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INFLUENCE OF MICRONUTRIENTS ON QUALITY SEED PRODUCTION OF ONION (Allium cepa L.)

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ABSTRACT

The research work was carried out for consecutive two years during rabi seasons of 2012 and 2013 to study the effect of micronutrients on yield and quality of onion seed. The experiment was laid out in randomized block design with nine different combinations of micronutrients with three replications. The treatments consist of soil application of three micronutrients and one micronutrient mixture viz., Zn, Fe, B and micronutrient mixture, each in two doses (Zn @ 1 and 2 kg ha-1, Fe @2.5 and 5 kg ha-1, B @ 0.5 and 1 kg ha-1, micronutrient mixture @ 10 and 20 kg ha-1) and no micronutrient as control along with recommended dose of fertilizer. The applications of micronutrients were done as basal along with recommended dose of fertilizer before planting. Results of over the two year of experimentations indicated that soil application of recommended dose of fertilizer (N: P: K: S:: 125:80:100:40 kg ha-1) + Micronutrient Mixture @ 20 kg ha-1 gave better Vegetative and flower characteristics followed by recommended dose of fertilizer +Boron (B) @ 1 kg ha-1. Application of recommended dose of fertilizers along with Boron (B) @ 1 kg ha-1 produced higher seed yield (907.55kg ha-1) followed by recommended dose of fertilizers + Micronutrient Mixture @ 20 kg ha-1 (870.14 kg ha-1). Increased yield in this treatment was due to better umbel and yield attributing characteristics. Application of recommended dose of fertilizers along with Boron (B) @ 1 kg ha-1 was also influenced markedly on seed quality characteristics and economics viz., benefit cost ratio (4.25) than other treatments. Soil application of B (@1kg ha-1) along with recommended dose of fertilizers gave the superiority in all measured parameters than other treatments.

Keywords: Micronutrients, Onion, Production, Quality seed.

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops belongs to *Amaryllidaceae* family being grown all over the country. It has diuretic properties, relieves heat sensation, hysterical faintness, insect bites. India is one of the largest producers of onion in the

Vol. 2, No. 02; 2017

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world second only to China, accounting for 24.47% of world area and 20.20% of production (Anonymous, 2013). The area and production of onion in India are about 1051 thousand hectares and 16813 thousand tones of bulb, respectively, with an average productivity of 16.0 t ha^{-1} (Anonymous, 2013). The productivity is very low as compared to the world average productivity of 19.40 t ha^{-1} (Anonymous, 2013). The Reason for lower productivity of onion in India could be attributed to the limited availability of quality seeds and associated production technologies used, among the others.

Application of micronutrients to soil deficient in them has shown remarkable increase in yield of several crops. Micronutrients play an active role in the plant metabolic process from cell wall development to respiration, photosynthesis, chlorophyll formation, enzymes activity, nitrogen fixation etc. Micronutrients work as a co-factors for a large number of enzymes. In addition, they play an essential role in improving yield and quality, and highly required for better plant growth and yield of many crops (Alam *et al*., 2010; Barker and Pilbeam, 2007; El- Tohamy *et al*., 2009; Hansch and Mendel, 2009)

Foliar applications of micronutrients were effective in improving growth, yield and quality of onion was reported by Manna and Maity (2016) and Dake *et al*. (2011). Shehata *et al*. (2012) also reported higher seed yield and yield attributing characters of onion was obtained with the foliar application with different micronutrients. Foliar application of boron @100ppm was found most effective for highest seed yield of tomato was reported by Kumar and Sharma (2006) and Sharma *et al*. (1999). Improvement in onion growth and yield has been reported through micronutrient by many scientists at different types of soils and agro-climatic condition. But very little information is available on effect of micronutrients on quality seed production of onion. Keeping in view, the present experiment was undertaken.

MATERIALS AND METHODS

The research work was carried out at Horticultural Research Station, Mondouri, Bidhan Chandra Krishi Viswavidyalaya, West Bengal, for consecutive two years during *rabi* seasons of 2012 and 2013**.** The research station is located approximately at 23.5°N latitude, 89°E longitude having an average altitude of 9.75m from the sea level. For assessing the exact nature of the micronutrients, a composite soil sample up to 20 cm depth was taken from the experimental field before planting of mother bulb and was subjected to chemical analysis. The soil type of experimental site was sandy loam in texture and slightly acidic in nature. The details of physicochemical properties of the experimental soil along with methods used for their determination are furnished in Table 1. The present experiment was laid out in randomized block design with nine different combinations of micronutrients with three replications. The treatments were, $\mathbf{T_1}$= RDF (Recommended Dose of Fertilizer=N: P: K: S:: 125:80:100:40 kg ha^{-1}) + Zinc

(Zn) @ 1 kg ha^{-1}, **T_2**= RDF + Zinc (Zn) @ 2 kg ha^{-1}, **T_3**= RDF + Iron (Fe) @2.5 kg ha^{-1}, **T_4**= RDF + Iron (Fe) @ 5 kg ha^{-1}, **T_5**= RDF + Boron (B) @ 0.5 kg ha^{-1}, **T6**= RDF + Boron (B) @ 1 kg ha^{-1}, **T_7**= RDF + Micronutrient mixture @ 10 kg ha^{-1}, **T_8**= RDF + Micronutrient Mixture @ 20 kg ha^{-1} and **T_9** = RDF + (no micronutrient) = control. Mother bulb (50-60 g) of onion cv. Sukhsagar was planted in flat beds during the 15^{th} November, 2012 (1^{st} year experiment) and 15^{th} November, 2013 (2^{nd} year experiment) at a spacing of 30 cm × 30 cm in a plot size of 3m × 3 m. The micronutrients were applied as soil application (basal) with RDF and recommended packages of practices were fallowed. Recommended Dose of Fertilizer was applied uniformly in all experimental plots and the source of macronutrients and micronutrients are presented in Table 2. Urea was applied in two splits, *i.e.*, at the time of transplanting and second dose 30 days after transplanting. Recommended packages of practices for onion seed production (bulb to seed method) were adopted except micronutrient application. Harvest was done by hand when most of the umbels were exposed their black seeds and 20- 30% capsule were splitted Umbels were harvested in the morning to prevent shattering of seed. Observations were taken on different Vegetative, Flower and umbel, Yield and Seed quality characteristics. Statistical analyses were done by Randomized Block Design (RBD) as described by Panse and Sukhatme (1989) and Gomez and Gomez (1984). Treatment means were tested at 5% level of significance.

RESULTS AND DISCUSSION

Vegetative characteristics

Perusal of the data presented in table 3 reflected significant variations in vegetative growth parameters of onion seed crops with respect to micronutrients. Results of over the two year of experimentations indicated that Soil application of recommended Dose of Fertilizer (RDF) + Micronutrient Mixture @ 20 kg ha^{-1} recorded higher plant height (58.59 cm) and number of leaves per plant (37.30) closely followed by RDF + Boron @ 1 kg ha^{-1}. The minimum values for these attributes were recorded in control (RDF + no micronutrient).

The favorable effect of micronutrients on plant growth might be due to its role in many physiological processes and cellular functions within the plants. Hansch and Mendel (2009) mentioned that in addition, they play an essential role in improving plant growth, through the biosynthesis of endogenous hormones which are responsible for promoting of plant growth. The same trends were also recorded by many authors on onion (Alam *et al.*, 2010 and El-Tohamy *et al.*, 2009). They reported that growth parameters of onion plant were positively affected by application of micronutrients. Application of micronutrients along with recommended dose of fertilizer have helped in the plant metabolic activity through the supply of such important micronutrients in the early crop growth phase, which in turn encouraged early vigorous growth. These results are in agreement with those of Manna and Maity (2016) in onion and Bose and Tripathi (1996) in tomato.

Flower and umbel characteristics

An examination of data regarding flower and umbel characteristics presented in Table 3 Showed significant superior results for length of scape and number of seeds per umbel whereas number of flower stocks per plant and umbel diameter showed that non-significant variations. Application of RDF + Micronutrient Mixture @ 20 kg ha^{-1} was found to be superior to other treatments in respect to number of flower stalks per plant (3.66) and length of scape (92.38 cm). On the other hand application of RDF + Boron (B) @ 1 kg ha^{-1} produced maximum values of diameter of umbel (6.55 cm) and number of seeds per umbel (765.09) compared to other treatments. Plant received RDF + no micronutrient showed lowest values of these characters.
Results on effects of micronutrients proved *at par* in respect to umbel diameter and significant variance in respect to number of seeds per umbel. Boron application proved to be on top in both the cases. It might be due to its role in enhancing metabolic process and improving development of pollen tube growth, which is likely to increase seed set (Wójcik, 2008). Therefore, boron fertilization may increase number of seeds per umbel. It was also reported that seed recovery rates increase by application of micronutrients (Kiran *et al*., 2010). These results are in harmony with those obtained by Elballa *et al.* (2004) in snap bean and Dongre *et al.* (2000) in chilli.

Yield characteristics

Micronutrient has a significant role on seed yield and yield characteristics except weight of 1000 seed (Table 4), however maximum values of weight of seeds per umbel (2.84g), seed yield per plant (10.21g), weight of seeds per plot (0.817 kg), weight of 1000 seeds (3.71g) and seed yield per hectare (9.07.55 kg ha^{-1}) were noticed where the plant received, RDF + Boron@ 1 kg ha^{-1}. Whereas, application of recommended dose of fertilizer with no micronutrient, i.e.-control showed poorest results (2.42g, 6.64 g, 0.531 kg, 3.58g and 589.92 kg ha^{-1} , respectively) in respect to above yield characteristics. Increased seed yield was obtained might be due to favorable effect of boron. A possible role of boron in pollen tube growth may involve vesicle production, transport, fusion or the subsequent formation of the pollen cell wall. Pollen tube cell-wall precursors are rich in polypeptides, mostly glycoprotein and polysaccharides rich in arabino furanosyl residues (Li and Liskens, 1983). Many of these compounds are known to form strong complexes with boron (Loomis *et al*., 1992). Most of cell boron is known to be located in the cell wall where it is associated with pectinaceous compounds (Hu and Brown, 1994). Under boron-deficient conditions, cell walls become rigid, inelastic and brittle. Boron may be involved in some of the biochemical/physiological events involved in pollen germination and tube growth which is likely to increase seed set (Wójcik, 2008).

Increase in seed yield in these treatments may be due to higher seed yield attributing components such as number of flower stalks per plant, number and weight of seeds per umbel,

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plant. These results are generally analogous to the findings of Shehata *et al*. (2012) who reported higher seed yield of onion was obtained with the foliar application with union Zn, Union Feer, shams K, Magnesium, boron, hummer and amino X. Foliar application of boron @100ppm was found most effective for highest seed yield of tomato was reported by Kumar and Sharma (2006) and Sharma *et al.* (1999).

Seed quality characteristics

The experiment data revealed that the seed quality characteristics of harvested seed significantly influenced by the micronutrients (Table 4). The maximum germination percentage (94.33%) and field emergence percentage (77.50%) of harvested seeds were recorded from the plot where plant received RDF + Boron @ 1 kg ha^{-1} followed by T_4 (91.83% and 76.67%, respectively) whereas the control plot (85.50 and 67.33 %, respectively) showed minimum results. The increase in seed quality parameters may be due to the participation of micronutrients (Zn, Fe, B) in catalytic activity and breakdown of complex substances into simple form (glucose, amino acids and fatty acids etc.).These results are in agreement with Shehata *et al.* (2012) who noticed that spray with boron, union feer, union Mn shams K increase seed germination percentage. These results also agreement with the findings of Kumari (2005) in tomato and Sharma *et al*. (1999) in radish. They reported that application of boron had positive impact on seed quality in terms of germination percentage in respective crops.

Economic analysis

A perusal of data presented in table 5 revealed that micronutrients treatments had marked effect on economics of onion seed production in respect to gross return (Rs ha^{-1}), net return (Rs ha^{-1}) and benefit cost ratio. Higher gross returns (Rs.), net returns (Rs.) and benefit cost ratio were calculated from the treatment where plant received RDF + Boron (B) @ 1 kg ha^{-1}.

With regards to impact of micronutrients on economic feasibility, the present findings indicated increased gross returns among all treatments than control. Application of RDF + Boron (B) @1kg ha^{-1} showed higher gross return is obviously due to the higher seed yield per hectare than control treatment and similar result showed in case of net return also, this could be due to lower dose of boron than other micronutrients and comparatively higher seed yield. Highest benefit cost ratio were calculated by the application of RDF + Boron (B) @1kg ha^{-1} than control where only Recommended Dose of Fertilizers were used for seed production. This is obviously due to higher seed yield and lower dose of boron as compare to other micronutrients. Thus, in general, it may be concluded that integrated application of RDF + Boron (B) @1kg ha^{-1} increased all the economic parameters of gross and net returns as well as benefit cost ratio indicating the feasibility of these packages for optimum profit in quality seed production of onion. Similar report of higher benefit cost ratio by adoption of application of boron has also been observed by Kumar and Sharma (2006).

CONCLUSION

From the above results it could be concluded that soil application of recommended dose of fertilizers(N: P: K: S:: 125:80:100:40 kg ha^{-1}) + Boron (B) @ 1 kg ha^{-1} may be followed in new alluvial zone of West Bengal for getting quality seed yield with economic return of onion cv. Sukhsagar.

REFERENCES

Alam, M.N., Abedin, M.J. and Azad, M.A.K. (2010). Effect of micronutrients on growth and yield of onion under calcareous soil environment. International Research Journal of Plant Science, 1, 56-61.

Anonymous, (2013). Indian horticulture database, 2013. National horticulture board. New Delhi: Aristo Printing Press. Pp: 2-255.

Barker, A.V. and Pilbeam, D.J. (2007). Handbook of Plant Nutrition, CRC Press, London, New York.

Bose, U.S. and Tripathi, S.K. (1996). Effect of micronutrients on growth, yield and quality of tomato cv. Pusa Ruby in MP. Crop Research. 12, 61-64.

Dongre, S.M., Mahorkar, V.K., Joshi, P.S. and Deo, D.D. (2000). Effect of micronutrients spray on yield and quality of chilli (*Capsicum annuum* L.) cv. Jayanti. Agricultural Science Digest, 20, 106-07.

Elballa, M.M.A., El-amin, A.H.B., Elamin, E.A. and Elsheikh, E.A.E. (2004). Interactive Effects of Cultivars, Foliar Application of Mirconutrients and *Rhizobium* Inoculation on Snap Bean (*Phaseolus vulgaris* L.) Performance, University of Khartoum Journal of Agricultural Science, 12, 321-26.

El-Tohamy, W.A., Khalid, A.Kh., El-Abagy, H.M. and Abou-Hussein, S.D. (2009). Essential oil, growth and yield of onion (*Allium cepa* L.) in response to foliar application of some micronutrients. Australian Journal of Basic and Applied Sciences, 3, 201-5.

Gomez, K. and Gomez, A.A. (1984). StatisticalProcedures for Agricultural Research. John Willeyand Sons, New York, pp: 633-636.

Hansch, R. and Mendel, R.R. (2009). Physiological functions of mineral micronutrients (Cu, Zn, Mn, Fe, Ni, Mo, B, Cl). Current Opinion in Plant Biology, 12, 259-66.

Hu, H. and Brown, P. H. (1994). Localization of boron in cell walls of squash and tobacco and its association with pectin: evidence for structural roles of boron in the cell wall. Plant Physiology, pp: 105 & 681–689.

Jackson. (1973) .Soil chemical analysis. Prentice Hall of India Pvt. Ltd., New Delhi, pp: 48-302.

Kiran, J., Vyakaranchal, B.S., Raikar, S.D., Ravikumar, G.H. and Deshpande, V.K. (2010). Seed yield and quality of brinjal as influenced by crop nutrition. Indian Journal of Agriculture Research, 44, 1-7.

Kumar, S. and Sharma, S.K. (2006). Effect of micronutrient sprays on tomato (*Lycopersicon esculentum*) seed production. Indian Journal of Agricultural Sciences, 676-8.

Kumari, S. (2005). Effect of micronutrient sprays on growth, yield and quality of fruit and seed in tomato. M.Sc. Thesis (abstract), Department of Vegetable science, Dr.Yashwant Singh Parmar University of Horticulture and Forestry, Nauni, Himachal Pradesh.

Li, Y. and Liskens, H. F. (1983). Wall-bound proteins of pollen tubes after self- and cross-pollination. Theoretical and Applied Genetics, 67,11–16.

Lindsay, W. L. and Norvell, W. A. (1978). Development of DTPA soil test for Zn, Fe, Mn andCu. The Soil Science Society of America Journal, 42, 421-428.

Loomis, W. D. and Durst, R. W. (1992). Chemistry and biology of boron. BioFactors, 3, 229–239.

Manna, D. and Maity, T.K. (2016). Growth, yield and bulb quality of onion (*Allium cepa* L.) in response to foliar application of boron and zinc. Journal of Plant Nutrition, 39, 438-441.

Panse, V.G. and Sukhatme, P.V. (1989). Statistical Methods for Agricultural Workers.Indian Council of Agricultural Research, New Delhi.

Piper, C.S. (1996). Soil and Plant analysis .Hans Publishers, Bombay, India.

Sharma, S.K., Singh, H. and Kohli, U.K. (1999). Influence of boron and zinc on seed yield and quality in radish. Seed Research, 27, 154-158.

Shehata, S.A., Hashem, M.Y., Ghada, I.M. and Karima, F.A.E.G. (2012). Effect of Some Pre-Harvest Treatments on Onion Seeds Production Under Sandy Soil Conditions. Journal of Applied Sciences Research, **8**, 763-69.

Sparks, D. L. (1996). Methods of Soil Analysis Part -3: Chemical Method. Soil Science Society of America, Book Series No. 5. American Society of Agriculture. Madison, Wisconsin,USA.

Wójcik, P., Wojcik, M. and Klamkowski, K. (2008). Response of apple trees to boron fertilization under conditions of low spoil boron availability. Scientia Horticulturae, 116, 58–64.

Vol. 2, No. 02; 2017

ISSN: 2456-8643

Table 1: Initial physico-chemical properties of experimental soil

Physical Properties:		
Particulars	**Values**	**Method used**
Sand	52.25%	International pipette (Piper, 1996)
Silt	31.20%	
Clay	16.90%	
Chemical properties:	**Values**	**Method used**
Soil pH	6.80	pH meter, (Jackson, 1973)
Organic Carbon (%)	0.35%	Walkley and Black's method (Jackson, 1973)
Total nitrogen (%)	0.04%	Modified micro kjeldal (Jackson, 1973).
Available phosphorus(kg/ha)	22.61	Bray and Kutzon calorimetric (Jackson, 1973)
Available potassium (kg/ha)	183.21	Flame photometer (Jackson, 1973)
Available sulphur (kg/ ha)	20.70	Turbidimetric Method (Sparks, 1996)
Available Fe (mg/kg)	50.68	DTPA extraction method using Atomic absorption Spectrophotometer (Lindsay and Norvell ,1978)
Available Mn (mg/kg)	10.74	
Available Zn (mg/kg)	0.716	
Available Cu (mg/kg)	9.08	
Available B (mg/kg)	0.41	
Available Cu (mg/kg)	8.59	
Available B (mg/kg)	0.50	

Table 2.Source of Nutrients

Name of nutrients	**Source**
Macro nutrients	
Nitrogen (N)	Urea (46 % N)
Phosphorus (P)	Single super phosphate (16 % P)
Potassium (K)	Muriate of potash (60 % K)
Sulphur (S)	Elemental sulphur (90 % S)
Micro nutrients	
Zinc (Zn)	Zeta (Zn EDTA, 12% Zn)
Iron (Fe)	Iron sulphate (19% Fe)
Boron (B)	Borax or Sodium borate (11% B)
Micronutrient mixture	Combination of Zn, Fe and B

Table 3: Vegetative, flower and Umbel Characteristics of onion seed crops as influenced by micronutrients (Pool data for two years of experiment)

Treatments	Vegetative Characteristics		Flower characteristics		Umbel characteristics	
	Plant height (cm).	**Number of leaves per plant**	**Number of flower stocks per plant**	**Length of scape (cm)**	**Diameter of umbel (cm)**	**Number of seeds per umbel**
T_1=RDF*+ Zinc (Zn) @1 kg/ha	49.91	29.54	3.00	81.55	6.18	697.83
T_2=RDF + Zinc (Zn) @2 kg/ha	54.05	32.60	3.26	87.24	6.47	718.91
T_3= RDF + Iron (Fe)@ 2.5 kg/ha	51.75	30.58	3.11	81.17	6.11	694.70
T_4= RDF + Iron (Fe) @5 kg/ha	54.63	33.13	3.40	86.22	6.52	712.51
T_5= RDF + Boron (B)@ 0.5 kg/ha	52.84	31.15	3.19	83.87	6.33	742.18
T_6= RDF + Boron (B) @1kg/ha	57.22	36.05	3.59	90.52	6.55	765.09
T_7= RDF + Micronutrient mixture @10 kg/ha	55.15	34.13	3.53	88.67	6.27	737.17
T_8= RDF + Micronutrient Mixture@ 20 kg/ha	58.59	37.30	3.66	92.38	6.38	751.00
T_9=RDF + (no micronutrient) = control	47.63	28.83	2.76	78.83	6.02	660.54
SE (m) ±	1.77	1.78	0.21	2.47	0.21	13.32
CD (5%)	5.31	5.33	0.62**	7.42	0.63**	39.94

*RDF= Recommended Dose of Fertilizer (N: P: K: S @ 125: 80: 100:40 kg hectare^{-1})

**NS= Non significant, P≤0.05.

SE (m) ± = standard error of the mean.

Table 4: Yield and Seed quality Characteristics of onion seed crops as influenced by micronutrients. (Pool data for two years of experiment)

Treatments	Yield characteristics					Seed quality characteristics	
	Weight of seed per umbel (g)	**Seed yield per plant (g)**	**Weight of seed per plot (kg)**	**Weight of 1000 seed (g)**	**Seed yield per hectare (kg)**	**Germination percentage (%)**	**Field emergence percentage (%)**
T_1=RDF*+ Zinc (Zn) @1 kg/ha	2.51	7.43	0.594	3.62	660.48	85.67 (67.78)	67.33 (55.12)
T_2=RDF + Zinc (Zn) @2 kg/ha	2.57	8.34	0.667	3.60	741.08	89.33 (70.91)	73.17 (58.82)
T_3= RDF + Iron (Fe)@ 2.5 kg/ha	2.48	7.61	0.609	3.57	676.61	86.17 (68.19)	69.67 (56.60)
T_4= RDF + Iron (Fe) @5 kg/ha	2.55	8.68	0.694	3.57	771.32	91.83 (73.36)	76.67 (61.14)
T_5= RDF + Boron (B)@ 0.5 kg/ha	2.70	8.54	0.683	3.64	758.78	88.00 (69.73)	72.67 (58.50)
T_6= RDF + Boron (B) @1kg/ha	2.84	10.21	0.817	3.71	907.55	94.33 (76.19)	77.50 (61.68)
T_7= RDF + Micronutrient mixture @10 kg/ha	2.62	9.20	0.736	3.57	817.74	89.33 (70.91)	74.83 (59.87)
T_8= RDF + Micronutrient Mixture@ 20 kg/ha	2.70	9.79	0.783	3.61	870.14	89.83 (71.37)	75.33 (60.20)
T_9=RDF + (no micronutrient) = control	2.42	6.64	0.531	3.58	589.92	85.50 (67.62)	67.33 (55.12)
SE (m) ±	0.04	0.53	0.043	0.11	47.37	1.35	2.28
CD (5%)	0.13	1.60	0.128	0.33**	142.01	4.06	6.84

*RDF= Recommended Dose of Fertilizer (N: P: K: S @ 125: 80: 100:40 kg hectare-[1])

**NS= Non significant, P≤0.05.

SE (m) ±= standard error of the mean.

- Figure in parenthesis indicates the angular transformed value.

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Table 5: Economics of onion seed production as influenced by micronutrients

Treatments	Gross return* (Rs ha^{-1})	Net return* (Rs ha^{-1})	Benefit Cost Ratio
T_1=RDF*+ Zinc (Zn) @1 kg/ha	528382.00	384362.00	2.67
T_2=RDF + Zinc (Zn) @2 kg/ha	592868.00	441348.00	2.91
T_3= RDF + Iron (Fe)@ 2.5 kg/ha	541285.00	404567.00	2.96
T_4= RDF + Iron (Fe) @5 kg/ha	617052.00	480138.00	3.51
T_5= RDF + Boron (B)@ 0.5 kg/ha	607021.00	469592.00	3.42
T_6= RDF + Boron (B) @1kg/ha	726042.00	587704.00	4.25
T_7= RDF + Micronutrient mixture @10 kg/ha	654189.00	516049.00	3.74
T_8= RDF + Micronutrient Mixture@ 20 kg/ha	696111.00	556351.00	3.98
T_9=RDF + (no micronutrient) = control	471935.00	335415.00	2.46

Cost of micronutrients (Rs/kg): Borax (11 % B) = 200.00; Iron sulphate (19% F e) = 15.00; micronutrient mixture =162.00; Zeta (zink EDTA- 12 % Zn) =900.00.

Cost of mother bulb-30q/ha (@Rs. 20 kg^{-1}); Urea: @Rs.7 kg^{-1}; SSP (Single super phosphate): 500 kg ha^{-1} (@Rs. 8 kg^{-1}); MOP (Muriate of potash): @Rs. 18 kg^{-1}; Elemental sulphur: 45kg ha^{-1}(@Rs. 49 kg^{-1})

Selling price of onion seed: Rs. 800/kg

*Gross return and net return (@Rs/Ha) was expressed in round figure.