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# Effect of Seed Priming on Seed Quality Attributes in Chickpea (*Cicer arietinum* L.)

**Thellam Surendra [a++*], Priyanka Gupta [b#] and Praveen Kumar S [c†]**

*[a] Genetics and Plant Breeding, School of Agriculture, ITM University, Gwalior, M.P, India.*
*[b] Department of Genetics and Plant Breeding, School of Agriculture, ITM University, Gwalior, M.P, India.*
*[c] Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India.*

***Authors' contributions***

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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## ABSTRACT

Effect of seed priming on seed quality attributes in chickpea (*Cicer arietinum* L.). The field experiment was carried out at the crop research centre of department of Genetics and Plant Breeding, ITM University, Gwalior rabi season 2021-2022.Field and Laboratory experiment (variety $G_2$-315) with 10 treatments. Viz T1- Tulsi leaf extract @ 1 % (12hours). T2 - Tulsi leaf extract @ 3% (12hours). T3 Tulsi leaf extract @5% (12hours). T4 Neem seed extract 1% (12hours), TS- Neem

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*[++] Research Scholar, M.Sc.;*
*[#] Assistant Professor;*
*[†] Ph.D. Research Scholar;*
**Corresponding author: E-mail: surendratellam@gmail.com;*

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seed extract @ 3% (12hours), T6- Neem seed extract @ 5% (12hours), 17- KNO3 @ 1% (12 hours). T8 - KNO3 @ 3% (12 hours). T9 - KNO3 @ 5% (12hours). T10- Control. In all treatment, the seeds of chickpea were soaked for 12 hours and dried for 2 hours except control (untreated seeds). It was found that all the priming treatments showed significance difference with the control while highest plant height, number of primary branches per plant germination percentage. Days to 50% flowering. Number of siliqua per plant. Number of seeds per siliqua, seed weight (gm), and seed quality parameters viz, Germination percentage (%), Root length (cm), Shoot length (cm), Seedling length (cm). Seedling fresh weight (gm). Seedling dry weight (gm), Vigour index-1, Vigour index -II. electrical conductivity were observed for seeds treated with $T_9$-$KNO_3$@ 5% followed by $T_3$-Tulsi Leaf Extract @ 5%, while the lowest was observed in $T_{10}$-Control. The study helps to study field and seed quality parameters with the help of seed priming treatments which are effective, economic, non-toxic and eco-friendly sources.

*Keywords: G2-315; chickpea. seed priming; tusli leaf extract; neem seed extract.*

## 1. INTRODUCTION

Pulses improve soil structure and fix atmospheric nitrogen, preserving soil fertility. Pulses are regarded as an excellent crop for the management of natural resources, environmental crop diversification, and consequently for sustainable agriculture because they play a significant role in improving the physical, chemical, and biological properties of soils in rain fed agriculture [1]. India's trade, production, and consumption of pulses. Leguminaceae, or chickpea (*Cicer arietinum* L.), has a 2n=16 genetic makeup. The name Cicer is a translation of the Greek word kiros, which refers to the famous Roman family Cicero. The Latin word arietinum, which means "ram," refers to the chickpea's ram-like head shape. It also goes by the name Bengal gramme. It is a cool-season legume crop that is grown as a food crop in many nations around the world.

“Chickpea contains protein (22-28 %), fat (4.8-5.5 %), carbohydrates (40-65 %), ash (48 %), moisture (4.9-15.59), vital vitamins like vitamin A, vitaminB1, B2 and B3, vitaminc, vitamin E vitamin K Folate and Pantothemic acid” [2]. Additionally, “chickpeas contain a variety of vital minerals, including calcium, iron, molybdenum, potassium, manganese, copper, and zinc. Additionally, chickpeas contain dietary fibre, water, and other nutrients. Generally improving germination rate and plant performance, seed priming is a pre-sowing technique for influencing seedling development by modifying pre-germination metabolic activity before the radicle emerges” (Bradford, 1986). “The primary goals of the investigation are to evaluate the impact of various priming techniques on the development, yield, and defining characteristics of chickpeas, as well as to identify the most effective priming technique for this crop. Perhaps the osmotic potential and chemical makeup of the salt species used have an impact on how effective priming with simple salt solution is. It has been suggested that compounds containing nitrate may act as priming agents more effectively than other salts. Numerous salts have been found to work very well as primers” [3,4].

“Seed priming is a simple technique that can enhance seedling vigor and establishment, which in turn improves crop performance in the field” [1]. By allowing early DNA replication, increasing RNA and protein synthesis, repairing damaged seed parts, and reducing metabolite leakage, priming is a pre-sowing seed treatment that improves embryo growth, seedling speed and uniformity in the field, increases drought tolerance, lessens pest damage, and increases crop yield.

The ability to store seeds is an important factor of seed vigor and can explain a lot about the high quality. Seed treatments or controlled-environment storage both allow for the maintenance of seed quality. Priming needs to be practised to increase the viability and vigour of seeds prior to sowing because storing seeds under controlled conditions is an expensive endeavour. When the soil moisture regime changes, seed treatment is said to increase seedling emergence and improve germination, especially in the sub-optimal range The practice of priming and seed treatment with fungicide has a long history and is used to protect chickpea seeds from seed mycoflora not only during storage but also to protect germination and encourage strong establishment. The insect and pest infestation typically starts in the field and causes severe during storage, resulting in a significant loss in germination and other quality

indicators. “The beneficial effect of these seed priming treatments were reflected in greater cellular membrane integrity, counter action of lipid peroxidation and free radical chain reaction often found to be directly correlated with the maintenance of viability and reduced moisture uptake by hydrated dehydrated seed antipathogenic effects repair of biochemical lesions by the cellular enzymatic repair system metabolic removal of toxic substances and counteraction of free radical and lipid peroxidation reactions” [1]. Using this information, it is necessary to identify a straightforward, practically applicable seed priming treatment for the crop's successful establishment in order to achieve a high yield potential with better quality seed.

## 2. MATERIALS AND METHODS

The field experiment was carried out at the crop research centre of department of Genetics and Plant Breeding, ITM University, Gwalior, Madhya Pradesh, India, geographically located at $26.22^0$N, $78.18^0$E and at an average elevation of about 197m above the mean sea level. The experimental research material was collected from local farmer from Maharashtra, the pure seeds of chickpea variety $G_2$-315.The seeds of the varieties $G_2$-315 were primed for 12 hours with various doses of Tulsi leaf extract, Neem seed extract, and $KNO_3$ leaf extract, then dried to their original moisture content according to the treatment. Foliar applications of various chemicals were given at the bud initiation stage and 8 days after bud initiation Details of the treatments are metioned below.

The treatments used at different concentrations viz.,

T1 - Tulsi leaf extract @ 1%
T2 - Tulsi leaf extract @ 3%
T3 - Tulsi leaf extract @ 5%
T4 - Neem seed extract @ 1%
T5 - Neem seed extract @ 3%
T6 - Neem seed extract @ 5%
T7–$KNO_3$ leaf extract @ 1%
T8 -$KNO_3$ leaf extract @ 3%
T9–$KNO_3$ leaf extract @ 5%
$T_{10}$- Unprimed Control

After cleaning and grading, the seeds were soaked in respective priming solutions at different volume of seeds for twelve hours. Then the seeds were air dried under the shade to bring back to their original moisture content and used for sowing

**Field observations:** Days to 50 percent Flowering, Plant height at maturity (cm), Number of primary branches per plant , Pod per plot ,Seed yield per pod (g),100 seed weight (g).

**Laboratory observation:** Germination percentage (%)**,** Shoot length (cm), Root length (cm), Seedling length (cm), Seedling fresh weight (SFW), Seedling dry weight (SDW),Seedling vigour Index I,Seedling Vigour Index II , Electrical conductivity (ds/m)

## 3. RESULTS AND DISCUSSION

A field experiment was conducted to study Effect of priming on the growth, yield, field attributing traits and seedling parameters on Desi Chickpea (*Cicer arietinum L*.) are as follows. The experiment was carried out during *Rabi* season 2021-2022, Department of Genetics and Plant Breeding, School of Agriculture, ITM University, Gwalior. The results are given and discussed under following headings.

### 3.1 Analysis of Variance

The analysis of variance for growth and seed yield characters was presented in Table 1. Analysis of variance revealed that the differences among thirteen treatments were significant for growth and yield, viz., field emergence percentage, Plant Height at Maturity, Primary Branches, Days to 50% Flowering, Pods per Plant, Seeds per Pod, Plot Yield (g), 100 Seed Weight (g), Seed Germination Percentage (%), Fresh Weight of Seedling, Dry Weight of Seedling (g), Shoot Length, Root Length, Seedling Length, Vigour index 1, Vigour index 2, Electrical conductivity.

### 3.2 Mean Performance

**Effect of different priming methods on field emergence percent:**

**Days to 50% flowering:** The data regarding Days to 50% Flowering as influenced by different seed priming treatments was shown in the Table 2.

**Table 1. Analysis of variance for 16 characters in chickpea**

| S.No | Characters V1(G2 -315) | Mean sum of squares | | |
|---|---|---|---|---|
| | | Replications (DF=2) | Treatments (DF=9) | Error (DF=18) |
| **1** | Plant Height at Maturity(cm) | 27.140 | 199.541** | 4.282 |
| **2** | Primary Branches(cm) | 0.261 | 1.308 | 0.146 |
| **3** | Days to 50% Flowering(%) | 1.43 | 327.73 | 7.69 |
| **4** | Pods per Plant (g) | 43.90 | 456.922 | 22.678 |
| **5** | Seeds per Pod(g) | 0.0025 | 0.292 | 0.014 |
| **6** | Plot Yield (g) | 3.0 | 24815.66 | 52.227 |
| **7** | 100 Seed Weight (g) | 3.1930 | 18.80 | 0.108 |
| **8** | Seed Germination Percentage (%) | 0.354 | 88.486 | 1.443 |
| **9** | Fresh Weight of Seedling(g) | 0.4459 | 2.0839 | 0.008 |
| **10** | Dry Weight of Seedling (g) | 0.0228 | 0.2639 | 0.008 |
| **11** | Shoot Length(cm) | 0.436 | 10.069 | 0.208 |
| **12** | Root Length(cm) | 0.012 | 0.17866 | 0.0074 |
| **13** | Seedling Length(cm) | 0.508 | 12.77 | 0.1936 |
| **14** | Vigour index 1(%) | 4857 | 199412 | 2350 |
| **15** | Vigour index 2(%) | 168.2 | 3616.2 | 77.4 |
| **16** | Electrical conductivity(ds/m) | 0.03033 | 1.04922 | 0.03700 |

*** 5% significant level*

The mean performance of days to 50% flowering variety G2-315 ranged from $T_9$ $KNO_3$ 5% (69.66) to $T_4$ Neem seed extract 1% (94.00) with mean value of 84.03. Significantly taken highest days to 50% flowering (99.00) was reported in $T_{10}$ with control and it was followed by $T_4$ Neem seed extract 1% (94.00) ,$T_5$ Neem seed extract 3% (92.00),$T_6$ Neem seed extract 5% (89.00,) $T_1$ tulsi leaf extract 1% (88.66) .Minimum days to 50% flowering was recorded by T9 $KNO_3$ 5% (72.00).The present findings are in confirmation with the results of Nelakurthi Venkata Praveen et al. [5], G. Abdul Wajid et al. [6] Deepak Chand Bhateshwar et al. [7].

**Plant height at maturity (cm):** The mean performance of plant height at maturity in variety G2-315 ranged from $T_4$ Neem seed extract 1% (54.00) to $T_9$ $KNO_3$ 5% (72.06) with mean value of 59.80. Significantly taken highest plant height at maturity flowering (72.06) was reported in $T_9$ $KNO_3$ 5% and it was followed by $T_3$ tulsi leaf extract 3% (68.50) $T_8$ $KNO_3$ 3% (64.56), $T_2$ tulsi leaf extract 3% (59.63), $T_1$ tulsi leaf extract 1% (58.13) .Minimum plant height at maturity was recorded by $T_{10}$ with control (43.30). Similar result was observed by Kalyanrao Patil et al. [8] Nelakurthi Venkata Praveen et al., [5], Deepak Chand Bhateshwar et al. [7], G. Abdul Wajid et al., [6].

**Number of primary branches per plant:** The mean performance of Number of primary branches per plant in variety G2-315 ranged from $T_4$ Neem seed extract 1% (2.03) to $T_9$ $KNO_3$ 5% (3.66) with mean value of 2.78. Significantly taken highest primary branches per plant flowering (3.66) was reported in $T_9$ $KNO_3$ 5% and it was followed by $T_8$ $KNO_3$ 3% (3.50) $T_7$ $KNO_3$ 1% (3.33), $T_3$ tulsi leaf extract 5% (3.13), $T_1$ tulsi leaf extract 3% (3.00). Minimum Number of primary branches per plant was recorded by $T_{10}$ with control (1.66). Similar result was observed by Nelakurthi Venkata Praveen et al. [5], G. Abdul Wajid et al., [6], Deepak Chand Bhateshwar et al., [7], Bethala kumeera et al., [8].

**Number of pods per plant:** The mean performance of Number of Pods per plant in variety G2-315 ranged from $T_4$ Neem seed extract 1% (103.00) to $T_9$ $KNO_3$ 5% (134.33) with mean value of 117.70. Significantly taken highest pods per plant flowering (134.33) was reported in $T_9$ $KNO_3$ 5% and it was followed by $T_3$ tulsi leaf extract 5% (133.00), $T_7$ $KNO_3$ 1% (126.33) $T_8$ $KNO_3$ 3% (125.66) , $T_2$ tulsi leaf extract 3% (119.33) .Minimum Number of pods per plant was recorded by $T_{10}$ with control (97.66). Similar result was observed by Nelakurthi Venkata Praveen et al. [5] Deepak Chand Bhateshwar et al. [6] Sampathi Sowjanya et al. [6], G. Abdul Wajid et al. [7].

**Number of seeds per pod:** The mean performance of Number of Seeds per pod in variety G2-315 ranged from $T_4$ Neem seed extract 1% (1.100) to $T_9$ $KNO_3$ 5% (1.933) with mean value of 1.4637. Significantly taken highest Seeds per pod flowering (1.933) was reported in $T_9$ $KNO_3$ 5% and it was followed by by $T_8$ $KNO_3$ 3% (1.833) $T_7$ $KNO_3$ 1% (1.733) , $T_3$ tulsi leaf

extract 5% (1.567), $T_3$ tulsi leaf extract 3% (1.400) $T_1$ tulsi leaf extract 1% (1.303) .Minimum Number of Seeds per pod was recorded by $T_{10}$ with control (1.000). Similar result was observed by Nelakurthi Venkata Praveen et al., [5], Deepak Chand Bhateshwar et al. [7], G. Abdul Wajid et al. [6].

**Seed yield per plot (kg):** The mean performance of Seed yield per plot in variety G2-315 ranged from $T_4$ Neem seed extract 1% (500.00) to $T_9$ $KNO_3$ 5% (707.46) with mean value of 580.48. Significantly taken highest Seed yield per plot flowering (707.46) was reported in $T_9$ $KNO_3$ 5% and it was followed by by $T_8$ $KNO_3$ 3% (699.70) $T_7$ $KNO_3$ 1% (685.93) , $T_3$ tulsi leaf extract 5% (641.46), $T_3$ tulsi leaf extract 3% (531.16) $T_1$ tulsi leaf extract 1% (515.60) .Minimum Seed yield per plot (kg) was recorded by $T_{10}$ with control (493.70). Nelakurthi Venkata Praveen et al. [5], Deepak Chand Bhateshwar et al. [7], G. Abdul Wajid et al. [6].

**Effect of different priming methods Seed quality parameters:**

**100 seed weight (gms):** The mean performance of hundred seed weight in variety G2-315 ranged from $T_4$ Neem seed extract 1% (10.66) to $T_9$ $KNO_3$ 5% (17.13) with mean value of 13.51. Significantly taken highest hundred seed weight flowering (17.13) was reported in $T_9$ $KNO_3$ 5% and it was followed by $T_3$ tulsi leaf extract 5% (16.36), $T_8$ $KNO_3$ 3% (15.90) $T_7$ $KNO_3$ 1% (14.36) , $T_2$ tulsi leaf extract 3% (13.93), $T_1$ tulsi leaf extract 1% (13.16). Minimum hundred seed weight was recorded by $T_{10}$ with control (9.63). Similar result was observed by Nelakurthi Venkata Praveen et al. [5].

**Seed germination percentage (%):** The mean performance of Seed germination percentage in variety G2-315 ranged from $T_4$ Neem seed extract 1% (81.10) to $T_9$ $KNO_3$ 5% (94.80) with mean value of 88.44. Significantly taken highest Seed germination percentage flowering (94.80) was reported in $T_9$ $KNO_3$ 5% and it was followed by by $T_8$ $KNO_3$ 3% (93.20) $T_7$ $KNO_3$ 1% (92.93) , $T_3$ tulsi leaf extract 5% (92.73), $T_3$ tulsi leaf extract 3% (90.43) $T_1$ tulsi leaf extract 1% (88.30). Minimum Seed germination percentage (%) was recorded by $T_{10}$ with control (79.10). The present findings are in confirmation with the results of Kalyanrao Patil et al. [8], Nelakurthi Venkata Praveen et al. [5].

**Shoot length (cm):** The mean performance of Shoot length (cm) in variety 1 – G2-315 ranged from $T_4$ Neem seed extract 1% (11.73) to $T_9$ $KNO_3$ 5% (15.93) with mean value of 13.21. Significantly taken highest Shoot length (cm) flowering (15.93) was reported in $T_9$ $KNO_3$ 5% and it was followed by by $T_8$ $KNO_3$ 3% (15.10) $T_7$ $KNO_3$ 1% (14.60), $T_3$ tulsi leaf extract 5% (14.43), $T_3$ tulsi leaf extract 3% (13.06) $T_1$ tulsi leaf extract 1% (12.90) .Minimum Shoot length (cm) was recorded by $T_{10}$ with control (9.83). the finding are in Sampathi Sowjanya et al. [9], G. Abdul Wajid et al. [6].

**Root length (cm):** The mean performance of Root length (cm) in variety G2-315 ranged from $T_4$ Neem seed extract 1% (1.50) to $T_9$ $KNO_3$ 5% (2.13) with mean value of 1.68. Significantly taken highest Root length (cm) flowering (2.13) was reported in $T_9$ $KNO_3$ 5% and it was followed by by $T_8$ $KNO_3$ 3% (1.96) $T_7$ $KNO_3$ 1% (1.90), $T_3$ tulsi leaf extract 5% (1.70), $T_3$ tulsi leaf extract 3% (1.63) $T_1$ tulsi leaf extract 1% (1.56) [10]. Minimum Root length (cm) was recorded by $T_{10}$ with control (1.36) Similar result was observed by Kalyanrao Patil et al. [8], Nelakurthi Venkata Praveen et al. [5].

**Seedling length (cm):** The mean performance of seedling length (cm) in variety G2-315 ranged from $T_4$ Neem seed extract 1% (13.23) to $T_9$ $KNO_3$ 5% (18.06) with mean value of 14.89. Significantly taken highest seedling length (cm) flowering (18.06) was reported in $T_9$ $KNO_3$ 5% and it was followed by by $T_8$ $KNO_3$ 3% (17.06) $T_7$ $KNO_3$ 1% (16.50), $T_3$ tulsi leaf extract 5% (16.13), $T_3$ tulsi leaf extract 3% (14.70) $T_1$ tulsi leaf extract 1% (14.46) .Minimum seedling length (cm) was recorded by $T_{10}$ with control (11.20). the finding are in Sampathi Sowjanya et al. [9], G. Abdul Wajid et al. [6].

**Seedling Fresh weight (gms):** The mean performance of Seedling Fresh weight in variety G2-315 ranged from $T_4$ Neem seed extract 1% (6.20) to $T_9$ $KNO_3$ 5% (8.43) with mean value of 7.03. Significantly taken highest Seedling Fresh weight flowering (8.43) was reported in $T_9$ $KNO_3$ 5% and it was followed by $T_3$ tulsi leaf extract 5% (7.90), $T_8$ $KNO_3$ 3% (7.80) $T_7$ $KNO_3$ 1% (7.42) , $T_2$ tulsi leaf extract 3% (7.06), $T_1$ tulsi leaf extract 1% (6.64). Minimum Seedling Fresh weight was recorded by $T_{10}$ with control (5.90). Similar result was observed by Singh Kalyanrao Patil et.al. [8].

**Seedling Dry weight (gms):** The mean performance of Seedling Dry weight (gms) in varietyG2-315 ranged from $T_4$ Neem seed

extract 1% (1.44) to $T_9$ $KNO_3$ 5% (2.16) with mean value of 1.69. Significantly taken highest Seedling Dry weight (gms) flowering (2.16) was reported in $T_9$ $KNO_3$ 5% and it was followed by by $T_8$ $KNO_3$ 3% (1.98) $T_7$ $KNO_3$ 1% (1.93), $T_3$ tulsi leaf extract 5% (1.87), $T_3$ tulsi leaf extract 3% (1.69) $T_1$ tulsi leaf extract 1% (1.60) .Minimum Seedling Dry weight (gms**)** was recorded by $T_{10}$ with control (1.17). the finding are in G. Abdul Wajid et al. [6].

**Seedling vigour index I:** The mean performance of Seedling vigour index 1 in variety G2-315 ranged from $T_4$ Neem seed extract 1% (1.073.48) to $T_9$ $KNO_3$ 5% (1.712.74) with mean value of 1326.70. Significantly taken highest Seedling vigour index flowering (1.712.74) was reported in $T_9$ $KNO_3$ 5% and it was followed by by $T_8$ $KNO_3$ 3% (1.590.70) $T_7$ $KNO_3$ 1% (1.533.60), $T_3$ tulsi leaf extract 5% (1.496.70), $T_3$ tulsi leaf extract 3% (1.329.21) $T_1$ tulsi leaf extract 1% (1.277.19) .Minimum Seedling vigour index was recorded by $T_{10}$ with control (885.95) Similar results was finding by Kalyanrao Patil et al. [8], Nelakurthi Venkata Praveen et al. [5].

**Seedling vigour index II:** The mean performance of Seedling vigour index 2 in variety G2-315 ranged from $T_4$ Neem seed extract 1% (117.27) to $T_9$ $KNO_3$ 5% (204.71) with mean value of 150.95. Significantly taken highest Seedling vigour index flowering (204.71) was reported in $T_9$ $KNO_3$ 5% and it was followed by by $T_8$ $KNO_3$ 3% (185.17) $T_7$ $KNO_3$ 1% (179.66), $T_3$ tulsi leaf extract 5% (173.80), $T_3$ tulsi leaf extract 3% (153.12) $T_1$ tulsi leaf extract 1% (141.27) .Minimum Seedling vigour index was recorded by $T_{10}$ with control (93.16) Similar results was observed finding Kalyanrao Patil et al. [8], Nelakurthi Venkata Praveen et al. [5].

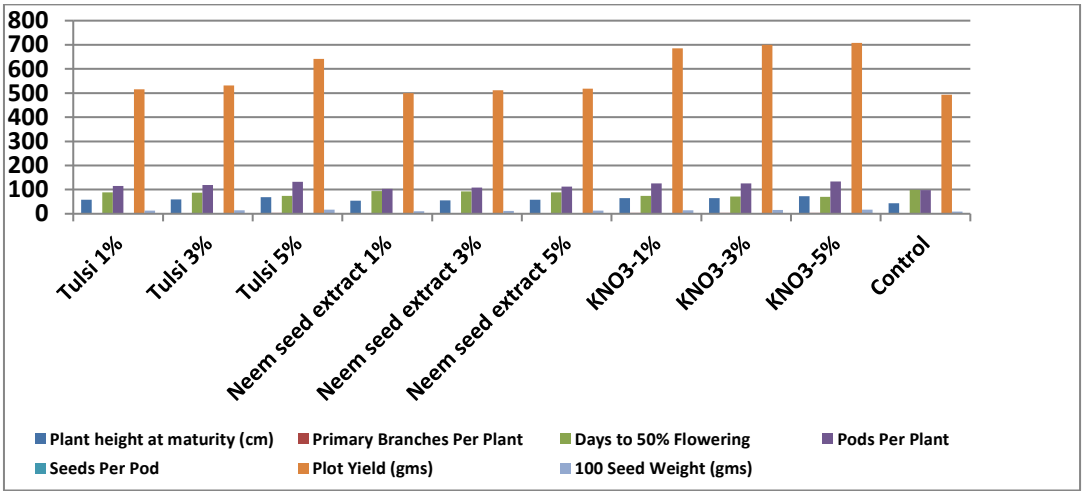


**Fig. 1. Mean performance of variety $G_2$315 field condition**

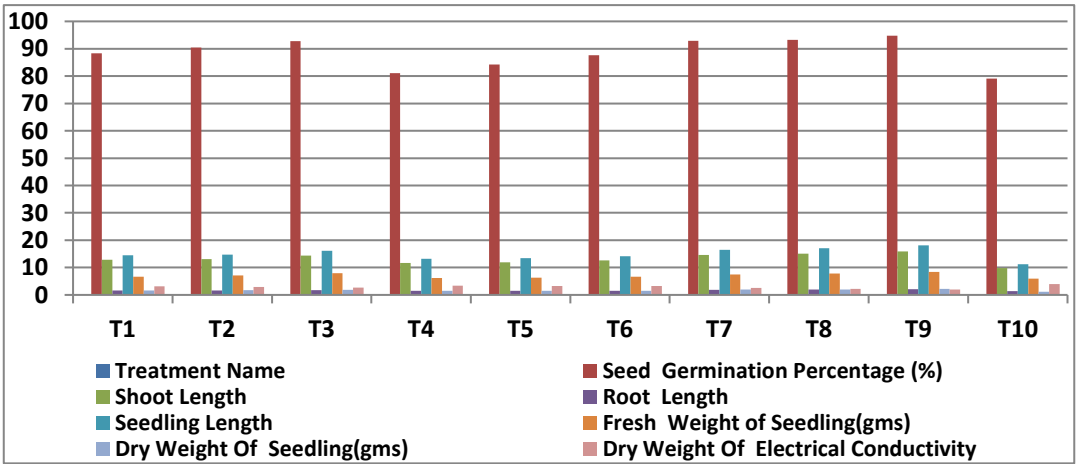


**Fig. 2. Mean performance of variety $G_2$315 lab condition**

**Table 2. Mean performance of chickpea for 7 quantitative chickpea Variety G2-315field**

| | Treatment Name | Plant height at maturity (cm) | Primary Branches Per Plant | Days to 50% Flowering | Pods Per Plant | Seeds Per Pod | Plot Yield (gms) | 100 Seed Weight (gms) |
|---|---|---|---|---|---|---|---|---|
| **T1** | Tulsi 1% | 58.133 | 2.767 | 88.667 | 115.667 | 1.303 | 515.600 | 13.167 |
| **T2** | Tulsi 3% | 59.633 | 3.000 | 87.333 | 119.333 | 1.400 | 531.167 | 13.933 |
| **T3** | Tulsi 5% | 68.500 | 3.133 | 74.333 | 133.000 | 1.567 | 641.467 | 16.367 |
| **T4** | Neem seed extract 1% | 54.000 | 2.033 | 94.000 | 103.000 | 1.100 | 500.000 | 10.667 |
| **T5** | Neem seed extract 3% | 56.000 | 2.367 | 92.000 | 109.000 | 1.233 | 511.933 | 11.467 |
| **T6** | Neem seed extract 5% | 57.467 | 2.367 | 89.000 | 113.000 | 1.533 | 517.867 | 12.467 |
| **T7** | KNO3-1% | 64.400 | 3.333 | 74.333 | 126.333 | 1.733 | 685.933 | 14.367 |
| **T8** | KNO3-3% | 64.567 | 3.500 | 72.000 | 125.667 | 1.833 | 699.700 | 15.900 |
| **T9** | KNO3-5% | 72.067 | 3.667 | 69.667 | 134.333 | 1.933 | 707.467 | 17.133 |
| **T10** | Control | 43.300 | 1.667 | 99.000 | 97.667 | 1.000 | 493.700 | 9.633 |
| **C.D.** | | 3.577 | 0.661 | 4.795 | 8.232 | 0.207 | 12.493 | 0.569 |
| **SE(m)** | | 1.195 | 0.221 | 1.601 | 2.749 | 0.069 | 4.172 | 0.190 |
| **SE(d)** | | 1.689 | 0.312 | 2.265 | 3.888 | 0.098 | 5.901 | 0.269 |
| **C.V.** | | 3.460 | 13.735 | 3.301 | 4.046 | 8.165 | 1.245 | 2.438 |

**Table 3. Mean performance of chickpea for 9 quantitative chickpea lab condition variety G2-315**

| | Treatment Name | Seed Germination Percentage (%) | Shoot Length | Root Length | Seedling Length | Fresh Weight of Seedling(gms) | Dry Weight of Seedling(gms) | Vigour Index 1 | Vigour Index 2 | Electrical Conductivity |
|---|---|---|---|---|---|---|---|---|---|---|
| **T1** | Tulsi 1% | 88.300 | 12.900 | 1.567 | 14.467 | 6.643 | 1.600 | 1,277.193 | 141.274 | 3.200 |
| **T2** | Tulsi 3% | 90.433 | 13.067 | 1.633 | 14.700 | 7.067 | 1.693 | 1,329.210 | 153.121 | 2.933 |
| **T3** | Tulsi 5% | 92.733 | 14.433 | 1.700 | 16.133 | 7.900 | 1.873 | 1,496.707 | 173.803 | 2.700 |
| **T4** | Neem seed extract 1% | 81.100 | 11.733 | 1.500 | 13.233 | 6.207 | 1.447 | 1,073.480 | 117.277 | 3.400 |
| **T5** | Neem seed extract 3% | 84.200 | 11.900 | 1.500 | 13.400 | 6.313 | 1.493 | 1,128.617 | 125.773 | 3.233 |
| **T6** | Neem seed extract 5% | 87.633 | 12.600 | 1.533 | 14.133 | 6.657 | 1.547 | 1,238.843 | 135.603 | 3.233 |
| **T7** | KNO3-1% | 92.933 | 14.600 | 1.900 | 16.500 | 7.423 | 1.933 | 1,533.600 | 179.660 | 2.567 |
| **T8** | KNO3-3% | 93.200 | 15.100 | 1.967 | 17.067 | 7.807 | 1.987 | 1,590.707 | 185.172 | 2.233 |
| **T9** | KNO3-5% | 94.800 | 15.933 | 2.133 | 18.067 | 8.437 | 2.160 | 1,712.747 | 204.714 | 1.933 |
| **T10** | Control | 79.100 | 9.833 | 1.367 | 11.200 | 5.900 | 1.177 | 885.950 | 93.167 | 3.933 |
| **C.D.** | | 2.078 | 0.790 | 0.150 | 0.761 | 0.323 | 0.157 | 83.803 | 15.204 | 0.333 |
| **SE(m)** | | 0.694 | 0.264 | 0.050 | 0.254 | 0.108 | 0.053 | 27.989 | 5.078 | 0.111 |
| **SE(d)** | | 0.981 | 0.373 | 0.071 | 0.359 | 0.153 | 0.074 | 39.582 | 7.181 | 0.157 |
| **C.V.** | | 1.359 | 3.460 | 5.174 | 2.955 | 2.658 | 5.379 | 3.654 | 5.826 | 6.550 |

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**Electrical conductivity (ds/m):** The mean performance of Electrical conductvity in variety G2-315 ranged from $T_9$ $KNO_3$ 5% (1.933) to $T_4$ Neem seed extract 1% (3.400) with mean value of 2.9367. Significantly taken highest Electrical conductvity flowering (3.933) was reported in $T_{10}$ control and it was followed by by $T_4$ Neem seed extract 1% (3.400) $T_5$ Neem seed extract 5% (3.233) $T_1$ tulsi leaf extract 1% (3.200) $T_2$ tulsi leaf extract 3% (2.933), $T_3$ tulsi leaf extract 5% (2.700). Minimum Electrical conductvity was recorded by) $T_9$ $KNO_3$ 5% (1.933) .Similar result was observed by Kalyanrao Patil et al. [5], Nelakurthi Venkata Praveen et al. [5].

## 4. CONCLUSION

It is concluded that chickpea seeds have dramatically improved vigor and germinability across all field measures. KNO35% dramatically raised the chickpea seedling characteristics and germination percentage. KNO 3 had the greatest increase in germination as well as the greatest rise in germinability and vigor. Chickpea seeds should be primed for 12 hours, as this will maximize germination, vigor, and seedling characteristics. Since these conclusions are based on the findings of a six-month examination, more research is required in order to develop suggestions that are reliable.

## DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc) and text-to-image generators have been used during writing or editing of this manuscript.

## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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