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Effect of seed priming treatment in chickpea (*Cicer arietinum* L.)

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Abstract
The Experiment was conducted at Department of Seed Science and Technology, B. A. College of Agriculture, Anand Agricultural University, Anand. Effect of priming on seed quality enhancement was studied with two chickpea varieties, GG-1 and GJG-3 for two consecutive years by giving different priming treatments *viz*., KNO_3, PEG, Bavistin and Neem oil with different concentrations along with control. The result showed significantly higher seed quality parameters when seeds were treated with KNO_3 @ 100 ppm for the year 2016-17, 2017-18 and pooled basis.

Keywords: chickpea- priming- seed enhancement-seed vigour

Introduction
Chickpea (*Cicer arietinum* (L.)) 2n=16, belongs to family *leguminaceae*. It is also known as Bengal gram. It is a cool season legume crop and is grown in several countries worldwide as a food source. Seed is the main edible part of the plant and is a rich source of protein (23.3-28.9%), carbohydrates (61.5%), fats (4.5%) and minerals (phosphorus, calcium, magnesium, iron, zinc). Seed priming is a physiological strategy that involves soaking of seeds in a solution of a specific priming agent followed by drying of seeds that initiates germination related process. This has been recognized as an important technology to obtain good germination, rapid development and improved yields in some field crops. The effectiveness of the priming with simple salt solution, perhaps, depends both on the osmotic potential and the chemical nature of the salt species used. It is reported that nitrate containing compounds may function more efficiently than other salts as priming agents. It has been found many salts can be used very effectively for priming. In the present experiment therefore an attempt has been mad to study effects of seed priming with $KNO_3$100 ppm, $KNO_3$200 ppm, PEG (6000) -1.2 M.pa, Bavistin (2g/kg) and neem oil (3 %) on the response of two Chick pea varieties viz. GG-1 andGJG-3, an experiment was designed keeping hydro primed seeds as controls.
According to Farooq *et al*., (2008) [8] pre-sowing seed treatments can improved the seedling emergence, root and shoot length, seedling fresh, dry weights and root score considerably compared with control both at optimal and chilling temperatures. One of the efficient practices which can improve seedling vigour and establishment and consequently crop performance in the field is seed priming (McDonald, 2000). The different methods of seed priming such as hydro priming and halo priming can be applied as pre-sowing treatments under various conditions. Although priming improves germination and seedling early growth predominantly under undesirable conditions (Beckers and Conrath, 2007, Jisha *et al*., 2013) [3, 16], the efficiency of different priming agents varies under different stresses and in different crop species (Ashraf and Foolad, 2005) [2].

Material Method
The present experiment was carried out in the Department of seed Science and Technology, B.A. College of Agriculture, Anand Agricultural University, Anand, Gujarat. Chickpea was selected for the present experiment. It is widely cultivated in Gujarat. The varieties taken namely were GG-1 and GJG-3. Both of these varieties belong to the desi type with coloured and thick seed coat. The experiment was conducted in laboratory. One way of improving productivity of chickpea in drought prone area is seed priming.

The seed priming process simply involves soaking the seed overnight (for about 8 hrs), surface drying them and put it on germination test in germination chamber to hasten germination and promotes seedling vigour (Harris *et al*., 1999) [12]. It includes soaking seed in water. The present study was initiated with the objectives to determine the effectiveness of seed priming treatment and variety on seed quality.The osmo-priming, halopriming has positive effect on the seed germination and their consequences. They help to release in enzymes and accelerate seed metabolism and physiological activities (Jie *et al*., 2002) [15].

Laboratory
The experiment was laid out into two factorial arrangement (two chickpea varieties and Six priming treatments: $KNO_3$100 ppm, KNO_3 200 ppm, PEG (6000) -1.2 M.pa, Bavistin (2g/kg), neem oil (3 %) and control in complete randomized design (CRD) with three replications.

Standard Germination Test (%)
In the laboratory 400 chickpea seeds in four replications for every treatment were tested for standard germination by keeping the seeds in between paper method at a temperature of 25ºC. The final count was made on the 8th days. At the end of the test, the seedlings were evaluated and clustered into normal, abnormal, and dead seed. The normal seedlings including hard seeds were considered as standard germination and their respective percentages were calculated for all the four replications (ISTA, 2004).

Germination % = Number of normal seedlings x100/ Number of seeds sown

Seedling shoot and root length
The seedlings shoot and root lengths were measured after the final count in standard germination test. Ten normal seedlings were selected randomly from each replicate. The shoot length was measured from point of the attachment of the cotyledon to the tip of the seedling. Similarly, the root length was measured from the point of attachment to the tip of the root. Average shoot or root length (cm) was computed by dividing the total shoot or root length by total number of normal seedlings measured (Fiala, 1987) [9].

Seedling fresh Weight
Seedling fresh weight was measured in grams after final count in the standard germination test. Ten randomly selected seedlings from each replicate were cut free from their cotyledons and placed in envelopes on analytical balance for taking a weight. The fresh seedlings were weighed to the nearest grams and the average fresh weight was calculated. Fresh Weight (gm) was computed by dividing the total fresh Weight (gm) by total number of normal seedlings measured (Fiala, 1987) [9].

Seedling Dry Weight
Seedling dry weight was measured in grams after final count in the standard germination test. Ten randomly selected seedlings from each replicate were cut free from their cotyledons and placed in envelopes and dried in an oven at 80±1oC for 24 hours. The dried seedlings were weighed to the nearest grams and the average dry weight was calculated. Average Seedling dry Weight (gm) was computed by dividing the total Seedling dry Weight (gm) by total number of normal seedlings measured (Fiala, 1987) [9].

Seedling Vigor Index I: This was calculated by multiplying the standard germination with the average sum of shoot length (cm) and root length (cm) on the 8th day of germination (Islam *et al*., 2009).

SVI- I: Germination (%) × Seedling length (cm)
Seedling vigor index II: It was calculated by multiplying the standard germination with mean seedling dry weight (Fiala, 1987) [9].
SVI- II: Germination (%) × Seedling dry weight (gm)

Results and Discussion
Effect of priming treatment on seed quality enhancement was studied with two chickpea varieties, GG-1 and GJG-3 for two consecutive years by giving different priming treatments *viz*., priming with KNO_3, PEG, Bavistin and Neem oil with different concentrations along with control. The critical difference (CD) and standard error (SE) were worked out for each case. The results as represented in table 1 to 8 have been described in the following manner:

Table 1: Effect of different seed priming treatments on germination (%), during 2016-17, 2017-18 and pooled of chickpea seed.

Treatments	Germination (%)								
	2016-17			2017-18			Pooled		
	Varieties			Varieties			Varieties		
	GG-1	GJG-3	Mean	GG-1	GJG-3	Mean	GG-1	GJG-3	Mean
T_1: KNO_3 100 ppm	94.66	92.66	93.66	95.00	92.67	93.83	94.83	92.66	93.75
T_2: KNO_3 200 ppm	91.33	87.33	89.33	92.67	90.00	91.33	92.00	88.67	90.33
T_3: -PEG (6000) -1.2 Mpa	88.00	82.66	85.33	91.33	85.33	88.33	89.67	84.00	86.83
T_4:Bavistin (2g/kg)	81.33	70.66	76.00	87.00	82.00	84.50	84.16	76.33	80.25
T_5: Neem oil (3 %)	84.66	78.66	81.66	89.33	84.67	87.00	87.00	81.66	84.33
T_6: Control	72.66	72.00	72.66	79.33	79.33	79.33	76.00	75.66	75.83
Mean	85.44	80.66	83.05	89.11	85.67	87.38	87.27	83.16	85.22
S.Em ± V	0.34			0.38			0.25		
C.D. @ 5% V	1.00			1.10			0.72		
S.Em ± T	0.59			0.65			1.58		
C.D. @ 5% T	1.73			1.90			5.75		
S.Em ± V X T	0.83			0.90			0.61		
C.D. @ 5% V X T	2.44			2.70			1.76		
CV %	1.75			1.80			1.78		

The variety GG-1 recorded significantly highest germination percentage of 85.44 % and 89.11 % during 2016-17 and 2017-18. Among the priming treatments, seeds primed with KNO_3 @ 100 ppm recorded highest germination percentage 94.66 %

and 95.00 % during 2016-17 and 2017-18 respectively. On the basis of pooled year data GG-1 Variety seeds primed with KNO_3 @ 100 ppm was showed higher germination percentage (94.83 %). Guzman and Olave reported that seed priming with nitrate solutions led to improved germination rate. Mohammadi & Amiri (2010) [21] proved positive effect of KNO_3 on germination and vigour of the rapeseed seed. Similarly, Arin *et al*. (2011) [1] determined improvement of onion seed germination.Sorghum seeds soaked in $CaCl_2$ or KNO_3 solution increased the activity of total amylase and proteases in germinating seeds under salt stress (Kadiri and Hussaini, 1999) [18]. In pigeon pea seed treatment with $CaCl_2$ or KNO_3 generally exhibited improvement in proteins, free amino acid and soluble sugars during germinating under salt stress (Jyotsna and Srivastava, 1998) [17].

Table 2: Effect of different seed priming treatments on Root length (cm), during 2016-17, 2017-18 and pooled of chickpea seed.

Treatments	Root length (cm)								
	2016-17			2017-18			Pooled		
	Varieties			Varieties			Varieties		
	GG-1	GJG-3	Mean	GG-1	GJG-3	Mean	GG-1	GJG-3	Mean
T_1: KNO_3 100 ppm	12.54	20.90	16.72	17.33	20.07	18.70	14.94	20.48	17.71
T_2: KNO_3 200 ppm	12.18	20.41	16.29	15.70	17.70	16.72	13.94	19.07	16.50
T_3: -PEG (6000) -1.2 Mpa	11.71	19.63	15.67	13.90	15.60	14.75	12.81	17.61	15.21
T_4: Bavistin (2g/kg)	11.04	18.63	14.83	11.90	13.21	12.56	11.47	15.92	13.70
T_5: Neem oil (3%)	11.27	19.03	15.15	13.00	14.23	13.62	12.13	16.63	14.38
T_6: Control	10.66	17.84	14.25	11.47	11.71	11.59	11.06	14.77	12.92
Mean	11.56	19.40	15.49	13.88	15.43	14.65	12.72	17.41	15.07
S.Em ± V	0.02			0.15			0.22		
C.D. @ 5% V	0.07			0.44			NS		
S.Em ± T	0.04			0.26			0.87		
C.D. @ 5% T	0.12			0.76			NS		
S.Em ± V X T	0.05			0.37			0.18		
C.D. @ 5% V X T	0.17			NS			0.53		
CV %	0.66			4.41			3.07		

The result revealed that GJG-3 recorded significantly highest root length of 19.40 and 15.53 cm during 2016-17 and 2017-18. Among the priming treatments, seeds primed with KNO_3 @ 100 ppm recorded highest root length of 20.90 and 20.07 cm during 2016-17 and 2017-18 respectively. On the basis of pooled year data GJG-3 Variety seeds primed with KNO_3 @ 100 ppm was showed higher root length (20.48 cm). Demir and Oztokat (2003) [6] also found that root and shoot lengths increased in seeds due to salt priming as compared to non-primed seeds. It has been observed that different types of seed priming improved seed germination rate and seedling emergence in a number of studies (Srivastava *et al*., 2010; Chen and Arora 2011) [5]. The fastest seedling emergence was recorded in KNO_3 primed seeds followed by hydro priming. The result corroborate the findings of Chang-Zheng *et al*. (2002) [4] who reported that rice seed treated with mixed salt solution germinated significantly more rapidly than unprimed seed.

Table 3: Effect of different seed priming treatments on Shoot length (cm), during 2016-17, 2017-18 and pooled of chickpea seed

Treatments	Shoot length (cm)								
	2016-17			2017-18			Pooled		
	Varieties			Varieties			Varieties		
	GG-1	GJG-3	Mean	GG-1	GJG-3	Mean	GG-1	GJG-3	Mean
T_1: KNO_3 100 ppm	7.10	9.63	8.37	8.23	9.40	8.82	7.67	9.51	8.59
T_2: KNO_3 200 ppm	7.10	9.35	8.22	7.20	8.47	7.83	7.15	8.91	8.03
T_3: -PEG (6000) -1.2 Mpa	6.89	9.06	7.97	7.36	8.34	7.85	7.12	8.70	7.91
T_4: Bavistin (2g/kg)	6.66	8.28	7.47	6.52	7.75	7.13	6.59	8.01	7.30
T_5: Neem oil (3%)	6.81	8.65	7.73	7.13	8.22	7.67	6.97	8.44	7.70
T_6: Control	6.20	8.04	7.12	7.00	7.25	7.13	6.60	7.65	7.12
Mean	6.79	8.83	7.81	7.24	8.24	7.73	7.01	8.53	7.77
S.Em ± V	0.02			0.06			0.37		
C.D. @ 5% V	0.06			0.18			NS		
S.Em ± T	0.04			0.10			0.15		
C.D. @ 5% T	0.11			0.31			0.54		
S.Em ± V X T	0.05			0.15			0.15		
C.D.@ 5% V X T	0.16			0.44			NS		
CV %	1.25			3.42			2.57		

The result found that variety GJG-3 recorded significantly highest Shoot length 8.83 and 8.24 cm during 2016-17 and 2017-18. Among the priming treatments, seeds primed with KNO_3 @ 100 ppm recorded highest Shoot length of 9.63 and 9.40 cm during 2016-17 and 2017-18 respectively. On the basis of pooled year data GJG-3 Variety seeds primed with KNO_3 @ 100 ppm was showed higher Shoot length (9.51 cm).

Table 4: Effect of different seed priming treatments on Seedling length (cm), during2016-17, and 2017-18 and pooled of chickpea seed.

Treatments	Seedling length (cm)								
	2016-17			2017-18			Pooled		
	Varieties			Varieties			Varieties		
	GG-1	GJG-3	Mean	GG-1	GJG-3	Mean	GG-1	GJG-3	Mean
T_1: KNO_3 100 ppm	19.65	30.53	25.09	25.57	29.47	27.51	22.61	30.00	26.30
T_2: KNO_3 200 ppm	19.28	29.77	24.52	22.90	26.20	24.55	21.09	27.98	24.53
T_3: -PEG (6000) -1.2 Mpa	18.60	28.69	23.64	21.26	23.94	22.60	19.93	26.31	23.12
T_4: Bavistin (2g/kg)	17.71	26.91	22.31	18.42	20.96	19.69	18.07	23.94	21.00
T_5: Neem oil (3%)	18.03	27.68	22.88	20.13	22.45	21.29	16.10	25.07	22.09
T_6: Control	16.86	25.89	21.37	18.47	18.96	18.71	17.66	22.42	20.04
Mean	18.36	28.24	23.30	21.12	23.66	22.39	19.74	25.95	22.84
S.Em ± V	0.03			0.15			2.59		
C.D. @ 5% V	0.10			0.43			NS		
S.Em ± T	0.06			0.25			0.96		
C.D. @ 5% T	0.17			0.75			3.49		
S.Em ± V X T	0.08			0.36			0.18		
C.D. @5% V X T	0.02			1.05			0.54		
CV %	0.65			2.84			2.03		

The result found that variety GJG-3 recorded significantly highest Seedling length 28.24 and 23.66 cm during 2016-17 and 2017-18. Among the priming treatments, seeds primed with KNO_3 @ 100 ppm recorded highest Seedling length of 30.53 and 29.47 cm during 2016-17 and 2017-18 respectively. On the basis of pooled year data GJG-3 Variety seeds primed with KNO_3 @ 100 ppm was showed higher Seedling length (30.00 cm).

Table 5: Effect of different seed priming treatments on seedling fresh weigh (gm) during 2016-17, 2017-18 and pooled of chickpea seed

Treatments	Seedling fresh weight (gm)								
	2016-17			2017-18			Pooled		
	Varieties			Varieties			Varieties		
	GG-1	GJG-3	Mean	GG-1	GJG-3	Mean	GG-1	GJG-3	Mean
T_1: KNO_3 100 ppm	4.75	5.66	5.21	5.09	5.37	5.23	4.92	5.52	5.22
T_2: KNO_3 200 ppm	4.66	5.50	5.08	4.88	5.16	5.02	4.77	5.33	5.05
T_3: -PEG (6000) -1.2 Mpa	4.17	5.31	4.74	4.62	5.06	4.84	4.39	5.19	4.79
T_4:Bavistin (2g/kg)	3.55	4.64	4.10	4.14	4.66	4.40	3.85	4.65	4.25
T_5: Neem oil (3%)	3.78	5.04	4.41	4.58	4.88	4.73	4.43	4.96	4.57
T_6: Control	3.04	4.05	3.54	4.13	4.43	4.28	3.58	4.24	3.91
Mean	3.99	5.03	4.51	4.57	4.93	4.75	4.28	4.98	4.63
S.Em ± V	0.01			0.01			0.24		
C.D. @ 5% V	0.05			0.05			NS		
S.Em ± T	0.03			0.03			0.14		
C.D. @ 5% T	0.09			0.08			0.52		
S.Em ± V X T	0.04			0.04			0.05		
C.D. @ 5% V X T	0.13			0.13			NS		
CV %	1.73			1.58			1.65		

The result revealed that variety GJG-3 recorded significantly highest Seedling fresh weight 5.03 and 4.93 g during 2016-17 and 2017-18. Among the priming treatments, seeds primed with KNO_3 @ 100 ppm recorded highest Seedling fresh weight of 5.66 and 5.37g during 2016-17 and 2017-18 respectively. On the basis of pooled year data GJG-3 Variety seeds primed with KNO_3 @ 100 ppm was showed higher Seedling fresh weight (5.52 g).

Table 6: Effect of different seed priming treatments on seedling dry weight (g) during 2016-17, 2017-18 and pooled of chickpea seed.

Treatments	Seedling dry weight (g)								
	2016-17			2017-18			Pooled		
	Varieties			Varieties			Varieties		
	GG-1	GJG-3	Mean	GG-1	GJG-3	Mean	GG-1	GJG-3	Mean
T_1: KNO_3 100 ppm	0.87	1.11	0.99	0.84	0.95	0.90	0.85	1.03	0.94
T_2: KNO_3 200 ppm	0.83	0.98	0.91	0.81	0.91	0.86	0.82	0.94	0.88
T_3: -PEG (6000) -1.2 Mpa	0.77	0.94	0.85	0.76	0.85	0.81	0.76	0.89	0.83
T_4:Bavistin (2g/kg)	0.73	0.82	0.78	0.73	0.78	0.75	0.73	0.80	0.76
T_5: Neem oil (3%)	0.71	0.88	0.80	0.75	0.81	0.78	0.73	0.85	0.79
T_6: Control	0.68	0.77	0.72	0.71	0.74	0.73	0.70	0.75	0.72
Mean	0.76	0.92	0.84	0.77	0.84	0.80	0.76	0.88	0.82
S.Em ± V	0.002			0.005			0.028		
C.D. @ 5% V	0.007			0.01			NS		
S.Em ± T	0.004			0.009			0.017		
C.D. @ 5% T	0.012			0.02			0.61		
S.Em ± V X T	0.006			0.01			0.014		
C.D. @ 5% V X T	0.01			0.03			0.051		
CV %	1.23			2.55			1.97		

The result showed that variety GJG-3 recorded significantly highest Seedling dry weight 0.92 and 0.84 g during 2016-17 and 2017-18. Among the priming treatments, seeds primed with KNO3 @ 100 ppm recorded highest Seedling dry weight of 1.11 and 0.95 g during 2016-17 and 2017-18 respectively. On the basis of pooled year data GJG-3 Variety seeds primed with KNO3 @ 100 ppm was showed higher Seedling dry weight (1.03 g). Mohammadi (2009) [20] on soybean (*Glycine max* L.) in field and laboratorial studies, found that seed primed with potassium nitrate increased Germination Percentage (GP), Germination Rate (GR), Seedling Dry Weight (SDW) and 1000-seed weight as compared to control.

Table 7: Effect of different seed priming treatments on seedling vigour index I during 2016-17, 2017-18 and pooled of chickpea seed

Treatments	Seedling vigour index I								
	2016-17			2017-18			Pooled		
	Varieties			Varieties			Varieties		
	GG-1	GJG-3	Mean	GG-1	GJG-3	Mean	GG-1	GJG-3	Mean
T_1: KNO_3 100 ppm	1860	2829	2344	2429	2731	2580	2114	2779	2462
T_2: KNO_3 200 ppm	1761	2600	2180	2121	2358	2240	1940	2479	2209
T_3: -PEG (6000) -1.2 Mpa	1637	2371	2004	1942	2043	1993	1789	2207	1998
T_4: Bavistin (2g/kg)	1440	1902	1671	1602	1719	1661	1521	1810	1666
T_5: Neem oil (3%)	1531	2178	1854	1798	1901	1850	1664	2039	1852
T_6: Control	1225	2261	1743	1465	1504	1485	1345	1882	1613
Mean	1575	2357	1966	1893	2043	1968	1734	2199	1966
S.Em ± V	7.05			16.56			223.23		
C.D. @ 5% V	20.58			48.36			NS		
S.Em ± T	12.21			28.69			79.31		
C.D. @ 5% T	35.64			83.76			288.39		
S.Em ± V X T	17.27			40.58			75.06		
C.D. @ 5% V X T	50.41			118.45			NS		
CV %	1.52			3.57			2.75		

The result has been recorded that variety GJG-3 recorded significantly highest Seedling vigour index-I 2357 and 2043 during 2016-17 and 2017-18. Among the priming treatments, seeds primed with KNO_3 @ 100 ppm recorded highest Seedling vigour index-I of 2829 and 2731 during 2016-17 and 2017-18 respectively. On the basis of pooled year data GJG-3 Variety seeds primed with KNO_3 @ 100 ppm was showed higher Seedling vigour index-I (2779). Mohammadi (2009) [20] reported that soaking seed in potassium nitrate had the best effect on germination and soybean seed vigour with late sowing.

Table 8: Effect of different seed priming treatments on seedling vigour index II during 2016-17, 2017-18 and pooled of chickpea seed.

Treatments	Seedling vigour index II								
	2016-17			2017-18			Pooled		
	Varieties			Varieties			Varieties		
	GG1	GJG-3	Mean	GG1	GJG-3	Mean	GG1	GJG-3	Mean
T_1: KNO_3 100 ppm	82.44	103.69	93.07	79.81	88.32	84.06	81.13	96.00	88.56
T_2: KNO_3 200 ppm	76.06	86.14	81.10	74.75	81.59	78.17	75.40	83.86	79.63
T_3: -PEG (6000) -1.2 Mpa	67.78	78.17	72.97	69.43	72.51	70.97	68.60	75.34	71.97
T_4: Bavistin (2g/kg)	60.16	58.35	59.25	63.23	63.95	63.59	61.69	61.15	61.42
T_5: Neem oil (3%)	60.37	69.61	64.99	67.29	68.80	68.05	63.83	69.20	66.52
T_6: Control	49.81	67.25	58.53	56.60	58.71	57.65	53.20	62.98	58.09
Mean	66.11	77.20	71.65	68.52	72.31	70.41	67.31	74.75	71.03
S.Em ± V	0.28			0.40			2.58		
C.D. @ 5% V	0.84			1.17			NS		
S.Em ± T	0.49			0.69			2.38		
C.D. @ 5% T	1.45			2.02			8.67		
S.Em ± V X T	0.70			0.98			2.27		
C.D. @ 5% V X T	2.06			2.86			NS		
CV %	1.71			2.42			2.09		

The result found that variety GJG-3 recorded significantly highest Seedling vigour index-II 77.20 and 72.31 during 2016-17 and 2017-18. Among the priming treatments, seeds primed with KNO_3 @ 100 ppm recorded highest Seedling vigour index-II of 103.69 and 88.32 during 2016-17 and 2017-18 respectively. On the basis of pooled year data GJG-3 Variety seeds primed with KNO_3 @ 100 ppm was showed higher Seedling vigour index-II (96.0). Singh and Rao (1993) [23] stated that KNO_3 effectively improved germination, seedling growth and vigor index of the seeds of sunflower varieties with the low germination. It has been reported that primed seeds showed better germination pattern and higher vigour level than non- primed (Ruan *et al*., 2002).

Summary and Conclusion

Seeds of chickpea were treated with various priming treatments recorded higher seed quality parameters compared to control.Seeds treated with KNO_3 100 ppm gave the significant results. It is concluded from the results of the experiment that among all the treatments, KNO3 100 ppm showed significant performance for Seed quality parameter, Germination (%), root length (cm), shoot length (cm), seedling length (cm), Seedling fresh weight (g), seedling dry

weight (g), seedling vigour index-I and Seedling vigour index-II followed by other treatments. Therefore, as pre-sowing treatment KNO_3 100 ppm are recommended for treating chickpea seed for better seed quality parameters.

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