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Effect of PGRs and their methods of application on yield, quality and economics of *kharif* onion (*Allium cepa* L.) cv. Agri found Dark Red

Bhanuja Dwivedi and KP Asati

Abstract
An experiment was conducted in field of the nursery, Department of Horticulture, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Indore during *Kharif* season, 2017-2018 to see the effect of plant growth regulators and their methods of application on yield, quality and economics of *kharif* onion (*Allium cepa* L.) cv. Agri found Dark Red and result have shown significant differences among the treatments. The maximum fresh weight of bulb (73.7g) and dry weight of bulb (8.70g), maximum yield per plot (8.50 kg) and per hectare (283.31q/ha), maximum TSS (17.67 ^{0}Brix) were recorded under treatment T_3 (GA_3 @ 100ppm-foliar spray). The lowest physiological weight loss (2.27 and 3.08 %) was also recorded under T_3 (GA_3 @ 100ppm-foliar spray) but maximum cost benefit ratio 1: 3.39 was found in T_6 (NAA @ 100 ppm-foliar spray).

Keywords: Yield, quality, economics, PGRs, TSS, cost benefit ratio

Introduction
Onion is one of the most important bulbous vegetable crops grown all over the world. Onion (*Allium cepa* L.) belongs to the family *Amaryllidaceae* (Alliaceae) and locally known as Pyaj. It is an old world crop and it was domesticated in Iran and Pakistan i.e. Central Asia. The onion crop is an export oriented crop earning valuable foreign exchange for the country. The demand for onion is worldwide. Onions are found in most of the markets of the world throughout the year and can be grown under wide range of Agro-climatic conditions. Irrespective of price, the demand remains almost constant in the market as it is primarily, used as seasoning for a wide variety of dishes in many homes. The crop export is done mainly to Malaysia, Singapore, Philippines, Indonesia, Gulf countries and Pakistan. Onion accounts for 70 percent of our total foreign exchange earnings from the export of fresh vegetables. India is next to China in area and production of onion. Among the different states Maharastra is leading state in terms of area and production. Other major onion states are Gujrat, Karnataka, Odisha, Uttar Pradesh, Andhra Pradesh, Tamil Nadu and Rajasthan. The area of onion is 1270.4 thousand hectare, total production is 21563.9 thousand metric tonnes and productivity is about 17.0metric tonnes per hectare in India (Anonymous, 2017a) [1]. The area of onion production in Madhya Pradesh is 118.20 thousand hectares. Total production is 2848.0 thousand metric tonnes and productivity is about 24.09metric tonnes per hectare (Anonymous, 2017b) [2]. Onion accounts for 310650.09 lakhs foreign exchange earnings from the export to different countries (Anonymous, 2017c) [3]. Government of India has declared onion as an essential commodity.

The pungency in onion is due to sulphur- bearing compound which is present in very small quantity (about 0.005%) in the form of volatile oil allyl propyl disulphides. The colour of the outer skin of onion bulbs is due to quercetin. It is consumed as a vegetable and condiment. The green leaves, immature and mature bulbs are eaten raw or used in vegetable preparations. It is an indispensable item in every kitchen and used to enhance flavour of different recipes. Onion has many medicinal values and used for preparation of various Homeopathic, Unani and Ayurvedic medicines. Phenolic compounds can offer significant anti-mellitus atherogenic protection by inhibiting the oxidation of low density lipoproteins (LDLs) (Scalbert *et al*., 2005) [16].

Onions are grown in three seasons, rabi, kharif and late kharif. For maintaining steady supply in the market, kharif crop of onion plays a major role. The production of *kharif* onion has several advantages i.e. increases total production per annum and fulfils the demand of fresh

onion in the market. *Kharif* onion provides high price as compared to *Rabi* season onion. The positive effect of plant growth regulators on horticultural crops have been shown by many workers (Lal *et al*., 2013, Lal and Das, 2017, Jain *et al*., 2017, Tameshwar *et al*., 2017) [11, 10, 9, 19]. The vegetative growth of *kharif* onion as represented by plant height, number of leaves per plant, fresh and dry weight of plant, increased to optimum level using GA_3 and NAA. CCC is very effective in inducing hardening of seedlings and increased growth of root and shoot. Therefore, the present investigation "Effect of plant growth regulators and their application methods on yield, quality and economics of *kharif* onion (*Allium cepa* L.) cv. Agri found Dark Red" was carried out.

Materials and Methods

An experiment was conducted in field of the nursery, Department of Horticulture, College of Agriculture, Rajmata Vijayaraje Scindia Krishi Vishwa Vidyalaya, Indore during *Kharif* season, 2017-2018 to see the effect of plant growth regulators and their methods of application on yield, quality and economics of *kharif* onion (*Allium cepa* L.) cv. Agrifound Dark Red. The experiment was laid out in Randomized Complete Block Design (RCBD) and thirteen treatments consisted with three replications. Fresh and dry weights of bulb were weighed at harvesting with the help of physical balance. Bulb yield per plot and per hectare were computed. TSS was measured from refractometer. Physiological loss in weight was assessed at 15 and 30 DAH. Cost benefit ratio was calculated based on net return. Analysis of variance (ANOVA) was used to test for differences among the treatments.

Results and Discussions

Fresh and dry weight of bulb (g)

The significantly maximum fresh weight of bulb (73.7, 73.0 and 71.7g) was recorded in treatment T_3 (GA_3 @ 100ppm-foliar spray), T_6 (NAA @ 100ppm-foliar spray) and T_2 (GA_3 @ 100ppm- seedling dip.), respectively and minimum (45.0 g) was recorded under control. The significantly maximum dry weight of bulb (8.70, 8.63 and 8.47g) was recorded in treatment T_3 (GA_3 @ 100ppm-foliar spray), T_6 (NAA @ 100ppm-foliar spray) and T_2 (GA_3 @ 100ppm- seedling dip.), respectively and minimum (5.60 g) was found under control which could be due to the rapid cell division and elongation leading to longer bulb formation. Results of the present investigation was also in confirmatory with the findings of Ledesma *et al.* (2000) [12], Bahadur *et al.* (2001) [4], Islam *et al.* (2007) [8], Bose *et al.* (2009) [5], Patel *et al.* (2010a) [13], Govind *et al.* (2015) and Thakur *et al.* (2018) [20].

Table 1: Effect of plant growth regulators and methods of application on fresh and dry weight of bulb (g)

Treatments	Fresh weight of bulb (g)	Dry weight of bulb (g)
Control	45.0	5.60
GA_3 @ 100ppm- seedling dip.	71.7	8.47
GA_3 @ 100ppm-foliar spray	73.7	8.70
GA_3 @ 100ppm-dropping methods	67.0	8.00
NAA @ 100ppm- seedling dip.	69.7	8.27
NAA @ 100ppm-foliar spray	73.0	8.63
NAA @ 100ppm-dropping methods	66.3	7.93
CCC @ 100ppm- seedling dip.	65.0	7.80
CCC @ 100ppm-foliar spray	65.7	7.87
CCC @ 100ppm-dropping methods	59.7	7.17
TIBA @ 100ppm- seedling dip.	56.3	6.83
TIBA @ 100ppm-foliar spray	58.3	7.03
TIBA @ 100ppm-dropping methods	55.0	6.70
S.Em±	0.98	0.10
C.D. (5%)	2.87	0.30

Bulb yield per plot (kg) and per hectare (q)

The treatment combination of T_3 (GA_3 @ 100ppm-foliar spray), T_6 (NAA @ 100ppm-foliar spray), T_2 (GA_3 @ 100ppm- seedling dip.) and T_5 (NAA @ 100ppm- seedling dip.) was exhibited maximum (8.500, 8.460, 8.325 and 8.317 kg) bulb yield per plot, respectively and which were at par with each other whereas minimum bulb yield (5.823 kg) per plot was found under control. The data for the bulb yield per plot under different treatments were recorded and converted into bulb yield q/ha. The significantly maximum bulb yield (283.31, 281.97, 277.47 and 277.20 q /ha) was recorded under the treatments T_3 (GA_3@ 100ppm-foliar spray), T_6 (NAA @ 100ppm-foliar spray), T_2 (GA_3 @ 100ppm- seedling dip.) and T_5 (NAA @ 100ppm- seedling dip.), respectively and minimum bulb yield (194.09 q/ha) was recorded under control. The increase in the bulb yield mainly attributed to more number of leaves and higher dry matter accumulation. Manipulation of source (leaf) and sink (bulb) relationship through the above treatments may be the principal reason for yield improvement. Higher yield in onion has so far been achieved mainly through the judicious applications of various plant growth regulators. The results of the present investigation are in accordance with the observations of Bahadur *et al.* (2001) [4], Tiwari *et al.* (2001) [21], Ganiger *et al.* (2002a) [6], Islam *et al*. (2007) [8], Rashid (2010) [10], Sharma *et al.* (2013) [12].

Table 2: Response of plant growth regulators and their methods of application on bulb yield per plot (kg) and bulb yield per hectare (q)

Treat. Symb.	Treatments	Bulb yield per plot (kg)	Bulb yield per hectare (q)
T_1	Control	5.823	194.09
T_2	GA_3 @ 100ppm- seedling dip.	8.325	277.47
T_3	GA_3 @ 100ppm-foliar spray	8.500	283.31
T_4	GA_3 @ 100ppm-dropping methods	7.500	249.98
T_5	NAA @ 100ppm- seedling dip.	8.317	277.20

T_6	NAA @ 100ppm-foliar spray	8.460	281.97
T_7	NAA @ 100ppm-dropping methods	7.400	246.64
T_8	CCC @ 100ppm- seedling dip.	6.667	222.20
T_9	CCC @ 100ppm-foliar spray	7.000	233.31
T_{10}	CCC @ 100ppm-dropping methods	6.657	221.87
T_{11}	TIBA @ 100ppm- seedling dip.	6.000	199.98
T_{12}	TIBA @ 100ppm-foliar spray	6.633	221.09
T_{13}	TIBA @ 100ppm-dropping methods	5.833	194.43
	S.Em±	0.09	3.07
	C.D. (5%)	0.26	8.98

Total soluble solid (TSS ^{0} Brix)

The treatments T_3 (GA_3 @ 100ppm-foliar spray), T_6 (NAA @ 100ppm-foliar spray), T_2 (GA_3 @ 100ppm- seedling dip.) and T_5 (NAA @ 100ppm- seedling dip.) were exhibited maximum TSS (17.67, 17.50, 17.43 and 17.17 ^{0}Brix), respectively and which were at par with each other whereas minimum TSS (15.17 ^{0}Brix) was found under control. This effect might be due to these substances, which might have enhanced enzymatic activity and translocation of the metabolites to onion bulb. These results are in agreement with those obtained by Govind *et al.* (2015) [7].

Physiological weight loss (%)

The physiological weight loss (%) of different treatments of plant growth regulators and methods of application is given in Table 3. The treatments T_3 (GA_3 @ 100ppm-foliar spray), was recorded lowest physiological weight loss (2.27 and 3.08 %) followed by T_6 (NAA @ 100ppm-foliar spray) which noted (3.33 %) and (3.51%) at 15 and 30 days after harvest, respectively and which were at par with each other whereas maximum physiological weight loss (7.02 and 8.09 %) was found under control. Inadequate and improper field curing after harvest, infection by different pathogen, sprouting are the main reasons of prevailing losses. In general, the losses due to reduction in weight, sprouting and rotting (decay) were found to be 20-25, 4-5, and 10-12 % respectively. These results are in agreement with those obtained by Patel *et al.* (2010a) [13].

Table 3: Response of different plant growth regulators and their methods of application on TSS and physiological weight loss (%)

Treat. Symb.	Treatments	TSS (^{0}Brix)	Physiological weight loss (%)	
			15 DAH	30DAH
T_1	Control	15.17	7.02	8.09
T_2	GA_3 @ 100ppm- seedling dip.	17.43	3.14	4.41
T_3	GA_3 @ 100ppm-foliar spray	17.67	2.27	3.33
T_4	GA_3 @ 100ppm-dropping methods	16.83	4.09	5.52
T_5	NAA @ 100ppm- seedling dip.	17.17	3.30	5.12
T_6	NAA @ 100ppm-foliar spray	17.50	3.08	3.51
T_7	NAA @ 100ppm-dropping methods	16.77	4.17	6.08
T_8	CCC @ 100ppm- seedling dip.	16.67	5.18	6.34
T_9	CCC @ 100ppm-foliar spray	16.67	4.39	6.18
T_{10}	CCC @ 100ppm-dropping methods	16.43	5.33	6.36
T_{11}	TIBA @ 100ppm- seedling dip.	16.00	6.15	7.35
T_{12}	TIBA @ 100ppm-foliar spray	16.17	5.38	7.23
T_{13}	TIBA @ 100ppm-dropping methods	15.33	6.38	7.64
	S.Em±	0.26	0.28	0.15
	C.D. (5%)	0.78	0.84	0.45

Economics

Result revealed (Table 4) that significantly maximum bulb yield of 283.31q/ha was obtained in onion variety Agrifound Dark Red. Under the treatment combination T_3 (GA_3 @ 100ppm-foliar spray) was obtain net return of Rs 1,56,314/ha and cost benefit ratio 1: 3.22 but maximum net return of Rs 1,59,004/ha and cost benefit ratio 1: 3.39 was found in T_6(NAA @ 100 ppm-foliar spray), it gave the bulb yield 281.97q/ha due to lower expenditure than the treatment T_3. These results are in agreement with those obtained by Singh *et al.* (2001) [18], Bose *et al.* (2009) [5] and Patel *et al.* (2010b) [14].

Table 4: Economics of different plant growth regulators and methods of application for Kharif onion.

Treat. Symb	Treatments	Bulb yield (q/ha)	Gross income (Rs/ha)*	Expenditure (Rs/ha)	Net income (Rs/ha)	C:B ratio
T_1	Control	194.09	155272	66374	88898	1: 2.34
T_2	GA_3 @ 100ppm- seedling dip.	277.47	221976	66550	155426	1: 3.34
T_3	GA_3 @ 100ppm-foliar spray	283.31	226648	70334	156314	1: 3.22
T_4	GA_3@100ppm-dropping methods	249.98	199984	70334	129650	1: 2.84
T_5	NAA @ 100ppm- seedling dip.	277.20	221760	66383	155377	1: 3.34
T_6	NAA @ 100ppm-foliar spray	281.97	225576	66572	159004	1: 3.39
T_7	NAA@100ppm-dropping methods	246.64	197312	66572	130740	1: 2.96
T_8	CCC@100ppm- seedling dip.	222.20	177760	66634	111126	1: 2.67
T_9	CCC @ 100ppm-foliar spray	233.31	186648	72224	114424	1: 2.58

T_{10}	CCC@100ppm-dropping methods	221.87	177496	72224	105272	1: 2.46
T_{11}	TIBA@100ppm- seedling dip.	199.98	159984	66376	93608	1: 2.41
T_{12}	TIBA @ 100ppm-foliar spray	221.09	176872	66419	110453	1: 2.66
T_{13}	TIBA@100ppm-dropping methods	194.43	155544	66419	89125	1: 2.34

*Sale rate of produce was Rs 800/q

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