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Standardization of suitable concentration and duration of seed biopriming with humic acid in chilli

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Abstract
Laboratory experiment was carried out to standardize the suitable concentration and duration of seed biopriming with humic acid to improve seed germination and seedling vigour. To optimise the concentration and duration of bio-priming, seeds were bio-primed with humic acid at 5, 10, 15 and 20 % for 3, 6, 9 and 12 h. Seeds were also hydro-primed for 3, 6, 9 and 12 h and non-primed seeds were used as controls. The result revealed that seed bioprimed with humic acid 10% for 9h was found to be the best biopriming treatment which improved the speed of germination, germination percentage, seedling length, dry matter production, vigour index over nonprimed seed.

Keywords: Chilli seeds, humic acid, germination and vigour

Introduction
Vegetables have a vital role in basic as well as nutritional security in the wake of the present global call for eliminating malnutrition. Per capita consumption of vegetables in India is very low against WHO standards (183$g^{-1}day^{-1}$ $capita^{-1}$ against 280 $g^{-1}day^{-1}$ $capita^{-1}$) recommended by FAO, (2007) [8]. Chilli (*Capsicum annuum* L.) belongs to Solanceae family, is famous for its pleasant aromatic flavour, pungency and high colouring substance. India is the largest producer, consumer and exporter of chilli, which contributes to about 40% of total world production. Next to India, China is the major producer of chilli in the world. In India, chillies are grown in almost all the states. Andhra Pradesh is the largest producer of chilli in India contributing to about 44% to the total production, followed by Karnataka (12%), West Bengal (8%), Madhya Pradesh (7%), Maharashtra (4%) and Tamil Nadu (2%).

Chilli is low volume and high value seed. The seed cost ranges from Rs. 1,000 (seeds of variety) to Rs. 30,000/kg of seed (hybrid seed), which is an heavy investment on inputs for the vegetable growers. Since the seed cost is very huge, it is important for the farmers to get a good and healthy plantable seedlings from each and every seed sown by him. Besides, delayed and erratic emergence is a serious problem in chilli that creates the production of non-uniform seedling with poor seedling vigour in the nursery (Demir and Okcu, 2004) [7]. Moreover, the seedlings of chilli in the nursery are easily attacked by the damping off which necessiates a suitable ecofriendly presowing seed treatment. Therefore, the treatments carried out before sowing, as seed priming, can be very useful not only for faster, rapid and synchronized germination and emergence with better performance, but also for protecting the seedling against seed and soil borne pathogens.

Biopriming is a process of biological seed treatment that refers combination of seed hydration (Physiological aspect of disease control) and inoculation (Biological aspect of disease control) of seed with beneficial organism to protect seed. It is an ecological approach using selected fungal antagonists against the soil and seed borne pathogens. Biological seed treatments may provide an alternative to chemical control. Seed may be planted moist or dried for storage. Biopriming improved the germination rate and uniformity and reduced the emergence time of many vegetables and some field crops (Kalaivani, 2010; Kavitha, 2011; Mariselvam, 2012, Ananthi *et al.,* 2014a, 2014b and Sarathkumar *et al.,* 2016) [12, 14, 17, 3, 4, 22]. The lack of research on biopriming of seeds with humic acid particularly their effects on germination, seedling vigour and establishment of seedling warrants a study to investigate the beneficial effects of seed biopriming using humic acid.

Materials and methods

Genetically pure, fresh seeds of the chilli (*Capsicum annuum* L) 'PKM 1' were obtained from Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore, Tamil Nadu and used in this study. Commercial grade humic acid was purchased from Centre for Applied Research and Development, Neyveli Lignite Corporation limited, Neyveli. The laboratory study was carried Out at the Department of Seed Science and Technology, Tamil Nadu Agricultural University, Coimbatore during 2013.

The extracts measuring 100% concentration were prepared by immersing the humic acid equal volume of water. Then, humic acid was diluted to prepare 5, 10, 15 and 20% concentrations. Seeds of chilli were soaked in equal volume of respective concentration in each of humic acid treatments. The seeds were hydroprimed with water and nonprimed seeds formed the control. After soaking, the seeds were removed from the solutions and shade dried at room temperature for assessing the following seed quality parameters.

Speed of germination

Four replicates of twenty five seeds each were used to test the speed of germination of seeds from different treatments. The seeds showing radicle protrusion were counted daily from fifth day for tomato and seventh day for chilli after sowing until fourteenth day for tomato and chilli. From the number of seeds germinated on each day, the speed of germination was calculated using the following formula and the results were expressed in number (Maguire, 1962).

$$\text{Speed of germination} = \frac{X_1}{Y_1} + \frac{X_2 - X_1}{Y_2} + \ldots\ldots\ldots + \frac{X_n - X_{n-1}}{Y_n}$$

X_1- Number of seeds germinated at first count
X_2- Number of seeds germinated at second count
X_n- Number of seeds germinated on n^{th} day
Y_1- Number of days from sowing to first count
Y_2- Number of days from sowing to second count
Y_n- Number of days from sowing to n^{th} count

Germination

The germination test was conducted by following the procedure outlined in ISTA (1999) [11] using paper (between paper) medium. Four replicates of 100 seeds each were germinated in a germination room maintained at 25±2°C temperature and 90±3% RH. At the end of fourteenth day of sowing, the number of normal seedlings in each replication was counted and the germination was calculated and expressed in percentage.

Root length

At the time of germination count, ten normal seedlings were selected at random from each replication and used for measuring the root length of seedlings. Root length was measured from the point of attachment of seed to the tip of primary root. The mean values were calculated and expressed in centimeter.

Shoot length

The seedlings used for measuring root length were also used for measuring shoot length. The shoot length was measured from the point of attachment of seed to tip of the leaf and the mean values were expressed in centimeter.

Dry matter production

The ten normal seedlings were placed in a paper cover and dried in shade for 24h and then, they were kept in an oven maintained at 103±2°C for 16±1h. The dried seedlings were weighed and the mean values were expressed in g 10 seedlings^{-1}.

Vigour index

Vigour index values were computed using the following formulae and the mean values were expressed in whole number (Abdul-Baki and Anderson, 1973) [1].

Vigour index = Germination percentage x Total seedling length (cm).

Statistical analysis

The data obtained from different experiments were analysed for the 'F' test of significance following the methods. Wherever necessary, the per cent values were transformed to angular (Arc-sine) values before analysis. The critical differences (CD) were calculated at 5 percent probability level. The data were tested for statistical significance. If the F test is non-significant, it was indicated by the letters NS.

Results and Discussion

The result revealed that, there is a statistically significant variation was observed for speed of germination, germination, root and shoot length, dry matter production and vigor index due to priming treatment, duration of biopriming and its interaction effect. The seeds bioprimed with humic acid 10% for 9h registered higher speed of germination (10.2) and germination (95%) than nonprimed seed. An increase of 16% was noticed for germination due to humic acid biopriming over nonprimed seed (Table 1).

Table 1: Effect of biopriming with humic acid on germination (%) of chilli seeds

Biopriming treatments (T)	Germination (%)				
	Soaking duration in h (D)				
	12	18	24	30	Mean
Control	79 (62.72)	79 (62.72)	79 (62.72)	79 (62.72)	79 (62.72)
Hydropriming	81 (64.15)	82 (64.89)	84 (66.42)	82 (64.89)	82 (64.89)
Humic acid5%	87 (68.86)	88 (69.73)	90 (71.56)	87 (68.86)	88 (69.73)
10%	89 (70.63)	92 (73.57)	95 (77.08)	90 (71.56)	92 (73.57)
15%	85 (67.21)	85 (67.21)	89 (70.63)	84 (66.42)	86 (68.02)
20%	79 (62.72)	82 (64.89)	84 (66.42)	81 (64.15)	82 (64.89)
Mean	83 (65.65)	85 (67.21)	87 (68.86)	84 (66.42)	
		T	D	T x D	
SED		0.24	0.21	0.48	
CD (P=0.05)		0.48	0.43	0.97	

Figures in parentheses indicate arcsine values

Humic acid 10% bioprimed Seed for 9h measured the longest root (9.6 cm) and Shoot (4.9 cm) while the shortest root and shoot was Observed in nonprimed seed (7.0 and 3.9 cm, respectively). Seeds bioprimed with 10% humic acid for 9h produced higher drymatter production (0.041 g/10 Seedlings) and lower (0.013 g/10 seedlings) was recorded in nonprimed Seed. This treatment also registered more vigor index (1406) when compared to other treatments. The vigor index value of control was 861 (Table 2).

Table 2: Effect of biopriming with humic acid on vigour index of chilli seeds

Bio priming treatments (T)	Vigour index				
	Soaking duration in h (D)				
	12	18	24	30	Mean
Control	861	861	861	861	861
hydro priming	1004	1009	1042	1000	1014
Humic acid 5%	1209	1250	1305	1227	1248
10%	1264	1334	1406	1305	1327
15%	1131	1156	1255	1142	1171
20%	1019	1091	1151	1069	1082
Mean	1081	1117	1170	1101	
		T	D	T x D	
SEd		15.83	14.15	31.66	
CD (P=0.05)		31.66	28.32	63.32	

Sera and Novak (2011) [23] also observed greatest germination stimulation effect of 20% in *Chenopodium album* seeds germinated with commercial and lignite humic acid. Similar stimulatory effects were also reported by Asenjo *et al*. (2000) [5] stating that humic acid shortened the period of seed germination. Humic acid is found to increase the water absorption, respiration, oxygen uptake, permeability of cell membrane and cell elongation (Russo and Berlyn, 1990) [21]. Humic fractions have been shown to influence biochemical and physiological processes during germination, thus stimulating the process of seed germination and seedling growth in different crops (Olk *et al*., 2007) [18].

The increase in root and shoot growth as noticed due to humic acid biopriming could be attributed to stimulatory effect of humic acid on respiration, cell elongation, more efficient water uptake and membrane permeability (Lulakis and Petsas, 1995) [16]. Many researchers reported that seed treatment with humic acid increase the seedling length (Hartwigsen and Evans, 2000 [10] in geranium and marigold); (Killi, 2004 in cotton) [15]; (Zandonadi *et al*., 2007 in maize) [24]; (Patil *et al*., 2010 in wheat) [20]; (Patil and Wadje 2011 in soybean) [19]; (Gulser *et al*., 2010 in vegetables) [9] and (Karthika, 2011 in maize) [13]. Akinci *et al.* (2009) [2] observed an increase in root development due to humic acid application which might be attributed to membrane permeability of root cells and uptake of nutrients transport. Enhancement of lateral roots in maize might be due to activating cell membrane when maize seed was treated with humic acid as observed by Zandonadi *et al*. (2007) [24].

The relative increases in drymatter production, vigour index observed in this study are in agreement with the findings were broad bean (Akinci *et al*., 2009) [2], soyabean, tomato and cucumber (Atiyeh *et al*., 2002) [6].

Conclusion

It is summarized from this study that, humic acid 10% biopriming for 9h found to be the best and suitable seed biopriming treatments for enhancing the germination and seedling vigor of chilli.

References

1. Abdul-Baki AA, Anderson JD. Vigour deterioration of soybean seeds by multiple criteria. Crop Sci. 1973; 13:630-633.
2. Akinci S, Buyukkeskin T, Eroglu A, Erdogan BE. The effect of humic acid on nutrient composition in broad bean (*Vicia faba* L) roots. Not. Sci. Biol. 2009; 1(1):81-87.
3. Ananthi M, Selvaraju P, Sundaralingam K. Effect of bio-priming using bio-control agents on seed germination and seedling vigour in chilli (*Capsicum annuum* L.) 'PKM 1'. Journal of horticultural science and biotechnology. 2014 a; 89(5):564-568.
4. Ananthi M, Selvaraju P, Sundaralingam K. Study of Biopriming Using Liquid Biofertilizers in Chilli cv PKM 1 Seeds. Environment & Ecology. 2014b; 32(3A):1172-1177.
5. Asenjo MCG, Gonzalez JL, Maldonado JM. Influence of humic extracts on germination and growth of ryegrass. Commun. Soil Sci. Plant. Anal. 2000; 31:101-114.
6. Atiyeh RM, Lee S, Edwards CA, Arancon NQ, Metzger JD. The influence of humic acids derived from earthworm processed organic wastes on plant growth. Bioresource Technology. 2002. 84:7-14.
7. Demir I, Okcu G. Aerated hydration treatment for improved germination and eedling growth in aubergine (*Solanum melongena*) and pepper (*Capsicum annuum*). Ann. Appl. Biol. 2004; 144:121-123.
8. Fao. Faostats Database. FAO, Rome, 2007.
9. Gulser F, Sonmez F, Sibel B. Effect of calcium nitrate and humic acid on pepper seedling growth under saline condition, J. Environ. Biol. 2010; 31:873-876.
10. Hartwigsen JA, Evans MR. Humic acid seed and substrate treatments promote seedling root development. Hort. Sci. 2000; 35:1231-1233.
11. ISTA. International Rules for Seed Testing. International Seed Testing Association, Bassersdorf, Switzerland, 2009.
12. Kalaivani S. Seed biopriming studies with biocontrol agents and liquid biofertilizers in COH (M) 5 maize hybrid. M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, 2010.
13. Karthika G. Seed biopriming using enriched humic acid with biocontrol agents in maize hybrid COH (M) 5. M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, oimbatore, 2011.
14. Kavitha S. Biopriming with biocontrol agents and liquid biofertilizers for rice seed cv. ADT 43. M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, 2011.

15. Killi F. Effects of potassium humate solution and soaking periods on germination characteristics of undelinted cotton seeds (*Gossypium hirsutum* L.). J. Environ. Biol. 2004; 25:395-398.
16. Lulakis MD, Petsas SI. Effect of humic substances from vine canes mature compost on tomato seedling growth, Bioresource Technology. 1995; 54:179-182.
17. Mariselvam D. Biopriming with biocontrol agents and liquid biofertilizers for bhendi seed cv. ADT 43. M.Sc. (Ag.) Thesis, Tamil Nadu Agricultural University, Coimbatore, 2012.
18. Olk DC, Samson MI, Gapas P. Inhibition of nitrogen mineralization in young humic fractions by anaerobic decomposition of rice crop residuum. Eur. J. Soil Sci. 2007; 58:270-281.
19. Patil RB, Wadje SS. Effect of potassium humate and deproteinised juice on seed germination and growth of *Glycine max* and *Phaseolus mungo*. Bioscience Discovery. 2011; 2(1):72-75.
20. Patil RB, Mokle SS, Wadje SS. Effect of potassium humate on seed germination, seedling growth and vegetative characters of *Triticum aestivum* (L).cv. Lokvan. International Journal of Pharma and Bio Sciences. 2010; 1(1):1-4.
21. Russo RO, Berlyn GP. The use of organic bio stimulants to help low input sustainable agriculture. J. Sustainable Agric. 1990; 1(2):19-42.
22. Sarathkumar A, Malarkodi K, Ananthi M. Effect of seed priming on seed germination and vigour in Turkey Berry (*Solanum torvum* Sw.). International journal of science and nature. 2014; 7(2):390-393.
23. Sera B, Novak F. The effect of humic substances on germination and early growth of Lamb's Quaters (*Chenopodium album*). Biologia. 2011; 66(3):470-476.
24. Zandonadi DB, Canellas LP, Facanha AR. Indolacetic and humic acids induce lateral root development through a concerted plasmalemma and tonoplast H^+ pumps activation, Planta. 2007; 225:1583-1595.