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

Abstract

A study was conducted at Ibadan (Derived savanna), Ife (Rainforest) and Kishi (southern Guinea savanna-northern fringe) to ascertain the agronomic potentials and variation in traits for weed suppression in pigeon pea in southern agro-ecologies of Nigeria in 2020. 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 weed 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}*** *was 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 yield 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.*

Introduction

Pigeon pea (*Cajanus cajan*) is a leguminous crop that is often grown as hedges at dwelling places or as a cover crop in rural communities (Akande, 2007), hence it is highly underutilized. The seed is high in protein and can be prepared into 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 weed menace at this stage. Profitable and sustainable production of pigeon pea is enhanced by good cultural practices with minimum cost of weed management. Minimal infusion of herbicides for weed control will reduce cost of production, minimize the risk to the environment, human and livestock. Cultivation of genotypes with inherent ability to suppress or tolerate weed incursion will further compliment weed control intervention(s) and may guarantee season-long weed suppression and minimize cost of production. The study is aimed at selecting genotypes with innate potentials for weed suppression and grain yield in different agro-ecologies. Identify promising genotypes for mixed cropping system to further minimize cost and frequency of weeding and enhance overall land productivity.

Methodology

The trial was established in Ibadan (Derived savanna agro-ecology), Ife (rainforest agro-ecology) and Kishi (southern Guinea savanna-northern fringe). Experimental sites were ploughed 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 interval, 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 Mode) and mean 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 agro-ecological differences of the locations. Genotypes with tall plants have been reported to have better weed suppression than short crop plants (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 most superior leaf area across the locations. Large leaf area enhances canopy formation, weed suppression 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 **NSWCC-7^{D}** (Table 1). Notwithstanding, crop plants in Ife had the highest canopy width across locations (Figure 2). Broad canopy width or coverage is a good weed suppressive index for weed smothering and improved crop yield (Aluko *et al*., 2010; Das, 2011; Aluko and Anjorin, 2019). However, genotypes with broad canopy coverage may inhibit agronomic potentials of companion crop(s) through shading in a mixed-cropping system. However, where large plant spacing is envisaged, weeding frequency is increased, low land equivalent ratio and profit may be sacrificed. **NSWCC-24** had the highest number of branches across genotypes and locations (Table 1). Genotypes grown in Ife had the highest number of branches/plant. This might have been effected by agro-ecological differences and availability of superior growth factors in Ife (Figure 2).

NSWCC-24 produced the highest number of pods/plant across genotypes and locations. Pods/plant was distinctly highest in Ife compared to other locations (Ibadan and Kishi). This might have been influence by superior genetic expression in number of branches in Ife. Agro-ecological variations might be implicated as better genetic expressions are linked to favorable growth factors (Saxena, 2008). Across genotypes and locations, **NSWCC-35^{A}** had the heaviest 100-seed weight (Table 1). Although, there was similarity with some other genotypes. Ife and Ibadan had similar but heavier 100-seed weight than Kishi (Table 2). These were about two times weightier than 100-seed counted in Kishi. Longer dry spell in Kishi might have impacted on proper seed filling at maturity. Hence, expression of genetic variations are influenced by agro-ecological differences. **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. Identified genotypes with weed suppressive potentials will reduce cost of weed management and optimize grain yield. Genotypes grown in Ife had 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 system across locations.

Table 1: 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 (tn/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}

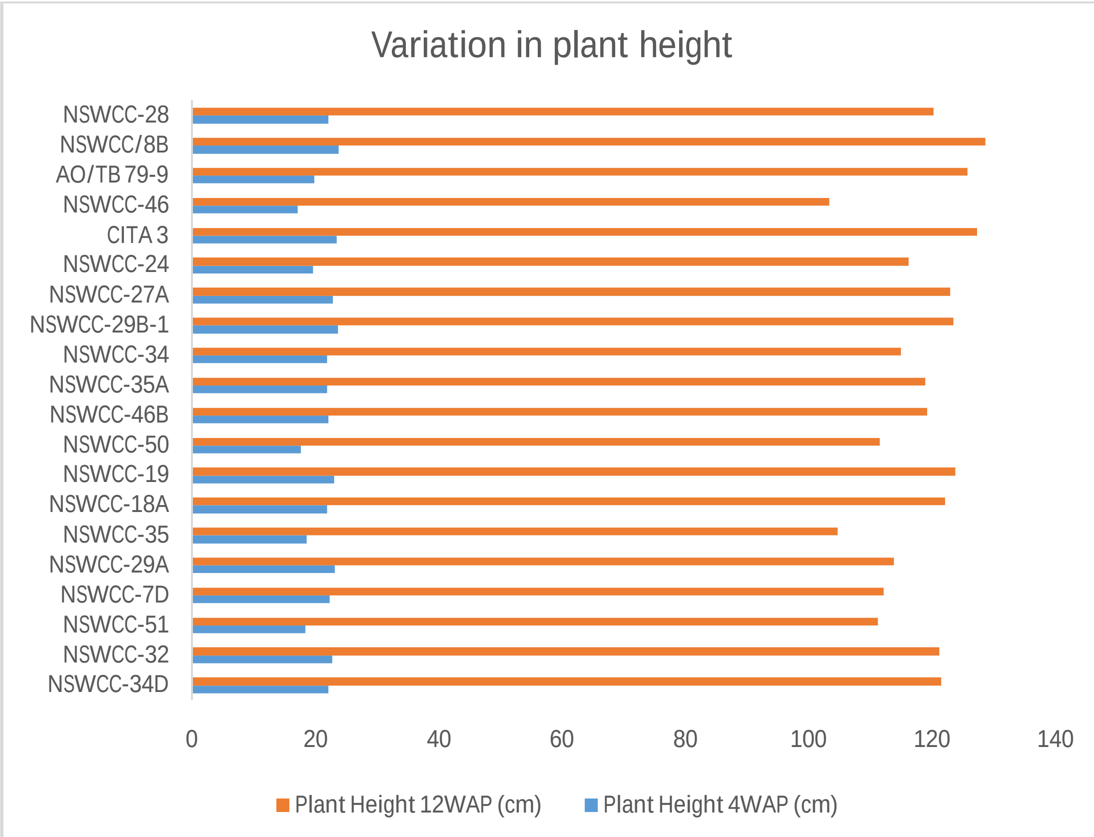

Figure 1: Variation in height of genotypes across locations

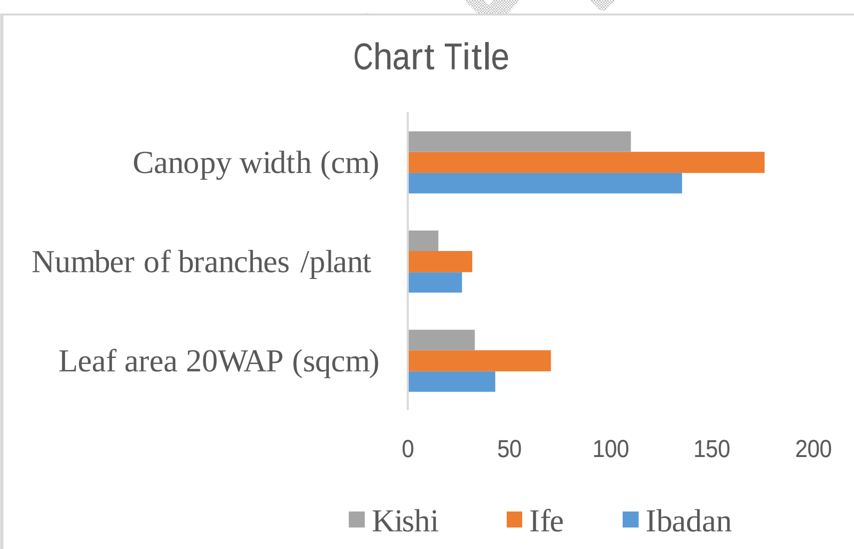

Figure 2: Variation in weed suppressive traits of genotypes across locations

Table 2: Agronomic potentials of 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 (tn/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-d}	142.81^{a-c}	295^{bc}	7.89^{ab}	2.49^{a-c}
NSWCC-29^{B-1}	25^{ab}	51.26^{a--c}	147.37^{ab}	274^{bc}	7.89^{ab}	2.45^{a-c}
NSWCC-27^{A}	26^{ab}	47.07^{a-d}	146.83^{ab}	318^{ab}	8.00^{ab}	3.27^{ab}
NSWCC-24	28^{a}	47.65^{a-d}	146.61^{ab}	428^{a}	7.89^{ab}	3.52^{a}
CITA 3	26^{ab}	50.87^{a-c}	143.20^{a-c}	346^{ab}	7.11^{ab}	2.49^{a-c}
NSWCC-46	20^{c}	37.59^{c}	133.42^{a-c}	227^{bc}	4.17^{c}	1.60^{c}
AO/TB 79-9	25^{ab}	46.17^{b-d}	143.96^{ab}	259^{bc}	7.13^{ab}	2.24^{a-c}
NSWCC/8B	26^{ab}	49.76^{a-c}	140.61^{a-c}	234^{bc}	6.67^{b}	2.22^{a-c}
NSWCC-28	25^{ab}	51.21^{a-c}	128.33^{bc}	180^{c}	7.22^{ab}	1.86^{c}

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

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