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OPTIMIZATION OF HYDRO-PRIMING TECHNIQUE TO ENHANCE PLANTING VALUE OF OAT (*AVENA SATIVA* L.) SEEDS

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SUMMARY

Present study was carried out on two varieties of oat *i.e.* OS 6 and HFO 611 having two seed lots (Fresh and one year old) in order to standardize the hydro-priming technique for enhancing planting value of oat seeds. The results revealed that maximum germination (100%) was recorded in fresh seed lot of OS 6 after 14 hours of direct soaking in 1½ times volume of water while it was recorded 96% in old lot after same soaking duration and volume of water. At half volume of water, maximum germination (99%) was recorded after 26 hours soaking duration while at equal volume of water, germination was found maximum (99%) at 24 hours soaking duration as compared to control (95%). Same trend was observed in other seed quality parameters also and maximum vigour index-I (3300), Vigour index-II (1162) and field emergence (65%) was observed at 14 hours soaking duration in 1½ times volume of water. One year old seed lot recorded more improvement in seed quality as compared to fresh seed lot. More enhancement in seed quality parameters was recorded in OS 6 over HFO 611. It is concluded from the study that hydro-priming for14 hours by direct soaking in one and half volume of water under ambient condition (20+2°C) is optimum for enhancing the seed quality in oat. If volume of water is reduced to half or equal quantity of water then soaking duration should be increased upto 26 and 24 hours respectively.

Keywords : Priming, *Avena sativa*, seed quality, Hydro-priming, seed lots

Oat (*Avena sativa* L.) is a an important cereal fodder crop of winter season. It ranks around sixth in world cereal production after wheat, maize, rice, barley and sorghum. The green plant have good roughage and used to make hay and silage. Green fodder contains about 10-12% protein and 30-35% dry matter whereas grain contains 66% Carbohydrate, 11% fiber. Green fodder is used to feed animals by mixing it with berseem or lucerne green fodder while grains are used as concentrate to fed ruminants such as horses, poultry, cattle, sheep and other animals. Oat is presently grown in temperate region of the world such as USA, Canada, Europe whereas in India, it is grown in Punjab, Haryana, Jammu and Kashmir, Himachal Pradesh, Uttar Pradesh, Madhya Pradesh, Rajasthan and Maharashtra. The popularity of oat is continuously increasing because of its excellent and quick re-growth habit, yield potential and high nutritive value. Poor vigour and viability many times combined with adverse environmental conditions result in poor crop establishment and ultimately low yield. Sometimes non-availability of fresh seed may compel to use carryover/ revalidated seed and consequently results in poor yield. Pre-sowing seed priming with water, plant growth regulators, agro-chemicals, fungicides etc. have been reported not only to maintain quality of seeds during storage but also enhanced in several crop species (Basu and Dhar, 1979). Priming is a useful technique to improve speed of germination, repair of cellular damage, increase protein synthesis, improve seedling vigour and growth and ultimately higher yield as compared to unprimed seed. Although priming is an old practice being used since centauries by the farmers and presently various priming techniques such as osmo-priming, halo-priming, hydro-priming, solid matrix priming, sand priming, drum priming, biopriming are being used by seed companies/researchers to enhance the seed quality. Among these, Hydro-priming is a simple technique of soaking the seed in water that allows the seeds to imbibe water resulting in first stage of germination but prevents seed for radicle emergence. Seeds are dried back to original moisture content after priming. Hydro-priming is a cost effective, simple and environmental friendly technique

to enhance the seed quality and to overcome the various type of stresses such as salinity, heat, drought etc. Although hydro-priming is reported as a beneficial practices but it must be standardized because the technique is affected by so many factors such as duration of priming, method of priming, volume of water, temperature of soaking environment etc. Seed germination process completes in three phases- Phase-I, water imbibation takes place and under phase-II, metabolism activates and repairing processes starts and during phase-III, cell elongation starts which leads to radicle protrusion. Upto end of phase –II the process is reversible and seed can be dried back without any adverse effect on seed viability during storage (Lutts *et al.,* 2016). Thus priming techniques should be standardized carefully. Although, a lot of studies have been conducted on hydropriming, comprehensive study on hydropriming technique in oat is not sufficient. Keeping in view the benefits of this technique, an effort was made to standardize the hydropriming technique for oat seeds.

MATERIALS AND METHODS

Present study was carried out on two oat varieties *i.e.* OS 6 and HFO 611 having two seed lots each (Fresh and one year old). The above seed was procured from Forage section of Department of Genetics and Plant Breeding and the study was conducted at laboratories of Department of Seed Science and Technology, CCS HAU Hisar during 2021. In order to standardize the priming technology, 50g seed of both lots of each variety was directly soaked in distilled water for different durations starting from 4hr of soaking to 30 h in half, equal and one and half volume of water under ambient condition (20+2°C). Hydro-primed seeds were dried back to initial moisture under shade at for 48 h. Initial moisture content of unprimed seed as well as moisture content of primed seeds was estimated by using standard hot air oven method (ISTA, 2019). The primed seeds were evaluated for germination %, vigour indices and seedling emergence (%) just after drying back to original moisture content. Test weight of both the varieties was also recorded by weighing 1000 seeds in 8 replications and expressed in grams. Germination test was conducted by using 3 replications of hundred seeds from each variety and treatments as per International Seed Testing Association rules (ISTA, 2019). The seeds were placed between sufficient moistened germination papers and kept at 20°C in seed germinator and final count was taken on the 8th day where only normal seedlings were considered for per cent germination. Ten normal seedlings were randomly selected from each replication of both lots of two varieties at the time of final count of germination test and average seedling length was measured in centimeters. These ten seedlings from each replication were then dried in a hot air oven for 48 hrs at 80°C and average seedling dry weight was calculated in milligrams. Seedling vigour indices were calculated according to the method given by Abdul-Baki and Anderson (1973):

Vigour index-I = Germination (%) x Average seedling length (cm)

Vigour index-II = Germination (%) x Average seedling dry weight (g)

The seedling emergence was calculated by counting the total number of seedlings in field when there was no further increase in the total number of seedlings. The experiment was conducted in factorial completely randomized design for laboratory parameters and randomized block design for field parameter as per standard method suggested by Panse and Sukhatme (1985). The data was analyzed by using the online statistical tool (OPSTAT) developed by Sheoran (2010) and the means were compared at p=0.05.

RESULTS AND DISCUSSIONS

Significant differences were observed for all seed quality parameters except for seed germination in variety OS 6 which were influenced by volume of water, seed lots and their interaction. The results revealed that enhancement in seed quality parameters was recorded in both the varieties with all three volumes used but maximum enhancement in germination as well as other seed quality parameters was recorded after 14 hours priming with direct soaking in one and half volume of water. Maximum germination (100%) was recorded in fresh seed lot of OS 6 variety after 14 hours of soaking in 1½ times volume of water while it was (96%) in old lot after same soaking duration and volume of water. At half volume of water maximum germination (99%) was recorded after 26 hours soaking duration while at equal volume of water germination was found maximum (99%) at 24 hours soaking duration. It may be due to insufficient quantity of water which resulted in slow imbibation of water into seeds. Seed soaking in1½

TABLE 1
Effect of hydro-priming on seed germination (%) in oat

Volume (V) → / Priming duration (D) ↓	OS 6						HFO 611					
	Fresh lot			Old lot			Fresh lot			Old lot		
	Half	Equal	1½ times	Half	Equal	1½ times	Half	Equal	1½ times	Half	Equal	1½ times
Control	95.00	95.00	95.00	86.00	86.00	86.00	94.00	94.00	94.00	64.00	64.00	64.00
4 hrs	95.00	95.67	98.67	86.00	86.00	88.00	94.33	94.67	95.00	64.67	65.00	65.00
6 hrs	95.33	96.00	99.00	87.33	86.67	88.67	94.67	95.00	96.67	65.00	66.00	67.00
8 hrs	95.67	96.33	99.00	88.00	87.00	89.00	95.00	95.67	97.33	65.00	67.00	69.00
10 hrs	96.00	97.67	99.67	87.33	87.67	91.00	95.67	96.00	98.00	65.33	69.00	73.00
12 hrs	96.33	97.67	99.67	90.00	88.00	92.00	96.00	96.33	99.00	68.00	70.00	78.00
14 hrs	96.67	98.00	100.00	90.33	88.67	96.00	96.00	97.00	100.00	70.00	72.00	84.00
16 hrs	97.00	98.00	99.00	90.67	90.33	94.00	96.67	97.33	99.00	72.67	74.00	82.00
18 hrs	97.67	98.33	99.00	91.33	90.67	93.00	97.00	97.67	99.00	73.00	76.00	79.00
20 hrs	98.00	98.67	98.00	91.67	92.00	91.00	97.67	98.00	98.00	74.00	79.00	73.00
22 hrs	98.00	98.33	97.00	92.00	93.00	90.00	98.00	99.00	98.00	76.00	80.00	69.00
24 hrs	98.00	99.00	95.00	92.33	94.00	90.00	98.00	98.00	97.00	78.00	82.00	65.00
26 hrs	99.00	97.00	94.00	91.00	93.00	88.00	97.33	97.00	96.00	79.00	80.00	58.00
28 hrs	98.00	96.00	90.00	90.00	91.00	87.00	96.67	96.00	95.00	76.00	77.00	52.00
30 hrs	95.00	94.00	88.00	88.00	88.00	85.00	95.00	94.00	93.00	72.00	70.00	49.00
SE (m) (±)	V=0.20, D=0.45, VxD=0.78			V=0.25, D=0.56, VxD=0.98			V=0.24, D=0.55, VxD=0.95			V=0.44, D=0.98, VxD=1.70		
CD (p=0.05)	V=NS, D=1.26, VxD=2.18			V=NS, D=1.58, VxD=2.74			V=0.69, D=1.54, VxD=NS			V=0.87, D=1.95, VxD=3.37		

TABLE 2
Effect of hydro-priming on Vigour index-I in oat seeds

Volume (V) → / Priming duration (D) ↓	OS 6						HFO 611					
	Fresh lot			Old lot			Fresh lot			Old lot		
	Half	Equal	1½ times	Half	Equal	1½ times	Half	Equal	1½ times	Half	Equal	1½ times
Control	3211	3211	3211	2237	2237	2237	3046	3046	3046	986	986	986
4 hrs	3249	3301	3453	2255	2272	2356	3076	3105	3137	1005	1021	1033
6 hrs	3260	3379	3515	2272	2318	2446	3105	3136	3364	1034	1056	1093
8 hrs	3301	3439	3564	2331	2392	2628	3126	3233	3494	1053	1106	1215
10 hrs	3331	3545	3787	2385	2486	2744	3158	3263	3627	1078	1166	1329
12 hrs	3352	3614	3987	2400	2505	2970	3244	3333	3891	1150	1197	1474
14 hrs	3461	3724	4400	2490	2687	3300	3283	3414	4280	1205	1245	1663
16 hrs	3492	3822	4227	2513	2725	3267	3383	3501	4158	1264	1310	1599
18 hrs	3584	3933	4158	2619	2823	3168	3493	3653	4089	1278	1361	1445
20 hrs	3724	4045	4018	2735	2871	3116	3604	3783	3921	1310	1422	1299
22 hrs	3822	4130	3783	2842	3069	2940	3646	3881	3823	1353	1464	1111
24 hrs	3920	4257	3610	2940	3136	2813	3705	3921	3587	1388	1517	1034
26 hrs	4158	3977	3478	3017	3046	2765	3698	3782	3361	1414	1456	783
28 hrs	4018	3648	3150	2900	2947	2584	3479	3457	3136	1254	1355	666
30 hrs	3420	3478	3080	2565	2444	2399	3231	3177	3061	1167	1190	579
SEm (±)	V=24.7,D=55.1,VxD=95.5			V=20.2,D=45.1,VxD=78.1			V=19.31,D=43.17,VxD=74.77			V=6.57,D=14.69,VxD=25.45		
CD (p=0.05)	V=69.4,D=155.2,VxD=268.8			V=56.8,D=127.0,VxD=220.0			V=54.33,D=121.49,VxD=210.43			V=18.49,D=41.35,VxD=71.63		

times volume of water after 30 hours duration resulted in adverse effect on germination. Imbibitional injury was first recognized by Powell and Mathews (1978) who predicted that it is due to higher rate of water imbibitions, the rapid inrush of water into embryonic cell of fast imbibing legume seeds causes physical disruption of the cell membrane. The enhancement in seed quality parameters by hydropriming might be due to the higher activities of amylase, invertase, sucrose synthatase and sucrose phosphate synthatase in the

TABLE 3
Effect of hydro-priming on Vigour index-II in oat seeds

Volume (V) → / Priming duration (D) ↓	OS 6						HFO 611					
	Fresh lot			Old lot			Fresh lot			Old lot		
	Half	Equal	1½ times	Half	Equal	1½ times	Half	Equal	1½ times	Half	Equal	1½ times
Control	922	922	922	679	679	679	1090	1091	1090	403	403	403
4 hrs	931	928	1007	688	705	748	1104	1117	1141	414	423	449
6 hrs	944	931	1139	707	737	780	1126	1140	1237	429	455	469
8 hrs	976	935	1257	730	766	819	1140	1186	1285	449	469	518
10 hrs	1008	947	1286	742	815	937	1196	1229	1421	457	511	584
12 hrs	1041	1123	1316	792	845	1049	1229	1291	1544	490	553	686
14 hrs	1054	1205	1370	831	878	1162	1258	1348	1620	518	576	832
16 hrs	1096	1245	1337	870	903	1128	1344	1382	1594	560	622	787
18 hrs	1143	1269	1267	904	952	1088	1377	1445	1574	577	661	727
20 hrs	1166	1283	1205	935	1003	1010	1436	1470	1529	592	711	643
22 hrs	1205	1288	1144	966	1023	927	1460	1515	1402	623	728	566
24 hrs	1245	1307	1093	1006	1109	918	1548	1558	1329	655	754	527
26 hrs	1277	1270	1024	1037	1079	871	1489	1513	1248	703	720	424
28 hrs	1255	1152	927	1008	992	827	1430	1421	1197	669	662	364
30 hrs	1131	1109	871	942	862	740	1321	1288	1107	591	553	304
SEm (±)	V=4.27, D=9.55, VxD=16.55			V=4.95, D=11.06, VxD=19.15			V=5.05,D=11.28, xD=19.54			V=3.56, D=7.96, VxD=13.79		
CD (p=0.05)	V=12.03,D=26.90, VxD=46.59			V=13.92,D=31.12,VxD=53.90			V=14.20,D=31.75,VxD=54.98			V=10.02,D=22.41,VxD=38.81		

TABLE 4
Effect of hydro-priming on seedling emergence (%) in oat

Volume (V) → / Priming duration (D) ↓	OS 6						HFO 611					
	Fresh lot			Old lot			Fresh lot			Old lot		
	Half	Equal	1½ times	Half	Equal	1½ times	Half	Equal	1½ times	Half	Equal	1½ times
Control	58.00	58.00	58.00	47.00	47.00	47.00	56.00	56.00	56.00	44.00	44.00	44.00
4 hrs	58.10	59.00	60.00	47.40	48.00	50.00	56.20	56.80	57.00	44.20	44.80	45.00
6 hrs	58.40	59.80	62.00	47.90	48.90	53.00	56.60	57.00	58.00	44.50	45.00	47.00
8 hrs	58.80	60.00	64.00	48.00	50.00	54.90	56.90	57.90	59.00	44.80	45.80	50.00
10 hrs	59.00	61.00	66.97	48.80	52.00	58.00	57.20	58.40	61.00	45.00	46.00	53.00
12 hrs	59.50	62.00	69.00	49.00	53.60	61.00	57.90	58.80	62.00	45.60	46.80	55.00
14 hrs	59.80	63.00	72.00	50.00	54.70	65.00	57.60	59.60	63.00	45.80	47.00	58.00
16 hrs	60.00	63.90	71.70	52.30	55.50	63.00	58.90	59.90	62.00	46.00	47.60	57.00
18 hrs	60.60	64.60	71.00	53.90	57.00	61.00	59.30	60.20	61.00	46.70	48.00	56.00
20 hrs	60.90	65.00	70.00	55.00	59.00	57.00	59.70	60.90	60.00	47.00	49.00	54.00
22 hrs	61.00	65.70	69.00	58.00	61.00	53.00	60.10	61.40	59.00	48.00	51.00	53.00
24 hrs	61.80	66.00	65.00	60.00	63.00	49.00	60.60	62.00	59.00	50.00	55.00	50.03
26 hrs	63.00	64.00	62.00	62.00	61.90	48.00	61.00	61.40	58.00	53.00	54.70	47.00
28 hrs	62.80	61.00	60.00	61.00	58.00	44.00	60.00	59.00	56.00	52.00	53.00	45.00
30 hrs	60.00	59.00	59.00	60.00	48.00	40.00	58.00	57.00	54.00	50.00	52.00	43.00
SEm (±)	V=0.07, D=0.16, VxD=0.28			V=0.06, D=0.13, VxD=0.22			V=0.05, D=0.11, VxD=0.19			V=0.05, D=0.10, VxD=0.18		
CD (p=0.05)	V=0.21, D=0.46, VxD=0.80			V=0.16, D=0.35, VxD=0.61			V=0.14, D=0.30, VxD=0.53			V=0.13, D=0.29, VxD=0.50		

seedlings of hydroprimed seeds. The higher amylase activity in the shoots of hydroprimed seedlings increased the rapid hydrolysis of the shoot leading to more availability of glucose for shoot growth and which was confirmed by the low level of starch in shoots of primed seeds. Poor and delayed germination and field emergence in seeds subjected to hydropriming for more than 30 h is probably due over priming. Same trend was observed in other seed quality parameters also and maximum vigour index-I (3300), Vigour index-

II (1162) and field emergence (65%) was observed at 14 hours soaking duration in 1½ times volume of water. One year old seed lot recorded more enhancement in seed quality as compared to fresh seed lot. This may be due to already high vigour content in fresh seed lot and hence less scope of improvement in new seed lot through priming technique. Variety OS 6 recorded more improvement in seed quality parameters than HFO 611 which may be due to the difference in genetic make up of these varieties. These findings support the earlier work where improved germination rate and percentage were observed following hydropriming for 48 h in wheat (Basra *et al.*, 2002; Nayyar *et al.,* 1995), maize (Afzal *et al.*, 2002) and gourd seeds (Soon *et al.,* 2000). Nagar *et al.,* (1998) also supported the results in their study in which hydropriming in maize increased the speed of seedling emergence and improved the field stand and plant growth. Verma *et al.,* (2014) conducted study on priming in oat and reported that priming by direct soaking is better than priming of seed between papers and 6 hours priming gave better results under ambient conditions (35+2°C) but in our study 14 hours direct soaking priming was found best. It might be due to lower temperature during soaking which results in slow imbibation process. It is concluded from the study that hydro-priming for 14 hours by direct soaking in one and half volume of water under ambient condition (20+2°C) is optimum for enhancing the seed quality in oat. If volume of water is reduced to half or equal quantity of water then soaking duration can be increased upto 26 and 24 hours respectively.

REFERENCES

Abdul-Baki, A.A. and J.D. Anderson, 1973 : Vigour determination in soyabean by multiple criteria. *Crop Science*, **13**: 630-633.

Afzal, I., S.M.A Basra, N. Ahmad, M.A. Cheema, E.A. Warriach and A. Khaliq, 2002 : Effect of priming and growth regulator treatment on emergence and seedling growth of hybrid maize (*Zea mays* L.). *International Journal of Agriculture and Biology*, **4**: 302–306.

Basra, S.M.A., M.N. Zia, T. Mehmood, I. Afzal and A. Khaliq, 2002 : Comparison of different invigoration techniques in wheat (*Triticum aestivum* L.) seeds. *Pakistan Journal of Arid Agriculture,* **5**: 11–16.

Basu, R.N. and N. Dhar, 1979 : Seed treatment for maintaining vigour, viability and productivity of sugarbeet (*Beta vulgaris*). *Seed Sci. Technol.,***7**(2): 225-233.

ISTA, 2019 : Informational rules for seed testing. *International Seed Testing Association.* Zurich. Switzerland.

Lutts, S., P. Benincasa, L. Wojtyla, R. Pace, K. Lechowska, M. Quinet and M. Malgorzata Garnczarska, 2016 : Seed Priming: New Comprehensive Approaches for an Old Empirical Technique. In S. Araujo, & A. Balestrazzi (Eds.), New Challenges in Seed Biology - Basic and Translational Research Driving Seed Technology. Intech Open. https://doi.org/10.5772/64420

Nagar, R.P., M. Dadlani, and S.P. Sharma, 1998 : Effect of hydropriming on field emergence and crop growth of maize genotypes. *Seed Science and Technology*, 26: 1–5.

Nayyar, H., D.P. Walia and B.L. Kaishta, 1995 : Performance of bread wheat (*Triticum aestivum* L.) seeds primed with growth regulators and inorganic salts. *Indian Journal of Agricultural Sciences*, **65**: 112–116.

Panse, V.G. and P.V. Sukhatme, 1985 : Statistical methods for agricultural workers, 4th Ed., ICAR, New Delhi.

Powell A.A. and S. Mathews, 1978 : Deteriorative changes in pea seeds (*Pisum sativum* L.) stored in humid or dry conditions. *Experimental Botany* 28:225-234.

Sheoran, O.P., 2010 : Online statistical analysis (OPSTAT) software developed by Chaudhary Charan Singh Haryana Agricultural University, Hisar, India. http://www.hau.ernet.in/opstat.html.

Soon, K.J., C.Y. Whan, S.B. Gu, A.C. Kil and C.J. Lai, 2000 : Effect of hydropriming to enhance the germination of gourd seeds. *Journal of Korean Society of Horticultural Sciences*, **41**:559-564.

Verma, R., D. Vijay, C.K. Gupta and D.R. Malaviya, 2014 : Seed quality enhancement of oat (*Avena sativa* L.) varieties through priming. *Range Management and Agroforestry,* **35**: 144-150.