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Response of Plant Growth Regulator on Bulb Yield of Onion (*Allium cepa* L.)

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ABSTRACT

Background: Maharashtra ranks first in onion (*Allium cepa* L.) production with a share of 28.32%. However, the productivity of onion is low as compared to other countries. In order to enhance onion productivity, new and innovative agri-inputs are being tried continuously like providing humic acid, fulvic acid, plant growth regulators (PGR), auxin/amino acid spray, seaweed extract, biofertilizers, sulphur application *etc*. PGRs are considered to be one of the novel inputs that can help in increasing the productivity of onion in India economically. Plant growth regulators are considered as a new generation of agrochemicals when added in small amounts, modify the growth of the plants usually by stimulation or modifying one part of natural growth regulatory system, thereby increasing the crop yield. Most of the research data available is based on biochemical, seaweeds *etc*. Almost negligible literature is available pertaining to a PGR made with formulation of Seaweed extract and Protein Hydrolysate. An attempt has been made in this research work to evaluate the effect of PGR formulated with seaweed extract and Protein Hydrolysate as major constituents on onion bulb yield through both foliar and drenching application.

Methods: A field experiment for evaluating the effect of plant growth regulator (PGR) formulated by Research and Development Department, M/s Rashtriya Chemicals and Fertilizers Limited was conducted at Chilli and Vegetable Research Farm, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola (MH). During the experiment, the effect of different concentration of PGR *viz*., 0.2%, 0.4%, 0.6% and 0.8% and 1.0%, 1.2%, 1.4% and 1.6% through foliar and drenching application, respectively were studied.

Result: Statistically, significant results of plant growth regulator application on vegetative growth, yield and qualitative characters of onion crop were observed. Significantly, maximum bulb yield was observed in the treatment PGR @ 0.6% (255.41 kg/ha) through foliar application which is at par with the treatment PGR @ 1.4% (246.67 kg/ha) through soil drenching along with RDF. According to the results, the suitable PGR dose for studied characters of onion under prevailing conditions was 0.6% foliar spray and 1.4% soil drenching along with recommended dose of fertilizers.

Key words: Bulb, Drenching, Foliar, Onion, PGR, RDF.

INTRODUCTION

Onion (*Allium cepa* L.) is an important horticultural crop grown worldwide for their culinary purposes and medicinal values. World over, onion crop is grown on about 5.30 million hectare area with an annual production of 88.48 million tons with productivity 16.70 tons per hectare. China ranks first in the onion production (22.61 million tons from an area 1.03 million hectares area) with productivity 21.85 tons per hectare followed by India. In India, onion crop is grown on about 1.20 million hectare area with a production of 19.40 million tons with productivity 16.12 tons per hectare (Anonymous, 2017). Maharashtra, Karnataka, Orissa, Uttar Pradesh, Gujarat, Andhra Pradesh and Tamil Nadu are the major onion producing states. Maharashtra ranks first in onion production with a share of 28.32%. However, the roductivity of onion is low as compared to other countries. In order to enhance onion productivity, new and innovative Agri-inputs are being tried continuously like providing humic acid, fulvic acid, PGR, auxin/amino acid spray, seaweed extract, biofertilizers, sulphur application, *etc*. PGRs are considered to be one of the novel inputs that can help in increasing the productivity of onion in India economically.

Plant growth regulators are considered as a new generation of agrochemicals. When added in small amounts, modify the growth of the plants usually by stimulation or modifying one part of natural growth regulatory system, thereby increasing the crop yield (Desh and Kumar, 2016). PGR are the growth regulating substances produced naturally by plants that participate in control of plant growth (Santner and Estelle, 2009). PGRs are key factors in vegetative growth, flowering, fruit setting and seed

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production in plants including onion crop. It is also one of the easiest and effective source to enhance the production of onion to some extent. RCF's plant growth regulator product has seaweed extract and Protein Hydrolysate as major components.

Seaweed extracts are extracts obtained from species of brown algae (Phaeophyceae); most notably the species *Ascophyllum nodosum* L. which are being popularly utilized in Agriculture for enhancing productivity of various crops (Shukla *et al.,* 2019). Seaweed extract contain plant growth promoters like auxins, cytokinins gibberellins, amino acids and mineral nutrients, that positively affect plant growth and division (Russo and Berlyn 1990; Panda *et al.,* 2012). Seaweed extracts improve nutrient uptake by roots (Crouch *et al.,* 1990). Besides growth promoting effect on plants, seaweeds also affect the physical, chemical and biological properties of soil. All these properties in turn influence plant growth. It enhances soil health by improving moisture-holding capacity and by promoting the growth of beneficial soil microbes (Halpern *et al.,* 2015).

Auxin is a plant hormone produced in the stem tip that promotes cell elongation. Auxins promote stem elongation, inhibit growth of lateral buds (maintains apical dominance). They are produced in the stem, buds and root tips. Auxin also plays a role in maintaining apical dominance (Desh and Kumar, 2016).

The other constituents of seaweed extract cytokinins are primarily involved in performing cell division in plant roots, shoot system. This hormone helps in promoting the cell's growth, development, differentiation, affecting apical dominance and delay in leaf senescence. Cytokinins help in increasing the cell division by maintaining the protein production that is important for mitosis (Desh and Kumar, 2016).

Apart from cytokinin, gibberilic acid (GA) present in the seaweed extract also modulate the plant growth. Gibberellins are plant hormones that regulate various developmental processes, including stem elongation, germination, dormancy, flowering, flower development and leaf and fruit senescence. Gibberellins are involved in the natural process of breaking dormancy and other aspects of germination (Desh and Kumar, 2016). The second major components of RCFs PGR is Protein Hydrolysate. Protein hydrolysates are defined as a complex mixture of oligopeptides, peptides and free amino acids that are produced by partial or extensive hydrolysis of various protein meals (Clare and Swaisgood, 2000). It also acts as plant growth regulator due to the presence of peptides. Proteins are broken down to bioactive peptides which are the mixtures of polypeptides, oligopeptides and amino acids. It stimulates carbon and nitrogen metabolism and interfere with hormonal activities. It enhances nutrient availability in plant growth substrate thereby increasing nutrient uptake (Colla *et al.,* 2017).

World over lot of research and field trials have been carried out to explore the utility of PGR in increasing the crop productivity (Harms and Oplinger, 1988). It has been reported by many authors that foliar spray of growth regulator increased the onion yield (Mathur 1971; Singh *et al.,* 1995; Hye *et al.,* 2002; Mondal and Shukla 2005; Singh 2006; Tyagi *et al.,* 2007; Devi *et al.,* 2018). Most of the research data available is based on biochemical, seaweeds *etc*. Almost negligible literature is available pertaining to a PGR formulated by utilizing seaweed extract and protien hydrolysate. An attempt has been made in this research work to evaluate the effect of PGR containing seaweed extract and protein hydrolysate on onion crop production through both foliar and soil application.

MATERIALS AND METHODS

A field experiment was conducted with PGR of Rashtriya Chemicals and Fertilizers Limited at Chilli and Vegetable Research Unit, Dr. Panjabrao Deshmukh Krishi Vidhyapeeth, Akola (MH) (20.7002°N, 77.0082°E) during *rabi* 2018. The experiment was laid out in randomized block design (RBD) with ten treatments and three replications. Healthy seedlings were transplanted in the field during October, 2018 with row to row 10 cm and plant to plant 10.0 cm space. A recommended dose of 100 kg N, 50 kg P_2O_5, 50 kg K_2O and 30 kg S ha^{-1} was applied in the form of urea, single super phosphate and muriate of potash, respectively. The RDF and plant protection measures were adopted for optimum growth. The treatment combinations involving four levels of PGRs concentration *viz.,* 0.2% (2 ml/litre), 0.4% (4 ml/litre), 0.6% (6 ml/litre) and 0.8% (8 ml/litre) as foliar spray and 1.0% (10 ml/litre), 1.2% (12 ml/litre), 1.4% (14 ml/litre) and 1.6% (16 ml/litre) as soil drenching were tested. Foliar application was done at 30 Days after transplanting (DAT), 45 DAT, 60 DAT and 75 DAT whereas drenching were done at 60 DAT, 80 DAT and 100 DAT. The testing material *viz*., PGR manufactured by M/s Rashtriya Chemicals and Fertilizers Limited were tested in the form of treatments. Five plants were randomly selected from each treatment and observations like plant height (cm), number of leaves per plant, neck thickness (cm), bulb yield (kg/ha), marketable yield (kg/ha), bulb equatorial diameter (cm), bulb polar diameter (cm) and total soluble solids-TSS °Brix were recorded. Collected data were analyzed by adopting the standard procedure. The significance of difference between pair of means was tested by the critical differences (CD) test at 5% level of probability (Panse and Sukhatme, 1985).

RESULTS AND DISCUSSION

Plant height, leaves per plant and neck thickness

Results showed that application of PGR @ 0.6% significantly increased plant height (55.59 cm) and number of leaves per plant (13.47) of onion plant and it was found statistically at par with the treatment RDF along with soil drenching PGR @1.4% *i.e.* 52.41 and 12.67 respectively (Table 1). Similar results have been reported that foliar

Table 1: Response of plant growth regulator on bulb yield and its determining characters in onion.

Treatments		Plant height (cm)	Number of leaves per plant	Neck thick-ness (cm)	Bulb yield kg/ha	Marketable yield- (kg/ha)	Bulb equatorial diameter (cm)	Bulbpolar diameter (cm)	TSS °Brix
Absolute control		35.74	7.93	0.51	163.33	130.67	4.27	3.80	12.72
Only RDF*		39.99	9.40	0.49	203.33	173.94	4.99	4.49	13.00
RDF + PGR @ 0.2%	Through foliar	43.55	10.07	0.45	213.33	181.32	5.26	4.82	13.10
RDF + PGR @ 0.4%	application	45.47	10.93	0.41	233.33	205.33	5.61	5.06	13.60
RDF + PGR @ 0.6%		55.59	13.47	0.33	255.41	229.87	6.59	5.87	14.08
RDF + PGR @ 0.8%		50.59	12.00	0.38	248.33	218.57	5.97	5.27	13.76
RDF + PGR @ 1.0%	Through	41.05	9.80	0.47	210.00	178.23	5.13	4.62	13.33
RDF + PGR @ 1.2%	drenching	44.37	10.60	0.43	240.00	210.70	5.47	5.03	13.36
RDF + PGR @ 1.4%		52.41	12.67	0.35	246.67	219.63	6.32	5.57	13.92
RDF + PGR @ 1.6%		48.05	11.20	0.40	236.67	205.14	5.81	5.19	13.68
SEm+		1.52	1.26	0.08	6.08	6.11	0.21	0.13	1.04
CD 5%		4.55	3.78	NS	18.19	18.31	0.61	0.38	NS

*(100:50:50:30 NPKS kg/ha).

spray of PGR increased plant height, leaves per plant by Tiwari *et al.* (2003); Dwivedi *et al.* (2019). These results are also in close conformity with those of Susheela *et al.* (2005); Islam *et al.* (2007); Bose *et al.* (2009); Shashi Kumar and Shashidhar, (2016). Application of PGR increased the neck thickness, although the increase was not statistically significant.

Bulb yield and marketable yield

The bulb yield was significantly maximum (255.41 kg/ha) due to application of RDF along with PGR @ 0.6% which is on par with the treatment RDF + 0.8% as foliar spray (248.33 kg/ha), the treatment RDF with the PGR soil drenching @ 1.4% (246.67 kg/ha) and the treatment RDF + PGR @ 1.2% (240.00 kg/ha). This results are in agreement with (Singh *et al.,* 1995; Hye *et al.,* 2002; Mondal and Shukla, 2005; Singh 2006; Tyagi *et al.,* 2007; Devi *et al.,* 2018). Similar trend was found in pea and strawberry by Nazeer *et al*. (2020) and Rathod *et al.* (2021) respectively. Significantly minimum bulb yield (163.36 kg/ha) was obtained by the onion plant without application of RDF and RCF's PGR.

RDF along with foliar spray of PGR @ 0.6% recorded significantly maximum yield (229.87 kg/ha) which is on par with RDF + soil drenching of PGR @ 1.4% (219.63 kg/ha) and RDF + foliar spray of PGR @ 0.8% (218.57 kg/ha). The treatments RDF plus PGR @ 0.4% and RDF plus PGR @ 0.8% representing foliar application of RCF's PGR were found at par with each other. In case of drenching treatments of RCF's PGR treatment RDF plus PGR @ 1.2% and RDF plus PGR @ 1.6% were noticed statistically at par. However, significantly the minimum marketable yield (130.67 kg/ha) was obtained by the onion grown without application of RCF's plant growth regulator *i.e.* only RDF (Control).

Bulb equatorial diameter and Bulb polar diameter

The bulb equatorial diameter was significantly maximum (6.59 cm) due to application of RDF along with foliar spray of PGR @ 0.6% and it was found statistically at par with the treatment RDF along with soil drenching of PGR @1.4% (6.32 cm). The results obtained are in agreement with those of Mathur (1971); Singh *et al.* (1983); Hye *et al.* (2002); Islam *et al.* (2007); Bose *et al.* (2009); Dwivedi *et al.* (2019) in onion. Conversely, it was observed that significantly minimum equatorial diameter (4.27 cm) was obtained without application of RDF and RCF's PGR.

Table 1 shows that significantly maximum bulb polar diameter (5.87 cm) was found due to an application of RDF along with PGR @ 0.6% and it was at par (5.57 cm) with the drenching treatment PGR @ 1.4% along with RDF. Similar results have been reported by Maurya and Lal (1987); Islam *et al.* (2007); Bose *et al.* (2009); Dwivedi *et al.* (2019) in onion crop. Significantly, minimum bulb polar diameter (3.80 cm) was obtained in treatment without RDF and PGR. Application of PGR increased the TSS °Brix, although the increase was not statistically significant.

CONCLUSION

The field trial results clearly demonstrated that the application of RCFs plant growth regulator in the form of foliar spray and through drenching increases the bulb yield and marketable yield of onion. Under the environmental conditions of present study, application of plant growth regulator at the rate 0.6% (Foliar) and 1.4% (Drenching) had positive effects on bulb yield. The results also confirmed that foliar application of plant growth regulator compared to drenching method had more efficacy in most studied features. Nevertheless, more research is needed to better define the doses of foliar and drenching aplication of Plant Growth Regulator on onion crop.

The results confirmed that the foliar spray and soil drenching of RCFs PGR is at par with each other. The foliar application was found to have profound effect on most of the features studied in this experiment.

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Conflict in interest

The authors declare that they have no conflicts of interest.

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