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Short communication

ON SOME "NOVEL" GENOTYPES OF THE ETHIOPIAN POPULATIONS OF *GUIZOTIA ABYSSINICA* (L.F) CASS. (NOUG)

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ABSTRACT: Some agronomically interesting genotypes were recorded from 147 populations of *Guizotia abyssinica* (noug). A preliminary comparison was made between these genotypes, LH- (Large headedness) and FH- (Fused heads) genotypes, and NLV- (Normal local variety)-genotypes based on the number of seeds per head. The LH-genotypes were found to have more average seed number than the NLV-genotypes. The FH-genotypes are believed to be transitional to the LH-genotypes. The effects of the breeding systems of noug on its yield are briefly discussed.

Key words/phrases: FH-, LH- and NLV-genotypes, *Guizotia abyssinica*, "novel" genotypes, self-incompatibility

INTRODUCTION

Guizotia abyssinica (L.f.) Cass. (noug) is an important oil crop and one source of cash in the agricultural system of Ethiopia. It is mainly cultivated in the highland areas of Ethiopia. Noug is genetically a variable crop. The low productivity of this crop is mainly associated with shattering, non-synchronous flowering and fruiting, self-incompatibility (SI) and male sterility (Teferi-Micael Adhanom, 1988). The absence of free intercrosses in the populations, i.e., the prevalence of self-incompatibility system, is reported by Sileshi Nemomissa (1987), Sileshi Nemomissa and Endashaw Bekele (1988) and Sileshi Nemomissa *et al.* in prep.). It is believed that SI affects the efficiency of pollination and hence is detrimental to yield.

This paper reports potentially valuable genotypes of noug which could be of considerable importance in its breeding and germplasm screening programme.

MATERIAL AND METHOD

Seeds of *Guizotia abyssinica* were acquired from the Biodiversity Institute, Ethiopia (formerly Plant Genetics Resources Centre, Ethiopia). A total of 147 populations were raised. The characters used in the present study were identified in nine out of 147 accessions. Accessions 15193 and 15049 are normal local varieties. The origin of the eleven accessions is given in Appendix 1.

Seeds were sown at the research station of Awassa Agriculture College in the 1995/96 growing season and at Holeta Research centre experimental field in 1996/97.

Large-headness (denoted as LH-genotypes) were determined visually from characteristic size of the heads. A preliminary seed count of 10 randomly selected heads for each population included in this report was performed. The seeds were carefully collected before the onset of shattering. All were obtained after open pollination.

Normal local varieties (NLV-genotypes) are defined as those which are commonly cultivated by local farmers and have significantly smaller heads than the LH-genotypes. Individuals with fused heads are denoted as FH-genotypes.

RESULTS

Table 1 gives the range and average seed number/head for LH- and FH-genotypes. The average seed number of LH-genotypes (A) and (B) which was 40.1 and 52.1 is larger than that of NLV-genotypes (a) and (b) which had an average of 28.9 and 26.7 seeds/head. Eighty per cent of the heads had 30 or more seeds and all heads had 35 or more seeds in the LH-genotypes. Only 50% of the heads had 30 or more seeds in both NLV-genotypes (Fig. 1).

Table 1. Average and range in numbers of seeds per head in the LH- and NLV-genotypes of *Guizotia abyssinica* (counts made from 10 heads/accession).

Accession numbers and genotypes	Average number of seeds/head	Range
LH(A) 15056	40.1	27–60
LH(B) 15096	52.1	37–67
NLV(a) 15193	28.9	15–42
NLV(b) 15049	26.7	13–40

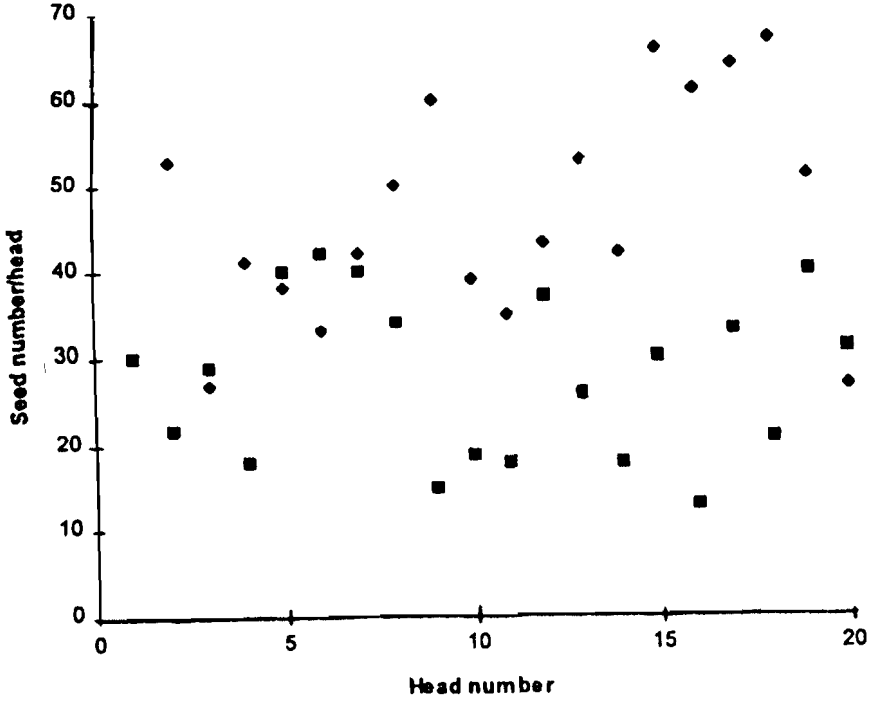

Fig. 1. Scatter diagram showing the variations of the number of seeds per head in two gene pools of *Guizotia abyssinica*. ■, NLV-genotypes; ◆, LH-genotypes.

Two broad categories of genotypes were recognized in *Guizotia abyssinica* based on the number of seeds. The weight of seeds/head was also considered to supplement the classification of LH and NLV genotypes. Number of seeds per head and average seed number were calculated for the two genotypes. The mean seed number/head in the two populations of LH-genotypes is 46.10 and that of the NLV-genotypes is 27.80. The difference between the mean seed number/head of the LH-and NLV-populations is statistically significant as found in t-test distribution. The calculated t-value is about 4 times greater than that from the t-table at 0.05 level of significance. This point shows the operation of a genetic base in the population structures of the two gene pools which contributed to the difference in their number of seeds per head.

FH-genotypes were recorded in the accession numbers 15005, 15012, 15024, 15054, 15055, 15067, and 15199. Usually 2-5 fused heads were observed on some branches of the NLV-genotypes, i.e., the plant has both fused and "normal" heads e.g. similar to those of NLV-genotypes. No plant was recorded with all its heads fused together. The occurrence of fused heads in the populations of *Guizotia abyssinica* is of rare nature and it is believed to be gene controlled.

Two degrees of fusion in the FH-genotypes were noticed:
i) heads completely fused and
ii) a transition to complete fusion of heads.

In the latter case the inflorescences bearing axes are completely fused and the heads are free. The number of ray florets coupled with head size could be used as a marker to distinguish LH- from FH-genotypes; the figure is usually higher in FH-genotypes. Due attention to head size is essential because variable numbers of ray florets have been reported in other species of *Guizotia* (Baagøe, 1974) and noticed in NLV-genotypes (personal observation; 6–17 ray florets).

DISCUSSION

LH-genotypes are of a rare occurrence in the populations of noug. Out of 147 populations nine plants representing two populations were identified. These genotypes are considered to be novel owing to their rarity and agronomic potential. LH-genotypes could be the source for producing agronomically superior genotypes in noug which are high yielding. The close association between LH-genotypes and higher average seed number (Fig. 1) suggests that yield in noug could be significantly increased by the maintenance and selection of the LH-genotypes.

However, parallel investigations on genetic factors which decrease yield in noug need also to be carried particularly on those that could interfere with the yield performance of the LH-genotypes. Studies on shattering behaviour, non-synchronous flowering and fruiting, self-incompatibility system and male sterility are expected to reveal relevant information.

The genetic factors that have been associated with the breeding system of noug are absence of free intercrosses which is coupled with self-sterility (failure to set self-seed). The establishment of inbreed lines which are self-compatible in the LH-genotypes or the infusion of self-compatible alleles into their gene pool could overcome the problem of inefficient pollination due to the non-synchronous flowering character of this crop.

Different systems for overcoming SI systems in crop plants have been extensively reviewed (Pandey and de Nettancourt 1976; Hinata *et al.*, 1994). The task of screening for pure inbreed lines can pose major difficulties due to the fact that filial generations of selfed-seeds exhibit self-incompatibility (personal observation). Alternative time effective procedures are to be explored and effectively employed at least to optimize or even change the properties of yield decreasing genetic factors which could be a bottle-neck to the establishment of LH-genotypes.

It is also noteworthy that the seeds of LH-genotypes may represent a mosaic genetic system because they are the result of open pollination. Genes from NLV-genotypes constitute a considerable portion of the gene pool of the LH-

genotypes. This point will be verified by recording the segregation patterns of the LH-filial generations.

The ultimate outcome of the trend in the degrees of fusion of heads in FH-genotypes could be LH-genotypes; FH-genotypes could be understood as an intermediate product in the process of producing LH-genotypes.

The genetic mechanisms underlying the two genotypes (LH and FH) are to be worked out in order to manipulate and utilize these genetic resources in the Ethiopian populations of noug. Such a study will contribute useful information to the national breeding and germplasm screening programme of noug.

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Appendix 1. List of accession numbers of *Guizotia abyssinica* studied.

Accession No.	Origin	Accession No.	Origin
15049	Wellega, Gimbi	15024	Shewa, Cheliya, Ambo
15056	Wellega, Gobu-Seyo, Anno	15005	Gojam
15096	Not given	15067	Arsi, Negele
15193	Not given	15012	Illubabor, Bure
15054	Harerghe, Chiro	15055	Shewa, Ambo
15199	Shewa, Ejaji		