



INHERITANCE OF POD HAIRINESS IN CROSSES INVOLVING THE WILD *Var. pubescens* AND LANDRACE COWPEAS IN BAUCHI AGROECOLOGY, NIGERIA

JOSHUA, N.N., O.A.T. NAMO¹ and Z. RUSSOM²

Department of Biology, Federal University of Education, Pankshin, Plateau State

¹Department of Plant Science and Biotechnology, Faculty of Natural Sciences, University of Jos, Nigeria

²Department of Crop Production, Faculty of Agriculture, University of Jos, Nigeria

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ABSTRACT: Hairiness on cowpea pods is a morphological obstruction to piercing and sucking insect pests. Possession of this attribute will afford a healthy pod that can translate to healthy grains, thus, improving grain yield per hectare. Breeding experiments were conducted in Bauchi environment between 2015 and 2018 to study the inheritance of pod hairiness in Cowpea. Thirty genotypes of cowpea obtained from collections and hybridisation trials were evaluated using complete randomised block design with three replications. The results showed that hairiness on cowpea pods was dominant in all the F₁ crosses. Segregation pattern of 3:1, a monogenic inheritance, was observed in all the F₂ crosses, except for Achishiru x Wild and NGB 00765 x Wild where there was no segregation, because both had similar pod attributes with the wild. The segregation pattern obtained in this study implies that pod hairiness is a heritable trait and can be transferred easily from the wild to the cultivated landrace cowpeas, where selection for the trait can be achieved on early segregating generations for improved and sustainable grain yield.

Keywords: Cowpea genotype, Landrace, Inheritance, Pod hairiness, Agroecology.

INTRODUCTION

Cowpea [*Vigna unguiculata* (L.) Walp.] is a versatile and important grain legume in the tropics and subtropics. Cowpea is known as vegetable meat due to high amount of protein in the grain with better biological value on dry weight basis. The grain contains 26.6% protein, 4.0% lipid, 56.2% carbohydrates, 8.6% moisture, 3.8% ash, 1.4% crude fibre, 1.5% gross energy, and 54.9% nitrogen-free extract (Owolabi *et. al.*, 2012). It is widely grown as a

grain legume, vegetable, fodder, green manure and cover crop, and is commonly referred to as black-eyed pea or lobia in India (Abebe and Alemayehu, 2022). Cowpea plant contributes to soil fertility through nitrogen fixation, fixing up to 58 kg N/ha (Bationo *et. al.*, 2000). However, despite the importance of the crop to man and sustainable livelihood, production of the crop is constrained by various biotic stresses, notably insect pest infestation (Togbe *et. at.*, 2014). Among the most damaging ones are the sucking pests such as aphids (*Aphis cracivora*), jassids (*Empoasca kerri*), thrips (*Megalurothrips sjostedti*) and white flies (*Bemisia tabaci*) as well as defoliators and pod borers like *Helicoverpa armigera* and *Maruca vitrata* (Bhuva and Patel. 2022, Lahutiya *et. al.*, 2024). At present, the control of insect pests on cowpea relies heavily on

*Corresponding Author E-mail: nehemiahj2007@gmail.com
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synthetic insecticides, which are often associated with negative environmental and health impacts, development of resistance and harm to non-target organisms (Jakhar *et al.*, 2017; Vijiyakumari *et al.*, 2025).

Genetic information as well as heritability studies on pod hairiness are very scanty. Recent work on variability studies on hairiness among different accessions of *Vigna rhomboidae* showed that there was sufficient genetic variability for density and length of hairiness on the leaf, stem and pod (Henry, 2004). Joshua (2009) and Mohammed *et al.* (2010) in their studies on inter-specific crosses between cultivated and wild (*var. pubescens.*) cowpea, independently reported dominance for the presence of hairiness on stems and pod in the F₁ crosses. The F₂ crosses indicated monogenic inheritance in most crosses and digenic inheritance in a few crosses. Hence, development of cowpea genotypes with hairy pods is desirable and will be a celebrated progress in cowpea breeding for the protection of pods. This study investigated the inheritance of pod hairiness in crosses involving the wild and landrace cowpeas in Bauchi agroecology in Nigeria.

MATERIALS AND METHODS

Site and Genetic material

The germplasm evaluation study was conducted on a field in Bar Arewa village of Bogoro Local Government Area of Bauchi 741104, Nigeria at latitude 9.719716°, longitude 9.56965°, along Bauchi-Pankshin road in Bauchi State during the wet season of 2018. Bauchi lies in the Northern Guinea Savannah zone of Nigeria.

Sources and Description of Materials: Materials used in this study consisted of 10 parental genotypes, nine F₁ genotypes, two backcross genotypes and nine F₂ genotypes of cowpea; making a total of 30 genotypes. The parental genotypes were advanced from the collection and agronomic evaluation study in 2015. The F₁, back crosses and the F₂ genotypes were developed from the hybridisation trials in 2016 and 2017, respectively, in the screen house in Tafawa Balewa town of Bauchi State, Nigeria.

Cultural Practices

The land used for the field evaluation was planted with sorghum the previous year. The vegetation in the field was burnt using a non-selective chemical herbicide called Vinash as the trade name with the active ingredient: Glyphosate IPA 41% WW (in the form of 480 g/l Glyphosate isopropylamine salt) SL at

the rate of 1 litre : 60 litres of water. The shrubs were cleared using cutlass and the left-over grasses and trashes were removed from the experimental field. Thereafter, the land was ploughed using cattle-drawn ridger.

The entire experimental field measured 100 m x 50 m which was then marked out with a measuring tape into three blocks of 25 m x 50 m each. The Parental and the F₁ genotype plots measured 0.8 m x 25 m each, while the Back crosses and the F₂ genotype plots measured 1.6 m x 25 m, respectively, to obtain larger populations. Relays between adjacent blocks measuring 2.0 m and 0.8 m served as discards between adjacent plots. These were clearly separated using pegs. The 30 genotypes were laid out in a randomised complete block design in three replicates. Sowing of the seeds was done on July 24, 2018. Seeds free of any physical defect were used. Seed scarification was used for the wild parent (*var. pubescens*) only to break dormancy and to allow for prompt germination. Inter- and intra-row spacing was 0.8 m and 1.0 m, respectively, giving an estimated plant population of 12,500/ha. Two seeds were sown about 2.0 cm per hole for all the genotypes except the wild parent in which three seeds were sown in 1.0 cm depth because of the small seed-size. The seedlings were later thinned down to one plant per stand two weeks after emergence.

Hand-weeding was employed using small hoe at four weeks after sowing. This was repeated at eight weeks after sowing. Pre- and post-flowering insecticides were sprayed to control and manage damage by insect pests on leaves, flowers and pods. The broad-spectrum insecticide called Sharp shooter (Profenofos 40%+Cypermethrin 4%) at the rate of 1 litre:120 litres of water was used.

Pods were harvested at full maturity, 12-14 weeks after sowing. Maturity was observed when pods changed from green colour to the characteristic pod colour of the genotype as yellow, pink or grey. Pod shattering was observed in the wild parent, F₁, Back crosses and F₂ genotypes. Pods from five randomly sampled plants in each plot of the three replications in the parents and the F₁ genotypes and all plants in the back crosses and F₂ plots were harvested into well-labeled polyethylene bags. Harvesting operation was commenced on September 10, 2018 and completed on November 8, 2018.

Observation and Data Collection

The following parameters were observed and data collected:

Days to first pod maturity: This was recorded from each of the sampled plants, whenever the first pod attained maturity.

Number of pods per plant: This was done by counting the number of pods in each of the sampled plants for all the genotypes.

Length of pod: Five pods randomly picked from each sampled plant were measured using ruler and the values added and averaged to obtain the mean length per pod for each plant after harvest.

Number of seeds per pod: This was determined on five randomly picked pods of each sampled plant. The number of seeds for each of the five pods was added up and averaged to obtain the mean number of seeds per pod.

Evaluation of qualitative characters

The following qualitative characters were recorded by counting:

- i. Number of plants with grey, pink and yellow pods was noted
- ii. Number of plants with or without hairs on their stems.

- iii. Number of plants with or without hairs on their pods. Number of plants with or without hairs on their stems and pods were assessed manually by hand-feeling on all F₂ plants.

- iv. Number of plants with shattering and non-shattering pods.

Data Analysis

Data collected during this study were subjected to one, or more, of the various forms of analytical tools available in System Analytical Statistics (SAS) Software: Analysis of Variance (ANOVA) and Statistical Analysis for Agricultural Research (STAR) (2014). Means were separated using the Duncan's Multiple-Range Test (DMRT) (Duncan, 1955). Test for goodness of fit on the qualitative characters was carried out using the Plant Breeding Tools, Version 1.3 (2014).

RESULTS AND DISCUSSION

Agronomic and genetic characterisation of the cowpea genotypes evaluated is presented in Table 1.

Table 1: Agronomic and Genetic Characteristics of the Cowpea Genotypes Evaluated

Genotypes	Growth Habit	Pod hairiness	Pod dehiscence	Pod colour	Pod shape	Mean days to first pod maturity
Mbereru	Spreading	Non-hairy	Non-dehiscent	Yellow	Bowed	77.0
Yar Ja	Spreading	Non-hairy	Non-dehiscent	Yellow	Bowed	76.0
Nafyali	Spreading	Non-hairy	Non-dehiscent	Yellow	Bowed	75.0
Yarwuri	Semi-erect	Non-hairy	Non-dehiscent	Yellow	Slightly Bowed	65.0
Ngb0076	Spreading	Non-hairy	Non-dehiscent	Yellow	Slightly Bowed	84.0
Ngb00 769	Spreading	Non-hairy	Non-dehiscent	Yellow	Slightly Bowed	75.0
Kanan nado	Spreading	Non-hairy	Non-dehiscent	Purple	Coiled	86.0
Ngb00765	Erect	Non-hairy	Non-dehiscent	Purple	Slightly bowed	62.0
Yarodakokari	Spreading	Non-hairy	Non-dehiscent	Yellow	Slightly	77.0
Yar dunga	Spreading	Non-hairy	Non-dehiscent	Yellow	Slightly Bowed	77.0
Achi Shiru	Semi- erect	Fairly-hairy	Semi-dehiscent	Yellow	Straight	65.0
Var. pubescens	spreading	Hairy	Dehiscent	Dark brown	Slightly straight	77.0
TVNU110-3A						

Most of the genotypes evaluated had spreading form of growth habit. Hairiness on pods was absent in most of the cowpea genotypes considered, except in the wild, which had hairy pods, while Achishiru and NGB 00765 had fairly hairy pods. Most of the landraces had indehiscent pods, except in Achishiru with semi-dehiscent pods and the wild with dehiscent pods. The pod colour in most of the genotypes was yellow, except in Kananado, NGB 00765 and the wild. Pod shape was mostly slightly bowed, while

Kananado had coiled pods. Days to first pod maturity ranged from 62 in NGB 00765 to 86 in Kananado. Table 2 presents pod hairiness in F₁ crosses involving the wild and some landraces of cowpea. The wild parent with hairy pods expressed dominance over all the nine crosses studied. The results of pod hairiness in the parents, F₁, Backcrosses and the F₂ genotypes are presented in Table 3.

Table 2: Pod hairiness in F₁ Crosses involving the Wild (*var. pubescens*) and some Landraces of cowpea grown and Crossed in Tafawa Balewa in 2017

S/N	Cross	Parental phenotype	F ₁ Phenotype
1	Achi shiru x Wild	♀Hairy x ♂Hairy	Hairy
2	Kanannado x Wild	♀Smooth x ♂Hairy	Hairy
3	Nafyali x Wild	♀Smooth x ♂Hairy	Hairy
4	NGB 00765 x Wild	♀Hairy x ♂Hairy	Hairy
5	NGB 00769 x Wild	♀Smooth x ♂Hairy	Hairy
6	Yaro da kokari x Wild	♀Smooth x ♂Hairy	Hairy
7	Yar dunga x Wild	♀Smooth x ♂Hairy	Hairy
8	Yarja x Wild	♀Smooth x ♂Hairy	Hairy
9	Yar wuri x Wild	♀Smooth x ♂Hairy	Hairy

The result shows that irrespective of the parental phenotype with respect to pod hairiness, all F₁ plants had hairs on their pods. All the plants in Achishiru x Wild x Achishiru backcross had hairy pods; Yarwuri x Wild x Yarwuri segregated into 19 plants with hairs and 27 plants without hairs on their pods in the ratio of 7:9. The result of pod hairiness in the F₂ genotypes showed that all the plants in the cross Achishiru x Wild had plants with hairy pods; Kanannado x Wild segregated into 108 plants with hairs and 36 plants without hairs on their pods in the ratio of 3:1; Nafyali x Wild had 98 plants with hairs and 30 plants without hairs on the pods in the ratio of 3:1; all the plants in the cross NGB 00765 x Wild had hairy pods; NGB 00769 x Wild segregated into 108 plants with hairs and 37 plants without hairs on the pods in the ratio of 3:1; the cross Yaro da Kokari x Wild had 83 plants with hairs and 27 plants without hairs on the pods in the ratio of 3:1. Yar dunga x Wild had 98 plants with hairs: 31 plants without hairs in the ratio of 3:1; Yar ja x Wild had 92 plants with hairs and 31 plants without hairs on the pods in the ratio of 3:1; Yarwuri x Wild had 111 plants with hairs and 38 plants without hairs on the pods in the ratio of 3:1.

The collection and crossing of cowpea germplasm in this study could stand as a gateway towards

contribution to the gene pool of the crop, segregation and creation of variability for selection (Tables 1 and 2); an important tool for varietal development. All the parents bred true to type, meaning there was no blending of the cowpea genotypes as planting material. All crosses in the F₁ had plants with hairy pods, suggesting dominance by the paternal parent. Achi shiru and NGB 00765 had semi-hairy pods similar to the wild. In the backcrosses; Achi shiru x Wild x Achi shiru did not segregate, because both Achi shiru and the Wild had hairs in their pods. Yar wuri x Wild x Yar wuri segregated into 9 hairy and 7 non-hairy pods, suggesting duplicate recessive epistasis. In the F₂ crosses Achi shiru x Wild and NGB 00765 x Wild did not segregate, because Achishiru, NGB 00765 and the Wild had hairs on their pods, suggesting that similar alleles controlling hairiness are found in their gene loci. Kanannado x Wild, Nafyali x Wild, Yaro da Kokari x Wild, Yar dunga x Wild, Yar ja x Wild and Yar wuri x Wild segregated into 3 hairy: 1 non-hairy pods, suggesting simple dominance or a monogenic inheritance. This implies that selection for the trait can commence on early generations of selfing. The presence of hairs on cowpea pods could stand as one of the major contributions of science to cowpea genotype resistance to pod piercing and sucking insects, translating into healthy grain production for sustained yield.

CONCLUSIONS

The dominance of hairiness on F₁ cowpea pods and the 3 hairy: 1 non-hairy cowpea pods results obtained in F₂ plants in this study showed that hairiness on cowpea pods is controlled by a single major gene. This also explains that developing cowpeas with hairs on their pods can be achieved easily for improved resistance to insect pests in cowpea which is one of the major constraints to grain yield optimisation of the crop.

RECOMMENDATIONS

Based on the findings in this study, it is recommended that the Wild *var. pubescens*, Achi shiru and NGB 00765 should be used as gene source for pod hairiness. Also, large number of landrace and wild cowpeas should be collected and explored for pod hairiness in cowpea improvement for resistance to pod piercing and sucking insects.

Table 3: Number of Plants with Hairy and Non- Hairy Pods in the Parents and Segregation Pattern in the F₁, Backcross and F₂ Crosses Involving the Landrace Cowpeas and their Wild Relative (*Dekindtiana var. pubescens*)

Genotype	Number of Plants	Hairy	Non- Hairy	Ratio	Chi- Square	Prob. Level
Parents						
Achishiru	22	22	0			
Kanannado	24	0	24			
Nafyali	23	0	0			
NGB 00765	24	24	0			
NGB 00769	25	0	0			
Yaro da kokari	24	0	0			
Yardunga	23	0	0			
Yarja	22	0	0			
Yarwuri	24	0	0			
Wild (var. pubescens)	25	25	0			
F ₁ crosses						
Achishiru x Wild	33	33	0			
Kanannado x Wild	26	26	0			
Nafyali x Wild	15	15	0			
NGB 00765 x Wild	42	42	0			
NGB 00769 x Wild	49	69	0			
Yaro da kokari x Wild	11	11	0			
Yardunga x Wild	20	20	0			
Yarja x Wild	12	12	0			
Yarwuri x Wild	27	27	0			
Back crosses						
Achishiru x Wild x Achishiru	27	27	0	-	-	-
Yarwuri x Wild x Yarwuri	46	19	27	9:7	0.055	0.850
F ₂ crosses						
Achishiru x Wild	136	136	0	-	-	-
Kanannado x Wild	144	108	36	3:1	0.000	1.000
Nafyali x Wild	128	98	30	3:1	0.167	0.683
NGB 00765 x Wild	91	91	0	-	-	-
NGB 00769 x Wild	145	108	37	3:1	0.021	0.886
Yaro da kokari x Wild	110	83	27	3:1	0.012	0.912
Yardunga x Wild	129	98	31	3:1	0.065	0.799
Yarja x Wild	123	92	31	3:1	0.003	0.958
Yarwuri x Wild	149	111	38	3:1	0.020	0.887

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