Original Research Article

Effect of seed priming on seed quality attributes in chickpea (*Cicer arietinum* L.)

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 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*

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 (Khan *et al*., 2006).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),vitalvitaminslikevitaminA, vitaminB1,B2andB3,vitaminc, vitamin E vitamin KFolateandPantothemicacid"(ZoharyandHopf,2000). 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" [9,10].

"Seed priming is a simple technique that can enhance seedling vigor and establishment, which in turn improves crop performance in the field" (Khan et al., 2005). 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" (Khan et al., 2005) .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.

MaterialsandMethods:

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 26.22^0N, 78.18^0E 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.

Thetreatmentsusedatdifferentconcentrationsviz.,
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}-UnprimedControl

Aftercleaningandgrading,theseedsweresoakedinrespectiveprimingsolutionsatdifferent volume of seeds for twelve hours.Then the seeds were air dried under the shadetobringbacktotheiroriginalmoisturecontentand 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,SeedlingVigour Index II , Electrical conductivity (ds/m)

ResultsandDiscussion:

A fieldexperimentwasconducted tostudyEffect of priming on the growth, yield, fieldattributing traits and seedling parameters onDesiChickpea(*CicerarietinumL*.)areasfollows.Theexperimentwascarriedoutduring *Rabi* season 2021-2022, Department ofGeneticsandPlantBreeding,School ofAgriculture,ITM University, Gwalior. Theresultsaregivenanddiscussedunderfollowingheadings.
Analysisofvariance
Meanperformance

Analysisof 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.

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**

2. Mean performance:

Effectofdifferentprimingmethodsonfieldemergencepercent:

1 Days to 50% flowering:
The data regarding Days to 50% Flowering as influenced by different seed priming treatments was shown in the Table –.2
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_1tulsi 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*., (2020) G. Abdul Wajid *et al.,* (2021) Deepak Chand Bhateshwar*et al*., (2020)

2 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_3tulsi leaf extract 3% (68.50) T_8 KNO_3 3% (64.56) , T_2tulsi leaf extract 3% (59.63), T_1tulsi 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.,* (2018) Nelakurthi Venkata Praveen *et al.,* (2020) Deepak Chand Bhateshwar*et al.,* (2020) G. Abdul Wajid *et al*., (2021)

3 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_3tulsi leaf extract 5% (3.13), T_1tulsi 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*., (2020) G. Abdul Wajid*et al*., (2021) Deepak Chand Bhateshwar*et al*., (2020) Bethalakumeera*et al.,* (2018)

4. 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_3tulsi leaf extract 5% (133.00), T_7 KNO_3 1% (126.33) T_8 KNO_3 3% (125.66) , T_2tulsi 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*., (2020) Deepak Chand Bhateshwar*et al.,* (2020) SampathiSowjanya*et al*., (2020) G. Abdul Wajid *et al*., (2021)

5. 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 byT_8 KNO_3 3% (1.833) T_7 KNO_3 1% (1.733) , T_3tulsi leaf extract 5% (1.567), T_3tulsi leaf extract 3% (1.400) T_1tulsi 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*., (2020) Deepak Chand Bhateshwar*et al*., (2020) G. Abdul Wajid *et al.,* (2021)

6. Seed yield per plot (kg):
The mean performance ofSeed yield per plotin 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 byT_8 KNO_3 3% (699.70) T_7 KNO_3 1% (685.93) , T_3tulsi leaf extract 5% (641.46), T_3tulsi leaf extract 3% (531.16) T_1tulsi 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*., (2020) Deepak Chand Bhateshwar*et al.,* (2020) G. Abdul Wajid *et al.,* (2021)

Effect of different priming methodsSeed quality parameters:
7.100 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_3tulsi leaf extract 5% (16.36), T_8 KNO_3 3% (15.90) T_7 KNO_3 1% (14.36) , T_2tulsi leaf extract 3% (13.93), T_1tulsi 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*., (2020)

8. Seed germination percentage (%):
The mean performance ofSeed germination percentagein 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 byT_8 KNO_3 3% (93.20) T_7 KNO_3 1% (92.93) , T_3tulsi leaf extract 5% (92.73), T_3tulsi leaf extract 3% (90.43) T_1tulsi 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.,* (2018) NelakurthiVenkata Praveen *et al*., (2020)

9. Shoot length (cm):

The mean performance ofShoot 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 byT_8 KNO_3 3% (15.10) T_7 KNO_3 1% (14.60) , T_3tulsi leaf extract 5% (14.43), T_3tulsi leaf extract 3% (13.06) T_1tulsi leaf extract 1% (12.90) .Minimum Shoot length (cm) was recorded by T_{10} with control (9.83)**.** the finding are in SampathiSowjanya*et al*., (2020) G. Abdul Wajid *et al*., (2021)

10. Root length (cm):

The mean performance ofRoot 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 byT_8 KNO_3 3% (1.96) T_7 KNO_3 1% (1.90), T_3tulsi leaf extract 5% (1.70), T_3tulsi leaf extract 3% (1.63) T_1tulsi leaf extract 1% (1.56) .Minimum Root length (cm) was recorded by T_{10} with control (1.36)Similar result was observed by Kalyanrao Patil *et al*., (2018) Nelakurthi Venkata Praveen *et al*., (2020)

11. Seedling length (cm):

The mean performance ofseedling 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 byT_8 KNO_3 3% (17.06) T_7 KNO_3 1% (16.50), T_3tulsi leaf extract 5% (16.13), T_3tulsi leaf extract 3% (14.70) T_1tulsi leaf extract 1% (14.46) .Minimum seedling length (cm) was recorded by T_{10} with control (11.20). the finding are in SampathiSowjanya*et al*., (2020) G. Abdul Wajid*et al.,* (2021)

12. 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_3tulsi leaf extract 5% (7.90), T_8 KNO_3 3% (7.80) T_7 KNO_3 1% (7.42) , T_2tulsi leaf extract 3% (7.06), T_1tulsi 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. (2018)

13. Seedling Dry weight (gms):

The mean performance ofSeedling 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 byT_8 KNO_3 3% (1.98) T_7 KNO_3 1% (1.93), T_3tulsi leaf extract 5% (1.87), T_3tulsi leaf extract 3% (1.69) T_1tulsi 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*., (2021)

14. Seedling vigour index I:

The mean performance ofSeedling vigour index 1in 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 byT_8 KNO_3 3% (1.590.70) T_7 KNO_3 1% (1.533.60), T_3tulsi leaf extract 5% (1.496.70), T_3tulsi leaf extract 3% (1.329.21) T_1tulsi 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*., (2018) Nelakurthi Venkata Praveen *et al*., (2020)

15. Seedling vigour index II:

The mean performance ofSeedling vigour index 2in 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 byT_8 KNO_3 3% (185.17) T_7 KNO_3 1% (179.66), T_3tulsi leaf extract 5% (173.80), T_3tulsi leaf extract 3% (153.12) T_1tulsi leaf extract 1% (141.27) .Minimum Seedling vigour index was recorded by T_{10} with control (93.16) Similar results was observed findingKalyanrao Patil *et al*., (2018) Nelakurthi Venkata Praveen *et al*., (2020)

16. Electrical conductivity (ds/m):

The mean performance of Electrical conductvityin 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_1tulsi leaf extract 1% (3.200) T_2tulsi leaf extract 3% (2.933), T_3tulsi 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*., (2018) Nelakurthi Venkata Praveen *et al*., (2020)

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 Percenta**	**Shoot Length**	**Root Length**	**Seedling Length**	**Fresh Weight of Seedlin**	**Dry Weight Of Seedlin**	**Vigour Index 1**	**Vigour Index 2**	**Electrical Conductivity**

		ge (%)				g(gms)	g(gms)			
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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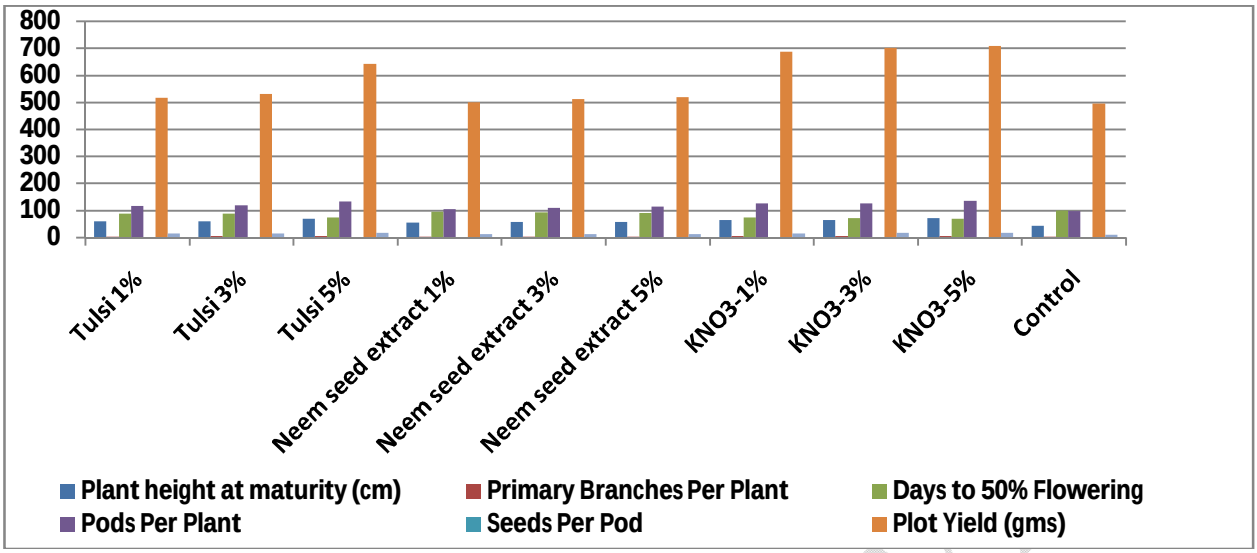

Fig 1 Mean performance of variety $G_2$315 field condition

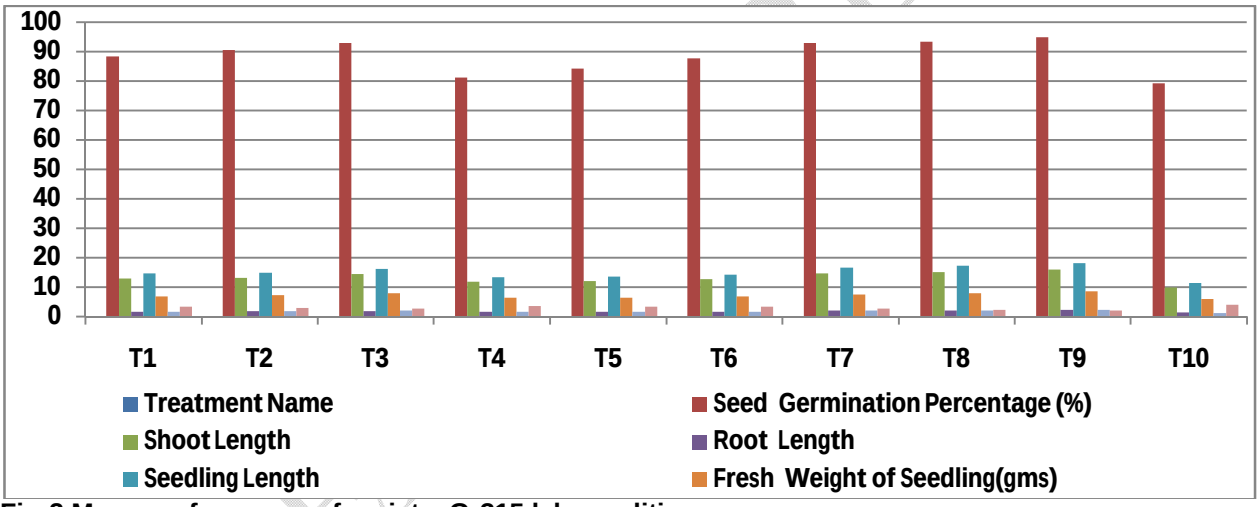

Fig:2 Mean performance of variety $G_2$315 lab condition

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)

Option 1:

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 manuscripts.

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Details of the AI usage are given below:

1.

2.

3.

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