RESEARCH ARTICLE

INFLUENCE OF FOLIAR APPLICATION OF MICRONUTRIENT AND GROWTH REGULATORON GROWTH AND YIELD OF LEAFY ONION (*ALLIUM CEPA* L.)

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Abstract: To get higher production and economical purpose, each crop needs to maintain its fertilizer requirement and plant growth regulators application. Micronutrients play an essential role in the plant metabolic processes that helps to improve growth and quality of onion while growth regulators govern all the factors of development and growth within plants. The field experiments were conducted during the *rabi* season of 2019 at Main Vegetable Research Centre, Anand Agricultural University following RBD design with 12 treatment including control. to investigate the effect of foliar application of micronutrients and growth regulators on growth, yield and quality attributes during development stage of onion. The application of $GA_3$and micronutrients like Zn, Fe and Si through foliar application significantly improve the growth parameters like plant height, number of leaves, leaf length, dry weight, fresh weight and yield parameters. The result showed that foliar application of Zn (1g/l) +Fe (1g/l) + GA_3 (100mg/l) at 30 DATP considered as the best treatment for higher phytochemical quality and yield production under Middle Gujarat agro-climatic condition.

Keywords: Onion, Foliar, Micronutrient, $GA_{3,}$ Yield

INTRODUCTION

Onion (*Allium cepa* L.) is one of the most important commercial vegetable crops belongs to Alliaceae family being grown all over the country. Onion is popularly known as poor man's Kasturi or "Queen of Kitchen". In India, onion is cultivated for vegetable as well as medicinal purposes (Pramanik, 2018). Among the various vegetables grown in India, onion has top priority in local as well as export market, because of its wide utility and range of processed products. The term green onion is usually used interchangeably with spring onion and scallion. All are onions that don't have a large bulb, either because they don't grow that way or because they are harvested before the bulb forms. Green onions deliver a lot of the flavor of mature bulb onions, with a little less of the bite. And the green leaves are edible, which offers some different nutrients from bulb onions.The most important chemical content in onion is 'allyl propyl disulphide' which is responsible for its pungency. Nutritionally, green onions are an excellent source of vitamin K (one medium green onion provides 34% of adequate intake for women) as well as a good source of vitamin A, vitamin C, and folate.Green onions have many therapeutic properties, and it can guard against many chronic diseases. In addition, research suggests that consuming green onions can positively affect inflammation. It is due to antioxidants like quercetin, flavonoids, and vitamins in green onions. These nutrients help reduce inflammation. Green onion is also high in vitamin C content which is very helpful in reducing common cold symptoms.Green onion also contains potassium which helps lower blood pressure and prevents hypertension. Green onions are rich in organo-sulphur compounds, known to lower cholesterol levels in the blood. In addition, the flavonoids in green onions help increase HDL or the "good" cholesterol.

For the profitable cultivation, it is highly desirable to find ways and means to enhance the productivity of vegetables by using techniques that are within the reach of Indian farmers. Plant growth regulators and micronutrients are considered as key factors for vegetative growth including yield. Therefore, there is an urgent need to work out application methodology of micronutrients and growth-regulators during the life cycle of Onion crop. Further there is also a need of in-depth studies for increasing the efficiency of applied micronutrients. However, to ensure higher economic productivity and considering the importance of micronutrients and growth regulators in determining production and quality of onion.Therefore, the present investigation was undertaken to find out effect of plant growth regulator and micronutrients on yield and growth during development in onion.

MATERIALS AND METHODS

The field experiments were conducted during the *rabi* season of 2019at Main Vegetable Research Centre, Anand Agricultural University following RBD design with 12 treatments. Experimental field is situated at 220 35" N latitude, 720 55" Elongitude and at an elevation of about 45.11 meters above mean sea level. The climate is subtropical with dry and hot summer season, fairly cold and dry winter and moderately humid monsoon. Generally, monsooncommences by the middle of June and ends by the middle of September with an average annualrainfall of 864.5 mm.

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The temperatures start dropping in thebeginning of November. December and January are the coldest months, while April and May arethe hottest months of the year. The soil of this area is classified as loamy sand and is locally known as “Goradu” soil. The soil is very deep and fairly moisture retentive. The soil responds well to manuring and irrigation.

Micronutrients like Zn as $ZnSO_4.7H_2O$ and Iron as $FeSO_4.7H_2O$ solution were prepared respectively by dissolving 1 g in one liter of water. GA_3 solution was prepared by dissolving 100 g in 10 ml quantity of 10% absolute alcohol in one liter of water. Silicic acid 0.1 percent solution was prepared by dissolving 1 g of silicic acid in one liter of water. Combination of chemical was also prepared as per the treatments.Foliarspray was applied after 30 days of transplanting. The control plants were sprayed with distilled water. Spraying was done in such a way that whole surface of the leaves was uniformly covered with spray solution. In every spray, freshly prepared solutions were used.

The raised beds were prepared and basal application of fertilizers was given according to the treatments designed. Healthy seedlings of onion cv. GAWO-2 were transplanted at 45 days after sowing (6 January 2020) at the time of transplanting, upper one third portion of leaves was removed to reduce the rate of transpiration. The crop was fertilized with 19:19:19 NPK and urea was applied as per recommended dose of fertilizer 100:50:50 NPK/ha. The 50% dose of nitrogen was applied as basal and remaining was applied in the form of urea.Immediately after transplanting of seedlings, a light irrigation was given for better establishment of seedlings in the field. Observations regarding growth and yield were assessed from the randomly selected 5 plants at 30 and 45 DATP.Proper care for weeding, intercultural operations, and plant protection measures were taken from transplanting to harvesting of green top onion.

The observations like, Plant height, number of leaves per plant and plant height were measured at 30 and 45 DATP.For estimation of dry matter accumulation, 100 g fresh onion slices were kept in oven at 60^0C temperature for drying till constant weight was obtained. On the basis of total dry weight Relative growth rate (RGR), Crop Growth Rate (CGR) and Absolute growth rate (AGR) were measured at 30–45-dayinterval. Observation of fresh weight and total yield were taken at 30 and 45 DATP.

Observations on green onion yield and quality were made from the selected tagged 10 plants for each treatment. The yield and quality parameters were recorded from randomly selected 10 bulbs of each experimental plot. Statistical analysis was done by using standard techniques (Panse and Sukhatme, 1995).

RESULTS AND DISCUSSION

The data on the growth parameters and total yield as influenced by various treatments of micronutrients and plant growth regulator presented in the presented in Table 1 and 2.

Foliar application of Zn, Fe and Si resulted highest value in growth characters. The treatment T_7 (30.23cm) at 30 DATP and (34.73 cm) at 45 DATP found highest plant height and the treatments like T_6 (25.80 cm), T_{11} (25.53 cm) and T_{11} (31.80 cm), T_6 (30.17 cm) follow them respectively.

The significant different was observed at 30 DATP. Highest leaf length was recorded under the treatment T_2 (27.07 cm) which were followed by the treatments like T_{11} (25.37 cm), T_6 (23.37 cm) and T_{10} (22.43 cm). Similarly, there was maximum leaf length was observed in the treatment T_2 (30.73 cm) which were followed by the treatments like T_3 (26.57 cm), T_{11} (28.27 cm) and T_6 (26.47 cm).

The result revealed that significantly higher number of leaves per plant recorded in the treatment T_7 (7.00 cm) which was at par with the treatment T_1 (5.67), T_6 (5.67), T_8 (5.67), T_{10} (5.68) and T_{11} (6.00). The same trend was observed on number of leaves at 45 DATP. The maximum number of leaves recorded under the treatment T_7 (9.33) which was at par with the treatment T_1 (9.00), T_3 (7.67), T_6 (8.33), T_8 (7.67), T_{10} (9.00) and T_{11} (7.67).

The data presented in table pertaining to 30 DATP significantly highest dry matter production in plant observed in the treatment T_{10} (5.90 g/plant) which was at par with the treatment T_1 (5.34 g/plant), T_3 (5.46 g/plant), T_6 (5.84 g/plant) and T_{11} (5.51 g/plant). While at 45 DATP there were maximum number of leaves recorded under the treatment T_{11} (6.93 g/plant) which was at par with the treatment T_2 (6.13 g/plant), T_3 (6.87 g/plant), T_6 (6.26 g/plant), T_7 (6.39 g/plant), T_8 (6.51 g/plant), T_9 (6.63 g/plant) and T_{10} (6.70 g/plant).

At, 30 DATP significantly highest green onion yield production in plant recorded in the treatment T_{11} (154.77t/ha) which was followed by the treatment T_3 (122.26t/ha), T_6 (126.11t/ha) and T_{10} (118.51t/ha).

While at 45 DATP there were maximum yield production in plant recorded under the treatment T_{11} (202.46t/ha) which was at par with the treatment T_3 (178.00t/ha) and T_9 (185.84t/ha).

Micronutrients like zinc requires for activation of different enzymes. It plays important role in biosynthesis of hormones and chlorophyll. The action of micronutrients and bio regulators might be involved in various metabolic processes leading to improved growth, yield attributes and bulb yield in onion. The use of micronutrients increased the chlorophyll content and thereby photosynthetic rate, which usually cause increased the yield of onion.Trivedi and Dhumal (2017) studied that micronutrient like Fe and Zn added in to the soil through alone and combination with FYM and cow dung slurry as per treatment they Soil application of zinc with cow dung slurry emerged as the best treatment for , plant height number of leaves per plant, yield, and mineral components of bulb. These results are closely associated with the findings of Manna et al. (2017) and Sharma and Singh (2018)

The treatment T_2 (4.96) recorded highest RGR which was statistically at par with the treatments T_5 (3.55), T_9 (3.51) and T_{12} (4.26). CGR in plant recorded in the treatment T_2 (14.33) which was statistically at par with the treatment like T_4 (9.23), T_5 (12.13), T_7 (10.79), T_8 (10.39), T_9 (12.12) and T_{12} (9.81) and T_2 (0.21) reported higher AGR which was statistically at par with the treatments like T_4 (0.14), T_5 (0.18), T_7 (0.16), T_8 (0.16), T_9 (0.18) and T_{12} (0.15).

At, 30 DATP result clearly shows that maximum total chlorophyll contents were find under the treatment T_{11}(10.41) which were statistically at par with the other treatment T_3 (10.13). While at 45 DATP there was maximum chlorophyll contents were found under the treatment T11 (14.78) which were statistically at par with the other treatments like T_9 (14.74) and T_{10} (14.60).

The increase in the RGR due to the application of micronutrients and growth regulator might be due to increase in photosynthetic efficiency by increasing leaf thickness, retaining more chlorophyll content and efficient translocation of photosynthates. Fe is an essential for the chlorophyll formation and it helps in the photosynthesis. More the photosynthesis, more photosynthates will be accumulate towards the leaf biomass. Duringinitial stage, leaf is the most powerful sink as compared to any other plant parts. Thus, the surface area of leaves gives a justification to the ultimate final expression of RGR, CGR and AGR.

All the micronutrients and plant growth regulator treated plants contained higher chlorophyll content than control plants. The higher level of chlorophyll content may be due to delay in degradation of chlorophyll caused by the exogenous application of micronutrients and plant growth regulator. Senescence of leaves is generally evidenced by the yellowing and loss of chlorophyll that occur before abscission. Micronutrients and plant growth regulator were used to delay senescence in some species by stimulating chlorophyll synthesis. These results were confirmed by the findings Similar results were reported by Goyal et al. (2017). Sravani*et al.* (2020) reported that GA_3 (25 mg l^{-1}) recorded highest chlorophyll content of leaves at 45 DATP (1.06 mg/100g), 60 DATP (2.64 mg/100g), 90 DATP (2.32 mg/100g).

Thus, the application of micronutrients and bio-regulators if used judicially will help to get better productivity with good quality bulbs by investing minimum inputs. This methodology will reduce the burden of heavy doses of chemical fertilizers on the soil and farmers. It will also help in the maintenance of soil fertility and protection of environment. On the basis of result of field experiment, it can be concluded that foliar application of Zn (1g/l) +Fe (1g/l) + GA3 (100mg/l) at 30 DATP and 45 DATP considered as the best treatment for higher quality and yield production under Middle Gujarat agro climatic condition for production of green top onion. However, for confirming the validity and utility on commercial scale local trial is necessary.

Table 1. Effect of plant growth regulator and micronutrients on growth parameters and yield at 30 DATP

Treatments	Plant height(cm)		No. of leaves/plant		Leaf length(cm)		Dry weight (%)		Total yield(t/ha)	
	30 DATP	45 DATP	30 DATP	45 DATP	30 DATP	45 DATP	30 DATP	45 DATP	30 DATP	45 DATP
T_1: Si (0.1%)	23.60	27.63	5.67	9.00	21.13	23.20	5.34	5.96	110.93	142.62
T_2: Fe (1g/l)	24.13	28.53	5.33	7.00	27.07	30.73	2.91	6.13	625.55	146.62
T_3: Zn (1g/l)	26.20	27.73	5.34	7.67	22.73	28.57	5.46	6.87	122.26	178.00
T_4: Zn (1g/l) + Fe (1g/l)	23.97	28.13	4.67	7.00	20.47	23.30	3.68	5.75	757.55	139.24
T_5: Zn (1g/l) + Si (0.1%)	20.20	27.73	4.65	6.67	21.30	25.80	3.86	5.59	864.44	171.95
T_6: Fe (1g/l) + Si (0.1%)	25.80	30.17	5.67	8.33	23.37	26.47	5.84	6.26	118.511	166.24
T_7: Zn (1g/l)+ Fe (1g/l) + Si (0.1%)	30.23	34.73	7.00	9.33	18.40	22.57	3.96	6.39	757.11	147.13
T_8: GA_3 (100mg/l)	20.93	26.80	5.67	7.67	17.63	21.97	4.17	6.51	876.22	166.68
T_9: Zn (1g/l) + GA_3 (100mg/l)	24.07	28.40	4.67	7.33	18.83	24.20	3.90	6.63	939.33	185.84
T_{10}: Fe (1g/l) +GA_3 (100mg/l)	24.67	30.10	5.67	9.00	22.43	26.13	5.90	6.70	126.11	175.46
T_{11}: Zn(1g/l)+Fe(1g/l) +GA_3(100mg/l)	25.53	31.80	6.00	7.67	25.37	28.27	5.51	6.93	154.77	202.46
T_{12}: Control	20.37	21.13	4.67	6.33	19.23	21.17	2.50	4.71	452.66	113.00

SEm ±	0.327	0.864	0.452	0.539	0.19	0.480	0.226	0.320	4.79	8.79
CD at 5%	0.960	2.535	1.327	1.581	0.56	1.410	0.661	0.940	14.07	25.79
CV%	2.35	5.24	14.46	12.04	1.53	3.3	8.85	8.83	8.59	9.44

Table 2. Effect of plant growth regulator and micronutrients on AGR, CGR and RGR

Treatments	**Total chlorophyll content (%)**		**30-45 DATP**		
	30 DATP	45 DATP	**RGR**	**CGR**	**AGR**
T_1: Si (0.1%)	9.94	13.67	0.71	2.73	0.04
T_2: Fe (1g/l)	9.53	13.23	4.96	14.33	0.21
T_3: Zn (1g/l)	10.13	14.07	1.53	6.24	0.09
T_4: Zn (1g/l) + Fe (1g/l)	9.71	14.01	2.97	9.23	0.14
T_5: Zn (1g/l) + Si (0.1%)	9.80	13.81	3.55	12.13	0.18
T_6: Fe (1g/l) + Si (0.1%)	9.98	13.75	0.47	1.87	0.03
T_7: Zn (1g/l)+ Fe (1g/l) + Si (0.1%)	9.67	13.97	3.17	10.79	0.16
T_8: GA_3 (100mg/l)	9.59	13.79	3.06	10.39	0.16
T_9: Zn (1g/l) + GA_3 (100mg/l)	9.17	14.74	3.51	12.12	0.18
T_{10}: Fe (1g/l) +GA_3 (100mg/l)	10.04	14.60	0.83	3.56	0.05
T_{11}: Zn(1g/l)+Fe(1g/l)+GA_3(100mg/l)	10.41	14.78	1.53	3.60	0.09
T_{12}: Control	9.30	12.92	4.26	9.81	0.15
SEm ±	0.05	0.14	0.56	1.79	0.02
CD at 5%	0.16	0.40	1.65	5.27	0.079
CV%	0.98	1.69	38.39	37.59	37.59

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