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Effect of different solutions on seed germination and physiological changes in *Vigna radiata*

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Abstract

The large number of vegetarians or vegans of world population consume legumes as it is the best source of high protein and low fat, it is also high in plant sterols and fibers they are good for heart health. Legumes like mungbean (*Vigna radiata*) has been consumed also as salad after sprouting, it is more nutritious with its sprout and in India it is also consumed by making daal. For seed germination of *Vigna radiata* in controlled condition is generally treated with growth hormones (Gibberellic acid, IAA, IBA, salicylic acid and etc), PEG (polyethylene glycol) and control is used for comparison. In this experiment, the seeds of mungbean are treated with hormones like gibberelic acid (GA) and salicylic acid (SA), PEG (polyethylene glycol) and as stress there is salt stress and citric acid (CA) to see the seed germination under this circumstances, and seeds also germinated in control (distilled water) condition for comparison in petridish on whatman paper for 10 days after that the germinated seeds (salicylic acid, gibberellic acid and distilled water) transferred to the mud pot with the soil and irrigate with their respective solutions for 20 days and take measurements and weight of plants after every 5 days interval.

Keywords: legumes, *Vigna radiata*, hormones, peg (polyethylene glycol), gibberellic acid, salicylic acid, salt stress and citric acid

Introduction

Seeds plays important role in world's diet, as it takes half of per capita energy intake all over the globe, it comprises about 90% of all cultivar, in plant physiology and seed biology is one of the most research area (Beweley, 1997) [1]. The seed germination is the beginning of the growth from seed dormancy; most of the seeds germination rate is vary in different seeds (Bradford, 1990) [2]. The relation between atmosphere, biosphere and lithosphere, they exchange materials like chemicals and physicals gradients for seed germination and growth (Jobbagy *et al.*, 2001) [3]. In plant growth hormones plays important role in seed germination, hormones like ABA, gibberellic acid, ethylene, IAA, cytokines and etc (Miransari *et al.*, 2014) [4]. The seed germination can be affected by the temperature, osmotic potential, salinity and depth of seed sowed (Wang *et al.*, 2016) [5]. In Asian agriculture mung bean (*Vigna radiata*) is an important legume crop, especially in southeast and East Asia and India, it has digestible protein as it is compliment cereal based diet and used as a Pulses and also after sprouting it is used as a salad vegetable (Lambrides *et al.*, 2007) [6]. To see the *Vigna radiata* seed germination and its seedling growth in different solution treatment this present study is done.

Materials and Methodology

Chemicals/Solutions

1. PEG (polyethylene glycol) - the seed of Vigna radiata treated with different level of water stress prompted by PEG 6000 to see the germination and growth, the growth of root and shoot was affected when seedlings wide open in PEG solution after imbibitions when water stress forced on germinated seeds after rooting in distilled water, it isn't get affected as far as -1.0MPa (De *et al*., 1995) [7]. The PEG induce effect on drought stress in germination and things related to germinated and after seed germination; the percentage of water absorb, its water content; root and shoot length, seedling vigour index working as parameters for approximate genetic variation from the ten *Cicer arietinum* genotypes and for selecting drought stress genotypes to be employed for breeding purposes or commercial use (Koskosidis *et al.*, 2020) [8]. In my work, mung bean seeds are treated with PEG solution to see the germination and seedling growth.
2. NaCl – The mung bean variety has been compared of summer season and spring season (Pusa vishal and Pusa ratna) it will Treated with two different NaCl concentration 50mM and 75mM, during spring season in screening the large mung for growing in saline soil (Sehrawat *et al.*, 2015) [9]. The selenium is described to Reduced the salinity stress in lab condition on seeds of *Vigna radiata* but not in soil so far, the treatment of low concentrated selenium, increase the absorption of selenium, decreases the sodium (Na^+) absorption and upgrade the plant function/growing in salt stress (Kaur *et al.*, 2015) [10]. In my experiment NaCl solution is used to see if the mung bean can survive the stress.
3. Salicylic acid – by pre-treating *Vigna radiata* with salicylic acid solution with different concentration 50µM, 100µM and 150µM to decrease the rate of salt stress in growth limitation in two mung bean genotypes

(NM19-19 and NM 20-21), NM 19-19 was less depletion in seedling length, fresh weight, dry weight under salt tolerance hence NM 20-21 appears to be more salt tolerant (Shakeel *et al.*, 2012) [11]. The salicylic is used as priming agent to study in mitigation oxidative damages under cadmium (Cd) toxicity in mungbean, before seed sowing it is primed with salicylic acid as it is induced anti-toxicity defense mechanism and improving the overall growth performances (Roychoudhury *et al.*, 2016) [12]. The Salicylic solution in my work is used to see the *Vigna radiata* germination and growth.

4. Gibberellic acid (GA) – The effect of GA_3 (100mg/L as seed pre-soaking + 100mg/L as foliar application = 200mg/L) on minerals of mung bean treated with NaCl solution 0mM, 50mM, 100mM and 150mM the results Shows the saline solution unpropitious affect the growth but GA_3 control the effect of salt stress and improve the growth (Akbari *et al.*, 2010) [13]. By pre-soaking in GA_3 (200mg/L) to tolerate salinity, NaCl with concentration 0, 100, 200 and 300mM treated to mung bean seed in pot experiment, GA_3 partially decreases the deleterious effect of salt stress in all variability (Mohammed, 2007) [14]. The GA solution in my experiment is used to see the mung bean seed germination and physiological growth.
5. Citric acid (CA) – The seed of *Prunus avium* pre-soaking in 0.1% CA it increases the pre-treatment efficacy but pre-soaking in distilled water is more effective than 0.1% CA (Eşen *et al.*, 2009) [15]. The seed of pea is treated with 200µM $CuCl_2$, 1µM IAA, 1µM GA_3, 10mM $CaCl_2$ and 100µM Na-citrate, applied, applied individually or in combination of Cu: Cu + IAA, Cu + Ca and Cu + Citrate (Ben *et al.*, 2018) [16]. The citric stress is given to the mung bean in my experiment to see if it's going to survive or not.

Source of seeds and solutions

The selected seed *Vigna radiata* (mungbean) are collected from supermarket in Ahmedabad, Gujarat, India. The experiment is done at home and solutions (NaCl, PEG, Salicylic acid, citric acid, Mercuric chloride and Gibberelic acid solutions) are made in laboratory with the help of gibberellic acid, salicylic acid, NaCl, PEG, lemon, glass ware (measuring cylinder, flask, beaker and pipette) and machines (weighing machine and water bath). Glass ware like petridish, bottles to put the solution in it are provided from laboratory of Department of Botany, Bioinformatics and climate change impact management of Gujarat University, Ahmedabad, India 380009; during February and March 2021.

Making of solutions and its pH

The solutions made in lab, for citric solution 30ml of citric juice + 220ml of distilled water, for NaCl solution 5.845gm of NaCl powder + 1 liter of distilled water, for salicylic acid solution 500ml of distilled water + 0.006gm of salicylic acid powder, for PEG solution first to warm 500ml of distilled water + 2.5ml of PEG and for gibberellic acid solution 248ml of distilled water + 2.5ml of GA from stock solution. For sterilization of seeds mercuric chloride is used and its solution is made with 100ml of distilled water + 0.052 gm of mercuric chloride.

Table 1: pH of solutions

Solutions	pH
CA	3.96
NaCl	7.44
SA	7.85
GA	6.86
PEG	7.84
DW	7.20

- The table no. 1 shows that citric acid solution is more acid compare to other solutions. (**Abbreviation**: CA- citric acid, NaCl- sodium chloride, SA- salicylic acid, GA- gibberelic acid, PEG- polyethylene glycol and DW- distilled water)

Seed germination and seedling growth

The seeds of mung bean were surface sterilized were first surface sterilized with mercuric chloride ($HgCl_2$) for 3 minutes and then washed with distilled water to remome the traces of mercuric chloride, then seeds air dried after that the seeds put in peteridish which are 10 cm in diameter with whatman paper, they are 12.5cm in diameter and with their respective solutions. There are 6 petridishs one for each 5 solutions and distilled water and each petridish had 40 to 50 seeds of mung bean for ten days. Pot has been prepared with soil, after 10 days of seed germination they transferred to the pot and irrigated regularly when needed with their respective solutions and measuring growth after every 5 days for 20 days to get the result.

Result and Discussion

Total number of seeds and number of germinated seeds

The total number of seeds mungbean is 280 and germinated seeds are 86 in which 21 seeds are of gibberellic acid solution, 28 seeds of salicylic acid solution and 37 seeds of distilled water.

Effect of solutions on the seeds

The seeds of mungbean germinated in salicylic acid solution, gibberellic acid solution and distilled water but got blackish, busted or contaminated in PEG, NaCl and citric acid.

Result tables

Table 2: Weight of *Vigna radiata* plant

Days	Solutions	Leaves (gm)	Roots (gm)	Shoots (gm)
After 5 days	SA	0.015	0.012	0.070
	GA	0.010	0.011	0.057
	TW	0.028	0.033	0.078
After 10 days	SA	0.070	0.052	0.136
	GA	0.048	0.039	0.022

	TW	0.059	0.043	0.174
After 15 days	SA	0.031	0.016	0.137
	GA	0.021	0.015	0.146
	TW	0.038	0.013	0.132
After 20 days	SA	0.048	0.016	0.175
	GA	0.029	0.015	0.108
	TW	0.039	0.017	0.156

- The table no.2 is showing good result in shoot it is after 20days in salicylic acid (SA), in roots and leaves also gives good result in salicylic acid after 10 days.

Table 3: length of roots and shoots of *Vigna radiata* plant

Days	Solutions	Roots (cm)	Shoots (cm)
After 5 days	SA	2.0	10.0
	GA	0.6	8.5
	TW	3.2	11.5
After 10 days	SA	4.6	17.0
	GA	1.8	15.0
	TW	4.5	15.5
After 15 days	SA	5.4	18.6
	GA	2.2	16.4
	TW	4.7	16.8
After 20 days	SA	4.0	19.5
	GA	3.2	17.2
	TW	4.5	18.8

- The table no.3 shows that length of root after 15 days in salicylic acid and then tap water except in gibberellic acid solution it is more in after 20 days and shoots increase its length as the day passes the length of shoot is more in salicylic acid solution, then tap water and lastly in gibberellic acid solution.

Table 4: length and width of plant leaf (*Vigna radiata*)

Days	Solutions	Length (cm)	Width (cm)
After 5 days	SA	1.4	0.6
	GA	1.1	0.4
	TW	1.9	0.6
After 10 days	SA	2.4	0.7
	GA	2.0	0.6
	TW	2.6	0.9
After 15 days	SA	2.5	0.9
	GA	2.2	0.8
	TW	2.9	0.9
After 20 days	SA	2.5	1.0
	GA	2.3	0.9
	TW	3.0	1.0

- The table no. 4 is showing leafs of tap water and salicylic acid solution is more in after 20 days as compare to gibberellic acid solution.

Graphs of the result tables (table no. 2, 3 and 4):

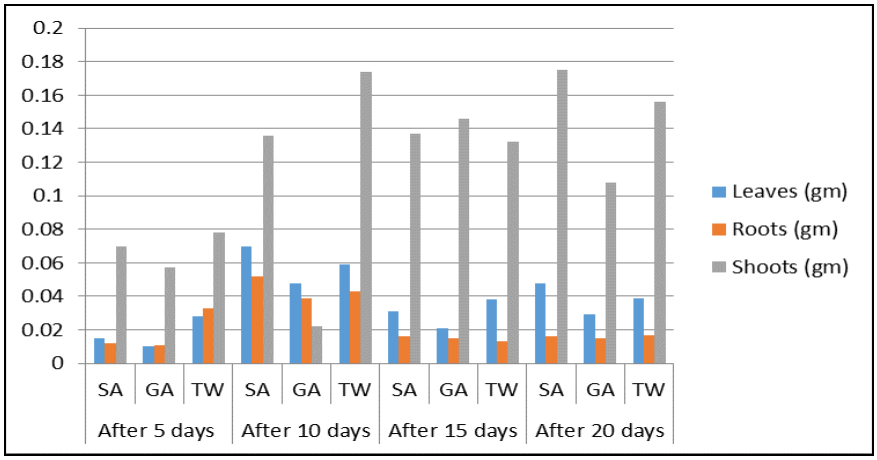

Fig 1: Bar graph showing weight of *Vigna radiata* plant.

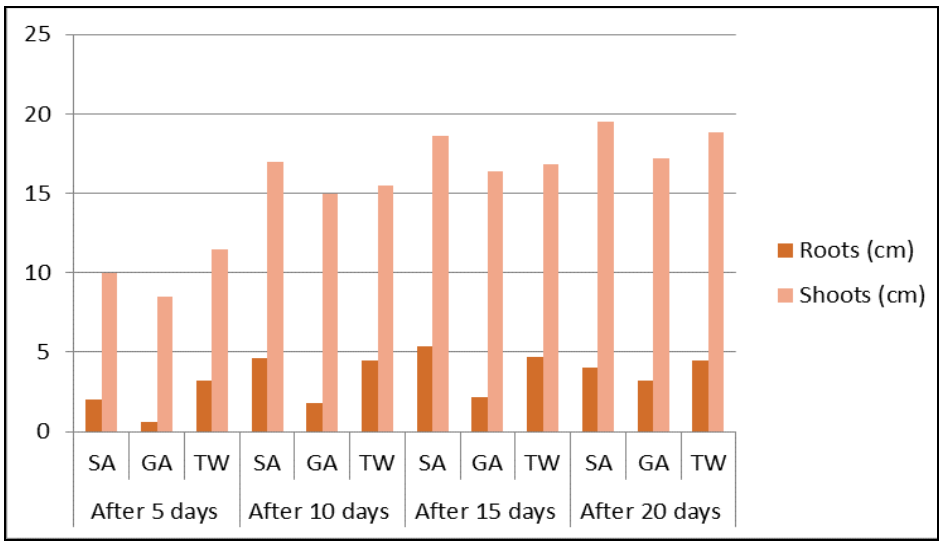

Fig 2: Bar graph showing length of roots and shoots of *Vigna radiata* plant.

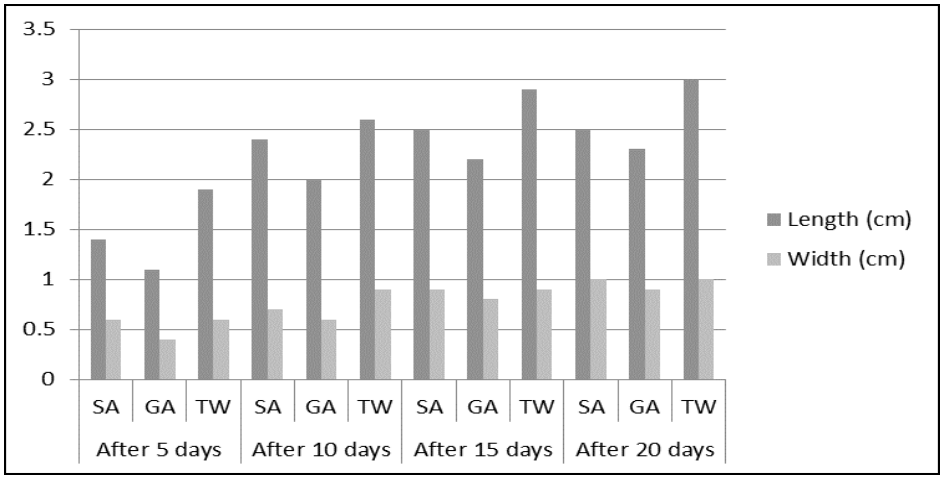

Fig 3: Bar graph showing length and width of leafs (*Vigna radiata* plant).

Conclusion

It turns out that the seeds of *Vigna radiata* (mungbean) germinated mostly germinated in salicylic acid solution, gibberellic acid solution and distilled water. The seeds get busted, contaminated or got blackish in colour. In pot salicylic acid solution gives the best result in every aspect of mung bean plant's growth.

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