International Journal of Science, Environment and Technology, Vol. 6, No 2, 2017, 1526 – 1534

ISSN 2278-3687 (O)
2277-663X (P)

EFFECT OF BIO-FERTILIZERS AND MICRONUTRIENTS ON SEED YIELDAND QUALITY IN TOMATO (*Lycopersiconesculentum* MILL)

Chakradhar Patra[1], Laxmi Priya Sahoo[2], Supriya Das[3] and Anuj Kumar Rai[4]

[1]Ph.D. Research Scholar, Dpt. of Seed Sc. & Tech, CA, OUAT, Bhubaneswar

[2]Sr. Scientist, Seed Technology, ICAR-CIWA, Bhubaneswar

3 Assistant Agriculture Officer, DAFP, Govt. of Odisha

[4]Subject Matter Specialist, Plant Science, KVK, Malkangiri

Abstract: Effects of bio-fertilizers and micronutrients on seed yield and quality was studied in tomato cultivar *Utkal Kumari* with 15 treatment combinations having three replications involving interaction of bio-fertilizers like P-solublizing bacteria (PSB) and Azospirillum @ 250 g/Ha in root dipping technique and micronutrientslike borax, zinc sulphate, $MnSO_4$and mixtures of these three as foliar spray at 30, 40, 50 days after transplanting with a concentration of 100 ppm each. Results with respect to seed yield and yield attributes and seed quality attributes revealed significant increase in seed yield per plant and 1000-seed weight (8.58 g and 3.84 g respectively) with the application of PSB, followed by Azospirillum except seed recovery percentage. The treatment combinations of P-solublizing bacteria (PSB) and $ZnSO_4$produced significantly higher seed yield per plant (10.33g) and 1000-seed weight (4.03g). Although freshly harvested seeds of P-solublizing bacteria (PSB) and $ZnSO_4$ treatment recorded higher germination percentage, root length, shoot length, seedling vigour index, field emergence and dry weight (91.60%, 8.27cm, 10.50cm, 1720, 84.87% 1.94mg respectively).No difference in treatments and control was found in seed quality of accelerated aged seeds.

Keywords: Tomato Seed quality, Seed yield attributes, biofertilizers, micronutrients, PSB, Accelerated ageing.

INTRODUCTION

Tomato fruits are rich in organic acids, amino acids, vitamins and minerals. Lack of proper nutrition management along with proper seed processing methods may be attributed as the major cause. So integrated nutrient management with inclusion of bio-fertilizers and micronutrients can help in establishing a healthy crop strand with less damage to soil health and environment. (Kabesh, Suber *et al*., 1987) Bio—fertilizers help in better nutrient assimilation, production of antibacterial and antifungal compounds as well as enhancement of growth, yield and quality of vegetable crops (Chattoo *et al*, 1997). However yield growth and fruiting in tomato was reported to be increased with application of micronutrients like boron, manganese, zinc etc. (Singh and Verma,1991; Rahman *et al.* 1996). Location specific

*Received Mar 21, 2017 * Published Apr 2, 2017 * www.ijset.net*

knowledge on strain selection, dose variation and proper application procedure of micronutrients will be beneficial for seed producers in nutrient management for large scale multiplication of quality seeds. So the present study was undertaken to standardize the effective bio-fertilizer and micronutrient application schedule and to study the effect of these on yield and quality of tomato seeds.

MATERIALS AND METHODS

The experiment was conducted in split plot design in the vegetable breeder seed production unit of central research station, OUAT, Bhubaneswar during Rabi 2012-13 with 15 treatment combinations having three replications involving interaction of bio-fertilizers and micronutrients. Different bio-fertilizers like P-solublizing bacteria (PSB) and Azospirillum were treated @ 250Kg/ha in root dipping technique. Micronutrients applied were borax, zinc sulphate, $MnSO_4$and mixtures of these three as foliar spray at 30, 40, 50 days after transplanting with a concentration of 100 ppm each. Mature fruits were harvested at red ripening stage. The observations were recorded with respect to seed yield per plant, seed yield per hectare and seed recovery (%). Seed quality was assessed based on 1000 seed weight, seed moisture content (by air-oven method, ISTA, 1985), seed germination test (Anon, 1999 b), shoot and root length, seedling dry weight, seed vigour index (Abdul - Baki and Andreson,1973) and field emergence. Seed storability was assessed by exposing the seeds to accelerated ageing treatment at 95-100 % relative humidity and 40 $\pm$ 1^0C temperature for seven days. (Delouche and Baskin, 1973). Then relative storability of seeds of different treatment was made based on the results of germination and vigour tests of aged seeds. Data was analyzed for significance using mean, standard deviation, CD and CV following the principles and procedures outlined by Panse and Sukhatme (1978).

RESULTS

Seed yield per plant and Seed recovery percentage

Seed yield per plant was found to be significantly higher in PSB (8.58 g/plant, 215.05 kg per hectare) followed by Azospirillum (7.17g) and control (6.02 g/plant). Seed yield per hectare as influenced by micronutrient spray was found to be significantly higher in $ZnSO_4$ treatment (8.25 g/ plant, 206.72 kg/ha) than micro-nutrient mixture and Borax treatment. Interaction effects of PSB and $ZnSO_4$ combination gave highest seed yield (10.33 g per plant, 258.84 kg per hectare) followed by PSB + micro-nutrient mixture (239.69 kg/ha) and PSB+Borax combination (221.11 kg/ha). The lowest seed yield (6.01gm per plant, 150.52kg per hectare) was recorded in Azospirillum treatment. Different treatments of bio-fertilizers, micronutrients

and interaction of both bio-fertilizers and micronutrients showed similar results with respect to seed recovery percentage. However, highest seed recovery was recorded for PSB+ $ZnSO_4$ (0.45 %) and Azospirillum+$ZnSO_4$followed by PSB+Borax (0.44 %) and PSB+ micro-nutrient mixture (0.44 %).

Germination percentage

Germination percentage of tomato was influenced by bio-fertilizer treatment. The plants applied with PSB showed higher germination percentage (91.60%) followed by Azospirillum treatment and control. Similarly in micronutrient treatments the $ZnSO_4$ treated plants recorded significantly higher germination percentage (91.56 %) than other treatments. This was followed by micro-nutrient mixture (91.11 %) and Borax (90.33 %).However the interaction treatments did not show any significant difference in results but, maximum germination percentage was observed in PSB+Borax and PSB+ micro-nutrient mixture treatment (93.67 %) compared to other combinations.

Field emergence percentage

Application of bio-feritlizer (PSB) along with recommended dose of fertilizer recorded significantly higher field emergence (84.87 %) followed by Azospirillum. Significantly higher field emergence (84.78 %) was recorded by $ZnSO_4$ treatment than micro-nutrient mixture (84.0 %) and Borax (83.44 %). While lowest result (80.33 %) was recorded in control. However, the different interaction treatments of bio-fertilizers and micronutrients did not show any difference.

Root and shoot length of seedling (cm)

Plants applied with bio-fertilizer PSB recorded significantly higher root length (8.27 cm) and shoot length (10.50 cm) of seedlings compared to Azospirillum treated plants, but the lowest root length of 7.71 cm and shoot length of 9.54 cm was recorded in control. Root length (8.32 cm) and shoot length (10.45) cm was recorded by $ZnSO_4$ treatment which was at par with bio-fertilizers. Interaction effects between different treatments with respect to bio-fertilizers and micronutrients on the basis of root length and shoot length were mostly similar.

Dry weight of seedling (mg)

The data on dry weight of seedlings indicated significant differences due to the application of different bio-fertilizers and micronutrients individually and/or in combinations. The dry weight of seedlings was significantly higher in PSB (1.97 mg) compared to Azospirillum. However, control showed lowest dry weight of seedlings (1.60 mg).Significantly higher seedling dry weight was recorded for $ZnSO_4$ (1.94 mg) followed by 1.89 mg for micro-

nutrient mixture treatment. The interaction effect of different bio-fertilizer and micronutrient treatments were also found to be significant. The interaction of PSB+$ZnSO_4$ combination recoded highest dry weight of seedlings (2.18 mg), followed by PSB+ micro-nutrient mixture treatment(2.05mg) which was more than individual applications.

Seedling vigour index (SVI)

Seedling vigour was significantly influenced by bio-fertilizer application and highest vigour index was recorded in PSB treatment (1720) followed by Azospirillum (1648). The lowest vigour index of 1509 was observed in the control. The treatment $ZnSO_4$ recorded significantly higher vigour index (1750) compared to micro-nutrient mixture (1693) and Borax (1650) treatment. Interaction effects between bio-fertilizers and micronutrients did not show any significant difference in seedling vigour index.

Storability of seeds

Accelerated ageing technique is the widely accepted standard method for prediction of storability of seed lot. The performance of seeds in terms of germinability, seedling growth rate and vigour after accelerated ageing indicates relative storage potential of different seed lots. The mean germination percentage of accelerated aged seeds revealed significant variation among the individual bio-fertilizer and micronutrient treatments in tomato. Seeds of plants receiving bio-fertilizer PSB and micronutrients application viz., zinc (60.67%) and mixture of micronutrients (59.33%) maintained higher germinability after accelerated ageing as compared to the other treatments. Among the bio-fertilizers PSB(5.54 cm) and among micronutrients $ZnSO_4$(5.55cm) showed highest seedling growth rates measured in terms of seedling length and dry weight either singly or in combination. Accelerated aged seeds of $ZnSO_4$ (832) treated plants exhibited significantly higher seed vigour index followed by PSB (815) and micro-nutrient mixture in comparison to other treatments. But interaction effects of bio-fertilizers and micronutrients were mostly similar with individual treatments for germination, seedling growth and vigour.

Discussion

Bio-fertilizers like *Azospirillum, Azotobacter* etc. are important for their nitrogen fixing efficiency and ability to produce antibacterial and antifungal compounds as well as enhancement of growth, yield and quality of vegetable crops. Phosphate solubilizing bacteria are found to be effective in improving phosphorus use efficiency and effects growth and yield of some crops. However yield was reported to be increased with application of micronutrients in different crops. Application of boron is essential for growth and fruiting in tomato.

Manganese acts as cofactor and activates about 35 different enzymes. Tissues suffering from Mn deficiency have small cell volume, cell walls dominate and the inter-epidermal tissue is shrunken. Zinc has significant effect on growth, yield and quality of tomato. The results made it clear that application of bio-fertilizers and micronutrients, either singly or in combinations, have enhancing effects on seed yield. Increase in seed yield may be due to higher fruit yield attributing components such as fruit set, number of fruits per plant, fruit size and weight, fruit yield, number of seeds per fruit and seed weight. The micronutrients might have enhancing role in seed setting that is resulting in improvement of seed recovery. Since in the present study maximum germination of 93.67 per cent was observed in both PSB+ZnSO4 and PSB+micro-nutrient mixture treatment combinations while individual application of PSB and zinc also showed enhanced effect on seed germination with minimum germination in control. The increase in seed quality parameters may be due to participation of bio-fertilizer and micronutrients in bio-fertilzier inoculation, catalytic activity and break down of complex substances into simple forms. These in turn were reflected on enhanced germination, elongation of root and shoot of tomato seedlings, vigour index. Field emergence and dry weight of seedlings were increased due to better seed quality of heavier and bigger sized seeds. These seeds also stores better.

From the results of present investigation it was inferred that in order to obtain good quality seeds in tomato, it is better to go for application of bio-fertilizes and micronutrients individually or in suitable combinations. Preferably the application of P-solubilizing bacteria @ 250gm/ha (root dipping) with foliar spray of zinc sulphate @ 100 ppm) in coastal ecosystem will be effective.

References

[1] ABDUL BAKI, A. A. & J.D. ANDERSON (1973). Vigour determination in soybean by multiple criteria. *Crop Sci.,* **13**: 630-633.

[2] CHATTOO, M. A., M.Y. GANDROO& ZARZAG, M.Y. (1997). Effect of Azospirillum and Azotobacter on growth, yield and quality of knol-khol (*Brassica oleracea* var. Gongylodes L.). *Veg. Sci*., **24**: 16-19.

[3] DELOUCHE, J.C. &C.C. BASKIN (1973). Accelerated aeging techniques for the relative storability of seed lots. *Seed Sci. & Technol*., **1**:427-452.

[4] ISTA (1985). International Rules for Seed Testing. Annexes 1985. *Seed Sci. and Technol*.,**13**: 356-513

[5] PANSE, V.G. & P.V. SUKHATME (1985). Statistical methods for Agricultural workers, ICAR, New Delhi, pp. 145-152.

[6] RAHMAN, M., A.T.M. FARID., M. SHAHIDULLAH., &W. SULFANA (1996). Improving seed yield and quality of tomato through integrated nutrient management and liming. *Seed Res.*, **24**: 34-37.

[7] SINGH, S.S. & S.K. VERMA (1991). Influence of potassium and boron on growth and yield of tomato (*Lycopersiconesculentum* Mill.) *Veg Sci*.,**18** (2): 122-129.

Table 1: Effect of bio-fertilizers and micronutrients on seed yield and yield attributing characters at different stages of tomato cv. Utkal Kumari

Treatments	1000-seed weight (g)	Seed yield/plot (g)	Seed yield/ha (kg)	Seed recovery (%)
control	3.68	6.46	161.80	0.30
PSB	3.84	8.58	215.05	0.42
Azospirillum	3.74	7.17	179.71	0.40
SEM (±)	0.024	0.144	3.601	0.037
CD (0.05)	0.09	0.56	14.13	NS
control	3.52	6.02	150.74	0.35
Borax	3.75	7.72	193.35	0.37
$ZnSO_4$	3.90	8.25	206.72	0.37
$MnSO_4$	3.68	6.91	173.08	0.35
micro-nutrient mixture	3.92	8.13	203.71	0.41
SEM (±)	0.028	0.099	2.483	0.021
CD (0.05)	0.08	0.29	7.24	NS

Table 2: Interaction effect of bio-fertilizer and micronutrients on seed yield and yield attributing characters at different stages of tomato cv. Utkal Kumari

Treatments	1000-seed weight (g)	Seed yield/plot (g)	Seed yield/ha (kg)	Seed recovery (%)
control	3.55	5.67	141.98	0.33
Borax	3.61	6.85	171.70	0.26
ZnSO4	3.78	6.79	169.99	0.26
MnSO4	3.63	5.96	149.28	0.25
mixture	3.85	7.03	176.07	0.39
PSB	3.53	6.38	159.73	0.37
PSB+Borax	3.89	8.83	221.11	0.44
PSB+ ZnSO4	4.06	10.33	258.84	0.45

PSB+ MnSO4	3.74	7.82	195.91	0.41
PSB+ mixture	4.00	9.57	239.69	0.44
Azospirillum	3.48	6.01	150.52	0.36
Azospirillum+Borax	3.76	7.47	187.26	0.40
Azospirillum+ ZnSO4	3.86	7.64	191.33	0.41
Azospirillum+ MnSO4	3.67	6.95	174.06	0.40
Azospirillum+ mixture	3.93	7.80	195.39	0.41
SEM (±)	0.049	0.172	4.300	0.037
CD (0.05)	NS	0.50	12.55	NS
CV (%)	2.25	4.01	4.01	17.16

Table 3: Effect of bio-fertilizers and micronutrients on seed quality attributes of initial and accelerated aged seeds of tomato cv. Utkal Kumari

Treatments	initial seed quality attributes						quality attributes of accelerated aged seeds				
	Germ^{n} (%)	Field emergence (%)	Root length (cm)	Shoot length (cm)	Dry wt. (mg)	Vigour index	Germ^{n} (%)	Seedling root length (cm)	Seedling shoot length (cm)	Dry wt. seedling (mg)	Vigour index
Biofertilizer											
control	87.47	80.53	7.71	9.54	1.60	1509	56.60	4.75	8.09	1.57	728
PSB	91.60	84.87	8.27	10.50	1.97	1720	58.67	5.54	8.34	1.90	815
Azospirillum	90.47	83.53	8.09	10.13	1.89	1648	57.87	5.33	8.24	1.84	785
SEM (±)	0.391	0.509	0.057	0.063	0.014	10.699	0.385	0.081	0.049	0.0108	7.878
CD (0.05)	1.53	1.99	0.22	0.25	0.05	41.99	1.51	0.32	NS	0.04	30.92
Micronutrient											
control	87.56	80.33	7.53	952	1.70	1493	56.22	4.70	7.79	1.69	703
Borax	90.33	83.44	8.11	10.16	1.80	1650	58.00	5.30	8.30	1.73	789
ZnSO4	91.56	84.78	8.32	10.45	1.94	1750	59.22	5.55	8.50	1.86	832
MnSO4	88.67	82.33	7.85	9.90	1.76	1574	56.67	5.02	8.02	1.73	740
mixture	91.11	84.00	8.32	10.26	1.89	1693	58.44	5.46	8.52	1.83	817
SEM (±)	0.435	0.390	0.054	0.075	0.011	10.519	0.708	0.124	0.082	0.0114	14.808
CD (0.05)	1.27	1.14	0.16	0.22	0.03	30.69	2.06	0.36	0.24	0.03	43.21

Table 4: Interaction effects of bio-fertilizers and micronutrients on seed quality attributes of initial and accelerated aged seeds of tomato cv. Utkal Kumari

Treatments	initial seed quality attributes						quality attributes of accelerated aged seeds				
	Germ^{n} (%)	Field emergence (%)	Root length (cm)	Shoot length (cm)	Dry wt. (mg)	Vigour index	Germ^{n} (%)	Seedling root length (cm)	Seedling shoot length (cm)	Dry wt. seedling (mg)	Vigour index
control	86.67	78.67	7.04	8.77	1.53	1370	55.00	4.19	7.76	1.55	658
Borax	88.00	81.00	7.78	9.86	1.60	1552	57.67	4.76	8.16	1.57	745
ZnSO4	88.33	82.00	8.05	9.87	1.65	1584	58.00	5.05	8.33	1.60	777
MnSO4	86.67	79.33	7.49	9.53	1.55	1475	54.67	4.62	8.05	1.55	693
mixture	87.67	81.67	8.20	9.66	1.66	1565	57.67	5.14	8.17	1.59	767
PSB	87.67	81.00	7.91	9.98	1.81	1568	56.67	4.99	7.81	1.77	725
PSB+ Borax	92.67	85.33	8.37	10.41	1.93	1740	58.67	5.72	8.44	1.83	831
PSB+ ZnSO4	93.67	87.33	8.61	11.05	2.18	1841	60.67	5.88	8.74	2.08	888
PSB+ MnSO4	90.33	84.33	8.03	10.24	1.89	1651	58.00	5.23	8.00	1.85	767
PSB+ mixture	93.67	86.33	8.44	10.82	2.05	1803	59.33	5.87	8.71	1.97	865
Azo	88.33	81.33	7.64	9.80	1.77	1540	57.00	4.93	7.80	1.76	725
Azos+Borax	90.33	84.00	8.17	10.20	1.87	1659	57.67	5.42	8.29	1.80	791
Azo+ZnSO4	92.67	85.00	8.13	10.42	2.00	1735	59.00	5.70	8.42	1.89	833
Azo+MnSO4	89.00	83.33	8.03	9.92	1.84	1596	57.33	5.22	8.01	1.80	758
Azo+ mixture	92.00	84.00	8.31	10.30	1.95	1712	58.33	5.37	8.68	1.93	819
SEM (±)	**0.754**	**0.675**	**0.094**	**0.130**	**0.020**	**18.219**	**1.227**	**0.214**	**0.143**	**0.0198**	**25.647**
CD (0.05)	**NS**	**NS**	**NS**	**NS**	**0.06**	**NS**	**NS**	**NS**	**NS**	**0.06**	**NS**
CV (%)	**1.45**	**1.41**	**2.02**	**2.24**	**1.88**	**1.94**	**3.68**	**7.12**	**3.00**	**1.94**	**5.72**