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Screening of Upland Cotton Seed as a Nutrient Sources for Ruminants

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ABSTRACT

This study was designed to screen the thirty eight genotypes for their quality characteristics which can be exploited as feed for ruminant animals. The genotypes which posses high content of protein, oil and but low content of gossypol content will utilized for nutrient purpose. The protein and oil content were estimated by AOAC method, whereas, the gossypol content was estimated spectrophotomertically. The protein, oil and gossypol content ranged from 15.76 to 23.49, 11.37 to 16.23 and .011 to 0.29 percent respectively. The least gossypol content was observed in the ARBH 1501 (0.11%) genotype but also has low quantity of protein (19.80%) and oil (12.93%). Genotypes H 1478 and F2522 were best in terms of seed quality as seed of these genotypes contained more than 20% and 15% protein and oil content respectively, with less gossypol (0.19%) content. Such genotypes can be exploited further as a good nutrient source for the ruminants.

Key words: Protein, Oil, Gossypol, Ruminants, Cotton seed.

INTRODUCTION

There is variability in the chemical composition and nutritional value of cottonseed and its byproducts (Cottonseed meal). Cottonseed and its byproducts (Cottonseed meal) are mostly used to feed adult ruminants, because off relatively tolerance to gossypol. It can be a good source of nutrient also for mono gastric provided that its limitations are taken into account, notably the fiber content and the presence of gossypol (Tanksley, 1990; Chiba, 2001). However, the utility of this nutrient source is hampered by the presence of toxic gossypol that is unique to the gossypieae. This cardio and hepatoxic terpenoid, present in all part of cotton plant, renders cotton seed unsafe for human mono gastric animal consumption (Risco and Chase, 1997). These compounds protect the plants from both insects and pathogens. After the discovery of a glandless mutant, several breeding programmes were launched in U.S. Africa and Asia to transfer the glandless trait into commercial varieties to produce gossypol free cotton seed. However, these glandless varieties were a commercial failure due to naturally un-competiveness. Many factors contribute to variation in the nutrient and gossypol content of cotton seed. Besides being the good source of protein and oil, it was not a good source of feed and food. However, these nutritional components are inter related and a variation in one may adversely affect the other like high protein cotton seed may have lower gossypol content (Mandhania *et al*., 2015). Thus keeping in mind the importance of nutritional composition of cotton seed, the present study was designed to screen the best genotypes in term of seed quality with higher amount of protein and oil but with less quantity of gossypol.

MATERIALS AND METHODS

Seeds of thirty eight *G. hirsutum* genotypes received from AICCIP trials, conducted during 2015-16 at Cotton Research Area, Cotton Section, Department of Genetics and Plant Breeding, CCS Haryana Agricultural University, Hisar, were used for this study. The seeds samples were oven dried to reduce the moisture level to meet the accuracy of the results. About 10 g whole cotton seed were ground to powder by using course grinding and then defatted for protein and gossypol analysis. Protein content was determined by Micro-kejdahl method of AOAC (1970). In this method the defatted samples were digested until solution becomes colorless. Further distillation and titration was done by using 40 per cent NaoH and 0.1N HCl, respectively. The oil content was estimated by the method of AOAC (1970) using solvent extractor system. In this method, extraction of oil was done using non polar solvent petroleum benzene (40-60 ^{o}C). The gossypol an anti nutrient component in cotton seed was estimated by using phloroglucinol reagent. The samples were taken in technical triplicate repeats for the respective constituents' analysis. The data was statistically analyzed by CRD design with the help of OPSTAT.

RESULTS AND DISCUSSIONS

The seeds of test genotypes were evaluated for protein, oil and gossypol content (Table 1). The highest protein content (23.49%) was observed in H 1236 genotype. However, the genotypes F2532 and H 1478 were at par with the genotype H 1236. Zakirov *et al*., (1982) showed variation in crude protein content of cotton seed. Higher protein content was reported in the Nigerian commercial cotton seeds and Zhemian variety. The variation may be attributed to variety and location.The highest oil content (16.23%) was observed in genotype PBH 21 and RS 2815 and genotypes RAH 1271 was found at par with entry PBH 21 for their oil content. The anti nutrient factor gossypol content was lowest in entry ARBH 1501. Whereas, highest was observed in entry BGDS 1055. The gossypol content present in genotypes H 1236, CSH 2920, TCH 1716 and BDGS 1066 were at par with highest gossypol containing entry BGDS 1055. Similar level of gossypol content in cotton seed was reported but low (0.08 %) gossypol content in cotton seed was observed by Renuka *et al.*, (2005). Cotton seed meal (CSM) or meal contains gossypol (C30H30O8) which is toxic to farm animal.

Gossypol is produced in the pigment glands of the roots, leaves, stems, and seeds of the cotton plant genus Gossypium (Berardi and Goldblatt, 1969). Species and varieties of cotton plants differed in concentration of gossypol present in the seed. Pandey and Thejappa, (1975) reported variability in gossypol content with respect to the environment. The gossypol concentration is also influenced by method of oil extraction in cotton seed cake. Jones, (1981) reported that high temperature and pressure make cotton seed oil and meal less toxic as compared to solvent extraction method. Non-ruminants and pre-ruminants are more sensitive to gossypol toxicosis, but ruminant animals are somewhat resistant to toxicity. Reiser and Fu, (1962) studied ruminants ability to detoxify free gossypol by binding with soluble proteins within the rumen and convert it into physiologically inactive form. Whereas, Smalley & Bicknell, (1982) reported gossypol toxicosis in mature dairy cattle fed relatively high amounts of ammoniated whole cottonseed. (Grey *et al*., 1990) fed moderate amounts of cottonseed products containing free gossypol. Gossypol toxicity is also a potential problem when cotton products are fed to young calves with functionally undeveloped rumens (Leighton *et al*., 1953; Holmberg *et al*., 1988; Hudson *et al*., 1988; Kerr, 1989). The possible reduction of gossypol toxicity can be achieved by using iron salts. Iron salts bind gossypol in the gastrointestinal tract of swine and poultry fed CSM (Smith and Clawson, 1965), but this is not confirmed in ruminant animals.

Although gossypol problems are reported by various researchers, but in normal supplementary feeding, it is not a big problem.

CONCLUSION

The development of cotton genotypes which possess less amount of gossypol particularly in seed will be better option as a nutrient source for ruminants. In this content H 1478 and F 2522 were best in terms of seed quality as seed of these genotypes contained more than 20% and 15% protein and oil content respectively, with less than 0.2% gossypol content.

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Table 1: Seed protein, oil and gossypol content

Genotypes	Protein (%)	Oil (%)	Gossypol (%)
ARBH-1501	19.80	12.93	0.11
TSH 321	22.49	12.50	0.18
CSH 2932	16.60	14.43	0.22
GSHV-173	19.29	11.37	0.26
RAH 1069	18.03	13.10	0.20
Local Check	23.49	15.27	0.28
F 2522	22.07	15.13	0.17
ARBH-1502	16.27	13.00	0.20
HS 295	22.15	15.47	0.24
PBH 29	20.13	12.53	0.21
RB-602	19.63	13.47	0.17
CPD-1501	21.81	14.30	0.20
Zonal Check (H 1300/ CNHO 12/Suraj)	20.47	13.50	0.22
SHM-55	22.23	14.23	0.24
CSH 2920	15.76	11.37	0.28
BGDS 1055	18.87	12.47	0.29
F 2532	22.65	15.37	0.25
CNH 126	20.89	13.83	0.22
H 1478	23.07	13.07	0.19
RS 2815	15.93	16.23	0.15
Quality Check (F 2164/Suraj/Suraj)	20.47	13.73	0.20
RAH 1271	20.64	16.17	0.27
TCH 1716	22.23	15.43	0.28
CCH 15-1	16.69	14.40	0.23
HS 296	18.96	14.23	0.22
GSHV-172	19.80	13.60	0.24
PBH 21	16.10	16.23	0.18
BGDS 1033	19.63	15.47	0.28
RS 2797	19.37	14.57	0.17
CCH 15-2	17.53	12.77	0.19
CD at 5%	1.17	0.46	0.01
SE(m)	0.42	0.16	0.00
SE(d)	0.59	0.23	0.01
CV	4.20	2.00	3.39