Seed Germinating Potential of Silver Nano particles and Activated Carbon Prepared using Passiflora foetida

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Abstract —
The farmers are very much fascinated towards the use of nitrogen rich fertilizers to increase the germination as well as the growth of crop plants but it is not the fact, because excessive nitrogen may delay and reduce seedling emergence, also the chemical fertilizers are too expensive with hazardous toxic effect. To solve such problem, the extracts of plants which are the reservoirs of naturally occurring bioorganic compounds were employed in the seed germination process. There are several reports saying that, only a few plants could be utilized in seed germination process as some may induce allelopathic effect. Considering these drawbacks, the present work was focused on the analysis of silver nanoparticles and activated carbon prepared from Passiflora foetida on seed germinating potential of Vigna radiata(green gram), Trigonella-foenumgraecum (fenugreek) and Pennisetum glaucum (Pearl millet) as experimental tools. The study revealed that both silver nanoparticles and activated carbon had enriched the seed germinating potential on the seeds tested. The percentage of seed germination was visibly high for the silver nanoparticles on Fenugreek (76.6%) and Pearl millet (76%) than that of activated carbon. On the other hand, the activated carbon was observed to induce the shoot length on all the seeds especially more on green gram (15.1cm). Thus the use of green and ecofriendly approach with economically stable preparation of silver nanoparticles and activated carbon could play a vital role in agricultural industries for an effective crop production.

Keywords: Activated carbon, Passiflora foetida, Silver nanoparticles and Seed germination.

I. INTRODUCTION

At present, nanotechnology is set to play a significant role in agriculture. The majority of the reported studies point to the positive impacts of nanoparticles and activated carbon on plant growth and only a few isolated studies pertaining to negative effect. In order to understand the possible benefits of applying nanotechnology to agriculture, the first step is to analyze penetration and transport of nanoparticles in plants. Seed germination is an important phenomenon in modern agriculture because it is a threat of life on plants that guarantee its survival. The recent advances in nanotechnology and its use in the field of agriculture are astonishingly increasing; therefore, it is the right time to understand the role of silver nanoparticles in the germination of seeds. Silver ions such as AgNPs have been recognized to inhibit ethylene action. The various functions of nanoparticles on seed germination and growth, biomass yields of seedling depend in a multipart way on magnetic instability densities, frequencies and prehandling of materials and treatment duration. Nanotechnology enables enormous societal application and is a fast developing industry and hence has impacts on wealth, society and environment [1&2]. Agriculture has been the backbone of the third world country economics. Nanotechnology promise considerable help in agriculture throughout the world. It has been found to decipher many of the agriculture related problems with the use of nanoparticles to increasing growth of plants and control of plant diseases against current practice. Earlier studies on the seed germinating effect of silver nanoparticles over various plants viz., Corn, Watermelon and Zucchini plants [3],Wetland Plants [4], *Lens culinaris* Medik [5] which inspired to do the present study. The effect of ZnO nano particles on the growth of plant seedlings of mung and gram was tested [6]. So keeping this back ground information, the current study was aimed at analyzing the seed germinating potential of silver nanoparticles and activated carbon (PFAC) prepared from *Passiflora foetida.*

II. MATERIALS AND METHODS

i. Silver nanoparticles and Activated carbon

The silver nanoparticles and activated carbon were prepared using *Passiflora foetida* according to the method as described [7] and [8].

ii. Seed germinating potential

The Seed germinating potential of plant extract, silver nanoparticles and activated carbon was performed using the seeds of 3 crops in which 1 is dicot namely *Vignaradiata* (green gram), and 2 monocots, *Trigonella-*

foenumgraecum(fenugreek) , *Pennisetumglaucum* (Pearl millet).These seeds were procured from local area, Erode, Tamil Nadu. The seeds were kept in a dry and dark place under room temperature prior to use. The seeds were surface sterilized and soaked in distilled water for two hours followed by soaking in respective inducing agents for about five hours according to the earlier study with slight modification [9]. Five set of experiments in triplicates were performed viz., seeds treated (seeds were soakedfor overnight) with aqueous extract of *Passiflora foetida,* Silver nanoparticles (25mg/l), Silver nitrate (25mg/L), *Passiflora foetida* activated carbon (PFAC- 25mg/l) and distilled water which served as a control. To each of the petriplate with sterile tissue paper, about 25 to 30 seeds were inoculated and water was sprayed regularly. The germination percent of seeds and with the morphological response was noted and calculated the germinating effect of the different agents used.

III. GERMINATION TEST

The seed germination percentage was calculated using the total number of seeds germinated at the end of experiment as per the report [10]-12].The measurements were carried out with respect to the International Rules for Seed Testing. Mean values were analyzed from the measurements on three replicates for each treatment and the related controls.

Germination parameters were calculated using the following equations

Germination Percentage (GP %) = (Gf/n) × 100

Where Gf represent the total number of germinated seeds at the end of experiment and n refers to the total number of seed used in the test.

IV. RESULTS AND DISCUSSION

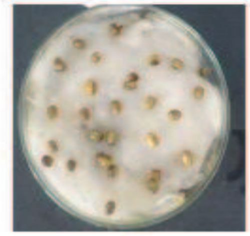
In the current study, the germination percentage of the seeds tested were found to be varied for different type of seeds when performed using the aqueous extract of *Passiflora foetida*, Silver nitrate, Silver nanoparticles, activated carbon and calculated the mean shoot elongation and the images mentioned were taken after 4 days of seed germination [Fig. 1 a, b, c & Fig. 2 a, b and Table 1 a & b]. The germination of seeds were appreciably induced by silver nanoparticles on *Trigonella-foenum graceum* (fenugreek)with 76.6% and *Pennisetum glaucum* (Pearl Millet) with 76% and germination induction was effective by activated carbon on *Vigna radiata* (green gram) seeds which constitute 74.2%. On observation, aqueous extract did not show any inducing effect which confirmed that germinating power was affected due to allelopathic effect [13] where the allelochemicals in the extract inhibited the germination and also found that silver nitrate did not induce the germination. The silver nanoparticles had triggered only the germination power, but the shoot elongation was achieved very trenchantly by activated carbon for all the three seeds viz., green gram (15.1cm), fenugreek (6cm) and pearl millet (5cm) that were investigated with reference to the observation on eighth day. The mechanism behind the faster germination induction was that the nanoparticles and activated carbon had penetrated the seed coat which made an effective water and nutrient absorption, reported by Zainab *et al.,* 2015. It was also observed that the germination rate was quick on green gram for both AgNps and activated carbon. Similarly, very good effect on germination using AgNPs was observed for corn, *Boswellia ovailifoliolata*. It was reported that percent of seed germination, mean germination time, seed germination index, seed vigour index, seedling fresh weight and dry weight of fenugreek, *Trigonella foenum-graecum* was improved on treating silver nanoparticles where the particles were purchased commercially but now it was legitimately proved that the biosynthesized silver nanoparticles were undoubtedly enriching the seed fertility[14] .It was also reported that a significant increase in protein contentwas observed in mustard seedlings [15]. It was found that the accumulation and uptake of nanoparticles was dependent on the exposure concentration and also dependent on size [16].It was revealed in the earlier report where high concentration of silver nanoparticles ie., more than 75ppm had inhibited the germination in cucumber, lettuce, barley and ryegrass [17]-[19].So based on the review, the current research was focused on single concentration alone with 25mg/L. Similarly the germinating effect of activated carbon was revealed for *Zygostates grandiflora* [20] and also for *invitro* embryo germination of *Pista ciavera [21].*

So further, AgNPs and PFAC could be combined together to have an effective seed germination and shoot induction in an effective manner. The outcome of this study could be useful for scrutinizing the biocompatibility of AgNPs and PFAC to identify the potential agricultural applications of nanoparticles in crop improvement and food production. An exposure to nanomaterials encouraged earlier plant germination and improved the plant production. These kinds of studies are of great interest in order to unveil the movement and accumulation of nanoparticles in plant tissues for determining the future applications in the field or laboratory and also for crumbling the dormancy of seasonal seeds.

Figure 1.a. Effect of Plant extract, Silver nanoparticles and Activated carbon on Green gram Seed germination

4th day after treatment

A



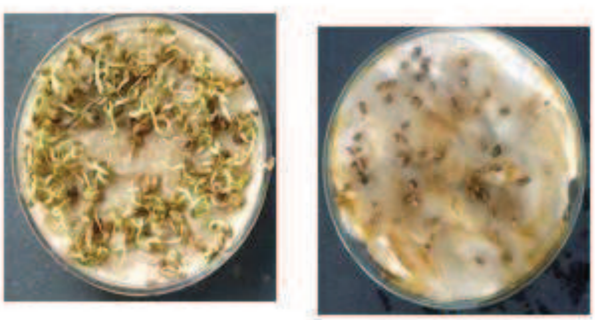
B

C D E

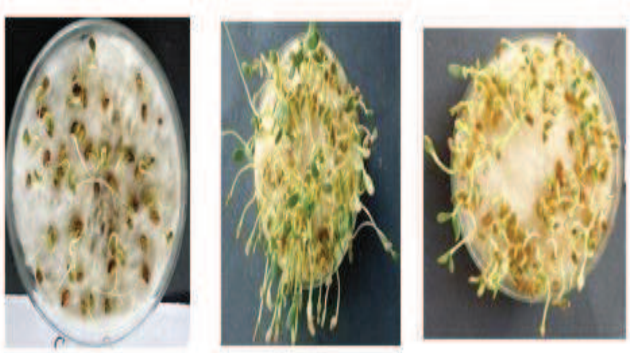
A-Control ($D.H_2O$) treated seeds
B-Plant extract (Aqueous) treated seeds
C-Silver nitrate ($AgNO_3$) treated seeds
D-Silver nanoparticles (AgNPs) treated seeds
E- *Passiflora foetida* activated carbon (PFAC) treated seeds

Figure 1.b. Effect of Plant extract, Silver nanoparticles and Activated carbon on Fenu greek seed germination

4th day after treatment



A B

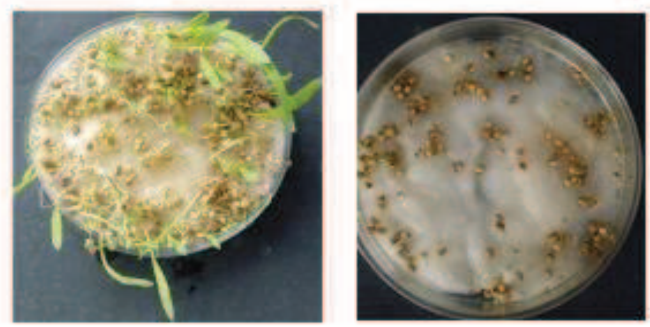


C D E

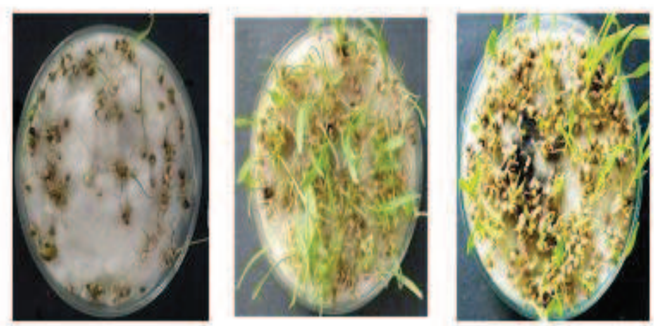
A-Control ($D.H_2O$) treated seeds
B-Plant extract (Aqueous) treated seeds
C-Silver nitrate ($AgNO_3$) treated seeds
D-Silver nanoparticles (AgNPs) treated seeds
E- *Passiflora foetida* activated carbon (PFAC) treated Seeds

Figure 1.c. Effect of Plant extract, Silver nanoparticles and Activated carbon on Pearl millet seed germination

4th day after treatment



A B



C D E

A-Control ($D.H_2O$) treated seeds
B-Plant extract (Aqueous) treated seeds
C-Silver nitrate ($AgNO_3$) treated seeds
D-Silver nanoparticles (AgNPs) treated seeds
E- *Passiflora foetida* activated carbon (PFAC) treated Seeds

Table 1. Effect of Silver nanoparticles and PFAC on Seed germination

Name of the seeds	Percentage of seed germination (%)				
	Control (Dis.H2O)	Aqueous Extract	$AgNO_3$	AgNPs	PFAC
Vigna radiata (Green gram)	64	0	40	40	74.2
Trigonella-foenum graceum (Fenu greek)	64	0	50	76.6	65.7
Pennisetum glaucum (Pearl Millet)	35	0	33.3	76	70

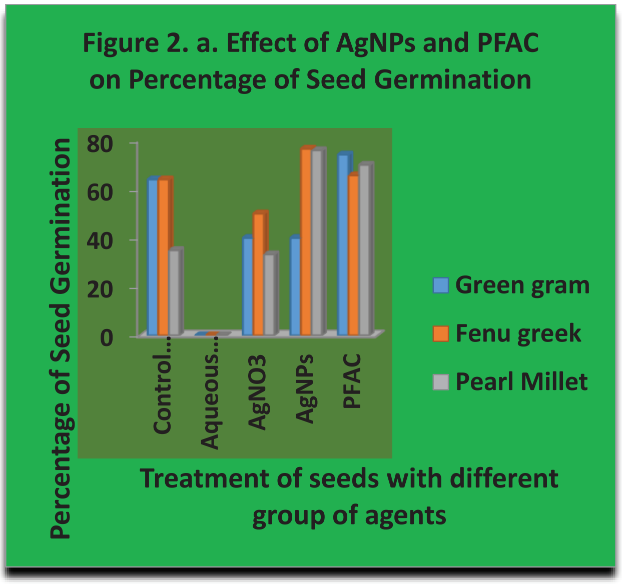
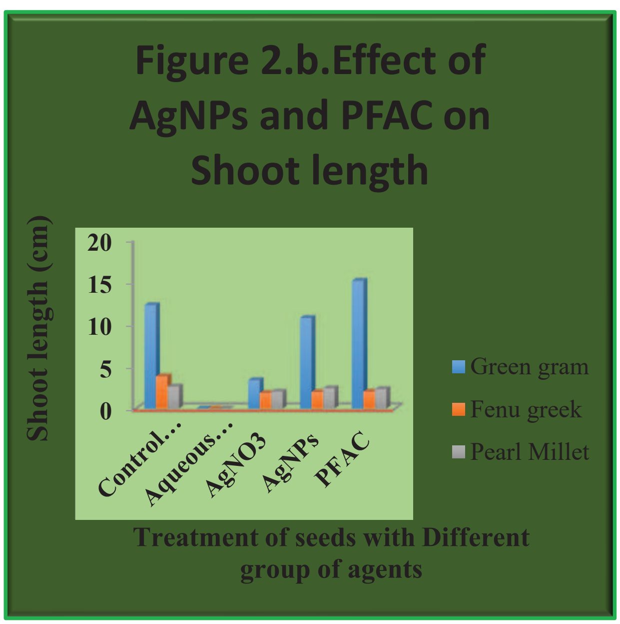


Table 2. Effect of Silver nanoparticles and *Passiflora foetida* activated carbon on Shoot Length

Name of the seeds	Mean Shoot elongation on 8th day (cm)				
	Control (Dis.H2O)	Aqueous Extract	$AgNO_3$	AgNPs	PFAC
Vigna radiata (Green gram)	12.22	0	3.35	10.7	15.1
Trigonella-foenum graceum (Fenu greek)	3.6	0	1.84	1.96	6
Pennisetum glaucum (Pearl Millet)	2.6	0	1.4	2	5



V.CONCLUSION

An exposure to silver nanomaterials and activated carbon encouraged the seed germination followed by shoot elongation which could effectively improve the crop production. Thus the result of the current study confirmed that exposure to AgNPs and activated carbon had significant effects on the seed germination and seedling growth simultaneously.

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