

Original Research Article

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Effect of Foliar Spray of Micronutrients and Growth Regulators on Seed Quality of Onion

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ABSTRACT

Keywords

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The field experiment was carried out to study the effect of foliar spray of micronutrients and growth regulators on seed quality of onion during rabi 2016-17 and 2017-18 at Seed Unit, UAS, Raichur. Foliar spray was given at 45 and 75 days after bulb planting (DAP). The seed quality parameters were recorded at Seed Unit, UAS, Raichur. From the present investigation, a significant increase in seed quality parameters were recorded with foliar spray of ZnSO₄ @ 0.5 per cent viz., root length (12.92, 12.74 and 12.83 cm), shoot length (9.51, 9.59 and 9.55 cm), seedling vigour index (2026, 2049 and 2037), seedling dry weight (36.0, 36.8 and 36.4 mg), dehydrogenase enzyme activity (2.612, 2.617 and 2.615 OD value) and α -amylase enzyme activity (18.70, 19.67 and 19.18 mm) followed by GA3 @ 100 ppm over control viz., (11.38, 11.30 and 11.34 cm, 8.33, 8.87 and 8.60 cm, 1773, 1823 and 1798, 32.5, 35.3 and 33.9 mg, 2.586, 2.593 and 2.590 OD value and 18.16, 18.47 and 18.32 mm) during 2016-17, 2017-18 and pooled data, respectively. The non significant differences were observed due to influence of foliar spray of micronutrient and growth regulators on seed germination per cent and electrical conductivity.

Introduction

Onion (*Allium cepa* L.) is one of the important commercial vegetable crops grown in India. It is widely grown in different parts of the country mainly by small and marginal farmers. Onion is cross pollinated crop and efficient pollination depends largely on presence of insects in the area and their

activity at flowering time. It is essential to ensure that there is sufficient population of pollinating insects including honeybees to achieve the full potential of onion seed and consequent higher seed yield. India produces around 168 lakh tons of onion annually ranking second in the world. The production has increased more than five times during past three decades. The reason for increase in

production is mainly due to increase in area under onion cultivation from 1.94 lakh ha during 1974-75 to 10.51 lakh ha in 2016-17. Onion is extremely important vegetable crop not only for internal consumption but also as highest foreign exchange earner among the fruits and vegetables. It occupies an area of 1064 thousand ha, with production of 15118 thousand tons. India is the 2nd largest producer of onion, in the world next only to China but the productivity of onion in India is very low *i.e.* 14.21 tons/ ha as compared to China and other countries like, Egypt, Netherlands and Iran *etc.*, (Annon., 2017).

The major onion producing states are Maharashtra, Madhya Pradesh, Karnataka, Gujarat, Rajasthan, Bihar, Andhra Pradesh, Haryana, West Bengal, Uttar Pradesh, Chhattisgarh, Odisha, Tamil Nadu, Jharkhand and Telangana in the country. These states account for 97 per cent of the total production of the country. As per the third advance estimates, the production of onion during the year 2016-17 is likely to be 3.8 per cent higher from the previous year. Among the different onion growing states, Maharashtra is the major onion producing state with 30.41 per cent of production share, followed by Karnataka, Madhya Pradesh, Rajasthan and Gujarat with 15.51, 13.66, 6.49 and 6.31 per cent share, respectively during year 2016-17.

Intensive cropping, imbalanced fertilization and minimal usage of micronutrients and limited application of organic manures have resulted in the depletion of soil fertility in India. Boron and zinc are the most important micro-nutrients and are essential for cell division, nitrogen and carbohydrate metabolism and water relation in plant growth (Brady, 1990). Application of boron can increase bulb size, number of cloves/bulb and yield of onion (Smriti *et al.*, 2002). Mishra *et al.*, (1990) have shown that application of $ZnSO_4$ (0.5 %) and $FeSO_4$ (1.0 %) as foliar

spray recorded significantly higher plant height and other growth parameters as compared to other treatments in onion.

Plant growth regulators are new generation agro chemicals and are expected to play an important role in overcoming the hurdles in manifestation of biological yield. In recent years, plant growth regulators are used to overcome the factors that limiting the growth and yield to obtain maximum benefit from seed production. It is revealed from experiments conducted in various part of the world that IAA, NAA, GA_3 , IBA, TIBA and Ethrel at various concentrations have remarkable effects on number of flowers per umbel, umbel size and quality seed production of onion. The objective of this study is to determine the influence of foliar sprays of micronutrients and growth regulators on seed quality of onion.

Materials and Methods

The present investigation was carried out to determine the influence of foliar spray of micronutrients and growth regulators on the seed quality of onion at Seed production plot, Seed Unit, Plot No. 187, University of Agricultural Sciences, Raichur during *rabi* 2016-17 and 2017-18. The experiment includes total 8 treatments involving foliar spray of micronutrients (T_2 : $ZnSO_4$ @ 0.5 %, T_3 : B @ 0.5 % and T_4 : $T_2 + T_3$) and growth regulators (T_5 : GA_3 @ 100 ppm, T_6 : NAA @ 100 ppm, T_7 : $T_5 + T_6$ and T_8 : TIBA @ 240 ppm + NAA @ 50 ppm) and with the reference T_1 (Control) replicated thrice. Foliar spray was given at 45 and 75 DAP. The row spacing of 45 cm and between plants 30 cm was maintained in plot size of 4.05 m length and 2.10 m breadth. The effect of foliar spray of micronutrients and growth regulators on seed quality of onion were assessed in terms of their effect on seed following below mentioned quality parameters *viz.*,

Seed germination (%)

The laboratory germination test was conducted in four replications of 100 seeds each as per the ISTA rules (Anon., 2014) by adopting “between paper method”. The seeds were uniformly placed on germination paper and were kept in germinator maintained at alternate temperature of 25 ± 2 °C and 95 ± 5 per cent relative humidity. The number of normal seedlings was counted at the end of twelve days of the test and germination was expressed in percentage (%).

Shoot length (cm)

Randomly selected ten normal seedlings from germination test were used and the shoot length was measured from collar region to the point of attachment of cotyledon and mean was worked out and expressed in centimetre (cm).

Root length (cm)

Seedlings used for shoot length measurement were also used for measuring root length. The length of root was measured from collar region to the tip of primary root and was expressed as mean root length in centimetre (cm).

Seedling vigour index (SVI)

The seedling vigour index was worked out by multiplying the per cent germination and total seedling length (Abdul-Baki and Anderson, 1973).

Seedling Vigour Index = Germination % × Total seedling length (cm)

Seedling dry weight (mg) per ten seedlings

Earlier ten normal seedlings chosen for measuring shoot and root length were used to

determine seedling dry weight. The seedlings were kept in butter paper bag and were dried in hot air oven at 70 ± 2 °C for 24 hours. After drying, they were cooled in desiccators for 30 minutes and were weighed on an electronic balance. Their average weight of 10 seedlings was expressed in milligram (mg) per ten seedlings (Evans and Bhatt, 1977).

Electrical conductivity of seed leachate (dSm^{-1})

Electrical conductivity of seed leachate was determined as per method given by Presley (1958). Five grams of seeds were surface sterilized by using 0.1 per cent mercuric chloride solution and washed twice with distilled water. Then 25 ml distilled water was added to the seeds and kept in the incubator maintained at 25 °C temperature for 24 hours and the seed leachate was collected. The seed leachate was collected and volume was made up to 25 ml by adding distilled water. The electrical conductivity of the seed leachate was measured in the digital conductivity bridge with a cell constant of 1.0 and the mean values were expressed in deci simons per metre (dSm^{-1}).

α -amylase enzyme activity (mm)

The α -amylase activity was analyzed as per the method suggested by Simpson and Naylor (1962). Two gram of agar shreds and one gram of potato starch was mixed together in water to form paste and the volume was made up to 100 ml with distilled water. The homogenous solution of agar-starch mixture after boiling was poured into sterilized petri-dishes and allowed to settle in the form of gel after cooling. The pre-soaked (for 8 hour) and half cut seeds (with their half endosperm and embryo portion intact) were placed in the petri-dishes in such a way that the endospermic part remained in contact with agar-starch gel. The petri-dishes were closed

and kept in dark at 30 °C. After 48 hour the petri-dishes were uniformly smeared with potassium iodide solution (0.44 g of iodine crystal + 20.008 g potassium iodide in 500 ml distilled water) and excess solution was drained off after few minutes. The diameter of halo (clear) zone formed around the seed was measured in mm and reported as α – amylase activity.

Dehydrogenase enzyme activity (OD value)

Twenty five representative seeds from each treatment in two replications were taken and preconditioned by soaking in water overnight at room temperature. Embryos were exercised from the seeds and were steeped in 0.25 per cent solution of 2, 3, 5-triphenyl tetrazolium chloride and kept in dark for two hours at 40 °C for staining. The stained seeds were thoroughly washed with water and then soaked in ten ml of 2 methoxy ethanol (methyl cellosolve) and kept overnight for extracting the red colour formazan. The intensity of red colour was measured using ELICO UV-VIS spectrophotometer (model SC-159) using blue filter at 470 nm wave length and methyl cellosolve was used as a blank. The OD value obtained was reported as dehydrogenase activity (Kittock and Law, 1968).

Results and Discussion

Seed quality parameters

The foliar sprays of micronutrients and growth regulators have resulted in improved quality parameters in onion. Among foliar sprays, ZnSO₄ @ 0.5 per cent (T₂) exhibited higher values for all the seed quality parameters followed by GA₃ @ 100 ppm (T₅), Boron @ 0.5 % (T₃), NAA @ 100 ppm (T₆), T₄ (T₂ + T₃), NAA @ 50 ppm and TIBA @ 240 ppm (T₈), T₇ (T₅ + T₆) and the lowest in control (T₁).

Seed germination do not differed significantly due to influence of foliar spray (Table 1). Significantly maximum root length was recorded with foliar spray of ZnSO₄ @ 0.5 per cent (T₂) (12.92, 12.74 and 12.83 cm during 2016-17, 2017-18 and pooled data of two years, respectively). While, the minimum root length was recorded in control (T₁) (11.38, 11.30 and 11.34 cm during 2016-17, 2017-18 and pooled data of two years, respectively) (Table 1). Significantly maximum shoot length was recorded with foliar spray of ZnSO₄ @ 0.5 per cent (T₂) (9.51, 9.59 and 9.55 cm during 2016-17, 2017-18 and pooled data of two years, respectively). While, the minimum shoot length was recorded in control (T₁) (8.33, 8.87 and 8.60 cm, during 2016-17, 2017-18 and pooled data of two years, respectively) (Table 1). The higher seedling vigour index (2026, 2049 and 2037 during 2016-17, 2017-18 and pooled mean data of two years, respectively) was recorded with foliar spray of ZnSO₄ @ 0.5 per cent (T₂) over control (T₁) (1773, 1823 and 1798 during 2016-17, 2017-18 and pooled mean data of two years, respectively) (Table 2). The treatment foliar spray of ZnSO₄ @ 0.5 per cent (T₂) recorded higher seedling dry weight (36.0, 36.8 and 36.4 mg during 2016-17, 2017-18 and pooled mean data of two years, respectively) over control (T₁) (32.5, 35.3 and 33.9 mg during 2016-17, 2017-18 and pooled mean data of two years, respectively). The electrical conductivity was found to be differed non significantly due to the influence of foliar spray (Table 2).

The foliar spray of ZnSO₄ @ 0.5 per cent (T₂) recorded higher dehydrogenase activity (2.612, 2.611 and 2.609 during 2016-17, 2017-18 and pooled mean data of two years, respectively) over control (T₁) (2.586, 2.593 and 2.590 during 2016-17, 2017-18 and pooled mean data of two years, respectively) (Table 3).

Table.1 Effect of foliar spray of micronutrients and growth regulators on seed germination, root length and shoot length in onion seed production

Treatments	Seed germination (%)			Root length (cm)			Shoot length (cm)		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
T₁- Control	88.67 (70.35)	90.00 (71.57)	89.33 (70.96)*	11.38	11.30	11.34	8.33	8.87	8.60
T₂- ZnSO₄ @ 0.5 %	91.33 (72.88)	91.67 (73.23)	91.50 (73.06)	12.92	12.74	12.83	9.51	9.59	9.55
T₃- B @ 0.5 %	90.00 (71.58)	91.00 (72.56)	90.50 (72.07)	11.78	11.76	11.77	9.05	9.38	9.22
T₄- T₂ + T₃	89.33 (70.95)	90.67 (72.22)	90.00 (71.59)	11.36	11.35	11.36	8.79	9.05	8.92
T₅- GA₃ @ 100 ppm	91.00 (72.56)	91.33 (72.88)	91.17 (72.72)	12.02	12.65	12.34	9.37	9.46	9.41
T₆- NAA @ 100 ppm	89.33 (70.97)	90.67 (72.22)	90.00 (71.59)	11.54	11.66	11.60	8.83	9.35	9.09
T₇- T₅ + T₆	88.33 (70.05)	90.00 (71.58)	89.17 (70.82)	11.36	11.33	11.35	8.69	8.96	8.83
T₈- TIBA @ 240 ppm + NAA @ 50 ppm	90.00 (71.58)	90.33 (71.89)	90.17 (71.74)	11.38	11.50	11.44	8.81	9.17	8.99
Mean	89.71 (71.37)	90.71 (72.27)	90.23 (71.82)	11.72	11.79	11.75	8.92	9.23	9.08
S.Em±	0.34	0.44	0.30	0.24	0.26	0.21	0.10	0.07	0.07
CD at 5 %	NS	NS	NS	0.73	0.80	0.63	0.31	0.22	0.21

DAT: Days after bulb planting

* Figures in the parentheses indicates arc sine transformed values

NS: Non Significant

Note: Foliar spray was given at 45 and 75 DAP

Table.2 Effect of foliar spray of micronutrients and growth regulators on seedling vigour index, seedling dry weight and electrical conductivity in onion seed production

Treatments	Seedling vigour index			Seedling dry weight (mg)			Electrical conductivity (dSm ⁻¹)		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
T₁- Control	1773	1823	1798	32.5	35.3	33.9	0.442	0.429	0.436
T₂- ZnSO₄ @ 0.5 %	2026	2049	2037	36.0	36.8	36.4	0.431	0.421	0.426
T₃- B @ 0.5 %	1881	1911	1896	35.5	36.2	35.8	0.431	0.424	0.427
T₄- T₂ + T₃	1826	1837	1832	35.1	35.9	35.5	0.435	0.423	0.429
T₅- GA₃ @ 100 ppm	1996	1933	1965	35.7	36.5	36.1	0.432	0.425	0.429
T₆- NAA @ 100 ppm	1851	1887	1869	35.3	36.0	35.7	0.433	0.424	0.429
T₇- T₅ + T₆	1809	1829	1819	34.9	35.8	35.4	0.435	0.426	0.430
T₈- TIBA @ 240 ppm + NAA @ 50 ppm	1835	1850	1842	35.2	35.8	35.5	0.438	0.424	0.431
Mean	1874	1890	1882	35.0	36.0	35.5	0.435	0.424	0.430
S.Em±	26	28	21	0.2	0.2	0.2	0.006	0.004	0.004
CD at 5 %	80	84	64	0.6	0.7	0.5	NS	NS	NS

DAT: Days after bulb planting

NS: Non Significant

Note: Foliar spray was given at 45 and 75 DAP

Table.3 Effect of foliar spray of micronutrients and growth regulators on dehydrogenase activity and α -amylase enzyme activity in onion seed production

Treatments	Dehydrogenase activity (OD value)			α -amylase enzyme activity (mm)		
	2016-17	2017-18	Pooled	2016-17	2017-18	Pooled
T1- Control	2.586	2.593	2.590	18.16	18.47	18.32
T2- ZnSO4 @ 0.5 %,	2.612	2.617	2.615	18.70	19.67	19.18
T3- B @ 0.5 %	2.607	2.611	2.609	18.57	19.47	19.02
T4- T2 + T3	2.601	2.603	2.602	18.37	18.90	18.63
T5- GA3 @ 100 ppm	2.609	2.615	2.612	18.63	19.50	19.07
T6- NAA @ 100 ppm	2.602	2.610	2.606	18.50	19.30	18.90
T7- T5 + T6	2.592	2.597	2.595	18.27	18.77	18.52
T8- TIBA @ 240 ppm + NAA @ 50 ppm	2.603	2.604	2.603	18.51	19.07	18.79
Mean	2.602	2.606	2.604	18.46	19.14	18.80
S.Em\pm	0.004	0.004	0.003	0.10	0.22	0.12
CD at 5 %	0.013	0.012	0.011	0.32	0.68	0.38

DAT: Days after bulb planting

Note: Foliar spray was given at 45 and 75 DAP

Significantly maximum α -amylase enzyme activity was recorded in T₂ (18.70, 19.67 and 19.18 mm during 2016-17, 2017-18 and pooled data of two years, respectively) while, the minimum α -amylase enzyme activity was recorded in control (T₁) (18.16, 18.47 and 18.32 mm during 2016-17, 2017-18 and pooled data of two years, respectively) (Table 3).

In general, we can infer that the spray of zinc influenced root and shoot length (cm) and germination of onion. Moreover, the difference found when comparing control and zinc explained by early seed roots, enriched with zinc, are supplied as foliar source (Prado, 2007), improving germination and vigour (Ribeiro and Santos, 1996). Increase in seedlings initial performance after treatment with ZnSO₄, was also verified by Prado (2007). Zinc, despite being an essential micronutrient, can affect growth and normal metabolism of plant species, present in excess levels in the environment, causing a phytotoxic effect (Albuquerque, 2010). According to Ribeiro and Santos (1996), the enhanced content in seeds of ZnSO₄ about 18 times, was not toxic to corn seeds, allowing a greater supply of zinc to the beginning of seedling growth. It is believed that in the case of using seeds of low quality, the positive effect of zinc can be shown, as noted by Dalmolin (1992). However, small increases in germination and vigor, using the best quality seeds, can be reflected in more vigorous plants, large population and greater homogeneity of plants in field, and can, thereby, increase productivity and quality of seeds (Arjmand *et al.*, 2014). The foliar spray of ZnSO₄ improved the seed quality parameters which may be due to Zinc element involved in auxin metabolism plays a vital role in seed set, seed size and quality. Higher seed quality parameters noticed in the present study may be due to well developed seeds with higher test weight, lower electrical

conductivity and higher dehydrogenase enzyme activity. Hence, additional supply of nutrients and direct availability of micronutrients to the plant which leads to the production of good quality seed. These results are in conformity with the findings of Rathinavel *et al.*, (2000) in cotton. The application of GA₃ increase the seed quality parameters might be due to more photosynthesis rate and better accumulation of food material in plant coupled with increasing growth character by cell division, cell elongation and cell enlargement that might have ultimately increased the seed weight and quality parameters. These findings are similar with Govind *et al.*, (2015).

From the above results it is concluded that foliar spray of ZnSO₄ @ 0.5 per cent at 45 and 75 days after bulb planting (DAP) was best over other treatments for seed quality of onion.

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