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Emergence and Morphological Response of Cashew (*Anacardium occidentale* L.) Treated Nuts as Influenced by Some Fungicides on Young Seedlings

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Authors' contributions

This work was carried out in collaboration among all authors. Author ADO designed the study, interpreted the result of the data analysis and wrote the first draft of the manuscript. Authors NBA and OEC managed the literature searches and were also involved in the analysis of the data. All authors read and approved the final manuscript.

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ABSTRACT

Cashew (*Anacardium occidentale* L.) seedlings are attacked by fungi diseases such as damping off and seedling blight caused by fungi such as *Fusarium spp*. and *Rhizoctonia spp*. which can amount to about 60-65% loss in the nursery. Cashew nut seeds are majorly sown by farmers untreated. Fungicides have also been observed to delay seedling emergence and negatively influence morphological traits in some crops. This experiment aims at observing the effect of using fungicide

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seed dressings on cashew seedling emergence and morphology before transplanting. Medium cashew nut biotype and three commonly used fungicides were used. The 3 months experiment was set up in the nursery using a Completely Randomized Design CRD. The treatments are; Control + Medium (Ct); Apron Star + Medium (AS), Dress Force + Medium (DF) and Seed Care + Medium (SC). Topsoil filled perforated nursery polythene bags were used. No significant difference was identified in all morphological traits observed in the experiment among the treatments all through the duration of the experiment. From a maximum vigour scale of 5, Ct, AS and DF all had a seedling vigour of 4.7 while SC had 4.2. As a precautionary measure against fungi diseases, Apron Star, Dress Force and Seed Care have been observed not to have a negative effect on the emergence and growth of young cashew seedlings when nuts are treated with them before sowing.

Keywords: Cashew; emergence; fungicide; seedling; nursery; seed treatment.

1. INTRODUCTION

Cashew (*Anacardium occidentale* L.) tree has established itself as one of the crops most suited for cultivation in regions with a variety of agroecological conditions. Nevertheless, is majorly grown in the tropics [1]. It was recognized as a perennial fruit crop with minimal input and great earning potential [2]. Cashew is a tree crop of major commercial value in Nigeria and other tropical countries across the world [3]. It is a sturdy drought tolerant tree crop grown for its apple and, more notably the nut in Nigeria and other cashew growing nations [4]. Commercial cashew plantations have been established in various agro-ecologies of Nigeria for cash earnings and long-term income generation [5], increasing the land area cultivated in Nigeria.

Seeds are the main method of cashew propagation [6], which is commonly raised in a nursery for 2 to 3 months before transplanting to the field [7]. Seedling performance in the nursery has been observed to have a direct effect on the field establishment of the seedlings after transplanting to the field [8]. Growing healthy, disease-free cashew seedlings is crucial. Consequently, it is crucial to effectively control the pest and disease problem to boost productivity in the nursery [2]. Fungi which is a common pathogen of cashew responsible for most cashew seedling diseases in the nursery must be controlled. Practices such as the use of dry, clean and insect free seeds are encouraged to enhance vigorous disease free cashew seedlings [9].

Diseases substantially affect the health of cashew plants, including growth and nut yield in terms of quality and quantity. They also constitute a significant biological limitation [10]. Fungi are responsible for more than 10 prevalent diseases of cashew [11]. Common fungal diseases of cashew at the seedling stage include seedling blight, root rot, dieback, seedling wilt and damping-off which together account for up to 60–65% of losses of cashew seedlings in nurseries, with damping-off the most common and responsible for 15-20% of losses [12]. Several well-known fungal pathogens that cause diseases include *Phytophthora* spp., *Pythium* spp., *Rhizoctonia* spp., *Fusarium* spp., and *Cylindrocladium scoparium* [13].

Widespread use of fungicide seed treatment offers inexpensive defense against soil and seed-borne diseases [14]. In addition to preventing fungi diseases and pathogens, seed dressing treatments have been observed to improve plant vigor and performance [15]. In Nigeria, common seed dressing fungicides with the brand names Apron Star, Apron Plus, Forte Plus, and Dress Force are frequently used in nurseries and on the field.

The majority of Nigerian cashew farmers do not use agrochemicals to grow their cashews, although researchers often use them for experimental purposes [16]. As a result of interactions with some cashew farmers in Nigeria, dressing cashew seeds with fungicide treatments is not a typical practice because farmers see cashew seeds as hardy seeds that don't require dressing before planting to prevent diseases. The need to investigate the use of fungicide seed treatments to prevent fungal diseases and to grow healthy seedlings has led to the loss of cashew seedlings in two commercial nurseries caused by fungal diseases in the south-western area of Nigeria justified by the report to about 85%.

However, it has been found that seed dressing can sometimes cause delayed germination, adversely affect early morphological features, interfere with yield of some arable crops, and

could positively improve their performance [15]. Hence, it is crucial to investigate how the selected fungicide seed treatments affect the emergence of cashew seedlings and their early morphological characteristics. Therefore, the objective of this study is to observe the effect of using some selected fungicide seed treatments on cashew seedlings' emergence and early morphological traits.

2. MATERIALS AND METHODS

A 3-month experiment was conducted in a commercial nursery located in Akinyele local government area of Ibadan, Oyo State. The experiment was laid in a Completely Randomized Design (CRD) with 4 treatments including: 1- the control (without treatment); 2- Seed Care (Imidacloprid 10% + Thiram 10% WS); 3- Dress Force (Imidacloprid 20% + Metalaxyl-M 20% + Tebuconazole 2% WS) and 4- Apron Star (200g/kg Mefenoxam + 20g/kg Difenoconazole + 200g/kg Thiamethoxam WS) with a medium sized (4g-8g) cashew nut replicated 3 times, thus the formation are Control + Medium nuts (Ct); Apron Star + Medium nuts (AS), Dress Force + Medium nut (DF) and Seed Care + Medium nut (SC). Fungicides were applied using the recommended ratio of 10 g fungicide/4 kg nuts as indicated on each fungicide label.

The topsoil was sieved with a 2mm sieve pan and one nut was planted in a soil filled 25cm X 12.5cm perforated nursery polythene bag. The treated cashew nuts were sown at 4cm depth and watered. Thereafter watering was done every 48 hours. Data collection on emergence percentage was recorded 2 weeks to 4 weeks after sowing. Other morphological data on plant height (cm), stem girth (mm), leaf area (cm^2) and the number of leaves were collected and recorded. Seedling vigour was measured biweekly for 1–3 months after sowing using the scale recommended by [17] (5-Excellent, 4-Good, 3-Average, 2-Below average and 1-Poor). Data collected were subjected to Analysis of Variance (ANOVA) and analyzed using SAS (2010) statistical package while means separation was done using Tukey's Standardized Range (HSD) Test at (0.05%) probability level.

3. RESULTS AND DISCUSSION

In a previous experiment, [15] have reported that application of fungicides as a pre-sowing treatment could delay emergence in some crops. Cashew, on the other hand, was discovered to be an exemption based on the chosen fungicides utilized in this experiment, as shown by the emergence% result in Fig. 1 at 2 weeks after sowing (WAS). At 2WAS, the treated and the untreated sown cashew nuts all had a uniform emergence of 25% (Fig 1) which is an indication that the selected fungicides did not delay the emergence of cashew seedlings. This agrees with the observation of [18] that cashew seedling emergence is expected between 12 to 14 days depending on nut size. A similar result on fungicide treatments not hindering seedling emergence was also observed in onions [19], maize [20] and field pea [21]. At 3WAS, the untreated nut which is the control treatment (Ct) had the least emergence of 58.33% followed by SC (66.67%), AS (83.33%) and DF which had 100%. This suggests that Dress Force-treated nuts had the highest level of seedling emergence at 3WAS, whereas Ct (58.33%) had the lowest level. DF and AS both attained maximum emergence of 100% while SC and Ct both had 75% emergence at 4WAS which indicates that cashew nuts treated with Dress Force and Apron Star had all seedlings emerged while both Seed Care and the control treatment had the least emergence (75%). The emergence % result from this experiment (Fig 1) does not support the findings of [15] as they reported that seed dressing with pesticides can result in delayed emergence of crop seedlings.

Fig. 2 shows the cashew seedling's plant height as influenced by the 3 selected fungicides. The results showed that no comparable difference in plant height of cashew seedlings was observed between treatments throughout the experiment. However, SC had the tallest plant when compared with other treatments at MTH1 (1 month after sowing) with 19.3cm seedling height, MTH2 (2 months after sowing) with 23.4cm seedling height and MTH3 (3 months after sowing) with 27.0cm seedling height. The control-treatment Ct had the shortest cashew plant height at MTH1 (17.1cm) as nuts treated with fungicides (AS, DF and SC) all had faster head start than the untreated nuts. However, the control treatment ranked 2nd at MTH2 (22.1cm) and MTH3 (25.6cm).

As shown in Fig 3, the effect of the selected fungicides on the number of leaves in cashew seedlings was not significantly different across treatment periods, although leaf number values varied across all treatments in the experiment. SC had the most number of leaves at MTH1

(8.3), MTH2 (12.3) and MTH3 (15.3). For the control treatment Ct, it ranked 3rd, 4th and 4th at MTH1 (7), MTH2 (9.7) and MTH3 (11.8) respectively when comparing the treatments.

Fig 4 reveals the effect of the selected fungicides on cashew seedling stem girth which can be observed that no notable difference was observed in the cashew seedling stem girth throughout the experiment. The control treatment Ct had the least stem girth in MTH1 (0.60cm), MTH2 (0.80cm) and MTH3 (0.82cm) when compared with the fungicide treated treatments in each of the months considered. SC also showed superiority once again as the result showed it had the thickest girth in MTH1 (0.70cm) though not different in value with DF and AS, MTH2 (0.88cm) and MTH (0.90cm). A similar fungicide having one of the main chemical components of seed care (Thiram) was reported by [22] to have the best pea seedling growth.

In contrast to previous report on the effect of SC on cashew plant height, number of leaves and stem girth ranking first in all the mentioned morphological parameters, it ranked least in leaf area in MTH1 (56.60cm^2), MTH2 (62.00cm^2) and MTH3 (73.05cm^2) though it wasn't significantly different from the other treatments as shown in Fig. 5. [23] observed in their work that some fungicides seed treatments did not influence leaf area in wheat.

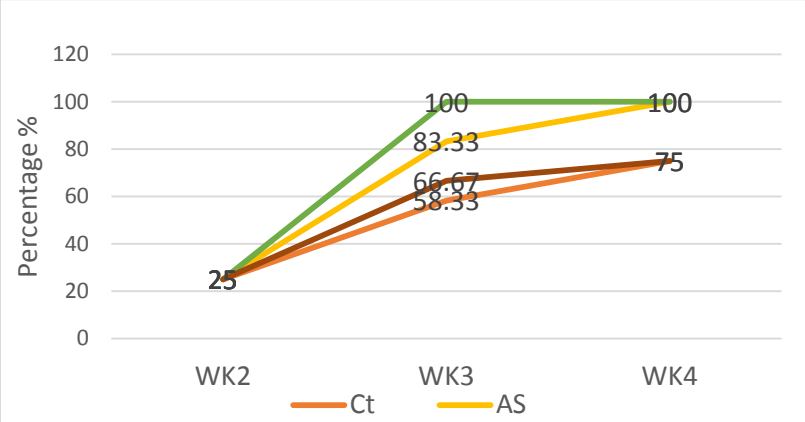

Fig. 1. Cashew seedling emergence % as influenced by 3 selected fungicides at 2, 3 and 4 weeks after sowing

WK2 = Week 2, WK3 = Week 3, WK4 = Week 4
Ct = Control, AS = Apron Star + Medium, DF = Dress Force + Medium, SC = Seed Care + Medium

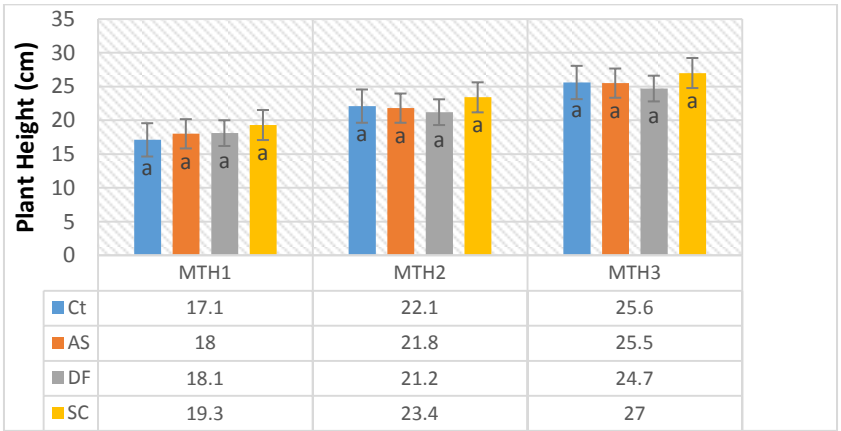

Fig. 2. Cashew seedling plant height as influenced by 3 selected fungicides at 1, 2 and 3 months after sowing

MTH1 = Month 1, MTH2 = Month 2, MTH 3 = Month 3.
Ct = Control, AS = Apron Star + Medium, DF = Dress Force + Medium, SC = Seed Care + Medium
Bars marked with different letters show means are significantly different at 0.05 level of probability.
Vertical bars show standard error

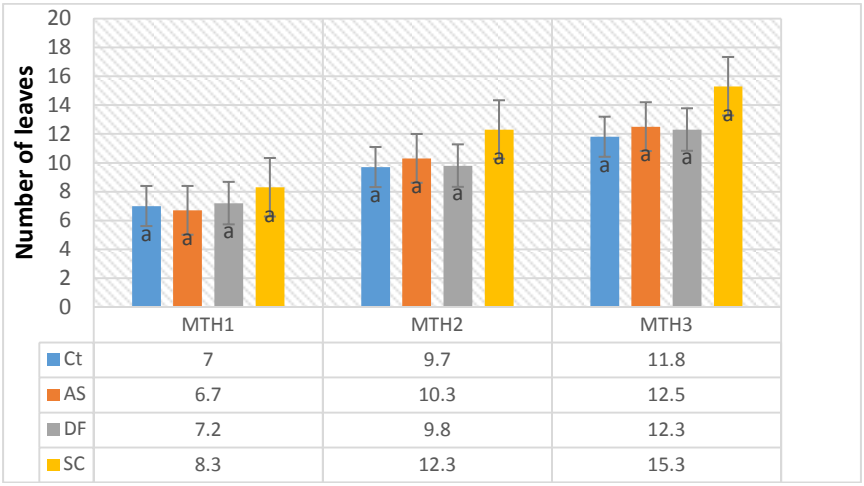

Fig. 3. Cashew seedling number of leaves as influenced by 3 selected fungicides at 1, 2 and 3 months after sowing.

MTH1 = Month 1, MTH2 = Month 2, MTH 3 = Month 3.
Ct = Control, AS = Apron Star + Medium, DF = Dress Force + Medium, SC = Seed Care + Medium
Bars marked with different letters show means are significantly different at 0.05 level of probability.
Vertical bars show standard error

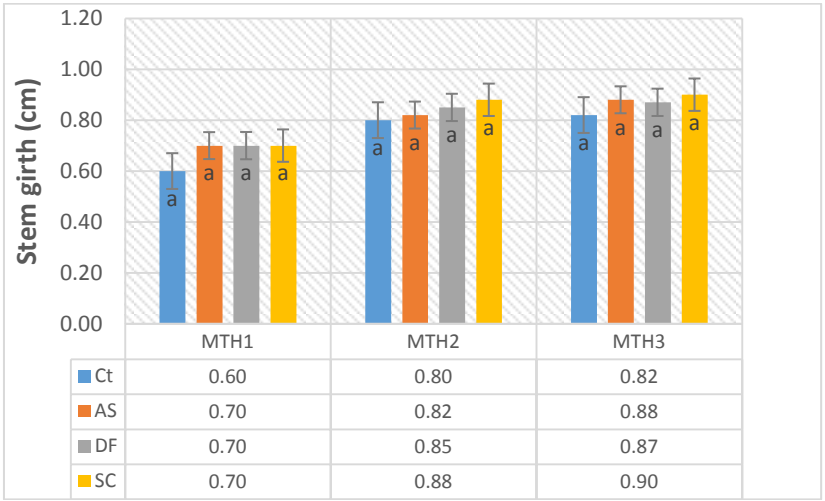

Fig. 4. Cashew seedling stem girth as influenced by 3 selected fungicides at 1, 2 and 3 months after sowing

MTH1 = Month 1, MTH2 = Month 2, MTH 3 = Month 3.
Ct = Control, AS = Apron Star + Medium, DF = Dress Force + Medium, SC = Seed Care + Medium
Bars marked with different letters show means are significantly different at 0.05 level of probability.
Vertical bars show standard error

The morphological parameters of these cashew seedlings were not affected by Apron Star, Dress Force and Seed Care fungicides used in this experiment as Fig. 6 shows that the growth of the seedlings was not altered as the treated nuts had similar seedling vigour with the control Ct all through the duration of the experiment. At MTH3, Ct, AS and DF all had similar excellent score values of 4.7 while SC also had an excellent score value of 4.5. Between good and excellent score values were recorded throughout the experiment which is an indication that the morphological parameters of the cashew seedlings were not negatively affected by the 3 different fungicides used. The result of the morphological parameters shown in Fig. 2, Fig. 3, Fig. 4 and Fig. 5 also contradicts the findings of [15] as they reported that treating seeds with fungicides before planting can adversely affect seedling growth and development negatively.

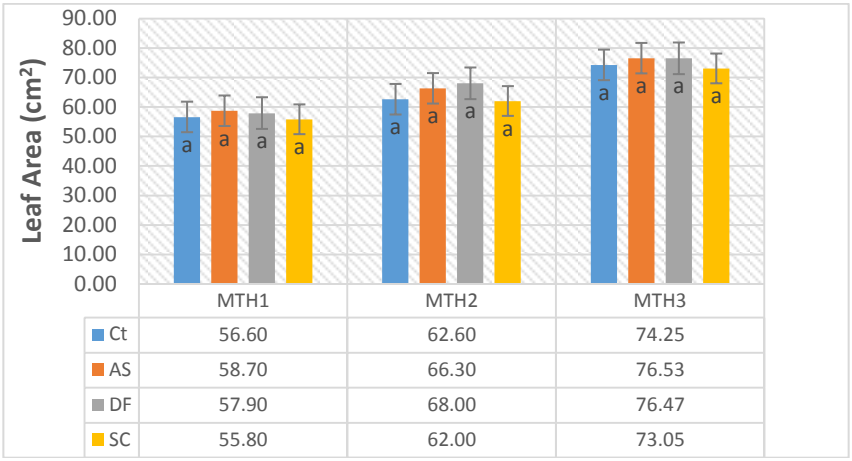

Fig. 5. Cashew seedling leaf area (cm^2) as influenced by 3 selected fungicides at 1, 2 and 3 months after sowing

MTH1 = Month 1, MTH2 = Month 2, MTH 3 = Month 3.
Ct = Control, AS = Apron Star + Medium, DF = Dress Force + Medium, SC = Seed Care + Medium
Bars marked with different letters show means are significantly different at 0.05 level of probability.
Vertical bars show standard error

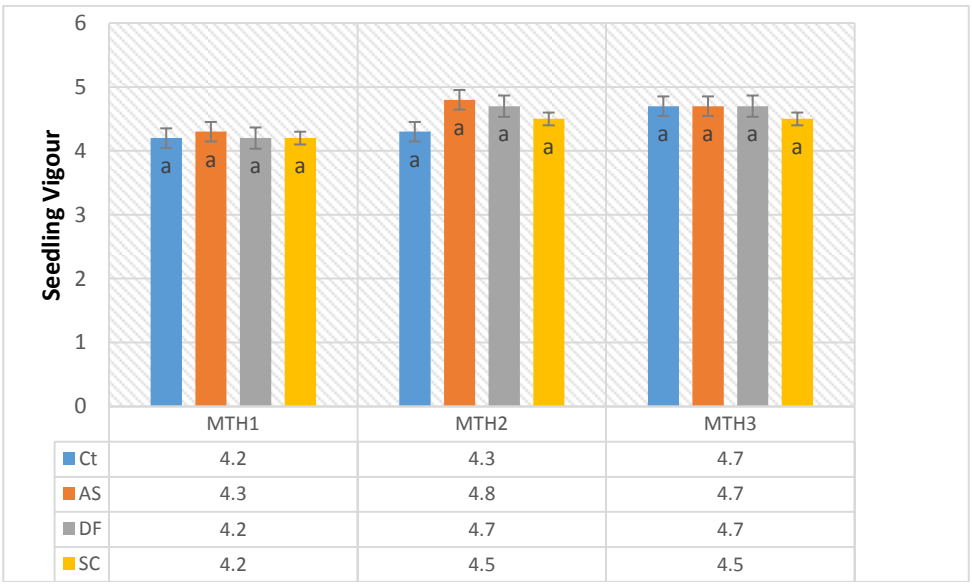

Fig. 6. Cashew seedling vigour as influenced by 3 selected fungicides at 1, 2 and 3 months after sowing

MTH1 = Month 1, MTH2 = Month 2, MTH 3 = Month 3.
Ct = Control, AS = Apron Star + Medium, DF = Dress Force + Medium, SC = Seed Care + Medium
Bars marked with different letters show means are significantly different at 0.05 level of probability.
Vertical bars show standard error

4. CONCLUSION

The three selected fungicides (Apron Star, Dress Force and Seed Care) used as pre-sowing treatment against fungi diseases did not encourage delay in the emergence of the young cashew seedlings. In addition, Apron Star and Dress Force fungicides showed the tendency to improve the emergence. Fungicides also showed a tendency to promote the growth and development of cashew seedlings rather than adversely affecting the growth of young cashew seedlings. As preventive measures against fungal diseases, Apron Star, Dress Force and Seed Care have been found to have no adverse effect on the germination and growth of cashew

seedlings. However, we recommend repeating this experiment to verify the effect of the selected fungicide on cashew seedlings. Additionally, the potential of the selected fungicide should be checked to see if it can prevent fungal disease in young cashew seedlings.

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COMPETING INTERESTS

Authors have declared that they have no known competing financial interests or non-financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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