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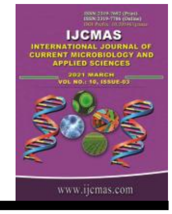

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Impact of Seed Priming on Rice under Anaerobic Germination

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ABSTRACT

Keywords

Rice, Germination, Anaerobic, IAA, KCL

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Present investigation was carried out to study the "Impact of seed priming on rice under anaerobic germination" during wet season, 2017-18. Experiment was laid out in randomized block design with three replication and two varieties Sambha Mahsuri and Sambha Mahsuri Sub1 in cemented pond (size; 20×20×1.25 meter). Primed seeds were direct seeded and field was completely submerged/ flooded, upto 25-30 cm water depth was maintained for one month. Recommended dose of N, P and K @ 120:40:40 Kg ha-1 was reframed with time schedule (1/4 dose of N and full dose of P2O5 and K2O were applied as basal and rest N was applied in there splits i.e. 30, 60 and 90 DAS respectively). Treatments comprised of (T1) Seed priming with GA3 @ 25 ppm, (T2) Seed priming with GA3 @ 50 ppm, (T3) Seed priming with JLE @ 2%, (T4) Seed priming with KNO3@ 0.5%, (T5) Seed priming with KCl @ 0.2%, (T6) Seed priming with NaCl @ 0. 5 %, (T7) Seed priming with IAA @ 0.2 %, (T8) Seed priming with CaCl2 @ 0.1 %, (T9) Control with distilled water. Results indicated that all the priming treatments increased the germination percent, mean germination time and biochemical parameters like total sugar content, reducing and non reducing sugar. However, effect of GA3 @ 50 ppm was found more pronounced followed by GA3 @ 25 ppm on various parameters in both the variety but Sambha Mahsuri Sub1 showed more response of seed priming as compared to that of Sambha Mahsuri.

Introduction

Rice (*Oryza sativa* L., 2n= 24), belongs to the family Poaceae (Graminae). Rice farming is about 10,000 year old and largest single use of land for producing food. Rice fields covers 11% of Earth's entire aerable land. Two rice species are important cereals for human nutrition i.e. Oryza sativa grown worldwide and *Oryza glaberrima* grown in parts of West Africa. Varieties of growth duration ranging from 70 to 160 days exist in diverse environments. Rice is the most important cereal food crop of India. It occupies about 23.3% of gross cropped area of the country and plays vital role in the national food grain supply. Traditionally rice is grown by transplanting nursery seedlings into the puddle field, which requires a continuous supply of water throughout its growth (Farooq *et al.,* 2007). In addition to high water inputs, it demands a high labour cost, particularly at the critical time of transplanting, which not only increases the cost of production but can also result in delayed transplanting due to labour unavailability (Farooq *et al.,* 2011).

Seed priming is a simple and low cost hydration technique in which seeds are partially hydrated to a point where pre-germination metabolic activities start without actual germination and then re-dried until close to the original dry weight. Seed priming is employed for better crop stand and higher yields in a range of crops including rice (Farooq *et al.*, 2009; Kaymak *et al.,* 2009). Priming has been used to improve the performance of germination at the field and potassium nitrate (KNO3) is a promising compound for this purpose. Besides, the priming could also activate the response of the antioxidant system, becoming the primed seeds more prepared for possible stresses Lara *et al.*, (2014). Rehman *et al.,* (2014) conducted an experiment to study the seed priming influence on early crop growth, phonological development and yield performance of Linola in Pakistan. Seeds were treated with 50 mmol/L salicylic acid, 2.2 % CaCl2 and 3.3 % Moringa Leaf Extract (MLE) including untreated dry and hydro-priming control.

Results showed that osmo-priming with CaCl2 reduced emergence time and produce the highest seedling fresh and dry weight including chl.a content. It also reduced crop branching and flowering and maturity time and had the maximum plant height, number of branches, tillers, pods and seeds per pod followed by MLE. An increase in seed weight, biological and seed yields were 9.30, 34.16 and 39.49 %, harvest index (4.12%) and oil content (13.39%) with CaCl2 osmo priming. It concludes that seed osmopriming with CaCl2 and MLE can play significant role to improve early crop growth and seed yield of linola.

Materials and Methods

The present investigation was carried out in *Kharif* season, during 2017-2018 at the Research Farm of Department of Crop Physiology, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad -224229 (U.P.) India. The present site is located at main campus of university. Faizabad district falls in semiarid zone, receiving a mean annual rainfall of above 1100 mm, in which about 80% of the total precipitation is required during monsoon season, July to end of September with few showers in winter. The winter months are cold and occasionally frosts occurs during this period and summers are hot and dry. Solutions of desired concentrations of GA3, JLE, KNO3, KCl, NaCl, IAA and CaCl2 were prepared. After that bold and healthy seeds of two genotype of rice were primed in the solution for 6 to 8 hours. Seeds were dried for six hour in shade after drain out solution. Non primed seeds were taken as untreated control. Seed germination was recorded as rate as well as percentage during successive period of germination. It was recorded daily up to 15 days. Seed germination was calculated according given formula:

$$\textbf{Germination \%} = \frac{\text{Number of seed germinated}}{\text{Total number of seeds}} \times 100$$

Germination test was conducted by following the procedure outlined by ISTA (1999) using liquid medium. Three replicates of 20 seeds each were germinated at room temperature at (25±2 ºC) temperature and 95±3% RH using liquid medium. Germination was counted in 24 hrs continued until no further germination occurred. At the end of fifteenth day, the number of normal seedlings in each replication were counted and expressed in percentage. Speed of germination was calculated based on the following formula of Maguire (1962). Chlorophyll content of leaf was directly measured from intact leaves through microprocessor plant efficiency analyzer Model: XSS / MPEA. The total soluble sugar of, 2nd,, 4th,, 6th and 8th, 10th, 12th, 14th, 18th day old seedling was estimated by the method described by Yemm and Willis (1954).

Results and Discussion

Germination % and speed of germination

Tolerance to anaerobic conditions during germination is a complex trait controlled by several families of genes that are involved in essential processes such as breakdown of starch, glycolysis fermentation and other biochemical and metabolic processes (Bailey-serres and Chang 2005; Ismail *et al.,* 2009, 2012). The breakdown of starch is a complex biochemical process modulated by both hormonal and metabolic regulations (Perata *et al.,* 1997). Amylases are the key enzymes for starch degradation in germinating seeds and rice varieties that have greater ability to degrade starch even under oxygen degradation through successful production of alpha amylase are more likely to vigorously germinate and survive the stress(Loreti *et al.,* 2003).

Key enzyme in the alcoholic fermentation pathway, alcohol dehydrogenase (ADH) and pyruvate decorboxylase (PDC) are induced by anoxia stress (Recard *et al.,* 1986). This pathway recycles nicotina mide adenine dinucleotide (NAD) to maintain glycolysis and substrate level phosphorylation which could provide energy for successful germination through coleoptile elongation in the absence of oxygen.

Seed priming with various sources like hormones, chemicals, aqueous plant extracts and cow urine registered increase in germination percent, speed of germination as compared to non-primed seeds in both the varieties at all stages of observation however the magnitude of the effect of various priming sources was higher in Sambha Mahsuri Sub 1 as compared to Sambha Mahsuri. Among all the seed priming treatments the maximum increase in germination % and speed of germination was found in GA3 @ 50 ppm followed by GA3 @ 25 ppm and minimum was found in IAA @ 0.2 % (Fig-1a, Fig-1b and Fig-2). This result corroborates with the findings of Harmeet Singh *et al.,* (2015) reported that germination and seedling emergence are the critical stages in the life cycle of rice. Insufficient seedling emergence and inappropriate stand establishment are the main constraints in the production of crops which receiving less rainfall It is well accepted fact that priming improves germination, reduces seedling emergence time and improves stand establishment. A method to improve the rate and uniformity of germination is the priming or physiological advancement of the seed lot. The general purpose of seed priming is to partially hydrate the seed to a point where germination processes are begun, but they would exhibit rapid germination when re-imbibed under normal or stress conditions. Similar results were also observed by Sharma and Saran (1992) reported that seed germination is highest in seeds primed with GA3 @ 40 ppm and concluded that the germination rates with GA3 were higher than in the control or NAA treatment. Kaya *et al.,* (2006) reported that primed seeds had more rapid water uptake abilities than untreated seeds in sunflower. Priming may improve germination by accelerating imbibition, which in turn would facilitate the emergence phase and the multiplication of radicle cells. Bewley and Black (1999) reported that priming allows the hydration of membranes and proteins, and the initiation of various metabolic systems. These are arrested when the seeds are dried or moisture is with held, but recommence when the seeds imbibe water for the second time. This positive response of seed priming is consistent with the findings of Coolbear and Grierson (1982) who reported that higher germination rate was a result of higher levels of nucleic acid in primed seeds of tomato cultivars. They indicated that increase in nucleic acid content in primed seeds was due to an enhanced ribonucleic acid (RNA) synthesis during and after priming treatment. According to Gray *et al.*, (1979) seed priming modifies the embryonic axis growth and consequently seedling development.

Fig.1(a) Effect of seed priming on germination (%) under anaerobic condition on Sambha Mahsuri Sub 1

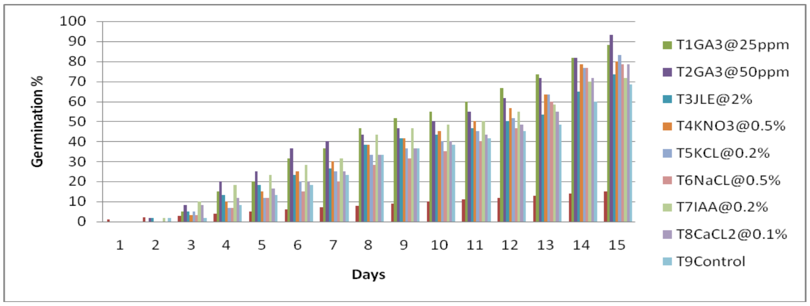


Fig.1(b) Effect of seed priming on germination (%) under anaerobic condition on Sambha Mahsuri

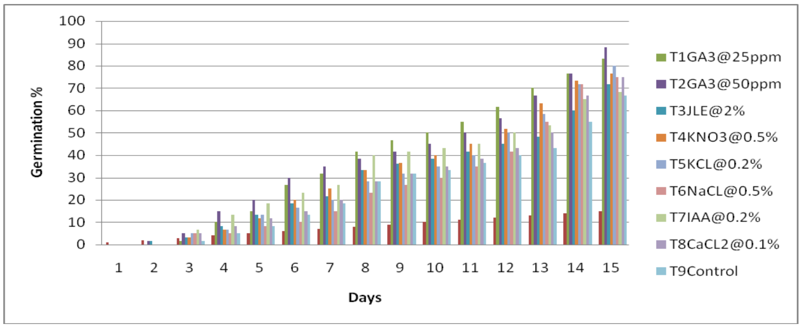


Fig.2 Effect of seed priming on Speed of germination under anaerobic condition on rice seedling

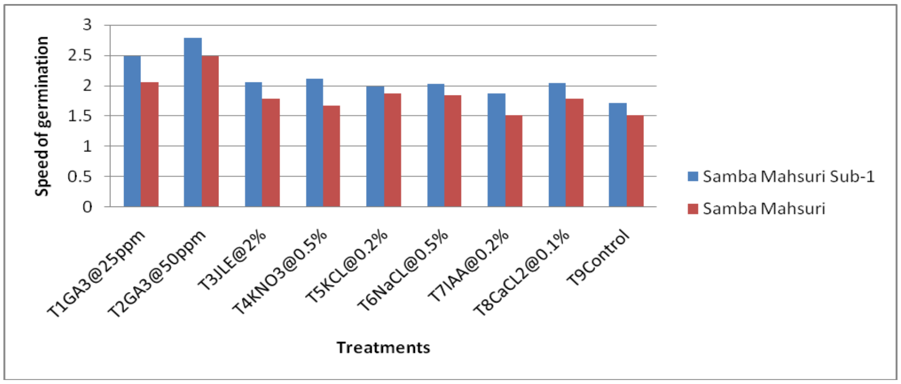


Fig.3(a) Effect of seed priming on total sugar content (mg g^{-1} dry wt.) under anaerobic condition on Sambha Mahsuri Sub 1

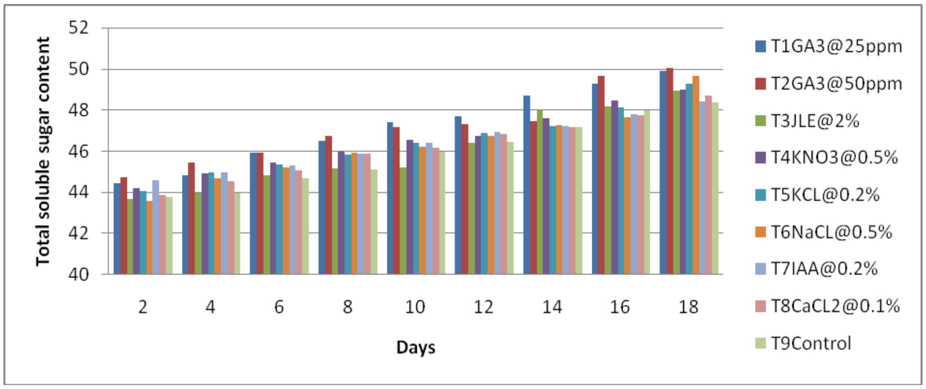


Fig.3(b) Effect of seed priming on total sugar content (mg g^{-1} dry wt.) under anaerobic condition on Sambha Mahsuri

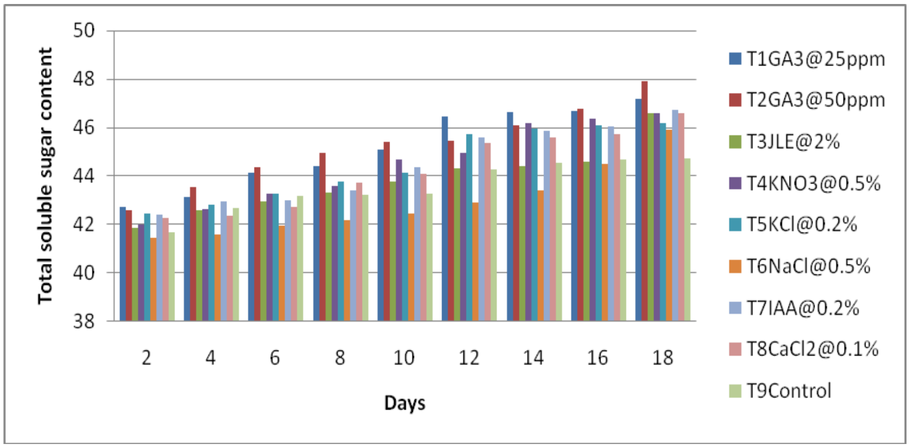


Fig.4(a) Effect of seed priming on reducing sugar content (mg g^{-1} dry wt.) under anaerobic condition on Sambha Mahsuri Sub 1

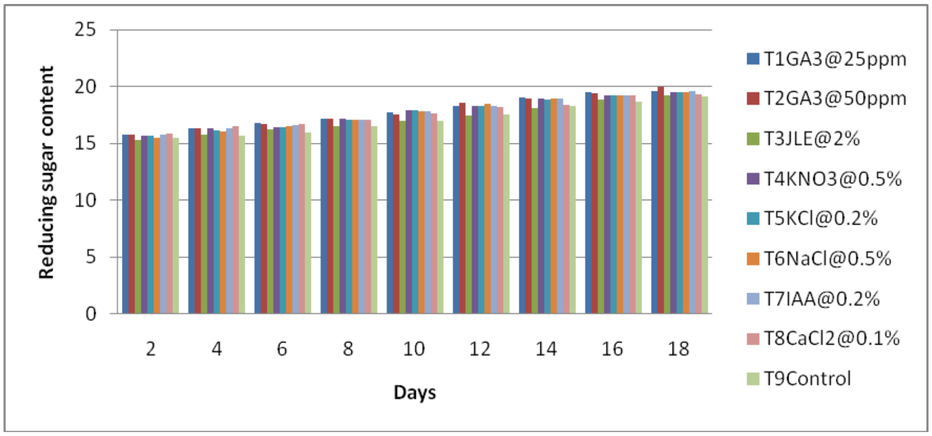
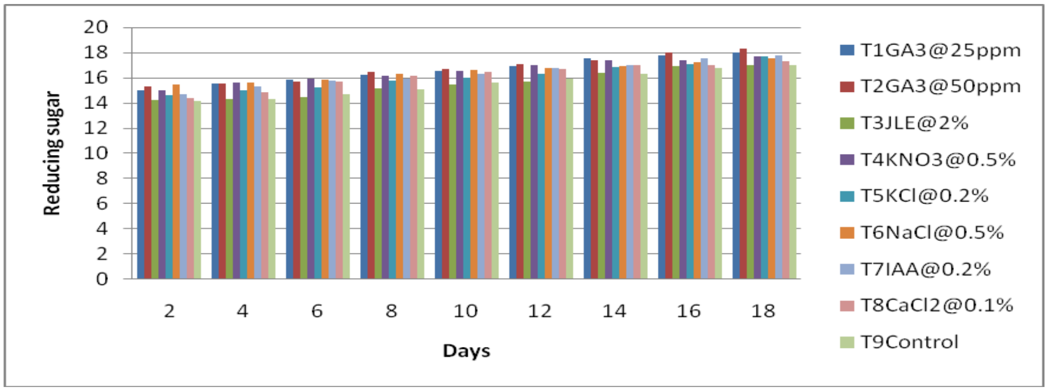


Fig.4(b) Effect of seed priming on reducing sugar content (mg g^{-1} dry wt.) under anaerobic condition on Sambha Mahsuri



Biochemical studies

Total soluble sugars (mg g-1 dry wt.)

Among all the treatments, GA3 @ 50 ppm showed maximum increase in total soluble sugars followed by GA3 @ 25 ppm and minimum was found in IAA @ 0.2% (Fig-3a and Fig-3b) in both varieties under anaerobic condition at all the time hours of observation. The results are in accordance with the findings of Xu *et al.,* 1986 showed that primed seeds has higher sugar content as compared to non primed seeds under stress condition which might mitigate the adverse effect caused due to stress. Similar results were also found by Samih M. Tamimi (2016) observed higher total soluble sugars in primed seeds as compared to the non primed seeds under stress condition.

Reducing and non-reducing sugar content (mg g-1 dry wt.)

Seed priming treatments also enhances the reducing and non reducing sugar contents under anaerobic condition in both the varieties but Sambha Mahsuri Sub 1 showed higher value of reducing and non-reducing sugar contents in primed seeds as compared to that of Sambha Mahsuri. GA3 @ 50 ppm showed higher reducing and non-reducing sugar content under anaerobic condition in both varieties followed by GA3 @ 25 ppm and minimum was found in IAA @ 0.2 % (Fig-4a and Fig-4b) at all time hours in both the varieties under anaerobic condition. It is generally reported that the reducing sugar content of seeds increases during the early hours of primed seeds showed much higher reducing sugar content than non-primed seeds.

On the basis of above findings following useful conclusions both having fundamental and applied values may be drawn that seed priming with GA3 @ 50 ppm showed higher germination % and speed of germination in both the variety under anaerobic condition but the effect was greater in Sambha Mahsuri Sub1. Maintenance of higher total soluble sugars, reducing sugars, non reducing sugars, protein contents and chlorophyll content under anaerobic condition seem better feature for tolerance to anaerobic condition. Seed priming with different chemicals of different concentration was helpful in mitigating the detrimental effect of anaerobic condition and influences the germination, growth, biochemical changes and yield of both rice varieties under anaerobic condition. Seed priming with GA3 @ 50 ppm can be used as a tool to increase the germination and yield of rice.

References

Afzal I, Hussain B, Basra S M A, and Rehman H U. (2012). Priming with moringa leaf extract reduces imbibitional chilling injury in spring maize. Seed Sci Technol, 40: 271–276.

Afzal, I., Basra, S. M. A., Shahid, M., Farooq, M. and Saleem, M. (2008). Priming enhances germination of spring maize (*Zea mays* L.) under cool conditions. Seed Science and Technology, 36, 497-503.

Austin, R.B.; Margin, B.B.; Ford, M.A. and Blackbell, R.D. (1980). Contribution to grain yield from pre-anthesis assimilation in tall and dwarf genotype in two contrasting season. Ann. Bot. (London) 45: 309-319.

Basra SMA, Farooq M, Tabassum R, Ahmad N (2005) Physiological and biochemical aspects of seed vigor enhancement treatments in fi ne rice. Seed Sci Technol 33: 623-628.

Bewley JD and Black M: (1999). Physiology and biochemistry of seeds in relations to germination. Vol. 2, Springer-Verlag, Berlin, 1982.

Bradford, K.J. (1986). Manipulation of seed water relations via osmotic priming to improve germination under stress conditions. Hort. Science. 21:1105–1113.

Das, K.K.; Sarkar, R.K. and Ismail A.M. (2005). Elongation ability and on-structural carbohydrate level in relation to submergence tolerance in rice. Plant Science, 168: 131-136.

Douglas I. (2009) Climate change, flooding and food security in south Asia. Food Sec, 1: 127–136.

Farooq M, Basra S M A, Tabassum R, and Afzal I. (2006). Enhancing the performance of direct seeded fine rice by seed priming. Plant Prod Sci, 9(4): 446–456.

Farooq M, Basra SMA, Wahid A, Khaliq A, Kobayashi N (2009) Rice seed invigoration. In: (Ed. E Lichtfouse), Sustainable Agriculture Reviews-Book Series Springer.

Farooq M, Siddique K.H.M, Rehman H, Aziz T, Wahid A, Lee D. (2011). Rice direct seeding: experiences, challenges and opportunities. Soil till Res, 111: 87-98.

Farooq, M., S.M.A. Basra and M.B. Khan, (2007a) Seed priming improves growth of nursery seedling and yield of transplanted rice. Arch. Agron. Soil. Sci., 53: 311-322.

Farooq, M., S.M.A. Basra, R. Tabassum and I. Afzal, (2006). Enhancing the performance of direct seeded fine rice by seed priming. Plant Prod. Sci, 9: 446–456.

Hafeez Ur Rehman, Muhammad Kamran, Shahzad Maqsood Ahmed Basra, Irfan Afzal and Muhammad Farooq (2015). Influence of Seed Priming on Performance and Water Productivity of Direct Seeded Rice in Alternating Wetting and Drying, Rice Science, 22 (4): 189-196.

Harmeet Singh, Rupinder Kaur Jassal and J.S. Kang, S.S Sandhu, Harrajdeep Kang1 and Kamaljit Grewal (2015) Seed priming techniques in field crops, accr Journals, 36 (4): 251-264.

Hayat, S., Hayat, Q., Alyemeni, M. N., Wani, A. S., Pichtel, J. & Ahmad, A. (2012). Role of proline under changing environments. Plant Signal Behav. 7(11), 1456–1466.

Hossain, M. M., Miah G., Ahamed T. and Sarmin N. S., (2012). Allelopathic effect of *Moringa oleifera* on the germination of Vigna radiate. Intl J Agri Crop Sci. 4 (3), 114-121.

Iqbal, M., Ashraf, M., Jamil, A. and Rehmaan, S. (2006). Does seed priming induce changes in the level of some endogenous plant hormones in hexaploid wheat plant under salt stress? J Int Pl Bio. 48181-89.

Ismail AM, Ella ES, Vergara GV and Mackill DJ. (2009). Mechanisms associated with tolerance for flooding during germination and early seedling growth in rice (*Oryza sativa*). Annals of Botany 103: 197–209.

Joshi, R., Rao, M. V and Baisakh, N. (2013) Arabidopsis plants constitutively overexpressing a myo-inositol 1-phosphate synthase gene (SaINO1) from the halophyte smooth cordgrass exhibits enhanced level of tolerance to salt stress. Plant Physiol. Bioche. 65, 61–66.

Kamran Iqbal Shinwari, Mehmood Jan, Gulmeena Shah1, Sehrish riaz Khattak, Shafiq Urehman, M.K. Daud, Rehan Naeem and Muhammad Jamil (2015). Seed priming with salicylic acid induces tolerance against chromium (vi) toxicity in rice (*Oryza sativa* L.). Pak. J. Bot., 47(si): 161-170.

Kaya MD, Okcu G, Atak M, and Cikili Y, Kolsarici (2006). Seed treatments to overcome salt and drought stress during germination in sunflower (*Helianthus annuus* L.). Eur. J. Agron. 24: 291-295.

Kaymak *et al.,* (2009).The effects of bio-priming with PGPR on germination of radish (Raphanus sativus.) seeds under saline condition. Turk J Agricfor 33: pp173-179.

Khan, H. A., Ayub, C. M., Pervez, M. A., Bilal, R. M., Shahid, M. A. and Ziaf, K. (2009). Effect of seed priming with NaCl on salinity tolerance of hot pepper (*Capsicum annuum* L.) at seedling stage. Soil Environ. 28: 81-87.

Kiran, Kumar, K.A.; Patil, B.C. and Chetti, M.B. (2005). Effect of plant growth regulators on physiological components of yield in hybrid cotton. Indian J. of Pl. Physiol., 10 (2): 187-190.

Kumar, A., Gangwar, J. S., Prasad, S. C. and Harris, D. (2002). On farm seed priming increases yield of direct-sown finger millet in India. Intl. Sorghum Millets News. 43: 90-92.

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