Evaluationof morpho-physiological variations in Pigeon pea for weed suppression and yield potentials in southern agro-ecologies of Nigeria.

Abstract

A study was conducted atIbadan (Derived savanna), Ife (Rainforest), and Kishi (southern Guinea savanna-northern fringe) to ascertain the agronomic potentials and variation in early interference traits for weed suppression in pigeon pea in southern agro-ecologies of Nigeria. The experimental site was marked out into 4 x 4 m plots and twenty (20) genotypes were randomly assigned with three replicates. Results showed that across genotypes in all locations, ***NSWCC-29^{B-1}*** *had the tallest plants. However,* ***NSWCC-46*** *had the shortest plants. Genotypes sown at Ife were the tallest across locations. This might have resulted from superior growth factors in Ife. Tall crop plants compete and suppress weedsmore than short crop plants.* ***NSWCC-19*** *had the largest leaf area across genotypes and locations at 20 WAP. Genotypes sown at Ife had the broadest leaves across the locations. Large leaf area enhances canopy formation, weed suppression, and light interception for improved grain yield.* ***NSWCC-7^{D}*** *had the broadest canopy width; though, similar to* ***NSWCC-24, NSWCC-29^{B-1}****,* ***NSWCC-27^{A,}*** *and* ***AO/TB 79-9.*** *Broad canopy width is loftier for weed suppression and crop yield.* ***NSWCC-24*** *had the highest grain yield across genotypes in all locations. Plants sown in Ibadan and Ife had better and similar grain yields than Kishi, which was about 50% lower than other locations.* ***NSWCC-7^{D}, NSWCC-29^{A}, NSWCC-35, NSWCC-46^{B}, NSWCC-35^{A}, NSWCC-34, NSWCC-29^{B-1}****,* ***NSWCC-27^{A}, NSWCC-24, CITA 3, AO/TB 79-9*** *and* ***NSWCC/8B*** *showed promising potentials for weed suppression and grain yield in all the agro-ecologies.*

Keywords: weed suppression, pigeon pea, canopy coverage, pigeon pea, genetic variation, agro-ecologies

Introduction

Pigeon pea (*Cajanus cajan*) is a leguminous crop that is often grown as hedges at dwelling places or asa cover crop in rural communities (Akande, 2007). Conversely, its potential as a food crop is not adequately exploited in most agro-economic settings. The seed is high in protein and can be prepared in various meals serving as a substitute for cowpea, but the crop has received little research attention in Nigeria in terms of weed management and profitability. Pigeon pea cultivation is adversely affected by weed infestation in the early growth phase before crop canopy formation(Ramanjit *et al*. 2015). It is a challenging task for resource-poor farmers to manage the weed menace at this stage. Profitable and sustainable production of pigeon pea-like most other crops is enhanced bygood cultural practices with a minimum cost of weed management. Minimal infusion of herbicides for weed control will reduce the cost of production, and minimize the risk to the environment, humans, and livestock. Cultivation of genotypes withan early inherent ability to suppress weed incursion through interference will also enhance better utilization of soil nutrients for optimum grain yield, supplementweed control intervention(s), guarantee season-long weed suppression, minimize the cost of production and reduce future weed incursion (Nicolas, 1993). The study is aimed at selecting genotypes with innate potentials for early weed suppression,high grain yield,and adaptability to mixed cropping systems to further minimize the cost of weeding and land productivityin agro-ecologies.

Methodology

The trial was established in Ibadan (Derived savanna agroecology), Ife (rainforest agro-ecology), and Kishi (southern Guinea savanna-northern fringe). Experimental sites were plowed and harrowed before sowing in June 2020 at all locations. The experimental site was marked out into 4 x 4 m plots and genotypes were sown with a plant spacing of 1 x 1m (2plants/stand). The treatments were replicated three times and arranged in Randomized Complete Block Design (RCBD). Pre-emergence herbicide (*Metolachlor* 960g E.C.at 1.44kg ai/ha) was applied at planting. Cultural practices were carried out throughout the study. Genotypes were studied for agronomic potentials and weed suppressive morphological traits. Data were collected on plant height at monthly intervals, number of branches/plant, leaf area, canopy width, number of pods/plant, 100-seed weight, and grain yield/hectare. Data were analyzed using SAS (General Linear Model) and the mean was separated using Duncan's Multiple Range Test (DMRT).

Results and Discussion

Across genotypes in all locations, **NSWCC-29^{B-1}** had the tallest plants (Figure 1). However, **NSWCC-46** had the shortest plants. Notwithstanding, genotypes at Ife were the tallest across locations (Table 2). This might have resulted from agroecological differences in the locations. Genotypes with tall plants have been reported to have better competition andsuperior weed suppression than short crop plants, due to their ability to intercept light and shade weeds better than short crop plants(Aluko *et al.*, 2010; Das, 2011; Aluko and Anjorin, 2019).

NSWCC-19 had the largest leaf area across genotypes and locations at 20 WAP. Genotypes sown at Ife had the largest leaf area across the locations. Large leaf area enhances canopy formation, weed suppression through smothering, and light interception for improved grain yield (Das, 2011; Aluko *et al.*, 2010).

NSWCC-7^{D} was distinct with the broadest canopy width across genotypes and locations. **NSWCC-24, NSWCC-29^{B-1}**, **NSWCC-27^{A,}** and **AO/TB 79-9** were equally comparable in canopy width with the highest recorded in **NSWCC-7^{D}** (Table 1). Broad plant canopy width is instrumental to early canopy formation and better weed suppression. This in turn will reduce weeding regimes and the cost of weed management. Genotypes with early canopy coverage in a sole cropping system might increase crop profitability as the weed competition is minimized and the cost of weeding is reduced. Genotypes grown in Ife had the highest canopy width across locations (Figure 2). Broad canopy width is a good weed suppressive factor,and as for improved crop yield (Aluko and Anjorin, 2019). However, genotypes with broad canopy coverage may inhibit the agronomic potentials of companion crop(s) through shading in a mixed-cropping system. Hence, genotypes with early and broad canopy coverage might be suitable for sole cropping where mechanizationis envisioned. **NSWCC-24** had the highest number of branches across genotypes and locations (Table 1). Genotypes grown in Ife had the highest number of branches/plants. This might have been affected by agro-ecological differences and the availability of superior growth factors in Ife (Figure 2).

NSWCC-24 produced the highest number of pods/plants across genotypes and locations. A number of pods/plants were distinctly highest in Ife compared to other locations (Ibadan and Kishi). This might have been influenced by the availability of superior growth factorsfor better genetic expression in pods/plants accruing from broadercanopy width in Ife. Agro-ecological variations might be implicated as better genetic expressions are linked to superior plant growth(Saxena, 2008).

Across genotypes and locations, **NSWCC-35^{A}** had the heaviest 100-seed weight (Table 1). Although, there was a similarity with some other genotypes. This might have resulted from better utilization of nutrients for seed formation and variation in maturity. Genotypes grown in Ife and Ibadan had similar, andheavier 100-seed weights than Kishi (Table 2). These were about two times weightier than 100-seed counted in Kishi. A longer dry spell peculiar to Kishi (southern Guinea savanna northern fringe) might have impacted proper seed filling. This might influence the expression of genetic potentials of cajanus in thisagroecology. This invariably influenced seed yield also. **NSWCC-24** had the highest grain yield across genotypes in all locations (Table 1). Plants sown in Ibadan and Ife had better and similar grain yield (Table 2) than grain yield in Kishi, which was about 50% lower than other locations.

Conclusion

NSWCC-7^{D}, NSWCC-29^{A}, NSWCC-35, NSWCC-46^{B}, NSWCC-35^{A}, NSWCC-34, NSWCC-29^{B-1}, NSWCC-27^{A}, NSWCC-24, CITA 3, AO/TB 79-9 and NSWCC/8B showed promising potentials for weed suppression and grain yield in all the agro-ecologies. Identifiedgenotypes with weed suppressive potentials will reduce the cost of weed management and optimize grain yield. Genotypes grown in Ife had the best expression of genetic potentials for grain yield and weed suppression. NSWCC-46, NSWCC-50, and NSWCC-28 with moderate branches, canopy width, and optimum grain yield are promising genotypes for mixed cropping systems across locations.

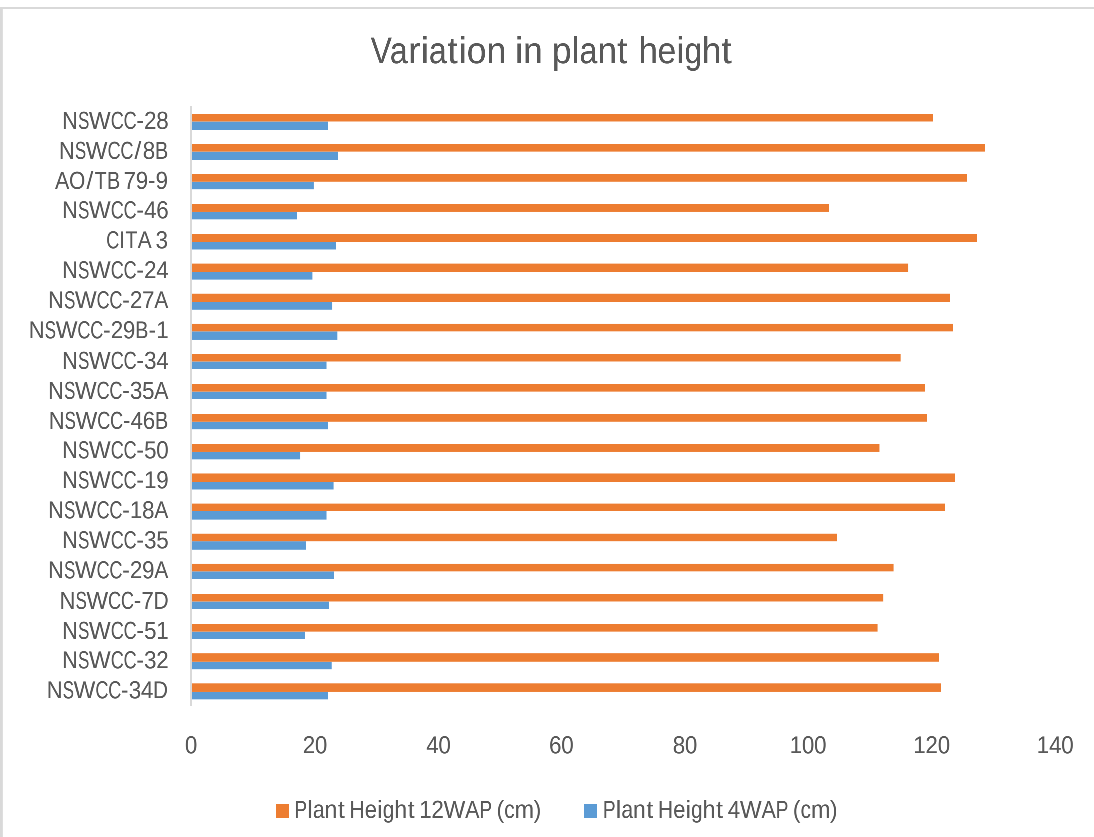

Figure 1: Variation in height of genotypes across locations at the specified time

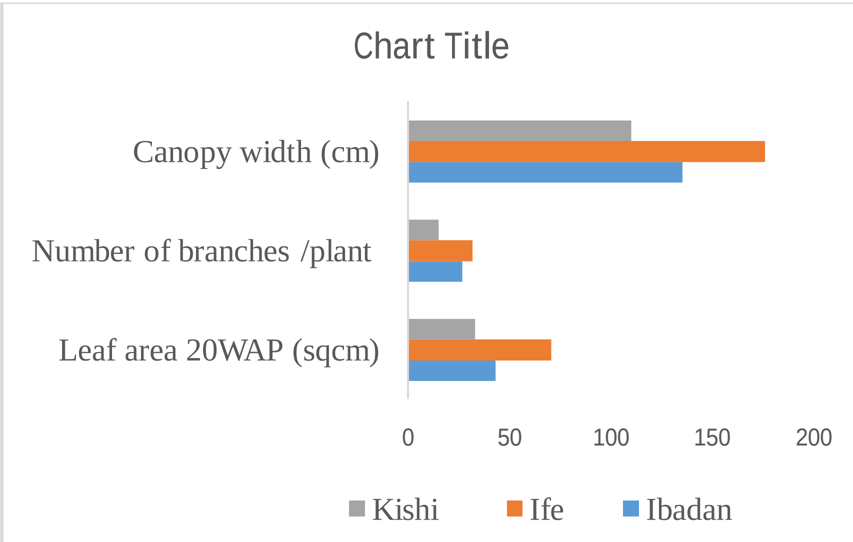

Figure 2: Variation in weed suppressive traits of genotypes across locations

Table 1: Agronomic potentialsof genotypes across locations

Genotypes	Number of Branches 10WAP	Leaf Area 20 WAP(cm^2)	Canopy width (cm)	Number pods/plant	100-Seed weight (g)	Grain yield (ton/ha)
NSWCC-34^D	25^{ab}	47.32^{a-d}	137.82^{a-c}	280^{bc}	7.22^{ab}	2.15^{bc}
NSWCC-32	24^{a-c}	49.29^{a-c}	140.77^{a-c}	257^{bc}	8.00^{ab}	1.76^{c}
NSWCC-51	25^{ab}	42.69^{cd}	136.83^{a-c}	258^{bc}	7.11^{ab}	1.45^{c}
NSWCC-7^D	22^{bc}	44.94^{b-d}	148.67^{a}	290^{bc}	7.78^{ab}	2.28^{a-c}
NSWCC-29^A	22^{bc}	48.05^{ab}	147.58^{ab}	290^{bc}	7.00^{ab}	2.23^{a-c}
NSWCC-35	23^{bc}	43.05^{cd}	133.26^{a-c}	311^{a-c}	6.75^{b}	2.31^{a-c}
NSWCC-18^A	25^{ab}	46.26^{b-d}	135.76^{a-c}	284^{bc}	6.75^{b}	2.12^{bc}
NSWCC-19	25^{ab}	57.45^{a}	137.26^{a-c}	291^{bc}	7.89^{ab}	1.63^{c}
NSWCC-50	22^{bc}	46.46^{a-c}	123.95^{c}	280^{bc}	6.88^{ab}	1.54^{c}
NSWCC-46^B	24^{a-c}	55.39^{ab}	135.06^{a-c}	307^{a-c}	7.89^{ab}	2.57^{a-c}
NSWCC-35^A	22^{bc}	49.49^{a-c}	136.59^{a-c}	274^{bc}	8.33^{a}	2.40^{a-c}

NSWCC-34	25^{ab}	47.68$^{a\text{-}d}$	142.81$^{a\text{-}c}$	295^{bc}	7.89^{ab}	2.49$^{a\text{-}c}$
NSWCC-29$^{B\text{-}1}$	25^{ab}	51.26$^{a\text{--}c}$	147.37^{ab}	274^{bc}	7.89^{ab}	2.45$^{a\text{-}c}$
NSWCC-27^{A}	26^{ab}	47.07$^{a\text{-}d}$	146.83^{ab}	318^{ab}	8.00^{ab}	3.27^{ab}
NSWCC-24	28^{a}	47.65$^{a\text{-}d}$	146.61^{ab}	428^{a}	7.89^{ab}	3.52^{a}
CITA 3	26^{ab}	50.87$^{a\text{-}c}$	143.20$^{a\text{-}c}$	346^{ab}	7.11^{ab}	2.49$^{a\text{-}c}$
NSWCC-46	20^{c}	37.59^{c}	133.42$^{a\text{-}c}$	227^{bc}	4.17^{c}	1.60^{c}
AO/TB 79-9	25^{ab}	46.17$^{b\text{-}d}$	143.96^{ab}	259^{bc}	7.13^{ab}	2.24$^{a\text{-}c}$
NSWCC/8B	26^{ab}	49.76$^{a\text{-}c}$	140.61$^{a\text{-}c}$	234^{bc}	6.67^{b}	2.22$^{a\text{-}c}$
NSWCC-28	25^{ab}	51.21$^{a\text{-}c}$	128.33^{bc}	180^{c}	7.22^{ab}	1.86^{c}

Table 2: Effects of locations on agronomic potentials

Location	Plant height 4WAP (cm)	Plant height 12WAP (cm)	Number of pods/plant	100-Seed weight (g)	Grain yield (ton/ha)
Ibadan	15.99^{c}	82.80^{c}	173.43^{b}	9.05^{a}	2.63^{a}
Ife	29.04^{a}	146.69^{a}	538.15^{a}	9.30^{a}	2.62^{a}
Kishi	20.28^{b}	129.46^{b}	170.25^{c}	4.00^{b}	1.46^{b}

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