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Ornamental Potential of Cowpea Using Cytoplasmic and Nuclear Mutant Traits

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Abstract: Mutant traits possess aesthetic forms which could serve in the production of ornamental plants. Thorough understanding of these mutant traits in crop improvement is necessary. The objective of this study was to evaluate the ornamental potential of cytoplasmic and nuclear leaf and floral mutants of cowpea. Plants with aesthetic traits such foliage colour stem type and flower colour under cytoplasmic and nuclear control were crossed. Backcrosses were also made to parents with desired character(s) between 2007 and 2009. Selected plants with ornamental potential were evaluated in 25 cm diameter plastic pots filled with garden soil on the rooftop garden of the Department of Crop Protection and Environmental Biology, University of Ibadan. Nigeria. Qualitative data like; terminal leaf shape, plant growth habit, flower colour and form, while quantitative traits like; plant height at flowering, number of days from sowing to first flower and ripe pod, pod length, number of seeds per pod, total number of pods per plant were recorded and analyzed using means separation, standard error, standard deviations and coefficient of variation. Results obtained showed cowpea plants with combination of variegated leaf colour and fasciated stem, *Rosa* flower and green foliage with purple flower. Mean number of days from sowing to first flower, plant height at first flower, pod length, total number of pods per plant were 82.60, 19.10, 09.50 and 03.40 cm, respectively. It was found that fewer pods produced the by a plant increases its life span. This experiment was able to show cowpea as an ornamental crop.

Key words: Mutant traits, cowpea, ornamental potential, agronomic trait

INTRODUCTION

Ornamentals serve an aesthetic function, which may or may not lead to the production of food, clothing or shelter. The first impression of a plant is visual and the willingness to admire it, depends largely on the intensity or combination of colour(s) (Arthey, 1975). The size and form of the flowers also determines the usefulness of a plant as ornamental (Beryl and Molley, 1986). Shape and style of the growth habit also denotes the method of presentation of such a plant to the public (Arthey, 1975). Absence of damage and defects due to pests and diseases or mechanical defects is also an important characteristic of an ornamental plant (Kramer and Twigs, 1970). An ornamental plant must also be easily quick maturing, form beautiful flowers and leaves and remain flowering a long time, easily propagated and of low maintenance requirements (Shank, 1976). Thorough understanding of the uses of these mutant traits in crop improvement is necessary. The objective of this study therefore was to evaluate the ornamental potential of cytoplasmic and nuclear leaf and floral mutants of cowpea.

MATERIALS AND METHODS

Evaluation of the ornamental potential of cytoplasmic and nuclear mutants of cowpea was carried out using lines that possessed traits of aesthetic value on the rooftop garden of the Department of Crop Protection and Environmental Biology, University of Ibadan between 2007 and 2009. The cytoplasmic and nuclear mutant lines studied and their traits of interest such as leaf colour, growth habit, stem type, flower colour and form are shown on Table 1, 2 and Fig. 1. The following parental lines were used for the study; IB-VAR-3, IB-Y-Cyt., DR-Yellow were crossed to IB-Fas-S, *Rosa*-1 and *Rosa*-2 and derivatives of the cross *Rosa* x *Vigna unguiculata* subsp.

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Fig. 1: A *Rosa* flower mutant of cowpea

Table 1: Some characteristics of the cowpea lines used in the study

Name	Origin*	Status	Trait(s) of interest
IB-VAR-3	U.I	Mutant	Variegated foliage
IB-Fas-S	U.I	Mutant	Fasciated stem
IB-Y-Cyt.	U.I	Mutant	Yellow foliage
Rosa-1	U.I	Mutant	Purple rosaceous flower
Rosa-2	U.I	Mutant	White rosaceous flower
Double recessive yellow (DR-Yellow)	U.I.	Mutant	Bright yellow leaf

Rosa-1 and *Rosa*-2 arose from different crosses, but are controlled by allelic genes (Plate 1), *U.I.: University of Ibadan, Ibadan, ITA: International Institute of Tropical Agriculture, Ibadan, IAR and T: Institute of Agricultural Research and Training, Ibadan

Table 2: Some lines used in studying the ornamental potential of cowpea

Lines	Traits of interest	Location of inheritance factor
IB-VAR-3	Variegated foliage	Cytoplasm
IB-Fas-S	Fasciated stem	Nucleus
Rosa-1	Rosaceous flower	Nucleus
Rosa-2	Rosaceous flower	Nucleus
IB-Y-Cyt.	Yellow foliage	Cytoplasm
DR-Yellow	Yellow foliage	Nucleus

grandiflora. The subspecies *grandiflora* is reputed to have the largest flower in the genus *Vigna* (Porbeni and Fawole, 2004). Backcrosses were made to parental lines carrying traits of interest in cases where the plants resulting from the crosses did not show the desired trait(s). Selection was done for plants that show combinations of desired characteristics. Evaluation of selected plants possessing characteristics of ornamental potential was done on the rooftop garden of the Department of Crop Protection and Environmental Biology, University of Ibadan. Nigeria.

Data collection: Data were collected on the following qualitative traits: growth habit, foliage colour, leaf type, flower form and colour, tolerance to insect pests and diseases, ease of propagation and maintenance. The following quantitative traits; plant height at flowering, number of days from sowing to first flower and first ripe pod, pod length, number of seeds per pod, total number of pods per plant were also recorded.

Data analysis: Data on quantitative traits were analyzed using means separation, standard error, standard deviations and coefficient of variation.

RESULTS

Plants showing ornamental potential were classified into three distinct groups, based on their foliage colour which varied from green (Fig. 2) to variegated (Fig. 3) to yellow (Fig. 4). Variation in terminal leaf shape within the group ranged from hastate to sub-hastate to subglobose to linear shape, while the leaf texture varied from smooth to rough brittle leaves. Selected plants showed determinate growth habit with compact leaf arrangement on normal stem or compact leaf arrangement on fasciated stem. Plants with fasciated stem had differing terminal stem form which may be coiled, ribbon, or rosette shaped. Two major flower forms were exhibited; the *Rosa* mutant form and the papilionaceous flower type (Fig. 2). The flower colour ranges from completely purple, white with purple wing petal to completely white (Table 3).

The plants varied widely in the number of days from planting to first flower, which ranged from 56 days (SL 2) to 110 days (SL 5) (Table 4). The mean number of days from planting to first flower for all the plants evaluated was 82.6 days with a standard error of ±3.97 and a coefficient of variation (21.49%). The various selections also showed variation in height at first flower with an overall mean of 19.1 cm. The 13th selected plant (SL 13) showed the least plant height (8.3 cm), while SL 11 had the highest plant height (37.0 cm). The number of days from planting to first flower was not related with plant height as indicated by SL 5 and SL 18 with plant heights of 13.2 cm in 110 days and 20.4 cm in 51 days, respectively. Most of the plants were fertile and produced pods except in SL 4, SL 10, SL 13 and SL 18 where all the flowers produced were aborted.

Generally, the number of pods produced per plant was low but differences also occurred among the plants with respect to total number of pods perplant ranging

Fig. 2(a-d): Green foliage cowpea plants with different ornamental traits, (a) A fasciated plants with compact liner leaves, (b) Determinate plants with purple *Rosa* flower, (c) Dwarf brittle leaf plant with papillonaceous flower and (d) Compact, determinate plants with *Rosa* flower

Fig. 3(a-d): Variegated foliage cowpea with ornamental traits variegation, (a) Determinate plant with yellow-green, (b) Plants with white-green variegation, fasciate stem and compact leaves, (c) Dwarf plants with variegated normal leaves and (d) Dwarf plant with variegated brittle leaves

from 0- 8 pods per plant with a grand-mean of 3.4 pods per plant. The number of seeds produced per pod however, varied widely and ranged from 0-11 seeds per pod.

The selected plants showed different combinations of the different characteristics of aesthetic values (Table 4).

Fig. 4(a-d): Yellow foliage of cowpea plants with ornamental traits, (a) Determinate, brilliant yellow foliage plant, (b) A yellow foliage plant, (c) Compact brilliant yellow foliage plant and (d) Determinate yellow foliage plant

DISCUSSION

Many plants species, primarily used for ornamental purposes also possess edible parts and are used as food. For example, many species in the family Campanulaceae contain very pretty plants, several of which are also edible (Johnson, 1992; Plants for a Future, 2009).

Table 3: Phenotypic characteristics of some selected plants exhibiting ornamental potential

Selections (SL)	Foliage colour	Leaf type	Stem type /growth habit	Flower form	Flower type
SL 1					
G12835-1	Green	Normal	Determinate	*Rosa*	Purple
SL 2					
G12605	Green	Normal	Fasciated stem	Papilionaceous	Purple
SL 3					
G12551	Green	Normal	Determinate	*Rosa*	Purple
SL 4					
G12835-2	Green	Nonpetiolate	Compact	*Rosa*	Purple
SL 5					
G12832	Green	Normal	Determinate	Papilionaceous	White, wing petal lightly pigmented
SL 6					
G12801	Green	Normal	Fasciated stem	Papilionaceous	White, wing petal lightly pigmented
SL 7					
G12792	Green	Normal	Compact	*Rosa*	White
SL 8					
G12760	Green	Normal	Compact	*Rosa*	Purple
SL 9					
G13022	Green	Normal	Determinate	Papilionaceous	White, wing petal lightly pigmented
SL 10					
G12680	Variegated	Normal	Compact	Papilionaceous	White, wing petal lightly pigmented
SL 11					
G12694	Variegated	Normal	Determinate	Papilionaceous	Purple
SL 12					
G12840	Variegated	Normal	Fasciated stem	*Rosa*	White
SL 13					
G12773	Variegated	Brittle	Compact	Papilionaceous	White, wing petal lightly pigmented
SL 14					
G13023	Variegated	Brittle	Fasciated stem	Papilionaceous	White, wing petal lightly pigmented
SL 15					
G13028	Variegated	Brittle	Compact	Papilionaceous	White, wing petal lightly pigmented
SL 16					
G12768	Yellow	Normal	Determinate	Papilionaceous	Purple
SL 17					
G13070	Yellow	Normal	Compact	*Rosa*	Purple
SL 18					
G12757	Yellow	Normal	Compact	*Rosa*	White, wing petal lightly pigmented
SL 19					
G12702	Brilliant yellow	Normal	Determinate	Papilionaceous	White, wing petal lightly pigmented
SL 20					
G12701	Brilliant yellow	Normal	Determinate	Papilionaceous	White, wing petal lightly pigmented

SL: Selected lines

Plant species such as *Lathyrus* spp. (sweet pea), *Lobelia* spp. (India tobacco), *Lycopersicum lycopersicum* (tomatoes), *Solanum tuberosum* (potatoes), *Murraya koeniji* (curry plant), *Persea americana* (avocado or alligator pear) used mainly as food crops have been reported to have varieties that are of ornamental value (Plants for a Future, 2009; Morris, 1999; Ewart, 1981).

Leaf and flower colour, size and form of the flowers, plant shape and growth habit are some of the characteristics that determine the aesthetic value of a plant and, therefore its ornamental potential. Cultivated cowpea germplasm and that of closely related taxa contain a large diversity of their characteristics (Ewart, 1981). In addition, the discovery of cowpea mutants with striking growth habit, flower form and leaf colour traits have greatly enhanced the prospects for the development of ornamental cowpea plants.

Cowpea plants selected for their ornamental potential in this study possessed desirable combinations of growth habit, leaf and flower form as well as colour characteristics in the same plant. The yellow and variegated foliage traits resulted from a plastid mutation and is therefore

Table 4: Some quantitative characters of ornamental potential of cowpea plants

Selection (SL)	Days to 1st flower	Plant height at 1st flower (cm)	Pod length (cm)	Seeds/ pod	Total pod/plant
SL 1					
G12835-1	63	15.1	15.7	11	05
SL 2					
G12605	56	18.3	17.8	10	08
SL 3					
G12551	85	15.6	13.4	07	08
SL 4					
G12835-2	59	21.8	00.0	00	00
SL 5					
G12832	110	13.2	12.0	07	03
SL 6					
G12801	109	10.3	09.0	06	03
SL 7					
G12792	77	19.2	06.5	02	01
SL 8					
G12760	60	12.0	09.4	06	09
SL 9					
G13022	93	14.3	11.8	05	04
SL 10					
G12680	90	08.8	00.0	00	00
SL 11					
G12694	96	37.0	13.0	07	04
SL 12					
G12840	75	19.3	11.0	05	02
SL 13					
G12773	83	08.3	00.0	00	00
SL 14					
G13023	92	36.6	06.4	03	02
SL 15					
G13028	91	26.2	12.1	02	01
SL 16					
G12768	99	20.2	11.9	10	07
SL 17					
G13070	75	25.8	06.8	01	05
SL 18					
G12757	51	20.4	00.0	00	00
SL 19					
G12701	104	17.9	16.9	03	03
SL 20					
G12702	84	20.8	16.2	09	02
X	82.60	19.10	09.50	04.80	03.40
SD	17.75	07.86	05.84	03.67	02.87
S.E (±)	03.97	01.76	01.31	0.86	0.64
CV (%)	21.49	41.28	61.50	75.85	85.69

X: Mean value; S.D: Standard deviation, S.E: Standard error (±), C.V: Cumulative variance (%), SL: Selected lines

maternally inherited (Fawole, 2001). A brilliant yellow foliage colour controlled by a double recessive gene was also used to produce plants with aesthetic value. These traits exhibit an excellent aesthetic appeal and floricultural value. Flower colour of plants in this study ranges from full pigmentation, pale pigmentation of standard and wing petals to non-pigmented, while flower form was either papillonaceous or *Rosa*. White and purple colours are some of the most common flower colours in ornamental plants (Mattew, 1990; Beryl and Molley, 1986). The combination of these flower colours in the different flower form gives aesthetic appeal to plants with these traits.

CONCLUSION

This study was able to establish the potential of cowpea as an ornamental plant using some of mutant traits that of aesthetic value, apart from the nutritious values associated with this crop. Further investigation on ornamental potentials of cowpea should be pursued.

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