Nig. J. Anim. Prod. 2017, 44(5): 232 - 238
Nigerian Journal of Animal Production

Germination percentage and emergence potential of nine newly introduced temperate forage germplasms in Shika, Nigeria

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Abstract

A trial was conducted to investigate the germination percentage and emergence potential of nine imported temperate forage germplasms at the National Animal Production Research Institute, Shika, Nigeria. The seeds consisted of seven grasses namely; Beefsteak plant (Fructus perillae), Sweet elephant grass (Pennisetum alopecuroides), Wild foxtail millet (Setaria viridis), Napier grass (Pennisetum purpureum), King grass (Pennisetum sinese), Chinese sorghum (Sweet sorghum) and Zea mexican schard (Purus frumentum) and two legumes namely; Chinese woad (Isatis tinctoria) and Chinese alfalfa (Medicago sativa). A laboratory germination test and pot emergence trial was carried out to ascertain their viability. The result of the experiment showed that Sweet elephant grass, napier grass and king grass recorded over 90 % germination and the least was 30 % in Chinese sorghum. Chinese alfalfa and wild foxtail millet had least germination percentage with 100 % Seed dormancy. Highest emergence rate, seedling length and seedling vigour index were observed in king grass than the other forage germplasms. The highest percentage emergence was obtained in king grass > sweet elephant grass > napier grass > Zea mexican schard > beefsteak plant > Chinese woad > Chinese sorghum, respectively. It was concluded that these forages can successfully be adopted as animal feed resources in Nigeria and therefore, recommended for multi-locational trials in all the ecological zones of the country.

Keywords: emergence, forages, germplasms, Nigeria, seeds, temperate.

Introduction

Most tropical countries of the world and Nigeria in particular are faced with constrain of inadequate livestock feeds in both quantity and quality, especially during the periods of long term dry season and drought. The quest to increase diversification and sustainable livestock production under rangelands and sown pastures has led to the importation of nine temperate forage germplasms from China in the year 2016 to the National Animal Production Research Institute, Shika, Kaduna State, Nigeria. The seeds were tested in the forage laboratory to determine their germination ability and adaptation to the new environment in accordance with the earlier works of Omokanye *et al.* (2000). The authors reported a screening performance trial of forage germplasm in

Shika with sixty-one forage species obtained from the International Livestock Research Institute (ILRI) Addis Ababa, Ethiopia in year 1990. Only thirty five accessions germinated. They reported that the following accessions are able to emerge but failed: *Cenchrus ciliaris* ILCA 6612, *Cenchrus ciliaris* ILCA 6646, *Chloris gayana* ILCA 6633, *Panicum coloratum* ILCA 7153, *Cassia mimosoides* ILCA 10068, *Zornia glabra* ILCA 11453 and *Lotononis bainesii* ILCA 6852. Also, the following accessions failed to emerge completely during the trial: three *Panicum maximum accessions*, one *Paspalum plicatulum* accession, one *Setaria anceps* accession, one *Cynodon aethiopicus* accession, one *Urochloa mosambicensis* accession, one *Melinis minutiflora* accession, one *Brachiaria decumbens* accession, one *Desmodium tortuosum* accession, one *Desmodium sandwicense* accession, three *Neonotonia wightii* accessions, one *Centrosema acutifolium* accession, one *Aeschynomene americana* accession, one *Acacia decora* accession, two *Acacia albida* accessions, one *Acacia aneura* accession, one *Acacia seyal* accession, one *Acacia nilotica* accession, one *Albizzia spp.* accessions, two *Gliricidia sepium* accessions. The authors attributed these emergence failure to poor seed viability and prolonged seed storage. These has set up a baseline information for further research on emergence, growth and nutritional quality of the temperate pasture species introduced into Nigeria. The germination percentage is an estimate of viability for a population of seeds (Akpensuen *et al*., 2015). The objective of this study was to test for germination ability and emergence potential of nine newly introduced temperate forage germplasms in Shika, Nigeria.

Materials and Methods

Germination and emergence trials were conducted at the forage laboratory of the Feeds and Nutrition Research Programme, National Animal Production Research Institute, Shika. Shika, is located on latitude 11^0 12' N longitude 07^0 33' E and altitude 660m above sea level in the Northern Guinea Savannah of Nigeria. Wet season starts from April to early May and ends in late September to early October. Long-term annual rainfall ranges from 1110-1580mm (Ovimap, 2017) with a maximum temperature of 30^0C and relative humidity of approximately 70% (IAR, 2016).

Germination test

The nine temperate forage seeds include: seven grasses namely; beefsteak plant (*Fructus perillae*), sweet elephant grass (*Pennisetum alopecuroides*), wild foxtail millet (*Setaria viridis*), napier grass (*Pennisetum purpureum*), king grass (*Pennisetum sinese*), Chinese sorghum (*Sweet sorghum*), Zea mexican schard (*Purus frumentum*) and two legumes namely; Chinese woad (*Isatis tinctoria*) and Chinese alfalfa (*Medicago sativa*). Thirty seeds from each germplasm was counted and placed in petri dishes covered with transparent lid and lined with two layers of Whiteman filter paper (Ishiaku *et al*., 2015a). Water was added to the filter paper to provide moist environment. The seeds were arranged in a completely randomized design with three replicates totalling 90 seeds per species. Watering and germination counts began 24 hours after the commencement of the experiment according to the procedure of Babayemi *et al*. (2003). Germination percentage was computed using the following formula:

Germination percentage
= Total seeds germinated X 100
Total seeds sown

Seedling emergence

A pot experiment was carried out for seedling emergence of all the temperate seed germplasms in 17cm x 13cm x 6 cm plastic containers. The containers were filled with sandy loam soil collected at the forage trial experimental plots of the National Animal Production Research Institute, Shika. Water was added to the soil until there was seepage from the holes drilled at the base of the containers to prevent water logging and continuous moisture was maintained to provide required moisture for germination (Ishiaku *et al.* 2015b).

Data collection and Statistical analysis

The data collected on seed germination was determined by counting the seeds that germinated daily for 15 days, while dormant seeds are referred to as those seeds that did not germinate after 15 days (Babayemi *et al.*, 2003). The emerged seeds were counted when the shoots emerged above the substratum surface and the number of emerged seedlings were recorded daily and expressed in percentage as described by Nogondar and Azizi (2013) in accordance with Maguire's Equation (Maguire, 1967): M = n1/t1 + n2/t2 +…+ n15/n15 (in days).

Seedling length and seedling vigour were determined at 15 days after sowing. The mean emergence time (MET) and seedling vigour index (SVI) were calculated following the formulae of Ellis and Roberts (1981):

MET = Σ number of emerged seedlings
Day of counting

The percentage seedling emergence was calculated using the formula:Emergence percentage = Total seeds emerged X 100
Total seeds sown

Seedling vigour index (SVI) =
[Seedling length (cm) x Germination percentage]
100

Data collected were subjected to analysis of variance (ANOVA) using the Statistical Analysis System Software (SAS, 2005) and significant means were compared using Duncan Multiple Range Test.

Results and Discussion

The percentage germination in figure 1, showed that sweet elephant grass, napier grass and king grass recorded over 90% germination. The beefsteak plant and Zea Mexican recorded 63.33 – 80 % germination, Chinese sorghum and Chinese woad recorded between 30 - 43.33 % germination while Chinese alfalfa and Wild foxtail millet had less than 20% germination. The prime characteristics of a good quality seed is high germination percentage, this shows potential of the seeds. The poor germination percentage recorded in Chinese alfalfa and wild foxtail plant could be attributed to longer storage period. It could also be possible that the environmental condition did not favour their germination and emergence being them temperate species tried under tropical condition (Omokanye *et al*. 2000).

The percentage dormancy in figure 2, showed that seeds of Chinese alfalfa and Wild foxtail millet were 100% dormant during the trial period. Chinese sorghum and Chinese woad recorded 56.67 – 70% seed dormancy, beefsteak plant and Zea Mexican had 20 -36.67% dormant seeds and the least dormancy of 3.33-6.67 % was recorded in sweet elephant grass, napier grass and king grass species, respectively. Dormancy of these seeds might be due to unfavourable environmental conditions of high temperature and low relative humidity. Previous findings revealed that sometimes a seed may not germinate due to some

inhibitory factors of the seed itself (Marzieh *et al*. 2011).

Emergence rate of the newly introduced temperate seeds is presented in figure 3. The highest germination rate was recorded in the order; king grass > sweet elephant grass > Zea Mexican schard > beefsteak plant > napier grass > Chinese sorghum > Chinese woed with values of 29, 26.5, 20.3, 8.5, 7, 6.88 and 1.25 per day, respectively. Records of wild foxtail millet and Chinese alfalfa were at par with that of Chinese woed.

The seedling length in figure 4, at 15 days emergence trial was highest (14.0cm) in king grass followed by Zea mexican, Sweet elephant grass, Chinese sorghum and napier grass with values of 10cm, 9cm and 8cm seedling length, respectively while the least was 4cm recorded from beefsteak seedling. The results of preliminary trial of the temperate grass species in this study were similar to *Cenchrus* and *Chloris* species as reported by Omokanye *et al*. (2000) who reported the performance of 61 forage species appropriate for sub-humid zone of Nigeria.

The seedling vigour index in figure 5, at 15 days after sowing was highest in king grass (13.53), while sweet elephant grass, Zea Mexican grass, napier grass, beefsteak plant, Chinese sorghum, Chinese woad had 8.7, 8.0, 7.47, 2.53 and 1.99 seedling vigour index, respectively. Chinese alfalfa and wild foxtail millet had no record of vigour. Seedling vigour is an important quality parameter which needs to be assessed to supplement germination and viability test on the performance of a seed at the field or storage (ISTA, 2015). The king grass was more vigorous than the other plant species. This might be due to higher seedling length and germination percentage observed in our study. Ogedegbe *et al*., (2014) also reported a higher cummulative germination percentage, germination energy, shoot length and shoot fresh weight for *Cajanus cajan.*

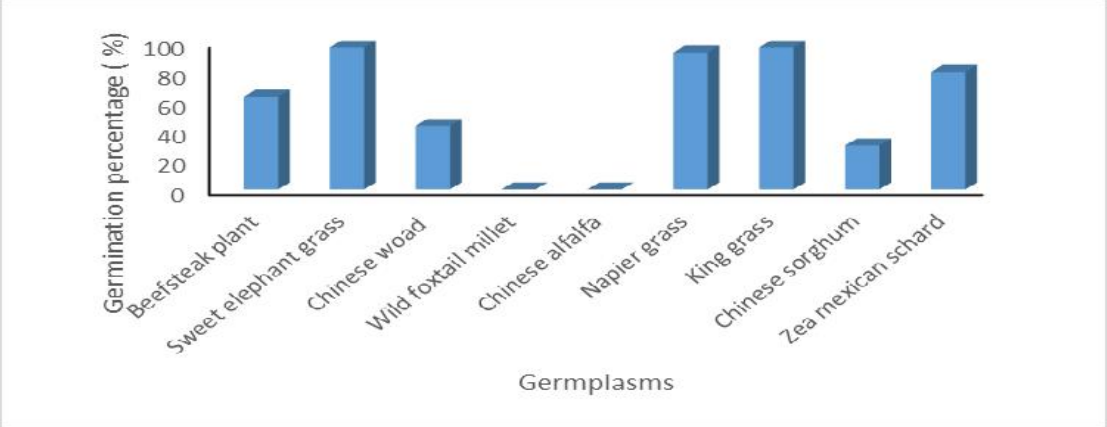

Figure 1: Shows the percentage germination of nine newly introduced temperate forage seeds to Shika environment.

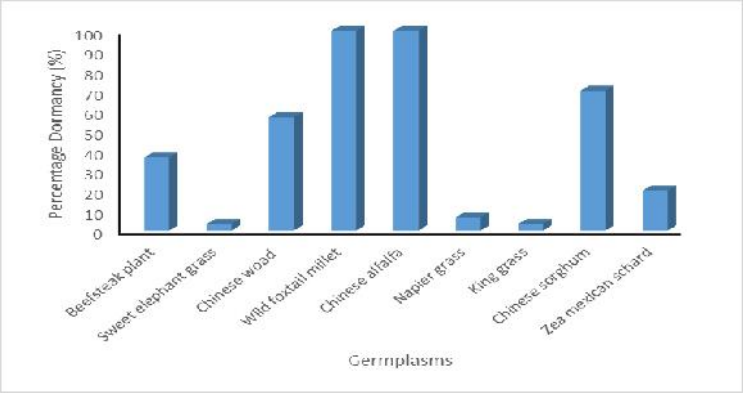

Figure 2: Shows the percentage dormancy of nine newly introduced temperate forage seeds to Shika environment.

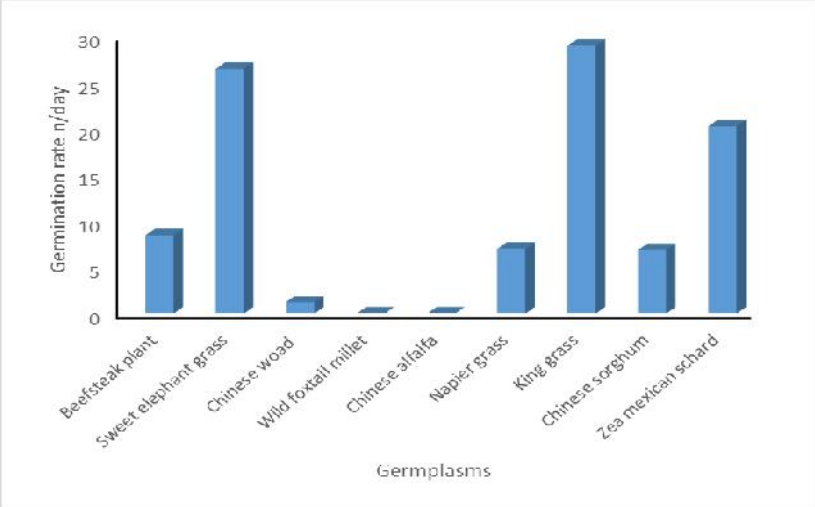

Figure 3: Shows the emergence rate of nine newly introduced temperate forage seeds to Shika environment.

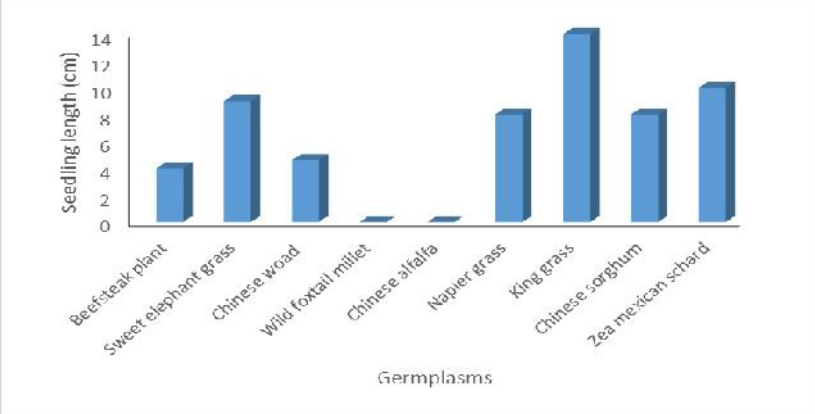

Figure 4: Shows the seedling length of nine newly introduced temperate forage seeds to Shika environment.

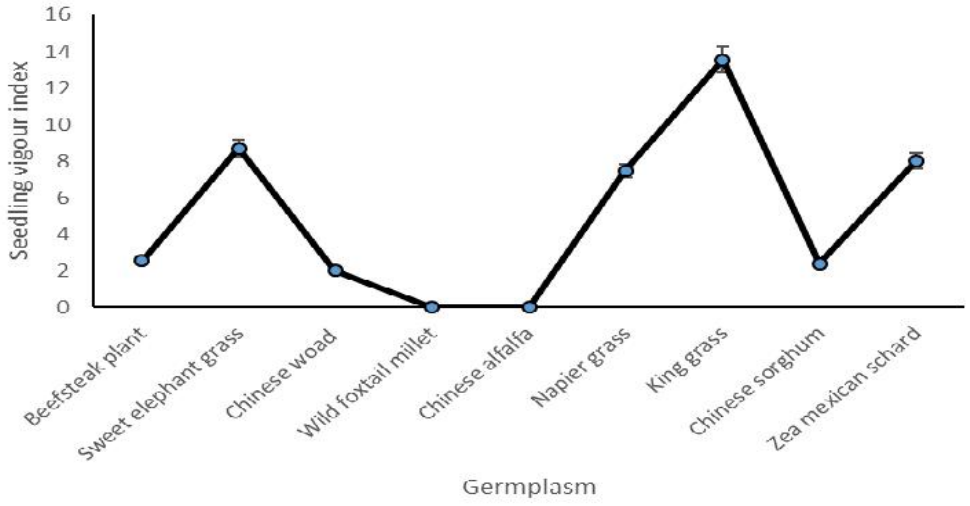

Figure 5: Shows the seedling vigour index of nine newly introduced forages to Shika environment.

Conclusion and Recommendation

Among the germplasms studied, king grass had the highest germination and emergence performance > sweet elephant grass > napier grass > Zea mexican schard > beefsteak plant > Chinese woad > Chinese sorghum. There is therefore an indication that these forages could be established in the northern guinea savannah of Nigeria and other ecological zones of Nigeria for improved animal production. However, these seeds need to be tested in other ecological zones of Nigeria to ascertain their adaptability. It could be recommended that more of these seeds should be imported into Nigeria so that multi locational trials can be conducted in various ecological zones of the country to determine their viability, adaptability and persistency. This will a long way help to mitigate the problem of livestock feed scarcity in Nigeria, thereby boasting our livestock industry.

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Received: 13th September, 2017
Accepted: 30th November, 2017