RELATIONSHIP BETWEEN SEED COAT COLOUR AND IMBIBITION CHARACTERISTICS OF AFRICAN YAM BEAN (*Sphenostylis stenocarpa* (Hochst. Ex. A Rich.) Harms) SEEDS

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ABSTRACT

The study investigated the relationship between coat colour and composition of African yam bean seeds; investigated the relationship between seed composition and the amount and rate of water imbibition characteristics of African yam bean seeds; and also investigated the influence of seed coat colour and composition on seed vigour of African yam bean (*Sphenostylis stenocarpa* [Hochst Ex. A. Rich] Harms). This was with a view to determining the influence of seed coat colour and chemical composition on imbibition of African yam bean.

Seeds of four cultivars of African yam bean were sorted into four colour classes using Munsell Soil Colour Chart. Imbibition test, hundred seed weight, standard germination test, and bulk conductivity test were conducted on the seeds by class. Biochemical analyses were also carried out to determine the seed chemical composition. Means were separated using Fisher's Least Significant Difference (LSD).

The results showed high significant differences ($P<0.01$) among the four coat colours of African yam bean for ash content, fat content, fibre content, quantity of protein, amount of carbohydrate and total phenol in the seed coat. The mean values for the four different colours of African yam bean showed that hundred seed weight ranged from 24.42 g in pale brown to 30.17 g in mottled light yellowish brown colour. Mottled light yellowish brown colour had the highest germination percentage (93.50%) while reddish brown colour had the least germination percentage (36.50%). Considering the vigour, light greenish gray had the highest conductivity value (2.99 $\mu S\ cm^{-1}\ g^{-1}$) while mottled light yellowish brown had the least value (0.98 $\mu S\ cm^{-1}\ g^{-1}$) indicating that mottled light yellowish brown had the highest vigour among them. The peak of imbibition occurred at 24 h hour for light greenish gray (32%), mottled

light yellowish brown (23%) and pale brown (17%), except reddish brown colour (7%) which

had the peak of imbibition at 30th hour. Light greenish gray seeds imbibed high amount of water within 54 hours compared to other seed colours (mottled light yellowish brown, Pale brown, Reddish brown) which took more than 54 hours to imbibe water but had lower germination percentage due to highest amount of fat in the seeds. Imbibition rate was fastest in light-coloured seeds due to high carbohydrate content. Generally, there was no relationship between seed composition and amount of water imbibed, but the lighter the colour of the seeds, the higher the fat content. There was a positive relationship between fat content and the rate of imbibition.

The study concluded that seed coat colour was not related to water imbibition while chemical composition significantly influenced the vigour but seed coat colour *per se* did not

CHAPTER ONE

INTRODUCTION

1.1 Background to the Study

African yam bean (*Sphenostylis stenocarpa* (Hochst. Ex. A. Rich) Harms) is a tuberous legume that belongs to the family Fabaceae (Adewale, 2010). According to Busson (2001), African yam bean originated from Ethiopia. However, both cultivated and wild varieties now occur in tropical Africa including Egypt and also across West Africa, and further extend to southern Africa. Ufter (2007) reported that it is cultivated in Nigeria (Benue state, Edo state, Osun state, and so on) mainly for seed while it is planted for tubers in Gabon, Cote d'Ivoire, Togo, Ghana, Cameroon, Democratic Republic of Congo, Ethiopia, Malawi, parts of Eastern Africa, and Zimbabwe.

African yam bean has twining vines that are vigorous, and could be pigmented red or green. The crop requires support of a height of about 3 metres or more, and its vines twine around the stakes in a clockwise direction (Adewale and Dumet, 2009). The leaves of the crop can be described as compound trifoliate and the flowers are attractive and admirable ornaments with either purple or pink colour (Adewale and Dumet, 2009). Each pod of African yam bean contains about twenty seeds, and the pod is normally linear in shape. According to Abioye *et al.* (2015), the crop has varying seed coat colour, shape and size. The seed coat colour varies from white to several shades of grey, brown and cream.

African yam bean is an important source of two edible products - seeds and tubers; both provide food for humans and livestock (Olasoji *et al.*, 2011). African yam bean seeds have high amount of dietary fiber, vitamin C, vitamin B6, manganese, and potassium (Ufter, 2007). However, the

seeds are low in sodium, saturated fat, and cholesterol (Uter, 2007). According to Busson (2001), the African yam bean is very significant as a pulse legume, and it is also regarded as a good source of protein and starch in Africa. Uter (2007) found out that 1,640 KJ is the energy content of every 100 g dry matter of the seeds. Moreover, Busson (2001) reported that the glycemic index of the products of African yam bean is generally lower than that of other legume products. This implies that African yam bean provides more sustainable form of energy.

Busson (2001) further noted that the crop performs very well in hot climates and on poor soils by producing a considerable yield more than other kinds of pulse (legume). African yam bean is a vital crop which can be chosen for land reclamation because of its ability for nitrogen fixation.

According to Okeola and Machuka (2001), the crop is less prone to diseases and pests when compared to other leguminous crops. This quality may be as a result of the inherent lectin in the seed. The authors further reported that the physiological system of *Callosobruchus tomentosicollis* was discovered to be susceptible to the lectin in African yam bean.

African yam bean seeds undergo epigeal germination which is characterised by the raising of the cotyledons above the ground surface. Germination of these seeds starts with uptake of water (imbibition) by a quiescent dry seed and is concluded by the protrusion of radicle via the surrounding tissues of the embryo, and this takes place when the growth of the embryo overcomes the constraints imposed by the seed coat (Bewley *et al.*, 2013).

Ma *et al.* (2004) reported that seed coat has a vital role to play in the process of water imbibition, in that it helps to prevent the occurrence of soaking injury or soaking damage during seed germination. Zhou *et al.* (2010) further noted that seed coat helps the seed to maintain good quality, viability and longevity by protecting the seed against deterioration. Meyer *et al.* (2007)

stated that soaking damage experienced by the seed usually occurs in the initial stage of water imbibition. Murat and Erol (2010) found out that seed coat colour is associated with the absorption of water, and that seed coat pigmentation had a negative correlation with the rates of imbibition in several legume species. Also, seed coat colour could be linked to the existence of polyphenols in the seed coat, and the variation in the coat colour could be caused by genetic factors (Saima *et al.*, 2014).

African Yam Bean is characterized by low viability and seed vigour which has been attributed to the slow rate of imbibition that could be influenced by seed coat colour (Olisa *et al.*, 2010). There is need to determine the influence of seed coat colour and chemical composition on imbibition characteristics of African yam bean seeds. Therefore, the objectives of the study were to:

(i) investigate the relationship between coat colour and composition of African yam bean seeds;

(ii) investigate the relationship between seed composition and the amount and rate of water imbibition characteristics of African yam bean seeds; and

(iii) investigate the influence of seed coat colour and composition on seed vigour of African yam bean.