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Original Research Article

Improvement of Quality Parameters of Onion (*Allium cepa* L.) CV. Agri Found Light Red through A Novel Approach

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Keywords

Onion, Pruning, Gibberellic acid, quality attributes, ascorbic acid, neck diameter, NPK in leaf and bulb

A B S T R A C T

A Field trial was carried out at Horticulture Farm of Indira Gandhi Krishi Vishwavidyalaya, Raipur, to assess the effect of pruning, Gibberellic acid and methods of application on quality were carried out on onion. Out of 19 treatment combinations comprised of three level of pruning, six levels of GA at different concentration and its methods of application *viz*., pruning (leaf pruning, root pruning, leaf & root pruning), GA (50, 100, 150 ppm and method viz., root dip, foliar spray). Leaf pruning along with GA 150 ppm as foliar spray perform superior in NPK content in leaf and bulb, neck diameter and ascorbic acid while the minimum was recorded in control. In general application of Gibberellic acid as foliar spray and leaf pruning improved the quality parameters in onion bulbs.

Introduction

Onion (*Allium cepa* L.) production is one of the most important vegetables crops grown in India, and has the potential for increased production because of its high demand. It belongs to the family Alliaceae and it is the oriented crop earning valuable foreign exchange for the country. The demand for onion is worldwide. Onions are found in most marketable of the world thought out the year and can be grown under wide range of agro climatic condition. It is an indispensable item in every kitchen and used to enhance flavor of different recipes. Onion bulb is a rich source of minerals like phosphorus, calcium and carbohydrates, protein and vitamin C etc. It is being used in several ways as a fresh, frozen, dehydrated bulbs and green bunching types. It contains several anti-cancer agents which have shown to prevent cancer in animals. The beneficial compound called 'quercetin' present in onion has shown to be powerful antioxidant. Its pungency is due to the presence of *Allyl propyl disulphide,* a volatile oil (Malik, 1994).

Gibberellins are one of the main regulators of plant growth and development which repress the growth and promoting cell division and elongation (Olszewski *et al.*, 2002). It is well known that GA_3 promotes plant growth and its secondary metabolite

production [Jones *et al.,* 2009]. The applications of gibberrelic acid (GA_3) on plants increases plant height and, subsequently, enhance dry weight (Sharma *et al.,* 1999). This plant growth regulators might be important for increasing onion production and GA_3 influences growth by promoting elongation of stem and internodes of plant. The treatment with GA_3 and their physiological action was found to enhance vegetative growth and plant yield and increase dry weight. Dry matter partitioned into the vegetative parts is important because the pattern and amount of fruiting in indeterminate plants are influenced by the size of the vegetative organs at fruiting (Marcelis & Heuvelink, 1999).It is essential that good vegetative growth occurs before fruit set. Vegetative growth of fruit-bearing plants appears to be regulated by the developing fruit (Gautier *et al.,* 2001).

Pruning is the more direct way of orienting different parts of the plant for supply and distribution of food materials into vegetative or reproductive channels (Gardner, 1966).Pruning is not a common practice among farmers. Probably because the benefits are not well known. No research has been done to investigate the benefits of onion pruning despite the importance of this information. The objective of this study was to investigate the influence of pruning on onion production.

Materials and Methods

The field experiment was conducted in Indira Gandhi Krishi Vishwavidyalaya, Raipur (C.G.) to find out the effect of seedling pruning and Gibberellic Acid (GA_3) and its application method on growth and yield of onion cv Agri found Light Red. It was a high yielding, grown in Rabi season. The experiment was laid out in factorial Randomize Block Design (RBD), with three replications. The treatments included: three levels of pruning (i) Root pruning (P_1): reducing the roots to 0.5 cm (ii) Leaf pruning (P_2): reducing the leaves to 3.00 cm (iii) Root and Leaf pruning: reducing the roots to 0.5 cm and reducing the leaves to 3.00 cm) and 6 levels of GA_3 and its application method (50, 100, 150 ppm as root dip and foliar spray) along with control. For root dipping treatments, seedlings were dipped for overnight hours before transplanting. Spraying with GA_3 was done 30 days after transplanting.

Preparation and application of GA_3

A 50 ppm solution was prepared by dissolving 50 mg of GA_3 completely in a small quantity of absolute alcohol. Then distilled water was added to make the volume one litre to get 50 ppm solution. In a similar way, 100 and 150 ppm concentration was made. The foliar sprays of GA_3 at 20 DAT and root dipping for eighteen hours were done at 50, 100 and 150 ppm concentrations before transplanting.

The seedlings of control treatment were not treated with GA_3.Five plants were selected at random and uprooted carefully at the time of collecting data of root from each plot. The data in respect of growth and yield components were statistically analyzed to find out the significance of the experimental results. The means of all the treatments were calculated and the analysis of variance for each of the characters.

Data collection the data on the qualitative characters *viz.*, neck-diameter (mm), NPK content in leaf, NPK content in bulb, ascorbic acid content in bulb (mg 100 g^{-1}) as influenced by pruning and GA and its application methods are presented in Tables 1 a & b Each of the parameters was measured as indicated below:

N, P and K content in leaf and bulbs

Nitrogen (%)

Nitrogen content in leaves was determined by micro-kjeldhal's method as given by Somichi *et al.,* (1972).

$$\text{Nitrogen (\%)} = \frac{\text{Sample titration – blank titration x N. of HCL x 14x100}}{\text{Sample weight x 1000}}$$

Phosphorus (%)

Phosphorus content in leaves was determined by vanadomolybdate yellow colour method as given by Jackson (1967).

Volume of acid extract finally prepared

Phosphorus (%) = {(X/10) x (Volume made up / Aliquot taken x weight of sample in (g))} x 100

Where, X= graph reading

Potassium (%)

Potassium content in leaves was determined by flame photometer by di-acid extract method given by Jackson (1967).

Potassium (%) = ($X/10^6$) x vol. of extract (ml) x (100 / Sample (g)) x DF

Where,

R = Flame photometer reading of sample
F = Factor from std. graph [Reading (ppm)]
DF = Dilution factor

Neck- diameter (mm)

Bulb and neck diameter are important quality characteristics of onions. Consumers prefer medium size onions (40-69 mm) (Bosch Serra & Currah, 2002) that will attain higher prices on the market than the extra small (10-34 mm), small (35-39 mm), large (70-89 mm) and extra-large (>90 mm) bulbs. The neck diameter of ten randomly selected bulb was measured with the help of vernier caliper and average was calculated.

Ascorbic acid content in bulbs

The ascorbic acid content was expressed as mg 100g-1 of fresh sample. Samples of onion bulbs were analyzed for the ascorbic acid content using 2, 6- Dichlorophenol indophenol dye titrimetrically as per the modified procedure of AOAC (1960). Five grams of sample was macerated with 0.4 per cent oxalic acid. This was filtered through muslin cloth to get a clear juice. A five ml aliquot was titrated against 2, 6-dichlorophenol indophenol (Foyer C., 1993). dye till the pink end point which persisted for at least 15 seconds. Similar procedure was followed against acid mixture to get blank titre value and against standard solution made in 0.4 per cent oxalic acid to get standard titre value. The ascorbic acid content was estimated using the given formula and expressed as mg per 100 g.

$$\text{Ascorbic acid mg/100gm} = \frac{\text{Titrate value x dry weight x Volume x 100}}{\text{Extraction taken x Wt. of the sample for etm.}}$$

Results and Discussion

Effects of pruning

Pruning showed influence on all the quality parameters of onion cv. Agri found light Red. The maximum Nitrogen (2.67 %), Phosphorus (0.13 %), Potassium (2.21 %) in leaf and neck diameter (11.67 mm) was obtained from P_2 *i.e.* leaf pruning while the

minimum Nitrogen (1.91 %), Phosphorus (0.11 %), Potassium (1.72 %) in leaf and neck diameter (10.00 mm) was recorded from P_3 *i.e.* leaf and root pruning. The maximum Nitrogen (2.20 %), Phosphorus (0.15 %), Potassium (1.67 %) in bulb and ascorbic acid content (11.96 mg/100g) in onion bulb was obtained from P_2 *i.e.* leaf pruning followed by root pruning respectively and the minimum Nitrogen (1.61 %), Phosphorus (0.06 %), Potassium (1.25 %) in bulb and ascorbic acid content (9.39 mg/100g) in onion bulb were obtained from P_3 *i.e* leaf and root pruning (Table 1(a) & 2 (a)). The increase in neck thickness under leaf pruning in the present investigation could be attributed greater bulb diameter under this treatment.

Effects of GA_3 and its application methods

The result demonstrated that GA_3 had significant influence on the growth and yield parameters of onion. The maximum Nitrogen (2.56 %), Phosphorus (0.13 %), Potassium (2.07 %) in leaf and neck diameter (11.49 mm) was obtained from G_6 *i.e.* GA 150 ppm as foliar spray while the minimum Nitrogen (2.16 %), Phosphorus (0.11 %), Potassium (1.80 %) in leaf and neck diameter (10.44 mm) were obtained from G_1 *i.e.* GA 50 ppm as root dip. The highest ascorbic acid content in GA_3 at 150 ppm as foliar spray could be attributed to the vitamin which synthesized in plant by the process involve the conversion of hexose mainly glucose and galactose into the ascorbic acid. Similar finding were reported by Veena kumari *et al.,* 1994, and the influence of GA_3 on neck diameter could be attributed to bulb diameter in the present investigation. This finding was reported by Anwar (1995) reported that Gibberellic acid had marked influenced on bulb diameter and neck thickness beside other vegetative growth and yield parameter will also improved in Garlic.

Table.1 (a) Effect of pruning and Gibberellic acid along with its application methods on NPK leaf character and neck diameter of onion

Treatment	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Neck– diameter (mm)
Pruning method				
P1(RP)	2.35	0.117	1.92	10.68
P2 (LP)	2.67	0.136	2.21	11.67
P3 (RP+LP)	1.91	0.110	1.72	10.00
SEm±	**0.02**	**0.004**	**0.06**	**0.27**
CD (5%)	**0.04**	**0.008**	**0.13**	**0.55**
GA_3 and its application method				
G1 (50 ppm as RD)	2.16	0.113	1.80	10.43
G2 (50 ppm as RD)	2.30	0.118	2.01	10.84
G3 (100 ppm as RD)	2.18	0.115	1.90	10.63
G4(100 ppm as FS)	2.38	0.128	2.01	10.82
G5 (150 ppm as RD)	2.27	0.116	1.90	10.60
G6 (150 ppm as FS)	2.56	0.136	2.07	11.38
SEm±	**0.03**	**0.005**	**0.08**	**0.35**
CD (5%)	**0.06**	**0.011**	**0.16**	**0.71**

Table.2 (a) Effect of pruning and Gibberellic acid along with its application methods on NPK bulb and ascorbic acid character of onion

Treatment	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Ascorbic acid content in bulb (mg/100g)
Pruning method				
P1(RP)	1.89	0.10	1.520	11.22
P2 (LP)	2.20	0.15	1.676	11.96
P3 (RP+LP)	1.61	0.06	1.253	9.39
SEm±	**0.08**	**0.04**	**0.06**	**0.27**
CD (5%)	**0.16**	**0.08**	**0.13**	**0.56**
GA_3 and its application method				
G1 (50 ppm as RD)	1.77	0.09	1.42	10.44
G2 (50 ppm as RD)	1.95	0.11	1.46	10.82
G3 (100 ppm as RD)	1.78	0.09	1.42	10.54
G4(100 ppm as FS)	2.01	0.13	1.61	11.35
G5 (150 ppm as RD)	1.83	0.09	1.45	10.55
G6 (150 ppm as FS)	2.08	0.13	1.54	11.49
SEm±	**0.11**	**0.05**	**0.09**	**0.35**
CD (5%)	**0.23**	**0.01**	**0.18**	**0.73**

Table.1 (b) Interaction effect of pruning and Gibberellic acid along with its application methods on NPK leaf character of onion

Treatment	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Neck– diameter (mm)
P1G1	2.06	0.113	1.57	10.20
P_1G_2	2.42	0.124	2.13	11.02
P_1G_3	2.36	0.129	1.90	10.70
P_1G_4	2.49	0.120	1.99	10.45
P_1G_5	2.30	0.089	1.74	10.50
P_1G_6	2.46	0.126	2.16	11.23
P2G1	2.38	0.142	2.17	11.00
P2G2	2.77	0.137	2.41	12.00
P2G3	2.42	0.069	1.48	9.90
P2G4	2.85	0.151	2.43	12.50
P2G5	2.72	0.144	2.34	11.80
P2G6	2.87	0.174	2.44	12.80
P3G1	2.06	0.084	1.65	10.10
P3G2	1.69	0.093	1.50	9.50
P3G3	1.77	0.146	2.31	11.30
P3G4	2.30	0.118	1.93	10.40
P3G5	1.78	0.114	1.61	9.50
P3G6	2.35	0.107	1.63	10.10
P0G0	1.48	0.047	1.32	7.78
SE±	**0.05**	**0.009**	**0.14**	**0.60**
CD (5%)	**0.11**	**0.019**	**0.28**	**1.23**
Control vs rest				
SE±	**0.03**	**0.006**	**0.10**	**0.43**
CD (5%)	**0.07**	**0.014**	**0.20**	**0.89**

P_1 = RP (Root pruning), P_2 = LP (Leaf pruning), P_3 = LP + RP (Leaf + Root pruning), GA = Gibberellic acid, RD =Root dip, FS = Foliar spray

Table.2 (b) Interaction effect of pruning and Gibberellic acid along with its application methods on NPK bulb character of onion

Treatment	Nitrogen (%)	Phosphorus (%)	Potassium (%)	Ascorbic acid content in bulb (mg/100g)
P1G1	1.56	0.07	1.265	10.02
P_1G_2	1.99	0.12	1.667	11.65
P_1G_3	1.87	0.12	1.665	11.54
P_1G_4	2.14	0.14	1.667	12.20
P_1G_5	1.66	0.06	1.191	10.05
P_1G_6	2.11	0.13	1.667	11.87
P2G1	2.02	0.11	1.665	10.82
P2G2	2.25	0.16	1.677	12.35
P2G3	1.97	0.12	1.673	11.23
P2G4	2.29	0.17	1.681	12.46
P2G5	2.22	0.15	1.675	12.21
P2G6	2.43	0.18	1.684	12.85
P3G1	1.73	0.09	1.317	10.50
P3G2	1.60	0.04	1.031	8.45
P3G3	1.43	0.05	0.930	8.85
P3G4	1.86	0.10	1.629	10.71
P3G5	1.61	0.07	1.481	9.40
P3G6	1.70	0.07	1.279	9.76
P0G0	0.95	0.04	0.889	8.25
SE±	0.20	0.09	0.15	**0.61**
CD (5%)	0.40	0.19	0.31	**1.26**
Control vs rest				
SE±	**0.03**	**0.006**	**0.10**	**0.44**
CD (5%)	**0.07**	**0.014**	**0.20**	**0.91**

P_1 = RP (Root pruning), P_2 = LP (Leaf pruning), P_3 = LP + RP (Leaf + Root pruning), GA_3 = Gibberellic acid, RD =Root dip, FS = Foliar spray

In case of bulb maximum Nitrogen (2.08 %), Phosphorus (0.13 %), Potassium (1.54 %) in bulb and ascorbic acid content (11.49 mg/100g) in onion bulb were recorded from was obtained from G_6 *i.e.* GA 150 ppm as foliar spray respectively, while the minimum Nitrogen (1.77 %), Phosphorus(0.09 %), Potassium (1.42 %) in bulb and ascorbic acid content (10.44 mg/100g) in onion bulb were obtained from G_1 *i.e.* GA 50 ppm as root dipping methods (Table 2 (b)).

Interaction effects showed a significant influenced on the quality of onion. P_2G_6 *i.e.* leaf pruning along with GA 150 ppm as foliar spray produced maximum Nitrogen(2.87 %), Phosphorus (0.17 %), Potassium (2.44 %) in leaf and neck diameter (48.36 cm) while the minimum Nitrogen(1.48 %), Phosphorus(0.04 %), Potassium (1.32 %) in leaf and neck diameter (48.36 cm). In case of bulb maximum Nitrogen (2.43 %), Phosphorus (0.18 %), Potassium (1.68 %) in bulb and ascorbic acid content (12.85 mg/100g) was recorded from P_2G_6 *i.e.* leaf pruning along with GA 150 ppm as foliar spray, respectively and the minimum

Nitrogen(0.95 %), Phosphorus(0.04 %), Potassium (0.88 %) in bulb and ascorbic acid content (8.25 mg/100g) in onion bulb were obtained from the control plots (Table 2).Most of the treatment combination significantly increased the quality over control treatment. The significant increase improvement in NPK content in leaf and bulb, neck diameter and ascorbic acid content due to leaf pruning at higher concentration of Gibberellic acid could be attributed to combine effect of both treatments. Similar finding was reported by Patil and Kale (1985) reported positive association between neck thickness and neck diameter. In the present investigation leaf pruning and GA_3 at 150 ppm alone and in combination exerted significant influence in increasing the NPK contents in the leaves and bulbs. The result of present finding could be supported by the fact revealed by Sangakkara *et al.,* 2000 who indicated that potassium affects respiration, photosynthesis, chlorophyll development, water content of leaves, carbon dioxide assimilation and carbon movement (Sangakkara *et al.,* 2000).In plants, the potassium is related to the synthesis of proteins and carbohydrates, sugars and starch storage and this might have stimulated the growth and improved utilization of water as reported by Faquin, 1994.

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