International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2018; 6(5): 2595-2598

Received: 29-07-2018
Accepted: 30-08-2018

VR Shelar
Seed Research Officer, Seed Technology Research Unit, Seed Technology Research Unit, Seed Cell, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

AP Karjule
Junior Research Assistant, Seed Technology Research Unit, Seed Cell, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

GD Katkar
M Sc. Student, Seed Science and Technology, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Correspondence
VR Shelar
Seed Research Officer, Seed Technology Research Unit, Seed Technology Research Unit, Seed Cell, Mahatma Phule Krishi Vidyapeeth, Rahuri, Maharashtra, India

Electric field application for seed quality enhancement in onion (*Allium cepa* L.) during storage

VR Shelar, AP Karjule and GD Katkar

Abstract
Electric fields can be used to prevent the quantitative and qualitative losses due to several biotic and abiotic factors during storage as a non-chemical method in agriculture. An experiment was conducted with two onion lots *viz.*, old (previous year harvested) and new (freshly harvested) treated with electric field with different power levels and time periods along with control and stored in 700 guage plastic bag at ambient storage conditions. The germination percentage and vigour index were evaluated at 30 days interval. It was observed that the microwave seed treatment to onion seed had beneficial effect for improvement of seed quality and storability. The seed treated with microwave 60% power level for 20 sec. was found better than other treatments. The old seed lot gave higher response to electric field application. However, the higher germination and other seed quality parameters were reported better in freshly harvested seed lot.

Keywords: Electric field, exposure time, storage, germination, vigour index I

Introduction
Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops grown in India and queen of kitchen garden (Selvraj, 1976) [14]. It is an important crop used raw, as well as vegetable and as spice all over the world. Its demand is fairly constant. The onion, accounts for 90 per cent of the export of vegetables from India in terms of value. Among the different states, Maharashtra is leading onion producing state in India.

With the increase in area under onion cultivation in the country, the demand for seed has also increased tremendously. As per the given estimates of National Seed Corporation, there is wide gap between the demand and the production of seed. Unfortunately, in practice the quality of seeds used in tropical and subtropical countries of third world is often very poor. In India less than 15 per cent of fields are sown with quality seeds by using good quality seeds, yield could be substantially increased to about 15 to 20 per cent (Banerjee, 1984) [5]. Continuous and adequate supply of quality seeds remains to be major constraints in Indian agriculture and particularly with the various vegetable seeds. Use of different physical and chemical methods to prevent the storage losses and improvement of seed quality is the best alternative for adequate seed supply in India. Such application are less expensive and reduce the toxicity and pollution of surface and underground waters and finally decreases the costs of agricultural products, and increases best performance of such products. It has been perceived that the electric fields cause physio-biochemical changes in seeds. (Putincev and Platonova, 1997) [13].

The increase in seed germination by 20 to 30 per cent and seed rate reduction by 30 per cent, increase in the performance of products by 10 to 50 per cent are the results of treating cultivars by electric field by preventing the qualitative and quantitative loss and could be used as a non-chemical method in agriculture (Das and Bhattacharya, 2006) [6]. Use of physical methods for plant growth stimulations is getting more general due to the less damaging effects on the environment (Aladjaadjiyan, 2010) [2]. In view of above an experiment was undertaken to study the effect of application of electric field on onion seed quality at Seed Technology Research Unit, MPKV, Rahuri.

Material and Methods

The effect of electric field application and exposure timing on the onion seeds var. Baswant 780 with two different seed lots *viz.*, old (revalidated with low vigour) and new (freshly harvested) were taken for the current study. For application of electric field the microwave oven was setup for three desired power levels *viz.*, 80% (720 Watt), 60% (540 Watt) and 40% (360 Watt) each for three time periods i.e. 10, 20 and 30 sec. Seeds were treated for combination of each power level and time period. After the electrical field application the treated seeds were sealed in 700 gauge polyethylene bags. The observations on seed quality parameters were recorded at monthly interval.

For seed germination, four replications each of 100 seeds from different treatment combinations were germinated using top of paper method (T.P.) at 25 ± 2 ^{0}C in germinator for 10 days (Anonymous, 1995) [4]. The germination percentage was computed on the basis of normal seedling only. The vigour index I of the seed lot was assessed by the method suggested by (Abdul Baki and Anderson, 1973) [1]. The data obtained in present investigation was analyzed by using Factorial Completely Randomized Design (FCRD) given by Panse and Sukhatme (1967) [11].

Result and Discussion

The germination of onion seed during storage was significantly affected by the interaction effect of seed lot, microwave power level, and exposure timing. (Table 1)

The seed germination, an important quality parameter declined progressively with the increase in storage period irrespective of seed lot, microwave power level and exposure timing. The fresh seed lot recorded significantly higher germination than old seed lot during all periods of storage. The interaction of fresh seed lot, 60% (540 Watt) electric field level and 20 sec, exposure timing had significantly higher seed germination (93%) over the old lot with same power level and exposure time (85.3%). The same treatment combination of freshly harvested seed lot recorded the highest germination percentage during all storage period. The seed germination was above MSCS up to 330 days of storage period for the said treatments. Whereas the seed of fresh and old seed lot with 80% (720 Watt) electric field level for 30 sec. recorded the lowest germination of 62% and 59% respectively.

The old revalidated lot when treated with 60% (540 Watt) electrical field level for 20 seconds could maintain the seed germination above MSCS for 270 days of storage period only. Application of electrical fields causes physiological changes in seed that might resulted in faster water absorption which increased the biological capacities of seed. It was supposed that the biological process including free radicals, excite the activity of proteins and enzymes which increased seed power which affects seed germination, field emergence, growth rate and seed vigour and resulted in better germination of onion seed during storage than untreated control. (Pozeliene, 2000) [12]. The decrease in seed quality during storage may be attributed to natural ageing effect, leading to depletion of food reserves and decline in synthetic activity of the embryo apart from death of seeds because of fungal invasion. (Zhang and Kong, 1996) [16]. Similar type of observation was also reported by Amjad and Anjum, (2002) [3]. High seed germination could be maintained by using microwave power levels of 0.25 W/g for seeds of corn (Shivare *et al*., 1991) [15]. The inhibitory effect on germination when electric field intensities exceeded 12 kV/cm for exposure time greater than 60 sec. in tomato (Moon and Chung, 1999) [10].

The vigour index I of onion seed during storage was significantly affected by the interaction effect of seed lot, microwave power level, and exposure timing (Table 2).

It was revealed that the fresh seed lot treated with electric field level 60% (540 Watt) and 20 sec. exposure timing recorded the highest vigour index I followed by old seed lot during all the storage period. Whereas old seed lot treated with, 80% (720 Watt) electric field level and 30 sec. exposure recorded the lower vigour index I. All the treated seed recorded higher vigour index I than the untreated control. The fresh seed lot, 60% (540 Watt) electric field level and 20 sec. exposure timing recorded the highest vigour index (1302) at initial stage of storage which maintained till the end of storage period of 330 days followed by fresh seed lot, electric field level 60% (540 Watt) and exposure timing of 30 sec. at the initial stage of storage period. Whereas the seed of fresh and old seed lot with 80% (720 Watt) electric field level for 30 sec. recorded the lowest initial vigour index I of 564.20 and 387.83, respectively.

It was noticed that the root-shoot length, dry matter content and vigour index of onion seed found to have been decreased during storage. The decrease in root-shoot length of seedlings of onion could be ascribed to the ageing or deterioration of seed, which is progressive process depress germination and growth of seedling with increased age, ultimately reducing the vigour of onion seed during storage (Molamofrada *et al*., 2013) [9]. The root-shoot length, dry weights of the seedlings, vigour and viability, emergence, germination percentage compared with control in onion seed were increased by treating the seeds with electric field (Doijode, 1990) [7]. Lin, (2004) [8] suggested the positive effects of low power microwave radiation on germination and growth rate in wheat, bengal gram, moth bean, green gram. He also reported that the increase in frequency and power density has reduced the seed germination and seedling vigour in wheat, bengal gram, mothbean, green gram. The electric field exposure of seed may result in breaking of hydrogen bonding in ultra structural elements of cell. This structural alteration may increase enzyme activity depending on the strength of electric field and exposure timing. This might have resulted increase in seed germination which also increase the seed vigour than untreated control.

Table 1: Effect of seed lot, electric field level and exposure timing on germination of onion seed during storage.

Treatment	Storage period (days)											
	Initial	**30**	**60**	**90**	**120**	**150**	**180**	**210**	**240**	**270**	**300**	**330**
$L_1P_1T_1$	87.00 (68.87)	85.30 (67.40)	85.30 (67.40)	83.80 (65.90)	81.60 (64.60)	81.30 (64.40)	79.00 (63.00)	77.00 (61.00)	75.00 (60.00)	73.00 (59.00)	69.00 (56.00)	65.00 (53.00)
$L_1P_1T_2$	81.00 (64.16)	79.30 (62.90	77.30 (61.50)	74.30 (59.50)	73.30 (58.90)	71.30 (57.60)	70.00 (56.00)	68.00 (62.00)	66.00 (60.00)	63.00 (59.70)	61.00 (57.00)	58.00 (54.00)
$L_1P_1T_3$	62.00 (51.94)	60.60 (51.15)	58.60 (49.90)	55.30 (48.06)	53.30 (46.90)	52.30 (46.30)	50.00 (45.00)	47.00 (43.00)	45.00 (42.00)	44.00 (41.00)	41.00 (39.00)	38.00 (35.00)
$L_1P_2T_1$	90.00 (71.57)	88.66 (70.33)	88.30 (70.03)	85.30 (67.40)	86.30 (65.90)	83.00 (65.6)	81.00 (64.00)	80.00 (63.00)	77.00 (61.00)	75.00 (60.00)	73.00 (58.00)	70.00 (55.00)
$L_1P_2T_2$	93.00 (74.68)	90.30 (71.89)	90.30 (71.80)	89.30 (70.90)	89.00 (70.60)	85.30 (67.40)	85.00 (67.00)	83.00 (65.00)	80.00 (63.00)	77.00 (61.00)	74.00 (59.00)	70.00 (52.00)
$L_1P_2T_3$	91.00 (72.55)	89.30 (70.90)	87.30 (69.15)	87.30 (69.10)	86.30 (68.30)	84.30 (66.60)	84.30 (66.60)	82.00 (64.00)	79.00 (62.00)	76.00 (61.00)	71.00 (57.00)	67.00 (55.00)
$L_1P_3T_1$	85.00 (67.22)	82.30 (65.10)	81.30 (64.40)	80.30 (63.60)	79.30 (62.9)	79.30 (62.90)	76.30 (60.80)	75.00 (60.00)	73.00 (58.00)	71.00 (57.00)	68.00 (55.00)	63.00 (52.00)
$L_1P_3T_2$	88.00 (69.74)	85.30 (67.44)	84.60 (66.90)	83.30 (65.90)	86.30 (65.10)	80.30 (63.60)	79.00 (62.70)	76.00 (60.00)	84.00 (66.00)	72.00 (58.00)	67.00 (55.00)	63.00 (51.00)
$L_1P_3T_3$	89.66 (71.20)	88.30 (70.03)	86.30 (68.30)	84.30 (66.60)	82.00 (64.90)	73.00 (58.60)	80.60 (63.90)	77.60 (61.70)	75.00 (60.00)	73.00 (58.00)	69.00 (59.00)	64.00 (56.00)
$L_2P_1T_1$	80.00 (63.43)	78.30 (62.20)	77.30 (61.50)	74.30 (59.50)	73.60 (59.12)	83.00 (62.90)	70.00 (56.70)	67.60 (45.30)	65.00 (53.00)	62.00 (52.00)	59.00 (50.00)	52.00 (45.00)
$L_2P_1T_2$	71.00 (57.41)	70.60 (57.20)	67.30 (55.10)	65.30 (53.90)	63.30 (52.70)	50.30 (45.10)	61.60 (51.70)	59.00 (50.00)	58.00 (49.00)	56.00 (48.00)	52.00 (46.00)	50.00 (41.00)
$L_2P_1T_3$	59.66 (50.50)	56.30 (48.60)	56.30 (48.60)	55.30 (48.06)	51.60 (45.12)	45.30 (60.20)	43.00 (42.80)	40.00 (42.00)	39.00 (41.00)	37.00 (40.00)	36.00 (38.00)	35.00 (35.00)
$L_2P_2T_1$	80.30 (63.60)	79.30 (62.90)	82.00 (64.90)	79.30 (62.90)	77.30 (61.50)	80.30 (63.60)	73.00 (58.60)	71.00 (57.00)	70.00 (56.00)	69.00 (56.00)	66.00 (54.00)	62.00 (51.00)
$L_2P_2T_2$	85.30 (67.40)	84.30 (66.60)	83.30 (65.90)	82.30 (65.14)	81.30 (64.40)	74.30 (59.50)	79.00 (62.00)	77.00 (61.00)	75.00 (60.00)	70.30 (56.90)	66.00 (54.00)	64.00 (54.00)
$L_2P_2T_3$	82.30 (65.14)	81.30 (64.40)	80.60 (63.90)	78.30 (62.20)	75.30 (60.20)	80.30 (63.60)	73.00 (59.00)	71.00 (57.00)	70.00 (56.00)	68.30 (55.70)	64.00 (53.00)	64.00 (53.00)
$L_2P_3T_1$	80.30 (63.67)	80.00 (63.40)	78.30 (62.20)	76.30 (60.8)	74.30 (59.50)	73.00 (58.60)	72.00 (58.00)	70.00 (56.00)	69.00 (56.00)	67.60 (55.30	63.00 (52.00)	60.00 (52.00)
$L_2P_3T_2$	81.30 (64.40)	81.66 (64.64)	79.30 (62.90)	88.30 (70.03)	76.30 (60.50)	75.00 (60.00)	75.00 (60.00)	73.00 (58.00)	71.00 (57.00)	58.00 (49.00)	64.00 (53.00)	63.00 (53.00)
$L_2P_3T_3$	83.33 (65.90)	82.33 (65.14)	81.30 (64.40)	81.00 (84.40)	79.30 (62.90)	79.00 (62.00)	78.00 (62.00)	75.00 (60.00)	73.00 (58.00)	69.00 (56.00)	65.00 (53.00)	62.00 (50.00)
SE(±)	0.55	0.42	0.40	0.35	0.40	0.36	0.47	0.46	0.37	0.38	0.42	0.40
CD at 5%	1.47	1.20	1.09	1.00	1.09	1.02	1.30	1.19	1.08	1.10	1.20	1.09

(figures in parenthesis are arc sine values)
Seed Lot : L_1= Fresh seed lot, L_2 = Old seed lot
Microwave power Level (%) : P_1 = 80 (720 Watt), P_2 = 60 (540 Watt), P_3 = 40 (360 Watt)
Exposure Timing. (sec) : T_1 = 10, T_2 = 20, T_3 = 30

Table 2: Effect of seed lot, electric field level and exposure timing on vigour index-I of onion seed during storage.

Treatment	Storage period (days)											
	Initial	**30**	**60**	**90**	**120**	**150**	**180**	**210**	**240**	**270**	**300**	**330**
$L_1P_1T_1$	1000.50	955.70	896.00	958.33	898.33	854.00	820.50	770.00	735.00	699.80	651.70	632.00
$L_1P_1T_2$	810.00	793.30	734.60	743.33	718.60	670.50	647.00	638.00	679.00	642.00	599.20	547.00
$L_1P_1T_3$	564.20	525.06	533.80	503.53	480.00	471.00	447.90	405.00	385.30	369.00	336.20	300.00
$L_1P_2T_1$	1125.00	1108.30	1104.10	1066.60	1000.00	994.00	976.00	936.00	889.00	862.60	817.00	803.00
$L_1P_2T_2$	1302.00	1264.60	1264.60	1161.30	1085.00	1024.00	1003.00	902.00	903.40	858.00	817.00	789.00
$L_1P_2T_3$	1228.50	1206.00	1179.00	1030.50	1005.00	969.00	944.50	912.50	856.00	812.00	727.00	710.00
$L_1P_3T_1$	952.00	864.50	829.60	813.50	812.00	809.20	763.30	762.60	674.00	645.00	601.30	579.00
$L_1P_3T_2$	1012.00	938.60	889.00	871.00	848.00	812.00	801.60	767.60	838.00	687.00	629.00	605.00
$L_1P_3T_3$	1076.00	980.50	949.66	919.20	861.00	857.00	830.86	784.40	741.50	704.00	651.70	629.00
$L_2P_1T_1$	800.00	705.00	657.33	631.80	618.80	610.50	574.00	541.00	509.60	476.00	439.00	431.00
$L_2P_1T_2$	504.10	565.30	505.00	500.20	475.00	450.00	425.00	413.00	400.00	369.00	337.60	310.00
$L_2P_1T_3$	387.83	422.50	394.33	387.30	356.50	327.10	291.90	276.00	255.00	238.00	208.00	197.00
$L_2P_2T_1$	883.66	861.20	830.00	822.50	806.10	715.00	671.60	645.00	618.00	599.00	557.00	536.00
$L_2P_2T_2$	1092.20	1054.10	958.30	912.70	896.00	867.60	829.50	784.00	735.00	675.00	629.00	637.00
$L_2P_2T_3$	988.00	854.00	968.00	940.00	888.90	743.30	721.00	680.80	647.00	615.00	562.00	528.00
$L_2P_3T_1$	787.26	784.00	783.30	748.00	706.16	620.50	603.13	562.60	533.00	507.00	462.00	424.00
$L_2P_3T_2$	829.00	816.00	833.00	801.00	763.30	690.00	682.50	652.00	630.00	498.00	433.00	419.00
$L_2P_3T_3$	958.00	882.00	835.30	803.00	788.60	753.60	726.80	675.00	645.00	586.00	535.00	522.00
SE(±)	7.54	5.77	5.61	5.41	5.92	5.13	6.62	6.63	5.27	5.31	6.01	5.98
CD at 5%	21.90	15.18	15.85	14.43	15.49	14.93	18.98	18.99	14.13	11.21	17.69	15.34

Seed Lot : L_1= Fresh seed lot, L_2 = Old seed lot
Microwave power Level (%) : P_1 = 80 (720 Watt), P_2 = 60 (540 Watt), P_3 = 40 (360 Watt)
Exposure Timing. (sec) : T_1 = 10, T_2 = 20, T_3 = 30

Conclusions

The microwave seed treatment with power level of 60% and exposure timing 20 sec. to onion seeds was found better for seed quality and storability improvement. The fresh onion seed lot of variety Baswant 780 was found to be superior during storage with respect to all seed quality parameters than old seed lot. The microwave treatment to the onion seed improves seed quality and storability than the untreated seeds.

References

1. Abdul-Baki AA, Anderson JD. Vigour determination by multiple criteria. Crop Science. 1973; 13:630-33.
2. Aladjaadjiyan A. Study of the influence of stationary magnetic field on lentil seeds. International Agrophysics. 2010; 24:321-24.
3. Amjad M, Anjum MA. Effect of Gamma Radiation on Onion Seed Viability, Germination Potential, Seedling Growth and Morphology. Pakistan Journal of Agriculture. 2002, 39:202-6.
4. Anonymous. International rules for seed testing (ISTA), Seed Sci. and Tech. 1995; 13(2):299-55.
5. Banerjee SK. Seed in Indian Agriculture during 1980's and beyond. Indian Agriculturist. 1984; 28:115-20.
6. Das R, Bhattacharya R. Impact of electromagnetic field on seed germination. http://www.ursi.org/Proceedings Proc GA05/pdf/KP.14 (0983). pdf. International Union of Radio Science Web Site.2006
7. Doijode SD. The influence of storage conditions on germination of onion seeds. J. Maharashtra Agric. Univ. 1990; 15(1):34-35.
8. Lin JC. Evaluating scientific literature on biological effects of microwave radiation. IEEE Microwave Magazine. 2004; 5(1):34-37.
9. Molamofrada F, Lotfi M, Khazaei J, Tavakkol-Afshari R, Shaiegani-Akmal AA. The effect of electric field on seed germination and growth parameters of onion seeds (*Allium cepa*). Advanced Crop Sci. 2013; 3(4):291-98.
10. Moon JD, Chung HS. Acceleration of germination of tomato seed by applying AC electric and magnetic fields. J Electrostatistics. 1999; 48:103-14.
11. Panse VG, Sukhatme PV. Statistical methods for agricultural workers, ICAR Publications. New Delhi, 1967.
12. Pozeliene A. Influence of electric field on the quality of flax seed. Agricultural of Engineering International: CIGR Journal of Scientific Research and Development. 2000; 1: 6.
13. Putincev AF, Platonova NA. Treatment of seed with electromagnetic field. Annals. of Agricultural Science. 1997; 4:45-6.
14. Selvraj P. Onion queen of kitchen. Kisan World. 1976; 3(12):32-4.
15. Shivare U, Raghavan GSV, Bosisio RG. Drying corn using variable power with a surface wave applicator. Journal of Microwave Power and Electromagnetic.1991; 1: 38-44.
16. Zhang HY, Kong XH. Test on effect of vegetable seeds stored for many months. Acta Agriculturae Boreali Sinica. 1996; 11(1):118-23.