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EFFECTS OF BULARAFA (DIATOMACEOUS EARTH) TREATMENT ON THE GERMINABILITY OF STORED COWPEA VARIETY (*IT96D-610K*)

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Abstract

Different storage and treatment methods, length of storage have varying effects on the germinability of stored grains. Research was carried out to on cowpea variety IT96D-610K treated with a local diatomaceous earth (grain protectant) obtained from Northern Nigeria. Two different particle sizes (0.075mm and 0.090mm) at varying concentrations of 0.1g, 0.05, 0g/100g (control) of cowpea was used in treatment to reduce weevil infestation. Storage was done in galvanised mild steel (GMS) and wooden small scale prototype silos fabricated. Storage was done for a period of 4months. Ten wholesome, uninfested seeds were taken from each silo and taken for germination test at the end of each month of storage. Test was replicated five times at room temperature in the laboratory. Results showed that particle size and concentration of DE had little effect on the germination potential of the stored cowpea. The control sample also retained the germination potential of the cowpea at the end of the fourth month. Storage period, diatomaceous earth treatment all showed effect on the germination potential of the stored cowpea. In all germinability was retained after 4 months of storage. Germinability was retained along weeks of storage as storage period increased. Higher percentage germinability was retained for both control (94%) and treated (98%) samples. The GMS storage silo was the most efficient in retaining germinability and storage. High insect mortality was recorded in the 14th week of storage in wooden silo stored with 0.075 mm particle size of Diatomaceous Earth. Maximum and minimum temperatures were (28.88°C and 22.3°C) and maximum and minimum relative humidity was (88% and 54%) during the study period.

1.0 Introduction

Cowpea remains a cheap source of protein in the rural and urban population. Post- harvest losses of this produce occur as a result of attack by insect pest, cowpea weevil (*Callosobruchus Maculatus*). Global production of cowpeas in 2010 was 5.5 million metric tons and Africa was responsible for 94% of this value [4]. Out of this percentage, Nigeria has the lions share in terms of production and consumption. The

country produces 2.2 million metric tons of dried grain in 2010 with Niger being the second world largest producer. Over 200 million people in Africa depend on cowpea as a source of food [3] mainly because the crop plays a significant role in the diet of many homes in Nigeria and other developing countries in Africa. Germination is the measure of a seed's ability to produce a normal seedling when planted in ideal conditions (with optimal temperature and moisture plus good aeration). The seed germination test is the universal standard measure of seed quality. According to [6] the major purpose of storing seeds of economic plants is to preserve planting stocks from one season until the next. Hence there is the need to preserve the germinability and vigor of stored grains.

2.0 Materials and Methods

2.1 Diatomaceous Earth (DE)

Crude Diatomaceous earth of fresh water origin was obtained from Bularafa community in Yobe state, Nigeria. The organic compound was oven dried at 40°C to 4.5% moisture content [2]. A laboratory mortar and pestle was used to ground the DE to powder. The ground DE was sieved using a U.S standard 200 sieve (0.075mm openings) and 100 sieve (0.090mm openings) and kept in airtight Ziploc bags for a day prior to being admixed with the cowpea seeds for the experiment. The Bularafa diatomaceous earth was applied at three different dose rates of (0.1g per 100g cowpea, 0.05g per 100g cowpea, 0g per 100g cowpea) for each particle size stated above.

2.2 Cowpea Samples purchase

Freshly harvested cowpea seeds (*Vigna Unguiculata*) variety IT96D¬610K threshed and clean were obtained from International Institute of Tropical Agriculture (IITA) in Ibadan, Oyo State. Two bags each weighing 50kg were purchased. Samples were taken randomly in replicates from each bag and an average moisture content of 9.88% was recorded. The seeds were stored in drums in a hermetic system of storage.

2.3 Bioassays

Germination test for seed viability was determined monthly from the period of storage until the end of the experiment. For each sample taken from each prototype silo, the test was replicated five times. The seed viability/ germination potential test was carried out using the petridish method. Ten healthy seeds without holes from each sample taken from each silo were picked and planted. A flat thin layer of cotton wool was spread in a petridish and the seeds placed on top. About 2ml of distilled water [4]was sprinkled on the cowpea seeds in the petridish to soak through the cotton wool. The petridish was then covered with its lid and placed on a flat surface that had direct access to sunlight as shown in Figure 1 at room temperature. Average temperature recorded during the test was 28°C at 67% relative humidity. This was done for a period of 5 days. The percentage germinability of the seeds was then calculated as follows:

Total Number of seeds planted = Nt

Number of seeds germinated = Ng

Germination potential/ Seed viability

= % Germination = $\frac{Ng}{Nt} \times 100$

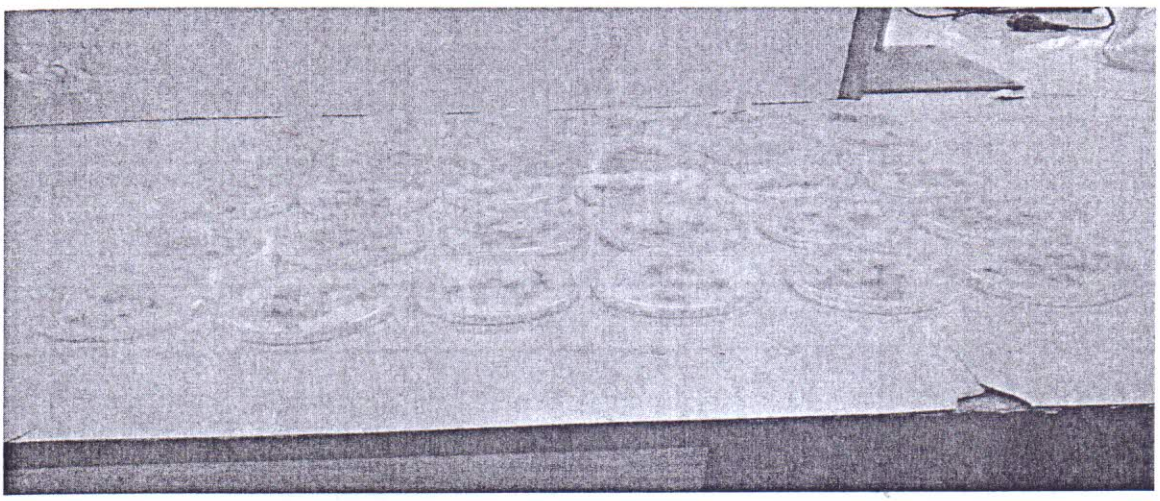


Plate 1: Germination Potential test using the Petridish Method

Table 1: Germination test results

Time (week)	Materials	Particle	Concentration	Insect Count		Germinability¥
				Live	Dead	
0	1	0.075mm	0.10/100g	0	0	12
			0.05/100g	0	0	
			0.00/100g	0	0	
		0.090mm	0.10/100g	0	1	
			0.05/100g	0	1	
			0.00/100g	0	0	
	2	0.075mm	0.10/100g	0	1	
			0.05/100g	0	0	
			0.00/100g	0	0	
12	1	0.075mm	0.10/100g	2	2	9
			0.05/100g	2	4	7
			0.00/100g	0	5	9
		0.090mm	0.10/100g	0	0	9
			0.05/100g	2	3	9
			0.00/100g	2	4	9
	2	0.075mm	0.10/100g	4	8	10
			0.05/100g	3	4	10
			0.00/100g	2	3	10

			0.10/100g	0	0				
		0.090mm	0.05/100g	0	1				
			0.00/100g	0	0				
			0.10/100g	1	1	10			
		0.075mm	0.05/100g	0	0	10			
			0.00/100g	0	0	10			
	1		0.10/100g	0	0	9			
		0.090mm	0.05/100g	0	0	9			
			0.00/100g	0	0	8			
4			0.10/100g	0	1	9	16		
		0.075mm	0.05/100g	1	2	10			
			0.00/100g	0	0	10			
	2		0.10/100g	0	0	10			
		0.090mm	0.05/100g	0	0	10			
			0.00/100g	0	2	10			
			0.10/100g	0	2	9			
		0.075mm	0.05/100g	0	0	9			
8	1		0.00/100g	0	1	9			
		0.090mm	0.10/100g	0	1	9			
			0.10/100g	0	0	10			
		0.090mm	0.05/100g	1	4	9			
			0.00/100g	1	3	9			
			0.10/100g	1	1	9			
		0.075mm	0.05/100g	0	62	8			
			0.00/100g	1	15	8			
	1		0.10/100g	0	12	9			
		0.090mm	0.05/100g	0	13	10			
			0.00/100g	0	2	10			
			0.10/100g	3	11	10			
		0.075mm	0.05/100g	1	29	10			
			0.00/100g	4	9	10			
	2		0.10/100g	0	2	10			
		0.090mm	0.05/100g	0	18	10			
			0.00/100g	0	13	10			

	0mm	0g			
		0.05/10 0g	1	1	8
		0.00/10 0g	0	0	9
		0.10/10 0g	1	0	10
	0.07 5mm	0.05/10 0g	0	0	9
		0.00/10 0g	0	0	10
2		0.10/10 0g	0	0	9
	0.09 0mm	0.05/10 0g	0	0	10
		0.00/10 0g	0	2	10

Germinability are measured monthly

of storage. On average, storage period does not seem to affect germinability. There was no sufficient reason to believe that cowpea stored for longer weeks have higher germinability but retainability was observed throughout the trend. However, on average, cowpea stored in GMS silos for the first four weeks have the highest germinability.

3.1 Effect of Storage Parameters (Storage Period, Storage Materials, Particle size and Concentration of Diatomaceous Earth (DE) on Germinability of Stored Cowpea

Figure 1.0 shows results for the effect of storage parameters on the germinability of stored cowpea. Germinability was better retained in metal (GMS) than wooden storage structures irrespective of the particle size and concentration of DE or how long the cowpea was stored. Germinability also appears to be better retained in samples treated with 0.05g/100g compared to samples treated with 0.1g/100g of cowpea and zero concentrations (control). The control recorded a lesser germinability as compared to the treated cowpea. Overall, high percentage germinability is retained along the sixteen weeks of storage. On average, storage period and DE concentration does not seem to affect germinability. This results supports findings by [7] where it was stated that DE applied at different concentrations/dose rate had no effect on germinability of treated and untreated(control) cowpea seeds treated for a period of six months. [8] stated that cowpea at 16% moisture content stored in metal and earthen bins showed low germinability after a period of ten months as compared to cowpea at 10% moisture content. The effect of diatomaceous earth helped in preserving the germinability of the cowpea seeds treated by reducing insect infestation. There was no sufficient reason to believe that cowpea stored for longer weeks had higher germinability. However, cowpea stored in (GMS) storage structure for the first four weeks have the highest germinability retained as compared to those stored in the wooden storage structure.[1] also recorded high retainability of the germination potential of two local cowpea varieties in Nigeria stored for a 7 year period. However the minimal loss experience in the germination potential of the stored cowpea could be due to the effect of insects feeding on the germ of the cowpeas. In all the effect of Diatomaceous Earth used reduced the infestation of insects thereby retaining high germination potential of the seeds.

4.0 Conclusion

The study focused on the effects of bularafa (diatomaceous earth) treatment on the germinability of stored cowpea variety (*IT96D-610K*). The following conclusions were drawn:

[1.] Germinability was retained along weeks of storage as storage period increased. Higher percentage germinability was retained for both control (94%) and treated (98%) samples.

[2.] The metal storage structure was the most efficient in retaining germinability and storage. High insect mortality was recorded in the 14^{th} week of storage in wooden silo stored with 0.075 mm particle size of Diatomaceous Earth.

[3.] Diatomaceous Earth using particle sizes 0.075 and 0.090mm contributed in the reduction of weevil infestation thereby retaining the germination potential of the stored cowpea variety *IT96D-610K*.

[4.] Maximum and minimum temperatures were (28.88°C and 22.3°C) and maximum and minimum relative humidity were (88% and 54%) during the study period.

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