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Relative Efficacy of Seed Priming with Vermiwash, Growth Regulators and Bio-controlling Agents in Response to Germination and Invigoration of Okra (*Abelmoschus esculentus L.*)

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In a field experiment, two varieties of Okra *viz*: MIS077 and BHINDI No-10 were primed with vermiwash @ 20% and 50% , growth regulators *i.e.* Indole-3-acetic acid @ 50ppm and 100ppm, Gibberellic acid @ 50ppm and 100ppm, Kinetin @ 50ppm and 100ppm and bio-controlling agents *i.e. Trichoderma viride* and *Trichoderma harzianum* v/w for 8 h and one unprimed set was also maintained as control. Seeds after shade drying were tested in three replicates. Observations in respect of seed germination, root and shoot length and seedling dry weight were recorded at initial stage and vigour index I & II was calculated. On the basis of data recorded it is concluded that priming of Okra seeds with all above-mentioned treatments improves seed germination, seedling length, dry weight. Vigour index I which is the multiple of germination % and seedling length and vigour index II that is the multiple of germination % and seedling dry weight was found to be enhanced over unprimed control in both the varieties evaluated. Among all vermiwash @50 % showed significantly superior values for all the above-mentioned characters over rest of treatments.

Key words: Okra, Seed priming, vermiwash, Growth regulators, bio-controlling agents.

Okra is an important vegetable crop grown in India as well as in different tropical and sub-tropical part of the world. It is economically suitable for cultivation in Indian kitchen garden and also for large-scale commercial production.

Okra is a powerhouse of valuable nutrients, nearly half of which is soluble fiber in the form of gums and pectin. Soluble fiber helps to lower serum cholesterol, reducing the risk of heart disease. The other half is insoluble fiber which helps to keep the intestinal tract healthy, decreasing the risk of some forms of cancer, especially colorectal cancer. It's high iodine contents control goiter. Okra provides an important source of vitamins, calcium, potassium and other mineral matters which are often lacking in the diet of developing countries (IBPGR, 1990). Being such an important crop there is the need of enhancement in okra production. Now a day's researchers are using various growth regulators as well as bio-controlling agents for enhancing the crop productivity and also getting positive effect with that but these treatments were not easily available for the poor farmers and also to overcome from this problem vermiwash is a great alternative as it contain plant growth hormones like auxins and cytokinin apart from that also containing nitrogen, phosphorus, potash and other micronutrients. It contains nitrogen-fixing bacteria like *Azotobacter sp*., *Arobactericum sp*. and *Rhizobium sp*. and some phosphate solubilising bacteria. It acts as a

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plant tonic and helps to reduce many plant diseases. The present study was therefore carried out to evaluate the effect of vermiwash overgrowth regulators and bio-controlling agents through the method of priming.

MATERIALS AND METHODS

Seeds of two Okra varieties viz: MIS077(V_1) and BHINDI No-10(V_2) were surface sterilized with 0.1% of $Ca(OCl)_2$ for five minutes which will be treated through the method of priming with vermiwash @ 20%(T_1) and 50%(T_2), growth regulators *i.e.* Indole-3-acetic acid @ 50ppm(T_3) and 100ppm(T_4), Gibberellic acid @ 50ppm(T_5)and 100ppm(T_6), Kinetin @ 50ppm(T_7) and 100ppm(T_8) and bio-controlling agents *i.e.Trichoderma viride*(T_9) and *Trichoderma harzianum*(T_{10}) v/w for 8 h. Seeds were taken out from the solution and allowed for shade drying. One set of unprimed control (T_0) was also maintained simultaneously. After shade drying primed and unprimed seeds of each variety were tested by using between the paper methods with three replications according to ISTA rules (Anon., 1999). Germination and root/ shoot length were recorded after 7th days and at the same time; the fresh seedlings (root+shoot) were kept for drying in the oven at 80°C. Dried samples were weighed with an electronic balance and vigour index I & II was calculated by following the method of Abdul-baki and Anderson (1973) as germination percent x seedling length and germination percent x seedling dry weight respectively. Data obtained were analyzed following the statistical procedure as described Panse and Sukhatame (1973).

RESULTS AND DISCUSSION

Effect of priming treatment on growth parameters

A study was undertaken for improving the germination, stand establishment and growth of okra crop through employing the seed priming techniques. One open pollinated (OP) okra variety (MIS 077) and one hybrid okra variety (Bhindi No. 10) were primed with vermiwash @ 20% and 50%, growth regulators IAA, GA_3, Kinetin @ 50 ppm and 100 ppm, and bio-controlling agents *Trichoderma viride and Trichoderma harzianum*. According to the obtained results primed okra seeds significantly enhanced the germination %, seedling length (cm.), dry weight (g.) and vigour in both the OP and hybrid variety of okra over unprimed control.

Table 1. Showing the response of priming on germination percentage, Seedling length, and Dry weight in Okra

Treatments	Germination%			Seedling length(cm.)			Dry weight(g.)		
	MIS 077(V_1)	Bhindi No.10 (V_2)	Mean	MIS 077 (V_1)	Bhindi No.10 (V_2)	Mean	MIS 077 (V_1)	Bhindi No.10 (V_2)	Mean
Control (T_0)	70.3	80.6	75.5	22.8	23.9	23.35	1.37	1.47	1.42
Vermiwash 20% (T_1)	75.3	84.3	79.83	28.9	29.1	29	1.70	1.74	1.72
Vermiwash 50% (T_2)	95.6	97.3	96.5	31.3	31.5	31.4	2.34	2.52	2.43
IAA@50 ppm (T_3)	72.3	82.3	77.335	29.7	28.8	29.25	1.48	1.55	1.515
IAA@100 ppm (T_4)	82.6	87.6	85.165	30.2	30.0	30.1	1.88	1.79	1.835
GA_3@50 ppm (T_5)	76.6	83.0	79.8	28.3	26.2	27.25	1.57	1.54	1.555
GA_3@100 ppm (T_6)	88.0	91.0	89.5	28.9	29.0	28.95	1.98	1.96	1.97
Kinetin@50 ppm (T_7)	78.0	85.3	81.665	26.1	27.5	26.8	1.64	1.66	1.65
Kinetin@100ppm (T_8)	92.0	93.6	92.83	26.9	28.5	27.7	1.99	2.00	1.995
T.viride (T_9)	81.6	87.6	84.66	26.1	27.9	27	1.73	1.89	1.81
T. harzianum (T_{10})	82.0	89.3	85.665	28.7	28.6	28.65	1.84	1.90	1.87
Mean	81.4	87.5		27.9	28.3		1.77	1.82	
	SE±	CD(0.05)		SE±	CD (0.05)		SE±	CD(0.05)	
Variety (V)	0.3039	0.61357		0.0372	0.07509		0.0067	0.01353	
Treatment (T)	0.7128	1.43896		0.0872	0.17611		0.0157	0.03173	
V× T	1.0081	2.03499		0.1233	0.24906		0.0222	0.04487	
CV	1.45%	0.53%		1.39%					

Table 2. Showing the response of priming on Vigour Index in Okra.

Treatments	Vigour Index I		Mean	Vigour Index II		Mean
	MIS 077 (V_1)	Bhindi No.10 (V_2)		MIS 077 (V_1)	Bhindi No.10 (V_2)	
Control (T_0)	1603.75	1927.77	1765.763	96.3658	118.5702	107.468
Vermiwash 20% (T_1)	2177.04	2454.01	2315.52	128.061	146.7342	137.3976
Vermiwash 50% (T_2)	2994.47	3065.89	3030.183	223.8678	245.2716	234.5697
IAA@50 ppm (T_3)	2148.49	2371.10	2259.801	107.0632	127.6115	117.3374
IAA@100 ppm (T_4)	2496.33	2630.10	2563.216	155.4008	156.9293	156.1651
GA_3@50 ppm (T_5)	2167.78	2174.60	2171.19	120.262	127.82	124.041
GA_3@100 ppm (T_6)	2543.20	2639.00	2591.1	174.24	178.36	176.3
Kinetin@50 ppm (T_7)	2035.80	2346.57	2191.188	127.92	141.6478	134.7839
Kinetin@100ppm (T_8)	2474.80	2669.31	2572.055	183.08	187.32	185.2
T.viride (T_9)	2131.32	2445.71	2288.52	141.2718	165.6774	153.4746
T. harzianum (T_{10})	2353.40	2554.84	2454.119	150.88	169.727	160.3035
	2284.218	2479.901		146.2193	160.5154	

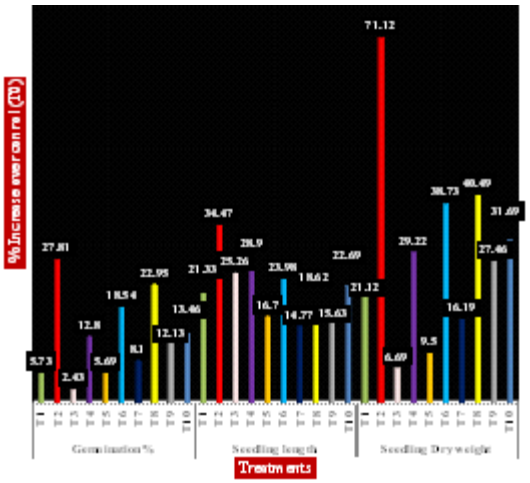

Fig. 1. Influence of treatments on Growth parameters over unprimed control in *Abelmoschus esculentus* L

Among the treatments vermiwash 50% enhanced the maximum germination (96.5%) followed by 100ppm doses of Kinetin (92.83%), GA_3 (89.5%) and IAA (85.16%)(Table 1). Percent improvement in germination was observed 27.81%, 22.95%, 18.54%, 12.8% (Fig. 1) respectively in these mentioned treatments compared to control (75.5%). Variety V_2 showed enhancive value than V_1 as it is a hybrid variety but if we consider the enhancement of V_1 which is an Open pollinated(OP) variety, its germination improvement with vermiwash 50 % treatment(T_2) (95.6%) is maximum than the control of Hybrid variety (V_2)(80.6%) (Table 1). Conclusively OP variety treated with vermiwash 50 % can be easily used by farmer instead of hybrid variety that is a cost effective method and promote the organic farming by

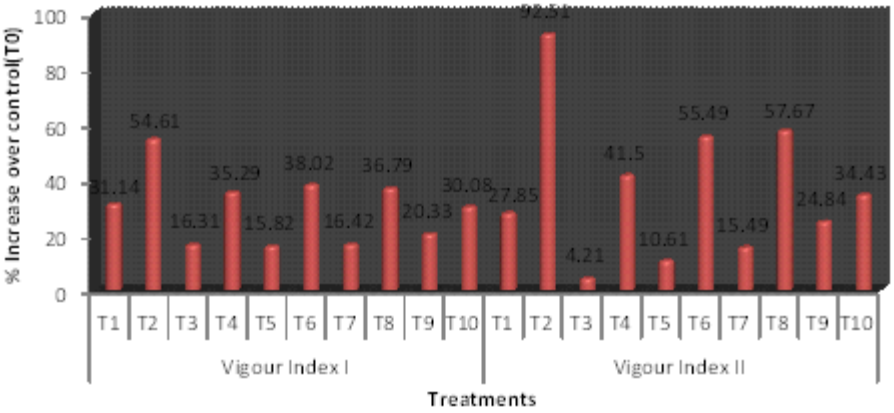

Fig. 2. Influence of treatments on invigouration over unprimed control in *Abelmoschus esculentus* L

protecting the environment from the threat of the use of chemicals in agriculture.

Seedling length is the sum of shoot and root length and it was very much enhanced through seed priming and the maximum enhancement was observed with vermiwash 50% (31.4 cm) (Table 1). This obtained value is 34.47% (Fig 1) enhanced compare to control (23.35cm).

Seedling dry weight which is a biomass of dried seedlings(root+soot) which is evaluated by calculating the reinvigoration of plant in terms of identifying the plant health and its real accumulated physiological content was also found maximum in vermiwash @ 50%(2.43g.) (Table 1) which is 72.12 % (Fig 1) more compared to the value of control (1.42 g.)

Vigour index I is the multiple product of germination X seedling length were also recorded maximum in vermiwash 50 % (3030.18) (Table 2) which is 27.81% (Fig 2) more than that of control (1765.763) (Table 2) and vigour index II is a multiple products of germination X seedling dry weight was also recorded maximum in vermiwash 50 % (234.56) (Table 2) which is 92.51 % (Fig 2) more than that of control(107.47) (Table 2). These results are also in harmony to some extent with the studies of Iqbal & Ashraf, 2007, Harris *et al.* 2004 in maize, rice, and chickpea, Rashid *et al.* 2004 in mungbean, Suresh *et al.* 2005 in chickpea and Rashid *et al.* 2006 in barley, nath *et. al.* 2009, Rai and bansiwal 2008.

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