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Influence of Seed Priming on Germination and Field Performance of Cotton (*Gosypium Spp.*) in Guinea Savanah Region of Nigeria

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Abstract: ***Poor seed germination and establishment cotton are major challenges for farmers. A field study was carried out at the University of Abuja Research Farm to evaluate the influence of different priming agents on the establishment and performance of cotton. Five treatments were used in the study, four priming agents (gibberrelic acid, sodium chloride (NaCl), coconut water and warm water) and the control. The study was arranged in randomized complete block design (RCBD) with three replicates. Seed priming improved germination percentage of cotton as well as number of flowers compared to the control.***

Keywords: Priming agents, Sodium chloride, Gibberelic Acid, Coconit water and Warm water

1. Introduction

Cotton is perhaps the most important vegetable natural fibre crops. It is a soft fibre shrub, native to tropical and sub-tropical regions around the world including America, India, and Africa (Idem, 1999). Cultivated cotton belongs to the Genus *Gossypium*, in the Family Malvaceae, and the commercial varieties belong to four species, *herbaceum, arboreum, barbadense and hirsutum.*

However, poor seed germination in field is a major challenge to cotton farmers in the Guinea savanna zone of Nigeria. Cotton seeds that are partially delinted as it is obtainable in Nigeria and other locations with low level of technology, the seeds contain thick layers of lint which absorb atmospheric moisture and predispose the seeds to attack by pathogenic soil fungi which tend to render the seed to lose viability. On the other hand when the seeds are thoroughly delinted, cracks and wounds are inflicted on the seed coats which are access routes for the pathogens to gain entry into the seed (Rathinavel, 2017). This pathogenic damage is achieved mostly through the production of exocellular enzymes like cellulases, pectinases, amylases and lipases as well as toxins such aflatoxins and mycotoxins (Mohammed-Yassen *et al*, 1994). Other factors which may cause cotton seeds to lose viability include varietal differences, and field plant nutrition (Sawan, 2016).

The poor cotton seed germination that results from the low viability poses a major threat to the efforts by the Federal government of Nigeria to revamp the ailing textile industry that depends solely on the production of cotton. Therefore, any technology that can enhance germination, seedling vigour and stand count per unit area of the cotton field should be appreciated. Seed Priming, a prior encounter with a particular type of stress is known to make plants have better tolerance to subsequent stress exposure of the same or different kind (Parra et al., 2007; Wahid et al., 2008; Patanea et al., 2009).

Seed priming in general, is the treatment of seeds with various priming agents for enhancement of germination and seedling quality besides improving the growth and flowering of plants. It is also an effective technology to enhance rapid and uniform emergence and to achieve high vigour leading to better stand establishment and yield.

The objectives of the study were to monitor ease of seed germination under different seed priming treatments, to determine the most efficient seed treatment for the farmers and evaluate the field performance of cotton as influenced by different seed treatment methods.

2. Materials and Methods

Experimental site

The research was carried out at the Teaching and Research Farm of the University of Abuja, FCT, Abuja, Nigeria in the 2017 cropping season. The location lies on Latitude 8^0 45' and Longitude 6^0 45' and is characterized by a bimodal rainfall pattern. The mean annual rainfall is about 1500 mm and from the analysis carried out, the soils are sandy loams and classified as Ferric Acrisol (FAO, 2017).

Source of Planting Material

The cotton seeds for the experiments were sourced from the Institute for Agriculture Research (IAR) Samaru, Zaria. The seeds of cotton variety SamCott 9 were used for this experiment.

Experimental Materials

The materials used include cotton (*Gossypiumhirsitum)* seeds, Giberrelic Acid (GA), a growth hormone, Coconut water (CW), Sodium Chloride (NC), Distilled Water and Warm water (WW).

Soil Sampling and Analysis

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A pre – planting soil sample of the experimental sites: Soil samples were taken across the fields with an auger at the depth of 0-30 cm and bulked in a polythene bag to form a composite soil sample. The samples were later taken to the laboratory for physico-chemical analysis. The samples were air dried and then sieved through a 2.0 mm sieve. The processed soil samples were analyzed for some physical and chemical properties using the following procedures. Practical size distribution of the soil samples was determined using the BOUYOCOUS hydrometer method using sodium hexametaphosphate as dispersing agent (IUSS/FAO, 2000). The various fractions of the soil were expressed in percentage using IUSS soil Textural Triangle. Bulk density was determined by core method. Soil pH was determined in a 1: 2.5 soil/ water and soil/$CaCl_2$ ratios using a glass electron pH meter, Organic Carbon by Walkley-Black Method (Nelson and Sommers, 1996), Exchangeable acidity as extracted by 1 NKCl and the extract was determined by titrimetric method. Available phosphorus was extracted with the Bray P 1 method and P in extract determined using spectrophotometer. Total nitrogen was determined by using the micro-Kjeldhal method. Effective cation exchangeable capacity (ECEC) was obtained by the summation of exchangeable bases and exchangeable acidity.

Seed Priming Treatments include:

1. The cotton seeds were soaked with coconut water for 12 hours, after which the seeds were removed and placed on top of cloth for air drying.
2. The cotton seeds were soaked in warm water at 25 ^{0}C for one minute after which the seeds were removed and placed on top of cloth for air drying.
3. The seeds were soaked with GA (3g/ litre) for four hours after which the seeds were later removed and placed on top of cloth and air dried.
4. The seeds were planted without any treatment (Control).
5. The seeds were soaked with a solution of NC (12g/litre) for 24 hours after which the seeds were removed and placed on top of cloth and air dried.

Experimental Design

The experimental design used was a Randomized Complete Block Design (RCBD).The treatments are Giberrelic Acid, Coconut water, Warm water, Sodium chloride and Control). The experiment was replicated three times. The plot size was 2.5 m by 4 m with inter – row spacing of 0.75 and intra – row spacing of 0.1m. Plots were measured to be 0.5m apart while blocks measured 1m apart.

Land preparation and sowing

The land area measuring 73m x 13m to give a total land area of 949 m^2 was ploughed, harrowed and ridged after which 72 plots of 2m by 3m ($6m^2$) would be marked out. The cotton seeds were sown at the spacing of 30cm by 75cm inter – row and intra – row respectively.

Observations

The following parameters were measured using the methods prescribed.

- Germination percentage (%)= Number of germinated seeds/emerged seedlings/Number of seeds sown x1000
- Plant height (cm) was measured at 2, 4, 6, 8, 10 and 12 weeks after sowing (WAS) but for this paper, only plant heights at 2, 4 and 6 WAS were reported
- Numbers of plant leaves were counted at 2, 4, 6, 8, 10 and 12 weeks after sowing (WAS) but for this paper, only the number of plant leaves at 2, 4 and 6 WAS were reported.
- Number of flowers to be determined by counting the flowers that have fully opened at 50, 60, and 70 days after sowing (DAS)

Data analysis

Data collected were subjected to analysis of variance (ANOVA) using GENSTAT 11th edition (Gen Stat, 2009). Prior to analysis, the data in percentage were transformed using ARCSINE transformation. Fischer's least significant difference (LSD) was used to separate the means.

3. Results

Effect of priming agents on germination percentage (%) of cotton

Cotton germination percentage (%) significantly was affected by seed priming. Superior germination was observed from seeds primed with GA at 5, 10 and 15 DAS and the lowest germination percentage was from the control. There was no significance difference among other priming agents in terms of inducing effective germination (Table 1).

Table 1: The effect of Priming on the Germination (%) of Cotton at 2, 4 and 6 WAS

Priming Agent	2WAS	4WAS	6WAS
Control	41.07c	46.10d	53.73d
NaCl	50.30bc	61.57b	70.53b
Giberrelic Acid	83.80a	91.70a	95.27a
Coconut Water	54.10b	58.80bc	69.53ab
Warm Water	54.83bc	48.60cd	57.23bc
SE	4.94	5.07	5.53

Means with the same letters are not significantly different at $P < 0.05$.SE: Standard Error.

Table 2: The effect of Priming on Number of leaves of Cotton at 2, 4 and 6 WAS

Priming Agent	2WAS	4WAS	6WAS
Control	3.07b	13.90b	65.67c
NaCl	4.73ab	16.87ab	72.77ab
Giberrelic Acid	7.67a	19.00a	82.93a
Coconut Water	7.00a	19.33a	69.53ab
Warm Water	3.47b	14.60ab	56.33c
SE	1.24	2.06	5.93

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Means with the same letters are not significantly different at P < 0.05.SE: Standard Error.

Effect of priming agent on number of leaves of cotton

At 2, 4 and 6 weeks after sowing, cotton plants treated with GA produced the highest number of leaves followed by those that were primed with CW which were however not significantly different from those primed with NC throughout the six weeks. Seeds primed with warm water produced cotton plants which were *at par*, in terms of leaf emergence, with those plants primed with GA, CW and NC. The lowest number of cotton leaves was counted from the control (Table 2).

Effect of priming agent on plant height (cm) of cotton

Cotton seeds treated with GA produced the tallest plants when compared to those treated with other priming agents and untreated (control) which had the shortest plants at 2 and 4 WAS. By 6 WAS, cotton plant height was not significantly influenced by seed priming (Table 3).

Table 3: The effect of Priming on the height (cm) of cotton plants at 2, 4 and 6 WAS

Priming Agent	2WAS	4WAS	6WAS
Control	1.79ab	48.77d	79.20
NaCl	1.49b	56.72ab	76.68
Giberrelic Acid	2.23a	66.65a	87.52
Coconut Water	1.83ab	59.21ab	81.02
Warm Water	1.97bc	54.10ab	78.04
SE	0.22	5.83	6.40

Means with the same letters are not significantly different at P < 0.05.SE: Standard Error.

Table 4: Effect of priming agent on cotton number of flowers at 50, 60 and 70 days after planting (DAP

Priming Agent	50 DAS	60 DAS	70 DAS
Control	74.83b	76.40c	78.60c
NaCl	76.53b	78.43bc	81.23bc
Giberrelic Acid	85.27a	86.60ab	88.70ab
Coconut Water	81.97ab	83.57abc	85.67abc
Warm water	87.17a	89.27a	92.30a
SE	3.71	3.88	3.61

Means followed by the same letter(s) within a column are not significantly different at P < 0.05.

Effect of priming agent on flowering of cotton

Table 4 shows that the number of flowers counted from cotton plants as influenced by priming with NC, GA and CW did not differ significantly at 50, 60 and 70 DAS. The cotton plants that were not primed (control) produced the least number of flowers at 50 and 70 DAS.

4. Discussion

Seed priming significantly affected the number of leaves of cotton. This is in agreement with findings of Draganic and lekic (2012) who reported that seed priming improves number of leaves, uniform and healthy crop stands. Various priming agents have been shown to result in different growth rates of cotton seedlings (Rezaee and Amir 2015). Hormonal seed priming in which hormone such as GA is used is relatively more effective in increasing the germination percentage, seed vigor and crop growth as measured by the height of cotton plants (Nazir *et al*, 2014) who reported that seed priming with some agents improved plant height significantly.

Cotton flowering percentage as influenced by NC, GA and CW did not exhibit any significant difference at 50, 60 and 70 days after planting. The control had the lowest number of cotton flowers at 50 and 70 days after planting. Many studies have reported that NC is an effective seed priming agent (Sivritepe *et al*., 2002; Naeem and Muhammad, 2006; Aymen and Hannachi, 2012). Ghassemi-Golezani *et al*. (2010) also reported that priming seeds with NC produced larger seedlings, good growth, high flowering percentage and increased number of pods and grains per plant. Using coconut water for seed priming is also effective, more accessible and cheap for farmers. CW water is an essential growth supplement for plant tissue culture/micro-propagation (Neumann et al., 2009).

5. Conclusion

Seed priming improved germination percentage, number of leaves, plant height and flowering percentage of cotton. Warm water among priming agents had the highest cotton germination percentage while the control recorded the lowest. GA andCW water performed better at improving flowering percentage, germination %, plant height of cotton compared to other priming agents and the control. Hydro-priming of seeds with warm water is also effective, efficient and cheap for farmers.

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