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Effect of Different Solutions on Seed Germination and Physiological Changes in *Cicer arietinum*

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ABSTRACT

The chickpea is rich source of vitamins, fibers and minerals; it provides variety of health benefits like aiding weight management, improving digestion and lessens the risk of several diseases. The chickpea is high in protein and it is the best way to replace meat in vegetarian and vegan diets. For seed germination of chick pea generally used growth hormones like gibberellic acid (GA), IAA, IBA, salicylic acid and etc, PEG (polyethylene glycol) and control is used for comparison. In present work, the seeds of chickpea (*Cicer arietinum*) are treated with hormones like gibberellic acid salicylic acid solutions, PEG solution and as stress there is salt stress (NaCl) and citric acid (CA) solutions to see the seeds 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 (PEG, gibberellic acid and distilled water) transferred to the mud pot with the soil and irrigate with their respective solutions for 20 days and take measurement and weight of plants after every 5 days interval.

Keywords : Vitamins, Fibers, Minerals, Hormones, *Cicer Arietinum*, PEG, Gibberellic Acid, Salicylic Acid, Salt Stress and Citric Acid.

I. 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, seed biology is one of the most researched area [1]. The genetics and physiology research manifest the importance of hormones (abscisic acid and gibberellic acid) in regulation of dormancy and seed germination [2]. In plant growth hormones plays important role in seed germination, hormones like ABA, gibberellic acid, ethylene, IAA, cytokines and etc [3]. The radical initiation, elongation and development can be regulated by growth hormones, it is mainly affected by sun light and its intensity, water availability, aeration of soil, amount of carbohydrate efficiency and nutrients (macronutrients and micronutrients); the soil consist micro-organisms, mesofauna and macrofauna which can increase or decrease the rate of root growth as the s*arietinum* is

important pulse crop grown and consumed as diet all over the world, it contains carbohydrate and protein; other than sulphur containing amino acid it has significant amount which can be complemented by adding cereals to the daily diety; it has good influence on some of the human disease like diabetes type 2, some cancer, digestive disease and CVD; it is an important pulse crop with diverse array of potential nutrition and health benefits [5].The utmost aim of *Cicer arietinum* propogation is to increase the production the genetic potential of cultivars or by removing the effect of drought, cold, disease and insect [6].

II. MATERIALS AND METHODOLOGY

A. Chemicals/solutions

1. NaCl –The legume crop like chickpea is an important food in Turkey and it is vastly grown on low misture or saline for human consumption. To see the effect in effect in electric conductivities (4.5, 8.6, 12.7 and 16.3 dS/m) and in seed sizes (7, 8 and 9) on germination and in beginning seedling growth of 3 popular chickpea cultivars (AKN-97, Gokce and Uzunlu-99), the use of small seeds of chickpea was seems to reduce the production costs in saline soils [7]. In chickpea plant, NaCl induced reactive oxygen species generation and antioxydative reactions in the leaves investigated in concentration-dependent manners, the concentration of NaCl was assisted by a step rise in the H_2O_2 and O_2^-. In chickpea, NaCl does trigger the antioxidative response and concluded that the plant is a good source of natural antioxidants [8]. In my experiment NaCl solution is used to see if the chickpea can survive the stress.

2. Salicylic acid – The foliar application of salicylic acid concentration 10^{-4}mol/L, 10^{-5}mol/L and 10^{-6}mol/L was used to increase the dry mass per plant, nodule dry mass and leghemoglobin content, the effective concentration was 10^{-5}mol/L >10^{-6}mol/L >10^{-4}mol/L > control in chick pea seeds [9]. The hormone plays a vital role in induction of plant protection against a variety biotic and abiotic stress through physiological, morphological and biochemical mechanism, from the concentration of salicylic acid 1, 1.5 and 2mM, the 1.5mM seems favorable to plant and protect against biotic and abiotic stress in chick pea plant [10]. The salicylic acid solution in my work is used to see the chickpea germination and growth.

3. Gibberellic acid – The seeds of *Cicer arietinum* soaked in four concentrated GA solutions 0, 10^{-7}, 10^{-6} and10^{-5} for 4,8 and 12 hours and then sown in pots; the number of pods per plant, yielding of seed and protein content stimulated by 82.69%, 5.44% and 54.32% respectively [11]. In low temperature stress chickpea is sensitive, mainly during germination and stand formation, to rescue chickpea seed from chilling stress by priming them with GA in combination with GA in combination with hydropriming in different concentrations, GA_3 can be used for crop growth, maintaining high relative water content, good stand establishment and reducing electrolyte leakage [12].the GA solution in my experiment is used to see the chickpea seed germination and physiological growth.

4. Citric acid – Ameliorate the phytoextraction of Cd (cadmium) by the application of citric acid on hydroponic plants under controlled condition, the citric acid increases the Cd absorption and decreases the Cd stress it is beneficial for phytoextraction of Cd through hyper accumulation of *Brassica napus* [13]. In both chickpea and *Lens culinaris* (Lentils) has changed in saponin and composition as they were investigated after soaked in distilled water, sodium bicarbonate and citric acid solutions. Soaking does not modify the content of saponin or composition of chickpeas and lentils even so the pH of the soaking solution, overall decreasing of saponin content was found in lentils but not for chickpea [14]. The citric acid stress is given to the chick pea in my experiment to see if it's going to survive or not.

5. PEG (polyethylene glycol) – The effect water shortage induced by different potential level (0, -0.4, -0.6 and -0.8) of PEG 6000 and NaCl treatment on chick pea cultivars, lines at germination and early growth stages by sampling them after 4th and 8th day of incubation, PEG is showing more successful in inhibition than NaCl at the MPa level tested, all the genotypes tested could be classified as tolerant, moderately tolerant and sensitive one. Some species like Canıtez and ILC-3279 are tolerant to PEG but ILC-3279 was sensitive to NaCl treatment [15]. The seeds of chick pea (GG-1 and GJG-3) with seed coat, for seed priming with 6 treatments including KNO_3 200pm, PEG 6000 (-1.2MPa), Bavistin (2g/kg), neem oil (3%), control in complete randomized design (CRD) with three replications, seeds will be soaked for 8 hrs for priming respectively air dried and put it on germination test by keeping them in between paper at 25°C, at the end seeds with radical are counted as germinated [16]. In my work, chick pea seeds are treated with PEG solution to see the germination and seedling growth.

B. Source of seeds and solutions:

The seeds of *Cicer arietinum* are purchased from supermarket in Ahmedabad, Gujarat, India. The experiment is done at home and solutions (PEG, Salicylic acid, Citric acid, gibberellic acid NaCl and Mercuric chloride) are made in laboratory with the help of lemon, gibberellic acid, salicylic acid, NaCl, PEG, glass ware (flask, beaker, pipette and measuring cylinder) and machines (water bath and weighing machine). Glass ware like peteridish, glass container to put the solution in it and whatman paper 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.

C. Making of solutions and pH

The solutions made in lab for citric solution 30ml of citric juice with 220ml of distilled water, for NaCl solution 5.845gm of NaCl powder with 1 liter of distilled water, for PEG solution first to warm 500ml of distilled water with 2.5ml of PEG, for salicylic acid solution 500ml distilled water with 0.006gm of salicylic acid powder and for gibberellic acid solution 248ml of distilled water with 2.5ml of GA from stock solution. For sterilization of seeds $HgCl_2$ is used and its solution is made with 100ml of distilled water with 0.052gm of mercuric chloride.

TABLE NO.1- PH OF SOLUTIONS

Solutions	pH
Citric acid	3.96
NaCl	7.44
Salicylic acid	7.85
Gibberellic acid	6.86
PEG	7.84
Distilled water	7.20

The table no.1 shows that citric acid solution is more acidic compare to other solution.

D. Seed germination and seedling growth

The seeds of chick pea were sterilized with mercuric chloride foe 3 minutes and washed with distilled water thoroughly to remove the traces of mercuric chloride, and then seeds air dried after that the seeds put in petridish which are 10cm in diameter with whatman paper, they are 12.5cm in diameter and with their respective solution. There are 6 petridishs one for each 5 solutions and distilled water and each petridish had 20 to 30 seeds of chickpea for 10 days. Next step for seedling growth is to transfer the germinated seeds in mud pot with soil and irrigate them with their respective solution and distilled water.

III. RESULT AND DISCUSSION

A. Total number of seeds and number of germinated seeds

The total number of seeds Cicer arietinumare 105 and number of germinated seeds are 85, in which 28 germinated seeds of gibberellic acid solution, 26 germinated seeds of PEG solution and 30 germinated seeds of distilled water.

B. Effect of solutions on the seeds

The germination is seen only in PEG solution, gibberellic acid solution and distilled water but did not give result in NaCl solution, citric acid solution and salicylic acid solution.

Result tables:

TABLE NO.2: WEIGHT OF *CICER ARIETINUM* PLANT

Days	Solutions	Leaves (gm)	Roots (gm)	Shoots (gm)
After 5 days	PEG	0.087	0.078	0.153
	GA	0.069	0.081	0.209
	TW	0.142	0.069	0.281
After 10 days	PEG	0.123	0.080	0.442
	GA	0.159	0.094	0.350
	TW	0.333	0.095	0.557
After 15 days	PEG	0.295	0.084	0.524
	GA	0.244	0.130	0.513
	TW	0.364	0.096	0.649
After 20 days	PEG	0.274	0.048	0.514
	GA	0.172	0.030	0.475
	TW	0.202	0.047	0.417

The table no.2 shows the highest result in after 15 days of plant's weight than after 20 days and in after 15 days, GA shows good result in root and tap water gives good result in leaves and shoots. (***Abbreviatio:*** PEG- Polyethylene glycol, GA- gibberelic acid and TW- tap water)

TABLE NO.3: LENGTH OF ROOTS AND SHOOTS (*CICER ARIETINUM* PLANTS)

Days	Solutions	Roots (cm)	Shoots (cm)
After 5 days	PEG	0.8	9.2
	GA	1.8	10.2
	TW	2.0	12.6
After 10 days	PEG	3.3	10.2
	GA	4.3	23.7
	TW	5.5	28.4
After 15 days	PEG	6.7	32.3
	GA	4.5	29.0
	TW	3.7	32.5
After 20 days	PEG	3.7	35.2
	GA	4.5	36.5
	TW	2.5	30.5

Table no.2 shows the after 15 days plant shows good height than after 20 days; in after 15 days the root of PEG is the highest and shoot of tap water is the highest compare to other.

TABLE NO.3: LENGTH AND WIDTH OF PLANT'S LEAF AND ITS LEAFLET (*CICER ARIETINUM*)

Days	Solutions	Length (cm)		Width (cm)	
		Leaf	Leaflet	Leaf	Leaflet
After 5 days	PEG	1.5	0.4	0.8	0.3
	GA	1.0	0.4	0.8	0.4
	TW	0.6	0.6	1.1	0.4
After 10 days	PEG	3.8	0.8	1.5	0.5
	GA	4.4	0.8	1.5	0.7
	TW	5.3	1.0	2.0	0.8
After 15 days	PEG	4.6	0.8	1.6	0.6
	GA	4.5	0.8	1.6	0.7
	TW	5.4	1.0	2.0	0.8
After 20 days	PEG	4.3	0.9	1.5	0.7
	GA	4.0	0.5	1.1	0.5
	TW	4.5	0.9	1.6	0.7

The table no.3 shows the after 15 days leaf and leaflet is wider than after 20 days; in after 15 days tap water leaf and leaflet is giving the good growth than other.

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

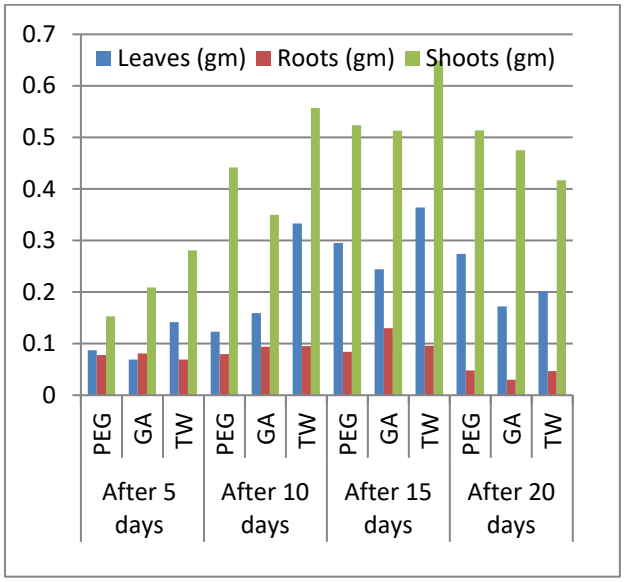

Figure 1 : weight of *Cicer arietinum* plants (leaves, roots and shoots)

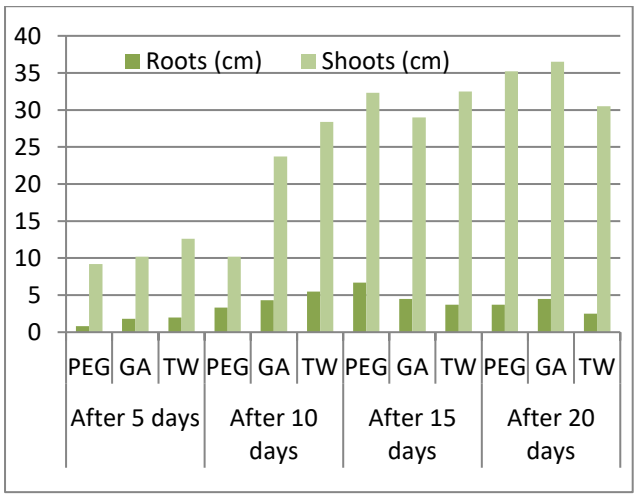

Figure 2 : length of *Cicer arietinum* plant (roots and shoots).

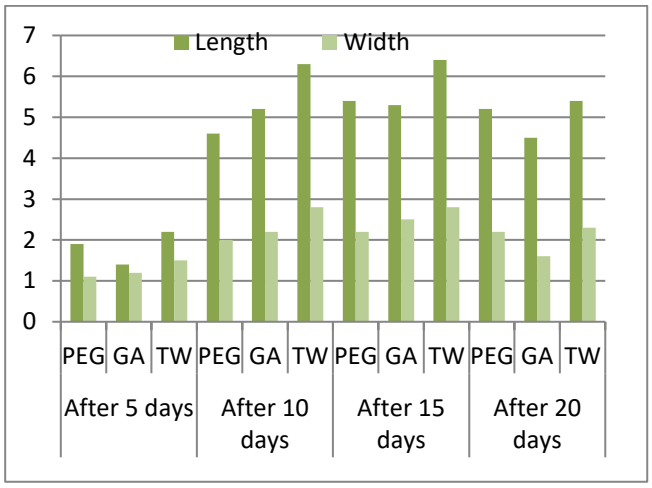

Figure 3 : length and width of *Cicer arietinum* leaves.

IV. CONCLUSION

It turns out that the most of *Cicer arietinum* seeds germinated in PEG solution, gibberellic acid solution and control (distilled water). In salicylic solution, NaCl solution and citric solution doesn't germinate and get blackish in colour, busted and contaminated. In pot PEG and tap water gives more result than gibberelic acid solution.

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