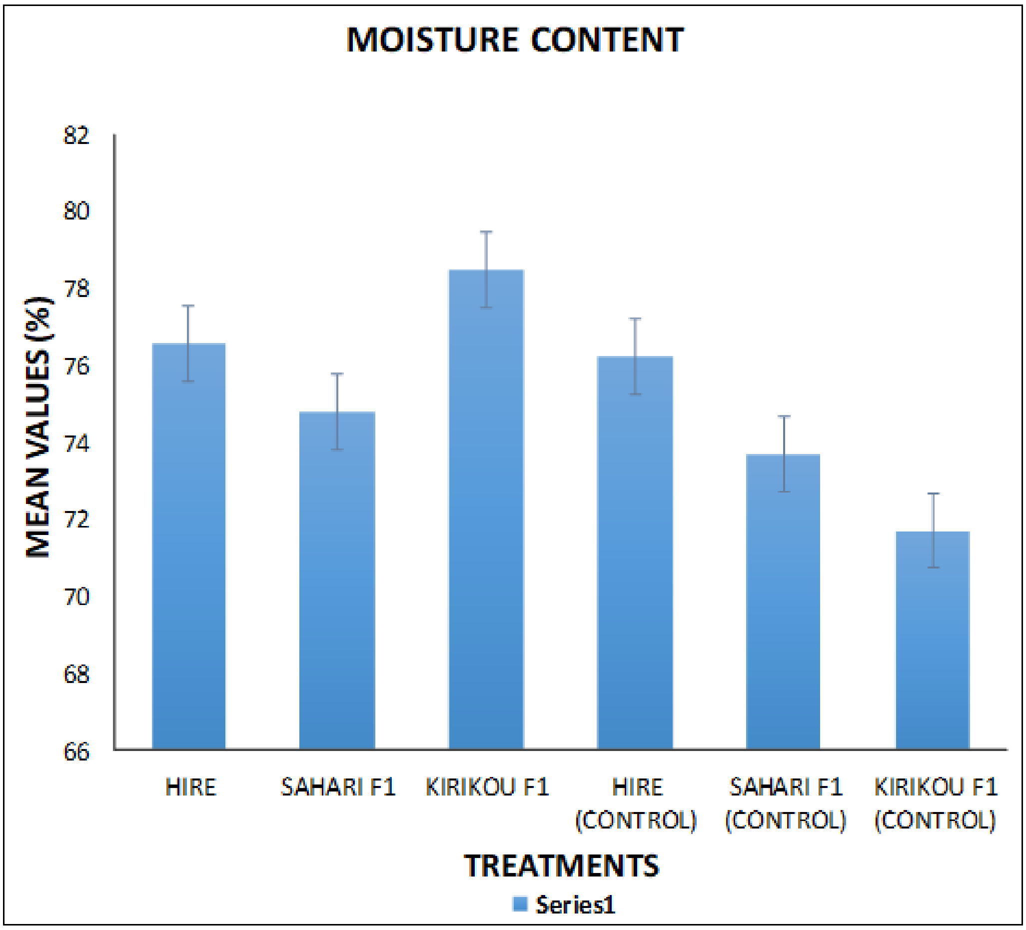

Fig 10: Three kinds of Abelmoschus esculentus' moisture content during 1–8 weeks after planting, as influenced by Chromolaena odorata (WAP).

Discussion

The results of the pre- and post-planting soil study (Table 1) show that perhaps the soil has low levels of organic carbon, nitrogen, and accessible phosphate (FMANR, 1990). This suggests that the yield and mineral content of the soil are low. So it would be encouraged to respond to Chromolaena odorata compost. (Agbogidi and Okonmah, 2012) [3]. The lack of magnesium in the soil contributed to its acidic nature, necessitating the provision of soil amendments for optimal crop performance.

Chromolaena odorata significantly (p0.05) affected all 3 types of Abelmoschus esculentus' mean plant height among some of the treatments. This supports the claim made by Olatunji et al. (2006), who claimed that tomatoes and okra performed better when planted in poultry manure than when grown in other forms of manure. This supports Anon's observations as well (2002) [4 5] who believed that organic manure is a superior form of fertilizer because it contains high levels of nitrogen, phosphorus, and potassium, is more easily accessible than mineral fertilizer, and has a stable, slow-releasing impact on nature of the soil while also enhancing the physical and chemical properties of the soil.

The impact of Chromolaena odorata on the average fresh weight, seed count, and fruit weight of the three types of Abelmoschus esculentus varied significantly (p 0.05) between treatments. This was consistent with Windham's conclusion (1969) [41] that organic manure, such as chicken droppings, enhances soil structure, hence promoting increased vegetative growth and fruit size and quantity.

According to the study's findings, Chromolaena odorata can improve the yield of Abelmoschus esculentus. The potential of Chromolaena odorata to raise soil organic matter content, the storeroom of organic fertilizers, and to energise the operations of soil organisms, which aid in the liberation of the chemical nutrients required by the crop plant, could all be attributed to the identified progress in all the specifications evaluated.

The usage of Chromolaena's composts resulted in higher yield components because these biomasses served as organic biomass substitutes for some of the vital nutrients as well as other elements the crop needed. When they decompose, they immediately deliver plant nutrients and byproducts to the standing crop, including important hormones and others. Additionally, the biomass from these Chromolaena plants has a good microbial association in the rhizosphere, which, when used to compost and supplied to the main field, would promote healthy development by promoting beneficial microorganisms in the soil. Additionally, using weed composts improves the soil's organic carbon, which aids in boosting the number of plant-growth-promoting rhizobacter in the soil. In addition to fixing nitrogen for the developing plant growth by free dwelling microorganisms, they were known to produce phytohormones and vitamins. All of these biological traits increased from approximately of seeds that germinated, the height of the plant, the number of leaves, the area of the leaves, the weight of the fruits, the number of seeds, the length of the longest root, the fresh weight, the dry weight, and the moisture content. This enhanced light absorption by the okra plant's canopy, which in turn promoted an increase in the accumulation of dry matter in the plant. Using weed composts also favored the chemical and biological qualities of the soil, which increased the crop's ability to absorb nutrients. Abelmoschus esculentus's average productivity improved as a result of all of these (Figure 1-10).

Mishra et al., 1996; Mani, 1991 reported similar findings. [21]; Arunachalam et al, 1995M [7], Rathore et al, 1993 [32] and Shivakumar (2001) [36]; Anon, 2004 and Kumar, 2004.

This may be because both NH4-N and NH3-N were released steadily during the active crop growth period, which may have helped the crop produce a bigger yield, according to Mani (1991) [21] and Ramachandra Prasad (2009) [30]. Thakur and Singh reported equivalent outcomes (1987) [39] from Himachal Pradesh found that applying 5 t. ha-1 of chromolaena's compost boosted rice grain production over control by 20%. Maskey and Bhattaraj (1984) made a similar discovery, reporting that the application of chromolaena's compost 5 t. ha-1 resulted in a better grain production in the rice-mustard sequence than Ipomea cornea. Other employees reported an improvement in grain yield when weeds were added as a green manure. Rathore and others, 1993 [32]; Anon, 2002a [6]; Ramachandra *et al*., 2007 and Ramachandra Prasad 2009 [30]. This soil may not even be able to supply the crop with the nutrients it needs, which would explain the inferior growth performance in the non-compost manure control plots. Thakur and Singh reported equivalent outcomes (1987) [39]. It was discovered that Chromolaena's compost cost less than FYM. Therefore, in addition to helping with weed management, Chromolaena's biomass can be used to recycle nutrients to the crops..

The availability of widely accessible macro and micro nutrients in the compost of Chromolaena odorata contributed to the growth and yield of the three kinds of Abelmoschus esculentus (Acharya and Kapur, 2001). [2]; Quanslah *et al*., 2001; Saravanane, 2005; Channappagoudar *et al*., 2007 [10]. Sahari F1 variation may more readily absorb these nutrients from Chromolaena's compost than Kirikou F1 and Hire kinds, and use them to synthesize higher photosynthates as shown by the plants' increased dry matter buildup. The plant height was boosted by enhanced production of dry weight matter. These conclusions are in line with those of Subramanian and Kumarswamu (1989) and Shankarappa (1993), respectively. [35], Shivakumar *et al*., 2001 [36] and Channappagoudar *et al*., 2007 [10].

Conclusion

According to this study, Chromolaena odorata enhances the soil's physicochemical qualities, which in turn stimulate the development and yield of the three types of Abelmoschus esculentus. In Sahari F1 variety, followed by Kirikou F1 and Hire, Chromolaena odorata application significantly increases percentage germination, plant height, number of leaves, leaf area, fruits weight, seed count, number of roots, length of longest root, fresh weight, dry weight, and moisture content.

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