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Priming of vegetable seeds: A review

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Abstract
Vegetable crops embrace a major part in Indian agriculture in terms of providing food and nutritional security. Recently a marvelous progress in vegetable production in India was due to arrival of high yielding varieties and novel technologies. Vegetables are vital sources of vitamins, minerals and additional nutrients of medicinal and therapeutic value. Due to low germination per cent and seedling emergence, yield of the crops decreasing gradually. Farmers are not having enough resources for seedbed preparation for sowing and they are at more jeopardy as compared to progressive farmers. On the other hand good establishment increases competitiveness aligned with weeds, increases tolerance to drought period, yield and avoids the time consuming need for re-sowing that is costly too. Seed priming elevates the percent of germination and reduce time of seedling emergence alongside improve the crop stand. A method to improve rate and uniformity of germination is the priming or physiological advancement of the seed lot. Seed priming is the method of improve germinations and uniform emergence of seedlings in field conditions. It will increase the vigour and crop establishment and finally enhance the yield. It is very low cost hydration technique in which seeds are treated with various chemicals or sometimes with normal water also. Seed priming is generally adopted for improved crop stand, germination and yield of various vegetable crops.

Keywords: Priming, vegetable, seeds, establishment, emergence

Introduction
Seed priming is a pre sowing treatment of seed which modifies the physiological state that enables seed to germinate more efficiently. It is a technique which involves water uptake by seeds followed by drying to initiate the quick process of germination upto the point of radicle germination, improved seedling vigour and growth under a wide range of environments resulting in better plant stand establishment and alleviation of phytochrome -induced dormancy in respective crops. Seed priming is controlled hydration of seeds to an extent which allow pre-germinative metabolic activity to continue, but interrupt the emergence of the radicle. Seed priming improves seed performance**,** ensures uniformity and healthy plant establishment**,** enhances the yield in diverse ecosystems**,** greater tolerance to environmental stress and helps to overcome dormancy. Change in seed water content, cell cycle regulation, modification of seed ultrastructure, management of oxidative stress and reserve mobilization are the major physiological and biochemical changes that takes places during seed priming.
During subsequent germination, primed seeds exhibit a faster and more synchronized germination and young seedlings are become vigorous and resistant to abiotic stresses than the seedlings obtained from unprimed seeds. Priming allows some of the metabolic processes necessary for germination to occur without germination. In the processe seeds are soaked in different solutions with high osmotic potential. This prevents the seeds from absorbing in enough water for radicle protrusion thus, suspending the seeds in the lag phase. Seed priming has been commonly used to reduce the time between seed sowing and seedling emergence thereby enhancing speed of germination. In seed priming, the osmotic pressure and the period for which the seeds are maintained in contact with the membrane are sufficient to allow pre-germinative metabolic processes occur within the seeds up to a level limited to that immediately preceding radicle emergence. Since germination and seedling establishment are critical steps in plant life, and the successful establishment of plant, not only depend on rapid and uniform germination of seed but depend on the ability of rapid germination of the seed under varied environmental conditions. For this purpose, seed pre-priming or priming methods are used to increase the qualitative and quantitative performances of seedlings.

Priming in legume seeds
Eskandari and Kazeni (2011) [8] evaluated the effects of hydro-priming (8, 12 and 16 hours

duration) and halo-priming (solutions of 1.5% KNO_3 and 0.8% NaCl) on seedling vigor and field establishment of cowpea. Analysis of variance of laboratory data showed that hydro-priming significantly improved germination rate, seed vigor index, and seedling dry weights. However, germination percentage for seeds primed with KNO_3 and non-primed seeds were statistically at par, but higher than those for NaCl priming. Overall, hydro-priming treatment was comparatively superior in the laboratory tests. Invigoration of cowpea seeds by hydro-priming and NaCl priming resulted in higher seedling emergence and establishment in the field, compared to control and seed priming with KNO_3. Seedling emergence rate was also enhanced by priming seeds with water, suggesting that hydro-priming is a simple, low cost and environment friendly technique for improving seed and seedling vigor of cowpea.

Yazdani *et al*. (2011) [44] studied seeds of four legumes (lentil, soja bean, green bean and broad bean) in the laboratory conditions subjecting to hydro-priming for 0, 4, 8 and 16 h. It revealed that length of time for priming, were having different effect on seedling. Seed treatment of hydro-priming of 16 h increased rate of germination, seedling dry mater and seed vigor. In lentil, percentage and rate of germination was not varied greatly with hydro-priming treatments. But, in soja bean and green bean, hydro-priming treatments significantly resulted in various parameters of seedling. Treatment of 8 and 16 h hydro-priming was effective in broad bean. Golezani *et al.* (2010) [10] Studied the effects of hydro-priming duration (P1, P2, P3 and P4: 0, 7, 14 and 21 h, respectively) on field performance of three pinto bean (*Phaseolus vulgaris* L.) cultivars (Talash, COS16 and Khomain). The highest seedling establishment, ground cover, plant biomass and grain yield per unit area were recorded for P2 followed by P3. Mean chlorophyll content index of Talash was significantly higher than that of COS16 and Khomain. Ground cover, plant biomass, pods per plant, grains per plant and grain yield per unit area of COS16 and Talash were significantly higher than those of Khomain but, 1000 grain weight of Khomain was higher than that of other cultivars. Ground cover was positively correlated with plant biomass, pods per plant, grains per pod, grains per plant, harvest index and grain yield per unit area. Thus, it can be used as a reliable index to estimate the yield potential of pinto bean cultivars. No significant interaction of priming duration and cultivar indicated that optimal time of hydro-priming for all pinto bean cultivars was 7 hours. Kumar (2014) [14, 15] evaluated the effect of seed priming duration on germination and seed quality parameters. Seeds of blackgram cv. VBN 4 were primed in water for 2 hrs, 4 hrs, 6 hrs, 8 hrs, 10 hrs, 12 hrs, 14 hrs, 16 hrs, 18 hrs, 20 hrs, 22 hrs and 24 hrs to determine the effect of priming duration on seed quality parameters. Seed primed for 14 hrs exhibited higher germination per cent and along other seed quality characters. Da Costa *et al.* (2013) [5] also reported that the effect of hydro priming on soybean seeds and correlated this technique to occurrence of storage fungi and observed that hydro priming is beneficial to improve seed quality with low incidence of micro-organism; high incidence can reduce hydro priming benefits. Pradhan *et al.* [25] during 2017 assessed the Influence of halo priming and organic priming on germination and seed vigour in Black gram (*Vigna mungo* L.) The seeds were treated with un-soaked seed (control), Hydro-priming (soaked with distill water for 12 hrs), Organic priming (Cow urine, Coconut water), Halo priming with KNO3, KCl, and CaSO4 (1% solution) soaked for 12 hrs, on seed of Black gram. KCl @ 1% primed seed recorded higher germination per cent (83.25%),energy of emergence (78.75), seedling length (40.30 cm), seedling dry weight (0.452 gm/10 seedlings), vigour index I (3358.93) & vigour index II (37.66). The treatment interactions were significant & the seeds treated with KCl followed by KNO3 performed better growth compared to control. Tufa and Nego (2016) conducted one experiment under controlled environmental condition of green-house taking priming common bean seed with different concentration of NaCl. Data were collected on standard germination, rate of germination, seedling height, shoot length, root length and Vigor index. The result revealed that different NaCl concentrations statistically ($p \leq 0.05$) affected standard germination, rate of germination, seedling height, shoot length and Vigor Index I of common bean crop. The highest value of all these parameters were obtained from seed primed with 0.1M NaCl as well as when the seed primed with distilled water. However, the lowest values of these parameters were recorded on the seed primed with the highest concentration (0.4M) of NaCl and un-primed seed. More of the examined parameters were decreased with increasing of NaCl concentration. In conclusion priming seed with 0.1M of NaCl concentration enhanced germination and seedling performance of common bean. Soliman *et al*. (2016) [35] noted that seed priming of Faba bean with low concentration of Salicylic acid will speed up the germination time and enhance the establishment of seedlings as well as powerful tool in enhancing the growth and productivity of such crop particularly in saline irrigation conditions. They documented primed seeds to be less susceptible to soil-borne pathogens. Kundu *et al*. during 2016 [16] experimented the effect of application of IBA (10 ppm), GA_3 (10 ppm) and H_3BO_3 (0.05%) and found that there was increase in germination percentage to the tune of 5.39%, 3.53% and 4.56%, respectively as compared to control as well as other priming treatments. GA_3 at 5 ppm concentration resulted in highest shoot length. Application of GA_3 at all concentrations had higher vigour index. Among all the seed priming treatments PEG-6000 had no additional benefit on seed germination of mung-bean though it had pronounced effect on root growth. Mazed *et al*. (2015) [18] experimented on chickpea with giberellic acid (GA_3) - 5 levels: GA_3 75 ppm – T_1, GA_3 150 ppm – T_2, GA_3 225 ppm – T_3, GA_3 300 ppm – T_4 and hydro-priming – T_5. Among the treatment on maximum plant height and dry matter content recorded from plants in T_3 irrespective of growing period. This treatment also exhibited maximum number of seeds and pods per plant, longest pod length and maximum number of seeds per pod, where as it required minimum duration for pod maturity. The maximum weight of 1000 seed, heigher grain yield, harvest index and also maximum germination percentage as well as vigor index were found with chickpea when primed with 225 ppm GA_3. Study of priming in common bean Monalisha *et al*. (2017) [19] reported that un primed dry seed resulted in germination (69%), shoot length (27.5 cm), root length (14 cm), seedling dry weight (1.71g), SVI-I (2859.2), SVI-II (118.0) and speed of germination (5.8) while hydro primed seeds resulted in germination (72%), shoot length (31.9 cm), root length (15 cm), seedling dry weight (1.80 g), SVI-1 (3375.9) SVI-II (129.8) and speed of germination (6.7). *Trichoderma harzianum* at 40% concentration and for 4 hours of soaking

resulted enhancement of above quality parameter like 13.0% in germination, 21.1% in shoot length, 20.7% in root length, 31.6% in seedling dry weight, 36% in seedling vigor index-I, 48.1% in seedling vigor index-II and 58.6% in speed of germination over unprimed seeds. Bio-priming with *P. fluorescence* (at 40% concentration and for 4 hour) closely followed and at par with the best treatment with 11.6%, 18.2%, 16.4%, 30.4%, 30.7% and 56.9% enhancement of above mentioned quality parameters, respectively. Singh *et al.* (2016) [32] evaluated plant growth promotion effect in pea and the results revealed enhancement in plant growth in the treated plants as compared to control. There was increase in shoot length, root length, number of leaves, shoot fresh weight, root fresh weight, shoot dry weight and root dry weight by 35.29, 96.49, 28.13, 36.10, 146.26, 30.17 and 77.20%, respectively, as compared to the control. Fath El-bab *et al.* (2013) [9] found bio-priming of seed treatments with *T. harzianum* and *T. viride* significantly reduced root rot disease incidence in green bean. Under field conditions, bio-priming and fungicide seed treatments successfully suppressive root rot incidence at pre and post emergence stages and significantly increase vegetative growth parameters, early and total pods yield and improved the quality of green pods such as TSS, total sugar, total protein and total nitrogen of green bean pods. They concluded that bio-priming could be safely used in commercial scale as alternate to chemical fungicide for seed treatments for controlling seed and soil borne plant pathogens. EL-Mohamedy *et al.* (2006) [6] reported that bio-prime seed treatment with *T. harzianum* reduce root rot disease incidence in cowpea by 64% and 56.3% at pre emergence stage and by 68.0%, 60.1% and 57.1%, 64.0% at post emergence stage after 40 and 60 days of sowing during 2004 and 2005 seasons, respectively. Hence fresh pods yield was increased by 44.0 and 36.1% compared with 19.5% and 11.2% in case of Rizolex-T treatment during the same season respectively. Yadav *et al.* (2013) evaluated the performance of three rhizosphere competent microbial strains, *viz.*, *Pseudomonas fluorescence*, *Trichoderma asperellum* and *Rhizobium spp.* individually and in combination in bio-primed seeds of chick pea and rajma. The bio primed seeds showed higher germination and better plant growth as compared to control. Results demonstrated all combinations comprising of *Trichoderma* performed better than other combinations and their individual application. Bio-priming treatment is potentially prominent to induce profound changes in plant characterstics and to encourage more uniform seed germination and plant growth associated with fungi and bacteria coatings (Entesari *et al* 2013) [7]. They reported that bio-priming of soybean seeds with *T. harzianum* strain BS1-1(T.h4) showed to be highly efficient and positively affected soybean growth factors. The fungi increased seedling length, root length and their dry weight and total chlorophyl content, as compared with uninoculated control. *T. virens* As19-1(T.v7) increased Iron uptake and UTPF-5 increased zinc uptake, Nitrogen and total protein as compared to other priming methods and control. Arun *et al.* (2016) [2] observed the vigour of cowpea during storage at high Temperature and high Relative Humidity. The study was conducted to invigorate the performance of high and low vigour seeds (exposed to 45 ± 2o C and 100% RH) by seed priming with different chemicals and concentrations (GA3 (100ppm); CaCl2 (10-3M); Ammonium Molybdate (10-3M); KBr (10-3M); Mg (NO3)2 (10-3M); ZnSO4 (10-3M) with hydro primed and dry seed (control) at 15 ºC for 24 hours. Priming was effective in reducing the time for 50% germination and mean germination time and increased the germination percentage in less vigour seeds, where as energy of germination and final germination percentage in normal seeds displayed a minor increase. Priming of normal / low – vigor seeds improved the vigour of seedling in terms of seedling length and their dry weight and seedling vigour index. Priming of fresh and accelerated cowpea seeds increased the electrical conductivity of seed leachate, cell membrane stability, total protein content, amylase activity, peroxidise activity and dehydrogenise activity over control dry seeds. Abadeh *et al.* (2013) [1] reported that seed bio-priming with plant growth promoting Rhizobacteria (PGPR) increased grain yield and nitrogen use efficiency in red lentil as to no seed priming. Nitrogen fertilizer rates and seed inoculation with PGPR had significant effects on grain yield, grain 1000 weight, number of grains per plant, plant height and all of grain filling parameters such as grain filling period, rate and effective grain filling period as well as nitrogen use efficiency (0.75kg/kg) with application of 50 kg urea/ha× seed inoculation with *Azotobacter chrococcum*. Toklu (2015) [40] evaluated the effects of different priming treatments, specifically KNO_3 (1%), KCl (2%), KH_2PO_4 (1%), $ZnSO_4$ (0.05%), PEG-6000 (20%), IBA (100 ppm), Mannitol (4%), GA_3 (100 ppm) and distilled water, on seed germination properties and several agro-morphological plant characteristics of red lentil both invitro and in vivo. Seeds not primed were used as a control. GA_3 treatment increased shoot length, increased plant height and seedling emergence rate, whereas KCl treatment improved the number of nodules, as well as root and shoot dry weight when compared to the control. $ZnSO_4$ treatment increased yield components and grain yield in field conditions. The results demonstrated that $ZnSO_4$, GA3 and PEG-6000 seed priming treatments may be effective for their positive effects on germination rate, germination percentage, yield component and grain yield of lentil. Singh *et al.* (2017) [29, 30] evaluated the effect of seed priming treatments on seed quality parameters and storability parameters of field pea (*Pisum sativum* L.) variety KPMR-522 (Jay). The experiment was comprised of nine seed priming treatments *viz.*, T_0- Control, T_1- Seed priming with *Trichoderma harzianum* @ 1.5%, T_2- Seed priming with Vitavax power @ 0.25% T3- Seed priming with GA3 @ 50 ppm, T_4-Seed priming with GA3 @ 50ppm + seed coating with *Trichoderma harzianum*@ 15g/kg seed,T_5 -Seed priming with sodium molybdate @ 500 ppm, T_6-Seed priming with sodium molybdate @ 500ppm + seed coating with *Trichoderma harzianum* @ 15 g/kg seed, T_7- Seed priming with leaf extract of *Lantana camara* @ 10%,T_8- Seed priming with water,T_9- Seed treatment with Bavistin @ 3g/kg seed. The present investigation revealed that seed priming with sodium molybdate @ 500 ppm + seed coating with *T. harzianum* @ 15g/ kg seed significantly improved the seed quality of harvested seeds with percent improvement of 5.75% and 8.00% in germination, 15.37 and 13.73% in shoot length, 17.03 and 16.05% in seedling dry weight, 13.06 and 17.96% in seed vigour index-I, 24.50 and 26.90% in vigour index-II over control. Singh *et al.* (2014) [33] conducted the effect of osmo-priming duration on germination, emergence and early growth of cow pea. Treatments consisted three osmo-priming duration (soaking in 1% KNO_3 salt for 6, 8 and 10hrs) and one hydro-primed control (10hr). The results

showed that osmo-priming with KNO_3 for different durations were superior to un primed treatment in term of seed germination, emergence, plant height and dry matter accumulation in cowpea. Primed seeds (both osmo-priming and hydro-priming) increased performance of cowpea. However, osmo-priming with KNO_3 salt (soaked in 1% KNO_3 salt solution and dried before sowing) for 6 hours reported more seed germination and seedling height than hydro-priming.

Priming in Malvaceous Vegetable Seeds

Sharma *et al.* (2014) [28] reported four priming methods in okra cv. Hisar Unnat such as, hydro-priming, osmo-priming, halo-priming and solid matrix (SM) priming comprising a total of 19 treatments of different priming combinations (P1–P18) along with control (P0). Hydro-priming for 12h and SM priming with calcium aluminium silicate (1:0.4:1;Seed:SM:Water) for 24h significantly increased the seed germination, seedling vigour, mean germination time and marketable fruit yield in okra cv. Hisar Unnat. Hydro-priming, being simple, economical and safe, is recommended which was effective to increase the fruit yield up to 55% as compared to control. Rai and Basu (2017) studied the seeds of eight varieties of okra: Lalu, Arka Anamika, Ramya, Satsira, Lady Luck, Debpusa Jhar, Japani Jhar and Barsha Laxmi, bio-primed with *Trichoderma viridae* and *Pseudomonas fluorescens*,. *Trichoderma viridae* improved plant length as 108.21cm and 112.25 cm for variety Arka Anamika, maximum pod length i.e. 19.01 and 19.21 as well as in pod diameter as 16.64 mm and 16.85 mm for Lalu variety in first and second year respectively. Overall seed yield per plant was 49.14g and 51.58g in 2011 and 2012 respectively for Lalu, while it was lowest for Lady Luck (24.13g and 25.69g) in both the years. There might be existence of genotypic response in enhancing the seed yield of individual varieties after pre-sowing with specific bio-primed of seeds. Hence the bio-priming with compatible bio-agents will enhance the plant growth and yield attributes.

Priming in Solanaceous Vegetable Seeds

Khan *et al*. (2009) [13] experimented with hot pepper under salinity stress conditions. Priming with NaCl was effective in reducing the adverse effects of salinity. Significant increase in germination percentage, germination index and germination speed, vigor index, plumule and radicle length, and dry weight of the seedlings as compared to control was recorded. On the other hand, mean germination time, time to reach 50% germination and fresh weight of seedlings were non-significant against control. In this experiment, it was concluded that seed priming with NaCl has been considered better performing as compared to non-primed seeds in case of hot pepper for improving the seedling vigour and seedling establishment under salt-stressed conditions. Nakaune *et al*. (2012) [20] reported that seed priming with salts synchronise seed germination. In general, a long-term treatment with a relatively high salt concentration, such as 1 M NaCl, is employed. A comprehensive gene expression analysis showed that the genes related to seedling growth and stress responses were up-regulated by NaCl-priming at 144 h from the start of the treatment, followed by advanced and uniform seed germination. Seedlings exhibited an increased tolerance to *Ralstonia solanacearum*, as compared with the hydro-primed and non-primed seedling in tomato. Maiti *et al*. (2013) [17] experimented on vegetable seeds and found halo-priming increased speed of emergence, seedling vigor index, root length and shoot length over hydro-priming in tomato and chilli. At field level halo priming showed better performance than control and hydro-priming. Halo-priming caused early flowering in tomato and chilli. Increased plant height is also noticed in halo-priming with respect to tomato and chilli. Mostly importantly halo-priming increased total yield in tomato and chilli. This is the first observation in the aspect of increased yield under field condition with respect to seed priming in vegetable crops. Vaktabhai and Kumar (2017) [42] studied on seedling invigoration in tomato against salt stress with three levels of halo-priming [P (1, 2, 3% KNO3)] and two levels each of priming duration [D (24 and 48 hrs)] and salinity [S (2.5 and 5.0 EC)]. Halo-priming, priming duration and salinity individually as well as in interaction to each other influenced majority of growth, nutrient, biochemical and enzyme parameters of tomato seedlings. It is inferred from the study that Halo-priming of tomato seeds either with 1% or 2% KNO3 for 24 or 48 hrs of duration could invigorate tomato seedlings against salt stress. Nawaz *et al.* (2011) studied the effects of halo-priming on germination, seedling growth and biochemical responses of tomato seeds. Priming was done by exposing seeds of two tomato cultivars 'Nagina' and 'Pakit' to aerated solutions of 10, 25 and 50 mm NaCl and KNO_3 for 24 h. Halo-priming with 25 mm KNO_3 increased final germination percentage, germination index, root length, shoot length and seedling fresh weight of both tomato cultivars as compared to all pre-sowing seed treatments including control. Seeds of both tomato cultivars primed with 25 mm KNO_3 for 24 hours significantly reduced the time taken to 50% emergence and mean emergence, increased final seedling emergence percentage and seedling growth. Results indicated that halo-priming with varying concentrations of KNO_3 improved germination potential and seedling establishment of both cultivars and it proved better option than NaCl which resulted in poor emergence and seedling growth. Maximum improvement was recorded in seeds primed with 25 mm KNO_3. The better performance of halo-primed seeds may be due to lower electrical conductivity (EC) of seed leachates, higher total and reducing sugars along with increased α-amylase activity. Jyoti *et al*. (2016) [11] primed three important growth regulators *viz*. Gibberellic acid (GA_3), Napthlene acetic acid (NAA) and potassium nitrate (KNO_3) in tomato. NAA had showed adverse effect on the root length while other growth regulators were found to be significant role to improve the root length. Maximum seed germination (74%) was observed at 50 and 75ppm GA_3. Highest shoot length (4.83 cm) was found at 25ppm of GA3 whereas enhancement of root length occurred with the priming of 1% KNO_3 (3.52 cm). Seed Vigour-I, on the basis of seedling length was observed higher at 25 ppm. GA_3 (720) and seed vigour–II on the basis of seedling dry weight was also observed maximum with 100ppm GA_3 (1460). From this study it was suggested that GA_3 priming was important growth regulator to enhance the seed germination as well as seed vigour. Before sowing seed should be priming with GA_3 for obtaining high% germination and vigourous seedling that survive under adverse climatic conditions with uniform plant stand. Chauhan and Patel (2017) [4] studied the efficacy of various seed bio-priming against chilli *in vitro*. Chilli (*Capsicum frutescence* L.) seeds were subjected to bio-priming with *Trichoderma viride, T. Harzianum, Pseudomonas fluorescens,*

Bacillus subtilis and *Paecilomyces lilacinus* applied at imbibition and after imbibition. Seed bio-priming of chilli seeds *in vitro* revealed seed biopriming with *P. fluorescens* @10 gm/kg seed recorded maximum seed germination 86.70% than the other treatments, but it was statistically at par with *T. harzianum* applied at imbibitions and minimum per cent infected seeds were found when *P. fluorescens* applied at imbibitions.

Priming in Cucurbitaceous Vegetable Seeds

Bankji *et al.* (2018) evaluated the impact of two priming techniques (hormonal priming and hydro-priming) on seedling growth and seed germination of *Cucurbita pepo* treated with different concentrations of mercury (0, 200, 500, 1000 and 2000 µm). Seeds of *Cucurbita pepo* were soaked in aerated solution of gibberellic acid, 2 mm (hormonal priming) and in distilled water (hydro-priming). The addition of Hg at 200, 500 and 1000 µm in the medium did not have a significant effect in the growth of no priming seeds of *Cucurbita pepo*. The phytotoxic effect of mercury on seedling dry weight was observed at high concentration, 2000 µm. Results showed that the hormonal priming induced by gibberellic acid enhanced the germination percentage of *Cucurbita pepo* as compared to hydro-priming seeds. Sivakalai and Krishnaveni (2017) [34] studied the impact of bio-priming impact on pumpkin Cv.CO2 and seeds & found that the performance and productivity of bio primed seeds under field conditions brought out the positive influence of seeds bio-primed with *Azospirillum* 10% + Phosphobacteria 20% + *Pseudomonas fluorescens* 20% for 12hr maximizing the plant growth and development, seed yield and quality of resultant seed. The seed yield for this treatment was 304 kg ha-1 which accounted for 21 per cent increase over the non-primed seed. Saini *et al*. (2017) [27] conducted an experiment, in order to standardize the suitable methods of priming along with control bitter gourd seeds. Seeds of bitter gourd primed with hydro-priming, halo-priming, osmo-priming were evaluated by screening a range of durations and concentration *viz*, T_0-unprimed or control,T1-2-Distilled water hydration (for 6 and 12hrs),T 3-4Nacl (for 6 and 12hrs) and T5-6 PEG (for 6 and 12hrs).Observation shows that the Osmo-priming 12hrs of Bitter gourd displayed significant high percent of seed germination, seedling length, fresh weight, dry weight, speed of germination and vigour as compared to other treatments and unprimed. However less priming time germination and vigour of seeds were decreased. Kamra *et al*. (2017) [12] assessed the effect of seed priming with different chemicals on germination and nursery raising of Ridge Gourd (*Luffa acutangula*) and Summer Squash (*Cucurbita pepo*) at. The seeds of both ridge gourd and summer squash were treated with GA_3 (0.1% and 0.2%) and KNO_3 (0.3% and 0.4%) for 24hrs at room temperature. Untreated seeds of both ridge gourd and summer squash were used as control. After 24hrs of priming, the seeds were surface washed with distilled water. Ten treated seeds of each treatment were then sown in germination tray filled with growing media (coco-peat) and Ten control seeds of both vegetables were sown in plastic cups containing coco peat. Both treated and untreated (control) seeds were then allowed to grow in laboratory for 30 days. Priming with 0.2% GA_3 solution enhanced the germination initiation, percentage of germination, mean germination time and vigour index of ridge gourd and summer squash than unprimed seeds. Average seedling length was higher in 0.3% KNO_3 primed seeds than the other seeds.

Conclusion

This review aimed at compiling priming approach and its effect on vegetable seeds of different genera and family. However it's a low cost technology to practice and to obtain good seed germination in relatively less time and which has a positive impact on seedling growth, vigour and ultimately developing a good plant stand, enhancing quality of all yield attributes. Hydropriming was found effective in crop like cowpea, all types of beans and grams. Among halo priming 0.1M NaCl enhanced growth of beans and among growth regulators GA_3 at all concentration were found effective in mungbean chickpea like crop. GA_3 and KNO_3 performed better than other priming agents when experimented in cucurbitaceous vegetables. Priming with 1% KNO3 salt solution & dried before sowing for 6 hours, performed better than hydro priming. Experimenting with crop like okra it was found hydro priming, biopriming were much efficacious influencing growth and yield parameters in okra. A vivid review of priming with solanaceous vegetable revealed, priming with NaCl reduce adverse effect of salinity when tested with hot pepper. Overally halopriming proved better than hydropriming performed better in other approach by increasing yield in tomato & chilli. Among PGRs GA3 was found superior compelled to any halo & hydropriming experimented in tomato. However biopriming with *T. viride*, *T. harzianum*, *P. flurosens*, *B. subtilis* in tomato seeds were found to perform better than hydro & halo priming may be used to enhance both qualitatively & quantitative performance for seedlings.

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