BREAKING OF SEED COAT DORMANCY IN SOME GENOTYPES OF WEST AFRICAN OKRA (*Abelmoschus caillei*) [A. Chev. Stevels.]

ABSTRACT

A two weeks laboratory experiment was conducted in the Department of Crop Science Adamawa State University, Mubi using 15 genotypes of *Abelmoschus caillei*. The seeds of genotypes were soaked in NaCl solution for 24 hours to study breaking of seed coat dormancy, to induce seed germination; since tough seed coat hinders germination by establishing a permeability barrier that can interfere with the water uptake required for imbibition, radicle and plumule emergence. The results revealed that okra accessions NG/AA/SEP/09/038, NG/SA/DEC/07/0528 and Okra 47-4 responded faster to radicle and plumule emergence. There were significant improvement in seed germination, seedling emergence, seedling establishment and higher crop yield could be achieved through okra seed priming with NaCl solution.

Keywords: Seed coat, Seed priming, dormancy, germination, ~~Nacl~~ NaCl solution and *Abelmoschus caillei*.

INTRODUCTION

Okra belongs to the family *Malvaceae* also known as lady's fingers is one of the most important nutritious vegetable extensively grown for its fibrous pods. The two most important cultivated species are: *Abelmoschus esculentus* (common okra) of the native of Asia and *Abelmoschus caillei* (West African okra) [1]. West Africa okra is a widely cultivated vegetable which is found in every market all over Africa [2]. It is a good source of vitamin A, B and C, and also rich in protein, minerals especially iodine [3,4]. The crop is grown mainly for its leaves and young pods which are eaten as green vegetable in different forms [1]. Most vegetable species and commercially important cultivars are relatively free of dormancy mechanism, but members of the Apiaceae, Asteraceae, Malvaceae, Solanaceae and Chenopodiacae are among the families with erratic germination due to seed dormancy [5,6]. Furthermore, physical barriers such as seed coats impermeable to water and/or gases are reported for vegetables species in the Fabaceae and Malvaceae (okra) [7]. Anderson *et al.* [8] earlier reported that delayed and erratic emergence due to seed hardness is a serious problem in okra that creates problems with fertilizer utilization, post emergence weed control, and uniform harvesting. The hard seed coat of okra interferes with water up- take and a major physiological constraint to uniform stand establishment and performance [9]. Germination is a complex physiological process controlled by a large number of genes, which are affected by several environmental factors, such as light, temperature and the duration of seed storage [10]. The dormancy of a seed must be broken to induce germination, because tough seed coats may regulate germination by establishing a permeability barrier that can interfere with the water uptake required for imbibition and subsequent radicle emergence; for gaseous exchange, particularly oxygen required for respiration and/or for the outward diffusion of endogenous germination inhibitors [11].

Water is used for the soaking (priming) of the seed to split or soften the hard seed coat for speeding up and synchronizing the germination process in okra [12,13]. Seed priming is the basic chemical

reaction or framework needed for the seed to germinate in the laboratory or field under high moisture and ideal temperature conditions and it helps germination process to continue at a faster rate and at less time, and aids rapid seedlings establishment with higher stand, early flowering, early crop maturity and higher grain yield, thereby allowing escape from end of season stress [14]. However, priming is suitable for seeds that have problem or difficult in breaking their dormancy such as vegetable seed (okra, tomato and lettuce) and cereals such as wheat and rice seeds.

This study therefore attempt to evaluate and select okra accessions that have desirable qualities of early germination ability. Early seed germination is one of the characters of a good seed that results in early plant establishment and can be easily adopted by peasant farmers and thus it has the potential to benefit farmers in many ways. Therefore, the general objective of the study is to determine the effect of halo-priming (sodium chloride solution) in breaking hard seed coat in West African okra and to select genotypes with early radicle and plumule emergence.

MATERIALS AND METHODS

Fifteen accessions of West African Okra were collected for this study (Table 1). These comprised of twelve okra accessions from National Centre for Genetic Resources and Biotechnology (NACGRAB), Nigeria; one accession from National Horticultural Research Institutes, Nigeria and two accessions from farmers in Mubi, Adamawa State. The laboratory experiment was conducted in the Department of Crop Science, Adamawa State University, Mubi. In ensuring that seeds utilised for the experiment were viable, a seed viability test using tetrazolium [15] was done. In order to study okra hardness, one gram of sodium chloride (NaCl) was dissolved in 100 ml of water in 15 beakers and 60 seeds of each accession were imbibed in each beakers of salt solution for 24 hours. Germination testing was done in 9cm sterile petri dishes in which 900 seeds in total were used, with three replications [16] and the experiment was laid out in a completely randomized design. Twenty (20) seeds per replicate were wrapped in a moistened cotton wool and were supply with 10 ml of water daily. On the 3rd day of the germination experiment, seeds were considered germinated when the tip of the radicle had grown free of the seed coat [17]. Radicle and plumule counts were taken at two days interval. Seed that could not germinate due to low water absorption were considered as hard seeds. Germination percentage was calculated by the following formula [15]:

$$\text{Germination (\%)} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds tested}} \times 100$$

Data on radicle and plumule counts were analyzed using analysis of variance [18].

RESULTS

The effect of halopriming (NaCl) on percentage of radicle emergence of 15 accessions of okra is presented in Table 2. The different accession of okra showed different radicle emergence. Result indicated that okra accession 47-4 had the highest radicle emergence (98%) on the fifth day after sowing in moistened cotton wool; followed by accession NG/AA/SEP/038 (97%) and then accession

NG/SA/DEC/07/0528 (95%). Also accession NG/SA/DEC/07/498, and NG/SA/DEC/07/0441 recorded 92% and 90% radicle emergence respectively. The lowest radicle emergence was obtained by accession NG/TO/JAN/07/116 (12%) and accession Yar kwadon (13%).

Table 3 showed the effects of NaCl priming on plumule emergence percentage of the okra accession 9 days after seeds were wrapped in cotton wool. Application of NaCl priming stimulated plumule emergence of all the accessions studied. Among all the genotypes, four accessions (NG/SA/DEC/07/0528, NG/SA/DEC/07/0507, NG/AA/SEP/09/038 and okra 47-4) recorded between 82–85% plumule emergence with accession NG/SA/DEC/07/0528 having the highest plumule emergence. The least plumule emergence percentage was recorded by accession Yar kwadon (Mubi2).

Table 4 showed the effect of radicle emergence from 7–13 DAP of okra seeds in moistened cotton wool. Results indicated that highly significant difference (P=0.01) occurred among the okra accessions with respect to radicle emergence. Similarly, Table 5 showed the effect of plumule emergence from 7–13 DAP of okra seeds in moistened cotton wool and the result obtained revealed a highly significant ($P < 0.01$) difference.

DISCUSSION

The ability of the emergence of radicle from 90 to 98% in accessions okra 47-4, NG/SA/DEC/07/038, NG/SA/DEC/07/0528, NG/SA/DEC/07/498 and NG/SA/DEC/07/0441 revealed that halopriming enhanced the breaking of seed hardness of seed coat. In okra seed germination is influence by the cultivar [19]. In some cultivars, the occurrence of hard seeds becomes more frequent the longer the pods remain in the plant [20]. Furthermore, El-Balla *et al*. [21] reported that seeds of *Hibiscus esculentus* at 13% moisture content tend to show little or no hardseediness, but once the seeds have been dried and their moisture content dropped to 4 to 6%, their hardness becomes prevalent. Ibrahim *et al.* [22] and Hardeep *et al.* [23] revealed that the germination percentage of okra significantly increased in seed that were primed as compared to untreated seeds (control).The result of this study also showed that priming had significant effect on emergence of plumule in West African Okra. Ben *et al.* [24] observed that NaCl priming stimulated plumule emergence of all the accessions they studied. Ibrahim *et al.* [22], similarly reported that priming enhanced the germination of many field crops such as onions, carrot, musk melon, okra and sorghum. Furthermore, Parera and Cantliffee [25]; reported that the use of seed priming reduces the time between seed sowing and seedling emergence of crop plants. Dumisa and Ekpo [26] in their trial on impact of priming okra seed on seedling performance revealed that seeds primed for 24 hours showed the best percentage of seedling emergence at 5–14 days after planting. The radicle and plumule emergence plays crucial role in overcoming the future fate of the plant [27]. Faster emergence may be due to halopriming as it synchronizes the metabolism of all seeds in the seed lot, thus ensuring uniform emergence and growth in the field. In fact, it synchronizes all the cells of germinating embryo in G_2 phase of the cell cycle for uniform development of the seedling and also triggers β – tubulin production that has key role in spindle formation during cell division [28,29]. These findings are in line with the work of Arif *et al.* [30], who found that seed soaking enhanced emergence in Mungbean as compared to unprimed

seeds. They documented that priming may result in the early activation of the metabolic machinery of the seeds thereby making the seeds of West African Okra ready for the germination. Likewise Farooq *et al.* [31] reported that seed soaking decreased the germination time that may allow the seedlings to escape the deteriorating soil condition. Furthermore, the result also agreed with the findings of Murungua *et al.* [32]; Ashraf and Foolad [33], which reported faster emergence and increased germination of primed seed than unprimed (Control) in many field crops.

Table 1. Fifteen okra accessions collected for the Study

S. No	Accession Number	Accession ID	Source
1	Acc 2	NG/SA/DEC/07/0483	NACGRAB, Ibadan
2	Acc 3	NG/SA/DEC/07/0448	NACGRAB, Ibadan
3	Acc 4	NG/AA/SEP/09/038	NACGRAB, Ibadan
4	Acc 8	NG/SA/DEC/07/0528	NACGRAB, Ibadan
5	Acc 10	NG/TO/JUN/09/007	NACGRAB, Ibadan
6	Acc 14	NG/SA/DEC/07/498	NACGRAB, Ibadan
7	Acc 16	NG/TO/JAN/07/116	NACGRAB, Ibadan
8	Acc 18	NG/SA/DEC/07/0475	NACGRAB, Ibadan
9	Acc 21	NG/SA/JAN/09/109	NACGRAB, Ibadan
10	Acc 22	NG/SA/DEC/07/0507	NACGRAB, Ibadan
11	Acc 23	NG/SA/DEC/07/0441	NACGRAB, Ibadan
12	Acc 31	Syria (Mubi-1)	Mubi Local Cultivar
13	Acc 32	Yar kwadon (Mubi-2)	Mubi Local Cultivar
14	Acc 30	Okra 47 – 4	NACGRAB, Ibadan
15	Acc 15	NG/MR/09/009	NACGRAB, Ibadan

NACGRAB = National Centre for Genetic Resources and Biotechnology

Table 2. Radicle emergence percentage of 15 accessions of okra 5 days after wrapping seeds in moistened cotton wool

S. No	Accession number	Total number of Seeds	Total number of radicle emergence	Percentage emergence (%)
1	Acc 2	60	47	78
2	Acc 3	60	22	37
3	Acc 4	60	58	97
4	Acc 8	60	57	95
5	Acc 10	60	28	47
6	Acc 14	60	55	92
7	Acc 16	60	07	12
8	Acc 18	60	12	20
9	Acc 21	60	09	15
10	Acc 22	60	53	88
11	Acc 23	60	54	90
12	Acc 31	60	38	63
13	Acc 32	60	08	13
14	Acc 30	60	59	98
15	Acc 15	60	53	88

Table 3. Plumule emergence percentage of 15 accessions of okra 9 days after wrapping seeds in moistened cotton wool.

S. No	Accession number	Total number of Seeds	Total number of plumule emergence	Percentage emergence (%)
1	Acc 2	60	42	70
2	Acc 3	60	29	48
3	Acc 4	60	49	82
4	Acc 8	60	51	85
5	Acc 10	60	40	67
6	Acc 14	60	19	32
7	Acc 16	60	15	25
8	Acc 18	60	21	35
9	Acc 21	60	20	33
10	Acc 22	60	50	83
11	Acc 23	60	42	70
12	Acc 31	60	40	67
13	Acc 32	60	13	22
14	Acc 30	60	49	82
15	Acc 15	60	43	72

Table 4. ANOVA for radicle emergence from 7–13 DAP okra seeds in moistened cotton wool

Days	Source of Variation	DF	Sum of square	Mean square	F-value	Significant
7	Treatment	14	1582.31	113.02	53.06	0.0001
	Error	30	64.00	2.13		
	Total	44	1646.31			
9	Treatment	14	911.33	65.10	40.19	0.0001
	Error	30	48.67	1.62		
	Total	44	960.00			
11	Treatment	14	192.97	13.78	7.49	0.0001
	Error	30	55.33	1.84		
	Total	44	248.31			
13	Treatment	14	164.58	11.76	5.05	0.0001
	Error	30	70.00	2.33		
	Total	44	234.58			

DAP = Days after planting

Table 5. ANOVA for plumule emergence from 7–13 DAP okra seeds in moistened cotton wool

Days	Source of Variation	DF	Sum of square	Mean square	F-value	Significant
7	Treatment	14	471.87	33.70	9.42	0.0001
	Error	30	107.33	3.58		
	Total	44	579.20			
9	Treatment	14	893.91	63.85	10.26	0.0001
	Error	30	186.67	6.22		
	Total	44	1080.58			
11	Treatment	14	594.44	42.66	11.87	0.0001
	Error	30	107.33	3.58		
	Total	44	701.78			
13	Treatment	14	601.47	42.96	10.80	0.0001
	Error	30	119.33	3.98		
	Total	44	720.80			

DAP = Days after planting

CONCLUSION

Seed priming through soaking in NaCl solution can break seed coat hardness, trigger germination process and ensure rapid and uniform seed germination in okra. From the study, results showed that okra accession NG/AA/SEP/09/038, NG/SA/DEC/07/0528 and okra 47-4 responded faster to radicle and plumule emergence, indicating that significant improvement in seed germination, seedling emergence, uniform seedlings establishment and higher crop yield in okra could be achieved.

RECOMMENDATIONS

Based on the results of this study, okra accession NG/AA/SEP/09/038, NG/SA/DEC/07/0528 and okra 47-4 can be recommended for farmers as seeds that can respond quickly to seed to coat dormancy breakage and hence rapid seed germination, uniform seedlings establishment and higher crop yield.

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