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Cross-Compatibility Between Some Cultivated Cowpea Varieties and a Wild Relative (Subsp. *Dekindtiana* Var *Pubescens*)

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Abstract

Four cultivated cowpea (Achi shuru, Ife Brown, Kanannado and Zebra bean) were crossed to their wild relative subsp. *dekindtiana* var. *pubescens* to ascertain their cross compatibility, reproductive potential and possible heterosis in the F_1 generations. Results show that the cultivated varieties hybridized relatively well with their wild relative with pod set of 40.8% to 46.7%. F_1 hybrid plants also showed high heterosis in plant height and number of leaves and produced viable seeds. These results are indications of a good reproductive potential of the hybrids thus making the wild, good candidate for transfer of important gene pool into the cultivated populations.

Keywords: Cowpea; F_1 hybrids; Cross-compatibility; *Dekindtiana*; Heterosis; Wild.

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1. Introduction

Cowpea (*Vigna unguiculata* L. Walp) is one of the most important pulse crops native to West Africa, belongs to family Fabaceae. Cowpea is called as vegetable meat due to high amount of protein in grain with better biological value on dry weight basis. On dry weight basis, cowpea grain contains 23.4 per cent protein, 1.8 per cent fat and 60.3 per cent carbohydrates and it is rich source of calcium and iron [1]. Apart from this, cowpea forms excellent forage and it gives a heavy vegetative growth and covers the ground so well that it checks the soil erosion. As a leguminous crop, it fixes about 70 – 240 kg per ha of nitrogen per year.

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Cowpea is native to West Africa and wild and weedy forms exist in many parts of the region [2, 3, 4]. Wild relatives of crop species are often sources of genes for disease and insect resistance, increased yield, improved product quality, earliness and wide adaptation [5, 6]. Wild forms and closely related species of cowpea, therefore, have great potential as an additional source of useful germplasm for cowpea improvement [7, 8]. In addition to their use in breeding, crop wild relatives are also used in their wild state. A number of wild cowpea species (*Vigna* spp.) in Africa contribute directly to food security through consumption of their tubers, fruits and seeds [9]. Crop wild relatives (CWR) are important for maintaining genetic diversity and preventing loss of germplasms due to genetic vulnerability.

The first crossings between crop wild relatives and cultivars to obtain disease resistant varieties date back to the 1890's [9], with pest and disease resistance currently remaining the highest priority for breeders and CWR being used primarily for this purpose. Several reports [4, 7, 10-12] have shown that wild and the weedy subspecies of cowpea (V. *unguiculata* subsp. *dekindtiana*, *stenophylla* etc.) hybridize easily with the cultivated forms and produce viable hybrids. F_1 hybrids are also known to have a degree of vigour over the parent genotypes. [12] reported successful crossing between cultivated cowpea (*vigna unguiculata* [L.] Walp) varieties and their wild relative (var *pubescens* TVNu110-3A). However, according to [13], the wild form could only be used as the male parent and attempts to use it as the female parent were unsuccessful. In order to utilise wild relatives of cowpea effectively for cultivar improvement, their cross compatibility and reproductive potential need be ascertained.

Members of the var. *pubescens* have been known to confer some degree of insect resistance on cowpea [14] owing to the presence of hairs (hence the name *pubescens*) on the plants. The wild cowpea variety subsp. *dekindtiana* var. *pubescens* used in this study is extremely hairy. Therefore, transferring the hairiness trait from the wild lines to the cultivated varieties will be of great interest in cowpea improvement for insect resistance and thus avoidance of pathogens transmitted by such insects. The objectives of this study, therefore, were to determine the cross compatibility between cultivated cowpea and wild varieties belonging to the subsps. *dekindtiana* var. *pubescens*, and to ascertain the reproductive potential, and heterosis of the F_1 hybrids from these crosses.

2. Materials and Method

Six cowpea lines, consisting of four cultivated and two wild varieties, were used in the study. The cultivated varieties are *Achi shuru, Kanannado* (both are cultivated widely in the Savannah region of Nigeria), *Ife Brown* and Zebra bean (are cultivated in the western rainforest region of Nigeria). The properties of the wild variety *Subsp dekindtiana* var *pubescens* is described [15,16]. This was collected in Bauchi state, Nigeria.

The experiments were conducted between September, 2011 and March, 2012 in the mesh house at National Centre for Genetic Resources and Biotechnology, Moor Plantation, Ibadan (7° 22'N and 3° 50'E). The first Experiment involved hand crossing the four cultivated cowpea varieties and the wild variety (subsp. *dekindtiana*, var *pubescens*). This exercise was carried out between October and November 2011 as described by [12]. The wild variety was used as pollen parent. Pods containing F_1 seeds were harvested at maturity. Recorded data of number of flowers emasculated and pollinated and number of mature pods set were compared using percentages. Parents and F1 seeds were sown in the second experiment at the NACGRAB Mesh House. Seeds each of the five parents and their four F_1 genotypes were sown in poly pots measuring 35cm in height and 18cm across. Two seeds were sown per pot and this was replicated five times in a completely randomized design. Seeds of the wild variety were mechanically scarified before sowing. The pots were watered regularly and weeds were hand removed. Data on mean plant height, number of leaves per plant, mean number of flowers and number of pods plant^{-1} were recorded, compiled and subjected to Analysis of variance (ANOVA) using Minitab 15. Pod set was also compared using percentages.

3. Results and Discussion

The four cultivated cowpea varieties crossed well with the wild relative by classical breeding, producing 230 mature pods out of total 408 flowers emasculated (Table 1). This means that 53.7% of emasculated flowers had pod set. This result compares well with percentage pod set of 48.1% achieved by natural selfing among the parent genotypes (Table 2). The F_1 crosses mean percentage pod set of 58.8% is higher than that of the parents (Table 2), showing heterosis for pod set in the crosses and thus cross-compatibity between the cultivated cowpea and their wild relative. The result corroborates those of refs. [10-12]

Table 1. Number of flowers hybridized, pod set and percentage of pods set in crosses of cultivated and wild *Vigna*.

Cross	Number of flowers pollinated	Number of pods set	Percentage of pod set (%)
Achi shuru x var *pubescens*	120	58	48.3
Ife brown x var *pubescens*	132	69	52.3
Kanannado x var *pubescens*	108	50	46.3
Zebra bean x var *pubescens*	98	42	42.9
Total	408	219	53.7 (mean)

Viability of the F_1 seeds of all the crosses indicates good reproductive potential. Number of flowers produced was significantly higher in the F_1 crosses as compared to the parents except for the wild genotype (Table 2). The wild significantly produced higher flowers and pod set than all the other parents. However the F_1 genotypes had a higher number of pod set than all the maternal parents. This may be an indication that the high yielding capability of the wild cowpea is dominant and may have been inherited by the F_1 crosses. Similarly, the F_1 crosses had higher number of pods per plant and percentage mature pods per plant than most of the parents. However, results from percentage pod set show that more of the flowers of the wild parents were wasted as compared to the paternal parents and the F_1 crosses.

Table 2. Number of flowers per plant, number of pods per plant and percentage of mature pods produced per plant in parents and F_1s in crosses of cultivated and wild *Vigna* varieties.

Genotype	Mean number of flowers per plant	Mean number of pods set	Percentage of pod set (%)
Parents			
Achi shuru	30cd	16c	53.3
var *pubescens*	90a	36a	40.0
Ife brown	26d	14c	53.8
Kanannade	29cd	14c	48.3
Zebra	20d	9d	45.0
Mean	39	19.8	48.1
F_1 crosses			
Achi shuru x var *pubescens*	59b	33a	55.9
Ife brown x var *pubescens*	47bc	29ab	61.7
Kanannado x var *pubescens*	36c	24b	66.7
Zebra bean x var *pubescens*	47bc	24b	51.0
Mean	47.3	27.5	58.8

Means followed by the same letter(s) in the same column are not significantly different at 5% level of probability (Tukey's).

Furthermore, plant height and number of leaves per plant were significantly higher in F_1 crosses as compared to the parents (Table 3). This result again confirms the reproductive vigour and heterosis of the F_1 crosses of cultivated cowpea and their wild relative var. *pubescens* over the parents.

Table 3. Mean plant height and number of leaves of per plant of parents and F_1s of crosses between cultivated and wild *Vigna* varieties.

Genotype	Plant height	Number of leaves per plant
Parents		
Achi shuru	95.8ab	23bc
var *pubescens*	72.0bc	19bc
Ife brown	43.3c	18c
Kanannade	39.9c	26ab
Zebra	89.7b	19bc
Mean	68.1bc	21b
F_1 crosses		
Achi shuru x var *pubescens*	124.0a	27ab
Ife brown x var *pubescens*	128.3a	30a
Kanannado x var *pubescens*	122.5a	26ab
Zebra bean x var *pubescens*	82.2b	21b
Mean	114.3	26

Means followed by the same letter(s) in the same column are not significantly different at 5% level of probability (Tukey's).

4. Conclusion

The results show that cultivated varieties of cowpea are cross-compatible with their wild relative var. *pubescens* and their F_1 produce viable seeds of had high reproductive potential as well as good hybrid vigour. It is suggested therefore, that the gene pool of wild cowpea varieties be sourced for improving the cultivated varieties.

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