EFFECT OF SALT STRESS ON GERMINATION OF SEEDS OF MUNGBEAN

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Abstract

Salinity is one of the most important abiotic stresses that negatively affect plant growth and development around the world. Salt stress is the accumulation of excessive salt contents in the soil which results in the inhibition of crop growth and leads to crop death. The present paper deals with the germination of Mungbean seeds under different salt concentration (0%, 1%, 2%, 3%, 4%, and 5%) in the dark. Germination percentage was evaluated. The high germination percentage was recorded in water at a control treatment, whereas gradual decreases on the percentages of germination were noticed with the increase of salt concentrations at all treatments. Germination was delayed at higher salt stress. Germination percentage was 100% at control treatment. Germination percentage was 80% at 1% NaCl solution treatment and 6% at 2% NaCl solution treatment. At 3%, 4%, 5% NaCl solution treatment, the germination percentage was zero. The lowering water uptake and inhibiting activities of hydrolytic enzymes are the main reason for retarding the seed germination during salt stress.

Key words: Moongbean, salinity, different salt concentration, germination analysis

1. Introduction

Salinity is one of the abiotic factors limiting the productivity of crop plant. Salt stress is the accumulation of excessive salt contents in the soil which results in the inhibition of crop growth and leads to crop death. According to an estimate, about one third of irrigated land on Earth is affected by salt stress. The total area of salt-affected soils in the world is 831 million hectares which is equivalent to more than 6% of the world's total land area. Seed germination is one of the most fundamental and vital phases in the growth cycle of a plant that determines the yield. Seed germination is defined as the emergence of the radical through the seed coat. Seed germination can be initiated by water imbibitions and any shortage in water supply will let seed under stress. Globally, agriculture productivity is inhibited by abiotic and biotic stresses, but abiotic stresses in particular [11] affect spreading of plant species across different environmental zones [6]. Salinity is the presence of soluble salts in the soils or water which can cause stress or death to crops and vegetation, increase soil erosion, pollute drinking water and damage roads, fences, railways, buildings and natural ecosystems [3]. Soil salinity is the concentration of dissolved mineral salts present in water and soils on a unit basis or weight [24]. Salinity can be termed as abiotic stress and comprises all the problems due to salts primarily by an abundance of sodium chloride (NaCl) from irrigation or natural accumulation [9]. One - third of the worlds land surface is arid or semi - arid, out of which one - half is estimated to be affected by salinity [5]. The total world wide area of land affected by salinity is about 190 million ha [8]. Waisal (1972) reported that over four-fifth of the surface of our earth is covered with salt solution containing, among many other constituent approximately 0.5 M NaCl [25]. Salt stress negatively influences 60 million hectares, or round about 20% of the total irrigated land area in the world [10]. Mungbean (Vigna radiata (L.) Wilczek) is an important diploid crop with 2n = 22 chromosomes. It belongs to the genus Vigna that is composed of more than 150 species originating mainly from Africa and Asia where the Asian tropical regions have the greatest magnitude of genetic diversity. Mungbean is an important eco-friendly short term leguminous crop of dry land agriculture. It contains minerals, proteins and also serves as a food filler, resistant starch and dietary fiber [4]. Salt stress imposes substantial adverse effects on the performance and physiology of the crop plants, which eventually leads to plant death as a consequence of growth arrest and metabolic damage [12]. Many dicotyledonous halophytes require 100-200 mM salt concentration to their optimum grow [9, 19]. Seed germination is usually the most critical stage in seedling establishment, determining successful crop production [2]. Salinity stress creates potential problems during the seed germination and survival of seedlings. The crop performance largely determines by germination of seeds which is more susceptible to soil salinity than established plants [16]. Mungbean seeds could tolerate 6 m mhos/cm salinity, compared to 3 m mhos/cm for black gram. Mungbean shows completely inhibited seed germination in NaCl solution with osmotic potential of -1.5 MPa) [22, 2]. conducted an experiment to determine the effect of salinity on germination and the seedling growth of four mungbean genotypes and reported that the maximum germination percentage (99.00%) was found in BARI Mung-6 in 0 mM/L which was statistically similar to Binamoog-5 (92.00).The lowest germination percentage was recorded in Tila Mung (52.00%) at 160 mM/L [4].Generally, increasing salinity significantly reduces germination percentage and rate, root and shoot length, and fresh and dry weights of the exposed plants[13]. The present paper deals with the germination effects of Moongbean on different salt concentration.

2. Materials and Methods

2.1. Plant material

Seeds of mungbean (V. radiata L. Wilczek) were taken and washed with tap water to remove dirt and pollutant.

2.2 Salt solution preparation

Salt solution was prepared by dissolving calculated amount of commercially available NaCl with tap water to make 1%, 2%,3%,4% and 5% NaCl solution. The control treatment (0 % NaCl solution) was without sodium chloride.

SOAKING OF SEED:

2.3 Methods

Six small paper cups were taken and marked from 0 to 5,in which 20ml of NaCl solution from each concentration (0%,1%,2%,3%,4%,5%) were taken. 0% NaCl solution was taken without salt (control).15 healthy seeds of mungbean were put in each concentration of salt and soaked that for 6 hours. Six disposable paper plates were taken and marked from 0 to 5.One layer of cotton were placed in each plate. Fifteen soaked seeds of mungbean were placed in each plate. An equal volume of salt solution was added to maintain the concentration of salt treatment constant. Twenty ml of the appropriate solution (0%,1%,2%,3%,4%,5% NaCl solution) were applied in each plate and kept those plates in the dark. The complete process had been repeated thrice. Germination percentage was determined and evaluated. After 12 hours seed started to germinate. Seeds were considered to be germinated with the emergence of the root tip. The germinating seeds were counted. Percentage of seed germination were calculated by following this formula

$$\text{Percentage of germination} = \frac{\text{Total no of germinated seeds}}{\text{Total no of germinated and non germinated seed}} \times 100$$

3. Results and discussions

3.1. Results

Salinity caused considerable delay and reduction in seed germination (Table 1). The germination percentage drastically reduced with increasing salt stress.

Sl. no.	Salt(NaCl) concentration (In percentage)	Total Number of seeds of Mungbean	Observation 1	Observation 2	Observation 3	Average	Percentage of germination
1	0	15	12	13	12	12.33≈ 12	100%
2	1%	15	1	1	1	1	80%
3	2%	15	0	0	0	0	6%
4	3%	15	0	0	0	0	0
5	4%	15	0	0	0	0	0
6	5%	15	0	0	0	0	0

3.2 Observation -1

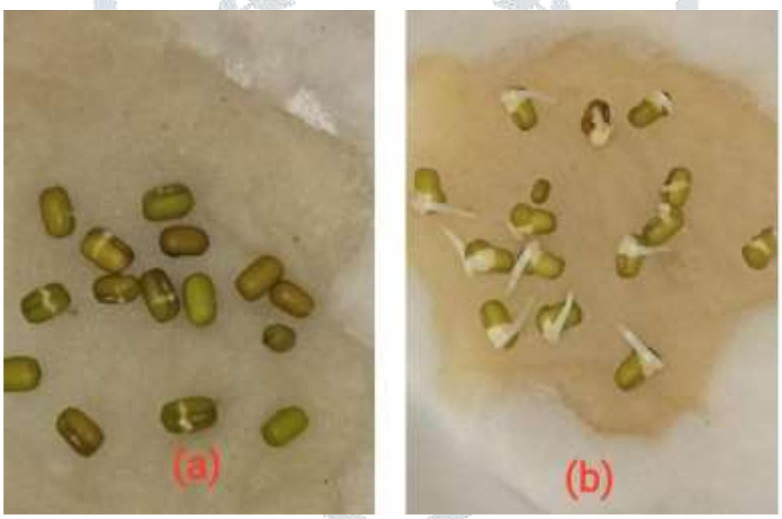

Figure (2) - (a) before germination (b) after germination at control

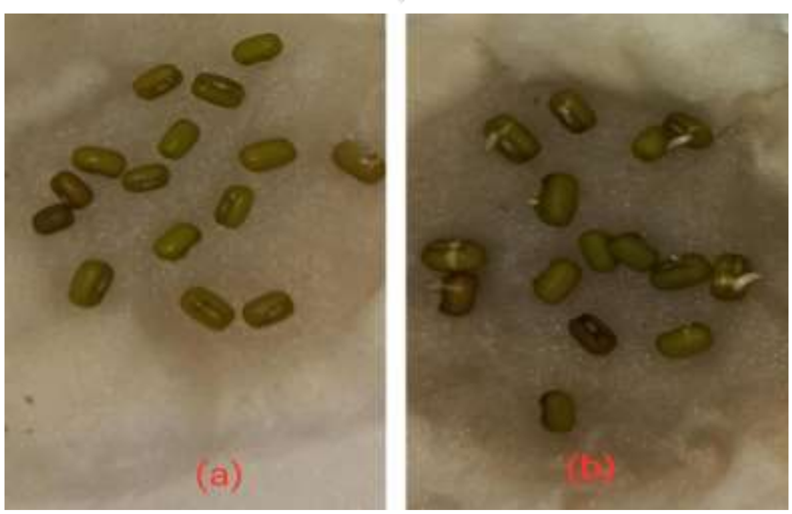

Figure (3)- (a) before germination (b) after germination at 1% NaCl solutions

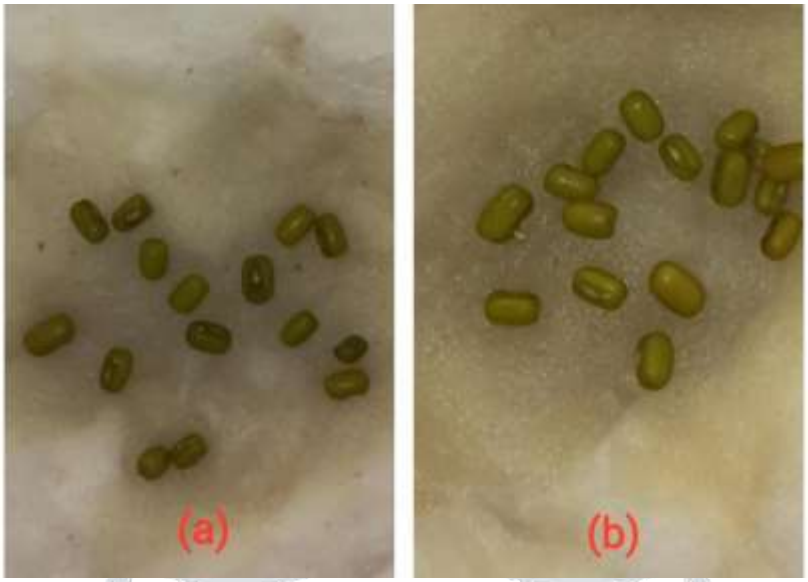

Figure (4)-(a) before germination (b) after germination at 2% NaCl solutions

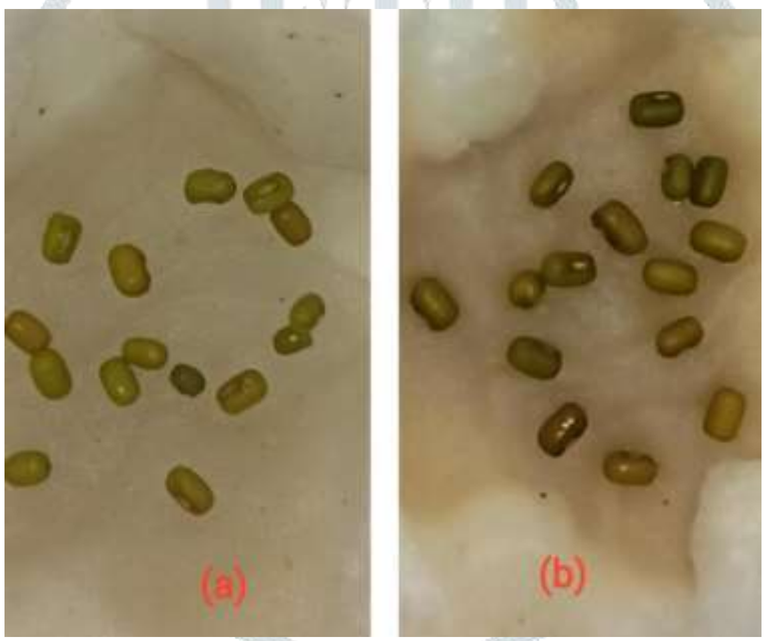

Figure (5)-(a) before germination (b) after germination at 3% NaCl solutions

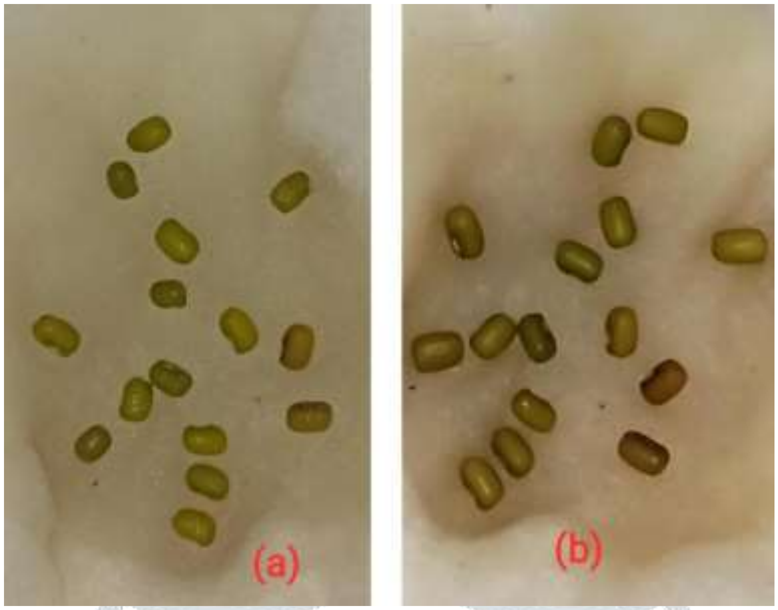

Figure (6)-(a) before germination (b) after germination at 4% NaCl solutions

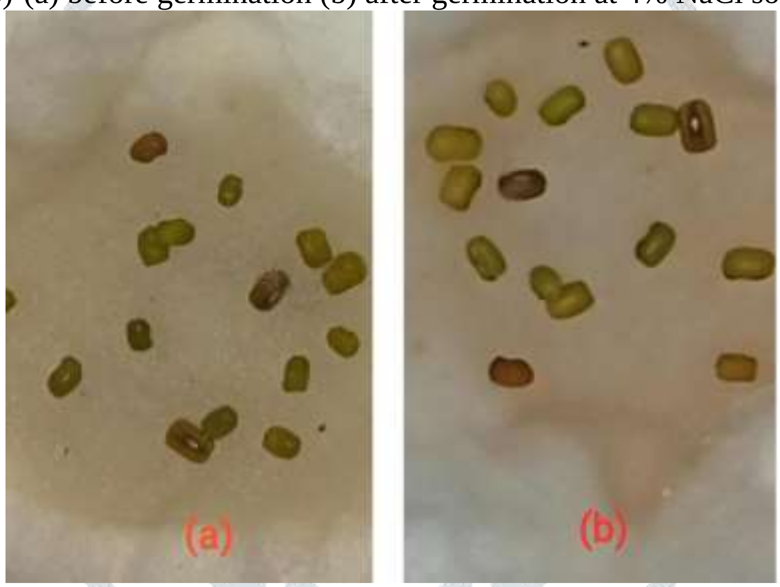

Figure (7)-(a) before germination (b) after germination at 5% NaCl solutions

3.3 Observation -2

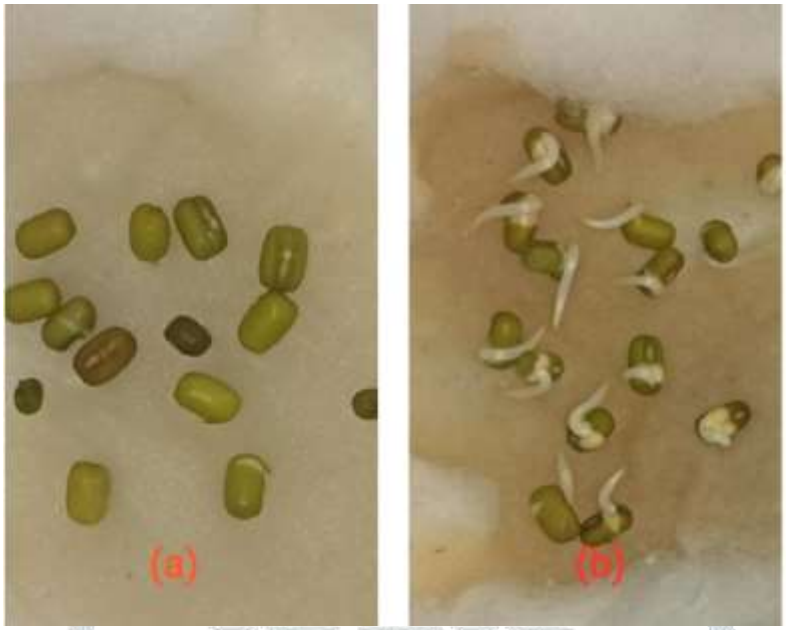

Figure (8)- (a) before germination (b) after germination at control

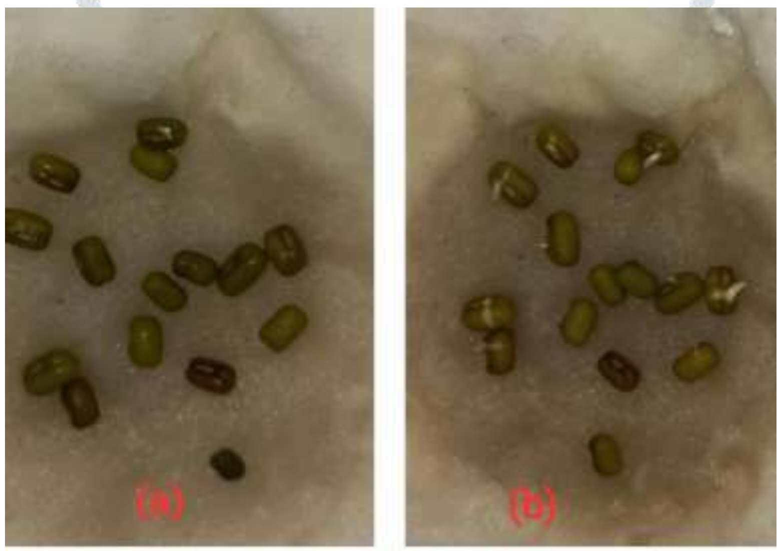

Figure (9)- (a) before germination (b) after germination at 1% NaCl solutions

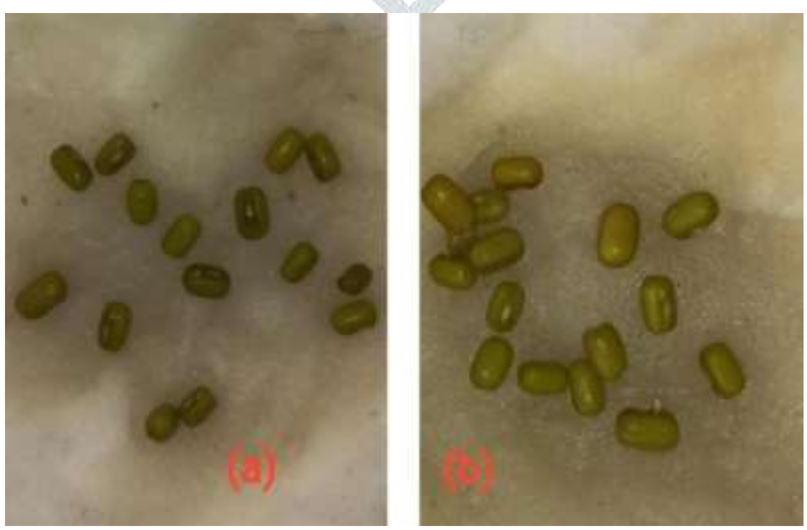

Figure (10)- (a) before germination (b) after germination at 2% NaCl solutions

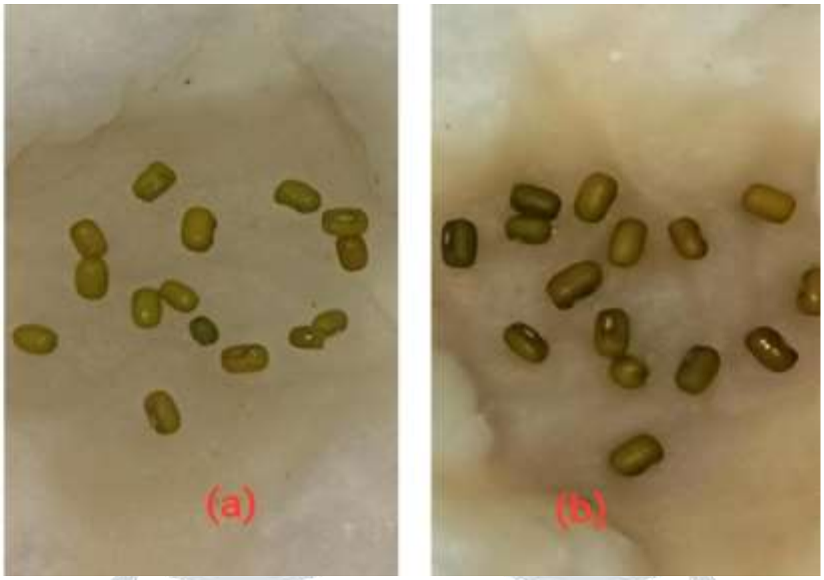

Figure (11)- (a) before germination (b) after germination at 3% NaCl solutions

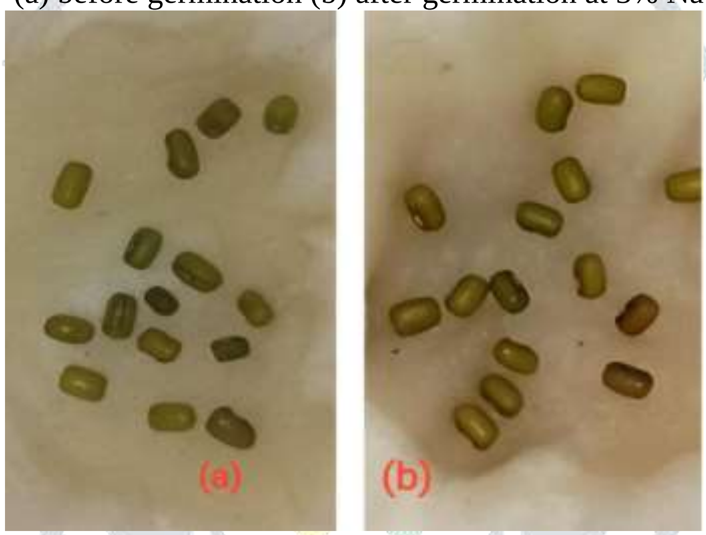

Figure (12)- (a) before germination (b) after germination at 4% NaCl solutions

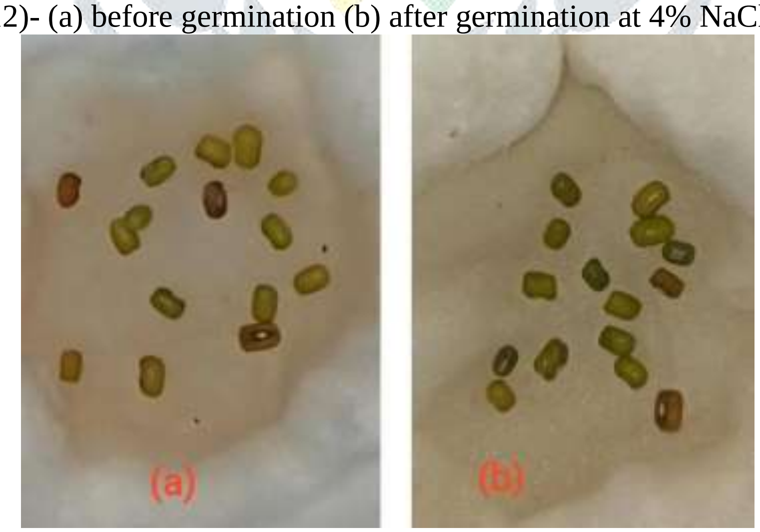

Figure (13)- (a) before germination (b) after germination at 5% NaCl solutions

3.4 Observation-3

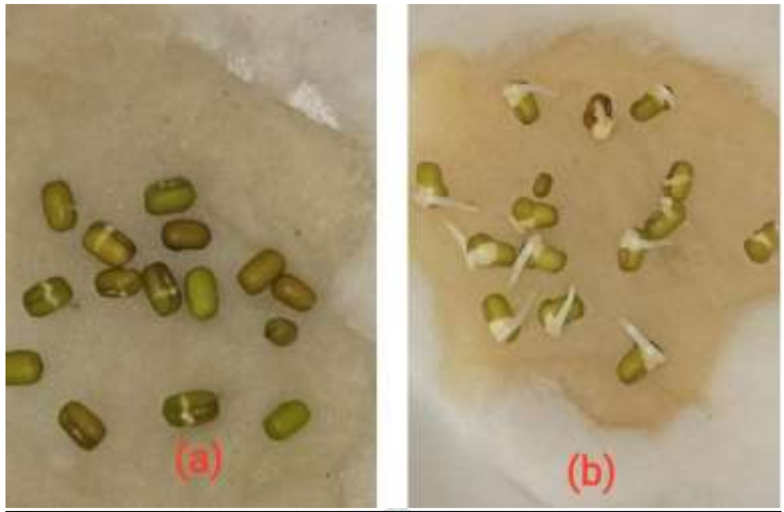

Figure (14)- (a) before germination (b) after germination at control

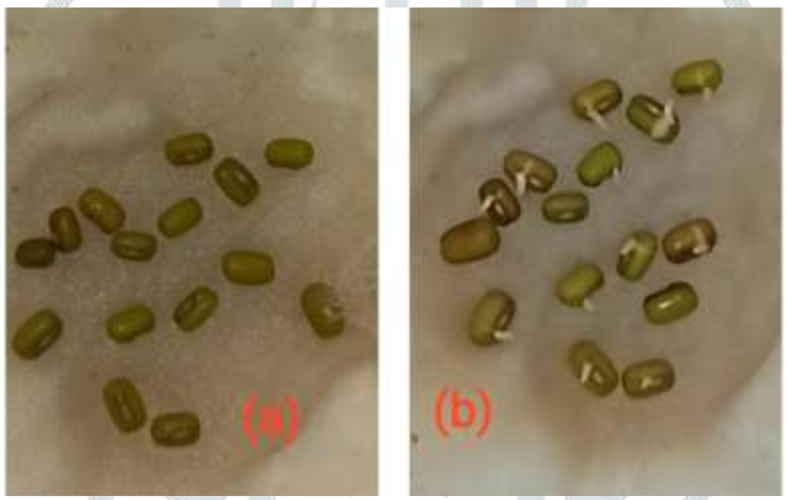

Figure (15)-(a) before germination (b) after germination at 1% NaCl solutions

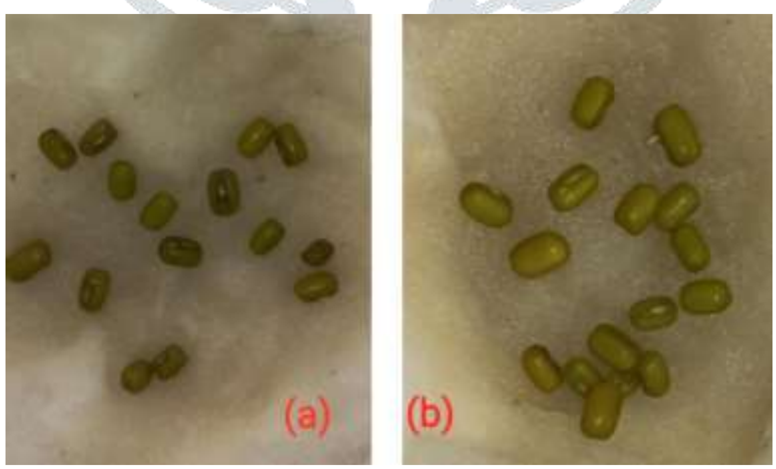

Figure (16)-(a) before germination (b) after germination at 2% NaCl solutions

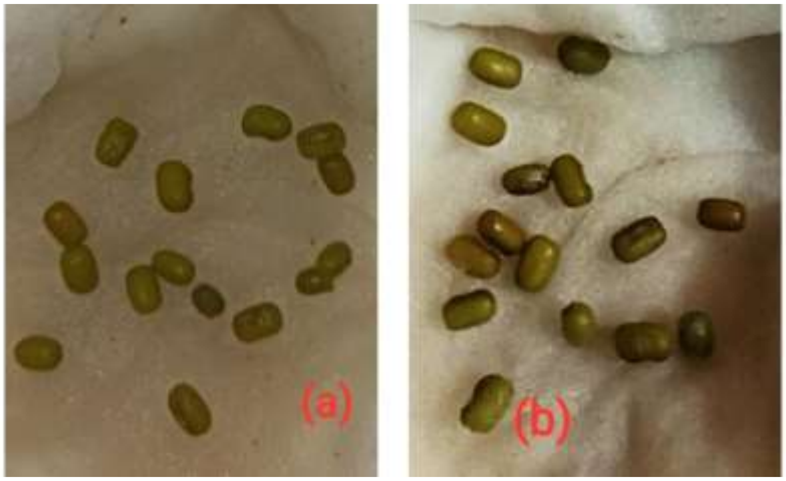

Figure (17)-(a) before germination (b) after germination at 3% NaCl solutions

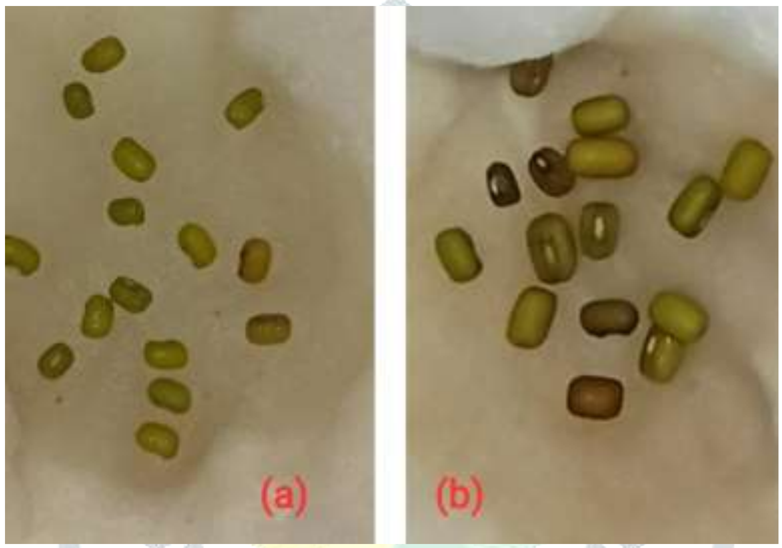

Figure (18)-(a) before germination (b) after germination at 4% NaCl solutions

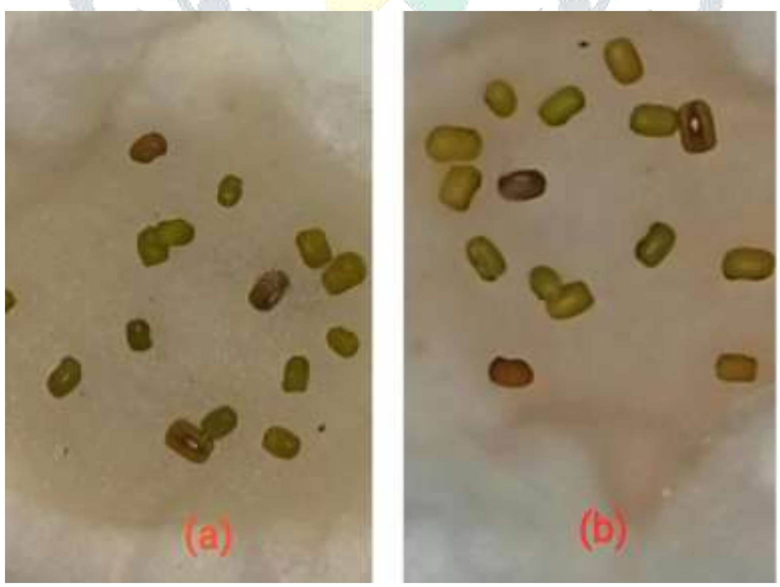

Figure (19)-(a) before germination (b) after germination at 5% NaCl solutions

Figure (2,8,14) shows that the high germination percentage was recorded in water at a control treatment, whereas gradual decreases on the percentages of germination were noticed with the increase of salt concentrations at all treatments. From figure (2,8,14), it was observed that at control condition showed higher germination percentage i.e. 100%. A decreasing trend was observed with the increasing of salinity. Germination percentage was 80% at 1% NaCl solution(figure3,9,15) treatment and 6% at 2% NaCl solution treatment(figure 4,10,16). At 3%,4%,5% NaCl solution treatment, the germination percentage was zero. That means no seed were germinated in these concentrated solution.

3.5 Discussions

Germination percentages greatly varied between the control treatment and the salt treatments as reported by [13]. The results of decreasing germination percentage under salt stress are in agreement with Kannan et al [15]. Increasing concentration of salts reduced the seed germination percentages and growth of many crops were reported by many authors [21, 1].This is due to the inadequate supply of water resulting the low osmotic potential. These results are in general agreement with the findings in mungbean [14, 23]. The lowering water uptake and inhibiting activities of hydrolytic enzymes are the main reason for retarding the seed germination during salt stress [7, 17]. Seed germination may be affected by salinity through either creating external osmotic potential or toxic effect of Na+ and Chloride ions [13, 20]. High accumulation of sodium and chloride ions produced an outside osmotic potential that avoids adequate water uptake or toxic effect of Na+ and Chloride ions in saline environment resulted in poor activation of the hydrolytic enzymes and further reduced the seed germination [18, 20].

4. Conclusion

Saline stress is one of the main factors limiting legume productivity in arid and semi-arid regions. Salinity adversely affects seed germination process. From this experiment it is concluded that seeds of mungbean shows higher germination percentage in water at a control treatment, whereas gradual decreases on the percentages of germination with the increase of salt concentrations at all treatments, i.e. Mungbean seed germination varied according to the change in NaCl concentration. High soil salinity inhibits seed germination.

5. References

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